The Formalism > Physicality (F > P) Principle *

Scirus/Scopus SciTopic Paper

David L. Abel

Department of ProtoBioCybernetics/ProtoBioSemiotics
Director, The Gene Emergence Project
The Origin-of-Life Science Foundation, Inc.
113-120 Hedgewood Dr. Greenbelt, MD 20770-1611 USA

The F > P Principle states that "Formalism not only describes, but preceded, prescribed, organized, and continues to govern and predict Physicality." The F > P Principle is an axiom that defines the ontological primacy of formalism in a presumed objective reality that transcends both human epistemology, our sensation of physicality, and physicality itself. Formalism set in motion and controls physicality.

The F > P Principle works hand in hand with the Law of Physicodynamic Incompleteness. The latter states that:

1. Physicochemical interactions are inadequate to explain the mathematical and formal nature of physical law relationships.
2. Physicodynamics cannot generate formal processes and procedures (e.g., algorithms) leading to nontrivial function.
3. Chance, necessity and mere constraints cannot steer, program or optimize algorithmic/computational success to provide desired sophisticated utility.
4. Physicodynamics cannot explain or generate life. Life is invariably cybernetic. Cybernetics of all kinds are invariably formal and choice-contingent, not chance contingent or "necessary" (physical law-constrained)

Both the physicodynamic force relationships of classical physics and quantum statistical reality conform to mathematical description. The prescriptive mathematical formulae known as "natural laws" are formal, not physical. Why do these mathematical expressions work so well not only to describe, but to predict future physicodynamic interactions? The F > P principle addresses and answers the question of, "The unreasonable effectiveness of mathematics in the natural sciences." This subject has been the topic of multiple Nobel laureate papers.[1-3] Eugene Wigner [4], Hamming [1], Steiner [2], and Einstein [5] all published on the "unreasonable" effectiveness of formal mathematics to describe and predict physical interactions. Einstein, for example, asked,

> "How is it possible that mathematics, a product of human thought that is independent of experience, fits so excellently the objects of physical reality?" [5]

The answer to this riddle lies in the fact that the effectiveness of mathematics in the natural sciences is *not* the least bit "unreasonable." To the contrary, the effectiveness of mathematics is exactly what one would expect if Formalism organized and gave rise to

Physicality. The starting pre-assumption of Einstein was wrong. He initially believed that reality is fundamentally chaotic and disorganized. That alone made the effectiveness of mathematics "unreasonable." Eventually, he realized the "God does not play dice with the universe."

An additional error was to suppose that mathematics was the "product of human thought." Human thought did not create mathematics. Human thought is just progressively discovering mathematics, and its role in cosmic organization. Our empirical experience continues to correspond with the underlying Formalism > Physicality Principle.

Mathematics is the ultimate expression of formal logic. Numerical representation and quantification are highly prized in science. Quantification permits by far the best modeling of physicality. But quantification is formal, not physical. The rational rules of mathematics, logic theory, and the scientific method are also all formal, not physical. Together they provide for reliable prediction of physical events. Scientific method works because the object of its study, objective reality, is itself fundamentally rational

The F > P Principle denies the notion of unity of Prescriptive Information (PI) with mass/energy. The F > P Principle distinguishes instantiation of formal choices into physicality from physicality itself. The "arbitrary" (not random, but freely choosable) settings of configurable switches, and the selection of symbols in any Material Symbol System (MSS), are physicodynamically indeterminate—decoupled from physicochemical determinism. They are arbitrary in the sense of choice contingency, not chance contingency.

The reality of nonphysical formalism

Relationships in nature tend to stay constant despite varying local initial conditions. This constancy is defined by numerical constants. We value laws and the numerical constants they employ because they are invariant in nature (excepting quantum decoherence, for the moment). Invariance is the key to prediction. Despite the variables, universal mathematical relationships exist that tell us how forces and physical objects will interact. The preciseness of quantification in force relationships minimizes subjective factors, objectifying our understanding of physical reality. Most advances in science have resulted from the formal manipulation of these numerical representations. In short, nonphysical formalism is the glue that holds all forms of scientific investigation together.

Other formalisms include logic theory, language, cybernetics, ethics and esthetics. None of these formalisms can be explained by physicality alone within a materialistic, physicalistic, naturalistic worldview. Naturalism looks for derivation of everything though mass/energy interactions and through chance-and-necessity causation. But chance contingency does not explain computational programming, or any other form of nontrivial utility. Logic gates cannot be set to open-or-closed functionality by redundant fixed law, either. If logic gates were set by law, they would all be set to the same position. Logic would be impossible. Binary programs would consist either of all "1's," or of all "0's." No uncertainty would exist, and therefore no Prescriptive Information potential. There would be no freedom of purposeful choice from

among real options. Programming of any kind requires choice contingency, not forced law, and not mere chance contingency.

