# Polanyi's "Cosmic Field"—Prophetic Faith or Religious Folly?

Aaron Milavec

milavec@fuse.net

Third Draft for Polanyi Conference

Notice: This ms. represents my best thought as of 08 June 08. My actual presentation will be an evolved and shorter form of this paper. Any suggestions—even at the last minute—are welcome.

In the year 1208, Francis of Assisi and his band of followers could look up into the sky at twilight and marvel at the fact that as God was putting away the sun into its place of rest under the sea while his angels were, at the same time, lighting distant bonfires as beacons whereby night travelers and sailors could steer their course. In the eyes of Francis and his contemporaries, "brother sun" and "sister moon" were continually being assigned their rightful places by a host of spiritual beings who served man's interests humbly, faithfully, and without reward. This was the spiritual lesson Francis learned from his astronomical observations.

In our own day, the vision of Francis is reserved to a small minority of simple souls and poets. Modern astronomy, armed with the Newtonian laws of gravitation looks up into the evening sky and senses that the massive satellite that we call "earth" is turning its face away from our local star that we have traditionally called "our sun." As the ambient light decreases, the iris of every animal and human eye gradually enlarges to admit more light and to take notice that the cold and impersonal cosmic void surrounding our earth-satellite is littered with billions of massive stars that have been randomly flung into their respective places by a Big Bang that erupted ten billion years ago. Each of these massive fireballs in the night sky are in various phases of being born, maturing, or dying out—all according to the impersonal laws of nuclear physics and celestial mechanics. As in the case of our own star, not a single one of them ever gives a fleeting nod to the prayers of our saints or to the telemetric data being gathered by our space probes. The lesson learned from these observations is that we are utterly alone in a universe that takes no notice of whether we laugh or cry, get sick or die.

In the year 1208, Francis of Assisi could raise his eyes upward and imagine Jesus ascended into heaven and sitting at the right hand of the Father. On the last day, when the stars fall from heaven and the light of the sun goes out, Francis anticipates that this Jesus will have his Second Coming to earth to rescue the righteous and to bring them up with him into their heavenly reward.

In our own day, the vision of Francis is reserved to a small minority of simple souls and poets. Even if Jesus did rise up into the heavens (as Acts 1:9 claims), a reflective scientist can calculate that, given his forward momentum, he might, after two thousand years, be just now reaching the outer limits of our solar system. His body, of course, has long been completely dehydrated and his flesh[1] has been burned beyond recognition. He had, you see, no climatized space suit to protect his fragile skin as he rose into the thin air of our atmosphere. Likewise, there never was nor ever will be any loving arms to receive him at the end of his space flight.

I begin my examination of Polanyi with a stark reminder of just how massively the emergence of modern science has challenged the Christian worldview of an earlier era. Polanyi, needless to say, was himself sympathetic to the Christian worldview at the same time that he was a hard-headed practicing scientist. Vigorous debates have arisen within the Polanyi Society as to (a) how Polanyi viewed the ontological status of "God" and (b) how the quest for truth within religion coincided with and differed from the pursuit of truth in science. In the past, I tried to show how Richard Gelwick and Elizabeth Sewell found encouragement for their faith in and adherence to Christianity from Polanyi while, at the same time, Marjorie Grene and Harry Prosch found further support for their faith in and adherence to agnosticism.

My purpose today is to examine the final section of PK. In these chapters, Polanyi dismisses the notion that the "evolutionary achievement" (385) that culminates in the consciousness and responsible personhood exercised by humans could be accounted for in terms of random mutations and survival of

---

[1] Not even Jesus' soul survives, since the notion of an eternal soul is merely an empty Neoplatonic myth that got carried over into medieval Christianity. Even biblical scholars recognize today that Jesus and his Galilean band of followers had no idea whatsoever that they had or needed an "eternal soul" to insure that they could or would enter into everlasting life.

the fittest. Just as Polanyi fiercely opposed the inadequacy of objectivism to account for progress in science; in parallel fashion, he objected to the inadequacy of neo-Darwinism to account for progress in biological evolution. On the constructive side, Polanyi suggests that morphogenetic fields guiding embryonic development and philogenetic fields guiding evolutionary development find their parallels in the heuristic fields guiding the advancement of knowledge. In his closing words of PK, Polanyi envisions these fields as spin-offs of a universal "cosmic field" that harmonizes with what Christians mean "when worshipping God" (405). Polanyi thus closes **PK** with an outburst of religious sentiments that parallels Darwin's final words in the **Origin of Species**. And my question is-- Is this Polanyi's prophetic faith or his religious folly?

