In Defense of Methodological Neutrality: Exorcising the Hobgoblin of Methodological Naturalism

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Methodological Naturalism

versus Methodological Neutrality

Methodological Naturalism

- As a constraint on scientific theorizing, methodological naturalism is the restriction of explanations deemed to be "scientific" to material causes operating within the constraints of physical law in other words, it excludes non-material (super- or supra-natural) causes from the domain of scientific explanations. For all practical purposes, then, this makes methodological naturalists adherents of the Mechanical Philosophy.
- Stated succinctly, methodological naturalism requires explanation in the form of a mechanism instantiating efficient material causality; nothing else will do because any implied need for non-material causality to remedy material insufficiency points to supra-natural causation.

The Mechanical Philosophy and Methodological Naturalism

- There is a good historical reason for this connection between the Mechanical Philosophy and methodological naturalism: the scientific successes of the former *were the catalyst* for the sensibilities characteristic of the latter.
- The Mechanical Philosophy, which helped catalyze the growth of scientific knowledge, grew out of the recognition of the contingency of divine creation in medieval scholastic theology along with the proliferation of mechanical invention in the Middle Ages. It played a role in scientific thought *at least as far back* as the work of Thomas Bradwardine (1290-1349) at Oxford and Nicole d'Oresme (1325-82) at the University of Paris.
- The Mechanical Philosophy sought to explain the behavior of Nature *solely in terms of matter in motion by way of contact mechanisms*. As such, it exemplified the strictures of methodological naturalism.

The Significance of Darwinism

- Some say that the Mechanical Philosophy *purged Aristotelian formal and final causation* from science, but this is *not true*. While a distinctly *non-Aristotelian* emphasis was placed on the search for efficient material mechanisms, formal causes were **retained in the** *design* of the mechanism, conceived as intentional, and final causes were **retained in the** *purpose* the mechanism was designed to serve (the matching of means to ends by Nature's Designer).
- Formal intent realized through purposeful implementation was banished from science by the advent (1859) and acceptance of *Darwinism*, which, while not offering an explanation for life's origin, nonetheless purported to explain the origin of different biological species and the growth in complexity in the history of life by means of *natural selection* acting on *random variations* in populations.
- Darwin's (1876) view of this process was that "there seems to be **no more design** in the variability of organic beings, and in the action of natural selection, than in the course which the wind blows."

From Methodological Naturalism to Scientific Materialism

- This rendering *otiose* of theistic metaphysics as the foundation for science completed the causal closure of the material universe in modern "scientific" conception.
- By the end of the nineteenth century, natural science was regarded as the paradigm intellectual activity and a *model for epistemic rigor* that represented the standard to which all other academic disciplines should aspire.
- Darwin's promotion of *absolute methodological naturalism* in biology as an indispensable criterion for any truly scientific theory, in conjunction with the strong contemporaneous influence of *Hegelian evolutionary historicism*, catalyzed and enhanced the spread of *philosophical naturalism* in the academy. This consequence was strengthened by the fact that *discrete biological design* had been one of the mainstays of *natural theology*.
- Such effects were particularly notable in the fledgling *human sciences* of anthropology, psychology and sociology, which felt bound, in their quest to be truly "scientific," to *emulate the natural sciences* and endorse the principle of methodological naturalism. In their desire for scientific "respectability," anthropologists, psychologists and sociologists so thoroughly naturalized the study of humanity that *we became nothing but material products of our environment*: plastic, malleable, and ever-so manipulable through biological and social engineering.

Methodological Neutrality

- What is *methodological neutrality* in contrast to methodological naturalism?
- It **is** *not* the recommendation that scientific theories be treated instrumentally (pragmatically and non-realistically) so as to set aside metaphysical implications regarding scientific methodology.
- Rather, it *is* the policy of following the evidence to the best theory available, regardless of whether that theory satisfies the strictures of methodological naturalism or entails their denial.

The Limits of Science

There are many areas to which science *cannot* speak directly, and many questions that it *cannot* answer:

- Science *cannot* demonstrate the validity of its various methods

 conjectural, mathematical, experimental, observational as
 a guide to truth, at least not without begging the question by
 employing the very tools in question.
- 2. Science *cannot* be used to argue for the presuppositions that govern its methods, namely, that the Universe manifests a ubiquitous order that is decipherable by the human mind.
- **3.** Science *cannot* speak directly to questions of the ultimate purpose (or any alleged lack of purpose) for human existence or for the Universe as a whole.
- 4. Science *cannot* tell us what we ought to do, what is morally right and what is morally wrong.
- 5. But isn't *methodological naturalism* at least a necessary constraint on scientific explanation?

Does Methodological Naturalism Impose a Natural Limit on Science?

- If scientists wish to retain certain theories and research programs as part of science, then they will have to *reject methodological naturalism* (efficient material causation) *as a necessary constraint* on scientific theorizing, in which case they will have no basis for rejecting intelligent causes, when the evidence warrants them, as explanations in natural science.
- Which theories would scientists have to set aside as violating methodological naturalism (by implying or demonstrating the need for non-material i.e., supra-natural causes) in order to exclude ID? As we shall see, this accurately describes Newtonian gravitation, general relativity, and all manifestations of quantum theory. If this is the price of excluding ID from scientific discussions, is methodological naturalism really worth it?

Of course not.

Is Modern Science Really Methodologically **Naturalistic?**

If a theory is inconsistent with the presupposition of metaphysical naturalism,

it is not methodologically naturalistic

- *Metaphysical naturalism* asserts that the physical universe is all that exists, so the proper understanding of anything must ultimately be given in terms of material efficient causality, that is, *the metaphysical naturalist insists upon the causal closure of the material realm*, for if it is *not* closed, it is open to supra-natural causation.
- Any theory of physical phenomena put forth that is *inconsistent* with metaphysical naturalism that is, which cannot be understood as explaining the behavior of material reality in terms of a closed system of causes and effects involving only material constituents, *implying instead the need for supra-natural causation* must therefore also violate the strictures of methodological naturalism.
- If there are widely accepted scientific theories that, on analysis, reveal themselves to be inconsistent with metaphysical naturalism, we may conclude that *methodological naturalism is not a* de facto *restriction on science*, so it may be set aside when the circumstances warrant it.
- As it turns out, the circumstances have frequently warranted it in physics and cosmology, and there is very good reason to believe the circumstances also warrant it in biology.

Newtonian Gravitation: Problems for Methodological Naturalism

The Mathematical Essence of Newton's Universal Gravitation

Between any two objects in the Universe there exists an *instantaneous* attractive gravitational *force* that is proportional to the masses of the objects and inversely proportional to the square of the distance between them:

$$F = Gm_1m_2/r^2$$

A Debate of Considerable Gravity

- Isaac Newton (1642-1727) *redirected* the Mechanical Philosophy from an emphasis on *corpuscularianism* and *contact mechanisms* to a consideration of *forces*, the *mathematical treatment* of which does not require any account of their *provenance*.
- The fact that the mathematical description of *universal* gravitation seemed to entail instantaneous and unmediated action-at-a-distance provoked much debate and a host of untenable proposals.

The Newtonian Attitude

• While Newton half-heartedly engaged in these debates, he also maintained a certain aloofness from them best captured in the quasiinstrumentalist attitude evinced by his famous "hypotheses non fingo" remark contained in the General Scholium appended to the 1713 edition of his Philosophiae Naturalis Principia Mathematica (1687):

I have not as yet been able to discover the reason for these properties of gravity from phenomena, and *I do not feign hypotheses*. For whatever is not deduced from the phenomena must be called a hypothesis; and hypotheses, *whether metaphysical or physical, or based on occult qualities, or mechanical, have no place in experimental philosophy*. In this philosophy particular propositions are inferred from the phenomena, and afterwards rendered general by induction.

• Of course, it is also no secret that Newton saw God's hand active in the course of Nature, for when speaking of the Solar System he also remarked in the General Scholium that:

Though these bodies may indeed continue in their orbits by the mere laws of gravity, yet they could by no means have at first derived the regular position of the orbits themselves from those laws. Thus, this most beautiful system of the sun, planets, and comets, could only proceed from the council and dominion of an intelligent and powerful Being.