In the case of evolution, we refer to choice contingency as "selection pressure." But selection pressure cannot steer events towards goals and *eventual* utility. Evolution cannot pursue *potential* function at the decision-node programming level where organization originates. Evolution cannot work at the genetic/genomic/epigenetic/epigenomic programming level where the phenomenon of regulation and control originates (The Genetic Selection [GS] Principle [6]).

Is physicality chaotic, or organized?

How was it determined that reality was initially chaotic, and only physical? Certainly not scientifically. The pre-assumption of ultimate chaos is not only purely metaphysical; it is antithetical to repeated observations of current reality, and to abundant formal prediction fulfillments of an underlying mathematical organization. It is contrary to the logic theory upon which math and science are based. Overwhelming empirical evidence exists that reality is *not* fundamentally chaotic. Not only repeated observation, but innumerable fulfilled predictions of physical interactions based solely on mathematical models is far more suggestive that physicality unfolds according to formalism's ultimate integration, organization and control of physicality.

Materialism has never been empirically or logically established to be absolute Truth. This physicalistic faith system is inherently self-contradictory. No "ism" is physical. Naturalism is illegitimately incorporated into the very definition of science. The term, "Naturalistic science" is an oxymoron. Science is a formal enterprise from beginning to end. "Naturalistic science" exists only in name. Science itself is an abstract, cognitive, epistemological quest of mind. There is nothing "natural" about it, at least as philosophic naturalism would define "natural." None of the formalisms inherent in scientific method can be reduced to cause-and-effect physicodynamic determinism. Mathematics and science cannot be practiced within a consistently held materialistic and naturalistic metaphysical worldview. Neither can cybernetic pursuits—activities involving any form of control.

The acquisition of information "about" reality is a purely formal enterprise. Whatever qualitative aspects of science that cannot be quantified are still dealt with logically. Linguistic logic theory, like mathematics, is also formal. Science also depends upon categorization. Categorization in turn depends upon drawing conceptual conclusions about distinctions between classes of objects and events. Categorization is formal, not physical.

The collection, categorization and organization of data, the reporting of results using representational symbols (e.g. in tables), and the drawing of conclusions are formal enterprises, not physicodynamic interactions. Physicality doesn't govern science. Nonphysical formalism governs science. In short, *formalism predominates,* not physicodynamics.

As Pattee has pointed out many times,[7-11] even initial physical conditions must be formally represented with numbers within the laws of physics. Physical conditions themselves cannot be plugged into the nonphysical mathematical equalities and inequalities that we call "the laws of physics." We insert numerical *representations* of initial conditions. Initial conditions cannot

measure or symbolically represent themselves. Without formal representations of initial conditions and formal manipulations using equations, no physicist could predict any physical outcome.

The essence of any formalism is purposeful choice contingency

Contingency—freedom from determinism—alone is not adequate to generate nontrivial function. Choice contingency is a purposeful selection from among real options. Choice contingency is exercised with directionality for a reason and purpose. The goal of choice contingency is almost always some form of utility that is valued by the chooser.

No computationally successful program has ever been written by a random number generator! Nontrivial programs can only be written by purposeful, wise choices at bona fide decision nodes. Otherwise, "Garbage in, garbage out."

Randomness is contingent, but not formally determinative. To contingency must be added "choice with intent." Randomly occurring events simply do not generate optimized algorithms, computation, nontrivial conceptual instructions, sophisticated programming, or the processing of that programming by devices and machines.[12-14] All formal systems, including mathematics, require *purposeful choice contingency*. Equation manipulations are a form of choice-contingent behavior.

Neither the rules of computation nor the computation itself are physical. More than any other factor, the bottom line of *any* formalism is the exercise of *expedient choice with intent at bona fide decision nodes*.

"Natural process" experiments that purport to have generated spontaneously occurring new programming, computational success, or non- trivial formal function can be shown invariably to be guilty of "investigator involvement" in experimental design and methodology [15]. Artificial rather than natural selection has been introduced.

Choice contingency has been thoroughly distinguished from chance contingency and law-like necessity in prior publications.[13-16] Choice contingency cannot be derived from a combination of the chance contingency and necessity of physicodynamics. Any attempt to extirpate purposeful choice contingency from the explanation of sophisticated function invariably results in the rapid deterioration of that function. Noise replaces meaningful communication with gibberish. "Bugs" and "blue screens" replace programming. Failure to halt replaces successful computation. Nonsense replaces sound reason. No escape exists from choice contingency in any rational explanation of sophisticated function. Sophisticated utility is realized only at the behest of wise purposeful choices—the essence of formalism.

The derivation of formalism

How could purely formal mathematics and biological Prescriptive Information (PI)[17] utilizing linear digital programming choices be derived naturalistically from physicality alone?