## How I began this project

I began this project because I was vaguely aware that Marjorie Grene, a professional philosopher with a special interest in modern biology, was very critical of Polanyi's final chapter. Phil Mullins has admirably traced how, from 1952 to 1958, Marjorie Grene worked closely with Polanyi as he labored during six years to revise his Gifford Lectures for publication. Mullins tells us:

> She [Grene] reports that she was "delighted" to join in Polanyi's struggle to do what he called "'articulate the inarticulate'" and that one of her first tasks in working with Polanyi was to find for Polanyi in the literature of biology "heresies in evolutionary theory, specifically critics of the evolutionary synthesis."[2] (Mullins: 2).

In her letter to J.H. Oldham, dated 12 May 1958, Grene thanks Oldham for his criticism of the final chapter sent to Polanyi a year earlier and suggests that, thanks to their combined support, Polanyi did "do it over--and . . . achieved absolutely the right finale." [3]

This euphoria, however, did not persist. Although always an advocate and capable interpreter of Polanyi, Grene in her later years expressed how unprepared both she and Polanyi were to interpret evolutionary theory in 1958 and how she had, over the years, **"**grown more skeptical about cosmologies of emergence in any form."[4] Having recently read Richard Dawkins, *The God*

---

2 PT, 91.
3 Grene letter to Oldham, May 12, 1958. 10.4. Oldham Archive, Edinburgh University Library.
4 "TK," 168.

*Delusion* (2006), I now believe that I understand better why materialistic geneticists would be prone to entirely dismiss Polanyi's final chapters as poorly informed about the power and beauty of neo-Darwinism. Even Polanyi, at one point, remarks that the field theories that he appeals to are "finalistic" and bound to be rejected by biologists such as Dawkins because they impute to living organisms "magical powers which could explain anything—and hence explain nothing" (PK:399). This, by the way, is the principal reason that both Polanyi and Dawkins systematically refuse to appeal to any form of divine intervention when talking about evolutionary development.

**My paper is divided into three parts. In the first two parts, I intend to briefly explore three things Polanyi got wrong followed by three things that Polanyi got right. In the final section, I will show how some sectors of contemporary microbiology are finding mechanism that guide evolutionary development—just as Polanyi expected they would. Despite limitations, therefore, I shall conclude that Polanyi's surmise that there are philogenetic forces guiding evolution has the prospect of being embraced by modern science.**

## Where Polanyi Got Things Wrong

1. **Man as the evolutionary apex**– Polanyi takes for granted that biological evolution has come to it's pinnacle in "man" as "the most precious fruit of creation" (PK:385, SM;86). This entails a very short-sighted and self-serving view of creation. Are not dolphins and eagles and cockroaches "most precious" in their own right and "more fitted for survival" in their own ecological niches? And by what accounting can "man" be regarded as "most precious" when, in such a short period of time, his species has recklessly destroyed the natural habitat and hunted nearly to extinction hundreds of species (bison, wolves, whales)? Is it even possible that man's industrial waste will soon bring a permanent death to the evolutionary chain of life as we know it on the planet earth?

In fairness to Polanyi, he wrote at a time in which "man" referred to "humans, male and female," when the evolutionary superiority of humans gave them the right to use, abuse, and destroy "lesser being," and when the ecology of the planet was imagined to be immune to the cumulative waste products of industrial production.

2. **Heuristic and morphogenetic fields**-- Polanyi surmises that morphogenetic fields guiding embryologic development find their parallels in the heuristic fields guiding the advancement of knowledge. Walter Gulick rightly faults Polanyi here for confusing apples and oranges: "Are there not significant differences in kind between the processes whereby a) an individual makes a discovery, b) a growing individual matures, and c) a species evolves?"[5], Gulick rightly asks.

Polanyi, for one brief moment, admits that "heuristic fields" cannot be "taken literally . . . since it once more describes the movement of the mind as a passive event" (PK:403). I would further add that this analogy fails because "the lines of force in a heuristic field" invariable suggests that independent minds would be prone to undertake the same investigations and to move towards the same conclusions.[6] While there is some research into independent investigators coming to claim overlapping discoveries, no one expects that some independent "heuristic field" needs to be postulated to account for such simultaneous discoveries.[7] Finally, the very proposition that the progress of thought follows a causal impulse that stands outside of and independent of the human organism is a violation of everything that has been hitherto proposed in PK.