Newton versus Laplace

- Of course, Pierre-Simon de Laplace (1749-1827), in presenting his nebular theory to Napoleon, famously remarked in response to an inquiry regarding God's place in his calculations, "*Sire, I have no need of that hypothesis*".
- Newton might well have responded that Laplace evinced a certain blindness to the *incredible precision required of the initial conditions in his differential equation.* We may also respond by noting that the Newtonian gravitational equations Laplace employed entail *instantaneous action-at-a-distance*, and thus constitute a *non-mechanical mathematical description of gravitational "effects" that have no discernible material cause*, even though a cause is required.
- In short, Newtonian gravitation *violates the strictures of methodological naturalism* by manifesting a lawful instantaneous action-at-a-distance that has no physical explanation, even though it requires a cause (which under these conditions could only be supra-natural). Should scientists therefore have *dismissed* this hypothesis until a non-instantaneous "mechanism" was provided?

Of course not.

Relativity Theory and the Big Bang: Problems for Methodological Naturalism

Einstein's Methodologically Naturalistic Sensibilities

- The fact that in Newtonian mechanics and gravitation the forces of Nature have no materially restrictive conditions on their source or operation, was deeply troubling to Einstein, as was the inconsistency of Newtonian mechanics with Maxwell's electromagnetism (since the latter implied the speed of light did not satisfy the principle of addition of velocities). He offered his solutions to these problems in two stages.
- The first stage, his special theory of relativity, postulated that the laws of Nature should be the same in all inertial frames and that the speed of light in a vacuum was a universal constant independent of one's state of motion.
- Special relativity entailed a radical revision of Newtonian mechanics and established the speed of light as the *limiting velocity for efficient material causality*.

Einstein's Perception of a Two-Fold Need for a General Theory of Relativity

- Special relativity only dealt with inertial motion (bodies at rest or in uniform motion in a straight line). Einstein saw the need for a theory of relativity that would incorporate *accelerated* reference frames as well as inertial reference frames.
- Einstein also saw the need for a new theory of gravitation. Newtonian gravitational force induces acceleration, but Einstein was deeply bothered by the fact that *Newton's theory of gravity allows instantaneous action-at-a-distance*. Since, according to special relativity, the speed of light is the limiting velocity in the universe, *gravitational effects should not propagate faster than light*. A new theory of gravitation that had this consequence was also needed.

The Einstein Field Equations

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = 8\pi \frac{G}{c^4}T_{\mu\nu}$$

- $R_{\mu\nu}$ is the Ricci curvature tensor
- *R* is the Ricci scalar (the tensor contraction of the Ricci tensor)
- $g_{\mu\nu}$ is a (symmetric 4 x 4) metric tensor
- Λ is the Cosmological Constant
- *G* is the **Gravitational Constant**
- *c* is the speed of light in free space
- $T_{\mu\nu}$ is the energy-momentum stress tensor of matter

• In general relativity (GR), the curvature of space-time is related to the distribution of mass-energy according to the *gravitational field equations* given above.

• *Inertial motion in GR is along space-time geodesics*, and since the distribution of mass-energy determines which paths are geodesics, it also determines which paths are inertial and which are not.

• GR entails that gravitational energy is propagated through spacetime by gravitational waves that travel at the speed of light.

General Relativity and Universal Origins

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• Not only does GR predict the existence of black holes as the result of the gravitational collapse of super-massive stars, it also predicts that all past-directed geodesics are incomplete – they cannot be infinitely extended – and therefore that *the Universe itself has a beginning*.

• That all spacetimes have an absolute beginning in GR was demonstrated by the *Hawking-Penrose singularity theorems* proven in the 1960s. That this is true of our Universe is supported by discovery of the Hubble expansion, the existence of the cosmic microwave background radiation, and the conditions required for the nucleosynthesis of the lightest elements in their observed abundance.

The "Big Bang"According to Hoyle ... and Jastrow

• Astrophysicist Frederick Hoyle (1915-2001) stated the reason for his uneasiness about the universe's absolute beginning rather bluntly:

"Many people are happy to accept this position. . . The abrupt beginning is regarded as *metaphysical—i.e., outside physics*. The physical laws are therefore considered to break down at $\tau = 0$, and to do so inherently. To many people this thought process seems highly satisfactory because a 'something' outside physics can then be introduced at $\tau = 0$. By a semantic maneouvre, the word 'something' is then replaced by 'god,' except that the first letter becomes a capital, God, in order to warn us that we must not carry the inquiry any further."

• Hoyle's desire to avoid the intrusion of theism led him to defend steady-state models well beyond the bounds of plausibility. As the agnostic astronomer Robert Jastrow (1925-2008) observed (while simultaneously evincing a truncated understanding of the rational foundations of theology):

"Science has proved that the universe exploded into being at a certain moment. It asks: 'What cause produced this effect? Who or what put the matter or energy into the universe?' And science cannot answer these questions. For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountain of ignorance; he is about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries."

The Big Bang Violates Methodological Naturalism's Explanatory Constraints

- It is an historical fact that the "Big Bang theory" Hoyle's pejorative designation was resisted because it violated the provisions of methodological naturalism.
- Nonetheless, the *overwhelming evidence* for the Big Bang, from its mathematical basis in general relativity, to its evidential foundations in the Hubble expansion, the cosmic microwave background, and the nucleosynthesis of hydrogen and helium, won the day. *The Big Bang is now accepted as the received view in cosmology*.
- Should methodologically naturalistic presumption seek to *reverse this decision* within the scientific community?

Of course not.

Quantum Theory and the End of Material Efficient Causality: Problems for Methodological Naturalism Quantum Theory and Big Bang Cosmology

- Since *the laws of physics break down at a singularity*, many modern cosmologists attempt to deal with the earliest stages of the universe by postulating a "different physics" at the past-boundary of the Universe.
- Since *Big Bang cosmology* tells us that the whole Universe was once very small... they conclude it was once small enough for the whole universe to need a *quantum description*.
- Many cosmologists insist that this "different physics" is a "quantum nucleation event" of some sort that requires the resources of *quantum cosmological description*.
- But does the appeal to quantum theory bring the question of universal origins back within the scope of methodological naturalism? No, it does not.

Overview of the Quantum-Theoretic Argument Against Naturalism

- **P1.** Naturalism is the view that the sum and substance of everything that exists is *exhausted* by physical objects and processes and whatever causally depends upon them.
- **P2.** The explanatory resources of materialism are therefore *restricted* to material objects, causes, events and processes.
- **P3.** *Neither* nonlocal quantum correlations *nor* (in light of nonlocalizability) the identity of the fundamental constituents of material reality *can be explained* or characterized if the explanatory constraints of naturalism are preserved (i.e. if *methodological naturalism* is preserved).
- **P4.** These quantum phenomena *require an explanation* (and the only kind of explanation left is supra-natural)
- C. Therefore, materialism/naturalism/physicalism is *irremediably deficient* as a worldview, and consequently should be rejected as *false* and *inadequate* (as should methodological naturalism).

