# NATIONAL ACADEMY OF SCIENCES

# ERNEST WILLIAM GOODPASTURE

1886—1960

A Biographical Memoir by ESMOND R. LONG

Any opinions expressed in this memoir are those of the author(s) and do not necessarily reflect the views of the National Academy of Sciences.

Biographical Memoir

Copyright 1965 NATIONAL ACADEMY OF SCIENCES WASHINGTON D.C.



Ernes W. Gorsposiume

# ERNEST WILLIAM GOODPASTURE

October 17, 1886-September 20, 1960

# BY ESMOND R. LONG

**E** RNEST WILLIAM GOODPASTURE, distinguished figure in American pathology and pioneer in modern virological research, died at his home in Nashville, Tennessee, September 20, 1960. During his nearly seventy-four years he contributed notably to the advance of knowledge in many fields, particularly the pathogenesis of infectious diseases, the problems of parasitism, the laboratory cultivation of viruses, and the mechanism and course of a wide variety of rickettsial and virus infections.

# EARLY YEARS

Goodpasture was born on a farm near Clarksville, Montgomery County, Tennessee, on October 17, 1886. His parents, Albert Virgil Goodpasture and Jennie Willson Dawson Goodpasture, were native Tennesseans and relatively long lived. His father was a man of exceptionally wide interests and ability. He graduated in arts at the University of Tennessee and in law at Vanderbilt University, practiced law in Clarksville, farmed in Montgomery County, and took an active part in the politics of Tennessee, serving in its General Assembly and Senate and as clerk in its Supreme Court. He was devoted to literary pursuits, founded a book company of his own, and held responsible positions in societies and journals for local and American history. Much of Ernest Goodpasture's scholarship must have been derived from this source.

The influence of Goodpasture's mother is equally apparent. She was described as "cheery, gentle, and genteel," and it has been said by those closest to Ernest that he derived his quiet and pleasant sociability and his characteristic enthusiasm, whether for work or play, from her. The family life centered around her, and the old farm, where Ernest and his brothers and sisters spent many happy days, was her childhood home. She was devoted to her father, Dr. Stephen M. Dawson, whose influence is evident in Ernest's ultimate choice of a profession. Dr. Dawson, a graduate of Jefferson Medical College in the middle years of the century, after a colorful period in California in the gold-rush days, had returned to Tennessee for a long life of medical practice. During his boyhood years Ernest was said to be "a lot like Grandpa Dawson."

#### EDUCATION

Goodpasture's formal education began in the public schools of Nashville in 1893. Later he attended a locally well-known private school, Bowen's Preparatory School. In 1903 he matriculated at Vanderbilt University, from which he graduated in 1907. To add to his experience and to secure funds for expenses ahead, he engaged for a time in elementary academic teaching, at the Allegheny Collegiate Institute in Alderson, West Virginia, before pursuing his own professional studies. In 1908 he entered the School of Medicine of the Johns Hopkins University, and in 1912 graduated with the M.D. degree. The science of pathology attracted him strongly during his undergraduate course, and on its completion he went at once into the Department of Pathology of the school with the aid of a Rockefeller fellowship. He began his graduate work under the guid-

# ERNEST WILLIAM GOODPASTURE

ance of William H. Welch and George H. Whipple, who stimulated an already well-formed interest in research. His first scientific paper, on acute haemorrhagic pancreatitis, a field in which Johns Hopkins investigators contributed frequently, was published in collaboration with Whipple in 1913.

# EARLY RESEARCHES. THE JOHNS HOPKINS AND HARVARD UNIVERSITIES

Goodpasture remained at Hopkins for three years after his graduation, first as Fellow in Pathology, and then as Instructor in the Department. Under the original stimulus of Whipple he developed an interest in the relation of the liver to the metabolism of the blood protein fibrinogen, which led to contributions of importance in this field. He also studied with some success the relation of the aging process to cell overgrowth and the development of cancer. During his last year at Hopkins he served as resident pathologist in the Johns Hopkins Hospital.

In 1915, after this broad training and practical experience in general pathology at the Johns Hopkins Medical School and Hospital, he accepted an opportunity to pursue the subject in a new environment, among new associates, in the Department of Pathology at the Harvard Medical School. This department was headed by William T. Councilman, one of the leading pathologists of the time, who had been a pioneer, under Welch, in the formative years at Johns Hopkins, and was now in a position at Harvard comparable to that of Welch in Baltimore. Councilman trained many men who became leaders in American pathology, was instrumental in developing teaching hospitals for the Harvard Medical School, and in 1915 took over the directorship of the Department of Pathology of the new Peter Bent Brigham Hospital, which in succeeding years greatly extended the opportunities of the Harvard Medical School faculty for teaching and research.

From 1915 to 1918 Goodpasture served as Resident Pathologist in the Brigham Hospital and at the same time as Instructor in Pathology in the Harvard Medical School. His experience was typical of the best in American medicine at the time, and he steadily turned out scientific papers reflecting the suggestions of Councilman, his own developing interests, and chance findings of unusual interest at the autopsy table.

The outbreak of World War I temporarily changed the direction of his interests, as it did that of many young men in similar positions. On leave of absence from the Harvard Medical School he served as pathologist for a year in the laboratories of the Chelsea Naval Hospital near Boston, with the rank of Lieutenant, Junior Grade, U.S. Naval Reserve Force. In addition to the routine hospital diagnostic and service duties of his position he found time for research, and engaged, among other projects, in studies of a subject that attracted the attention of most other pathologists in the American armed forces at the time and in military forces abroad as well, viz., the highly fatal influenza pandemic of the war years. Goodpasture published papers on the pathology of influenzal pneumonia and the relation of hemolytic streptococci to the all too common postinfluenzal bronchopneumonia.

After the cessation of hostilities he returned to full-time service in the Department of Pathology at Harvard. He was promoted to the rank of Assistant Professor, and engaged vigorously in teaching and research, the latter on a variety of problems. His interests were not yet crystallized in any one field.