Physical explosions (e.g., the Big Bang) do not create mathematical constructs and computational algorithms. The physical laws may have become *apparent* at 10^{-43} seconds. But,

that does not establish that they didn't exist prior to becoming physically instantiated and actualized. In addition, it does not establish that physicality produced those nonphysical formalisms. Indeed, as one of the reviewers of this paper pointed out, circular logic is involved in arguing that Physicality produced formalism which then produced physicality. It is much more likely that the nonphysical formal laws pre-existed the cosmic egg "explosion," and only became apparent at 10^{-43} seconds within the time-space physical medium. If true, the Big Bang was not a chaotic explosion, but a controlled unfolding of prescribed and mathematically controlled physical organization and reality.

The valuation and pursuit of utility and work

The pursuit of functionality arises first out of a desire for and valuation of "usefulness." Inanimate nature (e.g., a prebiotic environment) possesses none of these formal attributes or motives. The environment does not value and does not pursue organization over disorganization. Physicodynamics *can* self-order spontaneously (e.g., Prigogine's dissipative structures of chaos theory: hurricanes, tornadoes, candle flames, falling drops of water forming spheres, etc.). But inanimate nature cannot self-organize itself into formal step-wise processes/procedures (e.g., algorithms) in pursuit of utility. A prebiotic environment had no sense of pragmatism. It exerted no pressure towards function over non-function. Only our minds imagine an environmental preference for function over non-function in order to make our molecular evolution models "work for us." Rationalization prevails rather than progressive communal discovery of what the objective world is actually like.

The postmodern concept of something "working for us" boils down to providing psychological, sociological and seemingly rational support for our already presupposed beliefs. Naturalism is already committed to the metaphysical presupposition that "physicality is sufficient to explain everything." Most of us bring with us this axiomatic pre-assumption *to* science. We were told from an early age on that science requires it. So most of us have cooperated fully with the incorporation of philosophic materialism and naturalism into our very definition of science.

If anyone dares to raise an eyebrow of healthy scientific skepticism about the all-sufficiency of mass and energy at any stage of our education, we are immediately pounced upon, ridiculed, shouted down by peers, and flunked out by professors. If we wait to raise any questions about the all-sufficiency of materialism until after we hold a degree, we are silenced by peer review and journal editors who are true-believers in physicalism. If we are fortunate enough to get a few open-minded peer reviewers, we are still stifled by a concerted effort of physicalists not to cite any paper that dares to challenge the all-sufficiency of physicodynamics to explain the whole of observational reality.

Mass and energy cannot represent meaning or programming choices using arbitrary symbol assignments. Mass and energy cannot state or manipulate mathematical equations. Physicality cannot organize data or draw abstracted conclusions. It cannot predict outcomes or practice any aspect of the scientific method.

Controls and rules, not constraints and laws, achieve pragmatism

Science must follow certain rules. Rules are not laws [18]. Rules are agreed-upon conventions that govern voluntary behavior. Rules exist to guide choices. Rules can be broken at will. Rules govern procedures, competing interests, and ethical behavior. Rules are formal. The rules of the scientific method require honesty in the reporting of results, for example. There is nothing physical about the expectation of and demand for honesty. Science would collapse without adherence to certain ethical standards. We castigate scientists who falsify results or who plagiarize the work of others. Yet it is widely acknowledged that such moral "shoulds" and "oughts" are not derivable from a purely material world. Yet without these metaphysical and ethical demands, science could not be trusted as a source of reliable knowledge. Thus, science depends upon formal values, rules and honest behavior. It cannot be reduced to the chance and necessity of physicality.

Most of what is really interesting in life was produced by choice contingency, not chance contingency or law. The most fundamental problem within naturalistic science lies in explaining how physicodynamic determinism could have produced the bona fide choice contingency that we all observe and practice on a daily basis. The most fundamental question of biology is, "How did law-constrained physicochemical interactions, along with "random" heat agitation, generate a formally prescriptive linear, digital, genetic symbol system?"

Language and any other form of sign/symbol/token system require deliberately choosing alphanumeric symbols from an alphabet of multiple options. Linguistic *rules* of language convention also must be arbitrarily chosen and adhered to. By arbitrary, we mean choice contingent, not chance contingent. Arbitrary does not mean that the chooser flips a coin to decide, or that the chooser does not care what is chosen. In addition to being choice contingent, "arbitrary" also means "unconstrained by natural law." Arbitrariness excludes determinism by law-like self-ordering. Self-ordering phenomena are extremely low in information [15]. High uncertainty and freedom are needed as a pretext to programming. No linguistic or cybernetic system has ever been organized by chance contingency or physicochemical determinism.

All forms of cybernetic programming in computer science are formal. Computational success can only be prescribed through formal choices with intent. The same is true of algorithmic optimization, the engineering of sophisticated function, and organization of any kind. Such formal utility cannot be achieved through after-the-fact selection of the best algorithms. A pool of "potential solutions" first has to exist before optimization is pursued. These stepwise discrete procedures ("potential solutions" are algorithms) must be programmed *at the decision node level*. A mere stochastic ensemble of symbols is not a potential solution.

