

NATIONAL ACADEMY OF SCIENCES

ROBERT KHO-SENG LIM

1897—1969

A Biographical Memoir by
HORACE W. DAVENPORT

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Biographical Memoir

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Robert W. Lim.

ROBERT KHO-SENG LIM

October 15, 1897–July 8, 1969

BY HORACE W. DAVENPORT

ROBERT K. S. LIM lived two lives. In the first, he was a physiologist with research interests in the control of gastric secretion and the neurophysiology of pain. He established Western physiology in China while teaching at the Peking Union Medical College.

In his second life, Robert K. S. Lim organized medical relief corps and trained doctors, nurses and technicians to meet the needs of China at war. He supervised medical services on the field of battle from the Great Wall to the retreat with Stilwell through the Burmese jungle. He built hospitals and medical schools on Mainland China and on Taiwan, and after the war he rebuilt his country's medical education and medical research. He was "one of the great men of China,"* the abundantly decorated Lieutenant General in the Army and Surgeon General of the Republic of China.

In both lives, Robert K. S. Lim was the vivacious, generous, charming, energetic, athletic and artistic man who spoke with a Scottish burr and was universally known as Bobby.

Robert Lim's ancestors came to Singapore from Fukien Province in southwestern China. The surname means a small

*B. Tuchman, *Stilwell and the American Experience in China, 1911-45* (New York: Macmillan, 1970).

forest represented by two trees, and the present official transliteration of the character is Lin. Although the Lim family, like many from their province, retained the old spelling, R. K. S. Lim sometimes appears in the indexes of books about war in China and in library catalogs as R. K. S. Lin.

Robert Lim's father, Lim Boon Keng, did so well as a poor boy at the Raffles Institution in Singapore that he won the Queen's Scholarship to Edinburgh University where he graduated in medicine. He worked briefly with W. B. Hardy in Cambridge, and together they published a paper in the *Journal of Physiology** on the origin and function of leucocytes in the frog. On returning to Singapore, Lim Boon Keng practiced medicine, but he was also active in public affairs in China as well as in Singapore. He was a Legislative Councillor, and in 1911 he was appointed Medical Advisor to the Chinese Ministry of the Interior. The next year he became physician and confidential secretary to Sun Yat-sen. He represented his country at meetings in Paris and Rome, and in 1923, with the help of a millionaire friend, he established the University of Amoy. Lim Boon Keng married Margaret Tuan-Keng Wong, one of the first Chinese women to be educated in the United States, and they had four sons, the oldest being Robert Kho-seng. Lim Boon Keng died at the venerable age of eighty-eight in Singapore.

Bobby Lim was born in Singapore on October 15, 1897. His father sent Bobby to Scotland when he was eight years old. The boy was in the charge of his father's apothecary, who was also an itinerant lay preacher, and in moving from parish to parish, Bobby's education was more peripatetic than substantial. Later, Bobby attended Watson's School in Edinburgh where he prepared for the University. At the outbreak of the First World War, Lim volunteered and was assigned to

**Journal of Physiology*, 15(1894):361-74.

the Indian Army in France as a warrant officer. His job was to drill recruits, and the young sons of Maharajas who had joined the colors objected to being ordered around by a young "Chinaman." In 1916, Lim was allowed to return to Edinburgh for medical studies, and he received the M.B. and Ch.B. degrees in 1919.

In the Medical School of Edinburgh University, Lim quickly established himself as a protégé of Sir Edward Sharpey-Schafer, the Professor of Physiology, and as an undergraduate he worked in the Physiology Laboratory on problems suggested by Sharpey-Schafer. Immediately upon graduation, he was appointed Lecturer in Physiology with responsibility for teaching histology. The next year Lim presented the results of his research to earn the Ph.D.

In the tradition of British physiology, microscopic anatomy came within the purview of the Physiology Department, and Lim developed skill in histological techniques and observations. His first major publication was a study of the histology of tadpoles whose development had been accelerated by being fed thyroid. This paper is notable for Lim's drawings. Lim had considerable skill as a draughtsman, and he had transiently wanted to be an artist before his father persuaded him to try medicine first. He continued to illustrate his papers with delicate drawings. The best example is Lim's paper, published in 1922, * on the microscopic anatomy of the gastric mucosa. The paper is distinguished by its smooth style, by its thoroughness based on wide observation and meticulous attention to detail, and by its correlation of structure with function.

