THE FACULTY OF MEDICINE
Harvard University

John Richard Pappenheimer

John Richard Pappenheimer was the youngest of the three children born to Alwin Max Pappenheimer, Sr., distinguished pathologist of the College of Physicians and Surgeons at Columbia University and Beatrice (Leo) Pappenheimer. John R. Pappenheimer was granted his B.S. degree from Harvard College in 1936: he followed his sister Anne and his elder brother Alwin Max, Jr.. Anne (later Forbes), went on to become Clinical Professor in Medicine based at the Massachusetts General. Together with Fuller Albright, Nan (Anne) produced "classic endocrinology, which made the treatment of many diseases routine." Elder brother Alwin Max, Jr. was to become Professor of Biochemistry at the College.

John started serious academic research at the Marine Biological Laboratories at Woods Hole. F.J. W. Roughton recruited John to Sir Joseph Barcroft's Department of Physiology at Cambridge. While doing the Cambridge Natural Science Tripos, John worked on the thermodynamic efficiency of urine formation. This work required the development of spectrophotometric methods for determining oxygen saturation in flowing blood. When war came to Britain in 1939, John, at Clare College, teamed with Glen A. Millikan, of Trinity College, to develop an ear oximeter and oxygen equipment for military aircraft. Lord Adrian had asked Millikan, his tutee, to help the Royal Air Force develop a reliable breathing apparatus to prevent loss of consciousness during high altitude dog fights. The oximeter was integrated into the pilot's mask and was clamped to the ear: a major factor in eventual Allied air supremacy. John Pappenheimer received his Cambridge Ph.D. in 1940. Of this stage of his career Pappenheimer later wrote, "I was fortunate to take the Natural Science Tripos in full-time physiology. One lecture each day followed by reading, reading and more reading…But we came to know the classical literature of three languages, leading up to the then frontiers in almost all sectors of physiology. I have been everlastingly grateful for this period of intensive study. It provided a framework for subsequent research and teaching and made possible the enjoyment of continued reading in fields outside one's own narrow research interests."

In tribute to their dedicated efforts to science and medicine, deceased members of the Harvard Faculty of Medicine (those at the rank of full or emeritus professor) receive a review of their life and contributions with a complete reflection, ***a Memorial Minute****.*

From 1940 to 1942 John Pappenheimer worked in physiology at the College of Physicians and Surgeons of Columbia University. From 1942 to 1945 John resumed his work with Millikan not at Cambridge but at the University of Pennsylvania. In 1946, at the end of this critical World War II work on assessing human oxygenation in unpressurized combat aircraft, John was called back to Harvard.

In the Physiology Department of Eugene M. Landis, John Pappenheimer resumed his studies begun at Cambridge on edema formation. In John's own words, "the theory of restricted diffusion, molecular sieving and osmotic transients", soon followed, and with it the understanding that diffusion permeability differs from flow permeability, and their ratio is directly related to the aqueous channels through the membrane. By 1951 Pappenheimer and colleagues "Were able to characterize the passive permeability of muscle capillaries in terms of the molecular dimensions of permanent molecules, on the one hand, and the dimensions of aqueous channels through capillary walls, on the other." This general theory stands to this day. Pappenheimer was elected to the National Academy of Sciences in 1965 and call to the George Higginson Professorship followed.

Almost every day, John Pappenheimer bicycled from Fayerweather Street, across Brattle Street and along the Charles River to the Medical School. As a result, he was called upon to open the Paul Dudley White Bikeway along the Charles. This he did with aplomb followed by several hundred bicycling Cliffies. John Pappenheimer reckoned that cycling upright on his old fashioned bicycle, Cambridge-Clare 1940s style, he could pass all but the college crews destined for Henley or the Olympics. Traffic along Storrow Drive engaged Pappenheimer's interest. On arrival at the Medical School he would recount the amount of gasoline that had been squandered by the idling vehicles. A particular joy was the jamming of trucks under the bridges since this increased the diesel and gasoline score. From these calculations, Pappenheimer used to announce the mileage that a DC-3 could cover with the same amount of fuel. The fuel consumption of all types of World War II planes was known to him from his work with Millikan.

John Pappenheimer recalled that,"Half-way between the Cottage Farm Bridge and the Medical School there is a park and here a little path leads to Mason's Pond. The pond is surrounded by willow trees which hide completely the nearby buildings. On high pressure days, when deadlines seem impossible to meet…I dismount at Mason's Pond to spend a few sane moments watching the ducklings swim behind their mothers…"

On his return from the Medical School after a difficult day Pappenheimer was wont to say that it was nice to return to Brattle Street and relatively intellectual order. Late in John Pappenheimer's career he worked at the Concord Station of the University. John claimed that the steep uphill bicycle travail was worth every pedal. On the downhill bicycle ride he often carried surplus emu eggs to cook as sole dinner nutrient. Dogs were invited to dine at the Pappenheimers'. Sherry was served in the living room and an emu omelet in the kitchen. John cracked the top of the egg with one of his old rotary hand drills, the egg in a big bowl to stabilize it and the drill at the perfect point on the top of the huge green egg. After dinner the health of the emu was assured and its muscle physiology discussed.

John's recounting of his return to the roots of Emerson and Thoreau and to Harvard's Estabrook Woods was spiritually uplifting. Working next to the Concord site of the College (October 5, 1775-June 11, 1776) during the American Revolution made him suggest to everyone that they read the three volumes of George Otto Trevelyan's epic account. The decision of the President and Fellows to preserve the

Estabrook Woods in their Thoreauvian state in perpetuity pleased John Pappenheimer immensely.

John Pappenheimer's work on the measurement of oxygen tensions in urine and flowing blood during and after World War II led to refusal by the U.S. Patent Office to issue a patent to investigators from the University of California and the University of Copenhagen. Pappenheimer was said to be the prior inventor. After this judgment John Pappenheimer was urged to pick up the patents for oxygen and carbon dioxide electrodes which require the accurate measurement of 10-15 volts. "Gentlemen do not take out patents," he declared, at least not those that drive up the cost of patient care. Later, when at the urging of Harvard he was issued patents for *Sleep Promoting Factor* (1982), *Sleep Inducing Agents* (1987) and *Somnogenic Compositions and Methods of Use* (1987), he assigned them in their entirety to the President and Fellows of Harvard College.

In 2003 John Pappenheimer published in the *Journal of Physiology* that capillaries of jejunal villi can absorb nutrients at rates several times higher than capillaries in other tissues. His studies detected that increase of villus capillary blood flow and permeability-surface area product are essential components of absorptive mechanisms. This jejunal absorption is significantly impaired by general anaesthesia.

John R. Pappenheimer was Visiting Professor at Cambridge based at Churchill College, and in 1975-76 he held the Eastman Professorship, "to be filled… by senior American Scholars of the highest distinction" at Oxford. All three distinguished Pappenheimer siblings served Harvard with distinction and humanity. Their international friendships and the summoning of F.J. W. Roughton led to Roughton's help in the establishment of the blood gas laboratories at the Anaesthesia Laboratory of the Harvard Medical School at the Massachusetts General Hospital. Rarely if ever has any University been blessed with three such delightful and erudite siblings. John Pappenheimer was survived by his wife of fifty-eight years, Helena (Palmer) and their four children.

Respectfully submitted by:

John Hedley-Whyte, *Chairperson*
The Lord Grabiner of Aldwych in the City of Westminster
Morris J. Karnovsky
Sharon Bushnell Sears