Letters

On the Origin of Life

Many papers have appeared in recent years, several in *Science*, on the topic of the origin of life. I have been somewhat disturbed to note the ever-increasing tendency, especially among biochemists, to identify the event of the origin of life with that of the origin of enzymes or of deoxyribonucleic acid. It appears to me that our greatly increased rate of discovery of facts pertaining to the chemistry of hereditary mechanisms and the relationship of enzyme constitution to genotype has led to a distortion of the basic problem and misled many into this identification.

I do not propose to enter here into a discussion of the problem of the origin of living systems and the possible importance of cyclic factors, which I have treated elsewhere [*Am. Naturalist* **81**, 161 (1947)], but should like, rather, to present an analogy which may serve to make my point.

Consider the problem of the origin of far-flung industrial corporations. To the untrained observer the problem of the origin of such structures might perhaps resolve itself into that of the origin of corporation buildings, machinery, raw materials, capital, workers, sales outlets, and so on. The trained observer would seek his answer in a study of the history of corporations. He would correctly conclude that the corporate giant often derives from the humble garage or basement workshop in which the inventor experiments in his off hours to develop a new product or process. He would then trace the slow process of corporate evolution through the small shop of two or three employees, to the modest factory, to the giant factory, to many factories, and so on and on to the industrial complex with its directing board and many stockholders.

Let us suppose that we can no more trace the history of corporations than we can directly trace the history of life. The trained observer might instead insinuate himself into the inner workings of the corporation until he breached the inner sanctum—the board of directors. He would then discover that the board of directors is the keystone of corporate policy and action, varying the company program, product emphasis, and even the corporate structure in response to changing economic conditions and opportunities, electing the officers who see to the fine details of operation, and so on, and, indeed, that every action of the corporate enterprise traces directly or indirectly to the make-up and actions of the board—to the corporate DNA. In his new familiarity with the manifold operations of the all-powerful board and the consequences of these operations, the solution to the problem of the origin of corporations might suddenly come upon him; dazzled by his suddenly acquired knowledge, he might conclude hastily that the problem of the origin of corporations was to be identified with the problem of the origin of boards of directors!

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Linear and Higher-Order Curves

In Fig. 1 of the article "Investigations of natural environmental radiation" [*Science* **131**, 903 (1960)] by L. R. Solon *et al.*, there is presented a straight-line regression on the relationship between barometric pressure and the log of radiation level. Even a casual inspection of this graph indicates that a better empirical description would be given by a second-degree curve. This may be inferred from the systematic deviation of the observed points from the fitted line.

As a simple description of the relationship within the range of observations, it would make little difference, but since this line is used for extrapolation, considerable error may result. For example, the 3.8 μr/hr extrapolation for cosmic-ray ionization intensity at sea level for New York City might result in an estimate of 5 μr/hr (or a difference of about 33 percent) if a curved line were used.

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In his letter Marvin Glasser suggests that a better fit to the data in Fig. 1 of our article could have been achieved by using a higher-order polynomial than the linear regression exhibited.

I agree that a quadratic or higher-degree polynomial would constitute a closer fit to the empirical data. (In fact, since the curve is based on 19 experimental points, an 18-degree polynomial exists which would fit the data perfectly).

I disagree that using a higher-degree polynomial would result in a curve that would be better for extrapolation.

Further, I submit that if a set of empirical points actually obey a linear law, any higher-degree curves—whether they fit the data better or not—almost certainly would be worse for extrapolation. Extrapolation of such a linear relationship depends simply on the slope