**Theory of Everything**

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ABSTRACT

All cells are little minds. Current theories assume that cognition is a consequence of inherited biochemical programming shaped by natural selection. Major conceptual problems force us to conclude that this causal story is backwards; cognition implies inheritance but the reverse is not true. We assert that all phenotypes are literally minds in Spinoza's sense that mind and body are two aspects of the same thing. We suggest that the primary aim of life, then, is understanding the world rather than survival and reproduction. We propose that cognition is a special case of harmonic resonance that arose in the very first living cells and this process implied the retention of various materials that store information as memories. Some of these memories (DNA, RNA, epigenetic, cytoplasmic, cultural, memetic) became heritable across generations, and through antagonistic and synergistic pleiotropy their interactions cause phenotypes to manifest the cycle of birth, growth, reproduction, and senescence. We suggest also that all minds are best understood as being engaged not in known forms of computation, but in Popperian conjecture and refutation. This is not an argument for theism or against atheism, only for the universal presence of subjectivity in biology.

These are the problems we seek to explain:
(*First, evolution by natural selection is an effect of reproduction but not necessarily its cause. Second, phenotypes often re-order their inherited materials in purposive ways, thereby altering their heritable influences. Third, since the phenotype is not an inherited configuration, survival and reproduction cannot be within its cognitive domain. Fourth, if inherited as a program, complexity would require greater fidelity and, contradictorily, greater plasticity. Fifth, organisms from unrelated lineages often combine facultatively into functional cognitive holobionts or in symbiogenesis. Sixth, antagonistic pleiotropy between inherited influences only explains senescence if target morphologies change with age. Seventh, consolidated sleep, required for cognition, runs counter to all conceivable heritable incentives. Eighth, morphological development preferentially expresses beautiful, non-arbitrary patterns.)*

## WHAT ARE MEMORIES?

A successful theory of life must explain both fidelity and variation. Inheritance-first theories assume that variation comes from random mistakes in fidelity, while a cognition-first theory assumes that fidelity comes from memories. Memories are new variations that are retained with some fidelity if they are useful to understand what is going on. Minds, we could say, are composed of nothing but memories and their uses. We perceive and remember whatever helps us explain the world. Memories are not always retained with perfect fidelity; they are very selectively chosen and often vanish forever. If they are retained we can assume there is a useful role they play in a mind's explanation of the world. Quite often memories are misremembered; they are changed and modified to fit a new understanding. For the same reason, perceptions are often misperceived; minds see what they think they know rather than what they actually see. Perceptions and memories, we suggest, are physical as well as mental, physiological as well as neural, and intrinsic to all biological materials and processes.

## WHERE IS THE REPLICATOR?

Life involves the winnowing of genomes through natural selection, and this process affects evolution. Once reproducing phenotypes exist, much of the change in phenotypes over time can be explained by the influence of the heritable configurations they carry: DNA, RNA, mitochondria, and everything else that is inherited from the initial cell. These heritable materials have influences that affect the reproductive rate of their offspring, thus they cause a process of natural selection that affects the composition of the next generation. This means that there is a recursive loop–reproductive phenotypes cause natural selection, and natural selection affects phenotypes. But is this loop entirely causally closed? Reproductive phenotypes are the only cause of natural selection, but is natural selection the only cause of reproductive phenotypes? An inheritance-first theory of life claims that it is— once you have a replicator that can faithfully inherit material from its mother, the idea goes, then you have a causally complete circuit that can lead to complexity.

This whole explanation rides on whether such a faithful replicator exists. If we had successfully built any such replicators outside biology, maybe our case could rest. We have never built any self-replicating robots or even self-replicating chemical machines that don't depend on many manufactured precursors. DNA self-replicates, in a sense, but then the cell corrects the errors that result from roughly 1 in 1000 down to 1 in 1,000,000. Perhaps the cell is itself designed by the genes for this purpose, but that isn't the only interpretation. The field of origin of life studies has made very little progress since the famous Miller-Urey experiments in the 1952 that showed amino acids could be made from a soup of inorganic minerals in a beaker with continual electrical stimulation. Since then, more and more conceptual problems seem to have accumulated in the field, and now we seem to be further than ever from making a chemical replicator to demonstrate lifelike evolution. This inability to make a replicator to validate the theory presents a bit of a riddle, which is ok, because there is an alternative.

