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## Historical Section



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## Public Affairs



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## The Physiology Teacher





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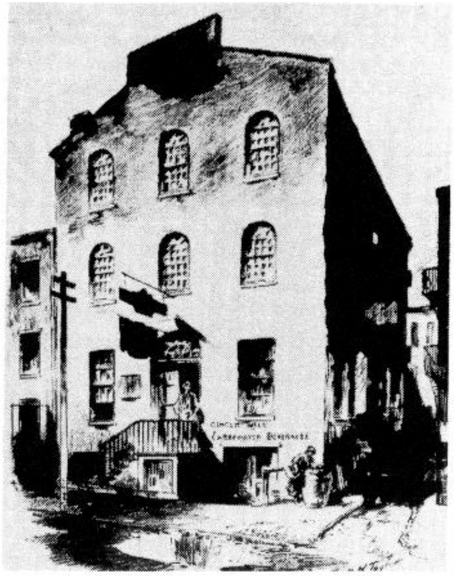
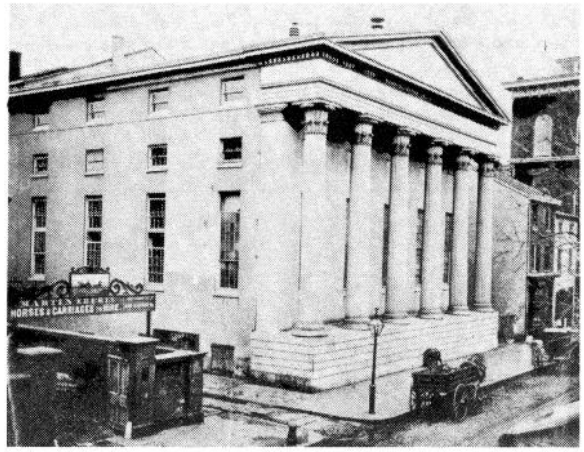
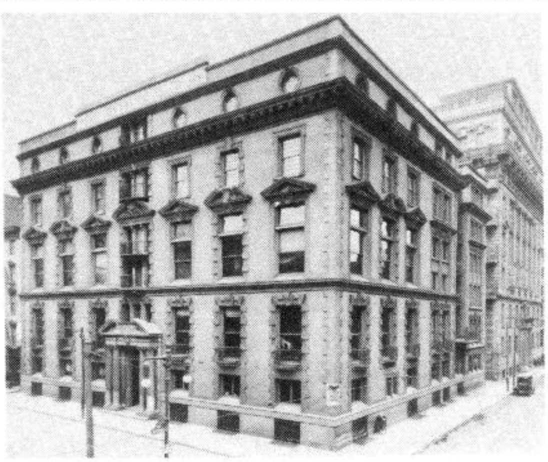


*Left*: Tivoli Theater, 6th and Prune (Locust) Streets. Original Medical School Building, in close proximity to Dr. G. McClellan's private office. Used 1825–28.

*Below*: Second Medical School Building, 10th and Sansom Streets, behind present Curtis Building. Used 1828–98.

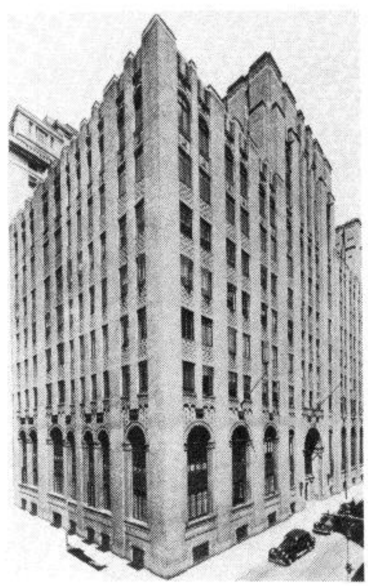


*Above*: Jefferson Alumni Hall, Jefferson Medical College, 1970.



*Above*: Third Medical School Building, 10th and Walnut Streets, NW. Used 1898–1929.

*Right*: Fourth Medical School Building, 1025 Walnut Street, next to Curtis Building. Used 1929–present. Still in use; known as College Building.



# Departmental History

## Physiology at Jefferson Medical College (1842-1982)

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Though it has been said (1, p. 3) that scientific physiology emerged when primitive man first began to measure, correlate, and repeat experiences, the development of medical science and its associated institutions was quite slow in the thirteen 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, chemistry, pharmacology, histology, hygiene, physical diagnosis, experimental pathology, and even medical history and jurisprudence. The exact duties 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.

While the first American hospital was established on Long Island in 1663, two such institutions were already in operation in French Colonial Canada. 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 Caspar 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 establishment 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." A forceful statement of principle, even visionary, but unfortunately subsequent practice did not vigorously apply this stated principle.

As the United States matured during the first fifty years of its independence, Philadelphia served as a center of political expression, commerce, and medicine. In 1824 Dr. **George McClellan** (father of General George McClellan of Civil War note) made arrangements with Jefferson College (forerunner of Washington and Jefferson University) of Canonsburg, Pennsylvania, to commence a series of lectures in medicine to be given in Philadelphia. This enterprise, as a branch of Jefferson College, was to be known as the Jefferson Medical College of Philadelphia. The establishment of a second school of medicine in Philadelphia was an event of considerable importance. At the time, neither London nor Paris could make this claim. An earlier similar attempt in New York did not meet with success. Jealousies were aroused, and for almost the next two decades, relations between the emerging Jefferson Medical College and the premier medical school of the nation, the University of Pennsylvania School of Medicine, were poor.

From its inception, instruction in physiology was taught to the students of Jefferson Medical College, 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 on Anatomy and Physiology by Geo. McClellan, M.D." (2, p. 9). 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. With time, the two disciplines would go their separate ways, reuniting briefly with the reintroduction of a coordinated, integrated structure-function curricular concept nationally in the 1960's and at Jefferson in the 1970's.

Following McClellan's initial effort, whatever limited physiological instruction was presented during the organizational phase of Jefferson's existence was successively 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 physick 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, formal lectures with exposure to actual clinical cases in both medicine and surgery. This concept was revolutionary. Believing "the eye to be the most important organ in the acquisition of knowledge" (3), a prominent museum containing an extensive collection of anatomical and pathological specimens was established. Professors made liberal use of these specimens in illustrating their formal lectures and encouraged their students to subsequently 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 1833–34, the faculty identified the need to enhance personal interaction between professor and student. Accordingly, a series of Medical Conversaziones was established, informal gatherings of students and professors on Saturday evenings, in the Hall of the Museum. Light refreshments were served and the hours were between 8 and 11 P.M. 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.

Recognizing "the progress of Medical Science" (4), the board of trustees of Jefferson Medical College established physiology, for the first time, as an independent course of study via the creation of a seventh chair: professorship in the Institutes of Medicine and Medical Jurisprudence. Dr. Robley Dunglison, distinguished physician and generally accepted Father of American Physiology, was elected to this chair in June 1836. Dr. Granville Sharp 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 (5, p. 82) that his chair would be entitled "Institutes" rather than physiology or materia medica so as to allow maximal latitude to 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 then went on for further studies at the University of Erlangen, Bavaria, leading to the M.D. degree in 1823. The following year, as George McClellan set out to create a second school of medicine in Philadelphia, to the south, the former president Thomas Jefferson was establishing the University of Virginia. The University was to open with professors of ancient and modern languages, mathematics, natural philosophy, and anatomy and medicine (6). 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.

At its inception, and for the first two years of his nine-year tenure, Robley Dunglison 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 Thomas Jefferson on July 4, 1826, fifty years to the day after signing the Declaration of Independence. This relationship was especially unique in that, throughout his life, Thomas Jefferson was reported to have a deep distrust of physicians (6).

Dunglison remained at Virginia for nine years (1824–33), when 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, Virginia, to a more civil climate and community led to acceptance of the professorship of materia medica in the University of Maryland at Baltimore. By this time, Dunglison's reputation was assured in America, having published in 1832 *Human Physiology*, a text which was to go through eight editions and become the standard in the field for many years. Dunglison's pen was prolific. He published his *Medical Dictionary* in 1833, which would similarly become a standard in the field, going through an unprecedented 23 editions. *Elements of Hygiene* was published in 1835.

Within three years of the publication of *Human Physiology*, Professor Pattison was to set in motion forces that would result in the Dunglisons' relocation from Baltimore to Philadelphia and the establishment of a vital role in the evolutionary development of Jefferson Medical College over a period exceeding 30 years. When Dunglison joined the Jefferson faculty, it was in a state of turmoil. Though it numbered only six individuals, it was split into two equal camps, neither of which could exert its will but merely maintain a state of continuous acrimony threatening the future growth and success of the institution. Dunglison's arrival and the creation of a seventh chair, thus created political as well as educational possibilities—he represented the power to break the deadlock in any future internal conflict. Since he had been recruited by Pattison, Jefferson's founder Dr. George McClellan feared that Dunglison's arrival would tilt the balance against his own position. This fear was soon shown to be unwarranted. As Dunglison himself stated, "I determined to pursue an independent course . . . Both parties then looked towards me; and both were disappointed" (5, p. 86).

Considering the primitive state of communications and travel of the day, the remoteness of Jefferson Medical College in Philadelphia from its mother institution, Jefferson College at Canonsburg, led inevitably to misapprehensions and inconveniences despite the best of intentions and actions on both sides. Accordingly, the Medical College petitioned the State Legislature during the 1837–38 session that it be detached. An act was passed, establishing an independent charter, under the title of "Jefferson Medical College of Philadelphia" and conferring upon the institution the same powers and restrictions as the University of Pennsylvania (7). Extensive improvements were made in the building and the course of instruction was extended from four to five months.

Dunglison's establishment of a department of physiology was well received. Jefferson's Catalogue of Instruction (1839) demonstrates obvious pride when it states, ". . . 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 schools of continental Europe, has also taken its place as a department of instruction in our medical college."

Regrettably, such promise was accompanied by continuing turmoil among the faculty. Rumors, questioning the quality of instruction and casting doubt on the future viability of the institution were rife among both the profession and the general populace. Incredulously, the source of these ugly rumors appeared to be Jeffersons' founder Dr. McClellan (5, p. 89). These attacks were not only against McClellan's own colleagues but were also directed against the board of trustees of Jefferson Medical College. In a letter (March 9, 1839) to his colleagues, Dunglison defended the competence and honor of the board while attempting to promote "harmony of action" among the faculty. Unknown to Dunglison, his letter was subsequently shared with the trustees, who, finally realizing the seriousness of the situation, convened an investigatory committee, interviewed each member of the faculty, and ultimately declared all chairs vacant and prepared to reorganize the faculty. Dr. McClellan and the then dean, Dr. Samuel Calhoun, were neither reappointed to their chairs nor to the faculty. Upon the appointment of new professors to the chairs of surgery (Dr. Pancoast) and materia medica (Dr. Huston), the reorganized faculty faced the commencement of a new academic year. On September 30, 1839, Dr. Samuel McClellan (George's brother), professor of obstetrics and the diseases of women and children, submitted his resignation (8, p. 62). Time and options being short, Dunglison entered the breach by adding materia medica and therapeutics to his Institutes of Medicine and Medical Jurisprudence while Huston assumed Samuel McClellan's chair of obstetrics. This double load was maintained for two years (1839–41) and without additional fees.

The retirement of Drs. Pattison and Revere and the death of the professor of chemistry (cofounder Dr. Jacob Green) concluded the total reorganization of the faculty. Huston returned to materia medica and general therapeutics, leaving Dunglison to concentrate on the Institutes of Medicine and Medical Jurisprudence. The reorganized faculty of 1841 brought stability, esteem, and mutual support to the institution, which would result in growth and maturation that would go unchecked for fifteen years, or almost until the time of the Civil War. In fact, the student body would become the largest of any medical school in the nation, as was the number of graduates each year (9).

From the time when Robley Dunglison accepted the Institutes chair in June, 1836, he ceased his personal participation in the practice of medicine (1, p. 48). By devoting all of his efforts to academic pursuits, he thus represents the first full-time American physiologist. Dunglison's keen mind and extensive experiences continued to be highly respected in practical medical affairs and culminated 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. In fact, it has been reported that Robley Dunglison was offended by the sight of blood, thereby ruling out both animal experimentation and human surgery. It is important to recognize that although he was not an experimentalist, Dunglison was involved in perhaps the most exciting and brilliant experimental contribution to the physiology of the period, the work of Dr. William Beaumont.

Dr. William Beaumont was the military physician who treated woodsman Alexis St. Martin for an accidental shotgun wound. St. Martin recovered, but a permanent gastric fistula remained in his abdomen. 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 would lead to a heightened understanding of the basic physiology of the stomach, the validity of which stands to this day. Samples of gastric juice were sent to Dunglison while he was still at 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 focusing future researchers. On at least one occasion, they met in Washington, DC, to discuss the accumulated data and to devise additional experiments.

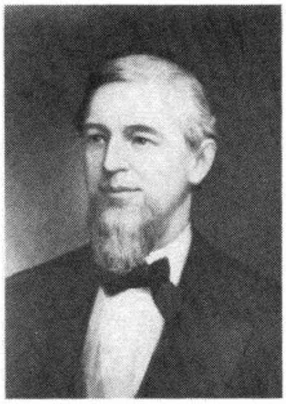
As a further irony, Dunglison, the nonexperimentalist, was a vital stimulant in the development of perhaps the greatest experimentalist, bridging physiology and experimental medicine, in the mid-nineteenth century. Silas Weir Mitchell was the son of a Jefferson professor. After graduating from Jefferson Medical College 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 researches. 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. Dr. Samuel Johnson, then occupying the chair in physiology at the University of Pennsylvania, advised young Mitchell that he would lose a patient for every experiment; yet he was able to demonstrate that an able physician could be a financial success and still do scientific work of the highest order of merit (1, p. 143). 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 (1, p. 145).

Silas Weir Mitchell never held an academic appointment in physiology. A man of many talents, world-renowned clinician with an active Jefferson clinical affiliation, premier experimental physiologist of the 1850–75 period, man of letters and literature, he nevertheless was an unsuccessful candidate for chairs in physiology when those ultimately became open at Jefferson and at the University of Pennsylvania. 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.

Robley Dunglison continued to inspire young minds at Jefferson. The College Catalogue of Instruction for 1851 points with justifiable pride at the large number of students who, having taken at least one medical session at another school, came to Jefferson to study (162 of a student body of 516). In addition, approximately 100 graduates of other schools were in regular attendance at the lectures, many of them practitioners of mature age and experience. Some of these subjected themselves to fresh examinations and received a second medical diploma from Jefferson.

In consequence of his academic, administrative, and political talents, Dunglison was named to the office of dean in 1854. The Civil War was especially traumatic for Jefferson Medical College and its students. Historically, Jefferson had served as the medical school for much of the south. In 1860, of a student body numbering 630, 419 were of southern extraction (67%). As passions escalated, arrangements were made to transport, house, and enroll these southern students free at the University of Virginia School of Medicine. Dean Dunglison and Jefferson's esteemed surgeon, Dr. Samuel D. Gross, convinced many of these southern students to stay at Jefferson until they graduated; however, 244 students did leave immediately for the south (39% of the student body) (8, p. 148). The 1861 student body numbered but 433 (a 31% drop in enrollment), of whom only 36 (8%) were from the south. Robley Dunglison held his chair and the office of dean until ill health forced his retirement in 1868.

Upon Dunglison's retirement, two of the prime candidates to succeed him were former students of his at Jefferson: Silas Weir Mitchell (class of 1850) and James Aitken Meigs (class of 1851). Mitchell's reputation, as clinician and investigator, was immense. His was one of the earliest elections to membership in the National Academy of Science (1, p. 151). There is dispute as to the sincerity with which Mitchell sought the appointment as well as the effect which his personal political persuasion may or may not have had on the selection process. These issue cannot be settled definitely, but the Trustees of Jefferson Medical College offered the chair of the Institutes of Medicine and Medical Jurisprudence to **James Aitken Meigs** with the commencement of the 1868–69 academic year.



Following his graduation from Jefferson, Meigs, a Philadelphia native, held a series of junior teaching appointments at the then existent Pennsylvania Medical College 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. He had a deep interest in anthropology, and his anthropological papers were widely respected in Europe as well as in the Americas (8, p. 162). He maintained a private clinical practice, which was primarily in the field of obstetrics and gynecology.

In the field of medical education, Jefferson Medical College had been a leader in the concept of integrating direct clinical experience with the didactic elements of medical education. With Meigs's assumption of the Institutes chair, his was 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 suffering by the animals, was quite progressive; however, a virulent antivivisection movement quickly developed and persists to this day. Among those who spoke most forcefully in defense of enlightened vivisection was Silas Weir Mitchell (1, p. 98).

Although not nearly as prolific an author as Dunglison had been, Meigs nevertheless published some 30 papers and edited American editions of such texts as Kirke's *Handbook of Physiology* (1, p. 67) and Carpenter's on the microscope (8, p. 162). Jefferson Medical College appeared to be among the earliest institutions to seriously utilize the microscope in medical education. A course in practical microscopy was inaugurated by the microscopic laboratory, under the direction of Meigs as the professor of physiology and conducted by a demonstrator in histology (10). The laboratory was reported to be amply provided with microscopes and all other appliances requisite for thorough practical instruction in histology.

Long a leading member of the Academy of Natural Sciences, Meigs was asked to give the address at the laying of the cornerstone of their new building in Philadelphia in 1872. James Aitken Meigs died, as the result of an intracranial embolism, on November 9, 1879.

With Meigs's death, the responsibilities of the department fell, in midterm, on his teaching assistant, Dr. H. C. Chapman. Born in Philadelphia, Henry Cadwalder Chapman was educated at the University of Pennsylvania and its School of Medicine, graduating in 1862. Following a residency at Pennsylvania Hospital, Chapman went abroad for three years of further study in London, Paris, Berlin, and Vienna. Upon his return to Philadelphia, Chapman was named prosector (prepare material for subsequent demonstration) of the Philadelphia Academy of Natural Sciences and of the Zoological Society (8, p. 198). The latter 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 of Jefferson Medical College. As we have seen, Chapman assumed complete departmental responsibility with Meigs's death in November 1879. After successfully performing the duties of that department, Henry Cadwalder Chapman was unanimously elected to the chair of Institutes of Medicine and Medical Jurisprudence by the board of trustees of Jefferson Medical College on April 12, 1880 (8, p. 197).

Chapman's association with Jefferson Medical College represents historical irony of the highest order. 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 (8, p. 197). Hostilities between the two schools became so intense as to actually lead to a duel: between Nathaniel Chapman's brother-in-law, General Cadwalder, and Jefferson's professor of anatomy, Dr. Pattison (whose efforts led to Robley Dunglison's affiliation with Jefferson) (5, p. 84). 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 one, Dr. Nathaniel Chapman (5, p. 84). This was despite the fact that they knew each other, Chapman having been entertained at Dunglison's home when he lived in Baltimore and Dunglison visiting Chapman in Philadelphia. Thus the irony of Nathaniel Chapman's grandson being appointed to the Institute's chair at the very institution whose creation he had so vigorously opposed.

As curator of the Museum, Henry Chapman had made significant additions to its collections. When space became a problem, appropriate building modifications were performed. Despite Chapman's background in prosection, he did not pursue Meigs's use of animals in teaching demonstrations with equal vigor (8, p. 179). His postgraduate travels in Europe led to increasing utilization of the modern mechanical apparatus, which was then coming into vogue, for teaching purposes.

Throughout its history, Jefferson Medical College 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 turn, edited American editions of leading European texts, and in 1887, Henry Chapman published *Human Physiology*. Subsequently, Chapman wrote the memoirs of his close friend and colleague in research, Joseph Leidy (8, p. 199).

The experimental elements in physiology had their foundation in Europe, primarily under the influence of Johannes Muller in Germany and Magendie and Bernard in France. With the notable exceptions of the remarkable work of Beaumont and the enlightened Weir Mitchell, the experimental traditions of physiology in America would wait for the late 1870's, when, nearly 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 (11, p. 1). 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 Weir Mitchell, had sought further specialized training in physiology and medicine in Germany and France, to warrant formation of a national society of physiologists.

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* reports that "the idea of forming a society of physiologists originated with Dr. S. Weir Mitchell" (11, p. 5). 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 organizational meeting was held at the College of Physicians and Surgeons in New York with Weir Mitchell presiding (11, p. 10). Of the 28 men identified in the minutes as original members of the society, three have prominent Jefferson affiliations. In addition to Silas Weir Mitchell and Henry Chapman, Dr. Hobart Amory Hare appears on the list. A Philadelphian by birth, Hare was educated at the University of Pennsylvania, receiving degrees in arts and in medicine (1884). Inspired by Mitchell, he pursued postgraduate experimental physiology in Leipzig and Berne, returning to Philadelphia as lecturer in physiology at the University of Pennsylvania (11, p. 30). In 1890 Hare was appointed clinical professor of children's diseases at the University of Pennsylvania and in 1891 commenced a long affiliation with Jefferson Medical College 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 of medical education, Hare's *Practical Therapeutics* would go through 22 editions.

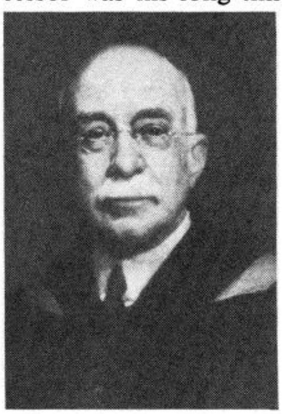
The importance of Jefferson to the founding of the American Physiological Society is further highlighted by the holding of the first annual meeting of the Society in Philadelphia, at Jefferson Medical College on December 29, 1888, at 2:30 P.M. (12). Whereas Weir Mitchell was probably the most distinguished and widely known member of the Society at the time of its formation, he had been elected to Council at the organizational meeting but declined the offer (11, p. 10). 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, Mitchell was again elected to Council, accepted election, and was subsequently elected president of the American Physiological Society by Council. Mitchell served as president for two terms (1888–90), when he again declined election to Council, in order to serve as president of the Triennial Congress of Physicians and Surgeons (11, p. 58). 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 (13, p. 109). Seven years later, the eighth annual meeting of the Society (1895) would return to Philadelphia, meeting at the University of Pennsylvania on December 27 and at Jefferson Medical College on December 28. At this meeting, Chapman addressed the Society on "Methods of Teaching Physiology" (13, p. 118). 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. Chapman, assisted by his able demonstrator, Dr. Albert P. Brubaker, relied on extensive demonstrations in digestion and absorption, in circulation, respiration, calorimetry, secretion, and the nervous system, and in vision, voice, and hearing (14).

These demonstrations were effective, but Chapman and Brubaker continued to advocate the desirability of medical students performing their own laboratory experiments, thereby acquiring 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 member of Jefferson's board of trustees (15, p. 10).

As reported in the February 1900 issue of the undergraduate publication, *The Jeffersonian* (16, p. 179), the organization of the laboratory had been 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 in length by 22 feet wide, could simultaneously accommodate 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 the phenomenon of respiration; and a section for second-year students investigating the nervous system (nerves, muscles, spinal cord) and special senses. From the top of each table in this section of the laboratory 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 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, was derived from the house current and distributed via 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" (16). It was a most auspicious manner for the department to enter the twentieth century.

Chapman retained his chair until the conclusion of the 1908–09 academic year, when he was made an emeritus professor (17, p. 65). His period of retirement was all too short and he died on September 9, 1909, in Bar Harbor, Maine (18, p. 199). 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.



The son of a general practitioner, Dr. Henry Brubaker of Somerset County, Pennsylvania, Albert P. Brubaker attended Jefferson Medical College, graduating with honors in 1874 (18). Following postgraduate training in clinical medicine at the Charity Hospital, Brubaker associated himself with Dr. Wharton Sinkler of the University of Pennsylvania at the Orthopedic Hospital (8, p. 303). 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, 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 board of trustees voted to vacate the 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 (8, p. 196). He thus had a tremendous advantage in being eventually elected to the chair of therapeutics but preferred to teach physiology. Jefferson was evolving to meet the medical and scientific needs of the approaching twentieth century. In 1891, a three-year mandatory curriculum was established, with an optional fourth year recommended (8, p. 235; 19). Within two years, this fourth year became an integral element in the medical curriculum. Upon the election of William Potter to the Jefferson Board of Trustees in 1894, he proposed that the College and Hospital change from a proprietary to a nonprofit corporation (8, p. 249). The board adopted a plan of reorganization on February 1, 1895, which was instituted on June 1, 1895. There would be no more tickets issued by professors for their individual courses.

In 1899, Brubaker was named adjunct professor of physiology and hygiene and, in 1904, professor of physiology and hygiene. This would be 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) (20); Chapman gave the course in medical jurisprudence. Increased emphasis in the course in hygiene relative to the prevention of disease by measures devoted to microorganisms and the spread of infectious disease would be the forerunner of latter courses in bacteriology/microbiology (21).

In addition to teaching physiology at Jefferson, Brubaker also taught at the Pennsylvania School of Dentistry and the Drexel Institute in Philadelphia (18). Upon Chapman's relinquishment of his chair in 1909, Brubaker was elected in his stead. He was known as a kindly and fatherly man, whose pedagogic style was clear, simple, and direct (22). Before class, he would draw illustrations for the students, in contrasting colors, and append a synopsis to which he would strictly adhere (8, p. 302). He was always available to his students (22). In keeping with the Jefferson tradition of textbook generation, Brubaker authored a *Textbook of Physiology*, which would go through eight editions. In addition, to complement the emerging student laboratory in physiology at Jefferson, Brubaker published a *Compendium of Physiology* for the laboratory. The superb clarity of his lectures was reported to be carried forward by both texts. This clarity of organization led to success in numerous faculty committees and ultimate selection as chairman of the faculty (18).

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: fifty years (1911–61). He was a tall thin moustached man, strong in mathematics and with a very private personality (23). Brubaker presented all of the lectures in physiology while Tuttle handled the weekly recitations (24). The laboratory responsibilities were shared by the two of them, the experiments dealing with the functions of muscles, nerves, the spinal cord, heart, circulatory, and respiratory apparatus as well as the pharmacological action of the more important drugs of the day (25).

Lucius Tuttle, a graduate of Yale, 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 (1908–10). 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. The Theory of Measurements* was published in 1916.

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 (26). This would be Jefferson's first attempt at graduate education. Such persons, at the end of one full year's work, might be recommended by the faculty to the board of 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 1914–15, the entrance requirement for admission to Jefferson's medical course was advanced, requiring 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 (26). 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 in Calcium Metabolism in Certain Pathological Conditions." Between 1915 and 1926, a total of three Ph.D.s, four M.S.s, two D.S.s, and two B.S. degrees were awarded. After this period, graduate education would not reappear at Jefferson for over 20 years.

At the conclusion of the 1926–27 academic year, Dr. Albert P. Brubaker retired as professor of physiology and medical jurisprudence at age 75. He was immediately named emeritus professor. As his successor, Jefferson chose Dr. **J. Earl Thomas**, a graduate (B.S., M.S., M.D.) of St. Louis University School of Medicine. Selecting an academic career, Thomas served as instructor/assistant professor of physiology at St. Louis University School of Medicine (1918–20) and as associate professor of physiology at West Virginia School of Medicine (1920–21) and then back at St. Louis University School of Medicine (1921–27).

Jacob Earl Thomas was a noted experimentalist, skillful experimental surgeon, and ingenious designer of research equipment. This talent for designing and making numerous pieces of laboratory equipment, which came to be widely used in teaching and research, has been ascribed to his boyhood experience as an apprentice in the mechanical trades (27). The author of more than 200 scientific papers, primarily concerning the physiology of the digestive system, Thomas materially enhanced our understanding of the regulation of gastric emptying, the filling and evacuation of the gallbladder, the autoregulation of gastric secretion, the complexities of the entero-enteric reflexes, and the mechanisms of pancreatic secretion. Instrumentation that he developed to aid these advances include the Thomas drop recorder, the Thomas wrench, the Thomas gastric pouch, the Thomas pancreatic fistula, and the Thomas intestinal cannula (27).

In Thomas's department, Tuttle assumed responsibility for approximately one-third of the lectures: the physiology of blood, muscle, and nerve, electrophysiology, and the physiology of sensation. Appropriate demonstrations were presented to the class relative to these topics. In 1929, Lucius Tuttle was named assistant professor of physiology and Jefferson Medical College occupied a new building. The new physiology laboratory contained facilities that fostered student experiments on larger animals than the prior laboratory of 1899. The equipment provided in 1899 was modified and supplemented to permit greater flexibility and a wider variety of experiments.

In 1931, Thomas expanded the full-time department faculty to three with the appointment of Dr. Joseph O. Crider as associate professor of physiology. At the time of his appointment, Joseph Otterbein Crider was a mature academician. Born in Harrisonburg, Virginia, Crider received his M.D. in 1912 from the University of Virginia School of Medicine, Charlottesville, the institution which Robley Dunglison had first established for Thomas Jefferson. After an initial appointment as associate professor of physiology and pharmacology at the University of Virginia (1912–13), he moved on to the University of Mississippi School of Medicine where he successively served as associate professor of physiology and histology (1913–16), professor of physiology and histology and assistant dean (1916–24), and professor of physiology and dean (1924-30). At Jefferson, he was appointed associate professor of physiology and assistant dean. A man with a deep southern accent, Crider did most of the interviewing of prospective new students to Jefferson as admissions officer under Dean Ross Patterson (23).

Crider joined Thomas in presenting lectures and demonstrations on the physiology of the major organ systems. Recitations were conducted by Thomas, Crider, and Tuttle, and Crider and Tuttle 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" (Catalog of Instruction, 1928, ref. 28). Such an enhancement of the program became possible not merely as a result of Thomas's 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 Medical College (29). 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" (30). Christopher J. Morgan, M.D., did serve as a research fellow in physiology (1931) and did assist with both recitations and the student laboratory.

Earl Thomas was a man who was intellectually curious and with a deep commitment to experimental physiology. Nevertheless, he never failed to devote himself wholeheartedly to the teaching of the medical student. His lectures were always exceptionally organized, on small note cards (22), clear, concise, and on a level that the medical student could understand (31). A significant

Physiology Laboratory depicted in 1928. *Clinic*, Senior Student Yearbook. Constructed in 1898.

amount of material was contained within each lecture, but so well paced, that the student could take excellent notes with little perceived need for undue reliance on texts (23). He always exhibited a sympathetic attitude toward the student who found himself in scholastic difficulties. He was never too busy to give the student help.

In 1932, J. Earl Thomas assumed the presidency of perhaps the oldest local physiology society in the nation, the Physiological Society of Philadelphia (32). 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 contain 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 of 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 contains 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, 1932–34. He was influential in enhancing the regional status and membership of the society. Under his auspices, the first meeting of the society at Jefferson Medical College occurred on January 16, 1933. He established the Physiological 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 had evolved – 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 physiology at Jefferson Medical College . . . Friedman . . . DeBias . . . Siegman . . . Lefer.

The year 1940 marked the beginning of a decade of significant expansion of the Department of Physiology under Thomas. The appointment of a number of truly outstanding fellows, with joint responsbilities 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, obtaining his M.D. in 1919. Following graduation, he accepted positions as assistant in anatomy, University of Vienna Medical School (1920), clinical appointment at Kaiser Franz Joseph Hospital (1920–24), and acting director of its Department of Pathology (1924–25) and subsequent clinical appointments in the Department of Medicine at Vienna's University Hospital (1925–31), and Allgemeine Poliklinik (1931–38) (33). As the political climate of 1938 Austria turned increasingly unsettled, Paschkis, at 42 years of age, with an established academic and professional reputation and an active practice, prepared to emigrate from Austria to the United States.