When Scrabble tokens are dumped out of the box onto the board and lined up upside down in strings, they sometimes contain happenstantial "words" when turned over. But this is only because our minds pick out those random sequences of letters by prior association. They are in reality just as random as any other letter strings. Similarly, a random pool of supposed "potential solutions" are not the problem solutions they are claimed to be. Only our minds select them in pursuit of the solution and optimization we are pursuing. Consciousness is always smuggled in subconsciously in successful Markov processes. Strings of symbols have to be processed to function as programmed computational solutions. This requires either the selection of logic gate

settings according to arbitrary conventions prior to the existence of any function[6], or the reading and processing of these instructions according to previously agreed-upon rules, or both. Optimization requires motivation, the declaration of value, and the pursuit of a desired ever-improving utility. All of these factors are formal, not physicodynamic.

What empirical evidence and prediction fulfillment support do we have for the metaphysical belief that physicality generated formalism (e.g., that physical brain generated mind)? Has anyone ever observed a single instance of chance and necessity generating nontrivial computational function? Has anyone ever observed constraints generating bona fide controls that specifically steer events toward formal nontrivial utility? Do the laws of physics and chemistry ever generate creative new Prescriptive Information (PI)?

Without exception every sophisticated pragmatic tool, machine or mechanistic procedure known to humanity required decision-node programming or integrative configurable switch setting to achieve. No bona fide nontrivial organization has ever arisen without purposeful steering, controlling and regulating the process. Constraints and invariant laws cannot perceive or pursue utility. Constraints and laws could not have generated a single complex machine, let alone life.

Subcellular biocybernetics predates *Homo sapiens* and our cognition

All known life is cybernetic. If one assumes that humans evolved from previous lesser life forms in only the last one thousandth of life's history on earth, it follows that cybernetics predates humans. The simplest known life forms all display undeniable evidence of linear digital prescription using a representational Material Symbol System (MSS)[19,20] and cybernetic regulation.[21] The biosemiosis that produced life, humans and their minds included, is formal. Even at a primordial life level, each ribonucleotide selection in a polymer is a configurable switch-setting.[13,16] It is a memory token in a material symbol system.[22] In a theoretical RNA World, each linear digital symbol sequence (syntax) prescribes a certain three-dimensional configuration space of potential ribozyme function.[6,15,23]

Pre-metazoan life utilizes the same representational symbol systems, linear digital programming, coding/decoding/translation between language/operating systems, and redundancy block-coding for noise reduction. They cannot be attributed to human mentation or heuristics. Neither chance nor necessity can explain these phenomena. Linear, digital, genetic algorithmic programming requires ontologically real selection contingency. Life could have arisen only through selection operating at the covalently-bound level of primary structure formation. Environmental selection of the fittest already-computed phenotypes is irrelevant to the question of how initial genes were programmed. Formally functional configurable switch settings could not possibly have been programmed by physicodynamics.

The destination of any message must have knowledge of the cipher and possess the ability to use it. Deciphering is a formal function—as formal as mathematics and the rules of inference. Deciphering of the source's code and prescriptive intent at the destination cannot be done by the chance and necessity of physicodynamics. An abstract and conceptual handshake must occur between source and destination. Shared lexicographical meaning must exist between source and

destination. Source and destination must be in sync regarding pragmatic significance of the arbitrarily chosen language system in order to create a protocol in a communication sense.

Natural selection is always *post-computational.* Natural selection is *after-the-fact* of relatively bug-free program halting. Environmental selection does not explain how the program got "written." Genetic digital selections must be distinguished from analog dynamic folding and from environmental phenotypic selection. Molecular evolution models of the spontaneous generation of life must be able to demonstrate selection at the covalently-bound decision-node level. No such theory or model currently exists in naturalistic scientific literature. No empirical evidence or rational support exists for attributing genetic programming to stochastic ensembles. This would be like attributing a Ph.D. thesis to nothing but a secretary's typographical errors. Although a stochastic ensemble could happen to match a reference sequence, no operational context would exist for that particular sequence to mean anything metabolically. An entire formal operating system (or several), power plant, and manufacturing factory would have to simultaneously arise from sequence space at the same time and place. Cybernetics is required to generate homeostatic metabolic utility in the face of thermodynamic decline. Since cybernetics is a formalism, and since life at all levels is cybernetic, formalism predates not only *Homo sapiens*, but even invertebrates. Cybernetics cannot be reduced to human mentation. Cybernetics is not just a heuristic tool or metaphorical epistemology generated by our minds [22]. Molecular biological cybernetics produced our consciousness, not the other way around.

Summary of the F > P Principle

The Formalism > Physicality (F > P) Principle states that Formalism not only describes, but preceded, prescribed, organized, and continues to control, regulate, govern and predict physicodynamic reality and its interactions. The F > P Principle is an axiom that defines the ontological primacy of formalism. Formalism is the source of all aspects of reality, both nonphysical and physical. Formalism organized physicality before the fact of physicality's existence. Formalism gave rise to the equations, structure and orderliness of physicality rather than to chaos. This alone explains why the scientific method must be conducted in a rational manner, why the applicability of mathematics to physical interactions is reasonable rather than unreasonable, and why such formalism can predict physical interactions.