The alternative is that replication is never perfectly faithful, it is only approximately so, because it is the result of a learning, remembering process. A cognition-first theory of life sees all cells as brains. Brains can learn about the world. Memories are replications of an event, but they are not perfectly faithful to the experience. When brains are lesioned, memories are often lost if the part of the brain where the memory was stored or processed has been damaged. But these lost memories can often be regenerated, and they appear in new parts of the brain as the patient recovers. This shows that at least in the case of brains, the specific underlying materials, the small parts, are less important than the overall pattern of interactions the brain engages between itself, the body, and the rest of the world. The only way a lost memory could be recreated is if, after a lesion, the undamaged parts of the brain influence each other to recreate a pattern that existed when the memory was intact. This means the overall multiscale pattern can, at least in principle, organize the underlying parts into a functional arrangement.

If you have ever had the experience of re-entering your elementary school a long time after you left it, you may get a sense of what we mean by "multiscale pattern." You walk the claustrophobic halls, feeling strangely large, noticing the low ceiling, small windows and doorways, the tiny tile patterns on the floor. You gradually remap the experience of being inside this well-known space onto the different hardware your body has become. Your own size, shape, attitude, and perspective is dramatically different, but the space you are in is still intimately familiar. You remember funny episodes from the past, the time a teacher scolded you for putting chewing gum under your desk, the time you kissed Lori in the cafeteria, the books you found in the library and their titles, their stories, their smell and texture. Nearly all the cells in your body have been replaced by now, and they all sit in slightly different relationships to one another. You are a ship of Theseus. And yet, little by little, you feel yourself becoming more like that distant child as you inhabit the school hallways, you expect some of the past to burst into reality as if it had never disappeared. Memories are patterns that are pushed down from outside, as much as a consequence of what is held inside.

Perhaps, in order to exist and reproduce, an organism must always change itself. Perhaps reproduction itself is just a special case of regeneration. Like memories in the brain, organisms could be self-organizing patterns of activity that take on the shape they do because of what they have learned about the world. Memories get into the brain through perception. There are good reasons to believe that all cells communicate in the way that neurons do, exchanging “cross-talk” with their environments and with each other across gap junctions and in other ways that we might call perception.

Consider this example. Planaria are small animals with heads, and brains, that reproduce by fission. This means that when a piece of a planarian is broken off, in normal conditions that piece regenerates into another planarian. This type of reproduction is common in plants, but planaria are the most complex animals to reproduce this way. A planaria can be chopped into as many as 180 pieces, and all the pieces will successfully regenerate. This is amazing but it goes further. If the inheritance-first theory is right, then the body plan of an organism is supposed to reside in its DNA, right? DNA carries the “instructions for life.” The genes are supposed to tell the organism what sort of shape to assume and how to act. Michael Levin and others at the Allen Discovery Center at Tufts University have shown that by directly manipulating the cellular gap junctions with chemicals and photons, thus influencing the patterns of bioelectricity carried between the cells, they can cause a planarian cut in half to regrow a head where its tail is supposed to be. These two-headed planaria, when cut in half again, reproduce into two-headed offspring for an indefinite number of generations. These experiments result in a new two-headed “species” of planaria, a whole new set of behaviors and a novel body plan, without any genetic modifications at all.

## GENES AS MEMORIES

This view of the organism as a mind better explains the influence of genes. The field of biology currently operates under the intuitively reasonable assumption that if genes are used to accomplish a task, then the genes must "code for" that task. This assumption is not necessarily correct because genes could be essential for accomplishing a task without specifying how it is to be done. A steering wheel is essential and always used for driving anywhere, but it does not contain a code telling the car where to go. Our cognition-first hypothesis is that genes and other inherited materials are steering wheels for cells, controlled by cognition which is the driver. They are always used for whatever task is necessary, but do not control how, when, and why the task is to be done.

The failure of the Human Genome Project to identify clear links between nearly all complex traits and particular genes demonstrates that we may have confused the role of genes in biology. Many researchers assume that if turning a gene off or on changes the phenotype, that forces the conclusion that the organism is just a collection of genetic programs. The steering wheel example shows how wrong that could be. The steering wheel is indeed connected to the column and the gearbox and the pitman arm and the tie rods, etc, and changes the direction of the wheels of the car, but even so it is still post facto to a driver.