Arriving in Philadelphia, Paschkis became a research associate at Temple University's Fels Institute, 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) (23). Additional important collaboration was supplied by Romano DeMeo (biochemistry), Adolph Wakling (surgery), and Joseph Rupp (medicine). Over 100 research publications would result from these collaborative research efforts.

At the time of Paschkis's 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

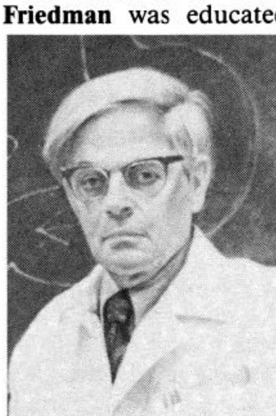
Wirts and J. Edward Berk. Both men shared Thomas's zeal for gastroenterology and devoted their careers to its advancement in education, research, and clinical training. Aside from postgraduate training in Chicago, London, and Paris, Wilmer Wirts, a 1934 graduate of Jefferson Medical College, would maintain his Jefferson affiliation for some 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 (34, p. 21). He served as president of both the American Gastroscopic Society and of the American College of Gastroenterology.

A 1936 graduate of Jefferson Medical College, Edward Berk 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 Medical College 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 has authored over 250 publications. In recognition of his many talents, Edward Berk has been elected governor of the American College of Physicians, president 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.

Once again, as Thomas strengthened his department with the addition of three such outstanding fellows, Jefferson Medical College in 1940 demonstrated still further maturity via establishment of the bachelor's degree, based on four years of collegiate work, as the standard prerequisite for admission (35).

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 (36).

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 back to McGill University (Ph.D. in Physiology, 1937) serving as a research associate at Wayne State University prior to assuming the position of associate in physiology at Jefferson Medical College in 1941. At the time, he was only the second nonphysician to be named to the medical faculty. Friedman's initial responsibilities included participation with Thomas, Crider, and Tuttle in recitations and with Crider and Tuttle in physiology laboratory and demonstrations. His investigative interests, as with Thomas, focused on the field of gastrointestinal physiology. While at Wayne State, Friedman had worked with an extract of urine that was reported to inhibit gastric secretion and offer therapeutic possibilities for ulcer treatment (urogastrone?). This was the work that he reported on 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 would utilize as the first commercially successful method of obtaining secretin in this country (36). It would be this preparation that Thomas and Crider would utilize in their pioneering studies of pancreatic physiology.



At the outbreak of World War II (1941–42), many of Jefferson's staff physicians went off to join the United States Army's Jefferson Hospital Unit. Friedman would often go to the Gastrointestinal Clinic to aid the remaining short-handed staff (36). 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 as Patterson Fellow in Physiology. A 1937 graduate of Jefferson Medical College, Pincus's postgraduate training was at the University of Pennsylvania and in Los Angeles. Following his fellowship year of 1941–42, 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 (37, p. 7).

In 1945, Thomas appointed William J. Snape 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 (37, p. 5). In addition, Snape, who would go on to become chief of gastroenterology (Cooper Hospital, Camden, New Jersey), engaged in cooperative studies with Drs. Friedman and W. Addison Clay (Public Health Service fellow in physiology, 1949–51) 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 which he had sustained since 1911. In an April 5, 1945, letter to Dean William Harvey Perkins, Thomas explained that, "Tuttle will not be able to carry the full load of teaching which he had done in the past. . . . He thinks that he will probably be able to continue with the special phase of the laboratory work in which his special knowledge has been particularly helpful" (38). Tuttle relocated to his daughter's farm in Fabyan, Connecticut, in order to recuperate, and Dean Perkins subsequently confirmed the leave of absence on April 25, 1945.

Unfortunately, Tuttle was not able to resume his duties. There being no pension plan in force at the time, social security, or other income, Tuttle was retained on the departmental roster as assistant professor of physiology and his salary was maintained. This special arrangement was confirmed by the board of trustees on October 27, 1947, and would continue until 1961 (50 years from the date when Tuttle first joined the department). On March 27, 1961, the executive faculty of Jefferson Medical College named Lucius P. Tuttle honorary assistant professor of physiology and on May 4, 1961, Tuttle passed away in Jefferson Hospital.

Further expansion of the Department of Physiology resulted with the appointment in 1946 of Irving H. Wagman as associate in physiology and in 1947, with the appointment of Jerome M. Waldron as an instructor in physiology and Samuel Stinger Conly, Jr., as assistant demonstrator in physiology. 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's interest in vagotomy as a potential treatment for peptic ulcer (37, p. 4). In addition, Wagman obtained a US Public Health Service grant to study the problems of aging, specifically to determine the changes which occur in the functional capacity of peripheral nerves and reflex centers from infancy to old age (37, p. 5). In cooperation with members of the Department of Biophysics at Johns Hopkins University, 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 (37, p. 6).

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 (37, p. 6). Within the department, Waldron joined Drs. Friedman and Snape in their studies on the secretion and activity of pancreatic and other digestive enzymes (37, p. 7).

As Samuel Stinger Conly, Jr., and his classmates entered the first-year class at Jefferson Medical College 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 significant numbers and quickly. The curriculum was modified to accommodate two classes a year. Conly's class was to graduate by September 1944 rather than June 1945. At the end of their junior year, most of the class entered the Army (ASTP, 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 (12-month program shortened to 9 months), they became first lieutenants. Conly interned at Bryn Mawr Hospital and then went into the Army for two years. Upon returning from military service, Conly informed Thomas of his interest in biology, whereupon he was offered the position of assistant demonstrator in physiology (31). Conly joined Dr. Crider in studying the secretion of bicarbonate by the pancreas in dogs with experimentally induced acidosis (37, p. 4). For three years (1947–50), Conly split his efforts between a developing private practice in South Philadelphia 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 (1950–53). In 1953, Dr. Conly reassumed his affiliation with the Department of Physiology as assistant professor of physiology. 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 between the Department of Physiology and the office of the dean, which had been held by Dr. Joseph O. Crider until 1952.

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 as to how research was to be fostered as well as to the actual training of potential researchers (39). These concerns came to a head during Thomas's 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 sciencies. Authority for such programs was vested in the full university charter, under which Jefferson Medical College had functioned since its founding. This proposal was unanimously endorsed by the board to trustees of Jefferson Medical College 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, . . ." (40). Thomas appointed a faculty committee, the chairman of the basic science departments, to draw up the plans for reinstitution of graduate education at Jefferson after a 20-year hiatus. This committee would evolve into the Board for the Regulation of Graduate Students.

Throughout the decade of the 1940's, Thomas had significantly enhanced the Department of Physiology via 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 (1946–48), 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's professional development (41). The year spent with Thomas (1951–52) was pivotal in directing Brooks into a career which combined clinical medicine with investigative medicine and physiology (42, p. 1).

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, Frank Brooks served as chief of gastroenterology at the Hospital of the University of Pennsylvania. His active research program continued the work of Thomas's laboratory: neurohumoral control of gastric secretion and the regulation of pancreatic exocrine function. The editor of several textbooks on gastrointestinal physiology and pathophysiology, Frank Brooks maintained an active role in national and international aspects of clinical gastroenterology and gastrointestestinal physiology: 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 1950's 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 position. It was a difficult time for civil liberties. Jefferson Medical College would not escape this turmoil nor would the Department of Physiology.

Refusing to sign a loyalty oath in 1953, Dr. Irving H. Wagman, associate professor of physiology, was one of Jefferson's faculty members whose "loyalty" was questioned. The Medical College held a summary review of Wagman's case and he was dismissed from the faculty. Dr. Thomas strenuously defended Wagman and was bitterly disappointed by his dismissal (36). 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, since he was one of the few basic scientists to be so recognized by these clinical societies (43, p. 22).

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 in physiology. 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 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 (44, p. 2).

Not too long after the Wagman incident, Thomas's health deteriorated. Suffering from ulcer disease, Earl Thomas was advised to take a prolonged rest, whereupon he departed for a lake in Northern Ontario for a period of approximately six months (36). With improved health, Thomas returned to Jefferson for a final year, retiring from service to Jefferson and accepting 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 was designated acting chairman until 1957, when he formally succeeded J. Earl Thomas to the chair in physiology.

On assuming the chair, Friedman moved to abolish both Saturday classes and mandatory attendance for medical students (36). Student laboratories were divided into smaller units. The faculty was augmented with the additions of Drs. Louis A. Kazal as assistant professor of physiology and Domenic A. DeBias as instructor in physiology. 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) prior to 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. Louis 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 since his arrival and served as associate director of the Cardeza Foundation from 1960 until his retirement in 1978.

Dominic 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's investigative studies involved adrenal and thyroid function stress (43). Later work involved hormonal factors associated with endurance to high altitude and the evaluation of sequellae to myocardial infarction, with exposure to environmental pollutants (e.g., carbon monoxide).

In the early 1970's, Jefferson's medical curriculum embraced a concept whose roots date back to the earliest days of this institution's existence: integrated teaching. After establishing a course, cell and tissue biology, which integrated biochemistry with elements of histology and genetics, anatomy and physiology were brought together into an integrated course, structure and function. Dr. Domenic DeBias was selected as course 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.

Friedman responded to the increasing importance of cellular physiology and biophysics by enhancing the department in these areas with the appointment in 1958 of Dr. June N. Barker as instructor in physiology and in 1960, Dr. Daniel L. Gilbert as assistant professor of physiology. Trained at the University of Rochester (B.S., 1952) and at Duke University (M.A., 1954, Ph.D. in Physiology, 1956), June Northrop Barker came to Jefferson after serving a year as instructor in physiology at the

Duke University School of Medicine. 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 female medical student—1961. A specialist in water and electrolyte metabolism, Barker's research was in fetal physiology—intrauterine fluid balance, cerebral and respiratory circulation, and metabolism. June Barker pioneered in the development of ultramicrotechniques in fluid and tissue analysis. She left Jefferson in 1964 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 (1955-56) and at Albany Medical College (1956-60) prior to coming to Jefferson. His work in biophysics involved membrane permeability, ion distribution and equilibria, radiobiology/radiation toxicity, and the biophysics of evolution. He left Jefferson in 1963 to head up 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 in physiology. 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 (1952-57) and physiology and pharmacology at the Dental School of Northwestern University (1957-60) before coming to Philadelphia. A dedicated teacher and skillful experimental surgeon, he took charge of and reorganized the medical student laboratories, in addition to his teaching responsibilities in intestinal absorption and renal physiology. His interests in intestinal absorption, inflammation, 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 to better understand smooth muscle function, Dr. Marion J. Siegman was appointed instructor in physiology in 1967. A graduate of Tulane University (B.A., 1954) and the State University of New York (Ph.D. in Pharmacology, 1966), Marion Siegman brought valuable laboratory experience in the study of the mechanical properties of smooth muscle. Her research interests include the energetics of contraction, excitation-contraction coupling, and cation transport and metabolism. A strong proponent of meaningful interaction among researchers, she was one of the founding members of the Philadelphia Muscle Institute, an interdisciplinary area-wide 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 medical physiology course. In that year, Friedman brought in Dr. Sheldon F. Gottlieb as assistant professor of physiology. The era of organ system specialization was at hand. Following graduation from Brooklyn College and the University of Texas (Ph.D. in Physiology, 1959), Sheldon Gottlieb joined the research laboratories of the Linde Division of Union Carbide Corporation as a research physiologist (1959-64), 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 via 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 of the University of South Alabama in 1981.

Friedman continued to build up his department through the 1960's. 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, he added a number of Jefferson's own trainees to the faculty. Dr. Leonard M. Rosenfeld (A.B., Univ. of Pennsylvania, 1959; Ph.D. in physiology, Jefferson, 1964) was appointed instructor in physiology in 1964. He assumed June Barker's teaching responsibilities in water and electrolyte metabolism as well as part of the gastrointestinal block (total after 1974). 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. He held this position until 1980. Rosenfeld's research includes 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 physiology 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, Eugene Zawoiski taught renal physiology to medical students and had extensive involvement in the teaching of physiology to student nurses in the diploma program, serving as course coordinator (1975-80). 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 of physiology 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 (1955-58) and in New York (1959-60), Banerjee served as staff scientist in respiratory physiology at Hazelton Laboratories, in Virginia (1967-68). 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, he left Jefferson to take up the position of professor of physiology at the Southern

Illinois University School of Medicine.

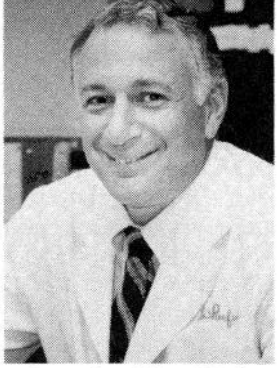
To fill the void created by Doemling's departure, Banerjee recommended a previous colleague from Virginia to Friedman. Dr. Robert E. Thurber (University of Kansas, Ph.D. in Physiology, 1965) had served as a research associate in radiation biology at the Brookhaven National Laboratories (1956–61) and at the Medical College of Virginia (1961–69) before assuming an associate professorship at Jefferson (1969–70). 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 in 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 1:1 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 the 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 1960–70, 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 . . . 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" (45).

Dr. M. H. F. Friedman retired from Jefferson on June 30, 1974. He was named an emeritus professor at Jefferson and then joined Domenic DeBias's Department at the Philadelphia College of Osteopathic Medicine.

On July 1, 1974, Dr. **Allan M. Lefer** became the seventh chairman of the Department of Physiology at Jefferson Medical College (tenth individual to be responsible for physiology since the start of the school in 1824). There is historical irony in this appointment. Robley Dunglison (1836) was the first occupant of the chair in physiology at this institution named in honor of President Thomas Jefferson. He had come from the University of Virginia, the institution established by Thomas Jefferson. Now, 138 years later, Allan Lefer, of the same University of Virginia was indeed following in Dunglison's footsteps as he, too, 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 (1962–64), Allan Lefer relocated to the University of Virginia School of Medicine at Charlottesville, rising through the academic rank from assistant professor to professor of physiology (1964–72). He spent the year 1971–72 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 in physiology ended almost a half-century of special departmental emphasis on gastrointestinal function (1927–74; through the chairmanships of J. Earl Thomas and M. H. F. Friedman). The new departmental "tilt" would be decidedly cardiovascular. Lefer's cardiovascular interests, experience, and involvement are varied and include 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" (46) while moving aggressively to enhance capabilities and productivity in activities such as 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 in physiology.

Dr. Michael Rovetto received his Ph.D. in physiology under Lefer at the University of Virginia (1970). On leaving Virginia, Rovetto served as a research associate in physiology at Hershey Medical Center, Pennsylvania State University (1971–73) before being named assistant professor of physiology at Hershey (1973–74). At Jefferson, he continued his studies on myocardial metabolism and the regulation of cardiovascular function. Advanced to an 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, Spath served as assistant professor of physiology, Virginia Commonwealth University, Medical College of Virginia (Richmond). His research has involved cardiac enzyme activity in pericardial tamponade, pharmacological limitation of ischemic heart injury, circulatory regulation in shock, and post-myocardial ischemia development of pulmonary edema.

From the start, Allan Lefer established international relationships that would result 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 (1974–76), 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 (47). 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 via enhanced extramural funding within the department. 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 1974–75 resulted in the appointment of Drs. Marlys H. Gee and Anatole Besarab as assistant professors of physiology. Marlys Gee received her graduate training at the University of Colorado School of Medicine, Denver (Ph.D. in Physiology, 1972). A three-year research fellowship (1972–75) 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 have been in the pathophysiology of pulmonary edema, pulmonary epithelial and interstitial protein transport, and post-myocardial 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 (1973–75). 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 1976–77, a fourth major departmental support facility was developed, an electron-microscopy suite (48). A departmental surgical area was converted to house a Zeiss EM-9S electron microscope, a preparation laboratory, and a photographic darkroom along with a departmental technician to operate the facility.

Continued recruitment activities resulted in the 1976 appointment of Drs. Thomas M. Butler, John T. Flynn, and Joseph R. Sherwin as assistant professors of physiology. 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. Davies, Pennsylvania Muscle Institute at the University of Pennsylvania (1974–76). Here he engaged in investigative studies of the energetics and regulation of muscle contraction. A number of these studies were collaborative between Butler, Davies, and Marion 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 is a graduate of the Hahnemann Medical College and Hospital (Ph.D. in Physiology, 1974). In 1974, he came to Jefferson as a research associate for additional postdoctoral training in cardiovascular physiology in Allan Lefer's laboratory (1974–76). 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, 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 a research associateship (1973–76) until he came to Jefferson in 1976 to assume teaching and research activities in endocrine physiology. His research activities focus 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, still further recruitment was pursued, resulting in the appointment (1977) of Dr. Paul S. Blum as assistant professor of physiology. Paul Blum received his Ph.D. from the University of Vermont in Physiology (1973). The year 1973–74 was spent as a National Institute of Mental Health postdoctoral trainee in sciences related to the nervous system at Duke University. Subsequently, Blum served as a research associate in neurology at the College of Physicians and Surgeons, Columbia University (1974–77). 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.

A growing research interest developed with emphasis on metabolic, hemodynamic, and pathophysiological aspects of myocardial ischemia and circulatory shock (49). The main focus of such activities was within the Department of Physiology, with significant additional interest in the Departments of Pharmacology, Medicine, and Surgery. Collaborative research projects developed, and out of this interaction there 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 are held to enhance scientific dialogue among the members of the ISRC. In addition, prominent scholars in the field are invited to give guest lectures, and on April 23, 1980, the Center sponsored a minisymposium on shock. Funding for the Center is derived from several donations from private industry and grants from the W. W. Smith Foundation and the Ralph and Marion Falk Foundation.

The departmental commitment to quality graduate education remains strong. The number of departmental trainees is down from its peak in the 1960's. This reflects the fact that each student now receives support, and thus the number of incoming students is limited by the fiscal resources of the department, supplemented by institutional funds.

## *Historical Articles*

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 has been awarded first prize for the most outstanding poster presentation for four consecutive years (1979-82). 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 Koln, Germany. Furthermore, Dr. Smith's thesis, concerning pathophysiological actions of thromboxane $A_2$ in coronary artery disease (thesis advisor, 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 to be one of the top 12 theses of 1981.

To partially replace the loss of cardiovascular expertise experienced by the department as a result of Michael Rovetto's relocation to Missouri, Dr. Stuart K. Williams II was appointed assistant professor of physiology in 1981. Educated at the University of Delaware (Ph.D. in Cell Biology, 1979), Stuart Williams served as a postdoctoral fellow in the Department of Pathology of the Yale University School of Medicine (1979-81). His research interests have been in microcirculation and the role of micropinocytosis in capillary endothelium.

The record of 158 years of physiology at Jefferson Medical College (1824-82) has been impressive. We have seen the department evolve from a basic one-man operation into a sophisticated modern operation staffed by a large complement of professionals. This department can take great pride in its past: 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. It will be our challenge to extend this record and to advance the frontiers of education and of investigation even further. We will gladly accept this challenge.

The author expresses his sincere appreciation to Robert T. Lentz, Archivist to Thomas Jefferson University, for his constant encouragement as well as sharing of a multitude of documents. To Dr. Frederick B. Wagner, Grace Revere Osler Professsor of Surgery, for his encouragement, sharing of private historical manuscripts and personal experiences. To Drs. M. H. F. Friedman, Emeritus Professor of Physiology and Chairman of the Department (1957-74); Andrew J. Ramsay, Emeritus Professor of Anatomy; the late Benjamin F. Haskell, Professor of Surgery (Proctology); the late Abraham E. Rakoff, Professor of Medicine (Endocrinology); Samuel S. Conly, Jr., Associate Professor of Physiology and Associate Dean; Frank P. Brooks, Professor of Medicine, University of Pennsylvania; and Caroline H. Hollshwander, Chairman, Department of Nursing, Allentown College of St. Francis de Sales, for their most valuable sharing of personal experiences. Finally to Dr. Orr E. Reynolds, Executive Secretary-Treasurer of the American Physiological Society, deepest thanks for his hospitality at Society Headquarters, Bethesda, Maryland, and access to the Society Archives and records associated with the founding of the American Physiological Society, and to Dr. Marilyn Hess, Professor of Pharmacology, University of Pennsylvania, for her hospitality and access to records associated with the founding and early history of the Physiological Society of Philadelphia.

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# A Retrospective Look Through the Camera of Fred A. Hitchcock

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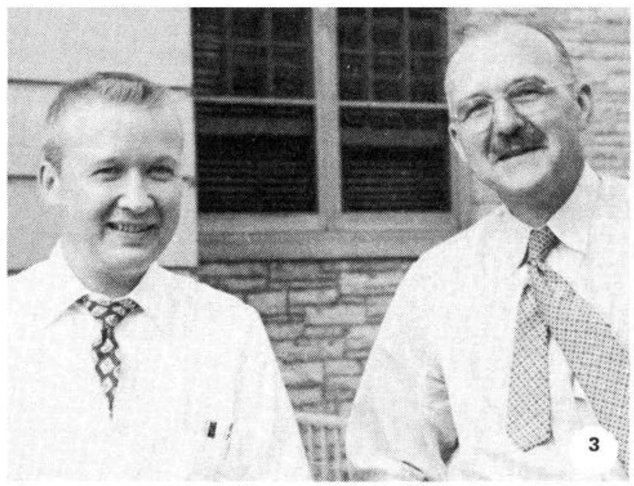
For 37 years Dr. Fred A. Hitchcock (1889–1980) served the Physiology Department, Ohio State University, in many capacities. His career at Ohio State started as a graduate student where he received a M.S. in Zoology in 1923. That same year, he joined the Physiology Department as an Instructor. In 1926 he was awarded a Ph.D. in Physiology and continued to teach advancing to Assistant Professor (1928) and Professor (1940). In 1947–49 he was the acting chairman of the department and in 1960 he retired as a Professor Emeritus.

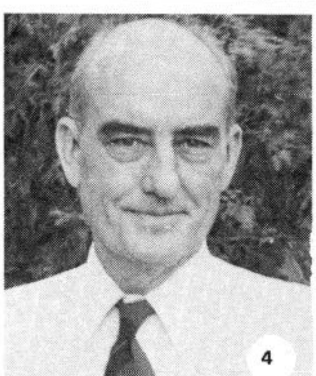
Dr. Hitchcock's earliest research efforts were in respiration; he studied factors determining alveolar $CO_2$, respiratory center sensitivity to ethyl alcohol, and respiration in artificial atmospheres. Dr. Hitchcock also enjoyed a lifelong love affair with flying and aerospace travel. In 1913 he served as photographer on the Goodyear hot air balloon. He received a private pilot's license in the mid 1940's and predicted, in the 1940's, that man would reach the moon by 1985. In later years when this became a reality, he was often heard to bemoan the fact that he was too old to be an astronaut. It was not surprising then that he combined his interests and established the Laboratory of Aviation Physiology at Ohio State in 1941. This laboratory produced over 40 papers on the physiological responses to high altitude and the pioneering work of the possible deleterious effects of explosive decompression (a sudden rapid drop in barometric pressure). His work contributed to the development of pressurized cabins in high-flying aircraft, and in 1956 he was presented the Arnold D. Tuttle Memorial Award by the Aerospace Medical Association for his achievements in aviation physiology. Dr. Hitchcock's interest on this topic was further demonstrated in 1943 when he, along with his wife, translated the 1878 Paul Bert classic, "La Pression Barometrique Recherches de Physiologie Experimentale."

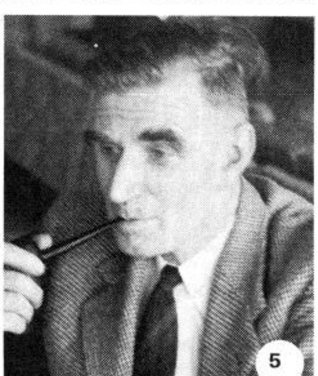
I will not list Dr. Hitchcock's numerous awards and memberships; but it should be noted that he was a member of the American Physiological Society for 53 years and served on Council during 1951–56. He was also President of the Aerospace Medical Assocation in 1956–57.

Recently, I moved into the office that Dr. Hitchcock had occupied during his retirement. While cleaning out a closet I found a box containing some of his photographic negatives; and luckily, he had notes on the envelopes containing them. While many of the negatives were scratched, they still provide a wonderful look back into the 1940's–50's at some of the American Physiological Society's most noteworthy members. Included in the photographs was a series taken at the 1954 Fall APS meeting in Madison, Wisconsin. The dates and locations of many of the other portraits are not known. As a tribute to Fred A. Hitchcock and his work, the Ohio State Physiology Department would like to share his photographs with you.



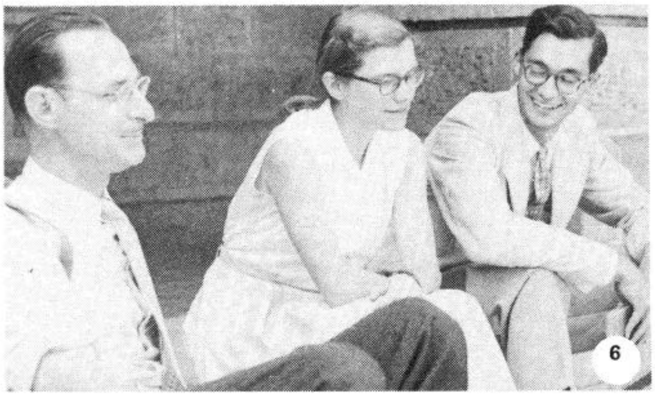


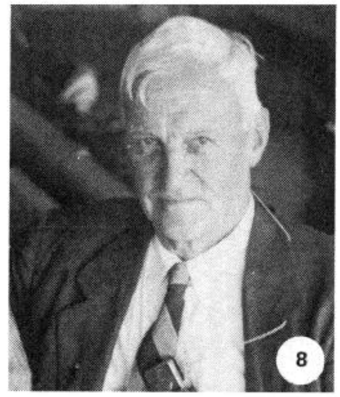



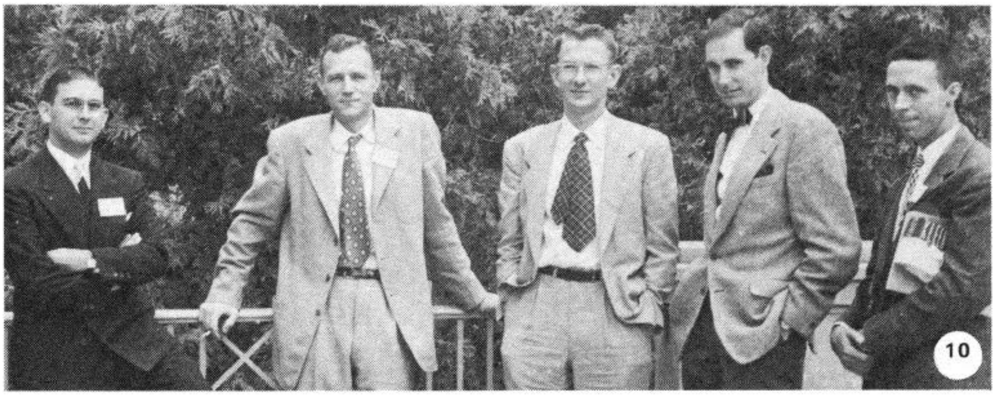



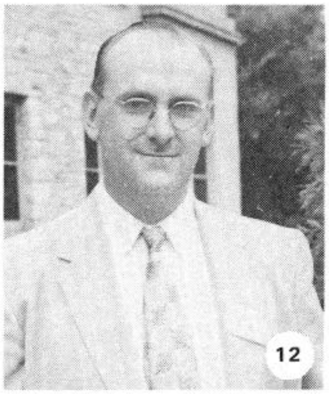

1. Milton O. Lee, 1954; 1st APS Executive Secretary-Treasurer (1948–56); alumnu of Ohio State Univ. Physiology Dept. (Ph.D., 1926).
2. Wallace O. Fenn (Univ. of Rochester), 1954; 19th APS President (1946–47).
3. *Left*: unidentified. *Right*: Maurice B. Visscher (Univ. of Minnesota), 1954; 19th APS President (1948).
4. Hiram E. Essex (Mayo Clinic/Foundation), 1954; 27th APS President (1954).
5. Alan C. Burton (Univ. of Western Ontario), 1954; 29th APS President (1956).

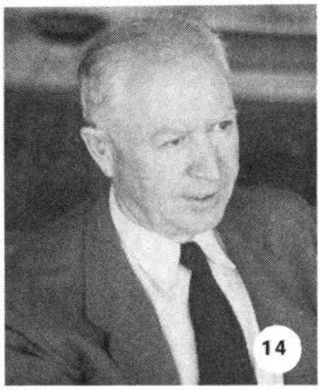
The Editor welcomes similar archival photographs.

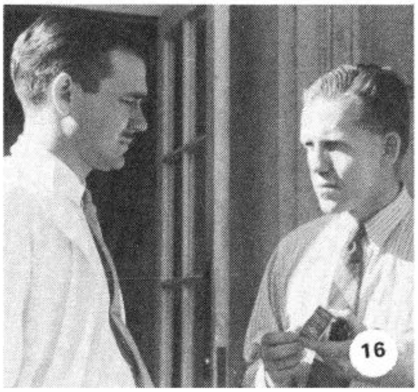








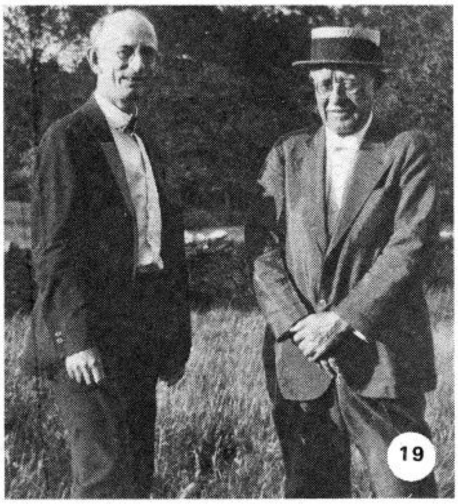




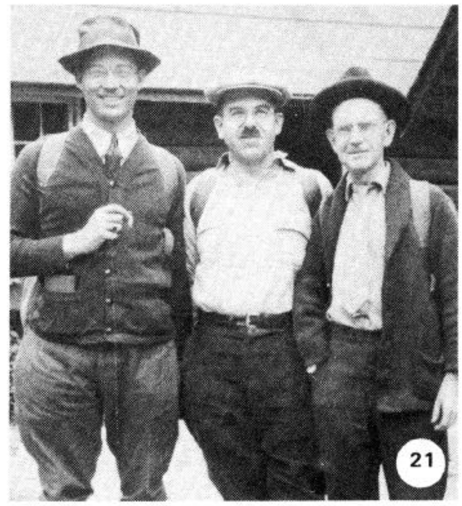

6. *Left to right*: Horace W. Davenport (Univ. of Michigan; 34th APS President, 1961), M. Elizabeth Tidball (George Washington Univ.), and Charles S. Tidball (George Washington Univ.) at APS Fall Meeting, 1954.
7. Arthur B. Otis (Univ. of Florida), 1954.
8. Alexander Forbes (Harvard Univ.), 1954; APS Treasurer (1926–36).
9. Orr E. Reynolds, 1954; APS Executive Secretary-Treasurer (1973–present).
10. *Left to right*: Gerald Kanter (Albany Medical College), Hermann Rahn (State Univ. of New York at Buffalo; 36th APS President, 1963), Walter Massion (Univ. of Oklahoma), Michael Lategola (Civil Aeromedical Inst., FAA, Oklahoma City), and unidentified, 1954.
11. John W. Bean (Univ. of Michigan), 1954; joined APS in 1932.
12. Otto H. Schmidt (Univ. of Minnesota), 1954.
13. Dave Tyler, 1954.
14. Unidentified, 1954.
15. Staff of Donner Laboratory, Berkeley, CA. *4th from left*: Fred A. Hitchcock; others unidentified; date unknown.
16. At Donner Laboratory. Both unidentified; date unknown.