Spukhafte Fernwirkung: Einstein's Methodologically Naturalistic Sensibilities Revisited

- Einstein had very strong reservations about quantum theory, reservations he expressed in various ways, but none more trenchantly than in the so-called "Einstein-Podolsky-Rosen" Paradox, which in 1935 put its finger firmly on the phenomenon of *nonlocality* (quantum behavior violating special relativity's prohibition of instantaneous unmediated action-at-a-distance) and argued that quantum theory's description of physical reality must be *incomplete*.
- Einstein expressed this concern very colorfully in a letter to Max Born dated 3 March 1947, in which he openly derided the entanglement of wavefunctions in quantum theory that led to the prediction of nonlocal correlations as "spukhafte Fernwirkung" "spooky action-at-a-distance."
- In the 1960s, the Irish physicist John Bell (1928-1990) reformulated *Einstein's conception* of the completeness of physical reality in terms of an inequality ("Bell's Inequality") that allowed it to be *tested against quantum theory*.
- The inefficiency loopholes in tests of Bell's Inequality were closed in experiments conducted at **NIST** in the last ten years, conclusively showing what every other experimental test of Bell's inequality had shown since Alain Aspect's first experiments in 1980: *Einstein was wrong about physical reality quantum theory DOES provide a complete description.*

The Quantum Phenomena

- Quantum Jumps, Quantum Tunneling, and Quantum Teleportation: discontinuous instantaneous jumps between quantized energy shells in atoms; quantum tunneling behavior through classical potential barriers; instantaneous spatial relocation of a quantum entity.
- Nonlocality in QM: the EPR Paradox and Bell's Theorem demonstrate the ubiquitous existence of instantaneous action-at-a-distance.
- Nonlocality in QM/QFT: Measurement induces instantaneous nonlocal collapse of the wavefunction
- Nonlocality in QFT: a local event in the quantum vacuum (the state of the quantum field with lowest energy) can instantaneously produce *any* state of the *entire* field (the Reeh-Schlieder theorem). This is the basis of the "Boltzmann Brain" problem in inflationary cosmology and the String Landscape.
- Nonlocalizability in RQM/QFT: if an unobserved individual particle can neither serve as an infinite source of energy nor be in two places at once, it can be shown the particle exists nowhere in space, i.e., that it doesn't really exist at all. This result holds even if there is a privileged reference frame. In short, there can be no intelligible notion of microscopic material objects.
- Failure of Material Identity in QS: In order for an entity to be a material individual, it must be numerically distinct from other members of its kind in a way that allows differentiation this is not the case for either BE or FD statistics.
- Failure of Material Identity in QFT: field quanta can exist in states of superpositions of particle number, but material individuals cannot exist in numerically indefinite states, so field quanta, whatever they are, are not material individuals.

Feynman's Assessment

"The more you see how strangely Nature behaves, the harder it is to make a model that explains how even the simplest phenomena actually work. So theoretical physics has given up on that."

– Richard Feynman (1918-1988)

No Refuge in Instrumentalism

- Feynman evinces a singularly instrumentalist attitude toward quantum theory one which physicists call *FAPP* (for all practical purposes) but this attitude will hardly suffice to rescue methodological naturalism from the grip of quantum theory's implications.
- If you deny that quantum theory can be interpreted realistically and insist that it only be used instrumentally, you *cannot* then claim that the theory is methodologically naturalistic without *making an assumption about the nature of Nature that begs the very question at issue.*
- This is especially true when the facts of quantum behavior beg explanation – as they do – and when, as we have seen, *no physical explanation of them is possible*. This implies that a non-physical (supra-natural) explanation is required.

No Refuge in Bohmian Mechanics

- Bohmian mechanics (de Broglie-Bohm theory) is an effort to restore causality to quantum phenomena by privileging its position representation and introducing a non-local second-order quantum potential field (or equivalently, a first-order guidance eqution / pilot wave) that renders determinate the trajectories (in configuration space!) of all the constituents of quantum systems.
- Its technical problems are manifold and it ultimately does not resolve the difficulties it sets out to address:
 - Though it solves the measurement problem in the non-relativistic case, the quantum potential field or guiding equation it invokes *carries no energy-momentum*, so it acts in a nonlocal manner that is both *undetectable and non-mechanical*. Since it does not, indeed *cannot* therefore serve the needed role as a physical mediator of *cause and effect* with respect to particle locations, it *violates the strictures of methodological naturalism*.
 - It is fraught with *insurmountable technical problems in the relativistic context*. As Simon Saunders at Oxford University has observed:
 - It is far from clear that it can be cast in a viable Lorentz-invariant form., especially since relativistic pilotwave bosons can travel at superluminal speeds and reverse their direction in time.
 - Fermionic relativistic pilot-wave theory cannot account for particle variability under strong external potential couplings, nor the existence of antimatter, which is wedded to negative energy states in standard RQM.
 - When the pilot-wave approach is extended to *quantum field theory*, as it must be, the appropriation of fields as the fundamental ontological entities of the theory undoes the sole remaining virtue of the non-relativistic theory by *rendering the measurement problem unsolvable*.

No Refuge in Everettian "Many Worlds"

- The *Many Worlds Interpretation (MWI)*, which traces back to Hugh Everett's doctoral work at Princeton under John Wheeler in 1957, "solves" the measurement problem by rather drastic measures: it denies that the wavefunction collapses and maintains instead that *reality itself divides*, with each and every quantum event in the history of the universe, into every quantum outcome that quantum theory says is possible.
- Since the MWI instantly creates entire new universes with each new outcome possibility inherent in the temporal evolution of the universal wavefunction, it would appear that the MWI is *radically nonlocal and non-mechanical*, requiring incessant nonlocal effects that instantaneously produce parallel realities, in clear violation of relativistic constraints on causality. *In other words, aside from its ontological absurdity, the MWI entails unmediated action-at-a-distance, and therefore violates methodological naturalism*.
- Furthermore, there is a technical difficulty that reveals an inherent contradiction at the heart of the MWI's treatment of quantum probabilities: if a quantum experiment with two possible outcomes is performed such that standard quantum mechanics predicts probability 1/3 for outcome A and 2/3 for outcome B, then, according to the MWI, *both the world with outcome A and the world with outcome B will exist*. It is therefore *meaningless* to ask "What is the probability that I will get A instead of B?" because both events will happen, which shows that each has *equal* probability. So whence the *true* quantum probabilities?
- Finally, quantum theory allows infinitely many ways to decompose the quantum state of the universe into a superposition of orthogonal states. So the question arises: "Why choose this particular decomposition and not any other?" Since each decomposition contains an infinity of different parallel realities, the whole approach manifests the characteristics of an infinitely arbitrary mathematical construction incapable of realistic interpretation. But if it cannot be interpreted realistically, the MWI is not a solution of the measurement problem, but at best an instrumental computational gimmick (as Feynman understood his path integral approach to finding the quantum wavefunction to be).

Reverberations from the Microcosm: The End of the Mechanical Philosophy and Methodological Naturalism in Physics

- When we descend into the *microcosm* below us, into the inner workings of what we call "matter," we find what Einstein found and what he objected to: *causal incompleteness* "spooky action-at-a-distance" in the form of events without a physical cause. But any attempt to provide a physical cause for quantum events leads to a theory that is empirically false. So Einstein was wrong about this: *quantum theory is not incomplete*.
 - But if quantum theory is complete, *physical reality must be incomplete*: it lacks an intrinsic (immanent) sufficient cause at the most elementary level of its existence; *it is not self-sustaining*. Since a cause that maintains physical reality in existence is a metaphysical and logical necessity, and no cause *intrinsic* to physical reality itself does this, the requisite cause must be *extrinsic* to physical reality, that is, it must *transcend* physical reality and sustain it (be *supra-natural*). This is what the *Principle of Sufficient Reason* as the bedrock of scientific rationality, indeed, of rationality *simpliciter*, demands.
 - In short, quantum theory spells the *end of the Mechanical Philosophy* at the very bedrock of physical theory and material reality; and this, in turn, spells the *end of methodological naturalism's pretense to govern the natural sciences*.

The Verdict on Quantum Theory

So do we now reject quantum theory as an outstanding piece of 20th century science because it violates the constraints of methodological naturalism? **OF COURSE NOT!** Get serious.

The Information Problem in Cosmology: Problems for Methodological Naturalism

The Goldilocks Universe

Just the right initial conditions

• Just the right natural laws and constants
How Special was the Big Bang? Setting the Stage

- In the observable universe there are about 10⁸⁰ baryons (protons and neutrons). The statistical entropy* *per* baryon in our Universe can be estimated by supposing that it consists of galaxies mostly populated by ordinary stars, where each galaxy has a million solarmass black hole at its center.
- Under such conditions, the statistical entropy *per* baryon (a dimensionless number) can be calculated to be 10^{21} , yielding an observed statistical entropy for our Universe as a whole on the order of $10^{80} \times 10^{21} = 10^{101}$.