Lim carried the microscopic anatomy of the gastric mucosa almost as far as it could be carried until the advent of electronmicroscopy. In fact, he carried it a little further than

* *Quarterly Journal of Microscopical Science*, 66(1922):187-212.

the resolution possible in light microscopy warranted, for in papers published later from China he described how mitochondria dissociate during secretion into a free lipid which condenses to form the Golgi apparatus and a remainder which either catalyzes or enters into the secretion.

Lim described the structure of the stomach, because he was already studying its function. The results were reported in a flood of papers in 1923.

At this time research in gastrointestinal physiology was in the doldrums. In Russia, Pavlov had turned to the study of conditioned reflexes, and in the United States, Walter B. Cannon had stopped work on the mechanical factors of digestion when he discovered he had been burned by X-rays. Cannon's observation on the supposed relation between gastric motility and the sensation of hunger had been taken up, without any notable results, by A. J. Carlson, whose reputation rests more on his picturesque behavior than on his scientific accomplishments. Carlson's industrious pupil, Andrew C. Ivy, was just beginning his long career.

In 1902 William Bayliss and Ernest H. Starling had established the fact that a hormone from the upper intestinal mucosa, *secretin*, could stimulate pancreatic secretion, but no progress had been made in purifying the hormone or in delineating its role in the course of digestion. Eddins had shown, by methods very similar to those of Bayliss and Starling, that extracts of the gastric antral mucosa stimulate secretion of acid by the oxyntic mucosa, and he had postulated that his extracts contained a hormone which he called *gastrin*. Unfortunately for Eddins, the two subsequent discoveries—that crude tissue extracts always contain histamine and that histamine stimulates acid secretion—were generally interpreted to mean that Eddins had made a ludicrous mistake.

This conclusion, which was to trouble gastroenterology

for another fifty years, was not accepted by Robert Lim. He repeated Edkins's experiments with no significant improvement, and he found that extracts of the pyloric mucosa, but not extracts of other tissues, stimulate acid secretion. Recognizing that the crucial test of a gastric hormone would be demonstration of it in gastric venous blood, Lim unsuccessfully tried to find acid-stimulating properties in blood drawn from dogs digesting a meal.

Lim became interested in the properties of pyloric secretion. With his colleague, N. M. Dott, Lim prepared, in a two-stage operation, a pouch of the gastric antrum devoid of oxyntic mucosa. Dott probably contributed much of the surgical skill, for he published separately on operative techniques. The pouch was found to secrete a viscid, alkaline secretion containing a proteolytic enzyme active in acid but not in alkaline solution. A dog with such a pouch was ready for the next step: the demonstration that stimulation of the pouch causes acid secretion by the remote oxyntic mucosa, but Lim did not do the experiment.

In the autumn of 1922, Lim applied to the China Medical Board of New York for a fellowship to enable him to study in European and American universities. His application was immediately welcomed by Roger S. Greene, the Board's Secretary. Greene knew Lim Boon Keng by reputation, and the day before he received Lim's letter he had been told about Lim by the Chinese Minister to the United States. Greene asked Lim whether, if he received a fellowship, he would be willing to take a year's appointment at the Peking Union Medical College.

The Peking Union Medical College had been developed by the China Medical Board with an endowment from the Rockefeller Foundation. In 1915 the Board, with the advice of W. H. Welch and Simon Flexner, had bought the missionary-founded Union Medical College in Peking and had

begun to build a medical school along Western lines.* The aims of the school were “to give medical education comparable with that provided by the best medical schools in the United States and Europe, through . . .”† an undergraduate curriculum and through graduate training in research and practice. Emphasis was always on quality, and pressure from the Chinese government for quantity was firmly resisted. The stated goal of those responsible for the College was to have Western medical science taken over by the Chinese people so that it became part of their national life. The suggestion that Lim consider an appointment at P.U.M.C. was an example of the Board’s continued search for competent Orientals.

Lim replied that the chief object in his life was to return to China to teach physiology and to do research there as efficiently as it was being done in the West. However, he cautiously refused to commit himself completely to P.U.M.C. without assurances of an adequate salary and a senior appointment.