All cells in the human body carry the same DNA, yet they differentiate into diverse tissues and organs, and they perform learning and other complex functions. If the inherited materials are identical, how do the cells make these epigenetic decisions effectively, changing themselves in just the right way to support the coordinated function of the whole Self? If organisms are minds and genes are memories, it makes perfect sense that a cell knows which genes to turn on and off at which times. A mind always knows which

memories to bring to bear on the situation at hand no matter how novel or strange it may be. That is what a mind *is*.

## WHAT IS LIFE?

The biologist Jakob von Uexküll coined the term *umwelt*, or the "world unto" an organism, to describe the subjective set of sensations only an individual can feel. We propose that all morphologies are temporary patterns reified by resonance with their *umwelten*. Unlike the resonant patterns in non-living resonators like trumpets, cymbals, or raindrops, phenotypes retain memories that inform their resonant patterns with a causal understanding of "what wiggles what" in their umwelten. Memories are partial traces of previous resonant patterns. Since patterns of resonance are waves distributed throughout a resonant system, there is not a sharp distinction between parts and wholes in cognitive function. These memories are both unified and shaped by their participation in the subsequent resonance of the whole self. A phenotype is thus an *explanation* of its world.

This resonance in living systems is clearly not identical to resonance in trumpets, for instance. Trumpets, bells, flutes, as far as we know, do not retain any knowledge of the notes they have played or develop a subjective point of view about the world. The species of resonance we are looking for in living systems, then, is a new, undiscovered process that we call *epistolution*. It is a memory-forming resonance that animates the underlying logic of all living biomaterials, the process that moves them together in harmony in order to accomplish learning and functional development, which is the same thing.

In current neuroscience, memories are often assumed to be instantiated in specific configurations of neurons, but when these brain configurations are damaged, memories can often be recovered. This recovery of memories after brain lesions, for example, demonstrates that memories are not just contained in certain configurations of neurons, but are a distributed property of the relations between living tissues. As resonant patterns, they do not reside in any particular place, but arise as a general property of things moving in concert in a special way. We propose that memory is a property of the harmonic resonance between all the components of all cells and their individual and collective umwelten.

Critically, these components include heritable materials. Some aspects of memory are transmissible through inheritance in the form of DNA, RNAs and cytoplasmic influences. Others are transmissible from phenotype to phenotype in the form of imprinting, communication, and learning. Memories are meme-ories, containing memes and genes utilized together for seamlessly unified purposes, but shared according to distinctly different rules of transmission.

There are two types of memory. Some memories are composed of Shannon information, discretely coded templates that can be corrected for errors up to an arbitrarily high level of fidelity in transmission. DNA is this type of code, and symbolic written information transmitted in human societies is also a templated form of memory. This templated form of information transfer has been well-studied, but much of the significant information necessary for life is not in this digital form. The second, more important form of memory exists in analog influences between the cells of living creatures and between those creatures and their surroundings or other living organisms. The rules for transmission of this second type of information, described as "a difference that makes a difference" by the writer Gregory Bateson, are still largely a mystery. Uncovering the physical basis of epistolution will explain how this type of information becomes meaningful in the context of a cell or organism's struggle to understand its world.

# HOW CAN MINDS SCALE?

If neuroscience currently envisions explanations or worldviews as entities that can only reside physically in human neurons, we propose instead that they reside at other biological scales, i.e. in individual cells, phenotypes, superorganisms, holobionts, in certain populations, or possibly even in the biosphere as a whole. Our primary conjecture is that curiosity and goals are being pushed down from higher levels to lower levels, and also back up again. This is called upward and downward causation.

For example, as a student makes decisions like where to apply for college she rearranges her behavior because she senses that society and her parents demand something from her. She tries to find a match between her desires and the larger system's expectations for her, including moral standards, reward structures, and indicators of status. This is downward causation. Likewise the entire market of education responds to the demand of students like her for educational services and supplies them insofar as all the conditions are present and the people involved can suffice to do so. This is upward causation. The two processes work together to determine both collective and individual behavior.

If the college application process demands that she take up a sport, for instance, maybe she decides to run track. The goals of the collective are then not only pushed down to her as a phenotype but to her individual cells as she trains for the sport. Her metabolism quickens, muscle fibers accumulate, neurons fire new patterns, immune responses strengthen; her entire physiology changes with exercise. As it does, the particular epigenetic markings in all her cells are modified to express different functional expression patterns of DNA. As she sprints around the track, her cardiac cells are sensing that she needs something from them, and they respond to the demands as the heart beats faster. Likewise the demand of her cells for relief dictates how aggressive and successful she becomes as a runner. Again, the upward and downward processes together, all the way from DNA to society as a whole, determine her behavior.