Roger Penrose (1931 –)

* In statistical mechanics, entropy is essentially a measure of the number of ways in which a system may be arranged, and is often taken as a measure of "disorder" (the higher the entropy, the higher the disorder, with maximum entropy being present in the equilibrium state). Specifically, this definition describes the Entropy, **S**, as being proportional to the natural logarithm of the number of possible microscopic configurations of the individual atoms and molecules of the system (microstates **W**) which could give rise to the observed macroscopic state (macrostate) of the system as a whole, the constant of proportionality being the Boltzmann constant, **k**_B: **S** = **k**_B**ln(W)**.

Penrose Entropy

- The fine-tuning of universal entropy is essentially the ratio of the volume of the phase-space space of the observed statistical entropy in the universe to the volume of the phase-space for the statistical entropy it could have had emerging from a singularity whose entropy is calculated using the Bekenstein-Hawking formula for black-hole entropy (as if the whole Universe had collapsed into a black hole rather than emerging from it).
- Since 10¹²³ is the natural logarithm of the volume of the position-momentum (phase) space associated with *Universal entropy* in the Bekenstein-Hawking calculation, the volume itself is given by the exponential:

 $V = e^{10^{123}}$; similarly, the *observed* total entropy is $W = e^{10^{101}}$.

For numbers this size, it makes no difference to the order of magnitude of our answer if we substitute base 10 for the natural logarithm, so let's follow Penrose in doing that.

• The required precision in the Big Bang is therefore given by:

[Observed entropy/Possible entropy] = W/V $\approx 10^{10^{101}}/10^{10^{123}} = 10^{(10^{101} - 10^{123})} \approx 10^{-10^{123}}$.

In other words, to satisfy the observed entropy of *our* universe, the Big Bang singularity *had to be fine-tuned to*:

One part in $10^{10^{123}}$, that is,

 $1/10^{10^{123}}$

How Special are the Constants of Nature? Two examples

The strength of the force of gravity

(Newton's gravitational constant) relative to the RANGE of strengths of physical forces: Fine-tuned to 40 decimal places

The rate at which the universe is expanding (Einstein's cosmological constant

> as vacuum energy): Fine-tuned to 120 decimal places

UNIVERSE (REATING MA(HINE



BY THEOS Unlimited





Weak Nuclear Force



Gravitational Constant





Strong Nuclear Force



Ratio of Protons to Electrons



Solar Luminosity



Electromagnetic Constant



Some Comments on the "Multiverse"

- **Multiverse cosmology** postulates there may be more than one universe, and universes different from our own may have different initial conditions, different laws of nature, and different natural constants, thus "explaining away" the design problem created by cosmological fine-tuning using anthropic reasoning. Currently, the most popular form of this idea is the inflationary string landscape hypothesis.
- The problems with multiverse cosmology are many:
 - It's practically impossible to find unequivocal evidence for it.
 - All of the proposed mechanisms for a multiverse are *quantum mechanical*, which means they are *not self-sustaining* (causally autonomous), so a *non-material cause extrinsic to the multiverse is needed* to effect the requisite causal closure. This shows that multiverse theories *violate methodological naturalism* (which must be expected, given their quantum basis, but runs counter to the motivations for proposing a multiverse in the first place).
 - Furthermore, all of the proposed mechanisms for creating a multiverse *require fine-tuning themselves*, that is, every "Universe-Creating Machine" will itself have fine-tuned characteristics that *catalyze a design inference*.
 - If the Principle of Sufficient Reason were false (and it is not false), a materialist multiverse would create a situation in which anything that can happen would happen, and it would happen infinitely many times, and it would happen for no reason at all. This consequence destroys the very foundations of scientific rationality.

The Information Problem in Biology: Problems for Methodological Naturalism

The Place of Design in Nineteenth Century Biology

- We saw earlier that, even with the rise of the Mechanical Philosophy, formal and final causes still played an important role in science: the *formal cause* was evident in the conceptual design of mechanisms and the *final cause* was evident in the purposes they were intended to serve.
- This kind of analysis in the biological realm was the conceptual framework that governed the *Linnaean classification system* in which *structural homologies* were understood in terms of *analogous functions* rather than *common descent* and was also one of the mainstays of nineteenth century *natural theology*.
- It was not until the advent of *Darwinism* that conceptual design and its purposeful implementation were questioned in biology.

Polanyi's Observation about DNA Structure

DNA Backbone

Alternating phosphate and sugar molecules

DNA Information

- 2 strands of nucleotides
- Joined by base pairs
- The N-glycosidic bond that binds the nucleotides to the backbone is chemically indifferent to their identity
- This last condition is essential to the information-bearing capacity of the DNA molecule
- Hydrogen bonding pattern across strands:
 - Adenine : Thymine
 - Cytosine : Guanine

Polanyi's Point: Life Transcending Physics and Chemistry

- The *independence* from the sugar-phosphate backbone to which it is attached of the information contained in the nucleotide sequence is *precisely analogous* to the *independence* from the chemistry of ink bonding to paper of the information contained in your daily newspaper.
- In short, Polanyi's point is that the information content of DNA has no explanation in terms of a physicochemical process, which means that if its origin were the result of purely physical processes, it would have no other cause than the accidental collocation of the requisite atoms and molecules.

Protein Structure

- Primary structure
 - Linear sequence of amino acids
- Secondary structure
 - Curling or folding due to hydrogen bonds
- Tertiary structure
 - Disulfide bridges and other additional bonds that occur because of secondary folding
- Quaternary structure
 - The joining together of more than one polypeptide chain

Protein Folding

- The protein-coding segments of DNA must produce proteins that fold properly in three dimensions, but what is the prevalence of properly folding proteins in the sequence-space of amino acids?
- It is important to recognize that the sequence of triplet-codons along the sugar-phosphate backbone of DNA (or in the mRNA) is *not* determined by any biochemical laws or self-organizational properties in physical chemistry any more than the chemistry of ink bonding to paper explains the daily content of the *Wall Street Journal*.
- Furthermore, the chemical independence exhibited by the nucleotide sequences relative to the backbone of the molecule is essential to the information-carrying capacity of DNA. In other words, there is an in principle reason that the biological information which forms the chemical basis of life has no causal explanation in terms of physico-chemical or biochemical laws or self-organizational scenarios.

The Mathematics of the Design Inference: Specificational and Replicational Resources

- How does one *distinguish* the product of intelligence from the product of chance?
- One way is to give a rigorous mathematical characterization of design in terms of the conformity of an event to a *pattern* of very small probability that is constructible on the basis of knowledge that is *independent* of the occurrence of the event itself.
- When the event in question is the origin of genetic information and the machinery of its replication and translation, this *specificity* is evident in a variety of *correspondences necessary to biological functionality*.
- In assessing the probability of such an event one has to take into account what William Dembski has called *specificational resources* and *replicational resources*.
- Specificational resources are essentially the number of possibilities for biologically functional patterns, and replicational resources are the maximum number of attempts the universe, with its structure of laws and constants, has to generate one of these patterns by undirected means.

Douglas Axe's Work on Protein Folding

- Axe's work leads to the conclusion that we may reasonably expect a *single protein folding domain* to have a probability in amino acid sequence space of about 1 in 10⁷⁴.
- Keep in mind that this is just *one* folding domain (superfamily). If we take one of the simplest known self-replicating systems, *mycoplasma genitalium*, we are looking at about 268 superfamilies (folding domains) that are required to get it off the ground, *each of which has a probability on the order of* **1** in 10⁷⁴.
- The probability of the nonintelligent production of this *minimal self-reproducing unit* is therefore on the order of 1 in $10^{(74 \times 268)} = 1$ in $10^{18,632}$.
- A more reasonable estimate for a suite of biologically functional proteins that might get life as we know it off the ground *requires about 1,000 superfamilies (folding domains)*, in consequence of which we'd be looking at probabilities on the order of 1 in 10^{74,000}.