The quest for a mathematical unified field of knowledge presupposes the F > P Principle. The F > P Principle further states that reality is fundamentally arbitrary—rule and choice-contingency-based, not indiscriminately forced by an infinite regress of cause-and-effect determinism. Physicality cannot even spawn a study of itself—physics—because physics is a formal enterprise. Nothing within the "chance and necessity" of physicality itself is capable of generating formal logic, computation, mathematical relationships, or cybernetic control. Only formalisms can measure, steer, manage, and predict physicality. Physicodynamics constrains; formalism controls.

The F > P Principle may well be the most fundamental axiom of science, even more fundamental than the laws of thermodynamics. Reality is first and foremost formal; physicality is realized only secondarily. Formalism can be instantiated into physicality through the use of configurable switch-settings, material symbol systems, and through the integration of components into a holistic functional system.

Physicality cannot merge with formalism. Physicality can *be used by* logical formalism, but physicality cannot merge with or control formalism. Only formalism can measure, steer, organize, manage, and predict physicality. The F > P Principle explains why and how design and engineering principles can be incorporated into physicality to render it uniquely functional and/or computational. Physicality cannot do this on its own.

A corollary of the F > P Principle is acknowledgement that humans did not create the formal physical laws; our minds just discovered them. Before our minds existed, physicality obeyed these mathematical rules of physical interaction. Their prescription and control are in no way dependent upon human consciousness. F = ma governed physicality long before human mentation arrived on the scene to recognize such formal relationships.

While the initial formal rules were arbitrary (choice-contingent), once instantiated into physicality they became physical fixed "laws." Their formal prescription and control became translated into fixed invariant directives of physicodynamic determinism. Cause-and-effect chains became "ordered" or forced into regularities. The fundamentally formal rules became physical laws. From the physicality side of The Cybernetic Cut,[21] the choice contingency of the initial rule-writing and instantiation can seem imperceptible. We see only the forced regularities described by the laws of nature. But the prescription of these regularities prior to instantiation into physicality was free, choice-contingent, and purely formal.

This formal rationality extends even to the roles of heat agitation, undetermined degrees of freedom in nature, and stochastic quantum events. Even randomness, chaos and dissipative structures can be formally and mathematically described, defined and predicted.

As we have learned throughout this anthology, it is a logical impossibility for order to have produced PI or organization. The orderliness of nature could not have produced mathematics, cybernetics, language capacity, the scientific method, scientific ethics, and all the other non-material formalisms; rather, it's the other way around.

The F > P Principle, Cybernetic Cut and Configurable Switch Bridge[24-26] all state that the flow of control and organization is unidirectional from formalism to physicality. No reversibility exists between the law-based necessity of physicality and the rule-based choice contingency of formalism. Physicality cannot generate formalism. Phase changes at the edge of chaos, fitness landscapes, so-called evolutionary algorithms, neural networks, cellular automata, and the infodynamics perspective cannot circumvent the F > P Principle. In every case, nontrivial function requires formal, choice-based, behind-the-scenes, artificial selection in experimental design in order to produce nontrivial utility.

Belief in "self-organization" and "emergence" in the absence of choice contingency is blind belief bordering on superstition. It completely lacks empirical confirmation, prediction fulfillment, and rational justification. The hypotheses of "self-organization" and "emergence" are not even falsifiable. What is potentially falsifiable is the null hypothesis that nontrivial *"self-organization does not happen absent choice contingency."* This null hypothesis was first published quite succinctly in peer-reviewed literature around the turn of the millennium [12,27] and

many times thereafter [6,13,15-18,21,28-35]. The scientific community has been rigorously invited to provide such falsification. After a decade, no falsification has been provided. The firm scientific prediction is hereby made that no falsification of this null hypothesis will ever be provided without behind-the-scenes investigator involvement in experimental design (artificial selection rather than natural selection). After another decade or two with no worldwide success at falsification, the above formal scientific prediction should become a mature generalized theory or theorem, if not a tentative law of science. This proposed tentative law states that inanimate physicodynamics is completely inadequate to generate, or even explain, formal processes and procedures leading to sophisticated function (The Law of Physicodynamic Incompleteness). Chance and necessity alone cannot steer, program or optimize algorithmic/computational success to provide desired nontrivial utility.

The time has come to extend this null hypothesis into a formal scientific prediction:

> "No nontrivial algorithmic/computational utility will *ever* arise from chance and/or necessity alone."