Going further, the notion of a "heuristic field" serves to obscure the risk, the individuality, and the aptitude for error that shrouds every pioneering venture. Grene laments this early formulation[8] because it slips into "ontological dogmatism"—a tendency that she finds corrected by the time he arrives at TD.

Polanyi adapted the notion of morphogenetic fields[9] since this language became popular in the 1920s and peaked in the 1950s when Polanyi was exploring his dissatisfaction with neo-Darwinism. Field theory was adapted by biologists from physics as a way of accounting for the orderly development of

---

[5] Walter B. Gulick, POLANYI ON TELEOLOGY: A RESPONSE TO APCZYNSKI AND GELWICK, Zygon 40/1 (March 2005) 93.

[6] The same can be said when Polanyi wants to apply field theory to the phylogenetic changes that accompany evolutionary development—evolution never follows one route in all times and in all places.

[7] Thomas Kuhn is much more on the mark here when he postulates that the persistence of anomalies within a shared field of endeavor leads independent investigators to adapt parallel strategies for resolving the problem at hand.

[8] Grene in 1991 said she rejected the ontology of Polanyi in the final chapter because it undercut the precarious nature of commitment. A heuristic field trumps epistemological vulnerability just as a cosmic field trumps evolutionary and ecological vulnerability.

[9] See overview under "morphogenetic field" in Wikipedia (http://en.wikipedia.org/wiki/Morphogenetic_field).

hundred of thousands of individual cells that subdivided from the original fertilized ovum and progressively took on differentiated forms in accordance with whether it was fashioning bone tissue or the eye or the nervous system. In the period when Polanyi wrote PK, "The basic paradigm of embryology, the idea that gave it structure and coherence, was the **morphogenetic field**" [10] Moreover, Paul Weiss, whom Polanyi cites in his text (PK:357), must have appealed to Polanyi because of his experimental realism:

> "The field concept is not only a useful circumlocution, but an expression of *physical reality*." This elevated the field to "the dignity of an *object of research*," and it imposed a duty to study it just as one would study any newly discovered natural phenomenon.[11]

With the discovery of the double helix by James Watson & Francis Crick in 1953, interest in morphogenetic fields gradually waned. Since then, the assumption has been that the master blueprint for embryonic development lies entirely embedded in the "genetic code." As a result, interest in Paul Weiss' morphogenetic fields fell into abeyance and those dedicated to investigating it were often unable to publish their findings.[12] In the 90s, however, field theory reemerged in molecular biology and today it forms a common mode whereby phylogenesis in evolution can be integrated with morphogenesis in embryiology. It should be recognized, however, that Polanyi's use of "morphogenetic fields" is significantly different from what finds in modern molecular biology.[13] In the end, we are left with strong reasons for lamenting Polanyi's use of field theory to link development in science with development in biology.

3. **Postulating a cosmic field** – In the final pages of PK, Polanyi draws a parallel between the long and hazardous route whereby evolutionary development led to the achievement of human consciousness and the equally long and hazardous route whereby societies of individuals achieved a growing body of knowledge to which all were committed (PK:380). In the end, Polanyi seems to be saying that every contribution to this joint achievement of biogenetic and noogenetic[14] evolution (even those who followed lines of development that are

---

[10] Scott F. Gilbert, "The "Re-discovery" of Morphogenic Fields" DevBio: a companion to Developmental Biology, 8th ed.(Sinauer Associates, 2006) (http://8e.devbio.com/article.php?ch=3&id=18) 1.
[11] Ibid.
[12] Ibid.
[13] Morphogenetic fields are used in embryology to account for how a cluster of undifferentiated embryonic cells progressively fashion a heart while others fashion a nervous system. In Polanyi, morphogenetic fields, as far as I can tell, are never used in this perspective; rather, they are appealed to by way of accounting for how embryonic development is guided from beginning to end just as was the million years of evolutionary development which it encapsulates.
[14] Polanyi explicitly names Teilhard de Chardin as describing how, at the ultimate evolutionary step, "human knowledge was born, noogenesis" (PK:388). Thus it would appear that Polanyi was

now extinct) ought to be reckoned as defeating the meaninglessness of our short, transient lives that return to the dust out of which they emerged. Then his closing lines:

> We may envisage then a cosmic field which called forth all these centers by offering them a short-lived, limited, hazardous opportunity for making some progress of their own toward an unthinkable consummation. And this is also, I believe, how a Christian is placed when worshipping God (PK:405).