# TROPICAL MEDICINE IN THE PHILIPPINES

In 1921, after three years as Assistant Professor, he accepted an opportunity to gather experience in the pathology of tropical diseases. Interest in such diseases was active in Harvard, where a department of tropical medicine had recently been established, and Richard P. Strong, A. W. Sellards, and others, who had had fruitful experience in the Philippine Islands, were capitalizing on that experience with continuing programs of research. On a leave of absence from Harvard, Goodpasture took a position as Assistant Professor of Pathology under H. W. Wade in the College of Medicine and Surgery of the University of the Philippines in Manila, where his former associate Sellards was active in research. His responsibilities were increased almost immediately by a development, brought about by General Leonard Wood, Governor General of the Islands, for relief of the Islands' serious leprosy problem. Wade assumed the directorship of a large colony of patients with leprosy on the island of Culion, with abundant research opportunities, and Goodpasture succeeded him as head of the Department of Pathology at the University. Here he had a profitable experience in the study of tropical diseases, and turned out original research on Asiatic cholera, leprosy, and yaws.

# THE SINGER MEMORIAL RESEARCH LABORATORY IN PITTSBURGH. EARLY STUDIES ON VIRUSES

While in Manila Goodpasture received a cablegram offering him a new position that, as it turned out, proved formative in his scientific life. Before he left the United States for his year in the Philippines, he had visited the William H. Singer Memorial Research Laboratory in Pittsburgh at the invitation of its director, Samuel R. Haythorn. This was an institution for medical research within the framework of the Allegheny General Hospital of that city. Haythorn had been a student of Frank B. Mallory at the Harvard Medical School and Goodpasture also had come under the influence of Mallory during his Harvard period, a few years after Haythorn's tenure there. The two young pathologists had much in common, and Haythorn, who was resigning from the directorship of the Singer Laboratory to succeed Oskar Klotz as Professor of Pathology and Bacteriology in the University of Pittsburgh, hoped to induce Goodpasture to become his own successor at the Laboratory. Goodpasture had been impressed by the facilities and opportunity in the Laboratory in the course of his brief visit and retained a strong sense of its dedication to research. The possibility of pursuing a career of pure investigation in the laboratory of a large general hospital appealed to him deeply. He accepted the position with some provision in advance for a satisfactory operating budget, and returned to the United States in July 1922 to become director of the Singer Laboratory.

Here he went intensively into the work that became his lifelong vocation, the study of viruses affecting man and animals. In undertaking this course he was greatly stimulated by the bacteriologist and public health worker Oscar Teague, Vanderbilt graduate in arts and doctor of medicine from the University of Berlin, who had left a position in bacteriology at the College of Physicians and Surgeons of Columbia University for a summer of study in Europe in 1922, and had returned to the United States full of ideas on promising research. Teague, who had had abundant experience in tropical medicine, and who, while at Columbia, had begun studies of herpes and other virus diseases, joined the Singer staff shortly after his return from Europe; he and Goodpasture plunged at once into studies on the transmission of the virus of herpes febrilis, new understanding of which had developed through current investigations by a number of European observers. Goodpasture and Teague promptly confirmed the reports of the Vienna pathologist Benjamin Lipschütz on intranuclear inclusion bodies in the epithelial cells of rabbits in experimental herpetic keratitis. They found these bodies widely distributed in the cells following inoculation of rabbits with the contents of the vesicles of human herpes labialis, and came to look upon them as pathognomonic of this virus infection.

The next step was to determine the route of spread. Early neurological symptoms, following local superficial injections, which had been observed previously by European investigators, particularly Doerr, Schnabel, and Levaditi, gave significant leads on the routes of transmission of the virus. In analyzing the development of experimental herpetic encephalitis Goodpasture and Teague were able to define the pathways exactly in terms of afferent nerves. By timing their experiments properly following an infection of the cornea of the eye or another organ, they were able to observe, at an early period after infection, inflammatory changes and the specific inclusion bodies at and limited to points where afferent nerves entered from the site of the experimental herpetic lesions, wherever the latter might have been established. The virus was shown to travel along the axis cylinders through sensory, motor, and sympathetic nerves, and apparently by invasive proliferation, rather than passive transportation. It could also proceed secondarily by centrifugal routes along neural pathways with the production of characteristic vesicles of the disease elsewhere. Latency in ganglia and other structures, with the possibility of subsequent recrudescence, was apparent.

This precise demonstration of neural transmission of the herpetic viruses was the principal fruit of the Singer Laboratory tenure. In later life Goodpasture always gave Oscar Teague great credit, both for original stimulation and for a remarkably harmonious and effective collaboration. Tragically Teague died in a motor accident in 1923, at the height of their collaborative effort. Goodpasture went on to even greater achievements, but the abrupt termination of this productive relationship cut short a piece of teamwork that had been brilliant in its results.

VANDERBILT UNIVERSITY. VIRUS AND OTHER STUDIES

In 1924 Goodpasture accepted the position of Professor of

# **BIOGRAPHICAL MEMOIRS**

Pathology at the School of Medicine of Vanderbilt University, entering upon a development of far-reaching importance in American medical education and research. Vanderbilt was one of the schools selected for improvement in the reform of medical education initiated by the Carnegie Foundation for the Advancement of Teaching and set in motion by Abraham Flexner in a survey of American medical schools sponsored by the Foundation in 1909-1910. The strategic position of Vanderbilt in the South, in which there were few medical schools of first rank, made it a natural choice for this development. In 1919 the General Education Board made \$4,000,000 available for reorganization of the Vanderbilt school, which was staffed largely by practicing Nashville physicians serving part time. The group were loyal and devoted, but resources were meager and teaching and research were on a level far below that in progressive medical schools elsewhere in the country. In caliber, although now a department of Vanderbilt University, the School of Medicine was not much better than other medical schools of Tennessee but Flexner believed that it offered the most promise of any of them for the desired reform.

Flexner himself, who had become secretary of the General Education Board, was instrumental in securing endowment to make the new development of the Vanderbilt school possible. G. Canby Robinson of the Department of Medicine at Washington University in St. Louis, which was itself undergoing reformation under the stimulus of the Flexner report, was selected to administer the reorganization. Robinson, a graduate of the Johns Hopkins Medical School, with later experience in leading hospitals in Philadelphia prior to his St. Louis position, was well informed on the requirements of "modern standards" as envisioned by the General Education Board. He was also a strong advocate of the system of full-time tenure. Under his guidance an able full-time faculty was assembled, which

soon became distinguished in American medical education and research. Goodpasture was one of the first choices in the new drive for superiority. His abundant experience at Hopkins, Harvard, and elsewhere made him exceptionally well qualified. Now thirty-eight years old, he was recognized as a general pathologist, competent by original and subsequent training, an experienced and dedicated teacher, and a leader in research in the field of viruses. His new responsibilities included the position of pathologist of the Vanderbilt University Hospital as well as that of Professor of Pathology in the medical school. During the period of construction of new teaching and research facilities at the Vanderbilt school and its associated university hospital, he, like several others of the newly assembled faculty, was given an opportunity, through a special grant from the General Education Board, for study abroad, Goodpasture chose the University of Vienna for his studies, where he worked under Carl Rothberger, an investigator of the pathology of the circulatory system, and at the time Acting Director of the Institute for General and Experimental Pathology at the University of Vienna. Here he continued studies on the neural transmission of viruses that had been under way at the Singer Laboratory, and undertook new researches on the significance of the inclusion Negri bodies of rabies.