17. E. Newton Harvey (Princeton Univ.); date unknown; joined APS in 1914.
18. Carl J. Wiggers (Western Reserve Univ.); date unknown; 21st APS President (1949).
19. *Left*: Raymond J. Seymour; chairman, Ohio State Univ. Physiology Dept. (1928–34). *Right*: Albert M. Bleile; established first teaching and experimental physiology laboratories at Ohio State Univ.; joined APS in 1917. Ca. 1930.
20. Fred A. Hitchcock (Ohio State Univ.); date unknown.
21. *Center*: Fred A. Hitchcock; others unidentified; date unknown.
22. Inside decompression chamber at Laboratory of Aviation Physiology, Ohio State Univ. This was the chamber Dr. Hitchcock used for his studies of explosive decompression. Ca. World War II.
23. John Lilly at Laboratory of Aviation Physiology. Ca. World War II.








## Name That Physiologist Contest

**Help us to identify unknowns:**

3. ____________________, M. B. Visscher

10. *Far right:* ____________________

14. ____________________

15. __________, __________, __________,
F. A. Hitchcock, __________, __________,
__________, __________, __________

16. ______________, ______________

21. __________, F. A. Hitchcock, __________

22. __________, __________, __________

**Can you supply missing dates?**

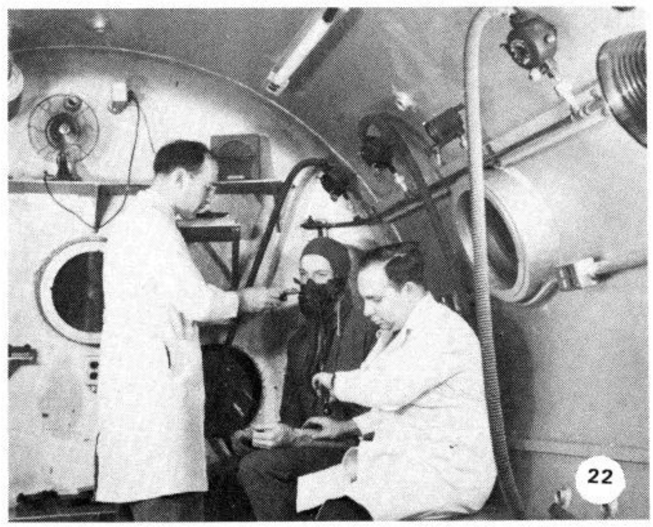
15. _____; 16. _____; 17. _____; 18. _____;

19. _____; 20. _____; 21. _____; 22. _____;

23. _____

Return to: Dr. Orr E. Reynolds
APS/Hitchcock Photographs
9650 Rockville Pike
Bethesda, MD 20814

Prize for most correct answers: Centennial memento
Deadline for receipt of entry: 8/1/84




# The Archives of the American Physiological Society

Compared with most professional societies, the American Physiological Society has a rich archives. From the founding of the Society in 1887, thought was given to preserving an account of the Society's activities. The first secretary, H. Newell Martin, began two large volumes in which he entered in pen and ink the deliberations of the Council and Society (Business) meetings. Not only were the official minutes kept but also treasurer's reports, programs of the meetings, and occasional official correspondence were pasted or tipped in. Among the correspondence in the first volume were examples of the two circular letters signed by Mitchell, Martin, and Bowditch inviting their colleagues to the organizational meeting of the Society held in the Department of Physiology at the College of Physicians & Surgeons, Columbia University on December 30, 1887.

The bound volumes of Council and Business Meetings, 49 of them through 1982, constitute the heart of the APS archives. [Two additional bound volumes deal with the purchase of the Hawley Estate (Beaumont) in 1954 and the purchase of the *Journal of Neurophysiology* in 1962.] By the second volume of Council minutes, beginning in 1915, the secretaries of the Society included a considerable amount of correspondence and even prefaced the volumes with tables of contents. To be found in these early volumes are accounts of the annual and special meetings; members accepted, rejected, and deferred; the establishment of the *American Journal of Physiology* in 1898 and its takeover by the Society in 1914; the founding in 1921 and unexpectedly quick success of *Physiological Reviews*; detailed annual reports on the progress of the journals by the Managing Editor and Editorial Committee; the founding of the Porter Fellowship in 1921 and information on applicants, both successful and unsuccessful; and the documentation of the proud week in 1929 when the Society was host to the first International Physiological Congress held in America.

Aside from the bound volumes, material for the period 1887–1947, the year when the Society acquired its first Executive Secretary, is not extensive. There are a series of account books, 1895–1947, maintained by Treasurers of APS and a series of publications account books maintained by Donald Hooker, Managing Editor of the journals from 1914 to 1946. Over the years the Society has gathered a collection of early directories of members from 1887 to 1913, but a few years are still missing. Federation Directories of Members from 1914 to 1964 are available in the FASEB Library (after 1964, APS also has a complete set). The Society has also gathered a good collection of programs, proceedings, lists of delegates, and memorabilia of International Congresses, by no means a complete set, but going back as far as 1898. Among other early items, mostly donated by members, are the earliest known letter related to the formation of the Society sent by S. W. Mitchell, H. N. Martin, and H. P. Bowditch to W. P. Lombard on May 23, 1887 (recently donated by Horace Davenport); a photostat copy of the first volume of minutes of the Physiological Society presented by the Physiological Society to APS in 1929; a folder of correspondence on journal policies in the 1930's; a scrapbook of the 1939 Federation meeting in Toronto prepared and donated by Arno B. Luckhardt; designs for an APS seal by Wallace Fenn and letters of Council members giving their opinions on the proposed seals, 1941–42; and a series of letters written to Velyien Henderson in 1932 by founding members of APS.

For the period after 1947, the bound volumes are supplemented by papers saved by the Executive-Secretary Treasurers (Milton O. Lee, Ray G. Daggs, and Orr E. Reynolds) and by the Publications Office. The former contain correspondence with the Presidents and Councils; correspondence related to spring and fall meetings; minutes, correspondence, and reports of committees including the Finance, Education, Porter Development, Animal Care, and Senior Physiologists Committees; considerable documentation of the many projects undertaken by the Education Committee; correspondence concerning the purchase of the Beaumont property, the organization of APS staff, and relations with FASEB; and correspondence on International Congresses and the founding of IUPS. The archives contains a full set of programs of APS Fall Meetings, 1948–83, as well as the remarkable "brown" and "black" books, maintained by successive local arrangement committees from 1948 to 1972 and containing a wealth of information, down to tickets for the clambake, on the conduct of the meetings. Publications records include minutes of the Board of Publications Trustees, 1956–1961, reports of the Managing Editors, 1914–1964, and minutes and correspondence of the Publications Committee. Much additional material is stored in the barn and yet to be sorted. While there is stored in the barn and yet to be sorted. While there is good summary documentation on the selection of articles for the journals and on journal finances, correspondence with individual authors and referees, because of its immense bulk, has not been saved.

Individual files have been recently created on all past and present members of APS. They contain the original application form (available for most members elected in 1946 and afterward), curriculum vitae (when available), membership questionnaires, letters written to the Senior Physiologists Committee, and miscellaneous information.

The "Historical Files" contain manuscripts related to the history of physiology, among them, Carlos Reed's unpublished history of American physiology; the manuscripts of many published and unpublished articles by Horace Davenport; and uncut versions of departmental histories published in *The Physiologist*.

Unfortunately, little material is available on APS Groups and Sections, because until recently they were informal in nature. The only section that has so far donated materials to the APS archives is the Circulation Section. Its records cover the period 1933–1980. Some material on early proposals for sectionalization is found in the papers of the Executive Secretary-Treasurers, in the papers of the Publications Office, and bound with Council minutes.

Letters of inquiry about the APS archives and about resources in the history of physiology are welcome. As the Centennial draws near, it is hoped that more physiologists will be stimulated to explore some aspect of the past of their discipline.

## Donations Solicited

The archives has a good but far from complete record of the history of APS. Donations are requested to fill the gaps. Also needed are programs, announcements, and other printed "ephemera" that can be exhibited at forthcoming meetings. While the archives has many of these announcements, they are bound with minutes and thus not readily available for show. Especially desired are the following:

Directories of Members before 1964

Programs and announcements of annual meetings, 1888–1913, of special meetings (with the Congress of American Physicians and Surgeons), 1888–1907, and FASEB Meetings, 1914–1961

Programs of 1948 and 1967 fall meetings

The October 1931 issue of *American Journal of Physiology*, or the whole of volume 98 – otherwise, thanks to Johnson Reprints, we have a full set from 1898 to the present

Additional published material related to International Congresses, especially before 1947

Material on special interest groups before 1975

Any printed announcements related to APS or APS publications prior to 1947

Special request for use in Centennial exhibits: Does anyone have and be willing to donate to APS the 1929 edition of Beaumont's *Experiments and Observations on the Gastric Juice* distributed at the XIIIth International Congress?

Toby A. Appel

## Health Benefits of Animal Research

The article, "The Dog as a Research Subject," on p. 133 by William I. Gay is the first in a series dealing with different species of animals in research. It is planned to subsequently reprint these articles as chapters in a book, *Health Benefits of Animal Research*, with introductory material and an index edited by Dr. Gay.

# The Dog as a Research Subject

WILLIAM I. GAY
Animal Resources Program
Division of Research Resources
National Institutes of Health
Bethesda, Maryland 20205

The dog has been a companion to hunters and herdsmen since the dawn of history. This relationship has occurred wherever both man and dog were known to exist, not only in northern Europe but also in Asia and among the aborigines in Australia. The dog has experienced many advantages and disadvantages as a result of this companionship. The testing of new food substances or suspicious foods, a common occurrence with some ancient rulers who did not have their own human food tasters, is one example of a disadvantage.

It is quite logical that early biomedical researchers would turn to the animals closest at hand and select the dog for their first research subject. In laboratory surroundings, the dog was smaller and easier to maintain than farm animals. Rats and mice were not thought of as research subjects by those early researchers who had yet to establish the first biological principles in their laboratories. The dog was selected generally from those animals that were readily available; and in urban areas, these were usually stray dogs. The most docile and cooperative of these animals were selected. Therefore, since the beginning of biomedical research, the dog has been known as a usually cooperative and uncritical patient, a reputation which he continues to enjoy today.

The seventeenth century was a very active time for budding medical researchers in Europe. One of the earliest recorded uses of the dog is in William Harvey's study of the movement of the heart. His research, done in the mid-1600's, was the beginning of the study of circulation. In 1661, Marcello Malpighi demonstrated that the lung was not a sponge but that it was composed of small sacs in which the oxygen was exchanged. In 1665, Richard Tower demonstrated transfusions in the dog using quills and silver tubes to transfer the blood. Robert Hook, in 1666, performed positive respiration with bellows in an anesthetized dog. During that same year Sir Christopher Wren injected medication intravenously, showing that it was possible to administer medications this way. Approximately 70 years later (1773), the Reverend Dr. Steven Hales, who had been very interested in measuring sap pressure in plants, demonstrated that one could measure blood pressure in animals in the same manner and obtain variable pressures from different animals at different times. This gave scientists, for the first time, information about the actual pressures which existed in the circulatory system. In 1850, James Blondell demonstrated that the restoration of blood volume in an exsanguinated dog would return the animal to life, thus being the first to demonstrate the potential value of blood transfusions. Unfortunately, lack of information about immune responses and problems associated with sterile conditions necessary for transfusion delayed the application of this technique for over 50 years.

## Behavior

The dog is a gregarious and highly evolved social animal that is easily managed in the laboratory. It has frequently been selected and bred for a good disposition. This good nature was well known and appreciated by early behavioral scientists and physicians, including Pavlov, who conditioned the dog for many responses (43). In fact, behavioral genetics, or the inheritance of behavioral characteristics, has been the subject of considerable research with the dog (49).

Pavlov is known throughout the world for identifying and defining the conditioned reflex. He demonstrated this phenomenon in a variety of ways, but always with the dog, which was a favorite and very well cared for subject of his. Pavlov was a physiologist and not trained as a psychologist. He was interested in objective physiology and found that digestive reflexes, beginning with salivation, occurred in response to specific environmental stimuli or situations. He postulated a social reflex in the dog and noted that people familiar to the dog stimulated stronger responses than could be initiated with electric shock. As Pavlov studied this "conditioned reflex," he became very interested in the function of the cerebral hemisphere and was a pioneer in the development of the experimental basis of neurophysiology and physiological psychology. Essential to his success, and the experiments he did, was the dog, a highly developed animal with whom he could communicate. The adaptation of the dog to cooperation with human needs has placed this animal in a key role in research requiring a high level of intelligence. The dog is essential to much preclinical research.

The dog has also contributed to the study of behavior development (1). Not only have the interactions among young puppies been studied but also their interactions with other animals and with man. Studies of variations in aggression and other behavioral characteristics have been conducted in many different species of animals. However, on a comparative basis, this knowledge has been transferred to a number of other species and has assisted in the establishment of principles for developmental behavior in humans. Much of the knowledge gained from these studies is now applied in the training of guard dogs, as well as guide dogs for the blind and hearing dogs for the deaf.

Puppies have been used in studies of social development, maturation, and learning. The puppy is born very immature; it opens its eyes about the 13th day and begins to interact with its environment about the 3rd or 4th week. At this time myelination of the neocortex is beginning to take place and training becomes possible. While you can teach "an old dog new tricks," the best time for training begins at the 5th or 6th week, just after the nervous system is finally integrated and ready to take on the environment. Social deprivation at this time has a very adverse effect on behavioral development in any species and is quite damaging to the dog. The puppy begins identification with future family or pack members at this time (imprinting) and also establishes future relationships with his own species or the human (18).

Scott and Fuller (49) have shown that much of the behavioral development of the dog is controlled by heredity, and their research has provided the basis for many comparative studies with humans and other animals (1, 26). Heredity influences such behavioral characteristics as aggression, learning, shyness, capacity to adapt to the environment, and temperamental stability. Satisfactory behavioral patterns have been selected and preserved in many dog breeds by careful breeding.

Some specific behavioral phenomena that have made the dog useful as a behavioral research subject, in addition to the genetics of behavior, have been the relationship between behavior and cardiac activity, particularly the association of cardiac arrhythmias with fear and stress; anorexia nervosa developing from isolation or psychological trauma associated with food; and the hormonal control of behavior, learning, and dominance studies (26). The dog has not been used as widely as the monkey for gastric ulcer studies. Even though fear does cause secretion of much more gastric acid, the dog is more resistant to gastric ulceration than the primate or the cat.

The dog has been an excellent subject for the study of drug-induced behavior. Animals that have been conditioned for certain functions or responses are excellent subjects for demonstrating the variations that can be introduced by certain drugs. Psychotropic drugs have been studied in the dog. The dog has not been used for the same sort of addictive studies that have been possible in primates; nevertheless, its contribution to this area has been significant over the years. Pavlov even tried to treat "neurotic dogs" with drugs.

## Aging

Aging is quite obvious in dogs, for, like humans, the aged dog has skin that sags, eyes that lose their visual acuity, and hair that turns gray. The dog also loses hair in various places, but most of them more obscure than the top of the head. Recent advances in biomedicine and health care of dogs have made it possible for them to have long lives, many living well past the age of 15 years. Many dogs perform the very valuable function of providing companionship to elderly and handicapped citizens. Aged canines are not unusual, and studies of their health problems have proliferated in recent years.

Scientists have been particularly interested in the amyloid that develops in the dog's kidney, because it appears to be related to other infectious or immunologic diseases. A similar condition occurs in the human and is a leading cause of kidney disease. The reproductive system becomes quiescent in this animal in advanced years but apparently does not go through the menopause seen in the human and some nonhuman primates (e.g., rhesus monkey). Aging in the nervous system has been studied extensively; the loss of cells and the decreased speed in processing information has been noted by researchers. The myocardium has also been a subject of studies. Although this organ is often affected adversely by infectious diseases, it is possible to do some comparative studies of the myocardium in the dog. Senility has been well described in the dog by Getty and Ellenport (20).

Microscopic changes in the brain of the older dog are seen frequently; some of them resemble changes in the aged human brain. It is believed by some that neurotic plaques (one of the neural pathological changes in Alzheimer's disease) are common in the dog. The correlation of these changes with behavioral changes in old dogs has yet to be determined and remains a curiosity for those studying the basic pathological changes in aging. Nevertheless, this animal, which remains with us as a companion well into his mid to late teens as a result of modern medical research, may serve to provide important new information on brain changes in the elderly.

## Anesthesia

As anesthesia equipment was developed and more pain-killing agents became available, it was necessary to test them in animals with reactions similar to those of humans and with anatomic structures (thorax, trachea, etc.) of similar size. The dog's cardiovascular and respiratory system closely approximate those of a small man. Therefore, equipment to be used on humans can be developed and tested on the dog. Modern animal surgery to treat clinical conditions in the dog is indebted totally to the development of this equipment.

With the development of equipment for anesthesia and for the maintenance of positive air pressure in the lung, it became possible to perform surgery in the chest of the dog. Subsequently, it became feasible to adapt these same operations to humans. It was at Washington University, in the 1930's, that the first patient with lung cancer had a lung removed and survived the operation. That patient, a man, lived another 40 years and is a classic case in American surgery.

The dog was one of the primary research subjects used in the development of hypothermia as a way of temporarily reducing brain size and preventing shock and brain damage during prolonged neurosurgery.

## Lung

The lung cavity of the dog varies from the human counterpart in that the mediastinum is not complete. A penetrating wound into either side of the thorax will allow leakage to the other side, thus collapsing both lungs. In spite of this and other minor anatomical differences, the dog has been a valuable subject for research on function and diseases of the lung. Much of the early research on the lung was performed in conjunction with research on the heart. Thus, as it was discovered that sections of the lung could be removed in cancer surgery, it was also found that it might also be possible to operate on the moving heart. A pioneer in this type of surgery, Dr. Alfred Blalock, a pediatric surgeon at Johns Hopkins University, worked with a cardiologist, Dr. Helen Taussig, in determining the etiology of the "blue baby" syndrome. Their work showed that it was possible to close the ductus arteriosus surgically in infants with this syndrome, thus preventing cyanosis. This work afforded direct experience for other surgeons who wished to operate on the living heart and the large arteries.

Major surgery on the heart and arteries required a method for oxygenating blood, as the lungs would be incapacitated in any bypass of the heart. The development of equipment that would enable such a procedure became necessary. Drs. Beck and Lehniger, at Case Western University, developed technology for stopping and resuming the heartbeat of the dog. They also developed methods of maintaining circulation that involved a pump oxygenator. Other researchers in the United States and Great Britain also developed pump oxygenators; one of the best of these, the Melrose pump, was made in Great Britain, but it was necessary to test this instrument in the United States due to restrictions on the use of animals for testing such equipment in Great Britain. This breakthrough with the Melrose and Gibbons pumps enabled surgery on the heart and large vessels to get underway in the mid-1950's, and it led to the development of a variety of artery and valve prosthesis, as well as other instruments and equipment necessary for this type of surgery.

The dog has been used extensively in emphysema research, which has led to the development of techniques to perform many of the physiological and biochemical studies necessary to understand the mechanisms involved in the distress of emphysema. Some dogs have been found to be naturally occurring models of asthma and have been studied concurrently as subjects in emphysema research (33, 47).

Patterson and his co-workers in Chicago (42) have documented a type of asthma and the release of mediators of the immune response that occurs in dogs. These dogs are unusual in that animal models having a defined hypersensitivity disease related to aeroallergens are found infrequently. Usually, dermatitis is a more common reaction to the antigens than asthma. The allergic dog manifests a cough and dyspnea and produces a thick mucous secretion in the bronchial passages. Although this immune response may be somewhat different from that of the human, it is possible to evaluate the effect of these responses on the respiratory system in a comparable way. Affected animals have been studied in considerable detail and have provided information useful for both allergic dogs and their human counterparts (21).

Chronic bronchitis in dogs closely resembles the same condition in humans and has been the subject of research. The disease occurs in smaller breeds and is seen more often in obese animals. It can be studied in the dog using the same clinical methods used in the human. In addition, the responses to therapy are similar. Such animal models provide a method of doing basic research on this condition. However, they are not often useful for evaluating new therapy, because the naturally occurring animal disease model is not usually encountered at the same time that there is opportunity to test the new drugs.

Obstructive airway disease has been the subject of numerous studies in the dog. Phenomena, such as compliance elasticity in the control of breathing and exercise in disease, have been the subject of numerous research projects dealing with obstructive airway disease and pulmonary edema (12). Pulmonary edema is also associated with other respiratory problems and shock, and research on this phenomenon has been integrated into most studies of the lung. It is particularly important to utilize the dog in functional studies, because it is large enough to permit use of today's instrumentation for clinical measurements evaluating phenomena similar to those occurring in humans.

Dogs have also been utilized in studies of airway structure and function and in the subsequent development of surgical techniques for the trachea, larynx, and lower respiratory system. This surgery is very important, not only in cases of cancer but also in the repair of wounds and particularly in the treatment of thermal burns of the lungs. These burns often occur in association with chemical or other fires in modern buildings, as well as in automobiles or aircract accidents (45).

It has also been possible to study the administration of drugs, toxic agents, and therapy via aerosol. Here again, it was important to have an animal of appropriate size, so that the equipment used and the physiological measurements could be compared with those in humans.

Transplantation of the lung has also been studied in the dog in connection with similar studies of the heart and large vessels. In this case, too, the dog's size and adaptability as a surgical patient have been significant (11).

## Gastrointestinal Surgery

The development of gastrointestinal surgery occurred just before the end of the nineteenth century. These same surgical methods have proved to be a very useful form of therapy for the dog. The ability to survive the loss of segments of small intestine and to tolerate colostomy were very important surgical advances with important implications for humans. The pioneers in this work were European researchers particularly Heidenhain in Germany and Pavlov in Russia.

Human abdominal surgery early in the twentieth century often resulted in adhesions of organs to the peritoneal lining of the body cavity or to each other. Researchers working with dogs noticed that abdominal surgery in that animal rarely resulted in adhesions in absence of infection. It was assumed that the dog was quite different from the human in his resistance to infection and adhesions until one surgeon noticed that his canine patients got up and walked around as soon as they recovered from their anesthesic. It occurred to him that, in spite of the discomfort, this might help his human patients. The practice of getting human patients up to move around the day after surgery dramatically reduced adhesions and has become standard practice.

The early researchers in Europe focused attention on the function of both the intestinal tract and the abdominal organs (liver, kidney, spleen, and pancreas). Pavlov advanced this work by exploring nervous control of the intestinal tract. This early research provided valuable information about the control of intestinal motility, the role of the liver and the pancreas in the digestive process, and the production and excretion of gas. The surgical methods developed for this research enabled surgeons to resect and rejoin the intestinal tract. This was in use for wound surgery and the treatment of cancer of the gastrointestinal tract by the end of the nineteenth century. It initiated the hospital-based surgical practice we know today, and it enabled much life-saving work that was dramatic and successful in its day. For example, the ailing appendix could be removed, usually with immediate improvement in the patient.

As more disciplines became acquainted with the techniques for research surgery on the dog, the staffs of departments of medicine, pharmacology, and physiology began to improve the treatments for gallstones and disorders of the bile duct and to develop and test new pharmaceuticals that could control intestinal motility and the digestive process by inhibiting excessive stimulation or by providing missing enzymes or salts. Although the gallbladder of the pig more closely resembles that of the human, the dog is often the animal of choice for experimental surgery on the gallbladder (36).

Present research with the dog uses many of these same research methods to explore current problems associated with diabetes, intestinal immunity, gallstone formation, and improved treatment of fluid balance in various disease states. The development of gastrointestinal tract surgery has also allowed removal of segments of the tract, or the terminal tract (the colon), and exteriorization of the digestive tract in a colostomy, thus permitting the patient to continue to live without the diseased lower tract. This surgery was the direct outgrowth of early research surgery involving "pouches" of intestine with exterior openings as developed by Heidenhain and Pavlov (34). Research on abdominal surgery, in which the dog plays an important role, continues, for example, in the development of new suture materials to improve support in the abdominal wall (3).

## Brain

The dog has been used in the study of ischemia of the brain and of cerebellar degeneration, which occurs naturally in the dog but also can be induced. The dog has also been used for in vivo detection of cerebral vascular accidents (strokes in the human). These lesions can be produced experimentally and their location can be determined by the new methodologies under study. In an animal the size of the dog, where the lesions are readily detected by radiographic or other means, methodology that might be directly applicable to the human can be developed.

Other naturally occurring defects in the dog, such as "shaking pups," have also been found to be good models for neurological studies (5, 15). The aim of these studies is the understanding of the basic mechanisms underlying the demyelination diseases.

A hereditary spinal muscular atrophy in the dog, similar to human motoneuron disease, has been described and used in comparative research by Cork and her associates (9).

## Organ Transplants

Paralleling the gastrointestinal work was the study of organ transplantation and depression of the immune system. Research in the late 1960's to prevent organ rejection during transplants was first undertaken in the dog. Even though the dog did not play a major role in the development of an understanding of blood types, blood grouping, and immune problems suffered by humans in organ transplantations, it did continue to be the primary model in the development of organ transplant technology. The first successful kidney transplants were conducted in dogs at Harvard University in the late 1950's. Kidney transplants in identical human twins soon followed. This led to research on transplantation of the liver, heart, lungs, and various endocrine organs. Although organ transplantation is not yet used for therapy in the dog, many associated technologies for successful anastomoses of arteries, maintenance of organs, and so forth have been of benefit to the dog.

As smaller and smaller organs were transplanted, and as toes, fingers, and even arms were being reattached following traumatic severing, the technology of microsurgery became increasingly important. Development of this technology is still an important research area in which the domestic dog is used here in the United States, as well as in Europe and the Orient.

## Radiobiology

At the end of World War II, important studies in radiobiology were undertaken in this country. Many of these long-range studies were carried out in dogs because of this animal's size, ability to communicate a sense of well-being, and long life-span. It was believed that it would be easier to obtain information about more subtle changes in the dog than in other laboratory animals with shorter life-spans. As a result, the dog has been very useful in evaluating radiation, both as a hazard and as a therapy (40, 51).

## Trauma and Shock

Shock and blood pressure regulation in response to trauma have been studied extensively in the dog. The dog has been an initial subject for many studies in the development of plasma substitutes and in attempts to replace fluid lost in shock. Fluid loss was initially studied and measured by a number of researchers, particularly those in the military. Irreversible shock, which evoked considerable discussion among researchers in the 1940's and 1950's, was often studied in the dog. As a result of these studies, much irreversible shock has now become reversible, and many of the hundred thousand people each year who pass through shock trauma units owe their successful resuscitation to those studies. In addition, military studies on the role of infection in shock and the effects of contusion on the general circulation have enabled surgeons to take prompt and effective action in treating injuries (50).

The dog has been a primary subject in the study of kidney function and shock as well as in fluid therapy and resuscitation. It has also been useful in the study of shock relative to anesthesia, work that has resulted in making modern anesthesiology much safer for the injured human, as well as canine patients.

Cardiogenic shock can also be studied in the dog (13). Techniques have been devised for producing, in the dog, proximal coronary arteriothrombosis, which closely resembles coronary thrombosis in humans (17). The dog has been the subject of studies of mechanical support measures aimed at increasing coronary artery flow and stimulating the development of intercoronary anastomosis. Earlier dog studies noted that anastomoses sometimes occurred naturally; more recently, it has been possible to produce these by the transplantation of vessels from other parts of the body by use of the coronary bypass technique. Studies in which many biochemical changes can be monitored in an animal the size of the dog with a blood volume closely approaching that of a human have enabled the development of many trauma therapies, safer anesthesia, and safer major surgical procedures in all members of the animal kingdom (16).

The dog has been studied frequently in trauma research. It has been useful in determining the impact of major surgery on metabolism and in finding that it is generally less than the metabolism deficit in major trauma. The dog has been used for generalized studies of both metabolism in trauma and for regional metabolism. Even though trauma is rarely produced in the unanesthetized dog, it has been useful to study the effects of hepatic failure, and particularly the metabolism of trauma, in trauma in the anesthetized dog. The dog has been studied for its defenses against infection following trauma and for organ failure. These two phenomena are thought to have a tremendous impact on the recovery from trauma and on whether the patient dies of an opportunistic infections posttrauma. The relationship of metabolism to trauma has also prompted many studies of parenterally administered nutrients in trauma that have provided much new information vital to understanding the appropriate nourishment of the injured patient.

## Arterial Diseases

The dog suffers from a variety of diseases of the cardiovascular system; however, cerebrovascular disease is rare (10). When it does occur in the dog, it is usually associated with congenital heart disease and congestive heart failure. Since it is not a frequently occurring disease, the dog is not commonly used as an animal model for it. Because the dog suffers from endocarditis naturally and because it is also possible to induce this disease, the dog frequently has been used in studies of endocarditis (22, 25). These studies have contributed much information about the microbiology and physiology of this disease.

The dog suffers from many inherited cardiovascular defects, among these the patent ductus arteriosus, pulmonary stenosis, persistent right aortic arch, intraseptal defect, and both tricuspid and mitral insufficiencies (42). In cases where these diseases, conditions, or defects have occurred naturally in the dog, they have provided better models for laboratory study than those cases in which the disease had been induced. Vascular disease, common in the aging dog, is treated clinically in most veterinary practices with drugs and other methods of therapy developed during the middle half of this century for use in humans.

Replacement of heart valves and segments of the larger arteries were major accomplishments resulting from "dog surgery" 30 years ago. Each emerging decade has seen improvements in materials, form, and methodology for installing these prosthetic devices, including the artificial heart. Research on these techniques will continue extending their benefits to an even greater number of patients in future decades (19).

Arteriosclerosis in the dog has been of interest to some researchers; however, most studies suggest that dogs do not develop arteriosclerosis unless thyroid activity is depressed and large amounts of cholesterol are added to the diet. Futher studies are needed in the dog to determine why the animal is so resistant to the development of atherosclerosis. Such information or knowledge may well provide us with clues for better preventive programs in humans. Other animals make better models for these studies (8).

## Hemophilia

Hemophilia in the dog is an inherited hemostatic defect considered nearly identical to that seen in the human; it is more frequently reported in dogs than in most other domestic animals. The characteristic bleeding following even minor traumas and the very long coagulation time are transmitted genetically as a sex-linked recessive gene. The blood plasma factor VIII is generally deficient. Dogs deficient in factors VII and IX have also been reported (24). Colonies of these animals have been developed (39). The genetics have been studied, and the dog has been a very useful model in developing therapies and in understanding hereditary patterns, as well as mechanisms of hemostasis (41). The dog has a naturally occurring, inherited form of von Willebrand's disease. Dogs, which have been studied in considerable detail both genetically and hematologically, have a factor VIII deficiency resembling the human disease (4).

## Ophthalmology

The dog has been widely used in ophthalmic research, although in recent years rabbits, monkeys, and cats have been more commonly used. Many animal models of eye diseases are observed in veterinary practice. Dogs develop many of the commonly occurring retinal diseases, such as glaucoma, cataracts, and uveitis. This latter condition in the dog is often secondary to another disease, such as infectious hepatitis. Dogs also suffer from retinal degeneration and pigmentitis retinosa. These conditions have been described in some detail by Aguirrey, Rubin, and Gelatt (see Ref. 44). Detached retina is also seen in the dog and can be produced experimentally; however, primates are generally preferred for research on this condition. Dogs are used in corneal transplantation research, but in recent years the nonhuman primate has been the experimental animal of choice because the layers and shape of the cornea in the primate more closely resemble those of the human. Development of ophthalmic procedures have proved to be very useful for the dog, and ophthalmology is a rapidly growing veterinary specialty. Specialists in this field of veterinary practice are now available in most major metropolitan areas (44).