I do not believe for one moment that Polanyi was affirming the efficacy of prayers to bring the needed rains or to withhold them on the occasion of a church picnic. Nor do I find evidence that Polanyi believed in a God who continually guided evolution and brought it to its Omega Point. With even greater force, I do not imagine that Polanyi thought of Jesus as divinely revealing God's plan for redemption. Rather, I find that Polanyi rejected both materialistic determinism and supernatural interventionism altogether. Polanyi, in one telling section, asks:

> Were all the works of the human mind already inscribed invisibly in the configuration of primeval incandescent gases? Or must, alternatively, each new discovery of man be ascribed to a new divine intervention? (PK:395)

To both of these options, Polanyi responds with a definitive "no" (PK:404). This is a telling admission. Polanyi has been sometimes portrayed as borrowing from Augustine. It must be remembered, however, that Augustine required divine intervention every time someone came to recognize the "truth" of an abstract formulation (even if it was just a mathematical theorem). Polanyi, in contrast, never appeals to God as prompting, guiding, or confirming the discovery process.

---

confirmed in his association of biogenetic and noogenetic evolution by *Le Phenomene Humain* (citing the French title first published in 1955 that did not get translated into English until 1959, a year after the publication of PK). Teilhard wrote: "Our century is probably more religious than any other. How could it fail to be, with such problems to be solved? The only trouble is that it has not yet found a God it can adore." Polanyi would have agreed with the last sentence and the last sentence in his book represents his attempt to resolves Teilhard's problem.

When it comes to the emergence of life on earth (PK: 394-395) or the emergence of humans within a colony of primates, Polanyi fully accepted the naturalistic commitment of a scientist and denied divine intervention:

> We shall say . . . that the rise of man includes a continuous intensification of individuality, similar to what takes place in the formation of the human person from the parental zygote. No new creative agent, therefore, need be said to enter an emergent system as consecutive new stages of being (PK:395).

The "cosmic field" that Polanyi embraces in PK is consequently not the "God of the gaps" that makes certain that the evolutionary thrust achieves its final goal. Nor does this field refer to the "God of the Deists" who sets the universe in motion but then quickly retires to a non-interventionist stance. Even in the heuristic domain, Polanyi never entertains the notion that God has to step in and to guide his/her devoted servants in their quest for truth.[15] Rather, Polanyi uses the term "cosmic field" as the unexplicated and unsuspected lure for transcendence that is found in both morpogenetic and noogenetic activity.[16] This will become clearer in what follows.

Having reviewed two soft spots in Polanyi, I pass on to two areas where Polanyi got things right.

## Where Polanyi Got Things Right

### 1. **Random mutations cannot account for progress**

Ac cording to neo-Darwinism, the mechanism for upward biological evolution is random mutations and natural selection. In most instances, DNA molecules are replicated flawlessly. There are times, however, when mutations are introduced. A virus might attack and alter a gene. A high-velocity particle (for outer space or natural radioactivity of the earth) might smash into the double

---

[15] Augustine believed that the unaided human powers could not distinguish truth from error; hence, a divine inspiration was necessary to confirm the truth of every discovery, whether made in the field of theology or the field of mathematics.

[16] This "cosmic field" was not just a passing fancy for, again, in the *Study of Man*,[16] Polanyi refers to our "cosmic calling" (97) by way of summarizing what he had presented in PK. In TD, published some eight years later, Polanyi refers only to the "cosmic emergence of meaning" within both morpogenetic and noogenetic activity.

helix. Or a chance error might take place in the replication process that is promoted by chemicals such as xxx. The vast majority of such mutations are so destructive that they result in sterility. When conception does take place, it gives rise to developmental malformations that are either spontaneously aborted or born grotesquely deformed (and hardly fit for survival).

According to neo-Darwinism, however, chance mutations sometimes produce a small biological improvement (better hearing, faster running, more immunity to disease). In these cases, the offspring outperforms other hatchlings, gains some small ascendency within its given environment, and lives to pass it advantage on in sexual reproduction. Within a series of successive generations, the improved gene offers a superior survival rate and more frequently gets passed on during the mating season. Over time, a large portion of the offspring incorporates the advantages of the beneficial mutation. Consequently, a small step has been made in preparation for the forward march of evolution.