How can such a bold, dogmatic prediction possibly be made by any reputable scientist? The answer lies first in the fact that it is just a null hypothesis designed for open-minded testing. The author of the hypothesis himself actively pursues falsification. Its deliberately absolutist tone begs falsification all the more in the challenging spirit of quality science. Second, the hypothesis itself arises from logical inference in addition to seemingly universal empirical observation. The statement is not just a product of inductive reasoning. The latter would be subject to overturning with minimal new data that could arise around the next blind empirical corner. The prediction is rather a logically valid inference enjoying deductive absoluteness within its own axiomatic system. Baring fallacious inference, the only possibility of falsehood would be that the logic flows from a faulty axiom. If a presupposition (pre-assumption about the nature of reality) is "out of touch with reality (ontologic, objective being)" then the prediction might not be "helpful." Unhelpfulness would be realized in the form of a prediction failure. Since no axiom is ever proven, science tends to proceed by assuming an axiomatic system to be tentatively valid, and testing it from many different directions through time. In this sense, all laws of science are considered best-thus-far generalizations subject to continuing experiment falsification.

But, what is the utility of the F > P Principle?

What does the F > P Principle *do* for us? The principle tells us to stop wasting time and hundreds of millions of research dollars trying to explain algorithmic optimization from physicodynamics alone. The Principle states that formal computational function cannot be generated by chance and necessity. Organization cannot be produced by physicodynamic self-ordering phenomena. Organization can only be generated through educated, expedient "choice with intent" at successive decision nodes. Organization arises out of the formal pursuit of desired utility.

Philosophical and metaphysical considerations are minimized in accord with Einstein's tenet of exercising a "minimum metaphysic" in scientific thought. Science, however, simply cannot be practiced competently without presupposing The F > P Principle. We already do this without realizing it. We just need to name and acknowledge the axiom we already

subconsciously presuppose, and scrap the one we consciously incorporate erroneously into the very definition of science.

The axiomatic nature of all laws and principles

The axiom of ontological primacy of Formalism and its governance of Physicality flows from a combination of repeated observation and rational plausibility. It is still axiomatic, of course, as are all laws and principles of science and mathematics. But human experience and reason are far more consistent with the axiom of formalism's primacy than the pre-assumption of chaos and/or physicality's primacy.

It is easy to demand proof of The F > P Principle, and in the absence of proof immediately discount it. This is true of all axiomatic principles. It is not so easy to falsify it, or to find the slightest bit of evidence inconsistent with the Principle. Metaphysical naturalism's rejection of the Principle is purely philosophic, not scientific. The dogmatic pontification that physicality is everything is easily falsified. The bottom line of reality repeatedly traces back to formalism's choice contingency and organization (e.g., the periodic table; the Anthropic Principle, the reliability of mathematical laws to predict future physical interactions).

Like all axioms and "universal" laws, absolute proof of such principles is unattainable. Whether hypothetico-deductive or empirico-inductive, universal principles and laws must be viewed tentatively. At best, they represent "best-thus-far" knowledge. We accept them primarily because they are internally consistent and because they seem to work for us across a broad array of disciplines. Note that both of these criteria are formal requirements.

Principles should support a metanarrative (an over-arching story) of our experience of the whole of reality. We typically have a large sample space of observational data which conform to the principle. Fulfilled predictions made by the principle are especially convincing when they occur in unrelated and unexpected areas of science. But the principle nonetheless must be potentially falsifiable to be considered scientific.[36,37] The F > P Principle is indeed potentially falsifiable. Only one example of physicodynamic causation of a single formalism is required.

Theorems are deduced from unproven axiomatic commitments. We choose to tentatively believe these axioms, and we choose to abide by the rules of logic theory within the deductive systems that flow from those axioms. We presuppose that self-contradiction cannot lead to progressive discovery of an objectivity outside our minds. We obey the rules of inference believing it will lead to pragmatic benefit or some computational utility. Obeying the rules seems to "work for us."

The reason Einstein advocated a "minimum metaphysic" in science rather than banning metaphysics from science was his realization of the inseparability of science from philosophy. He appreciated the axiomatic nature of mathematics and the presuppositional starting point of all scientific logic. The nature of the human condition is such that even scientific knowledge is inescapably finite, perspectival, and tentative. Some ideas must be pre-assumed to be true without absolute certainty. It is a non-sequitur to fallaciously conclude from our epistemological problem that objective reality is relative. Objective reality is exactly what it IS. We can only validly conclude that *our knowledge of* objectivity is subjective and relative, not reality itself.

Short-term usefulness can be provided even by ill-founded axiomatic systems. But long-term usefulness in many unrelated areas strongly suggests that an axiomatic system *corresponds to* objective reality—to the way things actually are. This is the realist's interpretation, at least. For the anti-realist, the centrality of choice with intent is all the more true. The solipsist's dreams of reality are not forced by external constraints and laws. The dream is a formal one, free and unconstrained by physicality or any inescapable objectivity outside of the solipsist's mind. Thus reality for the realist and anti-realist, for the modernist and the post-modernist, is ultimately formal, not physical. The F > P Principle holds either way.