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The Mathematics of the Design Inference: The Universal Probability Bound

- We may now ask for an *upper bound on the computational capacity of our Universe*. Seth Lloyd at MIT (no ID theorist) has produced a nice result showing that 10¹²⁰ is the maximum number of bit operations that the observable universe could have performed in its 13.7 billion year history.
- Let $\varphi_S(T)$ represent the specificational resources for a minimal suite of functional superfamilies, let P(T|H) represent the probability of the chance occurrence (defined by chance hypothesis H) of an event exhibiting pattern T, and note that 10^{120} places an upper bound on the replicational resources of our Universe.
- If $10^{120} \times \varphi_S(T) \times P(T|H) < \frac{1}{2}$, it is less likely than not on the scale of the whole Universe, with all possible probabilistic resources factored into the analysis, that the pattern can be explained by chance.

The Mathematics of the Design Inference: Dembski's Context-Independent Specified Complexity

Expressing this result in information-theoretic form yields what Dembski calls the *context-independent specified complexity* of the event represented by the pattern T, namely:

 $\kappa = -\log_2[10^{120} \times \varphi_S(T) \times P(T|H)].$

In other words, if $10^{120} \times \varphi_s(T) \times P(T|H) < \frac{1}{2}$, then $\kappa > 1$. So context-independent specified information is present when $\kappa > 1$, and under these conditions, a design inference is warranted.

The Mathematics of the Design Inference: Intelligent Design at the Origin of Life

• If we take 268 to be the lower-bound on the number of folding domains needed for a self-replicating system that could serve as the aboriginal biological unit needed for natural selection to begin, we find that:

 $10^{120} \times \varphi_S(T) \times P(T|H) = 10^{120} \times 10^{2.43} \times 10^{-18,632} = 10^{-18,509.57} \ll 1/2,$

or $\kappa = -\log_2[10-18,509.57] \approx 61,493.59 >> 1$.

• If we retain the more realistic estimate for a suite of biologically functional proteins that might suffice to get life as we know it off the ground, we have instead that:

 $10^{120} \times \varphi_S(T) \times P(T|H) = 10^{120} \times 10^3 \times 10^{-74,000} = 10^{-73,877} \ll 1/2,$

yielding $\kappa = -\log_2[10^{-73,877}] \approx 245,414 >> 1.$

• Either way, there is no realistic possibility that these things happened by non-intelligent means.

Protein-Coding DNA is 1.5% of the Genome: What about the Rest?

- Granted that undirected chemical evolution has little chance of producing DNA that codes for the construction of proteins and the fact that the sequence-specific information encoded in DNA is independent of the sugar-phosphate background in such a way as to make a lawful (self-organizational) account of its genesis intractable.
- Nonetheless, it has been known for over thirty years that only about 1.5% of the genome actually codes for the construction of proteins.
- Since it's hard enough to explain on a methodologically naturalistic basis how DNA could code for proteins, in regard to the origin of biological information, *assuming something like Darwinian processes*, it makes the most sense to *assume* that the rest of the genome is mostly accumulated *evolutionary junk*.

The Idea of "Junk DNA"

"Junk DNA" is DNA that is thought to perform *no function* in a living cell. People who assume that the only essential function of DNA is to code for proteins (the Central Dogma of molecular biology) regard non-protein coding DNA (which constitutes over 98% of the human genome) as junk.

A Recent Example of the Junk DNA Thesis and Its Polemical Use

"Rather than being intelligently designed the human genome looks more and more like a mosaic of mutations, fragment copies, borrowed sequences, and discarded strings of DNA that were jerry-built over millions of years of evolution."

- Michael Shermer, Why Darwin Matters (2006: 75)

The Origins versus Conservation Dilemma for Neo-Darwinism

- A *dilemma* is posed for theories of undirected chemical evolution at the origin of life and neo-Darwinian processes as an explanation of life's increasing complexity over time.
- Since it's already well-nigh impossible to offer a thoroughly naturalistic explanation for the origin of DNA information encoding protein construction, a rigorous application of the Central Dogma suggests we should *dismiss the non-protein coding parts of DNA as "junk"*. Indeed, this was Leslie Orgel's and Francis Crick's instinct:

"Much DNA in higher organisms is little better than junk," they argued, and its accumulation over the course of evolution "can be compared to the spread of a not-too-harmful parasite within it's host." Since it would be unlikely for such DNA to have a function, they concluded, "it would be folly in such cases to hunt obsessively for one." (Orgel & Crick, "Selfish DNA: the ultimate parasite," *Nature* **284** (1980): 604-607.

- Thus you have a clear case of *methodological naturalism* and *neo-Darwinism* as "SCIENCE-STOPPERS."
- On the other hand, if non-protein-coding stretches of DNA are *not* subject to the extensive accumulation of random errors, but rather are *transcribed* into a variety of RNAs, then *evolutionary theory would suggest* the very *conservation* of these non-protein-coding sequences in evolutionarily divergent organisms indicates that they *do have function*.
- And guess what? The greater portion of non-protein-coding DNA, including those stretches thought to be pseudogenes, *is transcribed and conserved* not just withing species, but across hypothesized evolutionary lineages. Go figure. (See the bibliography in Jonathan Wells' *The Myth of Junk DNA* (2011) for extensive documentation in the scientific literature).

"Junk DNA" from an ID Perspective

• *ID predicts* that most of the non-protein coding sequences in the genome *should perform some biological function*, even if they don't direct protein synthesis.

• It is *not denied* that mutational processes might degrade or break previously functional DNA, but *signal* (functional DNA) *should vastly overpower the noise* (non-functional DNA).

• *This prediction has largely been confirmed* over the last 15 years as it has been discovered that non-protein-coding DNA is transcribed into a vast collection of RNAs that have important biological functions.

The Vanishing of "Junk DNA"

Recent scientific discoveries have shown that the non-protein coding regions of the genome:

- (1) Direct production of RNA molecules regulating use of DNA protein-coding regions;
- (2) Regulate DNA replication;
- (3) Regulate transcription;
- (4) Mark sites for programmed rearrangement of genetic material;
- (5) Influence the proper folding and maintenance of chromosomes;
- (6) Control the interactions of chromosomes with the nuclear membrane (and matrix);
- (7) Control RNA processing, editing, and splicing;
- (8) Modulate translation;
- (9) Regulate embryological development;
- (10) Repair DNA; and
- (11) Aid in immunodefense or fighting disease, among other functions.
- (12) In some cases, 'junk' DNA has even been found to code functional genes.

In short, the non-protein coding regions in the genome function much like an operating system in a computer that can direct multiple operations simultaneously.

Stephen C. Meyer, *Signature in the Cell* (2009) and Jonathan Wells, *The Myth of Junk DNA* (2011)

Developmental Computation (1)

Richard Sternberg, a very careful and scientifically productive genomic analyst, has concluded that we need a *new model of the genome that moves beyond the Central Dogma* (DNA makes RNA makes proteins) and neo-Darwinian theory. His reasons for this are three-fold (Wells 2011:106):

1. The information carried by nucleotide sequences – both proteincoding and non-coding – is *bidirectional* (sense and anti-sense), *multilayered* (overlapping), and *interleaved* (exons are punctuated with introns and multiple differently ordered transcription processes take place on the same DNA template.



Richard von Sternberg Senior Research Scientist Biologic Institute

2. Repetitive elements *format and punctuate* the genome at different scales, introducing linear distance and three-dimensional geometric factors that function as a *multi-dimensional filing system*.

3. *Cells can write codes* onto non-protein-coding DNA – as they do in the case of *centromeres* – so the phenotype is *not* reducible to the genotype.

So *the Central Dogma is untenable*. In Sternberg's view, the genome is a multi-level computational device in which many operations occur as interactions among components, a type of computation he calls "*meta-programming*." Furthermore, as already intimated, DNA is *not* a linear code that can be mutated indefinitely to produce new information, but rather functions in a highly specified capacity as one component in a multidimensional system.

