

## Intelligent Design and Complexity Research

**An Essay and Book Review of the Book: *No Free Lunch: Why Specified Complexity Cannot be Purchased without Intelligence*, William A. Dembski, 429 pp., Roman and Littlefield, 2002**

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Many thinkers have wondered whether biological systems are too complex to have arisen naturally. Using these speculations, some people have rejected the scientific program of understanding the entire world in terms of natural processes. Instead they embrace an alternate viewpoint, called Intelligent Design or ID, in which natural processes are replaced by some kind of creation or design. It is tempting to talk about ID as a tool in a political movement.<sup>2</sup> Or a philosophical point of view.<sup>3</sup> Or as an outgrowth of religion, rather than something related to science or scientific scholarship.

However, some proponents of ID do work within the scientific tradition. Here, I look specifically at a recent book by William Dembski<sup>4</sup> entitled *No Free Lunch*, which discusses the complexity of living things and defends some of the ideas of ID. The book argues both about the generation of the first life and also about the very complex structures within existing organisms.

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<sup>2</sup> See, for example, Adrian Melott, *Intelligent Design is Creationism in a Cheap Tuxedo*, pp. 48–50, *Physics Today*, June 2002.

<sup>3</sup> Mano Singham, *Philosophy is Essential to the Intelligent Design Debate*, pp. 48–51, *Physics Today*, June 2002.

<sup>4</sup> See also Dembski's earlier work, *The Design Inference: Eliminating Chance Through Small Probabilities* (Cambridge University Press, Cambridge, 1998). I suspect myself of some bias in favor of Dembski since he was, for a brief period, my student.

Here, I try to follow the thinking of Mark Vuletic<sup>5</sup> and ask what science can gain from ID, and particularly from Dembski's book.

This book gives a quantitative and mathematically structured form of William Paley's watchmaker argument.<sup>6</sup> Dembski follows the neo-Darwinian tradition in describing the temporal development of a species as a motion through a very large, but discrete, space in which the different points represent different possible genotypes. As the species explores different biological forms, it gains local information about the space, specifically values of the fitness in its neighborhood. Here the word "fitness" is used as a summary measure of all the qualities needed to help the organism produce more offspring. Using the information it has gained, the organism employs some strategy to hunt for a state of better fitness. In this restatement of Dembski's picture, I have glossed over reproduction, death, sexuality, and much else.

The result of this search must be quite remarkable. Organisms we see around us have raised themselves to states of amazing complexity. The configurations of viable organisms must be breathtakingly rare in the space of all possible DNA chains of a given size. Dembski uses the words "specified complexity" to suggest the nature of the organisms and the fact that they have a magnificent degree of organization. The scientific view is that the organisms reach this state by utilizing an appropriately designed "Darwinian" algorithm to search through this space for really nifty designs: alligators, albatross, aardvarks, and people like you and me. But, Dembski notes that a theorem gets in the way. In the 1990s David Wolpert and William Macready proved a set of "no free lunch" theorems about the search process. They show that for a "typical" form of the function describing how the fitness depends upon the position in the space, no search algorithm works better than an examination conducted at random.<sup>7</sup> And it is easy to see that a random search could not, in the available time, produced anything like the complexity one finds in the simplest virus. So, the biological theorist Stuart Kauffman in his *Investigations* (Oxford University Press, 2000) says that the world must contain the right sort of fitness functions. These would be relatively smooth functions, permitting a better and quicker search process in the "fitness landscape." He agrees that

<sup>5</sup> [http://www.infidels.org/library/modern/mark\\_vuletic/dembski.html](http://www.infidels.org/library/modern/mark_vuletic/dembski.html)

<sup>6</sup> William Paley, *Natural Theology* (1802; reprinted Gould and Lincoln, Boston, 1852.)

<sup>7</sup> David H. Wolpert and William G. Macready, No free lunch theorems for optimization, *IEEE Trans. Evolut. Comput.* 1(1):67-82 (1997). The search is like looking for a hill of maximum height in some topography, using local information. It is probably good to walk uphill. That will often take you to the top if there is but one peak. If, however, there is considerably roughness and many local maxima, local information is useless for finding a global maximum.

no algorithm can work in a landscape so rough that it offers you no hint of far-away behavior. So Kauffman escapes the theorem by using smoother functions.

Dembski, in turn, noted an elegant way of escaping from Kauffman's argument. He says that a smooth fitness function is very unlikely. But we seem to see smooth functions in nature. So Dembski more or less says "who ordered them?." He asserts that putting the onus for an effective evolution on smooth functions just postpones the design problem to a different level. And on that level, Dembski demands that we accept the view that ID is the only reasonable answer.

