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ENERGETICS AND FITNESS
INTRODUCTION TO THE SYMPOSIUM[1]

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On February 8 and 9, 1974, the Program in Environmental Biology of The Ohio State University, the Ohio Academy of Science and Battelle Columbus Laboratories convened a symposium on Energetics and Fitness. The five papers read at that meeting appear in this issue of the Journal following the introduction to the symposium.

The fundamental tenet of Darwinian evolution is fitness: the number of progeny that an individual produces that survive to reproduce. This definition includes both the quality and quantity of offspring and a measure of either alone is not a measure of fitness, except under the special circumstance when the other is assumed to be constant.

Each egg or seed produced by an organism removes energy from the pool of nutrients an organism collects during its life. The energy available for producing progeny may be put into a small number of large eggs or a large number of small eggs. This is not a simple trade-off in which the survivorship of a propagule increases as the resources in the propagule increases. Instead it is a complex function of egg resources, environmental predictability and, in the case of animals, a function of the energy put into complex behavior that can greatly alter the success of a propagule. The alternatives of quality versus quantity and the trade-off of growth versus the cost of activity that alter survivorship can be defined as a set of tactics with measurable costs and benefits.

The costs are measured as the energy put into growth and activity and the benefits are in the survivorship of the propagules. An evaluation of the contribution of alternative patterns of growth and activity (tactics) requires a synthesis of energy budget information with life table data. It is only recently that these sets of data have become fairly easy to collect. Oxygen analyzers and microbomb calorimeters have made it much easier to collect data on metabolic activity and caloric content. The initial, taxonomic phase of data collecting now provides the basis for development of a completely new dimension in Darwinian biology. This advance is possible because the tools of the ecologist provide the basis for a more comprehensive analysis of fitness.

The consequence of taking a Darwinian view is that ecologists have begun to look at individuals and the elements determining individual success, and trapping energy as the essential element for existence. The first flush of enthusiasm for applying energy budgets to plants has been tempered by the discovery that photosynthesis is not a biochemical constant but is a set of fundamentally different devices with different properties. Little understood complications of photosynthesis require the ecologist to proceed with much more caution, and the contribution presented by Clanton Black develops that theme.

It is assumed that the metabolic properties of animals are not so varied as those of plants, and the problems of simple maintenance among endotherms are

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shown to be complex functions involving environment and strategies of resource exploitation. In examining these, Brian McNab moves comparative physiology beyond the taxonomic phase. He shows that collecting data on any animal that has not been in a metabolic chamber is far less exciting than the attempts to understand the data at hand.

The result of energy expenditures on reproduction is measured by the number of young produced and their subsequent survival. The relationships of these two properties can be summarized in a life table. How this schedule of births and deaths can influence the options open to individuals and how the quality of young are related to that schedule are subjects considered by Peter Price.

From a Darwinian point of view it would be desirable to explain the structure of communities as a summation of the interactions among individuals. At present, attempts to do so are incomplete. Yet the attention of ecology centers on investigations designed to elucidate and explain the relationships among species within a community. Robert Chew and S. J. McNaughton consider how energy flow, productivity, and fitness relate to the structure of communities. Their approaches to this problem are widely different and their contributions illuminate the diversity of thought that characterizes the study of this complex biological problem.

From the outset it should be clear that the participants did not necessarily subscribe to our notions of the inter-relationships of energetics and fitness; rather the theme of the symposium provides a focus for the interchange of ideas.