Polanyi finds difficulty in imagining how random mutations could produce any advantage whatsoever. To defend his position, he suggests the thought experiment whereby a monkey was allowed to make changes in a text of "Romeo and Juliet" on a keyboard. Only degradation would result, and the greater the degree of blind chance, the greater the degradation. Polanyi could also have appealed to the thousands of experiments performed on fruit flies whereby mutations were induced by exposure to low level doses of x-rays. The offspring from such radiation experiments are littered with still-births and deformities. Among those that survive into adulthood, not a single instance of biological improvement has ever been identified.

Let's suppose that Polanyi had the opportunity to talk with Richard Dawkins. Not only is Dawkins the best known and most highly respected public defender of neo-Darwinism, he is one of those rare scientists who openly defies any theologian who tries to insert some hidden influence of God within the evolutionary process. Dawkins openly admits that his commitment to Darwin demolished his early faith in God, and he is not ashamed to be regarded as "Darwin's Rottweiler."[17] Dawkins puts heavy stock in what natural marvels are possible when random mutations functioning in tandem with survival of the fittest perfect organisms over millions of years.

[17] It was Dawkin's colleague at Oxford, the theologian Alister McGrath, who first identified Dawkins as "Darwin's Rottweiler." The label has stuck because Dawkins plays the part so well.

Dawkins acknowledges that religious folk habitually use Genesis to imagine that God created our earth in just the right place such that it would be hospitable to life. For Dawkins, however, no such surmise is necessary or advantageous. "People of a theological bent," Dawkins notes, "are often chronically incapable of distinguishing what is true from what they'd like to be true." (Dawkins:135). Those who wrote Genesis, moreover, had not the vaguest notion of how old and how big the universe actually was. This is the opening that Dawkins has been waiting for:

> It has been estimated that there are between 1 billion and thirty billion planets in our galaxy, and about 100 billion galaxies in the universe (165).

Most planets, of course, are too hot or too cold to support life. Taking a conservative figure, and surmising that only one out of a hundred planets has a stable elliptical orbit in the "Goldilocks zone" wherein liquid water is present (and not just steam or ice). This means that only as few as a million planets in our galaxy could support life. With a 100 billion galaxies in our known universe, however, this allows us to compute that "a billion billion is a conservative estimate of the number of available" (165).

> Now suppose the origin of life, the spontaneous arising of something equivalent to DNA, really was a quite staggeringly improbable event. Suppose that it was so improbable as to occur on only one in a billion [suitable] planets. . . . And, yet . . . even with such absurdly long odds, life will still have arisen on a billion planets—of which earth, of course, in one. (165).

Once some primitive form of DNA emerges, however, we may have little more than a bacteria.

> The origins of the eukaryotic cell (our kind of cell, with a nucleus and various other complicated features . . .) was even a more momentous, difficult and statistically improbable step than the origin of life. The origin of consciousness might be another major gap which bridging was of the same order of improbability. (168)

So, let's say that only one out of a million life bearing planets emerge with the cell. Once cells are in the making, however, now statistics fall away. Now survival of the fittest comes into play and this "natural selection works because it is a cumulative one-way street to improvement" (169).

At this point, Polanyi would politely interrupt. In every sexual coupling, he would explain, two sets of genetic traits are mixed, and the genetic traits of the offspring follow Mendelssohn's laws. Over thousands of years, the various finches found on the various separated islands visited by Darwin take on distinct and stable variations akin to the genetic traits that separate the Japanese from the African from the European human. In all of these instances, however, one has a stable system that moves within the confines of the total diversity of genetic traits with which one begins.

The genetic variations necessary to account for upward evolutions however go way beyond genetic reshuffling. In the laboratory, thousand of experiments have bombarded fruit flies with x-rays. Too much x-rays renders the entire sample sterile. Too little x-rays have no effect at all. When just the right dose is applied, all sorts of variations appear in the offspring. In each instance, the variations are destructive. One fly has only one wing and cannot fly at all. Another has wings of two different sizes and can only fly in circles. Others have visual deformities. Others cannot walk because they have too few legs or that their legs are attached to the body in such a way that the six feet cannot reach the ground simultaneously. Why is this, Polanyi wants to know.

Dawkins admits that mutations are inherently random, and that they are far more likely to damage the organism rather than improve it. In fact, he says, only very rarely does one expect a positive mutation and, here and only here is "ultimately why evolution by natural selection is possible at all."