Developmental Computation (2)

What is required in embryogenesis is a therefore kind of *nth*-order meta-programming immensely more complex than computations the complexity of which are currently regarded as physically impossible to implement. But cells execute much more in space and time than these programs thought to lie beyond the limits of physical computability. Cells do the ultra-impossible. The complex-specified information in even the very first cell would have had to exceed that of our currently most sophisticated computing machines.



Richard von Sternberg Senior Research Scientist Biologic Institute

What is more, at this point we're only talking about coding for *species-specific embryogenesis*. The *transformation* of any one species into another would require the existence of an even higher-order meta-program that can *rewrite the lower level programs* to produce novel functionality and form. But for this to be true, evolution would be *undeniably goal-oriented* AND require even greater complexity of meta-programming and computational nesting than species-specific computation.

The situation seems to warrant a *very strong ID hypothesis*: (1) Cells engage in a form of computing that is light years beyond what has been thought possible, and this computing requires a logical depth that exceeds anything we have ever built or even schematized; and (2) The systems architecture of *this kind of computation makes evolvability a (near) impossibility*.

Evolutionary Informatics

The intractability of evolution in biological systems has led some researchers to try to demonstrate its vitality *in silico*. This has led to a whole discipline of computational biology offering examples of supposedly blind "natural selection" operating on "randomly" mutating entities in a virtual environment, and to a host of theorems about evolutionary algorithms and what they can and cannot achieve.

ID theorists have been contributing to this literature for some time, but have really stepped up their game in the last five years with the creation of the **Evolutionary Informatics Lab** that Bob Marks founded (see <u>http://www.evoinfo.org</u>), which has produced some seminal results on the conservation of information.



Robert Marks Evolutionary Informatics Distinguished Professor of Computer Engineering Baylor University

To be brief, if *p* designates the inherent difficulty (probability) of finding a target *T* in a search space Ω via a *blind* or *null search*, the information-theoretic measure of this, which Marks and Dembski call the *endogenous information*, is the base two logarithm $I_{\Omega} = -\log(p)$. Calling any search *S* that does better at locating the target an *alternative search*, and noting its probability of success is q > p, they call $I_S = -\log(q)$ the *exogenous information*. The *active information* is then defined as the difference between the endogenous and the exogenous information, $I_+ = I_{\Omega} - I_S = \log(q/p)$. The active information therefore measures the amount of information that has to be added (+) to a null (blind) search to raise the probability of success by a factor of q/p.

Evolutionary Informatics and ID

Various well-known evolutionary models – from the simplest, like Dawkin's WEASEL program, to Ray's Tierra program, Schneider's *ev* program, and Adami's and Lenski's AVIDA program – are all alternative searches that improve on blind searches by *replacing endogenous with exogenous information*. By doing so, they *fail to account for the active information* that has made a difference to their search.

In this context, Dembski and Marks prove conservation of information theorems in a number of forms. The central lesson of the "Law of Conservation of Information" (LCI) is that active information obeys accounting principles and cannot be acquired for free. In the biological context, this implies that evolutionary processes cannot create from scratch the information they need for a successful search.

In the context of evolutionary computation, intelligent design research focuses on tracking how evolving systems incorporate, transform, and export information, and in particular, distinguishing between internally generated and externally applied information in assessing evolving (changing) systems. Active information always constitutes a driving force in targeted evolutionary change, and as Dembski and Marks (2011: 394) explain:

"Tracking and measuring active information to verify intelligent design is readily achieved experimentally. Consider, for instance, that whenever origin-of-life researchers use chemicals from a chemical supply house, they take for granted information-intensive processes that isolate and purify chemicals. These processes typically have no analogue in realistic pre-biotic conditions. Moreover, the amount of information these processes (implemented by smart chemists) impart to the chemicals can be calculated. This is especially true for polymers, whose sequential arrangement of certain molecular bases parallels the coded information that is the focus of Shannon's theory of communication. In such experiments, a target invariably exists (e.g., a simple self-replicating molecule, an autocatalytic set, or a lipid membrane).... In such information-tracking experiments, the opponent of intelligent design hopes to discover a free lunch. The proponent of intelligent design, by contrast, attempts to track down hidden information costs and thereby confirm that the Law of Conservation of Information was preserved.."

A Methodologically Naturalistic "Hail Mary" Pass: Eugene Koonin's Assessment

"Despite considerable experimental and theoretical effort, no compelling scenarios currently exist for the origin of replication and translation, the key processes that together comprise the core of biological systems and the apparent pre-requisite of biological evolution. . . The MWO [Many Worlds in One] version of the cosmological model of eternal inflation could suggest a way out of this conundrum because, in an infinite multiverse with a finite number of distinct macroscopic histories (each repeated an infinite number of times), emergence of even highly complex systems by chance is not just possible but inevitable. . . . Specifically, it becomes conceivable that the minimal requirement (the breakthrough stage) for the onset of biological evolution is a primitive coupled replication-translation system that emerged by chance. That this extremely rare event occurred on Earth and gave rise to life as we know it is explained by anthropic selection alone. . . . By showing that highly complex systems, actually, can emerge by chance and, moreover, are inevitable, if extremely rare, in the universe, the present model sidesteps the issue of irreducibility and leaves no room whatsoever for any form of intelligent design."

> Eugene Koonin, "The cosmological model of eternal inflation and the transition from chance to biological evolution in the history of life," *Biology Direct* (http://www.biologydirect.com/content/2/1/15).

Eugene V. Koonin Evolutionary Genomics National Center for Biotechnology Information (NCBI)

Lewontin's Lament

"Our willingness to accept scientific claims that are against common sense is the key to an understanding of the real struggle between science and the supernatural. We take the side of science in spite of the patent absurdity of some of its constructs... in spite of the tolerance of the scientific community for unsubstantiated just-so stories, because we have a prior commitment, a commitment to materialism ... Moreover, that materialism is absolute, for we cannot allow a Divine Foot in the door ... anyone who could believe in God *could believe in anything*. To appeal to an omnipotent deity is to allow at any moment the regularities of nature may be ruptured, that *miracles may happen*."

> - Richard Lewontin, Evolutionary Biologist, Harvard University "Billions and billions of demons," *The New York Review of Books*, January 9,1997: 28-32.

The End of Materialism?

- In the materialist multiverse, *anything* can happen for *no reason* at all.
- In other words, the materialist is forced to believe in *random miracles* as an explanatory principle.
- In a theistic universe, *nothing happens without a reason*. "Miracles" are therefore intelligently directed deviations from divinely maintained regularities, and thus are *expressions of rational purpose*.
- Scientific materialism is *epistemically selfdefeating*: it makes scientific rationality impossible.



The Theory of Intelligent Design Defined



Certain features of the universe and of living systems are *best* explained as the result of an *intelligent cause* rather than an *undirected natural process* (like brute chance within the matrix of physical law or natural selection acting on random variation).



The Basis of Intelligent Design in Science

- 1. The Origin of the Universe and the Discovery of the "Fine Tuning" of the Laws and Constants of Physics
- Discovery of the Confluence of Independent Physical Factors Contributing to Earth's Habitability and Science-Friendly Environment
- **3.** The Origin of Life and the Discovery of Hierarchically Ordered Digital Information and Information Processing Systems in the Cell
- 4. Discovery of Irreducibly Complex Molecular Machines and Circuits in Living Organisms
- 5. Inferences based upon our Knowledge of the Cause and Effect Structure of the World

Some ID Predictions in Biology (1) (From Meyer 2009 & Wells 2011)

- 1. No undirected process will demonstrate the capacity to generate 500 bits of functionally specified information starting from a non-biological source.
- 2. Informational accounting will reveal that sources of active information are responsible for putatively successful computer-based evolutionary simulations.
- 3. The functional sequences of amino acids in amino acid sequence space should be extremely rare rather than common.
- 4. Future experiments will reveal that RNA catalysts lack the capacities necessary to render the RNA-world scenario plausible.
- 5. Informational accounting will reveal that any improvements in replicase function in ribozymes are the result of active information provided by ribozyme engineers.
- 6. Investigation of the regulatory and information-processing systems in cells will reveal the use of design strategies and hierarchically nested logic that mirrors though likely exceeds in complexity the strategies implemented by computer engineers.
- 7. Cell biologists will find regulatory systems that function in accord with a logic that can be expressed as an algorithm.
- 8. If ID played a role in the origin of life, but not subsequently, prokaryotic cells should carry amounts of genetic information that vastly exceed their own needs (or retain evidence of having done so), and molecular biology should provide evidence of structures at the base of life that are rich in specified information exceeding the generative capacity of undirected physical processes.