## Diabetes

While the dog is, of course, very well known because of the classical work of Banting and Best on the identification of insulin as the key hormone necessary to sustain the diabetic patient, it is less well known for studies on pancreatic metabolism and insulin secretion (2).

Diabetes can be produced in the dog by any of several chemical or surgical methods, and in recent years genetically diabetic dogs have also become available for study through referrals from veterinary practitioners. In this disease the dog and the human share many similarities, including ocular and other vascular complications. Early studies of diabetes in the dog were based on inducing the disease by removal of the pancreas. Recently, chemical methods, such as alloxan-induced aberration of the $\beta$-cells, have been preferred for inducing the disease (6). The disease as it occurs naturally in the dog is relatively easy to diagnose, and the treatment follows closely the diabetic medical treatment prescribed for humans. In the United States many dogs suffering from this disease can now lead relatively normal lives as quiet house pets because of the research in which they were the subjects.

Recently, the dog has also been used in the study of methods for transplanting the islets of Langerhans, the insulin-producing cells in the pancreas (23). This very important work is proceeding at a rapid pace, and it offers not only some hope that the insulin-producing cells necessary in the diabetic patient can be replaced but also the possibility that they can be replaced in a way which will provide the patient with a more normal metabolism and prevent some of the other degenerative arterial diseases found with long-term diabetes.

## Nutrition

For years the dog has been known to suffer from niacin deficiency, a condition which in the dog is called "black tongue" (55). In the human the same condition is called beriberi. In 1910, B. L. Anderson studied this disease, which was prevalent in Polynesia, and was able to persuade Polynesian women to suckle puppies; these puppies subsequently developed beriberi. Although he did not identify lack of niacin as the cause, he was able to show that the cause of the deficiency was the same in the human and the dog, thus providing the basis for research that later identified niacin deficiency as responsible for both black tongue and beriberi.

Another phenomenon studied in the dog was the use of nitrous chloride for bleaching flour. It was discovered that nitrous chloride caused canine hysteria. This finding, when studied on a comparative basis, was very useful in bringing about the change in treatment of flour for human consumption.

The dog was used extensively in the study of rickets and calcium and vitamin D deficiency. Many dogs have suffered from rickets over the years. It was a well-recognized clinical problem in veterinary practices. The deformity of the bones and the change in cartilage and joint structure in the dog are very similar to the conditions seen in humans. While other animals have been used for these nutritional studies in recent years, the dog was an early and important model for such research and contributed greatly to solving the problem of vitamin deficiencies.

The development of glycogen storage disease as a result of portacaval shunt is another metabolic subject that has been studied in the dog. This research has contributed to the understanding of this important metabolic disease.

## Cancer

Though the dog has not been widely used for cancer research, it has been a very important subject for some studies relative to the toxicity of drugs and particularly the mechanisms of action (46). These have been important in chemotherapy studies, especially in the clinical phases. The dog has also been very useful in studies of the development of techniques for regional therapy and the opening of the blood-brain barrier for chemotherapy for tumors of the brain. Access to the brain cells by many chemicals that circulate in the blood and also by most of the immune response proteins is prevented by the blood-brain barrier. While whole-body cooling and other techniques of opening the barrier can be studied in other animals, it is important to study them in an animal such as the dog for which measurements can be easily made and the impact on the brain tissue or tumors in the brain can be evaluated.

The dog has also been used widely in the study of neoplastic diseases (14). One of the first studies of chemotherapy and infectious cancer was carried out by Russian investigators who were studying the transmission of venereal tumor of the dog. This disease, probably no longer present in the United States, is a rare clinical entity, but it did represent an important area of cancer research in the dog and was one of the earliest studies of a tumor caused by an infectious agent.

## Lupus

Systemic lupus erythematosus (SLE) is another of the many human diseases that occur naturally in the dog. It is important to study SLE in dogs because this disease has not been successfully induced in laboratory animals. While a naturally occurring disease has been found in other animals, the dog is the only one in which SLE occurs spontaneously and most frequently. In addition, the dog experiences the full course of the disease over a relatively short period of time and is large enough for physiological studies and biochemical measurements requiring substantial samples of blood and other tissues. Genetics and many immunologic studies of SLE have been done in the dog and have provided a new understanding (28).

## Cyclic Neutropenia

This disease has been recognized in the human since 1910, but it has been identified in the dog only since 1967, when it was noted in three gray collies. Cyclic neutropenia is inherited as a simple autosomal pattern and is probably the result of a single genetic defect of two closely related traits. Although detailed studies of this disease have been conducted in the dog, many researchers believe that the disease is not exactly the same as that seen in humans. Nevertheless, this animal model has provided a great deal of information about inherited patterns in the course of the disease and about clinical measures that may be useful to humans suffering from cyclic neutropenia (30).

## Thyroiditis

Naturally occurring thyroiditis has been reported in the dog and has been studied for both the immunologic and metabolic aspects. Apparently, the development of canine thyroiditis resembles the development of human thyroiditis, particularly in regard to its immunological aspects (37).

## Hyperparathyroidism

Hyperparathyroidism occurs naturally in the dog. The skeletal demineralization typical of this disease, as seen in the dog, is typical of that seen in most human cases. The disease is usually associated with some neoplastic process.

## Hepatitis

The dog is subject to viral hepatitis, a severe infectious disease and one for which veterinary practitioners recommend vaccination. The canine infection has been studied in the laboratory, and clinical studies of the disease have added to the basic information on comparative medicine (31, 38). The canine liver is also subject to injury by a variety of chemicals, including ethanol; therefore, cirrhosis in the dog has also been a subject of comparative study (7, 36). Here again, manipulation of the blood supply and the gallbladder and bile ducts is surgically feasible in the dog. This, together with the ability to withdraw adequate blood samples for biochemical evaluation, has made the canine a valuable subject for the study of several liver diseases. Cirrhosis, often of unknown causes, is not uncommon in the dog or the cat, and studies have contributed both to prolonging the life of these pets and providing clinical therapy useful to animals and humans.

## Skeletal System, Fracture and Related Studies

Direct benefits to the dog have resulted from the considerable research done on it. Such was the case with many of the early attempts to improve the setting of bones and repairing of skeletal trauma in the dog. As small animal hospital practices began to grow in the 1930's and 1940's, fractures were often a major veterinary problem. A variety of splinting systems were developed for the dog by veterinary practitioners. Such a device was the splint developed by Otto Stader, a veterinarian in Philadelphia. Dr. Salo Jonas, a veterinarian in New Haven, Connecticut, was also interested in fractures and internal fixation procedures. Dr. Kirschner developed an intramedullary pin for internal fixation of long bones. These techniques were quickly adapted by the military service during World War II, and after the advent of antibiotics, they were especially successful in saving countless lives and limbs of humans, as well as animals.

Hip joint disabilities are common in the dog, as well as in humans. Therefore, many of the extensive experiments conducted to improve the technology of hip bone replacement were also beneficial to the dog. A number of skeletal prostheses, including the artificial hip, were developed using the dog. This led to the development of prosthetic devices for bone replacement, trachea replacement, and bone fusion. Arthritis has also been studied in a natural model of degenerative joint disease in the shoulder of the dog (53).

In addition to the many studies in fraction fixation, the dog has also been used in the study of cartilage and tendon repair, as well as surgical repair in osteoarthritis (32, 54). Nearly all of the early studies on the surgical repair of long bones in humans was preceded by research in the dog. The animal is large enough for convenient X-rays and for collection of synovial or joint fluid, and it is much easier to determine postoperative mobility in this animal than in most other laboratory animals. The mechanical properties of bone, the preservation of bone and other calcium materials that could be used to replace bone, and the principles of fracture repair have also been studied in the dog.

Surgery on the intervertebral disk has been and continues to be an orthopedic endeavor important in the relief of spinal injury frequently associated with falls and other trauma to which aging of the skeletal system predisposes both dogs and people. Many dogs, particularly the small and elongated breeds in which such injuries have been frequent, have been treated with surgery developed using the dog as an experimental model. Fusion of spinal vertebrae in chronic disk disease and surgery to provide relief of the pain of herniated disks are two examples that have benefited both dogs and humans.

One of the classic studies for which the dog has been used widely is the replacement of the hip with both metal and plastic devices. The hip prosthesis has many forms, and special materials have been developed, but research utilizing the dog to create improvements continues (52). Where installation of a prosthetic hip has been unsuccessful, surgical methods have been developed for reforming the femur or hip bone so that a workable weight-bearing articulation can be developed between the femur and the pelvis.

## Periodontal Disease

Periodontal disease occurs frequently in older dogs; the gingiva recede, the roots becomes exposed, and the teeth become mobile and fall out. Epidemiologically, this disease is related to the presence of plaque and calculus (27). Some investigators point out that the condition is accompanied in the naturally occurring disease by changes in the skeleton relative to calcium metabolism, in which there is low calcium, high phosphorus, or both. These diseases are believed not to be related to oral hygiene but rather to calcium metabolism and other losses of calcium in the skeleton. Some researchers believe the presence of dental deposits in the clinical model in the dog predisposes the animal to periodontal disease, but regardless of this all researchers agree that the dog can serve as a useful laboratory model in dental deposit research and periodontal disease (29).

## Cholera

Sack and Carpenter of Johns Hopkins University produced an experimental canine model of a disease closely resembling human cholera. This was a very severe gastrointestinal disease; however, it responded to fluid therapy and other treatments, which have subsequently become very useful in saving human lives from cholera. It was interesting that the treated animals which survived this disease suffered no sequellae. Cholera is a severe human disease, particularly in developing countries, and the information gained from these animal studies allowed a more economical and efficient treatment of patients (48).

## Pharmaceutical Testing

The dog is one of the classic animals used in pharmacological screening. Once again, this is because scientists are able to use the dog's well-known behavior, and their interpretation of that behavior, to detect the effects of controlled doses of pharmaceutical products. Many drugs for sedation, circulatory control, and control of intestinal motility, anthelmintics, and antibiotics have come to market after extensive testing in dogs and other animals. While the nonhuman primate now serves an important role in preclinical testing in the United States, the dog is the final test animal in some countries of Eastern Europe.

The dog has highly developed chemical senses. Its olfactory superiority has been known since early times and has been utilized in tracking humans and a variety of wild and domestic animals. Its senses of taste and olfaction have been used in the laboratory to evaluate effects on behavior of many products that might be marketed. The dog is also used widely to detect many prohibited substances of the illegal drug traffic.

## Conclusion

The dog will continue to play a major role in preclinical evaluation of drugs and the development of surgical techniques, prosthetic devices, and new physiological information. In keeping with the increased sophistication of medical research, more of these animals have been specifically bred for research use, ensuring a more uniform genetic composition and environmental exposure prior to use. On the other hand, the genetic heterogenicity and hybrid vigor seen in mongrel dogs available from municipal pounds is preferred by many investigators, because the surgical procedures they are developing will be used in genetically diverse human patients. The veterinary and husbandry staff of these animal colonies, applying information learned by the behavioral scientist, are adapting both colony-bred animals and those from random sources to the laboratory, so that they are as comfortable and functional in the laboratory as the racehorse is at the track. Through collaboration with animal clinics and dog breeders and through their own work in laboratories and clinics, veterinarians are continuing to identify in the dog naturally occurring conditions that can be of value in studying human health disorders. Even though the dog is used in small numbers in biomedical research, its contribution to the welfare of man through new research findings has been outstanding. The need in preclinical studies for such a well-developed and well-understood animal model ensures the importance of this animal in future discoveries.

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# Proposed Change in APS Guiding Principles
## in the Care and Use of Animals

The APS Animal Care and Experimentation Committee requests comments on a proposed revision of paragraph 4 of the APS *Guiding Principles in the Care and Use of Animals.* This revision would reflect a greater restriction on the use of muscle relaxants and paralytic drugs in conscious animals. Because of the ethical issue involved in the use of the paralyzed, unanesthetized animal preparation, the Committee requests members of the scientific community to comment on the impact the revision would have on the design and publication of their research. Please send comments to Dr. **Helene Cecil**, Chairman, APS Animal Care and Experimentation Committee, 9650 Rockville Pike, Bethesda, MD 20814

## Guiding Principles in the Care and Use of Animals
### (Approved by the Council of the American Physiological Society)[1]

Animal experiments are to be undertaken only with the purpose of advancing knowledge. Consideration should be given to the appropriateness of experimental procedures, species of animals used, and number of animals required.

Only animals that are lawfully acquired shall be used in this laboratory, and their retention and use shall be in every case in compliance with federal, state and local laws and regulations, and in accordance with the NIH Guide.[2]

Animals in the laboratory must receive every consideration for their comfort; they must be properly housed, fed, and their surroundings kept in a sanitary condition.

Appropriate anesthetics must be used to eliminate sensibility to pain during all surgical procedures. Where recovery from anesthesia is necessary during the study, acceptable technique to minimize pain must be followed. Muscle relaxants or paralytics are not anesthetics and they should not be used ~~alone for surgical restraint. They may be used for surgery in conjunction with drugs known to produce adequate analgesia.~~
**alone for restraint of conscious animals. If muscle relaxants are used, they must only be used after administration of a general anesthetic, adequate to cause unconsciousness, so that when the muscle relaxant is given, the animal is already unconscious. The animal must then be kept unconscious until complete recovery from paralysis occurs. The only exception to this guideline would be in those unusual cases where the use of an anesthetic would defeat the purpose of experiment and data cannot be obtained by any other humane procedure.** Where use of anesthetics would negate the results of the experiment such procedures should be carried out in strict accordance with the NIH Guide.[2] If the study requires the death of the animal, the animal must be killed in a humane manner at the conclusion of the observations.

The postoperative care of animals shall be such as to minimize discomfort and pain, and in any case shall be equivalent to accepted practices in schools of veterinary medicine.

When animals are used by students for their education or the advancement of science, such work shall be under the direct supervision of an experienced teacher or investigator. The rules for the care of such animals must be the same as for animals used for research.

________________________
Investigator

[1] Revised 1980

[2] Guide for the Care and Use of Laboratory Animals, DHEW Publication No. (NIH) 78-23, Revised 1978, Office of Science and Health Reports. DRR/NIH, Bethesda, MD 20205.

# Comments Being Sought on Proposed Changes in Animal Care and Use

Comments from scientists and educators are being sought by the National Institutes of Health (NIH) concerning proposed changes in Federal policies and institutional responsibilities regarding humane care and use of laboratory animals in programs supported by Public Health Service (PHS) grants and contracts.

The proposed changes would amend the PHS Extramural Animal Welfare Policy as specified in the US Department of Health and Human Services' Grants Administration Manual, Chapter 1-43, entitled "Animal Welfare." If the proposed changes are put into effect they would:

- Require that institutions designate clear lines of authority and responsibility for those involved in animal care and use issues;
- Clearly define the role and responsibilities of the Animal Research Committee (ARC), now called Animal Care Committees;
- Require that institution's assurances of animal use and welfare provide more specific information regarding the institution's program for the conduct of experiments involving animals; and
- Require ARCs to review and approve the proposed use of animals in each grant and contract to ensure compliance with the institution's assurances.

The proposed changes are a result of a two-year review by NIH's Office for Protection from Research Risks (OPRR), which included site visits to 10 NIH-supported research facilities. The policy changes being sought by PHS are patterned, by and large, after the legislative proposals initiated by Rep. Doug Walgren (D-PA) and Sen. Robert Dole (R-KS).

Should the proposed changes be put into effect institutions would have to accept as mandatory requirements the principles for the use of animals described in the NIH *Guide for the Care and Use of Laboratory Animals.* The current policy requires institutions only to state that they are "committed to comply" with the principles. Furthermore, the composition and functions of the ARC would be changed.

The proposed policy would continue to require that the committee membership be not less than five individuals but would specify the criteria for the selection of four of the members. These four committee members would be an individual who is unaffiliated with the institution and not related to the immediate family of a person who is affiliated with the institution, an attending veterinarian with appropriate qualifying expertise in laboratory medicine, a practicing scientist who is experienced in laboratory medicine, and an individual whose primary vocation is in a nonscientific area.

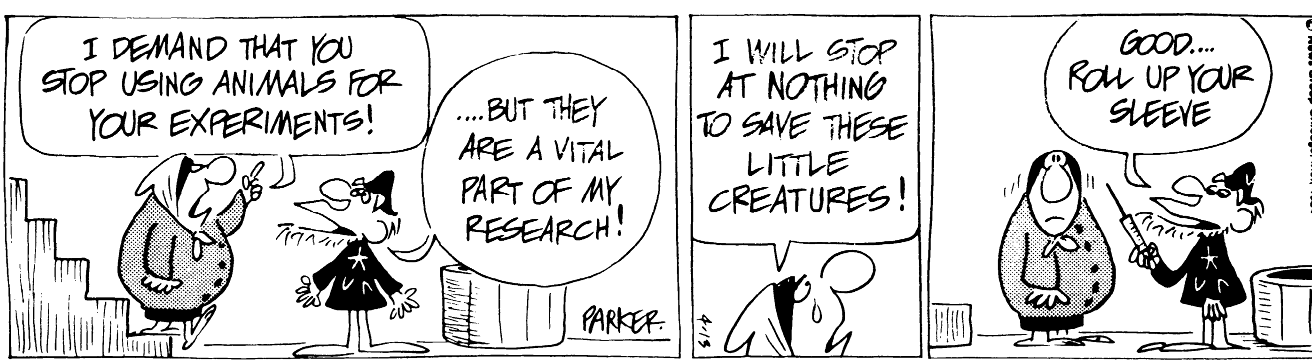
The committee's function would be the oversight responsibility for the institution's animal program, including conduct of the research supported by PHS grants and contracts. The committee also would have the authority to terminate a research activity if the committee determines that the activity is not in compliance with the policy.

As a part of the oversight responsibilities the committee would review individual research applications and proposals to ensure that the described care and use of animals are in compliance with the policy and the institution's assurances. The proposed policy also specifies that no award be made by PHS unless the institution verifies that the care and use of animals in the proposed research project has received the approval of the committee.

Additionally, the proposed changes would charge the committee with five specific categories for approval by the majority of the committee members. They are:

- Annual review of the institution's program for human care and use of animals;
- Annual inspection of the institution's animal facilities including satellite facilities;
- Approval of the care and use of animals described in grant and contract applications;
- Approval of changes in ongoing research that introduce significant concerns regarding the use of the

THE WIZARD OF ID by Brant parker and Johnny hart

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Comments on the proposed changes in Chapter 1-43, "Animal Welfare," of the US Department of Health and Human Services' Grants Administration Manual must be received before July 15, 1984. All written comments should be sent to Carol Young, Office for Protection from Research Risks, National Institutes of Health, Building 31, Room 4B09, 9000 Rockville Pike, Bethesda, MD 20205.

The American Physiological Society would appreciate receiving a copy of your comments so that the views of the membership can be reflected properly in APS' response to the proposed changes.

animals or when animal studies were not originally proposed and approved; and

- Review of specific animal welfare issues identified by PHS.

## Bill Would Create National Information Center

A New Jersey Congressman has introduced a bill that would establish within the National Library of Medicine a National Center for Research Accountability for the purpose of conducting full text literature searches prior to the funding of any Federal grant or contract that involves the use of laboratory animals.

The bill, entitled "Information Dissemination and Research Accountability Act" (HR 5098), was introduced by Robert G. Torricelli (D-NJ). The intent of the bill, according to Torricelli, is to prevent the duplication of experiments on live animals.

"Thousands of animals are needlessly being subjected to redundant and duplicative laboratory experiments each year," Torricelli said. "Consequently, of the $4 billion spent annually on experiments involving animals by the Federal Government, between 60 and 70 percent of the experiments have already been complete—sometimes thousands of times."

The proposed center would be responsible for acquiring in full text all biomedical information and data—including foreign information and data—involving laboratory animals to determine whether a proposed animal experiment approved for Federal funding has been done or is in the process of being done. If the center finds that the experiment is duplicative of other already accomplished or ongong research, then funding of the approved project would be denied.

The center would be operated by 20 experts in the biomedical information sciences, each to be appointed by the President.

The bill has been assigned to the House Committee on Energy and Commerce and no date has been scheduled for committee action.

William M. Samuels, CAE

## Correction

In the Public Affairs section of the April 1984 issue of the Physiologist a number was transposed in reporting on the work days the Congress has scheduled after the Easter recess. The actual number of working days is 81, not 18.

# APS Position on the Actions Against Dr. Edward Taub

On September 11, 1981, an activist animal "protection" organization obtained a search and seizure warrant in Montgomery County, MD, charging Dr. Edward Taub with violation of the animal cruelty law of Maryland. The police raid confiscated 17 experimental monkeys.

Dr. Taub has been relieved of these criminal charges. However, the disruption of the research and consequent suspension of funding by the National Institutes of Health (NIH) led to termination of the grant with Dr. Taub's institution and consequent failure to complete the approved research being conducted.

In August 1983, Dr. Taub requested that APS support his position in obtaining restoration of his status as a research investigator. At the August 1983 meeting of the APS Council, an investigation of the circumstances surrounding this affair was initiated. A special committee of the Society chaired by Dr. Earl H. Wood was formed.

This investigation extended over a period of three months and included review of hundreds of pages of documentation, such as court records and reports of US Department of Agriculture (USDA) inspections and NIH site visits, and interview of 17 persons with personal knowledge of the affair (see page ). Committee members also observed the animals at their present location, the NIH Animal Facility at Poolesville, MD.

On the basis of review and discussion of this report, the APS Council has arrived at the following conclusions and recommendations.

1. Although the controversy now seems to involve only one investigator, we are persuaded that the disposition of this matter will seriously affect biomedical research throughout the nation, if not the world, for years to come. It is therefore an appropriate matter for concern and participation by the scientific community and particularly biomedical societies such as APS.

2. APS and others in the scientific community should express serious concern to NIH, USDA, and other appropriate agencies if conditions warranting termination of a grant were allowed to exist for years while numerous inspection and evaluation reports did not note these conditions so that corrective actions could be taken. However, if the deficiencies were of recent origin, the suspension and ultimate termination of the grant without adequate notice or opportunity to remedy is unwarranted. Scientists have the right to be able to rely upon inspection and site visit reports to assure an effective job of self-policing.

3. Whenever research dollars are authorized for animal research, the appropriation should include funds to provide and maintain adequate animal facilities to meet the standards of the NIH Guide for Care and Treatment of Laboratory Animals and the Animal Welfare Act. To this end, NIH, APS, other scientific societies, and humane societies should work together to secure the availability of funds for research animal facilities.

4. Because suspension and termination of the NIH grant appears to have been motivated and unduly influenced by unusual political and societal pressures, APS, in concert with other societies, should encourage NIH to enable Dr. Taub to complete the research previously approved by peer review, with appropriate conditions imposed to ensure that the handling of the animals is beyond reproach.

## Special APS Committee to Review the Taub Case

Earl M. Wood, M.D., Ph.D.
Chairman
Mayo Medical School
Rochester, MN

Helene Cecil, Ph.D.
Chairman, APS Animal Care & Experimentation Committee
USDA, ARS
Beltsville, MD

Francis Haddy, M.D., Ph.D.
APS Past President
Uniformed Services University of Health Sciences
Bethesda, MD

Orr E. Reynolds, Ph.D.
Executive Secretary-Treasurer
American Physiological Society
Bethesda, MD

Donn Jenkins, Esquire
APS Attorney
Silver Spring, MD

William M. Samuels, C.A.E.
APS Public Affairs
Consultant
Bethesda, MD

G. Dale Smith, D.V.M.
Consultant
Veterinary Clinic
New Meadows, ID

## Individuals Interviewed by the Committee

Edgar H. Brennan, Esq.
Attorney
1200 New Hampshire, NW
Washington, DC

Strad Dick
Public Relations
Brookfield Zoo
Brookfield, IL

Peter Hand, D.V.M.
University of Pennsylvania
Philadelphia, PA

Paul Hildebrandt, D.V.M.
1777 Rockville Pike
Rockville, MD

John Kunz
Dr. Taub's former assistant

Adrian Morrison, D.V.M.
University of Pennsylvania
Philadelphia, PA

Robert E. Osborne
IBR Animal Caretaker
now in Marine Corps
Camp Pendelton, CA
MS 39 MAG 39 – Man

Janice Ott, D.V.M.
Brookfield Zoo
Brookfield, IL

Alex Pacheco
Founder, PETA
Washington, DC

Donald F. Patterson, D.V.M.
University of Pennsylvania
Philadelphia, PA

Arthur G. Perry, D.V.M.
USDA, APHIS
Washington, DC

Phillip Robinson, D.V.M.
San Diego Zoo
San Diego, CA

Richard C. Simmonds, D.V.M. – Director
Dept. of Laboratory Animal Medicine
USUHS
Washington, DC

Richard Swain
Detective Sgt.
Montgomery County Police
Rockville, MD

Edward Taub, Ph.D.
IBR Principal Investigator
Adelphi, MD

Joseph Vasapoli
Chief Executive Officer
IBR
Washington, DC

Georgette Yakolis
Research Assistant at IBR
now Research Assistant
at USUHS
Bethesda, MD

## Fifty-Seventh President of APS

**John B. West** of the University of California, San Diego, has been elected President of the American Physiological Society effective July 1, 1984.

Dr. West has an international reputation for his work in pulmonary physiology. He is Professor of Medicine and Physiology in the School of Medicine, University of California, San Diego, and his research has covered a broad front in pulmonary physiology including gas exchange, pulmonary circulation, mechanics, comparative physiology, high altitude, and space physiology. His work is published in some 200 papers and 8 books.

Dr. West obtained his medical degree at Adelaide University, South Australia, and after a year of medical residency, he moved to London where he became associated with the Royal Postgraduate Medical School, Hammersmith Hospital. There he obtained his Ph.D. The development of a respiratory mass spectrometer by K. T. Fowler sparked his interest in pulmonary gas exchange, and he is well known for this work, particularly in the area of ventilation-perfusion inequality. During the late 1950's, the Medical Research Council cyclotron at Hammersmith Hospital began producing radioactive oxygen, and Dr. West and his colleagues exploited this exotic radioisotope (half-life 2 min) to obtain the first measurements of the distribution of blood flow and ventilation in the human lung. Because of his interest in gas exchange, Dr. West spent a year in 1961-1962 with Dr. Hermann Rahn in the Dept. of Physiology at SUNY Buffalo. On returning to Hammersmith he embarked on a broad research program elucidating the factors responsible for the distribution of blood flow and ventilation in the lung.

In 1960, Dr. West was invited to be one of the physiologists on the Himalayan Scientific and Mountaineering Expedition led by Sir Edmund Hillary with Dr. Griffith Pugh as Scientific Director. A prefabricated laboratory was erected at an altitude of 5,800 m (19,000 ft), and an extensive program of high-altitude physiology was carried out during the winter months. In the spring the expedition moved to Mount Makalu where exercise studies with a stationary bicycle were carried out up to an altitude of 7,440 m (24,400 ft).

In 1981, Dr. West conceived and led the American Medical Research Expedition to Everest. This was specifically designed to obtain measurements of human physiology at extreme altitudes. Laboratories were set up at altitudes of 5,400 m (17,700 ft) and 6,300 m (20,700 ft), and a comprehensive research program was completed including a few measurements on the summit itself (8,848 m, 29,028 ft). These elucidated how it is just possible for man to reach the highest point on earth without supplementary oxygen.

Dr. West moved permanently to the United States in 1969 when he accepted an appointment as Professor of Medicine and Physiology at the new medical school of the University of California, San Diego. As one of the first faculty members in this institution, he was influential in developing the teaching of physiology, and he is Chairman of the course responsible for the bulk of physiology teaching for first-year medical students. He has been Chairman of the Medical School faculty, and also of the Physiology/Pharmacology Ph.D. Program. His interest in teaching has led him to publish two small books on respiratory physiology and pathophysiology that are used extensively all over the world and have been translated into eight languages.

In 1967-1968, Dr. West spent a sabbatical year at NASA Ames Research Center, Moffett Field, CA, because of his interest in the effects of weightlessness on the lung. He has continued to work in space physiology, and he is Principal Investigator of an experiment to measure the effects of weightlessness on pulmonary function in astronauts, which is scheduled to fly on Spacelab 4 at the end of 1985.

Dr. West is a member of many scientific societies including the American Society for Clinical Investigation, American Thoracic Society, Association of American Physicians, The Fleischner Society, and Physiological Society (of Great Britain), and he is also a member of the Explorers Club. He has served on the editorial boards of many scientific journals. He has received numerous honors including the Ernst Jung Prize for Medicine, 1977, and has given many named lectures in various parts of the world.

Dr. West has a keen interest in the history of physiology and has been active in promoting the Section for the History of Physiology in the APS. Other strong interests include the international relations of the Society, improvements and innovations in the teaching of physiology, and the publications and meetings of the Society.

### APS Election Results

Dr. **Howard E. Morgan**, Chairman, Dept. of Physiology, Pennsylvania State University, Hershey, was elected President-Elect. The two new Councillors are Dr. **Harvey V. Sparks, Jr.**, Professor and Chairman, Dept. of Physiology, Michigan State University, East Lansing, for a 4-year term and Dr. **Aubrey E. Taylor**, Professor and Chairman, Dept. of Physiology, University of South Alabama, Mobile, to complete Dr. Morgan's term expiring in 1987.

# Long-Range Planning Task Force Report

The Long-Range Planning Task Force was appointed in late 1980 and charged with the task "to consider all aspects of APS's activities they consider to be of importance relative to the well-being of our Society and the biomedical sciences in general, particularly during the next five years, and which hopefully will impinge favorably on the longer term, even less forseeable future. Certainly, APS-FASEB and other intersociety relationships should be considered. Problems of future meeting formats need not be excluded, although these aspects are being looked at intensively by the APS Future Meetings Task Force (the Vander Committee) and by Gene Yates' FASEB Thematic Meetings Committee.

The membership consisted of Drs. R. M. Berne (Chairman), A. P. Fishman, M. P. Hlastala, E. A. Hoffman, J. L. Kostyo, J. M. Marshall, and O. E. Reynolds (ex officio).

After several meetings, which included an interview with Dr. Robert Krauss, Executive Director of FASEB, the Task Force presented a preliminary report to Council at the FASEB meeting in 1982. Council discussed the recommendations of the Task Force and requested that the Task Force stay in operation for another year and gather input from the various sections of the APS. Although the information received was not up to the expectations of the Task Force, nevertheless there were sufficient data provided to enable the Task Force to obtain a consensus regarding some of the APS activities and to revise and add to the recommendations made the previous year. This report was made to Council at the FASEB meeting held in Chicago in April 1983.

However, there was insufficient time to adequately discuss the report, and a special meeting for discussion of the Task Force report (as well as other important subjects) was scheduled for November 1983. At this meeting the full report was presented, discussed, and acted on by the APS Council. The following constitute the Task Force recommendations and the responses (*italics*) and actions of the Council (*italics* underlined).

## Standing Long-Range Planning Committee

The appointment of a standing Long-Range Planning Committee consisting of a recent Past President as Chairman, a current Council member, as well as young, senior, and minority physiologists was recommended. The Committee should be representative of the different specialty areas and have a broad geographical distribution. The maximum number of members should be nine with three of the current Task Force members serving one year, three appointments for two years, and three for three years.