Goodpasture's acceptance of the position at Vanderbilt University, where he remained for more than thirty years, was a natural one personally as well as one determined by opportunity. He was devoted to the school and he felt most at home in the South. He had happy memories of boyhood and early youth in a delightful country environment, and the rural surroundings of Nashville promised a repetition of simple but much wanted pleasures. His later well-known reminiscences of Tennessee farm life showed his love for it. During his long period at Vanderbilt he received repeated and urgent invitations to

# **BIOGRAPHICAL MEMOIRS**

accept the headship of departments of pathology elsewhere, but all of these were declined in favor of continuance at Vanderbilt. Here he carried out the researches for which he is best known, on the pathogenesis of viral disease, the nature of viruses, and their propagation in the animal body and in laboratory culture. These studies, supplemented by investigations of the growth of bacteria, led to broad considerations of the whole subject of viral and bacterial parasitism.

His time was divided faithfully between teaching and research. He never succumbed to a desire that became common among ardent investigators in later years, to neglect teaching, with its onerous routine burdens, in favor of research and its exciting rewards in discovery and tangible benefits in prestige and promotion. He was recognized as an exceptionally able teacher of both undergraduate and graduate pupils, and many of his students have gone on to highly responsible positions in American academic pathology.

At the beginning of his Vanderbilt tenure, after an initial strenuous period of organization and departmental development, Goodpasture continued with the studies of herpetic encephalitis begun in Pittsburgh and the changes produced in neural cells by experimental herpetic infection. A new instrument for virus studies was soon found in the skin disease molluscum contagiosum, a milder process without visceral lesions; it proved to have certain advantages for the study of inclusion bodies, which are very numerous in its characteristic lesions. Early in the work it appeared to Goodpasture and his associates that the elementary bodies of Lipschütz represented the specific etiological agent.

Before long another disease was found to offer still greater advantages, the contagious epithelioma or fowl-pox of chickens. By now Goodpasture had in his hands a spread of viral diseases ranging from those operating so mildly on cells as to cause only

a slightly increased proliferation to others in which the viral agent stimulated cells to a violent and in some cases almost neoplastic reproductivity. He took some exception to the stress laid on filterability as a covering term for the "filterable viruses," feeling that the biologic changes they produced in animals were more fitting for classification purposes. Indeed in all of his work Goodpasture's primary outlook was that of a biologist rather than a specialist in one of its sub-disciplines.

What was now needed was some experimental means for rapid growth of viruses in the laboratory in pure culture. Two associates, C. Eugene Woodruff and his wife Alice Miles Woodruff, who had come from the Yale University School of Medicine to join the Vanderbilt staff in pathology, were set to work on the fowl-pox studies. The three of them made exact studies of the nature, infectivity, and purification of fowl-pox virus, and the character of the changes it induced on experimental infection of fowls. Their studies showed that the so-called Borrel body, described years before by A. Borrel in Paris, was the actual viral etiological agent of the disease. They were soon engaged in studies leading to its cultivation.

A medium for growing viruses, little appreciated up to that time, was at hand in the chorio-allantoic membrane of the chick embryo. Peyton Rous and James B. Murphy, at the Rockefeller Institute in New York, had used this successfully for the cultivation of the agent of the Rous avian sarcoma nearly twenty years previously. To Goodpasture and his associates the method offered promise of providing virus suspensions more nearly free from contaminating tissue elements than had been possible in the infective material from animal-to-animal passage. A number of variations of the method were tried, a principal intermediate objective being the attainment of bacteria-free infective viral particles. In this research ingenious and fruitful techniques were worked out by the Woodruffs. Techniques developed by other investigators for operating on the chick embryo were used, and before long it became apparent that ectodermal cells of the chorio-allantoic membrane of the chick and the embryonic chick skin itself could be infected with material from fluid obtained aseptically from experimentally induced fowl-pox lesions in chicks.

In 1931 a paper was published by Alice Woodruff and Goodpasture on the susceptibility of chick embryos to fowl-pox virus that proved the forerunner of a long series of fruitful applications of the method in the cultivation of viruses. The procedure was applied in that year to the cultivation of the viruses of vaccinia and herpes simplex. It was now quite evident that embryonic cells of the chick's chorio-allantoic membrane offered a remarkably favorable medium for the growth of viruses in general. This early start in Goodpasture's Vanderbilt tenure set the stage for a long stream of productive studies on viruses, the success of which has been reflected in fruitful research in many other hands, and practical application on a large scale in prophylactic immunization against virus diseases. The eminent virologist F. Macfarlane Burnet went so far as to say that "nearly all the later practical advances in the control of virus diseases in man and animals sprang from this single discovery" (Encyclopaedia Britannica, 1954, 9:237).

In succeeding years, using this technique, Goodpasture and his colleagues worked out the natural history of numerous viral diseases. A study of vaccinal infection of the chorio-allantoic membrane of the chick embryo brought to light new facts on the cellular inclusions in vaccinial lesions and pointed up similarities and differences among the Borrel bodies of fowl-pox, the Lipschütz bodies of molluscum contagiosum, and the Paschen corpuscles of vaccinia, i.e., the several virus infections to which Goodpasture and his students had devoted most attention. It was shown, too, that a chick embryo vaccine prepared from

cultivated vaccinia virus was effective in the same manner as calf virus in eliciting the immune mechanism brought about by the latter in the smallpox vaccination procedure. The method had the great advantage over calf virus of freedom from the hazard of bacterial contamination.

One of the most productive in the series of investigations was a study, in collaboration with Claud D. Johnson, of the etiology of mumps. This demonstrated that the infecting agent of this disease is a filterable cytotropic virus. The viral nature of the disease was proven in monkeys and human volunteers. The characteristic histopathology and immunological principles were well shown.