Lim received the fellowship, and he came to the United States in the autumn of 1924. Although the China Medical Board had suggested that Lim study in two departments, those of Joseph Erlanger in St. Louis and A. J. Carlson in Chicago, Lim worked only in the Department of Physiology of the University of Chicago. That laboratory was the only one in the country with a current reputation in gastrointestinal physiology. Most of the work was being done by a

*The administrative history of P.U.M.C. is fully described in M. E. Ferguson, *China Medical Board and Peking Union Medical College* (New York: China Medical Board of New York, Inc., 1970). The records of the China Medical Board and of P.U.M.C. are now in the Rockefeller Archive Center, North Tarrytown, New York. Copies of letters relating to Lim have been made available to me through the courtesy of the Center’s Director and Associate Director, J. W. Ernst and J. W. Hess. The educational and scientific program of P.U.M.C. is described in J. Z. Bowers, *Western Medicine in a Chinese Palace* (New York: The Josiah Macy, Jr. Foundation, 1972). Bowers is wrong in identifying Lim’s first wife as Sharpey-Schafer’s daughter.

†Ferguson, p. 44.

team under A. C. Ivy, and Lim was put to work as a member of the team. Research was on the control of gastrointestinal secretion and motility, and dogs with chronically prepared pouches and fistulas were used. In one study in which Lim participated, the entire stomach was separated from the esophagus and duodenum, and made into a pouch draining to the body surface. The vagus nerves had been cut, and cephalic stimuli could not affect the pouch through them. The pouch's secretion could be collected, and thereby the efficacy of stimuli could be determined. Because the distal end of the esophagus had been anastomosed to the proximal end of the duodenum, the dog could eat naturally. With such a preparation, Ivy, Lim and McCarthy found that mixed meals, meat extracts and milk stimulated gastric secretion after a latent period of one or more hours. Fats fed inhibited basal or continuous secretion.

This team, and indeed all such teams for many years, was dominated by Ivy; Lim, as a visiting fellow, cannot be held responsible for the conclusions of papers bearing his name. He can only be judged by the use to which he later put what he had learned in Chicago. The paper just cited lamely concluded that stimulation of gastric secretion by food in the intestine must result from some vascular response. Moreover, “. . . our work proves that Edkins' pyloric hormone theory is utterly inadequate; that there is either no hormone mechanism, or, if one, that the whole gastro-intestinal tract is involved.”* What Lim thought when he eventually saw this paper in print is unknown, but it seems unlikely that he, who had only recently published several papers of his own affirming the existence of gastrin, had abruptly changed his mind.

* A. C. Ivy, R. K. S. Lim, and J. E. McCarthy, "Contributions to the Physiology of Gastric Secretion. II. Intestinal Phase of Gastric Secretion," *Journal of Experimental Physiology*, 15(1925):55-68.

Having received a satisfactory appraisal of Lim from A. J. Carlson, a recommendation which said that Lim made an excellent impression even on those prejudiced against the Chinese, the China Medical Board recommended that Lim be made an Associate Professor in physiology at P.U.M.C. In the meantime, Lim's father had begun to organize the University of Amoy, and he asked his son to build a medical school from scratch. In contrast with the superb school, hospital, and staff being completed in Peking, Amoy had no buildings and no faculty, but young Lim could have at least the title of Professor. To get him for Peking, the P.U.M.C. made him a Visiting Professor with no increase in salary over that previously offered. In September of 1925 the trustees of the school made him Head of the Department of Physiology.

By the time Lim arrived in Peking in 1924, the buildings of P.U.M.C. had been completed. The preclinical and clinical departments, a hospital, and faculty residences occupied the site of a Prince's palace. The Prince's name of Wu sounded much like the Chinese word for oil, and P.U.M.C. was known to the Chinese as the Oil Prince's Palace. Lim occupied a fully equipped Physiology Department, and during his tenure from 1924 to 1938 he had a staff of seven professionals, five of them Oriental. The China Medical Board sent visiting professors to P.U.M.C., and the list is an honor roll of American medical science. In 1935 both Anton J. Carlson and Walter B. Cannon were Visiting Professors of Physiology.

Lim established a vigorous research program in collaboration with many colleagues and students. He founded the Chinese Physiological Society, and the Society began publication of the *Chinese Journal of Physiology*. Lim was managing editor, and he published many papers in the journal. He also organized a Peking branch of the Society for Experimental Biology and Medicine which gave him the opportunity of

publishing summaries of his work in a journal more easily accessible to Western physiologists.

