

Letter to the Editors

A place for theoretical cardiology

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We would like to report on the activities of the newly founded “International Institute for Theoretical Cardiology” (IIfTC). The aim of the institute is to create a forum for the examination of controversies in cardiology, with a special focus upon their philosophical and epistemological dimensions. In particular, we wonder whether certain controversies can be clarified by an evaluation of the axiomatic foundations underlying the disputes, and not simply solved by the perfunctory acquisition of additional experimental results.

The opening symposium of this institute was devoted to the theme: “The ischemic myocardium: definitions, measurements, and pathophysiology”. The emphasis of this meeting was an analysis of the assumed conceptual framework within which the reported observations were interpreted.

Questions arose early as to the very definition of ischemia. Some researchers felt that a state of ischemia occurs as soon as blood flow becomes insufficient to sustain normal contractile function. Other researchers advocated a different definition of ischemia that accounts for the phenomenon of “down-regulation”. Down-regulation is a reduction in myocardial function caused by partial restriction of coronary blood flow, such that the reduction in function is sufficient to prevent any “damage” to the myocardium as a result of the reduced flow. Thus, the alternate definition considers ischemia to be a state in which blood supply is insufficient to meet the oxygen requirements of the myocardium at its *reduced* level of contractile function. In this sense, the down-regulated myocardium is not ischemic. Accordingly, an obviously ischemic myocardium by the former definition may not be ischemic at all by the latter definition.

Is it at all necessary to have a unifying definition of ischemia, or is it enough to have several working definitions that would satisfy the temporary needs of scientists doing their experimental research? Some of the participants felt that mutually exclusive working definitions of the same concept were unproblematic, so long as everyone was aware of the explicit definition in use. From an epistemological point of view, then, crucially important questions were: (1) how the definitions interrelate, (2) how appropriately they classify the experimental phenomena being studied, and (3) how fruitful the definitions are for pointing up future studies.

A second foundational problem that arose during the symposium was how to relate properties observed at the larger, organ level to characteristics determined at the level of individual cardiac muscle fibers, or even to the properties of molecular cross-bridges. An

intriguing challenge has been how to explain the global end-systolic pressure-volume relationship observed in whole heart preparations (4) in terms of mechanical characteristics observed at the cardiac muscle level. For example, Sagawa (2) lamented the difficulties encountered in relating higher and lower level properties in his statement: "It is rather puzzling that the simple papillary muscle gives a more complex force-length relation than the pressure-volume relation of the ventricular chamber which has a more complex architecture." In a similar context, Gibbs and Chapman (1) state: "Some readers might dispute our extrapolations between whole organ pressure-volume diagrams and the stress-strain relation of individual cross-bridges, but we feel that any realistic muscle models must attempt to do just this."

Philosophers of science have also worked extensively on similar reduction problems at the logical and epistemological levels. One important insight from this approach is that there is typically no simple derivative relationship between lower-level and higher-level properties. Rather, as science progresses there is a complex interplay between the theories at the two levels such that eventually both theories are changed (3).

From these two examples, we propose that certain problems in cardiology might be resolved by a kind of research different from the familiar, empirical genre. In such cases, we need a species of research that is "Grundlagenforschung". In other words, we need research that examines the validity of and the interrelations between the foundational theories and definitions that are used to interpret newly found empirical observations in a given discipline. The justification for this kind of research is that some controversies might be resolved in part by highlighting possible inconsistencies among the conceptual axioms upon which empirical research is based, by heightening understanding of the semantic relationships between the terms used in a field of research, or by deriving insight from historical parallels to previous controversies. Precedence for the importance of such an approach has been amply documented by philosophers of science, especially with regard to the resolution of controversies arising in quantum physics at the beginning of the century. The IfTC aims to organize future forums of this type to foster further interdisciplinary collaboration between experimental researchers and philosophers of science, so that cardiological research might also benefit from Grundlagenforschung.

References

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