The F > P Principle is nothing new. But it does need parsimonious expression using a formal term, and it needs to take its place as the most fundamental principle of science. It should not be surprising or controversial to presuppose that formalism preceded and controlled the very birth of physicality and physicodynamic relationships (Figure 3). Only dogmatic metaphysical imperatives and a long-standing Kuhnian paradigm rut preclude our admission of the obvious. Physics flows from formalism, not from physicality (its object of study). Physicality cannot explain physicality.

The F > P Principle is fully falsifiable through documentation of a single observed incident of nontrivial spontaneous physicodynamic enlightenment of any formalism. The firm scientific prediction is made that no exceptions to the F > P Principle will ever be observed.

References

1. Hamming RW. The unreasonable effectiveness of mathematics. *The American Mathematical Monthly.* 1980;87(2 February):81-90.
2. Steiner M. *The Applicability of Mathematics as a Philosophical Problem.* Cambridge, MA: Harvard University Press; 1998.
3. Wigner EP. The unreasonable effectiveness of mathematics in the natural sciences. *Comm Pure Appl Mathematicsw.* 1960;13(Feb):The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. – "The Unreasonable Effectiveness "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," in Communications in Pure and Applied Mathematics, vol. 13, No. I (February 1960). New York: John Wiley & Sons, Inc. Copyright © 1960 by John Wiley & Sons, Inc.
4. Wigner EP. The unreasonable effectiveness of mathematics in the natural sciences. *Comm Pure Appl.* 1960;13 (Feb).
5. Einstein A. *Sidelights on Relativity.* Mineola, N.Y.: Dover; 1920.
6. Abel DL. The GS (Genetic Selection) Principle. *Frontiers in Bioscience.* 2009;14(January 1):2959-2969 Open access at http://www.bioscience.org/2009/v2914/af/3426/fulltext.htm [Last accessed Sept, 2017]

Also downloadable from WWW.DavidAbel.us

7. Pattee HH. Laws and constraints, symbols and languages. In: Waddington CH, ed. *Towards a Theoretical Biology.* Vol 4. Edinburgh: University of Edinburgh Press; 1972:248-258.
8. Pattee HH. Physical problems of the origin of natural controls. In: Locker A, ed. *Biogenesis, Evolution, and Homeostasis.* Heidelberg: Springer-Verlag; 1973:41-49.
9. Pattee HH. Evolving Self-Reference: Matter, Symbols, and Semantic Closure. *Communication and Cognition-Artificial Intelligence.* 1995;12:9-28.
10. Pattee HH. Artificial Life Needs a Real Epistemology. In: Moran F, ed. *Advances in Artificial Life.* Berlin: Springer; 1995:23-38.
11. Pattee HH. The physics of symbols: bridging the epistemic cut. *Biosystems.* 2001;60(1-3):5-21.
12. Abel DL. Is Life Reducible to Complexity? In: Palyi G, Zucchi C, Caglioti L, eds. *Fundamentals of Life.* Paris: Elsevier; 2002:57-72.
13. Abel DL, Trevors JT. Three subsets of sequence complexity and their relevance to biopolymeric information. *Theoretical Biology and Medical Modeling.* 2005;2:29 Open access at http://www.tbiomed.com/content/22/21/29.
14. Trevors JT, Abel DL. Chance and necessity do not explain the origin of life. *Cell Biology International.* 2004;28:729-739.
15. Abel DL, Trevors JT. Self-Organization vs. Self-Ordering events in life-origin models. *Physics of Life Reviews.* 2006;3:211-228 Open Access at http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B275DC-214M213J210X218-211&_user=210&_rdoc=211&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=000050221&_urlVersion=000050220&_userid=000050210&md5=000050225ff000051765a000050227e000050223edb000050222caafe025561554f000050225e000050222 Also Downloadable from http://DavidAbel.us Also available from http://lifeorigin.academia.edu/DrDavidLAbel.