*Council approved the appointment of a 6-7 member Long-Range Planning Committee composed of a Past President as Chairman, a current Council member, and the balance of young and senior physiologists.*

**A motion was passed instructing the Committee on Committees to submit recommendations for Committee membership to Council in April.**

## Duties of the Long-Range Planning Committee

The Long-Range Planning Committee should, through subcommittees, closely follow the planning, actions, and results of the various activities of the Society. These include *1*) FASEB-APS interests; *2*) publications over the long haul; *3*) the development of APS sectionalization, particularly with response to "section journals"; and *4*) committees on public affairs, finance, etc. The Long-Range Planning Committee should also *1*) assure adequate input from the younger members of the Society; *2*) examine the efforts to increase the number of women and minority members; *3*) encourage membership or affiliate membership of sister societies such as Biomedical Engineers, the General Physiologists, the Biophysicists, and the Microcirculatory Society; and *4*) continually evaluate the expansion and composition of the Society.

## Term of APS President

It is recommended that the term of the APS president can be extended to two years, thereby permitting greater continuity in the planning and development of new policies and programs.

*At the request of Dr. Fishman, each member of Council expressed his views concerning a one-year versus a two-year term as President. The discussion resulted in* **passage of a motion that the President's term continue to be for one year.**

## FASEB

The Society's relationship with FASEB seems to have stabilized. Therefore, no action was taken at this time, but it is recommended that a continuing periodic review be conducted. One member suggested that *Federation Proceedings* be made available to students at a low cost (ca. $5.00/year).

*As previously mentioned, a statement to this effect will be incorporated in the charge to the Long-Range Planning Committee.*

*Council agreed to prepare the Committee's charge before the Spring meeting. Continuing observation of the relationship between APS and FASEB should become part of the charge as well as a statement that Council may assign specific issues for which Council requires guidance. Also, it will meet with Council annually, and hopefully, it will be a "forward looking" and not only a "critical" Committee.*

## Section Advisory Committee

Establishment of a Section Advisory Committee to meet at least annually with Council and other APS committees for which there is a special requirement is recommended. Each section will appoint a representative to the Committee.

*Council favored the concept of a Section Advisory Committee which would have input into the system* *through the Long-Range Planning Committee and Council. The Committee should be composed of Section Chairmen with the chair rotating alphabetically among them. It would be advantageous for Council to convene a meeting in St. Louis to provide an opportunity for the President to explain the purpose and to answer questions. Even though the Section leadership might change every year, it was agreed to be important to have the Chairmen on the Committee.*

**A motion was passed approving the appointment of a Section Advisory Committee, composed of Section Chairmen or the equivalent with an alphabetical rotation of the chairmanship, to interact with the Long-Term Planning Committee and to meet annually with Council at the Spring meeting.**

**A motion was passed that the Sections nominate their Chairmen or their Secretaries if they do not have Chairmen who will be the member on the Section Advisory Committee for his/her term as Chairman.**

*It was agreed to send a letter to the Section Chairman announcing the formation of the Section Advisory Committee to interact with the Long-Range Planning Committee and Council and extend an invitation to meet with Council at the Spring Meeting in St. Louis on Sunday morning, April 1. The first charge to the Committee will be consideration of a uniform structure for the various Sections. Also at this time, the mechanism for selecting the Committee Chairman can be determined.*

## Membership Committee

It is recommended that the composition of the Membership Committee consist of a representative from each of the Sections, which would screen the applications and make recommendations to the Membership Committee for final action. This would obtain appropriate representation of the various sections on the Committee.

**Council decided not to accept this recommendation of the Long-Range Planning Task Force** *pointing out that the recommendations for Committee appointments can be advanced by the Section Advisory Committee. Currently, the Committee on Committees asks Sections to submit nominees for committee service. However, when the Membership Committee reviews the criteria for membership, it can take this item under advisement. This, too, may be an appropriate item for discussion at the Section Advisory Committee Meeting in April.*

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## Meetings (FASEB and APS)

Following the recommendation of the Yates Committee regarding thematic meetings, and continuance of two meetings per year for the present, the Task Force recommends the following:

*1*) The Fall meeting have no limit on the number of abstracts per member and should have symposia, refresher courses, tutorials, and state-of-the-art lectures by young and senior physiologists. Joint meetings with other societies should be encouraged. However, the question of continuation of Fall meetings should be reevaluated after the campus meetings are held in 1984 and 1985.

*2*) The Spring meetings with FASEB be restructured along different lines. It is recommended that a member can either coauthor or sponsor one paper, as was the practice until two years ago. A suggested format for the Spring meeting was prepared by the Task Force and is on file in the APS Headquarters. (A copy will be provided on request.) Details of restructuring the program of the APS Spring meeting must be worked out with the Section Advisory Committee and the Program Executive Committee with input from the Council and the Executive Secretary (practical and financial aspects).

*Council found the overall proposed format for the Spring meeting very attractive and liked the concept of the morning plenary sessions and symposia with afternoon paper and poster sessions. The most important aspect of the concept is to assemble all physiologists via the plenary session and business meeting with more high-quality symposia. It was reaffirmed that the Bowditch Lecture and Past President's address would be presented at the Spring meeting.*

**The proposed restructure of the Spring meeting as presented by the Task Force was approved by Council, and the Program Executive Committee was asked to implement the new format with the following modifications: Simultaneous paper and poster sessions in the afternoon and on Monday with spillover on Friday if necessary, and the restriction of one sponsored or coauthored paper per member.**

*There was discussion of the composition of the Fall meeting and that it not get short shrift but continue to have tutorials, refresher courses, symposia, state-of-the-art lectures, and having a plenary session would be desirable. The Fall meeting is regarded by some physiologists as important as the Spring meeting. Therefore, as long as there is an interest in the Fall meeting and it does not become a liability, it is to be continued.*

*An outline for the Fall meeting was prepared by the Task Force at the request of Council and is also available on request.*

*No action was taken on the Task Force's recommendation to "encourage FASEB to increase the number of Gordon Conference type meetings in areas of interest to physiologists and keep the APS abreast of the FASEB's plans."*

Robert M. Berne, Chairman

# 131st APS Business Meeting

Time: 10:15 A.M., Wednesday, April 4, 1984
Place: Clarion Hotel, St. Louis, MO

## I. Call to Order

The meeting was called to order by the President, A. P. Fishman, who welcomed the members to the 131st Business Meeting of the Society. The agenda and ballot for the Election of New Members were distributed to the members along with a statement, "APS Position on the Actions Against Dr. Edward Taub."

## II. Report on Membership

The President-Elect, J. B. West, reported on the current status of the membership and deaths since the last meeting.

A. Summary of Membership Status. As of March 1, 1984, there are 6,185 members. There has been some growth over last year with increases in all categories. Of particular interest to the Society are Corresponding members, who meet the same criteria as Regular members but reside outside North America, which has been defined as Canada, United States, and Mexico. The Society has extensive international links, and there has been an acceleration in this class of membership.

B. Deaths Reported Since the Last Meeting. The names of the twenty-one deceased members were read by Dr. West. The membership observed a moment of silence in tribute to them (p. 164).

## III. Election of Members

A. Appointment of Tellers. Tellers appointed by the President were John Cook, Franklyn Knox, Howard Morgan, and Harvey Sparks, Jr., and they were asked to collect the Ballots for Election of New Members. The members were instructed to strike the name from the ballot if they did not wish to vote for a particular candidate.

B. Election of New Members. It was announced by the Executive Secretary-Treasurer, O. E. Reynolds, that all candidates were elected, with 245 members casting votes.

## IV. Election of Officers

As a result of the Election of Officers by mail ballot, Dr. Reynolds announced that the new President-Elect is H. E. Morgan, and the two new Councillors are H. J. Sparks, Jr., for a four-year term and A. Taylor, to complete Dr. Morgan's term expiring in 1987. There were 1,741 received for the office of President-Elect of which 1,627 were valid, and 1,661 received for Councillor of which 1,471 were valid.

## V. Actions of Council

Dr. Fishman announced that his term as President has been exciting, and it has been a busy year for Council.

The Long-Range Planning Task Force was established in 1982 under the Chairmanship of Robert Berne to look into the question of the future of APS and examine all components of Society activities. A special meeting of Council was held in November 1983 to discuss the recommendations of the Task Force, and the report of this meeting appears on p.

The APS Council has already begun implementing some of the recommendations which will have an impact on the Society's future. As a result of one strong recommendation that APS Sections have direct input into Society affairs, an Advisory Committee has been established composed of a representative from each Section. This Committee will have access to Council and the Long-Range Planning Committee as well as other standing committees. A mechanism now exists whereby Council can interact and respond to the wishes of the membership. The first meeting was held in St. Louis, and the group not only selected Marion Siegman as Chair pro tem, it advanced recommendations for Council's consideration (see p. 147). This Committee can become an important instrument and provide an opportunity for new areas of physiology to emerge and for the Society to grow differently.

Some segments of the Task Force report are being debated. There are very serious recommendations about the nature of the programs for the Spring and Fall meetings which are not trivial. These will be reviewed by the newly constituted Long-Range Planning Committee and the Program Executive Committee.

The Program Committee is a very active group under the leadership of Michael Jackson. Symposia for the 1985 Spring meeting have been identified, and program recommendations have been submitted to the Canadian Program Committee for the 1986 International Union of Physiological Science (IUPS) Congress in Vancouver. One of the accomplishments during the past year has been clarification of the Society's role in international physiology, and there has been more interaction in shaping international meetings. It is hoped that this is the beginning of a closer relationship with international physiology. The Society anticipates developing stronger ties with the IUPS Council, physiological societies abroad, and Corresponding members. Therefore, an APS International Physiology Committee has been organized to pursue these goals.

The (British) Physiological Society has invited APS members to be guests at a joint meeting in Cambridge September 12-14, 1985. At the turn of the century, the two societies had close links. In fact, the *Journal of Physiology* had an editorial board composed of an equal number of American and British physiologists. However, this will be the first opportunity for a joint meeting. An announcement appearing in the April 1984 issue of *The Physiologist* includes a form to be returned to the Society indicating an interest in attending.

Under the leadership of Dr. West, APS President-Elect, a Section on the History of Physiology has been organized (see p. 158). It is most timely with respect to the Society's Centennial Celebration and the Centennial Committee's work.

The APS publications continue to prosper primarily because of the fact that the authors submit first-class papers reported H. E. Morgan, Chairman of the Publications Committee. The increase in receipt of manuscripts that began when the journals were sectionalized in 1977 has continued. Approximately 130% more papers are being received now than in 1977, totaling about 3,000 manuscripts per year. The number of pages published has grown in a commensurate way, and the quality of the papers is high. As a result of publication of more material, the cost of subscriptions has risen, and the Society is much more dependent on subscription income than a decade ago. As a result of this increase, there has been a slow but steady loss of subscribers, which is of concern. In general, the journals operate in the black; the operation is healthy, and the APS looks forward to further growth and improvement in the journals and books.

A topic that is troubling Council enormously is the image and future of physiology. This is a subject about which everyone should be concerned. Input from members as to how the Society can be directed will be welcome.

Animal welfare is another topic that is occupying our time. Dr. Fishman said that most of us have always regarded this as a peripheral preoccupation. It has always been the other person's headache, but in recent years it has been pushed on all of us more and more. Not only does this take the form of potential legislation, but in the fact that there is the ever present prospect of very serious disruption of animal experimentation. For a while, it was a matter of people who advocated antivivisection or animal rights. Everyone was talking at an intellectual level and everyone was responding in kind. The strategy now is that of individual laboratories and individual scientists being attacked illegally and in the press to the point where self-defense against unwarranted accusations becomes a preoccupation. We know directly of several leading investigators in this country who are extremely troubled by the fact that they have been beset by people who have invaded their laboratories, either openly or surreptitiously, who worked in them as technicians or caretakers and then accused them. The responses have not always been appropriate on the part of society or the government simply because we are not prepared. Dr. Fishman cited a recent event in England where a group of 100 people invaded a laboratory by climbing the walls. While the police were confronting one group, others invaded the laboratories, removed records and documents, took them over the wall, photographed them, and then threw them back over the wall so they could not be accused of stealing. The invasion of individual laboratories is being replicated in this country, and what is happening now may very well be the beginning of a larger effort.

This is an introduction to the Society's work on the case that involved Dr. Edward Taub. The document, "APS Position on the Actions Against Dr. Edward Taub," described how the event happened, the nature of the investigation and the way in which the Council is shaping its attitude (see p. 144).

In addition, representatives of APS, the Association of American Medical Colleges, the Society for Neuroscience, and the American Psychological Association met with the Director of the National Institutes of Health, James B. Wyngaarden, and his staff. It was a worthwhile encounter, and Dr. Fishman is hopeful that steps will be taken to remedy this situation and also help to shape policy for the future. The APS Council has been troubled sufficiently that it initiated a meeting of several concerning societies with the National Academy of Sciences President, Frank Press, asking it to become directly involved in a scholarly exploration of animal experimentation in this country.

There are several organizations, such as the National Society for Medical Research (NSMR), working very effectively to protect the scientist. On the other hand, other groups are working destructively to hamper research. All of this has a sense of unreality. However, one of the realities to bring home to the scientist is the appointment of an APS committee headed by Earl Wood to dispassionately look into the Taub Case from the point of view of the Society. It is the results of this committee that have shaped the APS position. Dr. Wood also has provided a videotape of a television program prepared by station WCCO, Minneapolis, which Council wishes to share with the membership. It brings home the Taub Case more clearly than any written presentation we have seen. After the audience viewed the tape, Dr. Fishman said he was certain the membership senses Council's reason for concern. Actions are underway to mount not only a strategic defense but to protect physiologists more vigorously.

## VI. Awards

One of the more pleasant parts of presiding as President is the presentation of awards.

A. Ray G. Daggs Award (see p. 150).

B. Caroline tum Suden Professional Opportunity Awards. Caroline tum Suden was one of the very first women members of the APS, who had a long and productive career as an investigator, teacher, and mentor. She left a sizable portion of her estate as an undesignated bequest to the Society. Upon the recommendation of the APS Women in Physiology Committee, Council established a series of awards. The Caroline tum Suden Professional Opportunity Awards are open to graduate students or postdoctoral fellows who submit abstracts and present papers at the FASEB Spring Meeting. A letter of recommendation from the sponsors of the papers is necessary. The Award entitles the recipient to a $500 check to attend the meeting, free registration, and access to the FASEB Placement Service. This year, there were 27 applications from which six candidates were selected.

The Chair of the Women in Physiology Committee, Dr. Marie Cassidy, joined Dr. Fishman in presenting the six awards to **Steven I. Bellin** (University of Iowa), **Andrew S. Greene** (The Johns Hopkins University), **Linda E. Kupfer** (Columbia University), **Mu-En Lee** (University of California, San Francisco), **Robabeh Moussavi** (University of California, Berkeley), and **Bruce A. Webster** (University of Washington).

The group was reminded of the Symposium, Nuclear Winter: The Long-Term Biological Consequences of Nuclear War, in which Dr. George Woodwell will be the main speaker at 4:45 P.M. that afternoon in the convention center (see p. 159).

With no new business, the 131st Business Meeting was adjourned at 11:15 A.M., April 4, 1984.

John B. West, President-Elect

### Special APS Award

The Society honored **Dennis Flanagan**, Editor of *Scientific American*, who as a nonscientist, has become a teacher of scientists by setting new and higher standards for presenting scientific information to the public. The APS President, A. P. Fishman, presented an Honorary Award to Dennis Flanagan at the annual Respiration Dinner at the FASEB Spring Meeting in St. Louis for his unique and outstanding contribution as an educator and editor.

# Ray G. Daggs Award, 1984

**Edward Adolph** is one of the oldest living members of the American Physiological Society. He was elected to membership in 1921, and he regularly has attended Society meetings since that time. Dr. Adolph was on Council from 1949 to 1955 and served as President of APS in 1953-54. He has served on many Committees, beginning with the Survey of Physiology Committee in 1945. He was instrumental in establishing the Education Committee in 1953 and served as its Chairman from 1953 to 1958. During his time on this Committee, summer workshops were established and also a system of small grants for college teachers of physiology. Education programs at national meetings followed. Dr. Adolph was on the Editorial Board of the *American Journal of Physiology* 1952–1954, on the Board of the *Journal of Applied Physiology* 1948–1954. He was on the combined Editorial Board AJP/JAP from 1969 to 1975. Dr. Adolph continues to serve the Society as a member of the Senior Physiologists Committee.

Edward Adolph attended the 10th International Congress of Physiology in Paris in 1920, and he has attended most International Congresses since then. In fact, he has probably attended more International Congresses than any living member of our Society.

Adolph's research and writings have had a major impact on the science of Physiology. He published an important review of Physiological Integration in the first *Handbook of Physiology.* His books *Physiological Regulations* (1943), *Physiology of Man in the Desert* (1947), and *The Development of Homeostasis* (a symposium) have had important impacts. Dr. Adolph's research has centered on problems of physiological integration and adaptation to the environment. He has published extensively on water balance, temperature regulation, and adaptation to regulatory mechanisms in young animals. His most recent review, "Physiological Integrations in Action," was published as a Supplement to *The Physiologist* in 1982.

His teaching has been an inspiration to several generations of medical students and graduate students. His approach is rigorous and critical but supportive and positive. Edward Adolph has been presented the Daggs Award because of his long and important contribution to the Society and to the Science of Physiology.

## Response

The Daggs Award! I thank the Committee of Selection and my colleagues of the American Physiological Society.

I will speak first of Ray Daggs, who is recognized in the award, and second of an aspect of future physiology.

The name of Ray Daggs brings me a special pleasure. Over 50 years ago, Ray appeared at the University of Rochester as a first-year medical student. Since there were only 28 students in his class, each was an individual in the physiology course conducted by Wallace Fenn and myself. After his first year, Ray became a National Research Council Fellow in Rochester's Department of Vital Economics—a brother department founded, with John Murlin as chairman, before the School of Medicine and Dentistry came into being. As a member of Ray's Ph.D. committee in 1930, I read his thesis on "Lactation" in dogs and rats.

Ray remained as a neighbor in the Vital Economics Department for six more years. Then in 1936 he became associate professor of physiology at the University of Vermont. Soon World War II found Ray an officer in the US Army.

For a decade after the war he continued in the Army, as supervisor of physiological research at Fort Knox, Kentucky. During part of that period he represented the Army in the Panel on Physiology of the Research and Development Board, in which panel I was a civilian member. At the end of that period, in 1956, he began to serve the American Physiological Society, as Executive Secretary of the Society, as Executive of its Education Committee, and founding Editor of *The Physiologist.* Now you each recognize in Ray Daggs, retiree, our versatile researcher, teacher, and administrator.

My second item is, What of future physiology? Both education and research will be principally guided by present concepts of education in our science.

Many of us think of physiology as an inheritance from the past, as an unplanned edifice built by our forerunners. Our job is to add details to this massive structure. I am not satisfied with this view.

Some others of us believe that major tasks, big tasks, are just beginning. I think the very foundations of our science are being modified now and in the foreseeable future. While a physiologist is busily classifying mechanisms, he can also be comparing the tasks accomplished and their utilities. Every task, such as energy transformation, consists of many coordinated processes and regulations.

How is research related to teaching? I think research *is* the education of the teacher. This education emphasizes the asking of a question, the analyzing of the available information, and the framing of an answer. Any topic of research serves to open doors of reasoning. He who enjoys doing research brings fresh and constructive concepts to students. If teaching becomes boresome, it is the teacher's fault; he it is who chooses the approach and can allow the topic to become dismal. For example, he shares responsibility for the choice of method of the student's learning. I believe any approach to teaching is suitable when the instructor has motivation and energy to put into it. A topic is a vehicle by study of which he helps the student to discover the significances of what is

### Recipients of the Ray G. Daggs Award

| | |
|---|---|
| 1974 | J. H. Brookhart |
| 1975 | M. B. Visscher |
| 1976 | J. D. Hardy |
| 1977 | J. H. Comroe |
| 1978 | H. Rahn |
| 1979 | J. R. Pappenheimer |
| 1980 | J. R. Brobeck |
| 1981 | A. C. Guyton |
| 1982 | R. W. Berliner |
| 1983 | C. L. Prosser |
| 1984 | E. F. Adolph |

observed. The instructor exerts a personal influence that develops the student as doer and thinker. Both teacher and student gain expertness not only in the particular phenomena seen but in the dealing with problems in general. Research procedures make education come alive, fresh, in the minds of both teacher and student.

There are tricks to be practiced in teaching as well as in research. I admire the scientist of whom it was said: the only result that really pleased him was a linear plot. We must seek simplicity as a preliminary to our insights into complexity.

In all modesty, one can say with the Lebanese poet Kahlil Gibran, "Let today embrace the past with remembrance and the future with longing." To you I recommend the future.

Edward F. Adolph
University of Rochester

# Committee Reports

## Animal Care and Experimentation

### APS Guiding Principles in the Care and Use of Animals (Proposed Change)

The Committee proposes a revision of paragraph 4 of the *Guiding Principles* to reflect a greater restriction on the use of muscle relaxants and paralytic drugs in conscious animals and requests APS members and concerned scientists to comment on the impact of the proposed change on the design and publication of their research. The proposed revision of the *Guiding Principles* and call for comments appear on page 000.

### Revision of the NIH Guide

The Institute of Laboratory Animal Resources held three public meetings for comments on revision of the Guide ("Guide for the Care and Use of Laboratory Animals," revised 1978). The first draft of the revision is expected in April with the final report due to NIH the end of September, 1984.

### National Society for Medical Research

Helene Cecil represented the APS at the December, 1983 annual meeting of the NSMR. The appointment of two new members to the Board of Directors was approved: Helene Cecil and Dwight E. Harken. David H. Cohen was named vice-president. The treasurer reported that NSMR operated in the black for the first time since 1980, and 5% of the revenue is being placed in restricted reserves. NSMR's image has been enhanced with more inquiries from the public and increased information supplied to the legislature. After the business meeting the NSMR sponsored a forum "The Need For and Use of Animals in Biomedical Research and Testing."

### Action of Animal Rights Groups

The Mobilization for Animals will hold mass demonstrations on April 28, 1984 (Laboratory Animal Day).

### NIH Symposium

NIH Symposium on Animals Involved in Research was held April 11 and 12, 1984, in the National Academy of Sciences Auditorium, Washington, DC. The purpose of the meeting is to develop a consensus among the research community and the general public on the use of laboratory animals in health research and related animal welfare issues. Symposium participants addressed Public Health Service (PHS) concerns, policies, and procedures for ensuring humane care and use of laboratory animals involved in PHS-supported projects. Proceedings of the Symposium will be published.

### Use of Animals in Biomedical Research

Several studies on the use of animals in biomedical research have been commissioned by the US government and international organizations.

*OTA Study.* The Office of Technology Assessment will conduct an 18-month study to make "an assessment of alternatives to animal use in research and testing." Specific objectives of the study are *1*) to examine current patterns of animal use and to assess the validity, reliability, and costs of existing animal models in biomedical and behavioral research; *2*) to analyze the state-of-the-art of alternatives and the time horizon for their application; *3*) to conduct a survey of the ethical positions surrounding the use and care of laboratory animals; and *4*) to prepare public options. This study began November 1, 1983, and a final report will be delivered to the Congress in April, 1985.

*Models for Biomedical Research Study.* Under the sponsorship of NIH, a National Research Council Commission on Life Sciences (CLS) will undertake a study of models for biomedical research. The study will focus on invertebrates, microorganisms, and in vitro techniques as well as nonbiological approaches to modeling and will address the question "From the perspective of the mission of NIH, what is a model?" The committee will seek to develop a consensus definition of "model" and will try to establish criteria for the suitability of models for use in biomedical research. The 12 member committee represents a wide array of scientific disciplines. The committee report is due in January, 1985.

*CIOMS Guiding Principles.* The Council of International Organizations of Medical Sciences hopes to issue international guiding principles for biomedical research using animals. Final adoption is expected near the end of 1984.

Helene Cecil, Chairman

## Centennial Celebration

### 1987 Centennial Meeting

The Centennial Celebration of The American Physiological Society will be held Mar. 29–Apr. 3, 1987 in Washington, DC in conjunction with the FASEB Meeting. The overall theme for this meeting is "A Century of Progress in Physiology."

### Historical Lecture Series

The History of Physiology lecture series continued with two excellent presentations at the FASEB Meetings in 1984. Dr. John West (UC San Diego) presented a lecture entitled "Stephen Hales—Neglected Respiratory Physiologist." Dr. Robert Frank (UCLA) spoke on "The Columbian Exchange—American Physiologists and Neuroscience Techniques." Both lectures were well attended and reflected the increasing interest of the APS/FASEB membership in learning more about the history of physiology. Two historical lectures are tentatively planned for the APS Fall Meeting in Lexington.

## Historical Vignettes

The Historical Section of *The Physiologist* is the medium for publishing vignettes. A number of very interesting vignettes have appeared in recent issues and the Centennial Celebration Committee (CCC) would like to have more published as the APS looks forward to its Centennial. Dr. Ralph Kellogg (UC San Francisco) is spearheading this effort and would welcome suggestions of physiologists to prepare historical vignettes. Properly written, these vignettes provide valuable insight and serendipity that will be lost forever if not recorded and published.

## Department Histories

Eighteen histories of departments of physiology have been submitted in response to a letter sent by Dr. Arthur Otis (Univ. of Florida Gainesville) to all department chairmen inviting them to prepare a history of their department. Nearly 100 departments indicated an interest in pursuing this goal. Several department histories have appeared in recent issues of *The Physiologist*. The CCC again urges all those interested in documenting the "genesis and evolution" of their department to send your completed manuscripts to Dr. Otis.

## APS Centennial Celebration Fund

The Centennial Celebration Fund was established to provide financial assistance for the various activities and publications planned for the Centennial Celebration. Recent issues of *The Physiologist* have presented opportunities for members to make a contribution and to receive special jewelry of their choice bearing the APS logo in recognition of their contribution. Also, at the 1984 Fall Meeting in Lexington, attractive T-shirts, with the anatomy of the thorax on the front and the abdomen on the back, bearing the phrase "Physiologists know the inside story" will be offered for sale ($8.00) again. Further information can be obtained from the APS office in Bethesda.

## APS Historian Archivist

Dr. Toby Appel, a trained historian and archivist, began her appointment with the Society in September 1983. Her activities have focused on organizing the APS archives, identifying material for future historical exhibits, and continued development of the APS roster and history.

## History of the APS, 1887–1987

The first 75 years of the history of the APS will be summarized and rewritten by Dr. Toby Appel. The history of the last 25 years of the Society is being prepared under the coeditorship of Drs. Brobeck and Reynolds. Work on this volume is progressing nicely.

## APS Centennial Roster, 1887–1987

A roster of all APS members, past and present, is also being prepared. This Centennial roster will be bound with the History of the APS and given to all APS members as a memento of the APS Centennial.

## Program Activities for 1987 Meetings

Fall 1986. "Kick-off" of the APS Centennial at IUPS Meeting in Vancouver, Jul. 12–20, 1986. The CCC is planning on sponsoring several historical lectures and an exhibit showing some aspect of the history of physiology in America.

Spring 1987. Opening plenary session, 10:00 A.M. No other papers scheduled. Talk will be a "Janus," looking backward and to the future. FASEB Historical Lectures, one by each FASEB member society tracing its roots to the APS. APS Historical Lectures, preceding various symposia within APS and focusing on related historical developments. APS Banquet with speaker, for members and spouses.

Peter A. Chevalier, Chairman

# Career Opportunities in Physiology

The Career Opportunities in Physiology Committee has been concerned with gathering and disseminating information about positions available to physiologists. It is important for graduate students and postdoctoral fellows to be aware of the many diverse opportunities open to them. As a result, a "Career Opportunities in Physiology" booklet, edited by D. J. Ramsay, was prepared during the past year. It is a collection of reprints from *The Physiologist* between 1980 and 1983. The Committee recommends that members of the Association of Chairmen of Departments of Physiology be informed of its availability.

Another project has been a report by C. M. Gregg concerning the doctoral educational programs in physiology in nonmedical school units. The report, "A Survey of Research Doctorate Programs in Physiology Not Associated with Medical Schools," contains new information concerning the graduate training programs in nonmedical school areas, such as biological sciences on undergraduate campuses, as well as schools of veterinary medicine.

The Committee sponsored symposium, Initiation of a Career in Pharmaceutical Industries, was held at the FASEB Spring Meeting under the chairmanship of R. C. Webb. The symposium covered career opportunities in industry and some of the desired characteristics being considered in the placement of Ph.D.-trained physiologists into such nonacademic settings. The speakers reviewed general job opportunities, criteria for appointment and advancement, opportunities for independence, and some of the desired characteristics and factors that should be considered in selecting a career in industry. The Committee recommends publishing the symposium papers and report in *The Physiologist*.

T. M. Saba, Chairman

# Education

The Education Committee has concentrated its efforts since last year largely in two areas: continuing medical education (CME) and computer-based education (CBE).

## Continuing Medical Education Projects

The continuing medical education audio-tape program is nearing completion. We have eight manuscripts and commitments for two more. As soon as the last two required papers are identified, the publisher, AV/MD Inc., will begin developing their marketing program.

Revision of the slide-tape programs into CME material is also underway. The instructional material for the cassette series on Aging has been agreed upon by Dr.

Paola Timiras and the special advisory board for this project. We are currently engaged in exploring ways of more expeditious production and more aggressive approaches to packaging and marketing all CME-related materials.

### Computer-Based Education

Two projects in the area of computer-based education are being pursued. An effort is underway to catalog existing CBE materials in the biomedical disciplines. This effort is being carried out in cooperation with the FASEB Office of Computer Services. An initial round of publicity has gone out and some programs have already been received and are being entered into the FASEB computers. Recent resolution of staffing problems in the Office of Computer Services is expected to result in further publicity and facilitation of the cataloguing phase.

Dr. Joel Michael organized a workshop on CBE materials for physiology teaching that was held April 1, 1984, preceding the FASEB meeting in St. Louis. Of the 50 or so people attending, more than half were from disciplines other than physiology. The possibility was raised of having a 2- to 3-page addendum to *The Physiologist* on content and applicability of available programs. It has been suggested that the Program Committee be approached with the request to schedule a full-day session or two half-day symposia on CBE in conjunction with the FASEB meetings.

### Possible APS Involvement in Scientifically Based Research in the Teaching of Physiology

As an outgrowth of our interest in computer-based education in physiology, as well as fostering new approaches and improvement in the teaching of physiology at various professional levels, the following policy statement was prepared:

> The Education Committee is proposing a mechanism whereby the APS may help investigators procure funds to support scientifically based research in the teaching of physiology. Two possible levels of involvement are envisioned: APS endorsement or APS participation in the study. In either case, a preproposal (< 5 pp) should be submitted to the Education Committee for initial screening. The preproposal should include background, specific aims, methodology, and significance with respect to improving the teaching of physiology. If the proposal is consistent with APS goals, a full proposal will be requested from the investigator. Further information may be obtained by contacting the Chairman of the APS Education Committee.

A similar issue of possible APS participation in a CBE project concerns a number of computer-simulated physiology experiments developed by Drs. A. Rovick and J. Michael, primarily for students in undergraduate physiology courses. The Elsevier Biomedical Press (Cambridge) has expressed some interest in producing this software material and indicated that the attractiveness of the project would be enhanced considerably by "official approval" of the APS. The Education Committee is prepared to seek appropriate mechanisms for the establishment of an adequate review process of the materials produced, whereby the APS could approve or "sponsor" the project in a similar fashion to sponsorship of the slide-tape programs.

### Refresher Course for 1984

The refresher course for the 1984 Fall Meeting in Lexington, KY, will focus on "Determinants of $O_2$ uptake during exercise." The course is being organized by Drs. Daniel Richardson of the University of Kentucky and Bryant Stamford of the University of Louisville.

Judy A. Spitzer, Chairman

## Finance

The Finance Committee met November 2-3, 1983, at APS Headquarters in Bethesda. Present were Francis J. Haddy, Earl H. Wood, Paul C. Johnson, Chairman, and ex officio members, Howard Morgan, Orr Reynolds, and Walter Sonnenberg. Also present was Stephen Geiger.