Minds have a property of scaling by these mutual upward and downward influences. Unlike a fixed set of inherited codes, a resonant pattern can learn. New sensations either reinforce or disrupt the resonant patterns already vibrating in the phenotype. Percepts that reinforce can be ignored, while percepts that disrupt must be integrated into the resonance, thus changing the knowledge embodied in the organism. We call this process of learning *incumulation*.

Explain the newt kidney microtubules example in terms of harmonic gestalt. They move into the tubule shape even though they only have one cell because the system has an abstraction that needs to be sensed from the world. The explanation of the newt has to be produced/interrogated/improved with respect to the umwelt, so the material moves into the right shape to do that interrogation. That is where goals reside.

Inheritance is not a morphological message, but an epistemological message. It is saying, "These are the questions we need to answer."

The upshot of (no selection pressure) is that the inherited materials you have to work with only constrain your ability to learn, they do not increase or support or program it.

Why is the thing that is interesting to me interesting to all humanity? Why is the thing that is interesting to my cardiac cell interesting to me? Mary says this is "holonic." To me it is opportunities for knowledge. We sense opportunities. How does that work?

Goals can either come from inheritance or from cognition, not both. They could even come from a form of inheritance that is a tapping-in to the whole memory of the universe (morphic resonance) but this still does not explain the origin of novel functions.

The main paradox we are solving is: if inheritance  scientists default to cognition as an inherited trait bc that makes it predictable, whereas if it is prior to inheritance life is unpredictable. The TO can learn anything and hold any view that makes sense, as long as it is coherent as a view. Its internal config depends entirely on its world, not its inheritance.

DEFINING EPISTOLUTION

The current paradigm in biology uses a story involving inheritance, natural selection, and propensities to survive and reproduce as the explanation for why life behaves in a different way from non-life. This explanation is often considered to be free of teleology, the purpose or primal drive experienced by living creatures, the reason why they do what they do. This claim is false because this explanation *is a teleology.* There is no way to explain the presence of a biological process without explaining what purpose it serves in the mechanism proposed by the explanation. In the current view, that role is always the same; every biological process is an *adaptation*. Karl Popper wrote, “teleology enters the world with adaptation.” We propose that fundamental progress in biology is blocked because this teleology is logically flawed, and should be replaced with a purely cognitive teleology. We claim that, rather than being biotic machines built for self-propagation, cells and all other living creatures pursue the entirely different aim of understanding the world from a subjective point of view. We assume that every living cell is part of a sentient, intelligent, agential self.

To explain the origin of orderly inheritance, cognition must be a property of all cells that is derived from certain universal features, for example perhaps from an ability of ordered states of liquid crystal water and membranes to create and modify memories through interaction with their surroundings. We call this universal cognitive function “epistolution”,  combining epistemology, the branch of philosophy concerned with the ways by which and the reasons why we learn, with evolution. We suggest that experimental research should now focus on uncovering epistolution’s physical basis.

THE PRIMACY OF MEMORY

THE MAIN PARADOXES OF LIFE

A cognition-first direction makes more sense because:

- There is no such thing as selection pressure, so phenotypes should not be able to learn anything without selection (Hume’s problem of induction, solved by Popper).

- Phenotypes can modify their heritable materials, which requires reversed cause and effect.

- Inherited complexity requires greater fidelity, but also greater plasticity, which is a logical contradiction. Acquired complexity avoids this paradox.

- Senescence is best explained by antagonistic pleiotropy between genes, but this only works if the phenotype is aiming at cognizing (changing itself) rather than replicating. Cognition continually

changes the target morphology, while replication is a static target according to which there would be no pleiotropy.

HOLONS

WEIRD INTERLUDE

Everywhere in our exploration of the origins of life and consciousness encounter the chicken and the egg problem. How can chemistry occur without mind to conceive of it? How can we conceive of conjectures and hypotheses without experience to demonstrate what might be plausible, based on what has come before?