Now Polanyi weighs in. Mutations are random events. Such random events are caused by inherently destructive forces. They are destructive to the extent required to disrupt the stable genetic code but not so destructive as to make it sterile—a way of saying "destroyed beyond recognition." Effectively, a constructive result is being anticipated from a blindly destructive force.

2. **That the Universe is Designed for Life**

Polanyi would allow that the recent speculation concerning the "anthropic principle" demonstrates that the five fundamental constants of physics are "fine-tuned" to support life. This does not mean that astro-physicists and cosmologists have proven that the physical constants in our current universe have produced life; rather, they suggest, negatively, that had any of the fundamental constants been much higher or lower, life would have been impossible anywhere in this universe.

Dawkins has no difficulty with the "anthropic principle" unless, of course, it is being used to suggest that there is some hidden design or Designer behind what is. To diffuse this, Dawkins takes the speculation of cosmologists to another level. Let's suppose, he suggests that in alternative universes that the physical constants could be and indeed are different from those within our own universe. Then, suppose further that what astro-physicists are speculating about an unending string of universes being fashioned by virtue of our present universe expanding to the point that universal gravitational brings this expansion to a halt and reverses it such that the universe is not contracting. Eventually, the entirety of the universe would be concentrated at the very center and set off a new Big Bang, fashioning universe #2. This expansion-contraction cycle of approximately 20 billion earth-years could repeat itself during an infinity of time. Thus, random variations of the physical constants could be tried. Eventually, no matter how improbable, the constants would be aligned in the way that we know them to be. The fact that we are here to witness it is a testimony to the particular random characteristics of this universe. In the billions upon billions of failures, there would be no conscious life to even notice that life did not take hold. Hence, in our own case, the fine-tuning of our own universe says nothing about design. We are just caught up in a happy accident (which has no explanation beyond probabilities).

Paul Davies, in his book *The Goldilocks Enigma* (2006)[18], suggests that one explanation of the "anthropic principle" is that "an intelligent Creator designed the Universe specifically to support complexity and the emergence of Intelligence." Christian Fundamentalist, needless to say, entirely endorse such a position because they are overjoyed when a prominent scientist allows that Intelligent Design can be acknowledged as one possible explanation of evolution.

Dawkins will have none of this.[19] For him, "the persuasive illusion of design" has no more place in biology than in cosmology. While Dawkins admits that some scientists do claim to be committed believers, he judges that they do a disservice to science when they mistakenly allow themselves or their co-religionists to imagine that there are supernatural forces at play in the cosmos in addition to the orderly natural principles. Or, if they make a choice for God,

---

[18] http://en.wikipedia.org/wiki/Anthropic_principle

[19] Polanyi, needless to say, would support Dawkins at this point but not for the reasons that Dawkins puts forward. Polanyi's objections will be taken up in the conclusion of this essay.

Dawkins asks them to decide "which God"[20]—Yahweh, Baal, the Trinity, Allah, Vishnu. Even if they make a choice for a God that "constantly keeps a finger on each and every particle [in the universe]," as Richard Swinbourne[21] claims, does this not make God redundant as soon as it is discovered that the natural forces inherent in the universe are doing exactly the same thing. In fact, given the evidence in the Scriptures that God is notoriously unreliable--given to fits of jealousy against rivals, of anger against sinners, and of blessing for the chosen few—wouldn't it be more intellectually satisfying and emotionally appealing to trust that invariant natural forces are in charge and that God is nowhere and at no time depended upon "to keep a finger on things."[22]

In sum, even if one allows that the genetic code does entirely encode all the operations of a living organism, Polanyi would affirm that random mutations of that code can never produce any movement toward a different and improved set of organismic principles. As a result, Polanyi believes that one is required to surmise that the long and gradual ascent of evolution depends upon the "action of the ordering principle underlying such a persistent creative trend" that is "necessarily overlooked or denied by the theory of natural selection" (PK:385). Once recognized, this would "reduce mutation and selection to their proper status of *merely releasing and sustaining the action of evolutionary principles* by which all major evolutionary achievements are defined" (PK:385). In effect, therefore, Polanyi embraces all the observations and conclusions of Darwin[23] but then adds that an ordering principle (hitherto unsuspected) must operate to guide the process along its course.

To understand this "ordering principle," Polanyi appeals to the process of intellectual advancement within a community of seekers who share the same tradition. To this our attention must now turn.