The chick membrane method proved adaptable to studies of rickettsiae, bacteria, fungi, and protozoa as well as viruses. Goodpasture and his associates used it successfully in studies of numerous species of bacteria, and found it particularly adaptable to culture of certain strains of streptococci, the typhoid bacillus, *Brucella abortus*, the avian tubercle bacillus, the meningococcus, the microorganism of pertussis, and the Donovan body.

In later studies Goodpasture and his associates cultivated human and chicken skin on the chorio-allantois of chick embryos, and with this facility at hand were able to make a novel study of experimental skin infections. They soon proved that skin grafts from man and chickens on chick membranes were susceptible to infection with several of the viruses affecting skin naturally. They showed also that the epithelial cells of the skin of chickens with acquired immunity to fowl-pox, which were resistant to skin infection with the virus as long as they remained in the intact host, lost their immune state when grafted on chick embryo membranes, but regained it when regrafted in immune chickens, a result indicating the important role of humoral factors in the immune process in skin infections. This series of ex-

# **BIOGRAPHICAL MEMOIRS**

periments demonstrated two instances in which human tissue grafted on chick chorio-allantois was susceptible to infection with viruses to which the chorio-allantois itself appeared to be nonsusceptible. Similarly, grafting of human fetal membranes on the chorio-allantois of chick embryos enabled them to open the road for precise experimental studies of the pathogenesis of naturally occurring intra-uterine virus infections.

Goodpasture's associates in these formative years from 1925 to 1945 at Vanderbilt were a dedicated band. All testify to the cordiality of relations within the group. Goodpasture was a master in designing an experiment and not uncommonly left its detailed prosecution to one of his gifted colleagues. Out of many who took some part in the studies, in addition to those mentioned above, note should be made particularly of the collaboration of W. A. DeMonbreun, G. J. Buddingh, Katherine Anderson, James R. Dawson, Alice Polk, and Mae Gallawan, who were co-workers in some of the most crucial studies.

Out of the wealth of material assembled from years of experimenting at Vanderbilt with viruses, bacteria, and other infecting agents in the animal body and artificial culture by the chick membrane technique, Goodpasture steadily accumulated facts bearing on the major phenomena of animal parasitism. Channels of entry and travel in natural and induced infections were defined, and a wide variety of parasitic relationships between cells and multiplying bacteria, as well as viruses, was recognized. Studies of lesions caused by the typhoid bacillus and numerous investigations by Goodpasture and his associates of B. tularense, the plague bacillus, the meningococcus, and other bacteria, as well as a series of viruses, confirmed old distinctions long in his mind among (1) extracellular parasites, proliferating freely in the blood and tissue fluids, (2) facultative epi- or intracellular parasites, and (3) obligate intracellular parasites, the last including the filterable viruses, the bacterialike rickettsiae, certain bacteria, and many protozoa. In time the completed individual researches had broad implications for understanding the complex relations of susceptibility and resistance to disease.

# SPECIAL HONORS

Goodpasture's talents were not limited to the acquisition of new knowledge. He was a gifted classroom teacher and lecturer, noted for the clarity of his exposition and the impressive way in which he correlated his facts. Beginning with a DeLamar Lecture at the Johns Hopkins University and a Harvey Lecture before the New York Academy of Medicine in 1929, the list of his most significant public addresses in the virus field includes a Ludvig Hektoen Lecture in Chicago (1937), a Leo Loeb Lecture at Washington University, St. Louis (1939), a Shattuck Lecture before the Massachusetts Medical Society (1940), an Alvarenga Prize Lecture before the College of Physicians of Philadelphia (1941), a Fiftieth Anniversary Lecture at the University of Chicago (1941), a Vanderbilt Lecture on poliomyelitis at the Vanderbilt School of Medicine (1941), a John Phillips Memorial Lecture of the American College of Physicians (1948), a Howard Taylor Ricketts Lecture at the University of Chicago (1955), and the Stonebrunner Lectures at the Medical College of Virginia (1956). Many other more or less related lectureships filled out a long list of public presentations. Substantial awards accompanied several of these.

Honors in addition included the Achievement Medal of the Southern Medical Association (1937), the Kober Medal of the Association of American Physicians (1944), the Sedgwick Medal of the American Public Health Association (1944), the John Scott Medal of the City of Philadelphia (1945), the Passano Foundation Award (1946), the John Phillips Award of the American College of Physicians (1948), the Howard Taylor Ricketts Award of the University of Chicago (1955), the Gold-Headed Cane of the American Association of Pathologists and Bacteriologists (1958), and the Jessie Stevenson Kovalenko Medal of the National Academy of Sciences (1958). He was given honorary degrees by Yale University (M.S., 1939), the University of Chicago (D.Sc., 1941), Washington University (D.Sc., 1950), and Tulane University (L.L.D., 1957).

He took an active part all his life in professional societies concerned with his fields of interest. He was a member of the American Association of Pathologists and Bacteriologists for forty-five years and its president in 1948-1949. He belonged to the American Society for Experimental Pathology for thirtyseven years and was its president in 1939-1940. As chairman of the medical section of the American Association for the Advancement of Science he was one of the Association's vice presidents in 1940. He became a member of the National Academy of Sciences in 1937, of the Association of American Physicians in 1938, and of the American Philosophical Society in 1943. He belonged to numerous other national and local medical societies, and was a member of several state and municipal academies of science and medicine.

# ADMINISTRATIVE AND OTHER RESPONSIBILITIES

In Goodpasture's later years at Vanderbilt, the exigencies of time and circumstance forced him into administrative work. He had little love for this, in comparison with his feeling for teaching and research, but his outstanding position on the Vanderbilt faculty and his own strong sense of loyalty to the school made it inevitable that he would accept the deanship at a critical time. The war years of 1942-1945, and the period of reorganization of medical schools after the war, were a time of great strain at Vanderbilt, as in other medical schools. The requirements of military service had disrupted the faculty, medical

school classes were accelerated to provide medical officers, and operational costs in school and hospital rose sharply. Goodpasture served as Associate Dean, with W. S. Leathers, from 1942 to 1945 and as Dean from 1945 to 1950. There was urgent need for refilling faculty ranks, and Goodpasture's prestige was effective in this purpose. It was an unselfish labor with little obvious reward for one with Goodpasture's taste and talent for research, but one in which he felt a moral responsibility in the light of his long identification with the medical school.

During the war and early postwar years Goodpasture held two posts of great significance in relation to medical aspects of the conflict. The first of these was membership on the original Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, established in January 1941 by the Secretary of War to serve the Army, the military forces generally, and civilian safety indirectly, by investigating outbreaks of infectious disease, controlling them, and conducting research upon them. Goodpasture served throughout the war. His competence as an original investigator of viruses made him singularly valuable in solving the military problems of viral hepatitis, influenzal pneumonia, measles, and mumps. His wisdom and forceful expression of judgment added greatly to the influential position of the Board.