GENES FIRST

Those arguing for the genes-first model of life's origins ever run up against six insurmountable conundrums. Regardless of the presence at some times in early Earth of some of the necessary precursors and actual biochemical molecules of life, none of the proponents can account for chemistry's mandates: simultaneity of reagent and substrate; concentration; pH; sorting and purification of products; the need for synthesis in specific sequential order; and chirality, the preference in life for molecules of a specific type of three-dimensional structure. Proponents of various proposed sequences of the evolution of these building blocks resort to leaps of logic and conceptual sleight of hand, such as use of readily available amino acids purchased from chemical supply sources without proposing the origin of these precursors. Many of the basic processes in life appear to be Kantian wholes or Rosen complex systems, circular chemical syntheses where the individual products in the cycle give rise to one another in a sequence with no explanation for a beginning point.

However the problem is not that these conceptual issues have not been solved. The problem is *not* that life could never have arisen from chemical precursors. Before biotic chemistry there logically must have been abiotic chemistry. The problem is that researchers are looking for the chemistry of inheritance rather than the chemistry of cognition. Life could not, in principle, have resulted from a non-cognitive inherited program. Inheritance cannot be presupposed in the origin of life. It must be explained as a result of a cognitive process in all cells.

POPPER AND EPISTOLUTION

Many cognitive theories are based on various forms of inductive reasoning, such as Bayesian probability, but this fundamental idea has long been refuted. In his 1934 book *The Logic of Scientific Discovery*, Karl Popper argued that no knowledge can ever be acquired by induction – building a theory from assembled facts– but only through conjecture itself, followed by rational criticism aimed at refutating the conjecture through contradiction and falsification. Observations, he wrote, are already theory-laden. Without a conjecture to define what counts as an observation, no learning could occur in biological minds.

We interpret the mental/physical state of an organism as a Popperian conjecture about the world. In all forms of perception, attention is focused on the aspects of experience that surprise or refute the conjecture contained in the organism's physiology. New conjectures then arise through harmonic resonance with the umwelt in a pattern of loosening and tightening configurations and relations between all the parts of a phenotype.

Popper could not explain where conjectures actually come from. He simply pointed out that they may arise from dreams, fantasies, inspiration, i.e. non-rational sources. If we apply his epistemology to fundamental biological cognition, we can further explain this process by assuming that conjecture is a process of harmonic resonance. Gestalt features of perception (and explanation) include reification, emergence, invariance, and multi-stability. These features of perception can be derived from harmonic resonance but not from any other known physical process or computational scheme.

## CURRENT AI AGENTS ARE NOT INTELLIGENT

Conjectures are not simply complex statistical algorithms. They underpin a fundamentally different process; a process of very selective comparison. Conjectures allow much more efficient cognitive processes because conjectures allow organisms to disbelieve their own senses and ignore almost all the data. All data that fit the explanation can be ignored; only impossible events must be investigated. We think of them as patterns of harmony, where disharmonic evidence from perception stands out and demands internal adjustment through incumulation.

Conjectures require understanding, not prediction. Any explanation can be converted into predictive probabilities once it has been built, but before this step is possible it is absolutely necessary to build a theory of the world in which entities and forces can be recognized. Entities and forces must be defined in relation to each other, and by these definitions some types of events are ruled impossible and other types of events ruled possible. Conjectures thus make a guess that can be contradicted by specific perceptual artifacts (dichotomous disproof). Prediction was ascribed to cognitive processes because of the assumption that cognition was a computation of the survival value of different actions for the phenotype. This is false; prediction is unnecessary to observe the world and learn from it.

Cognition aims at understanding the present. Understanding the world, producing accurate conjectures, can often provide no predictive power at all. Once you have an explanation, the claims of that explanation can be restated in probabilities, but explanation itself does not require a prediction. What is the probability of the Saints winning the Super Bowl this year? This sort of calculation will be at the end of a series of explanatory stories that a cognitive being can tell, stories involving entities and forces and their required ways of relating to each other. Someone might know a great many things about this question, yet be unable to force a prediction. They might have a lot of background understanding about football players, football fields, and football rules, and be able to describe to a high level of accuracy many aspects of the scenario, but still form no prediction at all because they simply do not follow the Saints.

Popper's scheme is contrary to the inductivist assumption that information itself can tell us how to process it. This computational paradigm is nearly ubiquitous in current scientific disciplines. In all current schemes for biological or artificial intelligence, the appointment of relevance, the assignment of meaning, (called the "grounding problem" in philosophy) is either ignored or presupposed. Careful reflection reveals that this method of conceiving of "intelligence" or "learning systems" or "agents" is fundamentally inapplicable to biology. These computations either do not discriminate between relevant and irrelevant data, or they do so on the basis of a rule applied by the programmer. This is a mistaken paradigm for true intelligence, which is fundamentally open-ended. Biology has no programmer other than the organism itself. The rules of thumb applied to perceptual artifacts are written by the phenotype itself.