By means of transplanted and perfused stomachs, Lim studied gastric metabolism and the control of secretion. His most important result was the demonstration that feeding olive oil inhibits secretion by a transplanted pouch of the stomach. In the process of preparation, the gastric tissue forming the pouch was totally separated from the donor dog, and it was therefore completely extrinsically denervated. The inhibitory influence of fat feeding must have been carried by the blood, and Lim showed that fat absorbed into the lymph was not responsible. Lim coined the word *enterogastrone* for the putative hormone, and he showed that it is probably different from the hormone cholecystokinin which had recently been identified by Ivy. Lim attempted to purify enterogastrone, but he succeeded no better than many after him. Today, it appears that the inhibitory property of enterogastrone is only one of the properties of a number of polypeptides extractable from the intestinal mucosa. Although the hormonal mechanism described by Lim indubitably exists, his name for it is being discarded.

Working with pupils and colleagues from other departments, Lim did three other substantial pieces of physiological research at P.U.M.C. He found a pressor center in the lateral parts of the floor of the IVth ventricle between the levels of the acoustic stria and the inferior fovea. Stimulation of the center electrically or by iontophoresis of acetylcholine elicits typical and complete sympathetic responses. The efferent pathway goes unilaterally down the ventrolateral columns of the spinal cord, and through it both sympathetic neurones and the adrenal medulla are excited. Stimulation of the central end of the cut sciatic nerve has its familiar pressor effects mediated by the center Lim described. In a thorough

comparative study, Lim demonstrated that a similar pressor response follows stimulation of corresponding parts of the medulla in fish, amphibians, reptiles, birds, and eight species of mammals.

Lim's efforts to identify circulating hormones released from the gastrointestinal mucosa made him a master of the techniques of cross circulation and *vivi*-perfusion. In *vivi*-perfusion, an organ removed from a donor animal, usually a dog, is perfused by way of the carotid arteries and jugular veins of another animal. The perfusing animal is frequently unanesthetized, its vessels being isolated under local anesthetic. Lim used this method to study humoral transmission in the central nervous system. In this case, the organ perfused was the severed head of a donor dog. Stimulation of the central end of the vagus nerves of the perfused head is followed by a small and brief fall in the blood pressure of the perfusing dog and then by a large and prolonged rise in its blood pressure. Lim showed, using standard pharmacological and physiological methods, that the response is mediated by acetylcholine liberated by the perfused head. The transient fall in blood pressure is the direct effect of acetylcholine on the cardiovascular system, and the rise is caused by epinephrine liberated from the adrenal medulla under the stimulus of acetylcholine.

Using the same *vivi*-perfused preparation, but one in which the life of acetylcholine was not prolonged by eserine, Lim found that when afferent fibers of the vagus nerve are stimulated there is also a pressor response, but one which is abolished by extirpation of the donor's pituitary gland. Furthermore, blood draining the perfused head also contains an oxytocic and an antidiuretic principle. Lim, returning to his histological methods, found that exhaustion of the reflex is correlated with disappearance of secretory granules from the posterior pituitary gland, and that the reflex returns when

the granules do. He believed that he had discovered a vago-posterior-pituitary reflex. Knowledge of this reflex seems to have died with Homer Smith, for in the 1970's renal physiologists interested in reflex control of antidiuresis do not refer to Lim's work.

In the 30's, Lim turned toward serving his country on a larger scale. He became President of the Chinese Medical Association and Chairman of the North China Council for Rural Reconstruction. Lim organized a training corps for reserve medical officers. As the Japanese attacks began, Lim founded the Chinese Red Cross Medical Relief Commission, and its field units first saw service when the Japanese moved against Shanghai. When fighting spread along the Great Wall, Lim had twelve medical units which treated over 20,000 casualties. He knew that China would require a vast number of persons at all levels of training, and he pressed upon P.U.M.C. the need for mass education of technicians and sanitarians. P.U.M.C., which conceived its mission to be the teaching of teachers, refused to change its standards, and Lim left it for good in 1938.

By 1940, the Chinese Red Cross, under Lim's direction, operated convoys, depots, and medical units. The units, now forty-nine in number, provided treatment and nursing services for the wounded; ambulance units, each with 120 stretcher bearers, brought the wounded, who otherwise would have been left on the field to die, into makeshift hospitals. Lim had by then inaugurated a school designed to train 200 men a month as hospital attendants and stretcher bearers. This and the similar schools he built in the next few years were intended to be the nuclei of future medical schools.

Lim built at Kweiyang the largest medical center in war-time China, and he was appointed Inspector General of the Medical Services in 1941. Following the defeat of the Chinese

armies in 1942, Lim accompanied General Joseph Stilwell in the retreat through Burma. He earned the friendship and admiration of Stilwell. When President Roosevelt ordered Stilwell to confer the Order of Merit upon Chiang Kai-shek, Stilwell said: "It will make me want to throw up."* Stilwell was allowed, as an anti-emetic, to pin the same decoration on Lim. In the many memoirs of the period, General Bobby Lim occasionally appears, distinguished amidst the surrounding chaos by his honesty, industry and accomplishments.

