AEC-NASA TECH BRIEF

Investigation of Temperature Dependence of Development and Aging

A paper is presented giving an analysis and theoretical discussion of published data on the temperature dependence of maturation rates, plus metabolic and mortality rates in insects.

This paper asks how living poikilothermic systems are affected in their aging and longevity by operating at different constant ambient temperatures. An attempt is made to put the effects of temperature on aging into context with the effects of temperature on essential life processes such as maturation and energy metabolism, and on the failure of those processes, as manifested in gene mutation, developmental anomaly, and mortality during development.

It is shown that the rate of aging per calorie expended increases on either side of a temperature optimum, and that this increase is complementary to the decrease in energetic efficiency of maturation of insects as temperature is displaced from optimum. Failures of vital processes, such as mutations, developmental anomalies, and developmental death also exhibit a temperature minimum. The temperature for optimum function (highest energetic efficiency and lowest failure rate) is found to be always within the temperature range to which that insect species is adapted.

These phenomena are proposed to be a result of the increase in organizational entropy as temperature is displaced from an optimum value. This increase is proposed to be a result of an irreducible heterogeneity of activation energies of enzyme-catalyzed reactions.

The general hypothesis is advanced that aging in biological systems is a consequence not of metabolic activity *per se*, but rather of the production of entropy concomitant with metabolic activity. Thus, aging can no longer be considered as a question of *how much* metabolic work; it is also a function of *how well* the work is done, in thermodynamic and informational terms.

Notes:

1. The paper, entitled "The Complementarity of Entropy Terms for the Temperature-Dependence of Development and Aging," has been presented by George A. Sacher of Argonne National Laboratory, Argonne, Illinois.
2. This information may be of interest to governmental agencies, research biochemists, and medical foundations working in the field of aging.
3. Reference: Additional details are contained in *Annals of the New York Academy of Sciences*, vol. 13., article 2, p. 680–712 (February 6, 1967)
4. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
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   Reference: B69-10022

   Source: G. A. Sacher
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   Argonne National Laboratory
   (ARG-10145)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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