For the 1983 fiscal year, it appears that we have achieved a break-even situation. Our fiscal fortunes depend very heavily on those of FASEB, and this year FASEB had excess income at the Spring meeting. In past years, FASEB has returned to individual Societies any excess funds realized during the Spring meeting or conversely turned to Societies to make up the difference if a deficit occurred. This has made fiscal planning for our Society rather difficult, especially in deficit years. This year the FASEB had decided to retain the surplus and put it into escrow for 1984 to cover possible losses. This policy will make financial planning for our Society subject to less uncertainty.

A new activity of this Society is the planning and preparation for the 1987 Centennial. Additional expenses associated with the Centennial include hiring a historian/archivist and preparation of appropriate monographs. It is estimated that this will cost about $40,000 a year. Council has appropriated $10,000 a year and authorized a $20 abstract handling fee for the Fall meetings, to be devoted to Centennial activities. In addition, Council has authorized that voluntary contributions to the 1986 International Meeting be used toward Centennial expenses. Members voluntarily contribute several thousand a year toward the Centennial celebration. it is anticipated that this aggregate income will cover the expenses of the Centennial. In addition FASEB has agreed to an as yet unspecified sum as part of the 1987 FASEB registration fee toward the APS Centennial celebration.

In the past 17 years Society operating expenses have frequently exceeded income even in years when no deficit was anticipated. Such deficits have usually been made up from interest earnings of the publications contingency fund. This subsidy has totaled $463,000 over this time period. As a consequence, the publications contingency fund has not grown appreciably and has failed to keep up with inflation. This fund currently stands at 1.4 million. Sound fiscal planning would require that we reinvest the interest earnings of the publications contingency fund and otherwise build the fund to 1–1.5 times the annual publications budget, which is currently 3.5 million. To achieve this goal would require that the Society operating expenses be in balance with income. To bring this about, the Finance Committee has proposed to Council the following operating principles. First, that the operations budget include a 5% contingency factor as a minimal hedge to cover unexpected expenses. Second, that after a budget is adopted no new items be added by Council or Committees during a fiscal year unless a source of income is identified to cover such items. If new money cannot be identified we recommend that expenditure be delayed until such time as it can be programmed into the following year's budget with appropriate adjustments to maintain a balanced budget.

The Finance Committee is working with the Headquarters staff to review Society operations on a cost-center basis. Some of the major cost centers identified for review are Society scientific meetings, Council meetings, Committees, Sections, *The Physiologist,* liaison activities, Business Office, Membership Office, Public Affairs, and Centennial. In conjunction with this review a Site Visit by the Finance Committee to the APS Office is planned in March.

The Finance Committee has been asked by Council to examine ways to stabilize support for symposia at Spring and Fall meetings at about $20,000 a year. Mechanisms by which such assured support can be provided to the sections and groups that organize the symposia will be discussed and forwarded to Council.

The Finance Committee has also reviewed the manner in which special operations such as Centennial celebration and Carolyn tum Suden Fund are reported within the budget. Since both of these have designated incomes, we have decided to make separate budgets for them which will show in the operations budget of the Society only to the extent that it is subsidized from regular income. In the case of the Carolyn tum Suden Fund, which is used to support student travel to meetings, this will be handled entirely within the context of the income from that fund. If expenditures exceed income in any given year, the deficit will be made up from principal; similarly, any excess income will be used to build up principal.

Paul C. Johnson, Chairman

## Perkins Memorial Fund

Since 1981 the Perkins Memorial Fund provided partial support for three foreign scientists and their families.

Dr. Huang Shao-yung from the Shanghai Institute of Physiology came to work with Dr. J. T. Reeves at Denver, CO. Dr. Shao-yung is a respiratory physiologist who participated in two expeditions to Mt. Everest; his wife, Tung Lin, is a geneticist. Their visit was unusually productive, both scientifically and culturally. Several publications resulted and a program for continued collaboration and exchange between Shanghai and Denver is now in operation.

Dr. Meinhard Kneussel from Vienna, Austria, came to work with Dr. H. Kazemi in the Pulmonary Unit of the Massachusetts General Hospital; he is accompanied by his wife and daughter. His work as Perkins Fellow on the role of GABA in regulation of pulmonary ventilation will be presented at the 1984 meetings of the society. Nonscientific productivity included the birth of a son in Boston. Dr. Kneussel will return to a faculty position in Vienna next July.

Dr. Kaoru Koika, his wife and daughter, are currently Perkins Fellows from Japan; their host is Dr. Norman Staub in San Francisco.

John A Pappenheimer, Chairman

## The John F. Perkins, Jr. Memorial Awards

The American Physiological Society invites applications for the John F. Perkins, Jr. Memorial Fellowships. The fund is designed to provide supplementary support for the families of foreign physiologists who have arranged for fellowships or for sabbatical leave to carry out scientific work in the United States. Applications by US physiologists, who require supplementary assistance to work abroad, will also be considered.

It is the interest of the Perkins Fund to develop the full potentialities for cultural benefit associated with scientific exchange. Preference will be given to physiologists working in the fields of respiratory physiology, neurophysiology, and temperature regulation.

Each application will be made by both the visiting scientist and his host. Ordinarily, the joint applicants will have made financial arrangements for the visiting scientist before applying to the Perkins Fund for family support. The application will contain an account of these arrangements together with a description of the proposed scientific work, and a brief account of how the visitor and his family intend to make use of the cultural benefits.

The amount available for each award will be in the range of $3,000–7,500, depending upon the estimated needs of the family over and above the amount already available to the visiting scientist. Ordinarily, 2–4 awards will be available in any one year.

Application forms for host and visiting scientist may be obtained from Dr. Orr Reynolds, Executive Secretary, American Physiological Society, 9650 Rockville Pike, Bethesda, MD 20814, USA.

## Porter Development

The Porter Development Committee is now supporting three postdoctoral fellows and three predoctoral fellows in physiology: Dr. Jose E. Garcia-Arraras, who is continuing his fellowship in the laboratory of Dr. Nicole Le Dourain at the Institut D'Embryologie in the Centre National de la Recherche Scientific, Nogent-sur-Marne, France; Dr. Nelson Escobales, who is a graduate of the Dept. of Physiology and Biophysics, University of Puerto Rico, and is now a postdoctoral fellow in the laboratory of Dr. Mitzi Canessa, Dept. of Physiology and Biophysics, Harvard Medical School; Dr. Jorge R. Mancillas, who is a graduate of the Dept. of Neurosciences, University of California at San Diego, and is now a postdoctoral fellow in the laboratory of Dr. Floyd E. Bloom at the Salk Institute; Jean A. King, who is a candidate for the Ph.D. degree in the Dept. of Biology, New York University, in the laboratory of Dr. Fleur L. Strand; Darlene K. Racker, who is a candidate for the Ph.D. degree in the Dept. of Physiology and Biophysics, Chicago Medical School, in the laboratory of Dr. Warren W. Tse; and Dr. Harris M. Mackey, who is candidate for a Ph.D. in Neurobiology in the Dept. of Biological Sciences, Columbia University.

The Committee has also continued funding for the Atlanta consortium, a program organized with the assistance of the Dept. of Physiology, Emory Medical School. Two former Porter Development Committee Fellows, Drs. Pamela Gunter-Smith and John C. S. Fray, have been Visiting Porter Lecturers in the Atlanta Complex. The Dillard Program in New Orleans has been assisted by the staff of the Dept. of Physiology at Louisiana State University and Tulane University.

The Committee is also providing support for a Minority Student Research Internship Program in the Dept. of Physiology, Michigan State University, for a Summer Student Research Program for Native American Indians in the Dept. of Physiology and Biophysics, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, and for a Teaching Demonstration Project in the Dept. of Physiology, Howard University College of Medicine.

We again express our appreciation to the Harvard Apparatus Foundation for its continuing support of the Porter Development Program.

A. Clifford Barger and
Edward W. Hawthorne, Co-Chairmen

## Program Executive

The proposal from the Long-Range Planning Task Force for the format of future spring meetings was reviewed by the Program Advisory Committee. The committee expressed concern that the proposal, if implemented, would result in a substantial curtailment in the original science component (contributed papers and symposia) of the program. In particular, the committee considered that the opportunity to present work, and receive criticism from a broad base of expertise, represented a major attraction of the present meeting format. These views were presented to Council, which agreed to defer modification of the spring meeting format pending further review by the Long-Range Planning Committee and the newly formed Section Advisory Committee. Members who wish to input these further considerations are invited to submit their views to Dr. Robert Berne, Dr. Marion Siegman, or myself.

### 1985 FASEB Themes

APS has agreed to organize a theme on Ganglionic Control of Autonomic Effector Systems for the 1985 Spring Meeting. The organizing committee is chaired by Dr. Jack Wood, who has outlined what promises to be an exciting program. Other themes to be presented at the 1985 Spring Meeting are Cancer, organized by Dr. M. Lieberman of AAP; Opiate Peptides, organized by Dr. W. Dewey of ASPET; and Nutrient Transport, organized by Dr. R. Cousins of AIN.

### APS Sponsored Symposia for 1985 Spring Meeting

Sixty-five proposals for symposia to be presented at the 1985 Spring Meeting were received from the organized sections of APS and the guest societies (Society for Mathematical Biology, Biomedical Engineering Society, and Society for Experimental Biology and Medicine) and reviewed at the meetings of the Program Advisory and Executive Committees. The number of proposed symposia was about three times the number that space and time limitations will allow to be presented. The selection process is a difficult and challenging task. The selections are made by the Program Executive Committee. The members of this committee review the proposals and assign each proposal a priority score. The factors contributing to the evaluation of priority include timeliness and novelty of topic, quality and distribution of speakers (it is usually considered preferable for the speakers panel to be comprised of active investigators representing alternative viewpoints), and interest and support from more than one section or group. Additional factors influencing the evaluation of priority include overall program balance and plans for publication of the symposium. When the evaluations are completed, the scores from individual members of the committee are averaged and symposia are selected according to the priority score to the limit of facilities and time available in the program.

The following list gives the symposia selected for presentation at the 1985 Spring Meeting; the organizers; and the APS section or guest society sponsoring the symposium:

Atrial Natriuretic Factor (2 sessions); H. Sonnenberg; Renal, Cardiovascular, and Water and Electrolyte Homeostasis Sections

Cardiovascular Neurobiology (4 sessions); C. M. Ferrario; Cardiovascular, Neural Control and Autonomic Regulation, and Neurophysiology Sections

Individual sessions will include the following:

- Functional Neuroanatomy, J. Sladek and V. Pickel
- Central Neurotransmitters, R. D. Foreman and P. M. Gootman
- Central Cardiovascular Actions of Humoral Factors, M. I. Phillips and K. B. Brosnihan
- Neurogenic Factors and Cardiovascular Control, V. S. Bishop and M. J. Brody

Neuroendocrine Mechanisms of Plasma Volume Regulation; S. L. Bealer; Cardiovascular Section

Membrane ATPase Function in Vascular Smooth Muscle during Hypertension; R. A. Hermsmeyer; Cardiovascular Section

The Role of the Endothelial Cell in the Transvascular Regulation of Macromolecular Permeability; G. J. Grega; Cardiovascular Section

Recycling of Pulmonary Surfactant; A. B. Fisher; Respiration Section

Role of Lung Macrophage in Host Defenses and in the Lung's Injury and Repair Processes (2 sessions); R. P. Daniele; Respiration Section

Intrarenal Role of Renin-Angiotension System; L. G. Navar; Renal Section

Neural Control of Endocrine Pancreatic Function: Physiologic Significance; L. A. Camfield; Neurophysiology Section

Muramyl Peptides as Modulators of Sleep, Temperature and Immune Responses; L. Chedid; Environmental, Thermal and Exercise Section

Biology of Sweat Glands; E. R. Nadel; Environmental, Thermal and Exercise Section

Urea Transport, Renal and Red Cells; R. I. Macy; Cell and General Section

Interactions of Peptides with the Brush Border Membrane; G. M. Gray; Gastrointestinal Section

Single Channel Measurements in Epithelia; J. L. Rae; Epithelial Transport Group

Pathophysiology of Human Mental Disease (3 sessions); G. F. Cahill; Committee on Clinical Physiology

Adjuncts to the Use of Animals in Biomedical Research; N. B. Marshall; APS Sustaining Associates Group

Membrane Channel Kinetics; D. J. Marsh; Society for Mathematical Biology

Blood-gas Measurement: New Approaches; P. G. Katona; Biomedical Engineering Society

New Approaches in Imaging: The Study of Physiologic Function; P. G. Katona; Biomedical Engineering Section

Dr. J. B. Bassingthewaite, Chairman of the US National Committee and Dr. C. Richard Taylor, IUPS Program Committee, attended the meeting of the Program Advisory Commitee and solicited suggestions from the program representatives of the APS sections for the program to be presented at the 1986 International Congress in Vancouver.

Michael J. Jackson, Chairman

# Publications

The phenomenal increase in the number of new manuscripts received and articles published in the journals of the American Physiological Society continues. Quality remains high. The necessary continued increase in subscription prices and greater dependency on subscription income while the numbe rof subscribers declines, as with many other similar publications, is of concern.

A vigorous book publishing program encompasses basic science, the bridge between basic science and clinical medicine, history of physiology, and animal welfare. Toward the end of 1983, three books were completed: two i nthe *Handbook of Physiology* series, *Peripheral Circulation and Organ Blood Flow* and *Skeletal Muscle,* and a special publication, *Animal Pain: Perception and Alleviation.* Work was in progress on additional Handbooks, a Clinical Physiology Series volume, and a technique book.

## Journals

### *Manuscripts*

The number of new manuscripts received for the journals increased by 231 (+7%), somewhat higher than last year's increase of 213 manuscripts (+7%). Despite the large increase for *AJP: Regulatory, Integrative and Comparative Physiology* (+106 manuscripts or +40%) and *AJP: Cell Physiology* (+35 or +18%), the overall increase for the individual journals of the *American Journal of Physiology* was only 137 or +7% compared with 203 or 12% in 1982. The receipt of new manuscripts was up by 87 or 10% for the *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology* and 15 or 5% for the *Journal of Neurophysiology.*

### Rapid Communications

Rapid Communications were received for each of the journals of the *American Journal of Physiology* in 1983. They were acted on more rapidly than Special Communications, which are of comparable length. The time from receipt to acceptance is shortened by about 2 months; the time from acceptance to publication by about 1.5 months.

### Articles and Pages Published

A total of 18,701 pages (19,287 with cumulative indexes) was published in 1983. This is an increase of 16% (18% with cumulative indexes) over last year and +130% since the journals were reorganized.

The number of articles and pages published increased for all but one of the journals. The greatest increase was in *AJP: Regulatory, Integrative and Comparative Physiology,* in which 84 more articles (+50%) and 703 more pages (+57%) were published. The single decrease was in *AJP: Heart and Circulatory Physiology,* in which 18 fewer articles (−6%) and 221 fewer pages (−10%) were published.

### Printing

Printing costs increased by 23% in 1983 to pay for 18% more pages printed and inflation.

### Subscriptions

The total number of paid subscriptions decreased from 17,318 in 1982 to 16,529 in 1983. This drop of 789 (−5%) is a continuation of the losses experienced last year (−2%). Decreases for the four main journals were −3% for the *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology,* −6% for the *Journal of Neurophysiology,* and −6% for *Physiological Reviews.* Subscriptions to the individual journals of the *American Journal of Physiology* were down 2%, continuing last year's trend, a loss of 6%.

Losses occurred in nonmember domestic and foreign subscriptions. The only gains were in the number of member subscriptions to the *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology* and to each of the individual journals of the *American Journal of Physiology.*

Subscription prices for 1983 were increased by about 50% for the consolidated *American Journal of Physiology, AJP: Regulatory, Integrative and Comparative Physiology,* and *Physiological Reviews.* The prices of the other journals were increased by about 30%.

### Page Charges

Page charges remain an important source of income for the journals. The percentage of authors arranging for page charges to be paid was 88% overall (86% in 1982).

### Reprints

The number of reprints of each article ordered continues to decline, although the number of authors ordering at least 100 reprints was the same as last year, 96%.

### Cumulative Indexes

Cumulative author and subject indexes were issued during the year to the *American Journal of Physiology* and the *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology.* Each appeared as part 2 of a regular issue of the journal that it indexed and was distributed to all regular subscribers to the journal. Subscribers to one of the specialty journals of the *American Journal of Physiology* received a copy of the index for all the journals.

### "Physiology in Medicine"

By the end of the year T. E. Andreoli, the Editor of "Physiology in Medicine," which will begin to appear in *Hospital Practice* in January 1984, had seen to the reorganization of this sadly missed series. This joint editorial venture between the Society and *Hospital Practice* will attempt to translate "physiologic precepts into rational guideposts for understanding clinical disorders." A series of about six articles will appear, one per month, on a particular topic. The first series will focus on "Dynamic imaging of the circulation in health and disease, coupled with an evaluation of the relation of cardiac performance to cardiac metabolism." The second series will deal with themes relating to the gastrointestinal tract.

### Financial Summary

Total income in 1983 increased by 23%. About \$650,000 (+34%) additional income was realized from subscriptions from the 30-50% price increase and 5% loss in the number of subscribers. Other sources of income were about the same as in 1982. Subscriptions accounted for 72% of the income, compared with 66% last year. Expenses in 1983 increased by 19%. The journals continued to be operated in the black. Total income including interest, dividend, royalty, and miscellaneous income was \$3,677,880. Total expenses were \$3,473,757.

## Books

### *Handbook of Physiology*

*The Nervous System.* Volume III, *Sensory Processes,* was being printed at the end of the year and should be available in Jaunary 1984. Three additional volumes are in preparation. *Intrinsic Regulatory Systems of the Brain,* edited by F. E. Bloom, should be completed next.

*The Cardiovascular System.* Volume III, *Peripheral Circulation and Organ Blood Flow,* edited by J. T. Shepherd and F. M. Abboud, was completed in December. All manuscripts for Volume IV, *Microcirculation,* have been set in type and began to go for page makeup in December.

*Skeletal Muscle.* The new Section 10, *Skeletal Muscle,* L. D. Peachey, Editor and R. H. Adrian, Associate Editor, was completed in October.

*New Commitments.* The revision of the section on the respiratory system is in preparation and should begin to appear in 1984. One new section on cellular and general physiology and revisions of *Alimentary Canal* and *Renal Physiology* are underway.

*Financial Summary.* In 1983, 1749 copies of the Handbooks were sold, providing an income of \$123,014 (1982 income was \$242,484). The cost of the series from 1959 through December 1983 totaled \$3,971,186; the income was \$3,428,589. The total deficit was \$542,597. Most of the deficit is from recently published books, which have not been on the market long enough to generate much income, and from work in progress. The cost in inventory was \$1,140,953.

### Clinical Physiology Series

*High Altitude and Man.* All manuscripts had been received for *High Altitude and Man,* edited by J. B. West and S. Lahiri, by the end of the year. It will be published in 1984.

*Financial Summary.* In 1983, 296 copies of the first six books in the Clinical Physiology Series were sold, providing an income of \$5,852 (1982 income was \$30,202). The cost of the series from 1977 through December 1983 totaled \$187,773; the income was \$222,854. The income over costs was \$35,081. The cost in inventory was \$56,204.

### Special Publications

*People and Ideas Series.* The reprint of *Circulation of Blood: Men and Ideas* has been well received, and 560 additional copies were printed in July. Three books have been commissioned in the People and Ideas Series.

*Animal Welfare. Animal Pain: Perception and Alleviation* was published in November. The two Editors are R. L. Kitchell and H. H. Erickson and the two Associate Editors are E. Carstens and L. E. Davis. A related book on animal stress is planned.

*Technique Book.* A technique book, *Voltage and Patch Clamping with Microelectrodes,* is being prepared. The manuscripts for this book were written by the participants in a workshop at a Satellite Symposium on Hayman Island in conjunction with the IUPS Congress in Australia. The Editors are T. G. Smith, Jr., H. Lecar, S. J. Redman, and P. W. Gage. After the manuscripts have been reviewed and revised, the authors have been asked to provide a disk as well as a printout. It is hoped that the test thus can be set in type without rekeying.

*Financial Summary.* In 1983, 600 copies of the three books listed as Special Publications, i.e., *Excitation and Neural Control of the Heart, Circulation of the Blood: Men and Ideas,* and *Animal Pain: Perception and Alleviation,* were sold. They provided an income of \$16,802 (1982 income was \$30,159). The cost of these books from 1982 through December 1983 totaled \$99,220; the income was \$46,961. The total deficit was \$52,259. The cost in inventory was \$62,539.

We look forward to an equally ambitious program in 1984. Special emphasis will be placed on an evaluation of what has been happening in the journals since they were reorganized in 1976-77. Members' comments are welcome.

H. E. Morgan, Chairman

## High Altitude and Man

The Publications Committee is pleased to announce the newest in the Clinical Physiology Series books, *High Altitude and Man,* edited by John B. West and Sukhamay Lahiri.

There is rich history on the subject of human physiology at high altitude. The wide-ranging features of acclimatization have long fascinated physiologists and physicians who see the topic as one of the best examples of how man can respond to a hostile environment.

Nevertheless the last few years have seen a burgeoning of interest in the physiology of man at high altutide. There are several reasons for this. One of the most dramatic was the ascent of Mount Everest by two climbers without supplementary oxygen in 1978, a feat that many physiologists thought was impossible. This provoked a great deal of interest in the physiology of extreme altitudes. Another reason is the increasing concern in how to improve man's well-being and physical performance at high altitude. A large number of people in the world are natives to altitudes over 3,000 m. Moreover in recent years a substantial number of people have moved to these altitudes, and with increasing industrialization in those areas, man's ability to carry out physical work becomes a matter of economic importance. In addition the armed forces are concerned about how to maximize human performance under these conditions. Finally, the study of man at high altitude provides unique information about the effects of severe hypoxia, which are clearly relevant to the pathophysiology of patients with lung and heart disease.

This monograph is an outgrowth of a symposium on man at high altitude sponsored by the American Physiological Society. The symposium and book are in three parts, covering the topics of man at extreme altitude, sleep and respiration at high altitude, and physiology of permanent residents of high altitude. The timing of the symposium was stimulated in part by the American Medical Research Expedition to Everest, which took place in the fall of 1981. Although the symposium was not solely devoted to results obtained by the expedition, a number of papers stemmed from it.

*High Altitude and Man* contains 207 pages and 109 figures. The price is $39.00 to nonmembers, $31.00 to APS members when they order directly from the Society Subscription Department, 9650 Rockville Pike, Bethesda, MD 20814.

## Section Advisory

During a special meeting of the APS Council, November 19-21, 1983, a report by the Long-Range Planning Task Force included the recommendation to Council that a Section Advisory Committee be established.

> ". . . to meet at least annually with Council and other APS committees for which there is a special requirement . . . Each section will appoint a representative to the committee."

Following thorough discussion of the concept, Council approved the charter of

> "a Section Advisory Committee, composed of section chairmen or the equivalent with an alphabetic rotation of the chairmanship, to interact with the Long-Range Planning Committee and to meet annually with Council at the spring meeting."

In so doing, Council established a provision "that the sections nominate their chairmen or their secretaries, if they do not have chairmen, to be the member of the Section Advisory Committee for his/her term as section chairman."

In response to an invitation to this effect from the president of the Society, the pro tempore Section Advisory Committee (SAC) met with Council during the Spring Meeting in St. Louis on April 1, 1984. The agenda included *1*) the purpose of the SAC; *2*) its organization; *3*) the desirability of standardization of APS sections; *4*) criteria for APS membership, especially "possible easement of (current) requirements"; and *5*) any items that section chairmen may wish to propose.

Following an interaction and exchange with Council on the issues aforementioned, the Section Advisory Committee separately convened to consider and discuss the charge of Council to the Committee. At the outset, Dr. Marion Siegman was elected Chairman pro tem and Dr. Janett Trubatch agreed to serve as Recorder pro tem. A subcommittee, consisting of Drs. Margaret Neville, Robert E. Shade, and Janett Trubatch, was established to develop the criteria for committee membership, rotation of members, assurance of continuity for representation to Council, etc. Dr. Neville accepted the task of compiling a description of the structure and function of the newly chartered committee of the APS.

For the remainder of this year and 1985, as well, this group will continue to serve as the pro tem officers of the Committee.

The Committee thereafter addressed the discussion of topics developed during its earlier interaction with Council.

There was a consensus for two sessions of the Committee during the Spring Meeting—a conclave of the Section Advisory Committee and a joint meeting with the APS Program Advisory Committee. This would enhance section interaction and collaboration toward developing meeting scientific sessions of mutual interest and benefit. Long-range plans could be developed for implementation. Thus the scientific quality of the APS meetings would be improved, a most important objective of the Society. A corollary to this goal was the Committee's emphasis and endorsement of increased financial support that would only abet improvement in the quality of symposia, tutorial lectures, workshops, and special sessions. Ultimately, this would lead to increasing the attendance and participation of APS members during the annual FASEB meeting and better interaction with other Societies and their scientific programs. Ultimately, this would be the vehicle for effecting greater scientific cohesiveness within the APS membership.

Recognized and endorsed with enthusiasm was the need for a permanent affiliation with Council through ex officio representation on Council by the established designee of the Section Advisory Committee. For the 1985 Spring Meeting, the Chairman and Recorder pro tem will meet with Council and render the report of the Section Advisory Committee.

The Committee emphasized the need for improving channels of communication with the Publications Committee and the Editorial Staff of the APS Journals dedicated to the scientific area encompassed in the APS sectional goals and objectives.

The desirability of standardization among the sections was considered and discussed followed by a unanimity that the current structural and functional organization of the APS sections is satisfactory.

The Committee declined participation and/or intervention in "easing the requirements" for APS membership. It considered this to be the responsibility of the Membership Committee. Sectional review of the credentials of candidates for membership, in essence, is a fait accompli from the view of sponsors (and dually, sectional affiliates) attesting to the qualifications of a physiologist seeking APS membership.

Attending this first meeting of the APS Section Advisory Committee were Dr. Harvey Sparks (Cardiovascular), Dr. Margaret Neville (Cell and General Physiology), Dr. George F. Cahill, Jr. (Clinical Physiology), Dr. Mary F. Dallman (Endocrine and Metabolism), Dr. Carl V. Gisolfi (Environmental, Thermal and Exercise), Dr. Joseph Handler (Membrane Transport Group), Dr. Marion Siegman (Muscle Physiology Group), Dr. Janett Trubatch (Nervous System), Dr. Karlman Wasserman (Respiratory), Dr. Robert E. Shade (Water and Electrolyte Homeostasis), and Dr. Joseph F. Saunders, ex officio, APS Headquarters.

Marion Siegman, Chairman
Janett Trubatch, Recorder

## APS Member to be Payload Specialist for NASA Spacelab 4

APS Member **Robert Phillips**, a physiology and biophysics professor at Colorado State University, has been selected by the National Aeronautics and Space Administration as one of four finalists to occupy a seat on a future space shuttle flight. Phillips, who is a physiologist and veterinarian, will be a payload specialist for Spacelab 4 either conducting experiments aboard the shuttle or working closely with the experiment on the ground.

## APS Fall Meeting August 26–31, 1984, Lexington, KY

The 35th Annual Fall Meeting of the American Physiological Society will be held August 26-31, 1984 in Lexington, KY. Registration will be located in the Lexington Center and will open at 2:00 P.M. on Sunday, August 26. Scientific Sessions—slide sessions, poster sessions, symposia, and tutorial lectures—will be scheduled in the Lexington Center, Hyatt Regency, and Radisson Hotels on Tuesday, August 28, through noon Friday, August 31. The APS Refresher Course will be held on Monday, August 27 from 1 to 4:30 P.M.

Special Welcome Lecture, "A Surgeon's View of a Race Horse," by Robert W. Copelan, Monday, August 27, 7:30 P.M.

Symposia and Special Sessions (tentative titles)

- Loaded breathing: load compensation and respiratory sensation (3 sessions)
- Neuroendocrine control of gonadotropin secretion
- Quantitative approaches to the study of cardiovascular regulation
- Interdisciplinary workshop: Physiologist's approach to age-dependent changes in function
- Interdisciplinary workshop: Integrative approaches to physiology education
- Intrarenal hemodynamics
- Alteration in microcirculatory function during hypertension
- Vasoactive agents in control of the mesenteric circulation
- Neural control of renal function
- Chronophysiology and athletic performance
- Life at reduced water activities

In addition to symposia, a series of tutorial lectures will be programmed. A special lecture titled, "Experiences of a blue grass physiologist in space," will be presented by Astronaut Story F. Musgrave.

Refresher Course, "Anaerobic Threshold," organized by Bruce Gladden, Daniel Richardson, and Richard Stremel.

Bowditch Lecture

- Glycoprotein hormone genes: hormonal regulation of expression, by William W. Chin.

*For further information*: APS Fall Meeting Office, 9650 Rockville Pike, Bethesda, MD 20814. Telephone: 301/530-7171.

## Nuclear Winter

The symposium on Nuclear Winter: The Long-Term Biological Consequences of Nuclear War, sponsored by APS at the April FASEB Meeting, attracted enormous interest. The hall was packed and overflowing with standees as Dr. Clifford Barger pointed out the critical significance of the new scientific findings, which indicate that nuclear weapons may be as lethal to the user as to the intended victim. As a result, he said, the concepts of mutual deterrence and of seeking security through nuclear arms buildup must be called into question. Dr. George Woodwell, one of the leading biologists involved in the nuclear winter studies, described the predicted climatic effects of a nuclear exchange: dust from the explosions and smoke from the ensuing fires will darken the sky and bring about an extended period of freezing temperatures and altered circulation patterns throughout the inhabited regions of the northern hemisphere and probably into the southern hemisphere as well. After considering the biological consequences of these changes, Woodwell concluded that the capacity of the Earth to sustain life could be seriously compromised. A brief but powerful film narrated by Dr. Carl Sagan illustrated the dangers in a dramatic way. In the discussion that followed, the main question from the audience was "What can we do?" Afterward, close to 100 scientists signed up to help bring the issues defined by ongoing research on the consequences of nuclear war to public attention.

## Fifty-Year Members and Year of Election

E. F. Adolph, 1921
E. C. Albritton, 1933
W. M. Allen, 1934
E. Anderson, 1934
J. W. Bean, 1932
R. J. Bing, 1922
T. E. Boyd, 1925
E. Bozler, 1932
C. McC. Brooks, 1933
P. C. Bucy, 1933
E. B. Carmichael, 1931
K. K. Chen, 1929 (R)
K. S. Cole, 1934
M. F. Crawford, 1933
M. C. Damour, 1934
H. Davis, 1925
H. H. Dukes, 1934
L. B. Flexner, 1933
F. E. Franke, 1934
M. H. Friedman, 1929
C. L. Gemmill, 1928
A. S. Gilson, 1927
P. O. Greeley, 1931
D. E. Gregg, 1933
H. Grundfest, 1932
H. K. Hartline, 1929
A. B. Hastings, 1927
J. M. Hayman, Jr., 1928
F. A. Hellebrandt, 1933
R. C. Herrin, 1932
E. C. Hoff, 1933
H. E. Hoff, 1933
C. B. Huggins, 1932
J. S. R. Johnson, 1925
J. L. Johnson, 1934
F. T. Jung, 1930
N. Kleitman, 1923
T. Koppanyi, 1924
E. M. Landis, 1928
A. Lieberman, 1931
H. S. Mayerson, 1928
A. T. Milhorat, 1934
E. S. Nasset, 1932
H. C. Nicholson, 1932
H. Pollack, 1933
P. Reznikoff, 1927
O. W. Richards, 1934
C. P. Richter, 1924
D. M. Rioch, 1931
J. J. Sampson, 1932
C. F. Schmidt, 1929
F. O. Schmitt, 1930
J. A. Shannon, 1933
H. Silvette, 1933
P. W. Smith, 1933
S. Soskin, 1930
I. Starr, 1929
E. U. Still, 1928
M. L. Tainter, 1929
S. S. Tower, 1932
G. E. Wakerlin, 1933
J. T. Wearn, 1921
R. W. Whitehead, 1932
L. C. Wyman, 1927

# APS Sections

## History of Physiology Section Statement of Organization and Procedures

ARTICLE I. *Name*

The name of this organization is the Section on the History of Physiology of the American Physiological Society.