When the Nationalist Government was on the point of collapse on the Mainland, Lim was offered the Ministry of Health. After a debate with his staff, all men and women of great integrity and dedication, Lim refused the job. Seeing that Mainland China was untenable, Lim proposed that the medical units be moved to Taiwan and that the government follow. He was able to save equipment and supplies, and he diverted from Shanghai to Taiwan a ship sailing to China with supplies he had ordered. On Taiwan, Lim built the National Defense Medical College and ten hospitals throughout the island.

Lim regretted that he had lost touch with teaching and research, and after twelve years of fighting under desperate circumstances, he wanted to return to the academic life. He resigned as Surgeon General and Lieutenant General and came to the United States. He remained *persona grata* with the government on Taiwan,† and on cordial terms with General

*Tuchman, p. 378.

†The statement in Tuchman, *op. cit.*, that Lim was dismissed in 1943 as the result of political pressure is clearly wrong. A man of Lim's vigor was bound to get into scrapes with the government. The 1943 episode may have been a temporary one from which he was rescued, as he often was, by Chiang's deputy and Lim's immediate superior, Chen Cheng, who befriended the intellectuals of China. Although Chiang's and Chen's background and education were totally different from Lim's, they appreciated Lim's ability.

and Madame Chiang Kai-shek. He revisited the island several times to do research and to arrange for postgraduate training of Chinese physicians in this country. The year before his death, he spent six months on Taiwan, setting up a neurophysiological laboratory.

After working briefly in Chicago and Omaha, Lim was invited by Miles Laboratories of Elkhart, Indiana to join its research team. Miles had a proprietary interest in preparations of acetylsalicylic acid, and Lim worked on analgesia. Eventually he was made Senior Research Fellow, and then he did the work on the neurophysiology of pain for which he will probably be best remembered.

In his most important experiment, Lim carried his method of cross-circulation into neurophysiology. Using two dogs, a donor and a recipient, Lim arranged for the circulation of the spleen of the recipient dog to be supplied entirely by the donor dog. A catheter permitted close intra-arterial injections into the spleen. Nerves from the spleen of the recipient dog were intact, and in some instances Lim placed electrodes on the nerves so that afferent impulses could be recorded. Intra-arterial injection of a minute amount of bradykinin into the spleen had no effect upon the donor dog, but the recipient dog gave a brief affective response, that is, it howled, struggled, and bit.

Using this method, Lim found that the non-narcotic analgesic, aspirin, eliminated the affective response of the recipient dog when it was given to the donor dog in appropriate dose. Afferent impulses in the recipient dog's splenic nerve were suppressed. Given to the recipient dog in the same dose, aspirin had no effect. Aspirin, therefore, is an analgesic because it blocks the generation of impulses in the receptor endings of the afferent nerves mediating the sensation of pain. Narcotic analgesics, such as morphine, block centrally and not peripherally. Lim confirmed his distinction between

central and peripheral action by experiments on man in which he injected bradykinin intraperitoneally. Lim's last work was an attempt to discover by means of fluorescent microscopy the pain receptors that had absorbed acetylsalicylic acid.

Robert K. S. Lim was elected a Foreign Associate of the National Academy of Sciences in 1942, when he was deeply involved in his war work. The nomination lists as his qualifications his scientific accomplishments, his stimulation of physiological research in China and his promotion of Western medicine there. It also cites his services to China, then our ally, in organizing the Medical Relief Corps, in providing medical and surgical services for the Chinese armies and in establishing military medical training schools. The relative importance of the two different kinds of qualifications in securing his election cannot now be determined. When he became a United States citizen in 1955, he automatically became a regular member of the Academy.

In May of 1967, a brief period of dysphagia led to the discovery of squamous cell carcinoma in the mid-third of Lim's esophagus. He responded well to cobalt-60 therapy, and in early 1968 his colleagues in Taiwan found his esophagus to be almost normal. Later that year, repeated mechanical dilatation was necessary, and in April 1969 a gastrostomy was performed in Chicago. His wife and a physician took him to his son's home in Jamaica, and his daughter came from England. He had a few weeks in which he enjoyed the company of his family before he died on July 8, 1969.