16. Abel DL, Trevors JT. More than metaphor: Genomes are objective sign systems. *Journal of BioSemiotics.* 2006;1(2):253-267 Downloadable from http://DavidAbel.us See http://books.google.com/books?id=GvRmYbN253n256UC&pg=PA251&lpg=PA251&dq=David+L.+Abel,+Director+the+Gene+emergence+project&source=web&ots=-ZK254eUDwpz&sig=MAuCnE251IOAFOIO-Ga-E252Y258ht_256E&hl=en&sa=X&oi=book_result&resnum=258&ct=result#PPA251,M251 [Last accessed Sept, 2017] Also available from http://lifeorigin.academia.edu/DrDavidLAbel.
17. Abel DL. The biosemiosis of prescriptive information. *Semiotica.* 2009;2009(174):1-19.
18. Abel DL. Constraints vs. Controls. *Open Cybernetics and Systemics Journal.* 2010;4:14-27 Open Access at http://www.bentham.org/open/tocsj/articles/V004/014TOCSJ.pdf.
19. Rocha LM. *Evidence Sets and Contextual Genetic Algorithms: Exploring uncertainty, context, and embodiment in cognitive and biological systems.* . Binghamton: Systems Science, http://informatics.indiana.edu/rocha/dissert.html (last accessed 1/19/10), State University of New York; 1997.
20. Rocha LM. Syntactic autonomy: or why there is no autonomy without symbols and how self-organizing systems might evolve them. *Annals of the New York Academy of Sciences.* 2000:207-223.
21. Abel DL. 'The Cybernetic Cut': Progressing from description to prescription in systems theory. *The Open Cybernetics and Systemics Journal.* 2008;2:234-244 Open access at www.bentham.org/open/tocsj/articles/V002/252TOCSJ.pdf
22. Abel DL, Trevors JT. More than Metaphor: Genomes are Objective Sign Systems. In: Barbieri M, ed. *BioSemiotic Research Trends.* New York: Nova Science Publishers; 2007:1-15 Downloadable from http://DavidAbel.us See http://books.google.com/books?id=GvRmYbN13n16UC&pg=PA11&lpg=PA11&dq=David+L.+Abel,+Director+the+Gene+emergence+project&source=web&ots=-ZK14eUDwpz&sig=MAuCnE11IOAFOIO-Ga-E12Y18ht_16E&hl=en&sa=X&oi=book_result&resnum=18&ct=result#PPA11,M11 [Last accessed Sept, 2017] Also available from http://lifeorigin.academia.edu/DrDavidLAbel.
23. Durston KK, Chiu DK, Abel DL, Trevors JT. Measuring the functional sequence complexity of proteins. *Theor Biol Med Model.* 2007;4:47 Free on-line access at http://www.tbiomed.com/content/44/41/47.
24. Abel DL. The Cybernetic Cut [Scirus SciTopic Page]. 2008; Downloadable from www.DavidAbel.us also from http://lifeorigin.academia.edu/DrDavidLAbel [Last accessed: Sept 2017].
25. Abel DL. The 'Cybernetic Cut': Progressing from Description to Prescription in Systems Theory. *The Open Cybernetics and Systemics Journal.* 2008;2:252-262 Open Access at https://benthamopen.com/contents/pdf/TOCSJ/TOCSJ-252-252.pdf [Last accessed Sept, 2017]

Also available from http://lifeorigin.academia.edu/DrDavidLAbel [Last accessed Sept, 2017]

26. Abel DL. The Cybernetic Cut and Configurable Switch (CS) Bridge. In: Abel DL, ed. *The First Gene: The Birth of Programming, Messaging and Formal Control.* New York, N.Y.: LongView Press--Academic, Biol. Res. Div.; 2011:55-74 Downloadable from http://DavidAbel.us https://www.academia.edu/33892031/The_Cybernetic_Cut [Last accessed Sept, 33892017].

27. Abel DL. Is Life Reducible to Complexity? Workshop on Life: a satellite meeting before the Millennial World Meeting of University Professors; 2000; Modena, Italy.
28. Abel DL. Life origin: The role of complexity at the edge of chaos. Washington Science 2006; 2006; Headquarters of the National Science Foundation, Arlington, VA
29. Abel DL. Complexity, self-organization, and emergence at the edge of chaos in life-origin models. *Journal of the Washington Academy of Sciences.* 2007;93(4):1-20 Available at WWW,DavidAbel.us.
30. Abel DL. The capabilities of chaos and complexity. Society for Chaos Theory: Society for Complexity in Psychology and the Life Sciences; Aug 8-10, 2008; International Conference at Virginia Commonwealth University, Richmond, VA.
31. Abel DL. The Cybernetic Cut [Scirus Topic Page]. 2008; http://www.scitopics.com/The_Cybernetic_Cut.html. Accessed Last accessed Sept, 2011.
32. Abel DL. The capabilities of chaos and complexity. *Int J Mol Sci.* 2009;10(Special Issue on Life Origin):247-291 Open access at http://mdpi.com/1422-0067/1410/1421/1247 [last accessed: Sept, 2017]

Downloadable from WWW.DavidAbel.us

Also available from http://lifeorigin.academia.edu/DrDavidLAbel [Last accessed Sept, 2017]

33. Abel DL. The GS (Genetic Selection) Principle [Scirus Topic Page]. 2009; http://www.scitopics.com/The_GS_Principle_The_Genetic_Selection_Principle.html. Accessed Last accessed September, 2011.
34. Abel DL. Prescriptive Information (PI) [Scirus Topic Page]. 2009; http://www.scitopics.com/Prescriptive_Information_PI.html Accessed Last accessed September, 2011.
35. Abel DL. Moving 'far from equilibrium' in a prebitoic environment: The role of Maxwell's Demon in life origin. In: Seckbach J, Gordon R, eds. *Genesis - In the Beginning: Precursors of Life, Chemical Models and Early Biological Evolution* Dordrecht: Springer; 2011.
36. Popper K. *Conjectures and Refutations.* New York: Harper; 1963.
37. Popper KR. *The logic of scientific discovery.* 6th impression revised. ed. London: Hutchinson; 1972.