At the end of the war his services were in demand in the solution of problems stemming from the radiation damage caused by the atomic bombs dropped by American forces in Japan. Goodpasture was a member of the Board of Directors of the Institute for Nuclear Studies at Oak Ridge, Tennessee, from 1946 to 1952, and was one of the original members of the Advisory Committee on Biology and Medicine of the Atomic Energy Commission. He grasped the essential needs of the Commission immediately, and, as a pathologist with fundamental understanding of the background of the medical problems involved, helped establish a sound program of research. At the solicitation of a later chairman of the Committee, Shields Warren, he went to Japan in 1950 to aid in outlining a productive program for the associated Atomic Bomb Casualty Commission, which, under arrangements through the National Research Council, was to conduct a continuing series of studies on radiation damage in cooperation with Japanese scientists. Goodpasture's warm personal friendships did much to cement working relations among all the investigators concerned.

These were by no means the only positions Goodpasture held that were important for the military effort. He was a member of several National Research Council groups concerned with that effort. At this period, too, he served two terms as a member of the Board of Scientific Directors of the International Health Division of the Rockefeller Foundation, which was engaged then as always in far-reaching enterprises of international welfare.

# ARMED FORCES INSTITUTE OF PATHOLOGY

In 1955, after more than thirty years at Vanderbilt, Goodpasture reached the age of retirement. But his lasting interest in research and widely known capabilities, both as scientific investigator and as administrator in medical education and research, made it inevitable that he would not stop long for a quieter life.

He was invited to assume what was to become one of this country's principal posts in his field, the scientific directorship of the Armed Forces Institute of Pathology. This unique institution, the lineal descendant of the Army Medical Museum established during the Civil War, has been called "the postgraduate school of pathology for the United States." At the time of Goodpasture's retirement from Vanderbilt, it was beginning a period of unprecedented expansion, following upon the opening of a new building designed and equipped for comprehensive mod-

ern and advanced research and staffed by a group of competent and devoted younger army officers well trained in pathology and eager for new opportunity.

During the formative years of the Armed Forces Institute of Pathology the necessary administrative reorganization was established, with a main department of pathology, the old but still well-kept Museum, an important medical illustration department, and a unique and valuable American Registry of Pathology, which had been developed in cooperation with the Division of Medical Sciences of the National Research Council. What was needed for maximum development of the Institute's chief responsibility, investigation in pathology as a major science, was a scientific director of national prestige in research, who could promote the professional aspects of the Institute's program without being smothered by the administrative detail of the Institute as a whole.

For this position, Ernest Goodpasture, just retiring from Vanderbilt University, was eminently qualified. He and Mrs. Goodpasture moved to Washington and there, under his leadership, the Institute underwent a great development, with a huge output of research, in which civilian pathologists throughout the country, on short- or long-time assignment, contributed heavily. As new fields opened up in any branch, e.g., aviation pathology, a corresponding department was established in the Institute. Goodpasture's role was necessarily that of stimulating and coordinating this large effort. There was much less time than previously for personal laboratory research. His own papers during this period were few. They show, however, a trend in his thinking toward a more comprehensive understanding of neoplastic disease.

In his long experience with viruses, particularly that of fowlpox, he had observed intense viral stimulation of cellular growth, but nothing that he was willing to call neoplastic. Later investigations, however, with a mutant of a field strain of the fowl-pox virus, disclosed a "greatly increased potency for stimulating certain cells to proliferate." He was able to produce these mutants by passage of virus through animal tissues other than their natural habitat. The resultant viruses were capable of inducing intense proliferation in epithelial cells of internal organs, e.g., those of the kidney, in which a vigorous local adenomatous hyperplasia was set up. This growth, superficially at least, simulated a neoplasm. The experience lent support to the concept that viruses can act as provocative cancerogenic agents, without remaining as essential components of a continuing cancerous growth. Goodpasture refused to go further, however, than to call these proliferations "viral hyperplasias."

# LATE YEARS. RETURN TO VANDERBILT

In 1959, when he had reached the age of seventy-three, and the scientific program of the Army Institute of Pathology was well established, Goodpasture resigned to assume posts of less strenuous physical requirements and opportunity for more leisurely research. He accepted an invitation first to spend the winter months of 1959-1960 as Associate in Pathology at the University of Mississippi Medical Center. Here he continued studies of certain pox viruses and the cytoplasmic and nuclear inclusions characterizing the lesions they induced. His last paper, representing joint labor with his wife Katherine Anderson Goodpasture, and published after his death, had to do with an avian pox virus, isolated from a junco, which appeared to offer possibilities for further study of the reaction of host cells to the pox viruses.

Goodpasture returned to Nashville in the spring of 1960, after some months in Mississippi, to live quietly as Emeritus Professor of Pathology at Vanderbilt University, the institution he had served so long, so faithfully, and so well. His final retirement, however, was not to last long. He died suddenly in September 1960 of coronary artery occlusion while engaged in moderate physical effort.

# PERSONAL RELATIONS AND CHARACTER

Although he spent highly productive years elsewhere, Goodpasture best loved the region of his birth, and it was truly his lifelong home. He was twice married. His first wife was Sarah Marsh Catlett of Clarksville, Tennessee, the town where he grew up. She died in 1940. In 1945 he married Katherine Anderson, with whom he was associated in some of his most productive research. She has completed studies on which they were engaged at the time of his death. He left one daughter, by his first marriage, Sarah Goodpasture (Mrs. Joseph A. Little), who married a physician, now a member of the faculty of the Vanderbilt medical school.

Goodpasture's range of association with colleagues and friends was very wide. Personally he was unostentatious, reserved, good-humored, and quietly friendly. Outside of his home probably no one knew him as well as his students, assistants, and close faculty associates. These testify uniformly to his modesty as a leader, and to a devotion to scientific research characterized by directness and simplicity in his approach to problems, originality in thinking, independence in judgment, and a generous confidence in the capacities of his associates.

For a few years after he left his active professorship at Vanderbilt University he was a member of its Board of Trust. On his retirement from this position he was asked to leave some expression of advice with the trustees and administrative officers. He replied with an emphasis on the ideals and unselfishness that should characterize a university and its faculty. He stressed freedom from the restrictions of regimentation as a university ideal and the preservation of an environment that steadily supported the simple search for knowledge and truth. These ideals, in his view, transcended all local interests. In his own course they had been his guiding principles.

