EDITORIAL

The Importance of the Broad View to Integration in Anatomy and Pathology

D. B. BURR
Associate Editor

Ultimately, the goal of any Editor or Associate Editor is to expand the quality and the quantity of published papers in the journal. Beyond this, the position of Associate Editor provides a unique opportunity to establish directions. I take this charge quite seriously.

Anatomy and Pathology are broad areas. My impression is that some, perhaps not very knowledgeable about these areas, find them arcane. Our challenge is to maintain the vitality and novelty of research in the morphological sciences, upon which Anatomy and Pathology both rely.

What ties these areas together, other than their concentration on structure in health and disease, is their emphasis on systems. This has become increasingly relevant because of the importance of genetically modified animal models to our understanding of health and disease. Such models can help us to understand the nature of conserved systems, and also the role of redundancy in biological processes. The emphasis of Anatomy and Pathology on systems biology is one crucial foundation on which I hope to build this section of *Experimental Biology and Medicine*.

A second tie that binds is the emphasis on imaging modalities as a quantitative (and sometimes qualitative) experimental outcome measure. Because of the reliance in Anatomy and Pathology on all forms of microscopy—from brightfield/darkfield to fluorescence to electron to acoustic and atomic force—I am hoping that the importance of quantitative imaging to our understanding of biological structure and function can be amply demonstrated in these pages.

The emphasis on systems biology and quantitative imaging can be accomplished using three complementary approaches.

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(1) Integration of biological levels

"But when the morphologist compares one animal to another, point by point or character by character, these are too often the mere outcome of artificial dissection and analysis. Rather is the living body one integral and indivisible whole, in which we cannot find, when we come to look for it, any strict dividing line ... Characteristics which we have differentiated insist on integrating themselves again."
D'Arcy Thompson, *On Growth and Form*, 1917

I have never been a big fan of hierarchies, whether social, political, economic, or educational. One reason is that hierarchical arrangements are often used to separate and disconnect. However, hierarchies in biology are a different matter, because they serve to interconnect rather than to separate. The disciplines of Anatomy and Pathology are united by an interest in structure, but structure on all levels. More than other areas, the Anatomy and Pathology section of the journal should provide integration between the molecular, cellular, tissue, organ, and organismal levels of organization. Molecular and cellular approaches are ideal for forming hypotheses and for defining biological mechanisms under tightly controlled conditions. Studies in animals are ideal for testing ideas about how these actually work in nature. All levels are important to different parts of the scientific process, and one goal of mine is to begin to integrate them.

(2) Patterns and fundamental mechanisms

"Nature follows the principle of redundancy by seeking a simple mechanism or module for a complex system and then using that module over and over again in other systems."
D. E. Koshland Jr, *Science*, 1993

Nature forms patterns, and it is our goal to elucidate and synthesize those patterns. There are not an infinite number of patterns in Nature: once contrived as a solution to a problem, the solution is used repeatedly and becomes a

general phenomenon. It is as much a physical law to biology as the physical laws of the universe are to the study of physics. We want to search for general principles, phenomena that are repeated in various different systems, rather than to focus atomistically on minute aspects of biological form or function in a single system.

(3) Multidisciplinary approaches

"The biologist ... learns to recognize that the whole is not merely the sum of its parts."

D'Arcy Thompson, *On Growth and Form,* 1917

To accomplish integration over broad levels of biological form and function requires multi- and interdisciplinary cooperation. This occurs across disciplinary boundaries, as well as along the hierarchical lines of biological organization. The advantage of the broad view brought by Anatomy and Pathology is that it can easily incorporate the perspectives brought by other disciplines. So I expect and encourage a wide range of disciplinary expertises to contribute to the Anatomy and Pathology section of *Experimental Biology and Medicine.*

In short, in these pages, my goal is to emphasize systems biology and imaging in biological research. And I am hoping that this can be done through vertical and horizontal integration that will include the interdisciplinary broad view together with the integration that comes by studying across all levels of biological organization.