Some ID Predictions in Biology (2) (From Meyer 2009 & Wells 2011)

- 9. If a designing intelligence acted discretely in the history of life, both at its origin and subsequently, then prokaryotes need *not* carry genetic information that exceeds their own needs, but the history of life should show both anatomical and molecular evidence of polyphyly rather than strict monophyly.
- 10. In particular, paleontology should show evidence of sudden episodic infusions of information into the biosphere, and anatomical and molecular homological investigations may well evince discrepancies that are *inconsistent* with a single tree of life.
- 11. In the possible case of strong polyphyly, ID predicts that the genome of one species cannot, maintaining continuous functionality, be transformed into the genome of another species by random re-arrangements, since this would compromise the regulatory formatting of the respective DNA molecules.
- 12. If the ID hypothesis is true, then studies of putatively bad designs may well reveal either (a) a hidden functional logic, perhaps related to the constraints of multiple optimization of properties; or (b) evidence of decay from good aboriginal design.

A Helpful Resource

The NATURE of NATURE

Examining the Role of Naturalism in Science



Bruce L. Gordon and William A, Dembski, editors



Photos © László Bencze



Bruce L. Gordon Associate Professor Science and Mathematics The King's College

William A. Dembski Senior Research Scientist Evolutionary Informatics Discovery Institute

Additional Helpful Resources



STEPHEN C. MEYER **Stephen C. Meyer** Director **Center for Science and Culture Discovery Institute**



http://www.evoinfo.org/

SIGNATURE IN THE CELL

DWA AND THE ENDERCE FOR INTELLIGENT DESIGN

http://www.biologicinstitute.org/





biologic

Jonathan Wells Senior Research Scientist Cell and Developmental Biology Discovery Institute

For the Glory of God: **The Place of Science** at a **Christian University**
Christianity, Science and Culture

- The cultural cachet and authority the modern world grants to all things "scientific" puts the activity of scientists at the forefront of worldview-shaping discussions.
- For this very reason, without basic scientific literacy and an understanding of some of the ideas at the cusp of scientific theorization, it is very difficult for Christians to speak into the modern context with credibility and authority.

The Secular Understanding of Science

The necessity for Christian scientific literacy and Christian involvement in the sciences is all the more evident when set against the narrative that shapes modern secular understanding of the significance of science:

- 1. Science is portrayed as advancing at the expense of religion, which is in retreat: science is a "candle in the dark that overcomes the superstitions of a demon-haunted world" (Carl Sagan).
- 2. Science is portrayed as underwriting a naturalistic worldview in which the Universe is causally closed and self-sufficient (Richard Dawkins, Daniel Dennett, Steven Weinberg).
- 3. Science is portrayed as being thoroughly naturalistic in its methodology: its explanations may only appeal to material entities and processes and things that depend upon them.

Secular Scientific Mythology

Every worldview has an account of human origins, human flourishing, and human destiny (a doctrine of creation, a soteriology, and an eschatology). The worldview of secular science is no exception:

- 1. The history of the Universe is to be understood as one of continuous undirected and wholly natural evolutionary development from inanimate Universal origins to the appearance of life on Earth to the advent of humankind in whom the evolutionary process has become aware of itself and able to take hold of the reins of its evolutionary destiny.
- 2. The salvation of humanity rests in the hands of the scientific expert, for it is the scientists who will heal all our diseases, save our environment and our planet from destructive human behaviors, discover the secret of increased longevity and perhaps immortality, and extend our reach beyond this planet to make the Universe our true home.

The Historical Truth (1)

"I do not think, however, that I have even yet brought out the greatest contribution of medievalism to the formation of the scientific movement. I mean the inexpugnable belief that every detailed occurrence can be correlated with its antecedents in a perfectly definite manner, exemplifying general principles. Without this belief the incredible labours of scientists would be without hope. It is this instinctive conviction, vividly poised before the imagination, which is the motive power of research: that there is a secret, a secret which can be unveiled. How has this conviction been so vividly implanted in the European mind?" (ANW, 1925)



Alfred North Whitehead (1861-1947)



The Historical Truth (2)

"When we compare this tone of thought in Europe with the attitude of other civilizations when left to themselves, there seems but one source of its origin. It must come from the medieval insistence on the rationality of God, conceived as with the personal energy of Jehovah and with the rationality of a Greek philosopher. Every detail was supervised and ordered: the search into nature could only result in the vindication of the faith in rationality. Remember that I am not talking about the explicit beliefs of a few individuals. What I mean is the impress on the European mind arising from the unquestioned faith of centuries. By this I mean the instinctive tone of thought and not a mere creed of words." (ANW 1925)



Alfred North Whitehead (1861-1947)



The Theistic Foundations of Scientific Rationality

- Natural explanations are only possible because they are grounded in a *rational* order that is *transcendently imposed* upon the natural realm. Without belief in the existence of such an order, scientific practice would seem little better than reading patterns into tea leaves or chicken entrails.
- The fact that scientific activity is less arbitrary and more useful than such fabrications may be taken as evidence for the existence of just such a transcendently imposed order; indeed, this presupposition is the *transcendental ground* of the very possibility of science as a rational and truth-conducive enterprise.
- As a matter of history, then, it is not surprising that Western science arose in the context of the Judeo-Christian worldview, which understands the Universe to be the contingent creation of a rational God, and its order thus discernible through empirical observation and rational thought.

The Need for Integration

Thirty-five years ago, Nicholas Wolterstorff issued a challenge to the community of Christian scholars and researchers:

"Science and ordinary life can be viewed as on a continuum with respect to the presence of theories and with respect to the actions performed on [as a result of belief in] those theories. What is eminently characteristic of science is the use of theories to suggest and guide research programs.... Everyone who weighs a theory has certain beliefs as to what constitutes an acceptable sort of theory on the matter under consideration. We call these *control* beliefs.... [T]he religious beliefs of the Christian scholar ought to function as *control* beliefs within his devising and weighing of theories. This is not the only way they ought to function. For example, they also ought to help shape his views on what it is important to have theories about. Nor does that exhaust their function. But their functioning as control beliefs is absolutely central to the work of the Christian scholar.... Seldom, however, do the attempts of Christian scholars to 'integrate faith and learning' suggest any research programs within the sciences. I consider this a sign of either a failure on the part of Christian scholars to see how their commitment can and should be related to theory-weighing, or of weakness of imagination. To make some comments at the beginning of a biology course to the effect that all biological reality has been created by God suggests nothing at all by way of any research program within biology. It consists merely of... 'setting within a Christian context.' Christian scholarship will be a poor and paltry thing, worth little attention, until the Christian scholar, under the control of his authentic commitment, devises theories that lead to promising, interesting, fruitful, challenging lines of research." (Wolterstorff 1976/1984: 65, 67, 70, 105-06).

ID is *Not* Creationism

- *Creationism* is a revelation-based concept. It begins with *an interpretation* of Scripture and offers a harmonization of it with *an interpretation* of the results of science (or, in the case of theistic evolution, more often begins with an interpretation of the results of science to which it seeks to accommodate Scripture).
- *Intelligent design* is a theoretical and empirical concept. It provides a conceptual and mathematical characterization of intelligently designed structures and processes, and a methodology for detecting these things wherever they may be found. As such, it follows the evidence wherever it leads and is properly regarded as a scientific hypothesis and methodology.
- It is important to *distinguish the scientific evidence from its implications*. ID is *not* creationism, but its implications, if applied successfully to nature, are broadly supportive of a theistic world-view, and hence should be congenial to advocates of creationism (which has multiple guises ranging across the spectrum from young earth views to old earth views and various species of theistic evolution).