---

[20] Dawkins, Delusion, 133-135.
[21] Richard Swinburne gave the Gifford lectures at Aberdeen from 1982 to 1984, resulting in the book *The Evolution of the Soul*. From 1985 until his retirement in 2002 he was Nolloth Professor of the Philosophy of the Christian Religion at the University of Oxford.
[22] Ibid., 177.
[23] Polanyi allows that wing colorations in moths have natural variations and that, in a given environment, a black moth could have a definite survival advantage over the white moth. This occurs, for example, when moths inhabit forests following fires and the light-colored moths get easily eaten by birds when they alight on blackened barks. For this to take place, however, the genetic laws of Mendelssohn suffice and no genetic mutations are necessary.

## 2. The link between noogenesis and phylogenesis revisited

At first sight, Polanyi seems to slip into a dead end. Normally the very complex is accounted for in terms of a less complex process that is better understood. Not so in this case. The experience of indwelling in a problem and gradually finding a secure way toward a novel solution is at the heart of Polanyi's epistemology. Today, many others have joined Polanyi in accepting that tacit powers are released in the deliberate straining over a problem that gradual yield a sense of approaching a solution.

> As Polanyi put it: "We must conclude that the paradigmatic case of scientific knowledge, in which all faculties that are necessary for finding and holding scientific knowledge are fully developed, is the knowledge of an approaching discovery" (TD 24-25). Indeed, many scientists have acknowledged relying on such anticipatory hunches in pursuing their scientific ideas. As the Nobel Laureate in medicine Michael Brown observed: "As we did our work, we felt at times that there was almost a hand guiding us. Because we would go from one step to the next, and somehow we would know which was the right way to go. And I really can't tell how we knew that" (cited in Claxton, 1998:57). The Nobel Laureate Stanley Cohen similarly commented on the importance of developing a "nose" for anticipating promising directions, noting "I am not always right, but I do have feelings about what is an important observation and what is probably trivial" (cited in Claxton, 1998:57).[24]

Without removing my earlier reservations regarding the misuse of field theory to apply to the problem, I do submit that Polanyi was absolutely right in so far as he eliminated "randomness" as the front runner in the advancement of ideas and the advancement of species. Polanyi, of course, never appealed to a god of the gaps to account for how a researcher comes to a satisfactory solution or how a break in the genetic code yields to a phylogenetic principle. The tacit powers of the knower and the inherent powers of the organism are where the solution is to be found. The solution, in both cases, is close at hand and not far away.

---

[24] Jonathan W. Schooler and Sonya Dougal, Why Creativity is Not like the Proverbial Typing Monkey, *Psychological Inquiry* 10/4 ( 1999) 351.

### 3. Hierarchies and boundary control

Another way that Polanyi opposes neo-Darwinism is by insisting that biological principles cannot be reduced to or derived from chemical principles. The chemistry that goes on in a sick or dead organism is just a valid (as far as chemical principles are concerned) as that going on in a living organism. Polanyi illustrates this as follows:

> A floating amoeba emits exploratory pseudopodia in all directions, which will catch food or else attach themselves to solid ground and then drag the whole mass of protoplasm . . . toward this foothold. All these maneuvers are coordinated: the amoeba hunts for food. Thus it grows fatter. . . (PK:387).

Polanyi has no intention of affirming a self-consciousness in amoebae; however, he does want to affirm that a living cell has "a stamp of individuality" and "a center of self-interest" that asserts itself against "the world-wide drift of meaningless [chemical and physical] happenings" (PK:387). Detecting and ingesting what is suitable as "food" is a self-serving and self-interested activity. Chemistry can say nothing about being hungry or being sated. Not to allow for such purposeful language is to entirely lose our ability to describe and compare living things altogether. Moreover:

> Lower levels bear on higher levels insofar as they "*define the conditions of their success and account for their failures, but they cannot account for their success, for they cannot even define it*" (*PK*, 382).

Polanyi sometime speaks of "emergence" of new principles. This takes place in the development of an embryo in so far as new organic systems (a circulatory system, a nervous system, an antiviral system) emerge that follow complex organic principles that were not previously present. Polanyi draws an analogy with this morphogenesis and the phylogenesis evident in evolutionary development. Polanyi himself used this term "emergence" hesitatingly because it could be construed as an appeal to "magical powers which could explain anything—and hence explain nothing" (PK:399).