# ACKNOWLEDGMENTS

In the preparation of this account of Dr. Goodpasture's life I have been helped greatly by his family and his former associates, students, and successors. I am particularly indebted to the following: Stanhope Bayne-Jones, formerly Technical Director of Research in the Office of the Surgeon General of the United States Army; James R. Dawson, Professor of Pathology at the University of Minnesota; Robert C. Grauer, Director and Head of the Department of Research Endocrinology and Metabolism at the Singer Memorial Research Laboratory of the Allegheny General Hospital, Pittsburgh; John L. Shapiro, Professor of Pathology, Vanderbilt University; Robert E. Stowell, Scientific Director of the Armed Forces Institute of Pathology, Washington; H. W. Wade, Emeritus Pathologist of the Culion Sanitarium, Palawan, the Philippines; Shields Warren, formerly Director of the Division of Biology and Medicine of the U.S. Atomic Energy Commission; George H. Whipple, Emeritus Professor of Pathology and former Dean, University of Rochester School of Medicine and Dentistry; and C. Eugene Woodruff, Pathologist and Director of Laboratories, Maybury Sanatorium, Northville, Michigan.

### BIBLIOGRAPHY

#### KEY TO ABBREVIATIONS

Am. J. Diseases Children = American Journal of Diseases of Children

Am. J. Hyg. = American Journal of Hygiene

Am. J. Pathol. = American Journal of Pathology

Am. J. Physiol. = American Journal of Physiology

Am. J. Trop. Med. = American Journal of Tropical Medicine

Arch. Internal Med. = Archives of Internal Medicine

Arch. Pathol. = Archives of Pathology

- Bull. Johns Hopkins Hosp. = Bulletin of the Johns Hopkins Hospital
- J. Am. Med. Assoc. = Journal of the American Medical Association
- J. Exp. Med. = Journal of Experimental Medicine
- J. Lab. Clin. Med. = Journal of Laboratory and Clinical Medicine
- J. Med. Res. = Journal of Medical Research
- Philippine J. Sci. = The Philippine Journal of Science
- Proc. Soc. Exp. Biol. Med. = Proceedings of the Society for Experimental Biology and Medicine
- Southern Med. J. = Southern Medical Journal

#### 1913

With G. H. Whipple. Acute haemorrhagic pancreatitis. Surgery, Gynecology and Obstetrics, 17:541-47.

- Fibrinogen. II. The association of liver and intestine in rapid regeneration of fibrinogen. Am. J. Physiol., 33:70-85.
- Fibrinolysis in chronic hepatic insufficiency. Bull. Johns Hopkins Hosp., 25:1-17.

- With G. B. Wislocki. Old age in relation to cell-overgrowth and cancer. J. Med. Res., 33(3):455-73.
- Double primary abdominal pregnancy. J. Med. Res., 34(3):259-61.

Crystalline hyalin. J. Med. Res., 35(3):259-64.

- A contribution to the study of pancreas intoxication. J. Exp. Med., 25(2):277-83.
- An acid polychrome-methylene blue solution for routine and special staining. J. Am. Med. Assoc., 69:998.

#### 1918

- An anatomical study of senescence in dogs, with especial reference to the relation of cellular changes of age to tumors. J. Med. Res., 38(2):127-90.
- Observations on mitochondria of tumors. J. Med. Res., 38(2): 213-24.
- With Victor C. Jacobsen. Occlusion of the entire inferior vena cava by hypernephroma, with thrombosis of the hepatic vein and its branches. Arch. Internal Med., 22:86-95.

- With F. L. Burnett. The pathology of pneumonia accompanying influenza. United States Naval Medical Bulletin, 13(2):177-97.
- Bronchopneumonia due to hemolytic streptococci following influenza. J. Am. Med. Assoc., 72:724-25.
- A peroxidase reaction with sodium nitroprusside and benzidine in blood smears and tissues. J. Lab. Clin. Med., 4:442.
- The significance of certain pulmonary lesions in relation to the etiology of influenza. American Journal of Medical Sciences, 158 (6):863.

- With Fritz B. Talbot. Concerning the nature of "protozoan-like" cells in certain lesions of infancy. Am. J. Diseases Children, 21: 415-25.
- Myocardial necrosis in hyperthyroidism. J. Am. Med. Assoc., 76: 1545-51.
- The influence of thyroid products on the production of myocardial necrosis. J. Exp. Med., 34(4):407-23.

- With Andrew Watson Sellards and Walfrido de Leon. Investigations concerning yaws. Philippine J. Sci., 22(3):219-89.
- Histopathology of the intestine in cholera. Philippine J. Sci., 22(4):413-21.
- Complement fixation in treated and untreated leprosy. Philippine J. Sci., 22(4):425-37.
- A poisonous constituent in cholera stools. Philippine J. Sci., 22(4): 439-45.
- With Oscar Teague. The occurrence of intranuclear inclusion bodies in certain tissues of the rabbit inoculated directly with the virus of herpes labialis. Proc. Soc. Exp. Biol. Med., 20:400.
- With Oscar Teague. The transmission of the virus of herpes febrilis along sensory nerves with resulting unilateral lesions in the central nervous system in the rabbit. Proc. Soc. Exp. Biol. Med., 20: 545-47.
- With Oscar Teague. Experimental herpes zoster. J. Am. Med. Assoc., 81:377-78.
- With Oscar Teague. Experimental production of herpetic lesions in organs and tissues of the rabbit. J. Med. Res., 44(2):121-28.
- With Oscar Teague. Transmission of the virus of herpes febrilis along nerves in experimentally infected rabbits. J. Med. Res., 44(2):139-84.
- With Oscar Teague. Experimental herpes zoster. J. Med. Res., 44(2):185-200.
- With Robert H. McClellan. A method of demonstrating experimental gross lesions of the central nervous system. J. Med. Res., 44(2):201-6.

- Spontaneous encephalitis in rabbits. Journal of Infectious Diseases, 34(4):428-32.
- With Dorsey Brannan. The pathology of pneumonia caused by Bacillus influenza during an inter-epidemic period. Arch. Internal Med., 34:739-56.

