

Tribute to Professor Bhanu P. Jena



Professor Bhanu P. Jena

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Professor Dr. Bhanu P. Jena a pioneer in modern cell biology, has made **monumental discoveries on the molecular machinery and mechanism of cell secretion**. His studies on cell secretion began more than 30 years ago, in 1975, while still a masters student in Zoology. At the young age of 19, he published his first scientific paper on cell secretion, *i.e.*, the '*role of hypothalamus in the regulation of pituitary hormone release*' [Prakruti, U.U. J. Sci. (12): 81–7, 1975 & Masters Thesis].

The extension of our sense of vision, especially of life, was revolutionized with the invention of the light microscopes almost four hundred years. Since then, our perception of the world has changed. Extending this perception further, has since been the driving force for scientific discoveries. The atomic force microscope (AFM), a force spectroscopy has extended our sense of touching into the nano-world of the live cell.

Using AFM on live cells, Professor Jena was the first to report the discovery of a *new cellular structure* the '**porosome**'. The porosomes are permanent supramolecular structures at the cell plasma membrane, where secretory vesicles dock and fuse to release intravesicular contents to the outside. This discovery was a major breakthrough in our understanding of cell secretion. Today, the porosome, has been determined as the universal secretory machinery in cells, from exocrine cells of the pancreas, to neuroendocrine

cells, and neurons. Professor Jena and his research team have subsequently determined the structure and dynamics of the porosome in live cells, at nm resolution and in real time. The structure of the porosome was further confirmed by electron microscopy in whole cells, and in isolated porosome preparations. The isolated porosome has been both structurally and functionally reconstituted in lipid membrane, and its composition determined. Thus the discovery of the porosome as a new cellular structure, and an understanding of its structure, function, composition, and reconstitution, opens a new field in cell biology; **nano cell biology**.

Among the honors and awards Professor Jena has received over the years are, the Swebelius Cancer Research Award, the Hallim Distinguished Award Lecture jointly with Prof. Ahmed H. Zewail (the 1999 Nobel Laureate in Chemistry), the Sir. Aaron Klug Award (Prof. Klug is the 1982 Nobel Laureate in Chemistry), Elected to the Korea Academy of Science & Technology, the 2005 George E. Palade Medal, six Honorary Doctorates including one from Babes-Bolyai University, Romania, jointly with Professors George E. Palade (the 1974 Nobel Laureate in Physiology or Medicine) and Günter Blobel (the 1999 Nobel Laureate in Physiology or Medicine), and Distinguished Visiting Professorships at numerous academic institutions world wide.

Editorial Foreword

'Cell Secretion' Review Series



Cell secretion - finally sees the light

L. L. Anderson *

Guest Editor for 'Cell Secretion' Review Series

It has been a quest for nearly a century, and finally 'Cell Secretion', the universal and the most fundamental of cellular processes, has been unraveled. The critical breakthrough came with the discovery of the '*porosome*', the universal secretory machinery at the cell plasma membrane, where membrane-bound secretory vesicles dock and transiently fuse to expel intravesicular contents to the outside [1-7]. What took so long for this discovery? The answer is simple: like other such pioneering discoveries, the development of the necessary tools, followed by their skillful use, combined with keen perception of the discoverer, *Professor Bhanu P. Jena*, made it possible.

The discovery of the '*porosome*', a new cellular structure at the plasma membrane of live secretory cells, is a landmark in cell biology. The further determination of the *porosome's* morphology and dynamics at nanometer resolution and in real time in live cells, its function, its biochemical composition, and its structural and functional reconstitution in lipid membrane, are ground breaking and pioneering contributions [1-7]. With the development of the light microscope over 300 years ago, cell

biology was born but in its infancy was limited; even micron size objects and less than 50 nanometer deep, remained unresolved and invisible under the light microscope. Similarly, even though the electron microscope (EM) is capable of near nanometer resolution, structural alterations introduced during sample preparation may have precluded earlier discovery of the *porosome*. Furthermore, observation of cell dynamics is not possible using EM since cells are no longer alive following processing for electron microscopy. Professor Jena and his research team circumvented these limitations faced by both light and electron microscopy by using the Atomic Force Microscope (AFM), a force spectroscope for imaging live cells in 3D, at nanometer to sub-nanometer resolution in real time. The 100-150 nm in diameter *porosomes* at the plasma membrane in live pancreatic acinar cells, chromaffin cells, growth hormone cells of the pituitary, and β -cells of the endocrine pancreas [1-6, 8], and the 8-12 nm *porosomes* at the nerve terminal [7] were observed for the first time in live cells using the AFM, and further confirmed by EM.

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This discovery has not only revolutionized our understanding of cell secretion in particular, and of the cell in general, it has given birth to a new field - 'Nano Cell Biology'.

Cell secretion involves the fusion of membrane-bound secretory vesicles at the porosome and the release of intravesicle contents to the cells exterior. The molecular mechanism of membrane fusion [9–14] and the regulated expulsion of intravesicular contents [15–18] during cell secretion have all been determined. These discoveries have resolved one of the most fundamental and important workings of Nature and is one which will profoundly impact human health and medicine.

In this special issue on 'Cell Secretion', a review by Prof. Jeftinija and a minireview on the discovery of the molecular machinery and mechanism of cell secretion are published [19, 20].

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