Lim married Margaret Torrance in Scotland on July 10, 1920. They had two children, a daughter Effie (Mrs. O. Philip Edwards) and a son, James T. After his first wife's death, Lim married Tsing-Ying Tsang in Shanghai on July 2, 1946. She and the children survived him.

IN ADDITION to the staff of the Rockefeller Archives Center already identified, I thank Ms. Opal Gunter of Miles Laboratories, Inc., M. I. Grossman, S. C. Wang, and T-M Lin for supplying information. I am especially grateful to Tsing-Ying Lim (Mrs. R. K. S. Lim) for her many kindnesses.

HONORS AND DISTINCTIONS

DEGREES

- M.B., Ch.B., 1919, Edinburgh University
 Ph.D., 1920, Edinburgh University
 D.Sc., 1924, Edinburgh University
 D.Sc. (Hon. Causa), 1961, Hong Kong

PROFESSIONAL RECORD

- 1919–1923 Lecturer in Physiology, Edinburgh University
 1920 Goodsir Fellow, Edinburgh University
 1923–1924 Rockefeller Foundation Fellow, University of Chicago
 1924–1938 Professor and Head, Department of Physiology,
 Peking Union Medical College
 1939–1941 Director, Emergency Medical Service Training School
 1944–1947 Special Lecturer in Physiology, Columbia University
 1945 Organizing Director, Institute of Medicine, Academia
 Sinica
 1946–1949 Director, National Defense Medical Center, Republic
 of China
 1949–1950 Visiting Research Professor of Clinical Science, Uni-
 versity of Illinois, Chicago
 1950–1951 Professor and Head, Department of Physiology and
 Pharmacology, Creighton University
 1952–1967 Miles Laboratories, Inc., Elkhart, Indiana, Director,
 Medical Sciences Research, Senior Research Fellow
 1968–1969 Visiting Professor of Physiology, University of Cali-
 fornia, Los Angeles, and Senior Medical Investigator,
 Veterans Administration Center, Los Angeles

PROFESSIONAL AND HONORARY SOCIETIES

- British Physiological Society, 1919
 Fellow, Royal Society of Edinburgh, 1923
 American Physiological Society, 1923
 Sigma Xi, 1924
 Society for Experimental Biology and Medicine, 1925
 President, Chinese Physiological Society, 1927
 President, Chinese Medical Association, 1928–1930
 Honorary Member, Deutsche Akademie der Naturforscher, Halle,
 1932

- Corresponding Member, Royal Academy of Sciences, Bologna, 1932
- Member, Permanent Commission for Biological Standardization, League of Nations, 1935
- Counsellor, Academia Sinica, 1936
- Foreign Associate, National Academy of Sciences, Washington, 1942; Member, 1955
- Honorary Member, American Gastroenterological Association, 1946
- Honorary Fellow, American College of Surgeons, 1947
- Member, Permanent Committee of the International Congress of Physiology, 1947
- Honorary Member, Association of Military Surgeons of the United States, 1948
- American Society for Pharmacology and Experimental Therapeutics, 1952
- Society of Toxicology, 1963
- Fellow, American College of Clinical Pharmacology and Chemotherapy, 1964

MILITARY RECORD

- Warrant Officer, Indian Army, 1914–1916
- Lieutenant, RAMC, 1919
- Field Director, Chinese Red Cross Medical Relief Commission, North China, 1933
- Director, Chinese Red Cross Medical Relief Corps, 1937–1943
- Inspector General of Medical Service, Chinese Army, 1942, 1944
- Deputy Surgeon General, Chinese Army, 1944–1945
- Surgeon General and Lieutenant General, Chinese Army, 1945–1949

DECORATIONS

- Great Britain: 1914–1915 Star; General Service Medal, Victory Medal, 1918
- United States: Legion of Merit, Officer Grade, 1943; Medal of Freedom with Silver Palms, 1946
- Republic of China: Kan Ching Medal; Chung Ching Medal; Sheng Li Medal; Yun Hui Order, 1st Class; Victory Medal, 1945

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1920

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1923

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- With S. E. Ammon. The effect of portal and jugular injections of pyloric extracts on gastric secretion. Q. J. Exp. Physiol., 13:115-29.

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- With A. R. Matheson and W. Schlapp. Observations on the human gastro-duodenal secretions with special reference to the action of histamine. *Q. J. Exp. Physiol.*, 13:361-91.
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1924

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1925

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1927

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1928

- With T. G. Ni. The gas and sugar metabolism of the vivi-perfused stomach. *Chin. J. Physiol.*, 2:45-86.
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