Conjectures are not simply computations of probability based on massive datasets. They are subjective points of view. We propose that this is the true basis of biological learning and the plasticity of phenotypes. Algorithms built to process data in a predictable manner are incapable of discovery because

they are incapable of the redefinition of their own observations and refining their own point of view. This is a matter of open-ended internal reflection and reorganization. Epistolution is an algorithm, but it is an algorithm that can in principle reorganize itself indefinitely into richer and richer explanatory structures to infinity. Subjectivity is the ability to sort relevance from irrelevance based on these endogenous configurations and intrinsic rules. We propose that this is the only source of creativity and meaning in the universe.

Imagine a child whose first 100 encounters with cows involved looking through a window out of their house at cows behind a screen of spruce trees. If this child was a probabilistic machine learning algorithm doing unsupervised learning, the construct “cow” and the sound of his mother’s voicing saying the word “cow” would be correlated with windows and spruces and being warm and near mother, among other things. Say one day the child was then on the porch in the cold air, without mother, and saw the cows standing in the field, unobstructed by spruce branches. How would he ever recognize them as cows? The new observation is swamped by 100 previous observations, so correlation between what he sees and the word and concept “cow” will be very low. The “preponderance of the evidence” will always show that these are not cows, so the new association will not even begin to form. Even with massive training sets involving many thousands or millions of examples, current machine learning cannot define distinct entities and forces because it cannot conjecture.

This deficiency is fundamental to probability itself. The computer scientist Judea Pearl argues in *The Book Of Why* that there is not a path from association to causal conjecture. In order to rise up the “ladder of causation,” Pearl notes that one must apply theories to physical actions that test those theories.

## SLEEP IS REQUIRED

Complex cognition appears to require sleep in widely divergent lineages in the tree of life. Not only all mammals, but also intelligent fish, insects, and cephalopods require sleep. Since sleep involves unconsciousness, sensory isolation, and physical immobility, we propose that the harmonic resonance process in all cells consists of two fundamental phases regulated by circadian rhythms. We envision this process as partial crystallization and liquefaction in periodic alternation. In wake cycles, cells absorb waves from their umwelten in the act of perception. In sleep cycles, cells largely resonate only within themselves, thereby strengthening the coherence of the self/nonself distinction required for immune and cognitive coherence and function. Whole-organism sleep cycles in complex life are thus an extension and elaboration of a basic underlying necessity of cognition.

## NEITHER DEIST NOR THEISTS DAMMIT

This paper is not to be misunderstood as an argument for theism. When Darwin first introduced his theory of evolution by natural selection, he conceived of the sources of variation as non-random. In this form, the theory is logically defensible and in full agreement with epistolution. Today, these non-random sources of variation have been replaced by a dogmatic assertion of blind genetic mutation, or else left unexplained entirely. Darwin’s original theory was paired with his assertion that the source of variation was due to a Lamarckian process he called “pangenesis.” Darwin referred to “use and disuse” eight times in the *Origin of Species* by physiologist Denis Noble’s count. We could only find five, but the point stands. Darwin proposed the idea of “gemmules,” tiny packets of informative molecules that traveled around the body and influenced the germline cells. These packets have now been discovered; they are named extracellular vesicles; they are sources of heritable information derived from the acquired state of the soma.

During the twentieth century the Lamarckian sources of variation were stripped out of the theory of life. Mendelian genetics was introduced, and the sources of variation were decreed to be random. We speculate that this transformation of the theory was intended to strip theism of its possible explanatory role. A model of life as a series of random accidents amplified by natural selection did not require a God. However, in this form, the theory of life became transparently false. In their eagerness to explain heritable sources of influence, i.e. “genes,” in their zeal to uncover all the molecular mechanisms in the cell, biological theorists forgot that Darwin’s theory actually required nonrandom sources of variation to make sense at all.

CON ARGUMENT ANYWAY, #1

Even though successful individuals leave more descendents, all those descendents continue to change randomly, thus continuing to erode the potential for any of them to survive. In order for extinction to be avoided in a given lineage, beneficial changes must occur more often than degradation in every average generation.