ARTICLE II. *Purpose*

The purpose of this organization is *1*) to foster an interest in and study of all aspects of the history of physiology; *2*) to advise the American Physiological Society on matters of interest in these areas; *3*) to assist the American Physiological Society in organizing, and presenting scientific sessions, symposia, and other programs of interest to physiologists in these areas; and *4*) to work toward the establishment of a Center for the History of Physiology.

ARTICLE III. *Membership*

Membership is open to any member (Student, Associate, Regular, Emeritus, Corresponding) or Staff Member of the American Physiological Society who wishes to be a member. Membership is automatic upon application to the Executive Secretary-Treasurer of the American Physiological Society.

ARTICLE IV. *Officers*

SECTION 1. *Steering Committee.* The responsibility for management and supervision of the affairs of the Section on the History of Physiology shall be vested in the Steering Committee. The members of the Steering Committee shall be the Chairman, the Secretary, Treasurer and the Representative of the Section on the History of Physiology to the Program Committee of the American Physiological Society.

A quorum for conducting official business of the Section on the History of Physiology shall be three of the four members of the Steering Committee. Such business may be conducted at meetings or by conference phone call.

SECTION 2. *Election of Officers.* Officers shall be elected each year at the Annual Meeting. Nominations shall come from the floor. Election of officers shall be by ballot if there is more than one nomination per office.

SECTION 3. *Term of Office.* The term of each officer is three years.

ARTICLE V. *Other Committees*

The Chairman may appoint committees that are necessary for the proper conduct of the affairs of this section.

## Water and Electrolyte Homeostasis Section

Amendment to the Statement of Organization and Procedures [*Physiologist* 25(3): 143, 1982]

Article IV, Section 4, Paragraph 2:

> Two nominations shall be made annually as appropriate, by the Nominating Committee. If three or more other members wish to propose a nominee, such nomination must be submitted in writing to the Chairman of the Nominating Committee no later than November 30 of the year prior to the next annual meeting and must be accompanied by the proposed candidate's written statement agreeing to serve if elected.

(Recommended by the Section Steering Committee and approved by the APS Council, April 1984)

**Joseph F. Saunders** recently became a member of the APS staff following his retirement from the U.S. Federal Service after a lengthy career. In the APS, he serves

as Manager, Membership Services Department. His Ph.D. degree, in physical biochemistry, was awarded by Georgetown University in 1960. His federal career, of some 34 years, was dedicated to the administration and management of scientific research programs in the physiological and biomedical sciences under the auspices of the Biological Sciences Division, Office of Naval Research, the Bioscience Programs Division, NASA Headquarters (principally as Scientific Director for the Biosatellite Program and Chief of Environmental Biology); and the Office of International Affairs, National Cancer Institute, NIH. His federal career included participation in the development, implementation, and management of a multitude of international activities. Through the arrangements of the grant, contract, and bilateral agreement mechanisms, he was associated with intergovernmental research programs toward the definite storage of human blood; the preservation and clinical utility of human tissue in reconstructive surgery; the design, development, and conduct of collaborative projects in gravitational physiology aboard Apollos 16 and 17, Skylab, and Apollo-Soyuz; and cooperative cancer research projects with the People's Republic of China, the Hungarian People's Republic, the USSR, and other nations in Europe and Asia. Dr. Saunders' awards include the Arthur S. Flemming Award, a NASA Group Achievement Award, and the NIH Director's Award. He is a Regular Member of the APS, Full Member of the American Chemical Society, the Council of Biology Editors, the Society of the Sigma Xi, and a Founding Member of the Society for Cryobiology.

# Membership Status

| | |
|---|---|
| Regular | 4,513 |
| Emeritus | 567 |
| Honorary | 11 |
| Corresponding | 105 |
| Associate | 746 |
| Student | 243 |
| Total | 6,185 |

NEWLY ELECTED MEMBERS
The following, nominated by Council, were elected to membership in the Society at the Spring Meeting, 1984.

## Regular Members

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# Future Meetings

| | |
|---|---|
| **1985** | |
| FASEB Annual Meeting | April 21-26, Anaheim |
| Joint APS/The (British) Physiological Soc Mtg | Sept. 12-14, Cambridge (UK) |
| APS Fall Meeting | October 13-18 Niagara Falls/SUNY, Buffalo |
| **1986** | |
| FASEB Annual Meeting | April 13-18, St. Louis |
| IUPS Congress | July 12-20, Vancouver, Canada |

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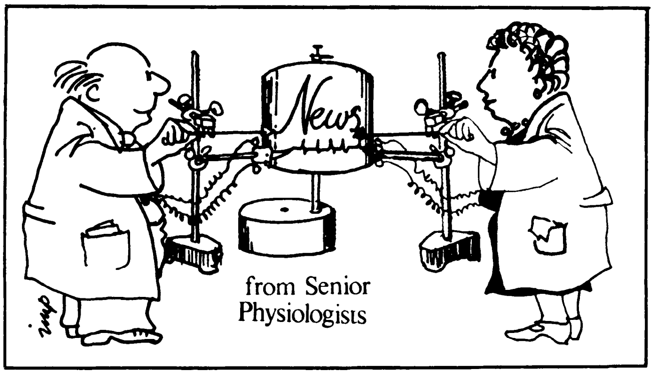


## Sheppard M. Walker to Roy O. Greep:

Thank you for your letter asking for information about my activities on the occasion of my 75th birthday. The Department has been very gracious in the days of my retirement. They have honored me with promotion to Professor Emeritus and have provided me with very nice office space where I can hang my hat and get out from underfoot. One bit of information that some members of the Society might be interested in is that I have recently purchased a Visualtek, which enables me to read the journals in spite of the low vision that developed as the result of macularscotoma. This instrument is very useful for anyone with low vision, since it has the capacity to magnify up to 30 times. A good part of my time is spent on the "fairways of indifference," namely the golf course. The fact that I have low vision has improved my golf game because I no longer commit the cardinal sin of golfers, that is, looking up when I'm trying to strike the ball. I have three wonderful golfing partners who watch the ball, tell me where it went, and then help me find it.

Dept. of Physiology and Biophysics
University of Louisville
Louisville, KY 40292

## Leonard H. Elwell to Roy:

Thank you for your letter inquiring about my life at 70 and after retirement. Multiple sclerosis has sapped my energy and limited my activities, but my time is more than occupied by those activities I can and do still pursue. Of course, it now takes me longer to accomplish most actions. In addition to daily living, I do a little volunteer adult basic education tutoring, dabble in genealogy, and spend time reading. I enjoy doing the things I am still able to do and waste no time bewailing those things I cannot do.

515 SW Bancroft St.
Portland, OR 97210

## Jay Tepperman to Roy:

Thank you for your welcome to the 7 zero club. It arrived the day *before* my 70th birthday, which proves that you and your committee have an excellent monitoring system. In answer to your specific questions—*1*) Helen and I are still working. Our present NIH grant runs out on November 30, 1984 and we do not plan to apply for a renewal. We are scheduled to retire Dec. 31, 1984. *2*) We have contracted to do an extensive revision of *Metabolic and Endocrine Physiology.* This time we will be coauthors. We hope to have the completed MS in by October of 1985. *3*) Our work, with Najma Begum and Janet DeWitt, on an insulin second messenger and related problems is not projected to go beyond our retirement. *4*) Words of wisdom to pass on to younger colleagues? The Catch 22 for the investigator is the fact that the more you learn the more aware you become of whole oceans of information you know nothing about. In fact, I have never felt dumber than I do now. Mercifully, I no longer particularly care how dumb I am.

I have had the usual intimations of mortality and like many of my friends, I sometimes make small fantasy wagers with my interior bookie on which of my organ systems will betray me next. So far, three unsuccessful operations for a detached retina are in the lead, but I confidently expect other outposts to be heard from soon. Meanwhile, I enjoy my interesting children, my fascinating, bright, and beautiful grandchildren, my books, my music tapes, and, most of all, my amazing wife, coinvestigator, cograndparent, and best friend.

State University of New York
Syracuse, NY 13210

## Stewart Wolf to E. B. Brown:

My last full-time academic post was as Director of the Marine Biomedical Institute and Professor of Medicine and Physiology at the University of Texas Medical Branch in Galveston. Throughout my 25 years in the Southwest (Oklahoma and Texas) I maintained a small research laboratory in eastern Pennsylvania that was within easy driving distance from my former post at Cornell in New York City. On the advice of Dr. Eugene DuBois I had negotiated the privilege to return East during the summers and bring along a few students and young investigators for a sort of "Wolf's Hole" research experience. Now that I have retired from gainful employment that laboratory, called Totts Gap, is developing into a year-round operation. My studies continue to focus on the control of body functions by the central nervous system, especially during adaptation to the psychologically and socially significant experiences.

In a current issue of *Circulation* is an article on the neural regulation of the QT interval of the electrocardiogram published with Tom Davidowsky, a student from Hershey Medical School. With Richard Veech of the Laboratory of Metabolism, NIAAA, the discovery of abnormal diols, 2, 3-butanediol and 1,2-propanediol, in about 80% of confirmed alcoholics was recently reported. Beyond that, in a collaborative effort with the Center for Social Research at Lehigh University, a 20-year follow-up of the Italian-American community, Roseto, PA, is being planned. The community, formerly remarkably stable, traditionally cohesive, and mutually supportive, had a surprisingly low death rate from myocardial infarction, despite a prevalence of usually accepted risk factors at least as great as neighboring control communities where coronary deaths occurred at twice Roseto's rate. Today, after 20 years of rapid social change and major shifts in traditional values the death rate seems to have climbed. We hope to discover the lesson in this experiment of nature.

My other activities include teaching in the Dept. of Medicine at Temple University in Philadelphia and serving as Chairman of the Scientific Advisory Committee of the Muscular Dystrophy Association and Chairman of the Advisory Committee to the Francis C. Wood Institute of the History of Medicine at the College of

Physicians of Philadelphia. Finally, I hope to be working shortly on a biography of Charles Richet, French physiologist and Nobel Laureate who made the first studies of the dive reflex and who also had the opportunity to study a man, Marcellin, with a gastric fistula.

Totts Gap
RD #1, Box 1262
Bangor, PA 18013

### Hayden Nicholson to E. B.:

Thank you for the card for my 80th birthday from the Committee on Senior Physiologists. My wife, Marian, and I are in reasonably good health. We both have had very successful cataract surgery and lens implants. Our chief occupations are gardening, bird watching, and reading. One of our chief interests is trying to raise azaleas and rhododendrons in the Chicago area climate. It's a challenge. I'm sure some of our friends wonder why we, who lived quite a few years in the south, would choose to retire in the Chicago area, but we are enjoying it here. One thing I have learned since retiring is that a severe climate isn't nearly as great a hazard if you don't have to get up and go to work every day. If you wake up in the morning with a blizzard outside you just stay in the house until the weather improves. The one thing that gets me outside with snow on the ground is feeding the birds.

22 W. 647 Elmwood Dr.
Glen Ellyn, IL 60137

### William M. Balfour to E. B.:

As you may remember I became Dean of Student Affairs in 1968, just in time to have many interesting crises come my way. However, by 1972 things quieted down and from then until 1976 when I left the post, it was fairly routine administrative work, but always fun. During those years I continued to teach the Human Physiology course and often felt it was the only time when I knew what I was talking about. In '76 I returned to the department and took charge of a new major in Human Biology. I also began advising premeds and pre-PT students, keeping only fairly busy. After considerable pressure from students the position of University Ombudsman was developed, I applied and was "awarded" the job. I continue these endeavors—half-time teaching and half-time ombudsmaning—and enjoy them most of the time. The Human Biology program has 90-100 majors and is popular with premeds. And I still teach the physiology course, plus a Human Biology Senior Seminar. I retire, perforce, in May '85. Only vague plans as yet. My wife died in August '82, so what plans we had no longer fit. Best regards to you and thanks for listening to the story of my fourth alternate career.

Dept. of Physiology and Cell Phyisology
University of Kansas
Lawrence, KS

### Ewald Selkurt to Bob Alexander:

As of July 1983 I became Distinguished Professor Emeritus. I still have an office in the department, but my lab and equipment have been turned over to a new young faculty member. I have been kept busy mainly with revision of our textbook, *Physiology* (Little, Brown). The 5th edition came out in February. I have also been occupied with writing manuscripts on a backlog of data. Another job completed last year was the writing of the departmental history. My future expectation is to join with one of our younger men to help out in his lab and learn some new techniques (microcirculation). For outside activities, I have continued my interest and participation in choral work; I belong to three choruses. Ruth and I have also developed an interest in art (oil painting, sketching, clay modeling) and have taken several courses offered in the Indianapolis branch of Indiana University School of Art. We also enroll in other courses offered by the university to broaden our interests. We still play a little golf and are both in reasonably good shape considering the age bracket!

Dept. of Physiology
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### M. J. Schiffrin to Edward Adolph:

How very kind of you to welcome me into the over-70 club, otherwise known as the Senior Physiologists. In the words of the sage, "If I had known I was going to live this long I would have taken better care of myself."

Your note was especially meaningful to me because when I was a graduate student under Sig Nasset, I have vivid recollections of you as one of the great teachers. Your compassion and dedication will always be remembered with affection and respect. Even though you did inspire terror with your "And what else Mr. —?" and your stimulating "What do *you* think the answer is?"

Whary Research Association Inc.
Port St. Lucie, FL 33452

### A. Van Harreveld to Edward:

I was pleasantly surprised by your greeting on the occasion of my 80th birthday. I want to thank you and the Committee on Senior Physiologists very much for this nice attention. I am in relatively good health and am able to do some work in my laboratory at Caltech. After doing this for some 50 years it is difficult to give it up.

241 S. Wilson Ave., #105
Pasadena, CA 91106

## Deaths Reported Since the 1983 Fall Meeting

Baetjer, A.M., Baltimore, MD (2/21/84)
Balinsky, J. B., Ames, IA (1/31/84)
Bromiley, R. B., Ottawa, Canada (8/6/83)
Brown, Jr., F. A., Woods Hole, MA (5/19/83)
Comsa, J., Hamburg, W. Germany (12/6/83)
D'Agrosa, L. S., St. Louis, MO (7/23/83)
Durbin, R. P., San Juan, PR (1/5/84)
Feigen, G. A., Stanford, CA (5/83)
Gilman, A., New Haven, CT (1/31/84)
Gold, E. M., Davis, CA (9/83)
Hegyeli, A. F., Rockville, MD (1982)
Julian, L. M., Davis, CA (4/4/83)
Maaske, C. A., Lakewood, CO (12/83)
Maher, J. T., Natick, MA (8/15/83)
McCandless, E., Hamilton, Ont., Canada (6/7/83)
Nachmansohn, D., New York, NY (11/2/83)
Sheppard, C. W., Memphis, TN (7/24/83)
Slotkoff, L. M., Chevy Chase, MD (12/8/83)

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PETERSON, NILS S., AND KENNETH B. CAMPBELL. Simulated Laboratory for Teaching Cardiac Mechanics. *The Physiologist* 27(3): 165–169, 1984.—Previous work in instructional computing in cardiovascular physiology has followed one of two paths. Microcomputers have been used to develop nonpulsatile circulatory models, and minicomputers have been used to solve more complex pulsatile ones. This paper reports on the use of a microcomputer with numeric coprocessor to simulate pulsatile events in the heart in time frames that approach the speed of physiological events. The computer program also simulates the experimental laboratory in which the mechanics of an isolated heart can be studied. The simulated laboratory stresses the discovery approach to learning. Students may recreate classical and modern experiments in exploring the effects of preload, afterload, heart rate, and inotropic state on cardiac performance. Five types of data displays are possible, illustrating different ways of analyzing data collected from the isolated heart experiments. Today's students have images of computers developed from experiences with science fiction movies and video games. The challenge in developing this program was to find visually stimulating displays that compare favorably with those images. An animated drawing that displays traditional laboratory apparatus for modifying the mechanical environment of an isolated heart is used as a visual interface to facilitate student interaction and to convey an intuitive feel for the physical character of the experiments. The end effect is a colorful, lively screen display that incorporates a realistic simulation of the heart with simple laboratory apparatus for conducting experiments in cardiac mechanics.

Simulation plays a central role in the use of computers for instruction in cardiovascular physiology. However, the computational complexity of the describing equations has placed limitations on the dynamic realization that is possible with a computer. Analog computers have been successful in providing the full dynamic range of cardiovascular behavior for student manipulation and observation (1). The more popular and widely used digital computers are more limited dynamic simulators. Until recently two classes of dynamic possibilities were available; minicomputers have been used to solve systems of differential equations and provide simulations of pulsatile cardiovascular behavior (3), and microcomputers have been used to develop nonpulsatile circulatory models (10). The minicomputer approach provides more realistic model behavior but remains too expensive to give students wide access to its instructional potential. When student patience and laboratory time is taken into account the computational limitations of the eight-bit processors can provide only very approximate nonpulsatile behavior. With the availability of numeric coprocessors for microcomputers, the processing speed of these systems approaches that of minicomputers. This offers new potentials for applications of physiological simulations. Recently, dynamic simulations lively enough to maintain student interest have been developed on a microcomputer with numeric coprocessor (8). The program can display the behavior of isolated muscle, the heart, and a complete circulatory system.

Previous workers have described simulations with either tabular or *X-Y* graph outputs. They have focused the student-program interface strictly on data output from the organ simulation. This paper extends the role of simulation to include not only the physiological organ to be studied, the heart, but also the laboratory in which it is studied. The attempt was to provide the student with a facility for conducting the classical experiments that are commonly described in textbooks, using graphic simulations of the laboratory apparatus. These experiments are exemplary in demonstrating essential aspects of physiology but are difficult to carry out in the student laboratory. The program was developed for the IBM Personal Computer with 8087 numeric coprocessor. It calculates the pulsatile behavior of the isolated canine left heart in time settings that, while slower than actual physiological speeds, are dynamic and lively.

## Design Goals

The overriding goal in the design of this instructional computing project was to develop a means for teaching observation and scientific method as well as the facts of physiology (18). Our hypothesis was that certain aspects of these goals can be better reached in the simulated laboratory than in the wet laboratory. This is not to say that the traditional laboratory can be replaced entirely. Rather, for many purposes, the distractions of dealing with details of laboratory technique, the inability to exert the appropriate kinds of controls, and the instability of the real animal preparation obscure, rather than illuminate, the underlying physiology and the intellectual content of the scientific method that is to be learned from the laboratory experience. The simulated laboratory allows the student to focus on hypothesis formation and testing in a setting that is largely free from the obfuscating details. Further, the simulated laboratory can provide an opportunity for many more, and more varied, experimental sessions.

The audiences we designed for are students in the first year of human and veterinary medicine and upper division and graduate students in physiology. We feel that this program is also appropriate for pharmacy, nursing, and paramedical students. The computer program can be used alone, in conjunction with conventional physiology laboratories, as a classroom lecture aid, or as an individual study tool.

This program differs from several others that have been developed in that it does not have a textual tutorial section preceding the experimental section (5, 17). This is in keeping with our goal of challenging students to use scientific methods to gain an understanding of the basic physiological facts.

The simulation embraces many facts about cardiac mechanics, but they are in a latent form. Students must learn and use scientific methods to recreate the classical experiments and discover these facts for themselves. To learn from this program the learner must be an active and creative participant. We anticipate that traditional prelaboratory materials would be used to prepare the student for work in the laboratory.

Current interactive video games provide a visual standard against which students judge educational simulations. Electronic spreadsheets and other highly refined interactive programs raise expectations about user interfaces. Science fiction movies have depicted elaborate computer-generated simulations. These animations give the impression that computer simulations can reproduce and display complex events in time frames close to those in which they happen. To be appealing in the classroom, instructional programs must learn from these examples and visual images. These standards motivated an effort to improve cardiovascular instructional computing along two paths: user interface and graphics. The interface that seems most natural and intuitive for the student is the actual laboratory experiment setting. The model presented in this paper uses as its interface an animated drawing of an isolated left-heart preparation that is patterned after the isolated whole-heart preparation used in the famous experiments of E. H. Starling (2).

## Using the Program

Program operation is centered around one graphic image, drawn from the apparatus used in an early isolated heart laboratory (Figure 1). From left to right its components are a filling reservoir, the heart, a surge capacitor, a Starling resistor, and a mercury manometer to measure the compression pressure within the resistor. We chose a mercury manometer over a pressure gauge to place an emphasis on the physical aspects of the experimental system. Two readings from the simulated meter stick must be subtracted to get the pressure reading. The

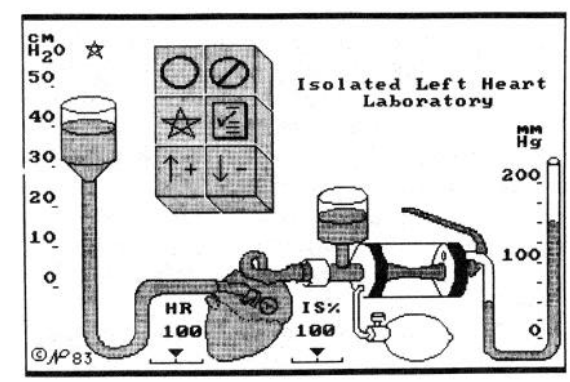



Figure 1
Computer display of laboratory apparatus for isolated left-heart experiments. Major components are (from *left to right*) filling pressure reservoir, heart, surge capacitor, and Starling resistor with manometer readout. *Star* can be moved among the 4 parameters under control of the student. These are filling pressure, heart rate (HR), inotropic state (IS%), and afterload. Above apparatus is a drawing of 6 function keys used for all input to the program. They are, pairwise, yes/no, move cursor/select from checklist, and increase/decrease.

heart rate (HR) and heart strength, or inotropic state (IS%), have no simple physical representation and are shown as scales with pointers. They, along with the fluid reservoir for cardiac filling and manometer, are animated and controlled by the student.

Program control is easy to learn. It is accomplished with only six function buttons shown at the top of Figure 1. The top two buttons have opposite meanings, loosely described by the word pairs yes/no and go/stop. The bottom two are similar; they refer to a parameter setting and allow the student control of parameter values (increase/decrease and up/down). For example, the filling pressure reservoir may be lowered 5 cm by pressing the down button once. This has the effect of reducing the pressure filling the heart by 5 cm $H_2O$. The settings displayed on the apparatus are used by the program to control model parameters. Numeric inputs are completely avoided. The middle key marked with a star allows selection of the specific parameter the student would like to change. Depression of this key moves the star cursor counterclockwise from parameter to parameter. This action is used to "connect" the up/down keys to a particular parameter. The last key, a checklist, is used to reach a menu of experiments.

## Simulated Left Ventricle and Its Hydraulic Afterload

The program utilizes a well-validated dynamic simulation of the left ventricle (LV) based on instantaneous pressure-volume and pressure-flow relationships. An electrical analog representation of the LV simulation with preloading and afterloading systems is shown in Figure 2. The passive pressure-volume behavior of the LV is approximated by the relation

$$P_{E_0} = a \cdot \exp[b \cdot (V - V_d)]$$

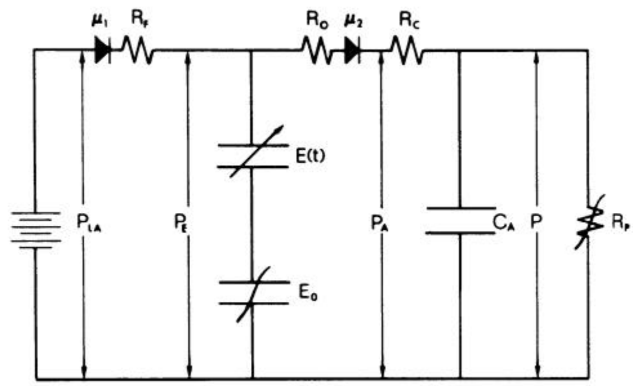
where $P_{E_0}$ is the pressure borne by the passive elastance element ($E_0$), $a$ and $b$ are constants, V is the LV volume, and $V_d$ is the LV volume at zero transmural pressure. Passive LV elastance is given by the commonly employed relationships (4)

$$E_0 = \frac{dP_{E_0}}{dV} = b \cdot P_{E_0}$$

The active pressure-volume behavior is taken from the time-varying elastance concepts of Suga and Sagawa (15) and is represented in Figure 2 as the element $E(t)$. The pressure borne by the active element is equal to $E(t) \cdot (V - V_d)$. $E(t)$ ranges from zero value during diastole to a nominal value of $7.0 \times 10^3$ dyn$\cdot$cm$^{-5}$ during systole.

The pressure across both elastance elements is the sum of the pressure on each ($P_E$ in Figure 2). A mechanical analogy would represent those elements as a passive nonlinear spring and an active time-varying spring in parallel. The electrical analogy in Figure 2 shows the equivalent representation of a passive nonlinear capacitor and an active time-varying capacitor in series. Thus an increase in $E(t)$ unloads, i.e., reduces, the pressure on $E_0$ at a given volume. Since $E(t)$ has zero value during diastole, all the pressure on the elastance elements is borne by $E_0$. During systole most of the pressure is borne by $E(t)$.

The third element in the LV model is an internal resistance, $R_0$. $R_0$ has been shown to be an important dy-




Starling Resistor $R_P$

$$q_{R_P} = g(P - P_C); \quad P_C = \text{chamber pressure} \quad g = \text{conductance}$$

Elastance $E_0$

$$P_{E_0} = a \cdot \exp(b(V - Vd)); \quad E_0 = \frac{dP}{dV} = ab \cdot \exp(b(V - Vd))$$

Valves $\mu_1, \mu_2$

$$\mu_1 = 1 \text{ if } P_{LA} > P_E \text{ else } 0$$
$$\mu_2 = 1 \text{ if } P_E > P \text{ else } 0$$

State Equations

$$\dot{V} = \frac{\mu_1}{R_F}[P_{LA} - P_E] - \frac{\mu_2}{(R_O + R_C)}[P_E - P]$$
$$\dot{P} = \frac{\mu_2}{C_A(R_O + R_C)}[P_E - P] - \frac{g}{C_A}[P - P_C]$$

Outputs

$$P_E = a \cdot \exp(b(V - Vd)) + E(t) \cdot (V - Vd)$$
$$P_{LV} = P_E + \mu_2 \cdot R_O \dot{V}$$
$$Q_{LV} = -\mu_2 \cdot \dot{V}$$
$$P_A = P + R_C Q_{LV}$$

Figure 2
Electrical analog circuit diagram for isolated left ventricle model and its hydraulic afterload. *Symbols* are defined in the text.

namic LV property that is necessary for realistically relating pressure and volume (7, 13, 16) and pressure and outflow (4, 11) during ejection. Roughly, $R_0$ arises as a dynamic LV property because of the inverse relationship between velocity of myocardial fiber shortening and the afterload against which the fiber shortens. Thus the pressure in the LV ($P_{LV}$) is the pressure developed across both elastances minus the pressure lost due to flow through $R_0$. Basal values for $E_0$, $E(t)$ and $R_0$ were derived from data collected in the experimental laboratory using the dog.

Variations in inotropic state were brought about by changing a multiplying factor applied to $E(t)$. Values less than 1.0 correspond to a decrease in inotropic state, whereas values greater than 1.0 correspond to increases in inotropic state. Changes in heart rate were brought about by changing the number of integration steps over a cardiac cycle as well as changing the time period of each integration step. This produces the effect of preferentially shortening or lengthening the diastolic period over the systolic period as heart rate is increased or decreased.

The mitral and aortic valves were simulated as perfect one-way flow devices. The afterloading system consists of an entry resistance ($R_C$), a compliance ($C_A$), and a nonlinear Starling resistor

$$R_P = g + P_C/Q_{R_P}$$

where g is a constant, $P_C$ is the pressure in the Starling chamber, and $Q_{R_P}$ is the flow through the resistor. The student has experimental control over the variables: left atrial pressure ($P_{LA}$), $E(t)$, and $R_P$. The differential equations are integrated by the third-order Runge-Kutta method to solve for the state variables of LV volume (V) and pressure on the arterial compliance (P). The state variables are used for calculation of the output variables: pressure across the LV elastances ($P_E$), LV pressure ($P_{LV}$), LV outflow ($Q_{LV}$), and arterial pressure ($P_A$).

## Experiments in the Laboratory

The program was designed to allow the student to perform prescribed experiments which demonstrate the most important features of cardiac pumping mechanics. Additionally, the program provides the opportunity for free experimentation. Examples of some of the experiments that are possible are described below.

### Ejected Volume vs. Filling Pressure

In his classic experiments, Starling (14) demonstrated that the greater the pressure that fills the heart the greater the performance from the heart. Performance is often measured as stroke volume. This expression of the Frank-Starling mechanism is a major part of textbook cardiac physiology. In the computer-simulated laboratory this phenomenon may be observed by the student by systematically raising and lowering the heart's filling reservoir while keeping all other parameters constant and observing the heart's response. The student uses the star key to move the star around the screen until it is over the filling reservoir. The location of the star adjacent to the filling reservoir indicates that the reservoir can now be raised or lowered with the up/down keys shown in Figure 1. With each button depression the reservoir visibly moves to a new position and the new filling pressure that drives the simulated heart may be read from the scale. Compare the reservoir positions in Figures 1 and 3.

These variations may be made as often as desired, with the results simultaneously accumulating in the graph inset of Figure 3. Having collected data from a normal heart the student may explore how this behavior is modified with either inotropic depression, as would occur in disease, or inotropic elevation, as would occur with sympathetic stimulation. To do this the star key is used to jump the star cursor to the parameter labeled IS% (IS stands for inotropic state). Now the up/down

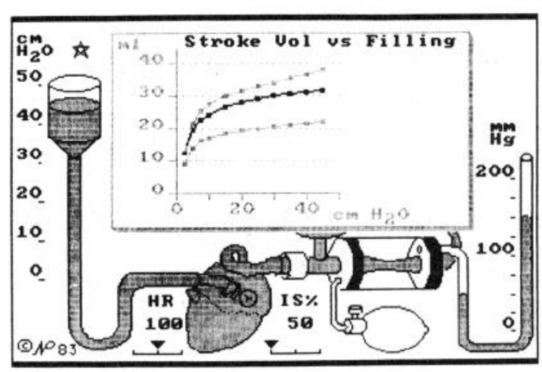



Figure 3
Computed results demonstrating Frank-Starling mechanism with experiments that are reminiscent of those done by Patterson and Starling. Stroke volume dependence on filling pressure for 3 contractile states. Curves connecting data points are (from *top to bottom*) 50% elevation in IS, normal IS, and 50% depression in IS.

keys apply to the IS parameter. The magnitude is shown numerically as a percentage of normal and also on the scale below. When a new IS level has been set, the star is moved back to the filling reservoir and the reservoir is raised and lowered as before. The highest and lowest curves in the graph of Figure 3 are results from performing the experiment on an excited and depressed heart.

