



**George E. Boxer**

**1915–1968**

## OBITUARY

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It is ironic that occasionally an investigator involved in medical research succumbs to the very disease he is fighting. Such was the case with Dr. George E. Boxer, who died on March 14, 1968, at the age of 53 years. The shocking news was universally felt by those who knew him both as an extraordinary person and as a scientist.

His life and work were oriented to understanding and attempting to resolve pathologic processes. Born in Vienna, he received his M.D. degree from the University of Vienna in 1938, during which time he published two papers on amino acid and protein chemistry with Dr. Kapeller-Adler. In 1939 he served as an assistant in biochemistry at Cambridge, England. At Columbia University from 1941 to 1945, he received his Ph.D. degree in biochemistry in 1944 while associated with Dr. DeWitt Stetten, Jr. During this period his interest in intermediary metabolism was reflected by papers published on lipid and carbohydrate metabolism and their interrelationships. The methodology for the isolation of glycogen described at that time is still in use.

Dr. Boxer joined the research staff at Merck & Co., Inc., in 1945 and worked on the chemistry and biochemistry of antibiotics and vitamins, particularly vitamin B<sub>12</sub>. These were fruitful years in his career as evidenced by the many publications stemming from this period.

When he became director of the cancer research group in the Merck Institute for Therapeutic Research in 1957, his interest returned to the problem of carbohydrate metabolism, principally to the indisputable fact that tumor cells carry out aerobic glycolysis. He began studying the complete glycolytic pathway in normal and malignant tumors in experimental animals. From this work, which was carried out both directly under him and with his colleagues, stemmed the idea summarized in a paper "Pathways of Intracellular Hydrogen Transport" published in *Science* (134: 1495-1501, 1961) that the malignant cell produced lactic acid from glucose primarily because it had no other way of oxidizing the NADH formed during an earlier step in glycolysis.

Dr. Boxer also felt rather strongly that findings in experimental animal systems were pertinent only if they were applicable to human malignancy, and he demonstrated that the findings in the glycolytic area could be extrapolated to human tissues. During this study, methodology both in assay of the enzymes and in handling surgical material from human sources

was developed, and the results and problems of using such material were delineated in the series *Methods in Cancer Research* (Vol. 2, pp. 581-661, Academic Press, 1967).

Even his interest in the well-trodden path of nucleic acid metabolism was directed toward the carbohydrate moiety, and he and his group investigated the origins of the deoxyribose moiety of DNA. In addition, the findings that the naturally occurring compound cordycepin was 3'-deoxyadenosine allowed the chemical group associated with him to synthesize a series of interesting variations in the carbohydrate moiety of the nucleoside.

He had no hesitation in embracing new and unusual findings in the area of cancer research if they had validity. The observation that spores of nonpathogenic bacteria germinate in and lyse tumors was investigated, and it was shown that the necrotic, anaerobic areas were lysed but that, unfortunately, areas of vigorous growth remained.

His depth of knowledge, his innate leadership ability, his vigor, enthusiasm, and personal warmth not only inspired those working with him, but also earned for him both the respect and affection of those in the wider scientific community. He was appointed to the Drug Evaluation Panel of the CCNSC, National Cancer Institute. Until his untimely death, he was an Associate Editor of the journal *CANCER RESEARCH*, to which he generously gave his time and efforts despite other demanding commitments. Merck & Co., Inc. also recognized his scientific and personal qualities by appointing him Executive Director of the Merck Institute in 1966.

Although he was uncommonly aware of the progression of the disease with which he was afflicted, he maintained his intense interest in the research of his group and in the wider aspects of biochemistry and cancer research. His dedication and courage were and will be an inspiration to all those who had the privilege of knowing him.

As a lasting reminder of the high esteem which he acquired during his distinguished career, Rutgers University Medical School has established a memorial fund in his name. Supported by many of his professional colleagues and friends and by matching funds from The Merck Company Foundation, the George Boxer Memorial Fund will be devoted to the advancement of biomedical research in the late scientist's honor.

George Boxer is survived by his wife, Lily, and by two sons, Steven and Peter. Sincerest personal regrets are extended to them at this time of great personal loss.