Editorial

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Legacy of a Distinguished Scientist: George E. Palade

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In the November 7th 2003 issue of Science [1], the discovery of a new cellular structure at the plasma membrane of pancreatic acinar cells, the secretory pore, and the elucidation of its function have been discussed. This new structure has now been demonstrated to be present in secretory cells. After almost 50 years since the discovery of the ribosome by Prof. George E. Palade in the pancreas and other cell types [2], we are witnessing the discovery of another new cell structure.

In October 1974, the Karolinska Institute announced its decision to award George Emil Palade the Nobel Prize in Physiology or Medicine jointly with Professors Albert Claude and Christian de Duve for their discoveries concerning 'the structural and functional organization of the cell'. The more than two decades of work, leading to fundamental findings on cellular structure-function, led to the birth of the new discipline of modern cell biology.

In the early 1950s, Palade's utilization of the then new technologies, such as electron microscopy and ultracentrifugation, brought understanding of the cell to a new level. Palade added important methodological improvements both to differential centrifugation and electron microscopy and was instrumental in combining the two techniques to solve fundamental problems in cellular physiology. His work was primarily devoted to a network of submicroscopic membranes within the cell, the endoplasmic reticulum. He discovered small granular components, now known as ribosomes present at the surface of endoplasmic reticulum, and further demonstrated that the ribosomes carry out protein synthesis in the cell. In a series of elegant experiments, Palade and his coworkers demonstrated that in secretory cells the secretory proteins are produced at the ribosomes outside of the reticulum and somehow enter the space between its membranes and then migrate to a special organelle, the Golgi complex, where they mature to form membrane-bound secretory vesicles for secretion. These pioneering scientific contributions by Palade are monumental [2]. His love and dedication to science and education continues to this day. Besides contributing to new understanding of the cell, Palade's work has paved the path for new discoveries on cellular structure-function. The two brilliant examples are the pioneering works of his student Prof. Günter Blobel, Rockefeller University, New York, N.Y., USA, and his grand student Prof. Bhanu P. Jena, Wayne State University, Detroit, Mich., USA.

Like those of his mentor, Günter Blobel's contributions are equally pioneering. For his discovery that 'proteins have intrinsic signals that govern their transport and localization in the cell', Blobel received the unshared 1999 Nobel Prize in Physiology or Medicine. Proteins carrying out essential functions are constantly made within our cells. These proteins have to be transported to their subcellular target compartments such as the endoplasmic reticulum or the mitochondria. The questions of how are newly made proteins transported across the membrane surrounding the organelles and how are they directed to their correct location were answered through the work of

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Günter Blobel. In the early 1970s Blobel discovered that newly synthesized proteins have an intrinsic signal that is essential for guiding them to and across the membrane of the endoplasmic reticulum. In the subsequent years, Blobel characterized in detail the molecular mechanisms underlying these processes. He also showed that similar 'address tags', or 'zip codes', direct proteins to other intracellular organelles. This pioneering discovery also gave birth to a new field in cell biology, molecular cell biology [3].

Following in the footsteps of his grand mentor, Prof. Bhanu Jena has also made equally pioneering contributions to cell physiology. Similar to his grand mentor, George E. Palade, B. Jena's utilization of new nanotechnologies, such as the atomic force microscopy, in combination with conventional technologies like electron microscopy, biochemistry, and electrophysiology, brought understanding of the cell to a new next level. B. Jena and his research team have discovered a new cellular structure, the 'porosome', located at the cell plasma membrane, where secretory vesicles fuse to release their cargo. This work has revealed, at nanometer resolution, the molecular structure and dynamics of the 'porosome' or fusion pore in live cells. The biochemical composition of the 'porosome' and its functional reconstitution into artificial lipid membranes have also been found. B. Jena and his group also determined the molecular mechanism of fusion of the secretory vesicle membrane with the 'porosome' membrane and the regulated expulsion of intravesicular contents. These pioneering findings have given birth to yet another important field in cell biology, nano cell biology [1, 4].

In short, it is remarkable and outstanding that in a period of half a century cell biology has experienced such revolutionary advances and contributions made by George E. Palade and his legacy. The science of pancreatology has immensely profited from these contributions.

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