In my view this mode of argument is fully within the traditions of science. Even the invocation of an implausible explanation at the final stage, when the more plausible ways out have been eliminated, is perfectly reasonable and traditional. Faced with this dilemma, Fred Hoyle punted by suggesting the extraterrestrial origin of life.

For myself, I won't look for early life in outer space and I don't believe ID. Not yet anyway. I'll need a lot more evidence to be pushed that way.

Neither Dembski nor Kauffman nor Wolpert and Macready can provide theorems directly treating the evolution of life. "Specified complexity" is somewhat elusive. I think that this concept cannot be defined with sufficient specificity to appear in the premise of a strong theorem while describing real life. The theorems of Wolpert and Macready only apply to generic fitness functions. Any actual fitness function in a pre-biological evolution process must be in the first instance an output from a physical process. The connection between process and function is very imperfectly known. So we are pushed to ask about the nature of the physical processes going on in the first stages of protolife. Then, as we get into real living things, we ask about how additional complexity might grow upon an initial complexity.

Recent work on physical systems provides some hints about how complexity arises. For example, computer studies simulate the cosmology formed soon after the big bang.<sup>8</sup> These studies construct entire universes, intended to be reasonably realistic, within the computers. The models begin with an almost uniform distribution of dark matter and baryons. Weak Gaussian fluctuations are added as random spatial waves. The models then simulate Newtonian motion within an expanding universe. Gravitational instabilities compress regions of high mass density and thereby bring together clusters on a variety of scales. Step by step the computers make

<sup>8</sup> For a review, see, Edmund Bertschinger, Simulations of structure formation in the universe, *Annu. Rev. Astron. Astr.* 36:599-654 (1998).

objects down to the size of galaxies, which even look reasonably realistic. In this way, very rich complexity, but perhaps not Dembski's "specified complexity" has been constructed within a computer program.

Conversely, several studies have looked for increasing complexity and failed to find it.<sup>9</sup> It is likely to be true that some degree of richness in the governing equations is required to produce a cascading complexity. Fluid flow apparently has enough complexity, especially when enriched with chemical or thermal processes. In my own work,<sup>10</sup> I have emphasized the amazing complexity that can arise in a Rayleigh–Bénard cell, where turbulence and thermal effect can work together. These cells engender a multiplicity of structures: mushroom-like plumes, jets, boundary layers, waves, and unexpected reversals of all-over motion. Certainly these structures show a degree of complexity much weaker than that observed in biological systems.<sup>11</sup> But I would argue that the degree of complexity is such that one might doubt the relevance of the free lunch theorems to these systems and by extension to biological systems.

These studies do, I think, isolate questions about physical systems that might, in the end, have some relevance to biology. We should wish to know: When will physical processes generate a cascading growth of complexity? Are those cascades "rare" or "likely?" Indeed there is considerable research showing that chaotic, dissipative physical systems will generate complex structures. Important work related to these issues has been done by Katchalsky,<sup>12</sup> Prigogine,<sup>13</sup> Kauffman and many others. But biological systems show many different levels of organization. Can chaotic physical structures, for example plumes, combine and "self-organize" to produce higher levels of structure—say a weather system? Does this cascading of levels of structure occur generically? When does it cut off? Can it produce things of truly great complexity?

Such questions form the nub of a research program in progress within several different fields and disciplines. The work is diffuse, complex and, appropriately, largely self-organizing. It might provide some parts of the

<sup>9</sup> For example, studies of the discrete dynamical systems called Kauffman K-N models have shown only the most limited growth of complexity, see, L. Kadanoff, S. Coppersmith, and M. Aldana-González, *Boolean Dynamics with Random Coupling*, preprint (2002).

<sup>10</sup> See, *Physics Today*, August 2000.

<sup>11</sup> For a readable description of the wonderful complexity which can be found within biochemistry of even "simple" organisms, see, Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (Simon and Schuster, New York, 1996).

<sup>12</sup> A. Katchalsky and P. F. Curan, *Nonequilibrium Processes in Biophysics* (Harvard University Press, Cambridge, Mass., 1967).

<sup>13</sup> G. Nicolis and I Prigogine, *Self-Organization in Nonequilibrium Systems* (John Wiley, New York, 1977).

answers to the questions asked by Dembski and his collaborators in the world of ID.

We scientists should indeed encourage the godly to quote science for their own purposes. Incisive and persistent questioners make for good answers.