Since the average number of organisms has steadily increased on Earth rather than decreased, this means that in each generation more organisms have survived on average.

the typical phenotype itself must, on average, develop beneficial changes.
We still have to explain why on average beneficial changes were more likely than degradation in THAT particular lineage.

Let’s imagine the evolution of lineages of organisms as calves on a ranch. Each calf is a discrete lineage of descendants. Let’s say the black and white marking on the calves’ coats represent all the propensities of the phenotypes in that lineage. These markings on each calf change randomly over time: blotches appear or disappear, grow, shrink, and morph into other shapes. Each calf looks different from one week to the next. It is hard to tell them apart without their ear tags.

Let’s imagine that the farmer sorts his calves and sells the fifty calves that have the most asymmetrical hide blotches. This is a metaphor for natural selection. Now, although the mean orderliness has increased in the population by virtue of selling off the disordered, the remaining calves’ hide blotches are no more symmetrical than they were before being sorted. They have just been standing there watching, chewing their cuds. Although the least orderly have been removed from the population, the remaining calves have not had their hides altered in any way. These remaining calves’ coats continue to change just as they would have anyway without the sale.

This example illustrates the first fatal problem with a genes-first theory of life. Natural selection cannot alter the propensities of organisms that avoid it. This is the philosopher Karl Popper’s argument against the existence of “selection pressure,” expressed in his unpublished essay, “A World without Natural Selection but with Problem-Solving.” Although natural selection may change the mean orderliness of the population, it does not pressure the remaining individuals to become more orderly than they already were.

Now suppose the farmer must sell all the calves whose markings become asymmetrical. How many days will it be until the farmer must sell all his calves? The correct answer is “not long.” Is it relevant that the more asymmetrical calves have already been sold? No.

Suppose there is one calf whose coloration always changes in a symmetrical fashion, thus it is never sold. Is this random? Not unless it occurs entirely by chance, which in this context means that each

change is statistically independent from symmetry. If it is not, then it comprises a nonrandom form of order that must be explained by some other principle. Random changes are by definition not changes with a tendency to be symmetrical. Just as a coin flip is no more likely to hit heads after a streak of tails, even if one million symmetrical changes occurred in a row, the next random change would be no more likely to increase the symmetry of the blotches.

This example illustrates why, given the premises of the genetic theory of life: even with natural selection, random changes eventually should cause fatal degradation extinguishing all life. These examples are metaphors, of course, for lineages that mutate over generations in ecosystems, lineages that are reproducing and undergoing natural selection. The principle of inheritance of random mutations still carries the same degradative force.

Critically, the length of evolutionary history is not relevant to the argument. Random mutations degrade the orderliness of a system (or a lineage of heritable phenotypes) no matter how many useful mutations have already accumulated. No matter how many “happy accidents” there are in the history of a system, it does not increase the likelihood that new random alterations will be functional. In fact, the more complex a system becomes, the more likely random mutations are to be harmful to it, because the more improbable the configurations become that are required to sustain a more complex order.

Many people, including some biologists, make an intuitive mistake when they imagine evolutionary history. They think of natural selection as a corrective force, somewhat like the bumpers applied to the sides of a bowling lane when kids are in a bowling alley. The bumpers nudge the ball back into the middle of the lane. This is what many imagine happens when more fit organisms reproduce more. But natural selection is not a bumper, and it does not nudge the ball, no matter how much reproduction happens. It is just a gutter, removing potential lineages from the population.

Due to random molecular perturbations and Brownian motion, a pool of liquid water could, in principle, pile itself up into a perfect replica of the statue of Venus de Milo purely by chance. If it did so, the fact that it had arrived at that improbable configuration would be no guarantee that it would stay that way for long, even if many other pools of water that were not shaped like Italian statues had been drained by their owners. If it did stay that way, we should want a better explanation for why.

The above argument is an exposition of a principle which is fatal to the worldview of the genetic explanation for life. A propensity to survive and reproduce is never logically entailed by inheritance and natural selection, no matter how long selection has been going on. If phenotypes took random trajectories through the space of all physically possible configurations, it would not be long before they all encountered fatal configurations. Without some entirely separate universal cognitive principle at work that creates and maintains orderly inheritance, ensuring that mutations are nonrandom with respect to function, lineages of organisms would be no more likely to stay adapted to the conditions of life after having been through trillions of rounds of natural selection than they were in the very first generation.

On this basis we can see that natural selection offers no explanatory value at all in establishing the physical difference between life and non-life.