- Intranuclear inclusions in experimental herpetic lesions of rabbits. Am. J. Pathol., 1(1):1-9.
- The axis-cylinders of peripheral nerves as portals of entry to the central nervous system for the virus of herpes simplex in experimentally infected rabbits. Am. J. Pathol., 1(1):11-28.
- The pathways of infection of the central nervous system in herpetic encephalitis of rabbits contracted by contact, with a comparative comment on medullary lesions in a case of human poliomyelitis. Am. J. Pathol., 1(1):29-46.
- Certain factors determining the incidence and severity of herpetic encephalitis in rabbits. Am. J. Pathol., 1(1):47-55.
- A study of rabies, with reference to a neural transmission of the virus in rabbits, and the structure and significance of Negri bodies. Am. J. Pathol., 1(6):547-82.

#### 1927

- With Howard King. A cytologic study of molluscum contagiosum. Am. J. Pathol., 3(4):385-94.
- Nuclear changes of ganglion cells in experimental herpetic encephalitis. Am. J. Pathol., 3(4):395-99.
- With J. D. Wilson. Yellow atrophy of the liver; acute, subacute and healed. Arch. Internal Med., 40:377-85.

### 1928

Virus diseases of fowls as exemplified by contagious epithelioma (fowl-pox) of chickens and pigeons. In: Filterable Viruses, ed.

by T. M. Rivers, pp. 235-70. Baltimore, The Williams and Wilkins Company.

The pathology of certain virus diseases. Southern Med. J., 21(7): 535-39.

The pathology of certain virus diseases. Science, 67(1746):591-93.

- With S. John House. The pathologic anatomy of tularemia in man. Am. J. Pathol., 4(3):213-26.
- With S. John House. Spontaneous arteriovenous aneurysm in the thorax. American Heart Journal, 3(6):682.

#### 1929

- Vanderbilt University School of Medicine Department of Pathology. In: Methods and Problems of Medical Education, Thirteenth Series, pp. 51-58. New York, The Rockefeller Foundation.
- Cellular inclusions and the etiology of virus diseases. Arch. Pathol., 7:114-32.
- Herpetic infection, with especial reference to involvement of the nervous system. Medicine, 8(2):223-43. DeLamar Lecture.
- With Alice M. Woodruff and C. Eugene Woodruff. Fowl-pox. II. The nature of the virus as indicated by further morphological data, and by experiments with certain chemicals. Am. J. Physiol., 90(2):560-61.
- Etiological problems in the study of filterable virus diseases. Harvey Lectures, 25:77-102, 1929-1930.
- With C. Eugene Woodruff. The infectivity of isolated inclusion bodies of fowl-pox. Am. J. Pathol., 5(1):1-9.

### 1930

- Cytotropismus und das Vordringen der Virusarten im Nervensystem. Zeitschrift für die gesamte Neurologie und Psychiatrie, 129: 600-16.
- With Alice M. Woodruff. The nature of fowl-pox virus as indicated by its reaction to treatment with potassium hydroxide and other chemicals. Am. J. Pathol., 6:699-711.
- With C. E. Woodruff. The relation of the virus of fowl-pox to the specific cellular inclusions of the disease. Am. J. Pathol., 6:713-20.

- With C. E. Woodruff. A comparison of the inclusion bodies of fowl-pox and molluscum contagiosum. Am. J. Pathol., 7(1): 1-7.
- With William A. DeMonbreun. Etiological studies of granuloma inguinale. Southern Med. J., 24(7):588-97.
- With W. A. DeMonbreun. Infection of monkeys with Donovan organisms by injections of tissue from human lesions of granuloma inguinale. Am. J. Trop. Med., 11(5):311-22.
- With Alice M. Woodruff. The susceptibility of the chorio-allantoic membrane of chick embryos to infection with the fowl-pox virus. Am. J. Pathol., 7(3):209-22.
- With Alice M. Woodruff and G. J. Buddingh. The cultivation of vaccine and other viruses in the chorio-allantoic membrane of chick embryos. Science, 74(1919):371-72.

### 1932

- With W. A. DeMonbreun. Infectious oral papillomatosis of dogs. Am. J. Pathol., 8(1):43-55.
- Yellow fever encephalitis of the monkey (Macacus rhesus). Am. J. Pathol., 8(2):137-50.
- With Alice M. Woodruff and G. J. Buddingh. Vaccinal infection of the chorio-allantoic membrane of the chick embryo. Am. J. Pathol., 8(3):271-81.
- The use of experimental procedures in teaching pathology. Southern Med. J., 25(9):991-95.

- Cytotrophic viruses, with references to filterable forms of bacteria and cancer. Am. J. Hyg., 17(1):154-67.
- Borreliotoses: Fowl-pox, molluscum contagiosum, variola-vaccinia. Science, 77(1987):119-21.
- Use of embryo chick in investigation of certain pathological problems. Southern Med. J., 26(5):418-20.
- With W. A. DeMonbreun. Further studies on the etiology of granuloma inguinale. Am. J. Trop. Med., 13(5):447-68.

A medical pageant. The Diplomate, 5(8):251-63.

With G. J. Buddingh. Human immunization with a dermal vaccine cultivated on the membranes of chick embryos. Science, 78(2030):484-85.

#### 1934

- With Claud D. Johnson. An investigation of the etiology of mumps. J. Exp. Med., 59(1):1-19.
- The pathogenesis of neurocytotropic virus diseases. In: The Problem of Mental Disorder, pp. 241-54. New York, McGraw-Hill Book Co., Inc.
- With W. A. DeMonbreun. An experimental investigation concerning the nature of contagious lymphosarcoma of dogs. American Journal of Cancer, 21(2):295-321.
- Cancer and viruses. Bulletin of the American Society for the Control of Cancer, 16:4-5.
- With G. J. Buddingh. Immunisation de l'homme par un vaccin dermique, cultivé sur les membranes de l'embryon de poulet. Bulletin de l'Office international d'hygiène publique, 26:1226-32.

#### 1935

- A review of human virus diseases. Transactions of the Kansas City Academy of Medicine, 1933-1935, pp. 119-35.
- With Claud D. Johnson. The etiology of mumps. Am. J. Hyg., 21(1):46-57.
- With G. John Buddingh. The preparation of antismallpox vaccine by culture of the virus in the chorio-allantoic membrane of chick embryos and its use in human immunization. Am. J. Hyg., 21 (2):319-60.

- Intracellular parasitism and the cytotropism of viruses. Southern Med. J., 29(3):297-303.
- With Claud D. Johnson. Experimental immunity to the virus of mumps in monkeys. Am. J. Hyg., 23(2):329-39.

