

Evolutionary Algorithm Cannot Account for Life:

A response to David Thomas

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Editor:

David Thomas, in his 7/24/97 letter, cannot grasp the fact that his genetic algorithm simply does not apply to the macroevolutionary problem of discovering a gene that codes for a protein with truly novel function. Genetic algorithms that mimic microevolutionary processes of heredity, mutation, and selection are indeed successfully applied to a variety of optimization problems like the one Mr. Thomas mentions in his letter. These methods, however, are not appropriate for the large scale searches which macroevolution implies.

To be more specific, genetic algorithms are effective in finding local optima in a fitness landscape. But when the fitness landscape consists of isolated islands of fitness separated by vast seas where the fitness is zero, such algorithms are next to worthless. This is certainly the case for the example I gave for which the ratio of sea volume to island volume is 10 to the 130th power. Mr. Thomas somehow just cannot comprehend how utterly special the micromachines (proteins) are that perform such diverse and complex tasks in the living cell.

Let me again try to frame this problem of finding a single new protein type with some new cellular function, such as a new enzyme to catalyze a new metabolic pathway. Let this new protein be 200 amino acid units in length (relatively short). Studies indicate on average half, or 100, of the sites must be specified exactly for the protein to have some semblance of the desired function. The other half on average can be arbitrary.

With 20 kinds of amino acids to choose from, there are 20 to the 200th power, or 10 to the 260th power, different candidates. Of these, 20 to the 100 power, or 10 to the 130th power will normally display a finite level of the desired

functionality. In general, this collection of functional proteins will form a cluster, or island, in the larger protein space.

But if one considers the size of this functional island relative to the larger space, the entire island occupies only 1 part out of 10 to the 130th power parts of the larger space. (That is 1 compared with 10 to the 50th power TIMES the number of atoms in the universe!) The vast regions outside the tiny island display none of the desired fitness.

What conceivable search algorithm could positively locate such an infinitesimal island in such a gigantic sea, even within the presumed 15 billion year age of the cosmos? One can be certain that a genetic algorithm, which performs only a local search and works only in regions with nonzero fitness, absolutely cannot.

Each of the thousands of protein types in a living organism is as special, if not more so, than the one I have offered as an example. From what we know of these structures, nothing other than a Superintelligence who understands in intimate detail how these systems work could ever have identified even the few hundred different proteins needed in the simplest living organism. A Superintelligence is just as essential to specify and assemble the additional special micromachines that appear in more complex organisms. This is what honest science demands.

Put another way, microevolution simply cannot be rationally extrapolated to yield macroevolutionary miracles. And it does not take all that much human intelligence or training to reach with confidence this fundamental conclusion.

John Baumgardner