ELSEVIER

Cell Biology International 28 (2004) 1–2

Cell Biology International

www.elsevier.com/locate/cellbi

Editorial

A new frontier in cell biology: nanocellbiology

Nanotechnology is advancing apace. Engineers see small as beautiful, not only in the field of electronics. But they have also become increasingly fascinated by the frequent demonstration that nature has been operating in this realm for years. In the last year, a major European congress and a large international conference on bio-engineering have included sessions in which cell biologists have been informing engineers about those quite extraordinary "ordinary" things to biologists, such as the composition of muscle cells and microtubules (in engineering terms the latter come closer to being nanotubules), and their functioning. Stabilised microtubules are stronger than steel cables of similar size, and have even been considered to operate as a network for information transmission across the *mare intracellum* (Penrose, 2001). In my own work, I have been discussing an intracellular *nanocirculation*, i.e. several orders smaller than the *microcirculation* (the capillary bed) in the fractal hierarchy of the circulatory system (Wheatley, 2003).

While we retain an enormous interest in space and the seemingly infinite expanses of the universe, where units are light-years, we also want to understand it from the obverse perspective, to explore everything at the minutest detail. We are not talking about going below the atomic level, where things get very bizarre, but at the very small level in living systems. Here we deal with collections of molecules that create structural supports, and machines and engines, discernible structures with high power microscopic techniques of different sorts (e.g. ribosomes, proteasomes) that function in the most co-ordinated way and allows a living cell to operate as a coherent entity. Just as for hundreds of years, we have trained telescopes of increasing sophistication toward the sky, so instrumentation has been developed to study, plumb and understand the depths of the cell with ever increasing sophistication. Throughout history, pioneers have invented increasingly finer devices, and through their associated technologies great discoveries have been made.

These advances include the use of light, x-ray, electrons, magnetism and sound waves, to image life. In spite of all these advancements, the study of cellular processes at the molecular level in live cells has largely eluded us. Furthermore, even with all these developments, it is not every day that a new cellular structure is found. "Palade bodies" (ribosomes) had been found almost 40 years ago, and in the late 80s and early 90s, the invention of the Atomic Force Microscope (AFM) became a turning point in the study of the cell. This new instrument was brilliantly used, more often than not in combination with other conventional approaches, and today a further entity has been revealed, the "*porosome*" and the elucidation of its function, its morphology and dynamics at nanometer resolution in real time, its biochemical composition, and functional reconstitution into liposomes are all well advanced. Such is the power of modern analysis and experimentation. This pioneering work has thus given new impetus to "nanocellbiology". Besides elucidating the molecular mechanism of one of the most vital cellular and physiological, the process of secretion and many other processes requiring membrane fusion, this discovery reminds us how highly organised the cellular architecture is, and how little we still know of it. What is more, the way in which membranes fuse turns out contrary to the expectation of many not to be an all-or-none event, a term which has been used about the firing of a nerve action potential across a synapse. The very process that set that in train was thought to be due to an all-or-none process of dehiscence of synaptic vesicles at the presynaptic membrane. Today we know this as a highly regulated event, with a very high level of sensitivity, not only in nerve synapses, but also in endocytotic vesicle fusion in other forms of secretion, as in acinar cells of the pancreas (Cho et al., 2002).

A minireview on the subject of the *porosome* by Lloyd L. Anderson is included in this issue.

References

Cho SJ, Sattar AK, Jeong EH, Satchi M, Cho JA, Dash S et al. Aquaporin-1 regulates GTP-induced rapid gating of water in secretory vesicles. Proc Natl Acad Sci U S A 2002;99:4720–4.

Penrose R. Consciousness, the brain, and spacetime geometry: an addendum. Some new developments on the Orch OR model for consciousness. Ann N Y Acad Sci 2001;929:105–10.

1065-6995/04/$ - see front matter
doi:10.1016/j.cellbi.2003.11.001

Wheatley DN.. Diffusion, perfusion and exclusion principles in the structural and functional organization of the living cell: reappraisal of the properties of the "ground substance". J Exp Biol 2003; 206:1955–61 [*Hochachka Memoral Issue*.].

D.N. Wheatley
Editor