- With C. D. Johnson. The histopathology of experimental mumps in the monkey, *Macacus rhesus*. Am. J. Pathol., 12(4):495-510.
- With G. J. Buddingh. The protective action of rabbit serum for vaccinia virus at high temperatures. Science, 84(2168):66-67.
- Immunity to virus diseases. American Journal of Public Health, 26:1163-67.
- With Leland M. Johnston. Acute encephalitis in a child with cerebellar lesions like those of louping ill in monkeys. Am. J. Diseases Children, 52:1415-23.

- Vaccinia. Proceedings of the Institute of Medicine of Chicago, No. 11, Volume 11, pp. 206-20. Thirteenth Ludvig Hektoen Lecture of the Frank Billings Foundation.
- With Katherine Anderson. The problem of infection as presented by bacterial invasion of the chorio-allantoic membrane of chick embryos. Am. J. Pathol., 13(2):149-74.
- Concerning the pathogenesis of typhoid fever. Am. J. Pathol., 13 (2):175-85.
- Comments on virus diseases and their control. Southern Med. J., 30(7):731-35.
- With Mae Gallavan. Infection of chick embryos with *H. pertussis* reproducing pulmonary lesions of whooping cough. Am. J. Pathol., 13(6):927-38.

### 1938

- With Alice Polk and G. J. Buddingh. An experimental study of complement and hemolytic amboceptor introduced into chick embryos. Am. J. Pathol., 14(1):71-86.
- Some uses of the chick embryo for the study of infection and immunity. Am. J. Hyg., 28(1):111-29.
- With Beverly Douglas and Katherine Anderson. A study of human skin grafted upon the chorio-allantois of chick embryos. J. Exp. Med., 68(6):891-904.

### 1939

With S. H. Auerbach, H. S. Swanson, and E. F. Cotter. Virus

pneumonia of infants secondary to epidemic infections. Am. J. Diseases Children, 57:997-1011.

- Virus infection of the chick embryo. Annals of Internal Medicine, 13(1):1-11.
- Virus and bacterial infection of the chick embryo (abstract and discussion). Arch. Pathol., 28:606-9.

### 1940

- Immunity to virus diseases; some theoretical and practical considerations. New England Journal of Medicine, 222:901-10.
- With Katherine Anderson. Immunity to fowl-pox studied by means of skin grafts on chorio-allantois of chick embryo. Arch. Pathol., 30:212-25.
- The developing egg as a culture medium. J. Lab. Clin. Med., 26 (1):242-49.

# 1941

- The cell-parasite relationship in bacterial and virus infection. Transactions and Studies of the College of Physicians, Philadelphia, 9(1):11-24.
- The pathology and pathogenesis of poliomyelitis. Symposium on Infantile Paralysis, pp. 85-125. Vanderbilt University.
- The pathology of poliomyelitis. J. Am. Med. Assoc., 117:273-75.
- With M. M. Cullom. Boeck's sarcoid; a case of bilateral tumor of the lacrimal gland. Archives of Ophthalmology, 26(1):57-60. (Old series, Vol. 83.)
- The pathology of virus disease. Journal of Pediatrics, 18(4):440-46.

### 1942

Virus infection of the mammalian fetus. Science, 95(2468):391-96.

With Katherine Anderson. Infection of newborn Syrian hamsters with the virus of mare abortion (Dimock and Edwards). Am. J. Pathol., 18(4):555-61.

With Katherine Anderson. Virus infection of human fetal mem-

branes grafted on the chorioallantois of chick embryos. Am. J. Pathol., 18(4):563-75.

# 1943

Herpes zoster. In: Cecil's Textbook of Medicine, 6th ed., pp. 37-40. Philadelphia, W. B. Saunders Company.

### 1944

The spirit of inquiry. Vanderbilt Alumnus, 29(3):5-8.

With Katherine Anderson. Infection of human skin, grafted on the chorioallantois of chick embryos, with the virus of herpes zoster. Am. J. Pathol., 20(3):447-55.

# 1945

- With Katherine Anderson and W. A. DeMonbreun. An etiologic consideration of Donovania granulomatis cultivated from granuloma inguinale (three cases) in embryonic yolk. J. Exp. Med., 81(1):25-40.
- With Katherine Anderson and W. A. DeMonbreun. Immunologic relationship of Donovania granulomatis to granuloma inguinale. J. Exp. Med., 81(1):41-50.
- With Katherine Anderson and W. A. DeMonbreun. An experimental investigation of the etiology and immunology of granuloma inguinale. American Journal of Syphilis, Gonorrhea and Venereal Diseases, 29(2):165-73.

#### 1946

Research and medical practice. Science, 104(2708):473-76.

#### 1948

The internal environment for infectious agents. Annals of Internal Medicine, 29(6):991-1002.

In memoriam, Cobb Pilcher (October 7, 1904–September 22, 1949). Nashville, Tennessee, Vanderbilt University.

#### 1950

 Some aspects of twentieth century research on infectious diseases. Washington University Medical Alumni Quarterly, 13(3):96-106.
The influence of William Henry Welch upon the development of pathology. Bull. Johns Hopkins Hosp., 87(2):3-11.

### 1952

- With Stewart H. Auerbach and Oscar Mims. Pulmonary fibrosis secondary to pneumonia. Am. J. Pathol., 28(1):69-87.
- Francis Gilman Blake (1887-1952). Year Book of the American Philosophical Society, pp. 302-7.

### 1955

Max Brodel and the role of the medical illustrator in modern medical education. Journal of the Association of Medical Illustrators, No. 7, pp. 39-43.

#### 1957

The pathology of viral neoplasia. Texas Reports on Biology and Medicine, 15(3):451-61.

#### 1958

Cytoplasmic inclusions resembling Guarnieri bodies, and other phenomena induced by mutants of the virus of fowl-pox. Am. J. Pathol., 35(2):213-31.

### 1960

The influence of Leo Loeb upon pathology in America. Read at

# **BIOGRAPHICAL MEMOIRS**

the Leo Loeb Memorial Service, Washington University, St. Louis, Missouri, January 24.

Leo Loeb, 1869-1959. Transactions of the Association of American Physicians, 73:19-23.

# 1961

Leo Loeb. September 21, 1869–December 28, 1959. National Academy of Sciences, *Biographical Memoirs*, 35:205-51.

# 1962

With Katherine Anderson. Isolation of a wild avian pox virus inducing both cytoplasmic and nuclear inclusions. Am. J. Pathol., 40:437-53.