Microphysiology

IF THE term physiology is to include the study of function at all levels of organization from intact animals down to groupings of molecular components, a substantial fraction of the field does not seem to be generally and explicitly recognized as physiology in this country. This is true of microphysiology, and especially mammalian microphysiology. By microphysiology is meant the description of the functional properties of cells that are significant in whole animal physiology, as well as the explanation of these properties in terms of subcellular components down to molecular dimensions. A description of the rates and other characteristics of oxygen absorption by cells during rest and activity, supplemented by an explanation of such observations in terms of the cytochrome system, the tricarboxylic acid cycle, and the glycolytic system, provides an example of a segment of microphysiology dealing with a general property of cells. A description of the contraction of a single skeletal muscle fiber, its all-or-none response, the dependency of response on frequency of stimulation and initial length of fiber, together with the beginnings of an explanation of these properties in terms of actomyosin and ATP, is an example of a portion of microphysiology dealing with a property highly developed in particular cell types.

Microphysiology as here defined is an active research field in which physiologists are engaged, but, as large amounts of new information become available, the field is apparently not being comprehensively and systematically arranged as a part of physiology. This is revealed in the handling of the literature, the programming of our meetings, the content of textbooks, as well as in many aspects of our teaching. It should be feasible to base the arrangement of facts in this area on cellular physiological functions, rather than on organ system functions as in classical physiology, which fails to consider, or separates, some properties common to many cells. A few possible headings might be *Transformation and Transfer of Materials,* including a reorganized and unified approach to the subject matter covered in part under such topics as metabolism, nutrition, electrolyte balance, membrane properties, osmosis, absorption, secretion, excretion, energetics, control, and the steady state; *Maintenance and Functions of Structure in Living Cells; Adjustment to the Environment,* including general influences and response to specific stimuli; *Transfer of Excitation; Movement;* and *Growth*—in all cases associated with related facts of the underlying integrated system of enzymatically catalyzed reactions. Within limits this is done in general physiology, but only in those phases of the subject that can now be expressed in physical and chemical terms or that are largely descriptive of cellular activity without much reference to chemical components.

Microphysiology as thus outlined would emphasize those properties of cells through which they act as the functional units at organ-system and intact-animal levels of organization. Descriptive information of such properties is currently limited, except for some characteristics of a few cells like the skeletal muscle fiber. On the other hand, the need for *understanding* what is described at the cellular level of organization would also be underscored. Complete understanding cannot be gained either from a description of the highly organized system, the cell, or from analytical studies of the molecular and other components of the cell. The latter, which is biochemistry, must be combined with the former, a part of physiology, no matter how great the present gulf may be. To cite a comparable analogy, few would claim that circulation of the blood is not a part of physiology just because its understanding depends on pure physics.

The long-range goal of microphysiology, whether mammalian or general, is the integration of the cellular components having certain physical and chemical characteristics into a unified system or set of systems out of which the observed cellular functions will emerge.

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