## Isovolumic Pressure vs. Filling Pressure

An alternative way of viewing the effects of increased filling pressure is in terms of data as it was collected by Otto Frank in 1896 (6). The heart is not allowed to eject any blood and beats isovolumically. The contractions occur around a heart chamber that does not change its volume. The pressures generated under these conditions are the maximum pressures that the heart is capable of producing. Isovolumic pressure depends on the filling pressure in a characteristic way.

Frank's experiments are simulated in the program by allowing the student to clamp the outflow tract from the heart at the location of the arrow in Figure 4. With the clamp in place the simulated left ventricle is not able to eject blood. The student then raises the filling reservoir once more and collects the data shown in Figure 4 simultaneously. The data are the time course of the isovolumic pressure in the left ventricle at several reservoir settings. The student can see first hand that increasing the filling pressure will increase the isovolumic pressure development capacity of the left ventricle. Again, this figure is one commonly seen in textbooks.

## Stroke Volume vs. Pressure Against Which the Heart Must Pump

Whereas increased filling pressure favors cardiac performance, an increase in the pressure against which the heart must pump blood has the opposite effect and decreases performance. This had been suspected for a long time but was difficult to show experimentally until the well-controlled experiments by Weber, Janicki, and co-workers in 1974 (19). This should be contrasted to experiments in the intact circulatory system, where changes in LV preload, secondary to changes in afterload, mask the effects of afterload variation. Sagawa (12) has identified the pressure at the very end of the ejection as the appropriate measure to which cardiac stroke volume should be related. The instrumentation required for either of these important experiments is well beyond that available in the student laboratory.

Students may perform their own experiment to demonstrate this effect using the options available in the program. Now, however, the hydraulic load against which the heart must pump is varied. The apparatus for this is the Starling resistor, a thin collapsible tube through which the blood flows, surrounded by a pressure chamber. Air pressure in the chamber collapses the thin tubing, constricting blood flow.

The student moves the star to the right of the screen, above the manometer. The difference in the levels of the mercury in the two arms of the tube is the pressure in the chamber around the collapsible tube. The student presses the increase/decrease button to add or remove air from the chamber (this is equivalent to squeezing the bulb at the bottom of the screen) and observes the change in chamber pressure recorded on the manometer. Compare the manometer in Figures 4 and 5. These maneuvers are analogous to what is done by a physician in a routine blood pressure measurement. The steady-state results for a pressure setting are computed and then displayed. As subsequent points at constant inotropic state are calculated, connecting lines are drawn, as shown in the graph of Figure 5. As in the previous experiments this one may be done with altered inotropic state, heart rate, and/or filling pressure. The upper and lower sets of data in Figure 5 demonstrate the effect of increases and decreases in inotropic state on the experiment results.

## Pressure-Volume Loop Displays

Sagawa (12) has recently reiterated and expanded the utility of interpreting LV pumping events in terms of pressure-volume loops. All of the preceding experiments could have been visualized in this data format rather than, or in addition to, the one that was shown. Figure 6 shows the experiment in which filling pressure is changed in the pressure-volume format. Alternative forms for viewing experimental data are important to a broad understanding of the complex events that are being observed.

In all these examples all four parameters, filling pressure, heart rate, inotropic strength, and afterload, may be varied. The permutations, which may be used by the student to investigate the effects of simultaneous changes in two or more parameters, are too numerous to present here.

## Strip Chart

The preceding experiments are based on the heart's pumping behavior when it is in equilibrium. The data have been processed in several simple ways to provide the graphs. It is also important for students to have an appreciation of what happens during the transients from

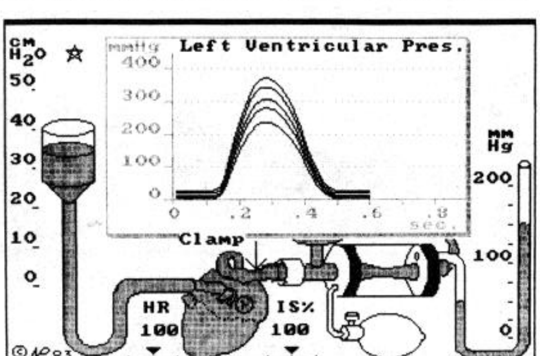



Figure 4
Time course of isovolumic pressure, duplicating the experiments of O. Frank. Varying filling pressures causes systematic changes in isovolumic pressure (from *top to bottom*) $P_{LA}$ = 35, 25, 15, 10, and 5 cm $H_2O$.

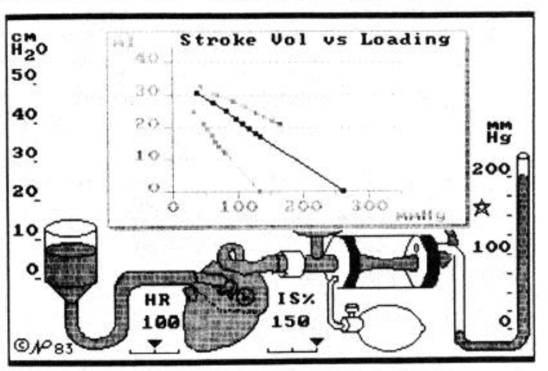



Figure 5
Variations in stroke volume as a function of afterload at 3 contractile states. Lines connecting data points are (from *top to bottom*) 50% elevation in IS, normal IS and 50% depression in IS. These results are similar to those found by Weber, Janicki, and co-workers (19).

one equilibrium beat to another. These transient beats are interesting because they show the time constants involved. The program can simulate a strip-chart recorder plotting pressure, volume, or flow with an electrocardiographic trace. The electrocardiogram provides a common reference for marking the time axis. Figure 7 is a composite made from printer outputs created by the program. This visualization of the multiple simultaneous events within the heart during the cardiac cycle is another classical textbook figure that the student can now observe in a dynamic setting. The capability to observe and control the dynamic behavior offers a much greater opportunity for learning the multiple intricate relations that are taking place in the beating heart.

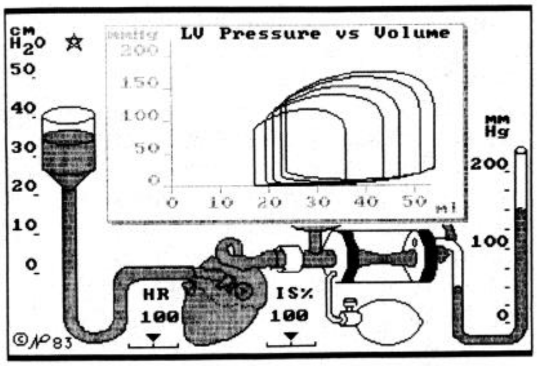



Figure 6

Pressure-volume loops with varying filling pressures, (from *left to right*, rightmost vertical limb) $P_{LA}$ = 5, 10, 15, 25, and 35 cm $H_2O$.

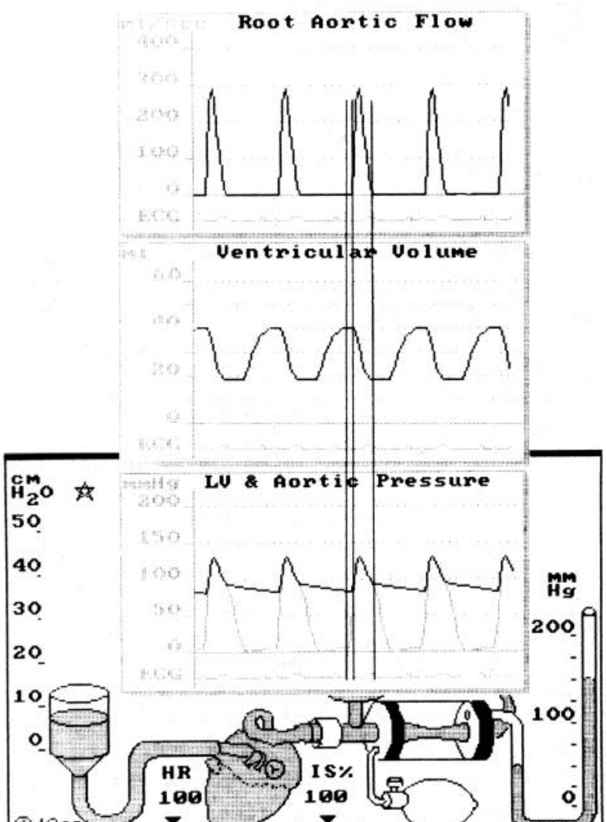



Figure 7

Composite of 3 printer outputs from the program in strip-chart mode. Four traces are aligned by their ECG records (from *top to bottom*): LV outflow, LV volume, arterial pressure, and LV pressure.

## Conclusions

Significantly more powerful and realistic simulations are now possible for classroom use with the advent of 16-bit microcomputers and their accompanying numeric processing units. These programs can represent the physiology of major experiments described in the textbooks in dynamic form, and graphics can be developed to depict the actual experimental settings.

The role of the computer needs to be explored in the science curricula for its potential to teach not only basic facts but also scientific method. The simulated laboratory experience offers an avenue for students to recreate classical experiments and see the scientific reasoning of pioneers first hand without the complications inherent in a real laboratory environment.

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# Book Reviews

## *Animal Physiology: Adaptation and Environment* (3rd ed.). K. Schmidt-Nielsen

New York: Cambridge Univ. Press, 1983, 619 pp., illus., index, $29.95

Professor Schmidt-Nielsen has taken a good text and, with this revision, made it better. Physiology today is such a vast field, encompassing endocrinological, neurobiological, and biochemical approaches, that no one text can treat all aspects and yet remain a useful teaching tool. Selectivity is mandated. Schmidt-Nielsen has succeeded where others have failed by not only explaining basic principles, from judiciously selected examples, but also conveying a sense of wonderment and excitement over the diversity of physiological adaptations of animals to environmental challenges.

By using the theme of physiological adaptation to the environment, this text provides a logical framework within which the student can organize physiological principles in a meaningful way. The writing style is lucid, straightforward, and informative. Even difficult concepts seem simple when explained by Schmidt-Nielsen. Examples are provided from all groups of animals, vertebrates and invertebrates alike, and even plants are occasionally mentioned when the subject demands (such as chemical defenses, plant poisons, CAM respiration). Physiological adaptations to the major environmental parameters are included: oxygen, temperature, water, food, and even light, under the section on vision. Some discussion of the temporal organization of physiological systems, as seen in circadian and seasonal cycles, would have been useful.

The approach of the author is directed at explaining basic physiological principles, i.e., how animals work. Some might quibble that not enough attention is given to regulatory aspects of physiology (such as endocrine, neural, and biochemical) in that control mechanisms are not discussed when a given physiological system is first introduced. Rather, there are separate chapters on the nervous and endocrine systems and a general discusison of control theory at the end of the book. This is in keeping with Schmidt-Nielsen's basic philosophy of presenting the principles and leaving it up to the student to integrate one area with another. Thus the text provides the framework necessary for understanding, for example, the hormonal control of osmoregulation in fish, even though this topic is not explicitly treated as such. By reading the chapters on osmoregulation and hormonal control, the student has the tools necessary for understanding most journal articles on detailed aspects of this subject. Schmidt-Nielsen's approach is necessary in an introductory text, both to limit the size of the volume (since everything cannot be covered) and to encourage the student to integrate topics as the situation demands.

The text emphasizes *physiological* principles in its treatment of environmental adaptation, with relatively little information on *biochemical* aspects (enzymology, metabolic pathways, etc.). This is in contrast to several other texts available today, in which physiology and biochemistry are integrated to explain animal function. However, to include biochemical aspects, to a degree greater than already present, in his text, Schmidt-Nielsen would have had to enlarge the book to such an extent as to make it impractical for an introductory course. This reviewer agrees with Schmidt-Nielsen's limitation of the topics to those more classically physiological, leaving environmental biochemistry to separate treatment by other books (e.g., *Strategies of Biochemical Adaptation,* by Hochachka and Somero) and introductory courses in biochemistry.

In summary, this textbook is an excellent choice for a first course in animal physiology. It is written in a highly readable style which will capture and sustain the interest of the beginning, or advanced for that matter, student. It is up to date, with inclusions of the most recent findings from the literature. This third edition contains new material on the brain and senses as well as a new chapter on endocrinology. It is comprehensive in its choice of major topics, presenting all the basic principles necessary for understanding any physiological system, yet selective in examples so as not to overwhelm with the plethora of facts. It provides a conceptual framework, that of adaptation to the environment, to unite what, in other texts, might appear to be disparate topics. After finishing the text, the student will appreciate that a comparison of physiological processes in a variety of organisms will either uncover fundamental functional principles or document the variety of means that have evolved to solve a common physiological problem.

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## *Aging and Cell Structure* J. E. Johnson, Jr. (Editor)

New York: Plenum, 1981, vol. 1, 385 pp., illus., index, $59.50

This is the first of a two volume set which emphasizes the application of the electron microscope in a study of changes which occur in tissues and cells during aging. This volume consists of ten chapters which focus on the nervous system, kidney, cardiovascular and skeletal systems, skeletal muscle and a comparison of insect with mammalian aging.

A. Peters and D. W. Vanghan review changes in the central nervous system. Their major account however, relates to their studies of the pyramidal neurons and neurologlial cells of the auditory cortex of the rat. They observe three patterns: (1) the monotonic, as exemplified by the gradual decrease in the number of dendritic spines along the dendrites of pyramidal neurons, (2) the rectangular, as manifested by the decrease in volume fraction of cytoplasmic ground substance in the perikara of layers II and V pyramidal cells which only start to decrease at about 27 months of age and (3) reversal of direction of change wherein the cell bodies of pyramidal neurons in the rat auditory cortex increase in size until 15 months of age then gradually become smaller in older rats. They discuss the dendritic changes, loss of neurons, synaptic populations, cell body and nucleus, neurofibrillary tangles, lipofuscin, neuroglia and the choroid plexus.

P. S. Spencer and J. Ochoa discuss the peripheral nervous system changes in aging. Motor, sensory, autonomic and reflex changes can be peripherally neurogenic in nature. Some changes are accepted being due to mechanical damage at sites of local nerve entrapment, others as the result of atherosclerotic ischemia, and others still of biological aging per se. They summarize their remarks that at least four neuropathological entities are involved: (1) pigmentation of neurons and myelinating cells, (2) low grade central-peripheral distal axonopathy, (3) demyelination and remyelination and (4) neuronal loss.

H. M. Wisniewski et al. discuss neurofibrillary and synaptic pathology, an area in which they have made many significant contributions. After consideration of fibrillar proteins, in the CNS they turn to the excessive accumulations of presenile dementia (Alzheimer's disease) and senile dementia (of the Alzheimer's type) with up-to-date information about the bundles of paried helical filaments that are structurally dissimilar from neurofilament profiles of normal nerve cells. Other leading lesions in these conditions are the neuritic plaques which represent sites of altered neuropil. These lesions, although present in brains of normal aged individuals and middle aged persons with Down's syndrome are particularly numerous in patients with presenile and senile dementia, most abundantly in the frontotemporal cortex, hippocampus and amygdaloid nucleus. The presence of amyloid is thought not to have a primary role in either plaque initiation or neurofibrillary degeneration.

R. Mervis discusses cytomorphological alterations in aging animal brains. Although there are no animal models of the pathological process such as the dementia of the Alzheimer type of man, within limits it is feasible to study the aging mammalian brain. He discusses the advantages of Golgi impregnation studies. Ultrastructural studies indicate a different interspecies response to the aging process. Man, monkey and dog brains seem to have numerous age-related indices. Aging rat brain may show a neutropil that is characterized as indistinguishable from much younger subjects.

A. C. Economos and coworkers discuss principles of variation and how it applies to aging. They conclude that biological variation should be fully recognized and accepted and the effect of age thereupon should be studied. This is an important section.

W. K. Bolton and B. C. Sturgill review the ultrastructural changes of the aging kidney. They present their work on Sprague-Dawley rats from birth to 24 months of age. The glomerular basement membrane increases progressively with aging from 1300 A in newborn to 4800 A by 2 years. The degree of proteinuria shows no correlation whatever with glomerular basement membrane thickness. The evidence seems to support age-related excess accumulation that is structurally abnormal. Changes in epithelial and endothelial cells also occur. They conclude that inherent genetically determined senescence is the basis for age-related renal changes in rats and that these changes are modified by environmental events.

E. A. Tonna discusses skeletal aging and in reviewing this area decries the paucity of literature and the problem of finding suitable animal models. He reports findings from the extensive work carried out with the inbred Swiss albino mouse from the Brookhaven National Laboratory. After an in-depth review of the electron microscopic studies of bone and cartilage, he concludes that while there is a basic understanding of the morphologic changes that occur in osteogenic cells, osteocytes and bone surfaces, including the perilacunar surfaces, there are still major gaps in our knowledge of age-related changes in bone, cartilage and mineralizing dental tissue.

S. I. Baskin et al. review physiological and pharmacokinetic effects of age on the heart. They present several photomicrographs demonstrating fibrosis, with loss and degeneration of cardiac muscle fibers, residual bodies, hypertrophy and myocarditis in 28-30 month old rats.

J. A. Shafiq and coworkers report on the effect of age on the skeletal muscle. After a cursory review they present their own findings on human subjects. Type I fibers were better preserved than type II which had more pronounced degenerative changes. These are focal changes in the myofibrils and the sarcotubular system. A general feature appears to be a decrease in size of mitochondria and accumulation of lipofuscin.

J. Miguel et al. compare insect with mammalian aging, with emphasis on D. melanogaster vs. the C57BL/6J mouse. All somatic cells in Drosophila consist of fixed post mitotics while only the nervous tissue, the muscle and endocrine glands of the mouse contain predominantly fixed cells. They conclude that fixed postmitotic cells of both insects and mammals show similar age-related fine structural changes. They share a fundamental mechanism of aging—disorganization of nonreplicating cells.

The volume contains some outstanding chapters with valuable information and new data. In general the electron micrographs are excellent. The reviewer has some difficulty with the use of the term "aging" to cover development and physiological decline. He has observed physiological decline to begin in the mouse after 8 months of age and in the rat after 12-14 months. This matter will probably always remain unresolved.

Harry Sobel
Crump Institute for Medical Engineering

## *Introduction to Pathophysiology: Basic Principles to the Disease Process.*
## J. H. Emes and T. J. Nowak

Baltimore, MD: University Park, 1983, 512 pp., illus., index, $24.95

This is an elementary text intended to meet the needs of those studying in the various allied health fields. It will introduce the reader with a minimal background in biochemistry and physiology to problems in disordered physiology. It emphasizes mechanisms of common diseases most likely to be encountered in North America. Uncommon diseases are in general not considered. The text is printed in large readable type. There are excellent illustrations and flow charts which should be very instructive to the novice. There are however major gaps in the subjects covered. The nervous system, infectious diseases, common congenital defects and metabolic diseases are scarcely mentioned. Hematology is poorly covered and the endocrine disorders which are covered are those of the thyroid and diabetes mellitus including NIDDM. Immune complex formation in glomerulonephritis is discussed but it is difficult to understand the omission of systemic lupus erythematosus. If a future edition is published it would add to the intended function of this text if a number of case histories were to be included. In the reviewer's experience these add greatly to the instructional quality of a book such as this.

In spite of the shortcomings, this text with its style of treatment of the subjects it covers is very readable and can be useful even for intelligent lay readers.

Harry Sobel
Crump Institute for Medical Engineering

## *Anti-Diuretic Hormone.* M. L. Forsling

Montreal, Quebec: Eden Press, 1982, 193 pp., index, $33.00

The fifth volume *Anti-Diuretic Hormone* (from Annual Research Reviews) brings a survey of works published predominantly in the years 1977–1979 and dealing with the theme of vasopressin. Even though there are about 800 citations quoted in the book, it cannot be said that all the literature from the given period has been covered. Papers from biochemistry and pharmacology are emphasized; synthetic and physicochemical aspects of these problems are covered only marginally. This is, however, not at all meant as a criticism, since these items (especially secondary structure and chemical structure-biological activity relationships) are thoroughly covered in *Amino Acids, Peptides, and Proteins* (a specialist periodical report of the Royal Society of Chemistry, London). In the reviewed book, included in the 18 chapter are all the most important periods of the fate of vasopressin, beginning with the localization of vasopressin-containing pathways and the synthesis and secretion of vasopressin, continuing with osmotic control and non-osmotic factors in vasopressin release and within recent times the effect of vasopressin on memory, up to the therapeutic use of vasopressin.

The greatest value of this book lies in its critical view at these biochemical and pharmacological aspects of vasopressin, a compound certainly of such an importance that it deserves its own treatment. Therefore it will be a great pity, indeed, if Mary Forsling carries out her threat declared in the introduction—that this fifth volume will be her last one to be edited.

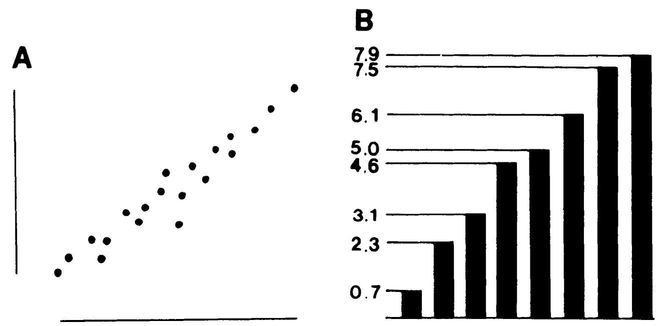
Karel Jošt
Prague, Czechoslovakia

## *Visual Display of Quantitative Information.* E. R. Tufte

Cheshire, CT: Graphic Press, 1983, $34.00

In 1983 almost 2,000 articles containing 10,000 figures, of which about 90% were graphs, were published in APS journals. *The Visual Display of Quantitative Information* is mainly about graphics and should be read by all who publish in the Society journals. The book is written by a Professor of Political Science and Statistics at Yale University whose primary interest is in the clear presentation of quantitative information rather than in producing slick graphics.

Carefully selected original illustrations and excellent descriptive text of historically important contributions are included. Emphasis is placed on the role of William Playfair (1759-1823), who used time-series plots of economic data and was the first to use bar charts, but also includes others such as E. J. Marey (1830-1904), who pioneered graphical methods for representing animal movement. The book includes practical information on the elimination of ink that does not tell the viewer anything, the misuse of color, and poor elements in computer-generated graphics. Some of the less frequently seen plots will take some getting used to but are worth considering before you prepare your next set of graphs; e.g., consider not extending the *x*- or *y*-axis above or below the values of the plotted data so that the axes provide easily read range information and do not imply extrapolated values (*A*) or using actual values on the vertical axis rather than regularly spaced numbers (*B*).




The main function of a graph in a scientific publication is to display quantitative data in an understandable way that is well integrated with the text. This book can be of great help toward achieving that goal.

Stephen R. Geiger
APS

# Letter to the Editor

## Computer-Based Examination Programs

HAROLD G. HEMPLING
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Medical University of South Carolina
Charleston, South Carolina 29425

Last April in *The Physiologist* (1) I provided a synopsis of some programs which the teacher may use with microprocessors to display text material on the video screen. Prompted by the many requests to copy them onto user disks and asked by several colleagues to adopt the programs to computer-based examinations, I have integrated the programs for that purpose. What follows is a sequence I use to prepare and to administer exams by computer. Now that the average learning resource center in most colleges has a number of these versatile instruments, computer-based examination is a highly-efficient way for the teacher or the student to test his comprehension of subject matter. It will save paper in any case. These programs are very simple, and because they are very simple, the teacher with only a peripheral interest in computers and a central interest in good teaching may prefer them to the more general and sometimes more esoteric software packages on the market. They certainly are cheaper.[1]

[1]Teachers wishing to use these programs need only send a blank 16-sector floppy disk and postage to cover return mail.

## I. Preliminary Steps

A. Assign a number to each student which he will use to call up his exam record.

1. I found it convenient to give him the same number as his position in the class list.

B. RUN ENTER CLASS LIST

1. This program will set up for each student a random access file large enough to record the answers to 100 questions at least.
2. The random access file is called CLASS-500, large enough to hold 500 characters for each student.
3. The user is asked for CLASS SIZE. Enter the number of students who will be taking the exam.
4. The user is asked for NAME. Enter same, but use **no commas.**
5. The user is asked for SSN, i.e., social security number. Enter same as a single number. Do not separate by dashes, commas, or slashes.
6. The SSN is often useful to protect the student's privacy.

C. RUN ENTER TEXT. This program has already been described.

1. It is used to prepare a library of questions. For each question I assign the file name, Q1, Q2, . . . until all questions have been written.
2. Since we use the format of multiple choice, usually with answers A or B or C or D or E, we format the text for twenty (20) lines per page (screen), spacing between each choice. If we plan to merge questions at some later date (see below) enter END on line 21.
3. Therefore each question is an independent file and may be accessed as a separate entity or as a sequence of questions.
4. Furthermore, one may use the program MERGE TEXT to select individual questions and merge them into one single file containing many questions.
5. If one uses MERGE TEXT for that purpose, be sure to enter END on line 21 when preparing the question using ENTER TEXT.

## II. Taking the Quiz

A. RUN QUIZ

1. The student is asked for his assignment number.
2. His answer will permit him to access CLASS-500 and the random file bearing that assignment number.
3. The student is asked for his SSN. The purpose is to provide some security to the file.
4. The student is greeted by name to complete the identification.
5. The student is asked, "How many questions?" The answer will determine how many questions he will be offered. The number entered should not exceed the total number of questions in the library available.
6. Questions are then supplied in sequential fashion.
7. Obviously the program QUIZ is easily altered to permit isolated questions to be selected.
8. The student enters his answer A, B, C, D, or E which is duly recorded in his file.

## III. Grading the Quiz

A. Preliminary step: prepare an answer key.

1. RUN ENTER TEXT and use this program to prepare a text file with each answer as a statement. For example 100 questions would have 100 statements: A or B or C or D or E and line 101 would be END.

B. RUN GRADING QUIZ

1. This program will sample each student's file in a sequential fashion, match his answer against the key, and sum up his correct answers.
2. A grade list will be printed out with name, SSN, and grade.
3. Students who did not take the exam receive a 0.

## IV. Flexible Options

A. Preparing an examination from a large pool of questions

1. RUN MERGE TEXT. *a*) Choose your questions Q1, Q5, Q9, . . . as examples requested and prepare a special file to hold this examination. *b*) Prepare a key as noted above. *c*) RUN QUIZ (MERGE); student will take the exam in the same fashion as described above. *d*) RUN GRADING QUIZ; student is graded as described above.

B. Preparing an examination from a large pool of questions by RANDOM sampling.

1. This type of examination is particularly valuable for students to evaluate themselves or to allow faculty to administer unproctored exams.
2. RUN RANDOM MERGE. This program will choose questions from the common pool at random and prepare a key based on answers for all questions in the pool stored in MASTER KEY.
3. The examination is taken by RUN QUIZ (MERGE).
4. The examination is graded by RUN GRADING QUIZ.

## Reference

1. Hempling, H. G. Letter to the Editor. *Physiologist* 265(2): 108, 1983.

## Optical Methods in Cell Physiology

A symposium on optical methods in cell physiology, organized by the Society of General Physiologists, will be held September 6–9, 1984, at the Marine Biological Laboratory, Woods Hole, MA. Keynote address by Professor Sir Andrew Huxley, PRS. Invited lecturers will discuss image enhancement techniques, optical measurements of membrane potential, intracellular pH, and intracellular [Ca], and photobleaching and photoactivation techniques. The conference will also feature workshops, laboratory demonstrations, and open poster sessions. *Conference program and registration information:* Dr. Robert B. Gunn, Department of Physiology, Emory University School of Medicine, Atlanta, GA 30322. *Note:* on-site housing is limited. *Deadline:* Aug. 1, 1984.

## Fulbright Scholar-in-Residence, 1985-86

The Council for International Exchange of Scholars is receiving proposals for the 1985-86 Fulbright Scholar-in-Residence program. Community and junior colleges, 4-year colleges, and universities may submit proposals to invite a scholar from abroad to lecture for an academic year or term in any field of the humanities or social sciences. Two separate competitions are conducted: for institutions that have not had frequent opportunities to receive scholars from abroad as lecturers and are introducing programs with an international perspective on their campuses; and for institutions that have an established international or area studies program. Institutions are asked to provide a supplement to the Fulbright stipend. *Information and proposal forms:* CIES, Eleven Dupont Circle, N.W., Washington DC 20036 (Mary W. Ernst, 202/833-4979 and Robert Burnett, 202/833-4957). *Deadline for proposals:* Nov. 1, 1984.

## Rehabilitated Birds Available for Research and Teaching

The Liberty Wildlife Rehabilitation Foundation has several live nonreleasable red-tailed hawks and great horned owls available for research or teaching purposes to persons with appropriate federal permits. *Information:* Susanna Morin, Specimen Disposition, 1222 W. Tyson St., Chandler, AZ 85224.

## National Diabetes Research Interchange

The National Diabetes Research Interchange (NDRI) in Philadelphia, PA, is a research support program established to advance the procurement, preservation and distribution of human tissues and organs for biomedical research. NDRI provides investigators nationwide with regular access to both diseased and normal control tissues. Tissue preservation is researcher-specific, and NDRI offers a broad range of processing alternatives, i.e., fresh, snap frozen, cryopreserved. Detailed donor information accompanies all distributed samples.

Researchers are invited to submit tissue requests for **Surgical and Cadaveric Tissues**—including kidney, liver, pancreas, eye, heart, pituitary, muscle, macrovessels, nerves, placenta, umbilical cord, and gastrointestinal specimens. Fetal tissue is also available. Donor criteria and post mortem time constraints can be accommodated. **Discard Transplant Tissues**—including kidney, pancreas, and liver.

All requests for tissue are subject to peer review. *Information:* James Goldschmidt, Manager of Research Systems, NDRI, 3624 Science Center, Philadelphia, PA 19104. Phone: 215/222-6374.

## International Symposium on Peptides and Ion Transport

An International Symposium on Peptides and Ion Transport will be held in Florence, Italy, on April 24-26, 1985. Topics will include peptides-ion transport interactions; role of ions in peptide secretion; modulation of ion transport by messenger peptides and synthetic analogues; peptides and ion transport in cardiovascular function, gastrointestinal and liver function, central nervous system, and renal function: interactions of peptides with drugs in ion transport; and peptide, ion, and receptor interactions. The Scientific Program will feature invited lectures, round tables, oral communications, and poster sessions. *Honorary chairmen:* J. Axelrod (USA) and H. W. Kosterlitz (UK). *Further information, abstract forms, and programs:* Organizing Secretariat, Fondazione Giovanni Lorenzini, Via Montenapoleone 23, 20121 Milan, Italy.

## International Congress of Systematic and Evolutionary Biology

The Third International Congress of Systematic and Evolutionary Biology will be held on July 4-10, 1985, at the University of Sussex, near Brighton, England. Symposia topics will include symbiosis in evolution, conservation of tropical ecosystems, biogeographic evolution of the Malay Archipelago, adaptational aspects of physiological processes, coevolution in eco systems and the Red Queen hypothesis, angiosperm origins and the biological consequences, measurement of rates of evolution, molecular biology and evolutionary theory, coevolution and systematics, molecules vs. morphology in phylogency, random and directed events in evolution, and biochemical innovation in microbial communities. Sessions for contributed papers, films, and poster papers will also be featured. *Information:* Prof. Barry Cox, ICSEB Congress Office, 130 Queen's Rd., Brighton, Sussex ON1 3WE, UK.

## ICSU Multidisciplinary Symposium

The First International Council of Scientific Unions Multidisciplinary Symposium will be held in Ottawa, Canada, 25-27 September 1984. Topics are Global Change, Teaching of Science, and Gene Technology. *Information:* ICSU Secretariat, 51 Blvd. de Montmorency, 75016 Paris, France; or National Research Council of Canada, Ottawa, Ontario K1A OR6, Canada.