Theodicy as a Red Herring

- It is an unfortunate irony of the debate surrounding ID that various critics of the research program, hardly paragons of theological virtue themselves, have asserted that it is "blasphemous" because, they say, it implies God engages in sub-optimal design.
- Aside from the fact that they are engaging in a time-honored tradition one that traces back to Darwin himself of trying to refute a scientific proposal in biology on the basis of the theological argument that "God wouldn't have done it that way," they also put forward the *ill-conceived suggestion* that Darwinian evolution actually aids in the task of theodicy, as if the resources of a biblical worldview and analytic philosophical theodicy constrained by historical Christian orthodoxy were somehow not up to this task. I assure you, they are up to the task.
- The *ill-conceived nature of this argument* is evident on at least *three levels*: (1) perhaps by equivocation on the mathematical manifestation of degrees of freedom in physical systems, it attributes freedom in the sense of choice-making to insensate material reality, thus committing a *category mistake*; (2) it suggests that God, whom such "theological" critics of ID presumably understand to have created the mechanism of natural selection (whatever the extent of its efficacy) is *not thereby responsible for what it produces*. If we believe that God knows what the mechanism of natural selection will produce, then the suggestion that the mechanism is somehow exculpatory is *obviously incorrect*; and (3) To avoid the conclusion that God can be held responsible for what natural selection produces, some of these critics have suggested that God did not know what the mechanism would produce, but he honored creation's "freedom," and hoped for the best. In other words, God doesn't know the future and he's rather ineffectual. If I might be so bold as to suggest it, if one is looking for "blasphemy" or "heresy," it is more readily to be found among these ill-conceived theological ideas than in the scientific trenches of the ID research program.

On the Alleged "Dangers" of ID (1)

- Should Christians hesitate to take a principled stance on intelligent design for fear they might get some detail wrong and the non-Christian world, which is always looking for grounds to criticize or ridicule Christianity, would then be provided with further ammunition for its attack?
- First of all, let us note that *timidity never won an intellectual or spiritual battle* and this is precisely the situation we are in as Christian researchers, scientists and scholars seeking to overcome the forces of intellectual and spiritual darkness. *We should not be seeking to accommodate* ourselves to the sensibilities of the secular academy, *but rather seeking to transform the very nature of the discussion* by the force of intellectual insights that emerge from our *Christian worldview*.
- The Christian worldview naturally suggests the truth of many ideas. Among these is the notion that *there should be evidence that the world is designed*.
- Of course, the truth of Christianity does not entail that every aspect and artifact of Nature must bear the mark of individual design, but it does entail that every aspect and artifact of Nature that is not subject to the influence of freely acting creatures finds its proper cause in either extraordinary or ordinary providence. (Referring to extraordinary versus ordinary providence rather than primary versus secondary causation is preferable because the former terms are more general and they encompass occasionalist as well as Thomistic models of providence. That occasionalism is the correct view seems to me required by quantum theory's incompatibility with necessitarian conceptions of physical law).
- In respect of ID, then, while *in-principle defeasibility* may be granted to any of its *individual judgments* subject to heretofore unavailable evidence, the idea *that the whole edifice of ID research could collapse is absurd*.
- Furthermore, what does not fall under the category of extraordinary providence must of necessity fall under the category of ordinary providence, so there is no disconfirmation of Christianity provided by the temporary misclassification of an aspect or artifact of Nature in respect of the causal mode of divine action. Understood this way, there is no intellectual price to be paid if ID analysis turns out to be incorrect in respect of this or that phenomenon, regardless of what the non-Christian world might try to claim.

On the Alleged "Dangers" of ID (2)

- To see that what I've just said is true, let me *flip this worry on its head*: what is the price of *not* having the courage of our convictions and always seeking the "innocuous" and gutless path of accommodation?
- Those who would seek to insulate Christianity from science so as to "protect" it *perpetuate the illusion that it is a fairy-tale with no basis in historical reality.*
- To make this point clear, *consider the historicity of the resurrection of Christ*: should we never argue that the *best explanation* of the historical evidence surrounding the life, death, and resurrection of Christ and the beginnings of the Christian church is the fact that Christ actually rose from the dead and the New Testament account is true? After all, if some evidence should come to light that might call into question even one feature of our case, the world might scoff and say that we have no case; better, then, to be Barthian existentialists and claim that the resurrection of Christ belongs to the realm of *geschichte*, not *historie*, so as to *completely insulate Christianity from any possible historical evidence*. Where matters pertaining to the historical foundations of Christianity are concerned, therefore, we should all be *fideists*. Right? No: WRONG, and I trust that everyone sees this.
- Christianity is a *historical faith par excellence*. As the Apostle Paul proclaimed, "If Christ be not raised, our hope is in vain" (*1 Corinthians* 15:14) To this may be added, "If God be not the Creator of all that is, and his hand not evident in the Creation so that men are without excuse (*Romans* 1:20), then our faith is groundless."
- These being the facts of the case, I would think that *intelligent design should be a research program on which all Christians could agree in principle, if not always in respect of the details*. Whether those who eschew ID out of fear for the consequences of being wrong in certain respects, or out of fear for their own professional reputation in the eyes of the world and the security of their own jobs, I would exhort them to have the courage of their true convictions.
- Naturalism, whether metaphysical or methodological in its delusional pretense, is a pathology of the mind and soul. One can trace its etiology as a socio-historical phenomenon, but it has never been necessary as a metaphysical or epistemological constraint on science – indeed, as already argued, it is violated by modern physical theory when properly understood – and its socio-cultural effects, particularly in the outworking of Darwinian naturalism, have been unimaginably destructive.
- While ID is not a panacea for these deleterious consequences, it provides, nonetheless, a strong dose of much-needed anti-naturalistic intellectual medicine. But what is even more important than ID's healthy socio-cultural implications and restorative intellectual power is the fact that the broad picture of the origin and nature of the world that it offers is true, and this is more than enough to recommend it as something the Christian community should advocate, defend, and aggressively advance with a resounding unity of mind, heart and voice.

The Place of Science at a Christian University

It is imperative, therefore, that educated Christians, especially those who work in the sciences, understand:

- 1. The metaphysical and epistemological presuppositions that justify scientific activity as a rational and truth-conducive enterprise.
- 2. The indispensable role of medieval scholastic theology in the origin of modern science and the fact that scientific research is a time-honored Christian vocation.
- 3. That the patina of metaphysical and methodological naturalism that overlays the practice of modern science is conceptually inaccurate and deeply destructive; it needs to be challenged right down to its roots.
- 4. That a theistic worldview provides a natural context for science, and that the analytical resources of intelligent design theory provide a natural tool for the pursuit of scientific theorization and research and one on which all Christians *should* be able to agree.

Not Conformation but Transformation

- "The *fool* says in his heart, 'There is no God.'" Psalm 14:1
- "For [God's] invisible attributes, namely, his eternal power and divine nature, *have been clearly perceived, ever since the creation of the world, in the things that have been made.* So they are without excuse. For although they knew God, they did not honor him as God or give thanks to him, but *they became futile in their thinking, and their foolish hearts were darkened. Claiming to be wise, they became fools*, and exchanged the glory of the immortal God for images resembling mortal man and birds and animals and creeping things."

- Romans 1:20-23

- "Do not be conformed to this world, but be transformed by the renewal of your mind, that by testing you may discern what is the will of God, what is good and acceptable and perfect." Romans 12:2
- "For though we walk in the flesh, we are not waging war according to the flesh. For the weapons of our warfare are not of the flesh but have divine power to destroy strongholds. We destroy arguments and every lofty opinion raised against the knowledge of God, and take every thought captive to obey Christ." II Corinthians 10:3-5

Some Final Helpful Resources

within the Bounds

of Religion



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END OF PRESENTATION

