George Emil Palade

Ia#i, Romania, 19 Nov. 1912 - Ia#i, Romania, 8 Oct. 2008

Nomination 2 Dec. 1975

Field Cell Biology

Title Professor of Medicine in Residence, Emeritus, and Dean for Scientific Affairs, Emeritus, University of California, San Diego

Commemoration – George Emil Palade was born on November 19, 1912, in Jassy, Romania. He studied medicine at the University of Bucharest, graduating in 1940. Already as a student, he became interested in microscopic anatomy and its relation to function and decided early to relinquish clinical medicine for research. After serving in the Romanian army during the Second World War, he moved to the United States in 1946, soon joining the laboratory of Albert Claude at the Rockefeller Institute for Medical Research, where, after Claude's return to Belgium in 1949, he developed an independent laboratory, first in association with Keith Porter and later, after Porter's departure in 1961, on his own. He stayed at what had become the Rockefeller University until

1973, when he moved to Yale University. His later years were spent at the University of California, San Diego, where he acted as Dean of Scientific Affairs. He passed away on 7 October 2008, after suffering major health problems, including macular degeneration leading to total blindness, a particularly painful ordeal for a man who had used his eyes all his life in a particularly creative way. He leaves two children from his first marriage with Irina Malaxa: Georgia Palade Van Duzen and Philip Palade. He married Marilyn G. Farquhar, a cell biologist, in 1971, after the death of his first wife. Palade's scientific work followed in the wake of Albert Claude's pioneering achievements, using the two new major technical approaches developed by his mentor for the coordinated investigation of cellular structure and function: electron microscopy and cell fractionation. With the help of these tools, to which he provided a number of important improvements, he accomplished some of the major advances made by cell biology after the last war. From the structural point of view, he described the fine structure of mitochondria, including the cristae, to which he gave their name; the dense granules, first called Palade granules and now known as ribosomes, that line the membranes of what his colleague Porter had named the endoplasmic reticulum; as well as detailed features of the Golgi complex, of endothelial cells and many other structures. In the functional domain, in collaboration with the late Philip Siekevitz and with an international team of first-class coworkers, he unravelled the fundamental pathway whereby secretory proteins are synthesized by membranebound ribosomes and simultaneously delivered into the cisternae of the rough endoplasmic reticulum, further processed and channelled, by way of smooth parts of this structure, toward the Golgi complex, where they are packaged into secretion granules, to be finally discharged outside the cells by exocytosis. Elected to the Pontifical Academy of Sciences on 2 December 1975, George Palade was also a member, among others, of the National Academy of Sciences, USA, and of the Royal Society. His achievements have been recognized by several important awards, including the Lasker Award (1966), a Gairdner Special Award (1967), the Louisa Gross Horwitz Prize (1970), and the Nobel Prize in Physiology or Medicine (1974).

Christian de Duve

Most important awards, prizes and academies

Awards: Lasker Award (1966); Gairdner Special Award (1967); Nobel Prize in Physiology or Medicine (1974); Louisa Gross Horwitz Prize (1970). *Academies*: National Academy of Sciences, USA; Foreign Member, American Academy of Arts and Sciences; Royal Society; Foreign Member, Leopoldina Academy, Germany; Foreign Member, Romanian Academy; Pontifical Academy of Sciences.

Summary of scientific research

His work in cell biology started with a survey at the electron microscope level of the organization of eukaryotic cells and led to the discovery of a number of important structures (or structural details) in mitochondria, endoplasmic reticulum, ribosomes and polysomes. The salient achievement of that period was the discovery of ribosomes. From electron microscopy he moved to cell fractionation (controlled by microscopy) to help define in chemical and functional terms many subcellular components such as ribosomes, polysomes, mitochondria, nuclei and cell membranes. In the process he contributed to the improvement of preparatory procedures in electron microscopy as well as in cell fractionation. From this level of inquiry, he proceeded to the analysis of a complex process, namely, the processing of secretory protein in grandular cells, using an integrated approach based on electron microscopy, cell fractionation and autoradiology. This was, in fact, the work that in his judgement justified the Nobel Prize he received. The results defined kinetically the pathway followed by secretory protein in eukaryotic cells and became the basis for further work in his and many other laboratories. In the next phase of my research activities he concentrated on membrane biogenesis defining again the conditions under which membranes, especially membrane proteins, are synthesized and processed by eukaryotic cells. Finally, in a separate type of investigation, he worked on the structure and function of the vascular endothelia, concentrating primarily on structures involved in exchanges between the blood plasma and interstitial fluid. This project had obvious implications for normal physiology and important medical problems related to cardiovascular diseases.

Main publications

Palade G. (1975) Intracellular aspects of the process of protein synthesis. *Science* 189(4200):347-58; Howell KE, Palade GE. (1982) Hepatic Golgi fractions resolved into membrane and content subfractions. *J Cell Biol* 92(3):822-32; Palade GE. (1983) Membrane biogenesis: an overview. *Methods Enzymol* 96:XXIX-LV; Sztul ES, Howell KE, Palade GE. (1985) Biogenesis of the polymeric IgA receptor in rat hepatocytes. II. Localization of its intracellular forms by cell fractionation studies. *J Cell Biol* 100(4):1255-61; Sztul E, Kaplin A, Saucan L, Palade G. (1991) Protein traffic between distinct plasma membrane domains: isolation and characterization of vesicular carriers involved in transcytosis. *Cell* 64(1):81-89; Jacobson BS, Schnitzer JE, McCaffery M, Palade GE. (1992) Isolation and partial characterization of the luminal plasmalemma of microvascular endothelium from rat lungs. *Eur J Cell Biol* 58(2):296-306; Saucan L, Palade GE. (1994) Membrane and secretory proteins are transported from the Golgi complex to the sinusoidal plasmalemma of hepatocytes by distinct vesicular carriers. *J Cell Biol* 125(4):733-41; Palade GE. (1995) Protein kinesis: the dynamics of protein trafficking and stability. *Cold Spring Harb Symp Quant Biol* 60:821-31; Predescu SA, Predescu DN, Palade GE. (1997) Plasmalemmal vesicles function as transcytotic carriers for small proteins in the continuous endothelium. *Am J Physiol* 272(2 Pt 2):H937-H949; Roberts WG, Palade GE. (1997) Neovasculature induced by vascular endothelial growth factor is fenestrated. *Cancer Res* 57(4):765-72.