Physiological Analysis of Adaptation

This involves cooperative programs between physiologists, ecologists, biochemists, and geneticists. The goal is to understand organism-environment interaction in terms of the feedback controls which are operative at cellular and organ levels. The principles of metabolic adaptation in respect to enzyme synthesis as regulated by substrate and products have been studied, especially for microorganisms. Application of these principles to regulation by physical factors in the environment, such as temperature, salinity, and oxygen, is poorly known.

An example may be taken from phenotypic metabolic compensations to temperature in some plants, microorganisms, and poikilothermic animals. After initial shift from one temperature to another, changes in metabolic rates occur which correspond to the Van't Hoff relations. After some time, many organisms compensate for the temperature alterations by a variety of biochemical changes; these include alterations in lipid composition, in abundance of certain isozymes, and in emphasis on alternate metabolic pathways. In order that the organism can be adapted in its entirety, many different proteins may be involved. Changes can occur only within the limits imposed by the genotype. However, those organisms having genotypes with extensive capacity for synthetic variations may be expected to differ in their ecogeographic limits from organisms with less metabolic adaptability. Some of the environmental control may be directly at the cellular level, some of it indirectly by hormonal or nervous intermediation. The metabolic mechanisms of temperature adaptation are so complex as to require much study.

Other examples of adaptive mechanisms may be taken from osmotic and ionic balance. At the organismic level, these include varied methods for water exclusion or retention, and mechanisms for active uptake or excretion of specific ions. At the cellular level patterns vary from tolerance of a wide osmotic range to functioning only within narrow osmotic and ionic limits. The identification of mechansims of active transport is essential for an understanding of adaptation of plants and animals to environments which differ in respect to water and ions.

Responses and Survival in Extreme Environments

Extremes of heat, aridity, radiation, oxygen, salinity, pressure, gravity, and other factors have a relevance for the