Paul Davies arrives at a position remarkably parallel to Polanyi. Instead of appealing to "emerging" properties or principles, he refers to a "sequence of self-organizing processes." This presents an option from complexity theory that might have given Polanyi a better hearing. Consider the following:

> The physical world is not arbitrarily regulated; it is ordered in a very particular way, poised between the twin extremes of simple regimented orderliness and random complexity: it is neither a crystal nor a random gas. The universe is undeniably complex, but its complexity is of an *organized* variety. Moreover, this organization was not built into the universe at its origin. It has emerged from primeval chaos in a sequence of self-organizing processes that have progressively enriched and complexified the evolving universe in a more or less unidirectional matter. It is easy to imagine a world that, while ordered, nevertheless does not possess the right sort of forces or conditions for the emergence of complex organization." [8]

The attempts on the part of reductionists to reduce even human thoughts and strivings to chemical reactions and synaptic impulses in the brain are entirely ludicrous. Polanyi explains:

> We speak of the thoughts Shakespeare had while writing his plays and not the thoughts of hydrochloric acid dissolving zinc, because men think and acids don't. . . . And so long as we can form no idea of the way a material system may become a conscious, responsible person, it is an empty pretence to suggest that we have an explanation for the descent of man (PK:389-390).

John C. Walton explained the growing dissatisfaction with reductionism in 1977 in the following terms:

> Some of the most eminent and influential theoreticians such as Schrödinger, Wigner, Polanyi and Longuet-Higgins have suggested that we cannot understand the origin and stability of biological structures in terms of the presently known laws of physics. . . . Living matter is distinguished from inanimate matter by its organization, function, purpose, adaptability etc., but these concepts are foreign in the physical sciences.[25]

---

[25] John C. Walton, "ORGANIZATION AND THE ORIGIN OF LIFE," *Origins* 4(1):16-35 (1977). www.grisda.org/origins/04016.htm

## Microbiology that Polanyi would have favored

During the last twenty years, a significant number of biologists have joined a research program known as evolutionary developmental biology. Insiders have abbreviated this to "evo-devo" and this term now appears regularly in the journals and grant proposals.[26] Foremost among the big names associated with this movement is Wallace Arthur, professor of zoology and head of the zoology department at the National University of Ireland, Galway.

[[[Click here to view a three-minute video: Sean B. Carroll discusses the science of evolution and the field of evo-devo.]]]

Evo-devo specialists are keen to explore DNA, not as a blueprint for the arrangement of parts, but as a complex toolkit[27] that determines the orderly development of the embryo. Anyone familiar with pictures of the human embryo taken every three weeks will immediately notice that the embryo at six weeks looks more like a fish than a human. Meanwhile, the "embryonic toolkit" within the DNA seems to be remarkably similar whether one is looking at the sequence in humans, fish, or fruit flies. In the case of humans, the miniature heart is beating in the third week even though the circulatory system has only begun to take shape. Furthermore, the growth of the beating heart proceeds in order to keep pace with the increased blood flow required by an expanding circulatory system that is routed throughout all the individual organs, muscles, and skin layers. Once the circulatory system is completed, heart growth is switched off. Meanwhile, the nervous system is being networked through all the muscles (including the heart muscle); yet, the nerve endings are not connected together inside the cortex until late in the fifth month of fetal

---

[26] Elizabeth Pennisi, "EVOLUTIONARY BIOLOGY: Evo-Devo Enthusiasts Get Down to Details" *Science* 298/5595 (1 November 2002) 953 – 955.

[27] "The developmental-genetic toolkit consists of genes whose products control the development of a multicellular organism. Differences in deployment of toolkit genes affect the body plan and the number, identity, and pattern of body parts. The toolkit is highly conserved across animal phyla. Only a small fraction of the genes in the genome are involved in development. The majority of toolkit genes are components of signaling pathways, and encode for the production of transcription factors, cell adhesion proteins, cell surface receptor proteins, and secreted morphogens. Their function is highly correlated with their spatial and temporal expression patterns. One of the major goals of evo-devo is to catalogue all genes (their identity, product, function, and interaction) in the toolkit" (http://en.wikipedia.org/wiki/Evolutionary_developmental_biology#The_developmental-genetic_toolkit).

development. Thus, in brief, the DNA provides a unified game plan whereby organismic processes are turned on and off as individual cells are differentiated and begin performing their particular tasks in the overall production that is under way.

DNA decoding has demonstrated that every gene has a large amount of "junk" built into it that was picked up during its evolutionary past but remains "switched off." The human genome, for example, has the duplicate of a yeast DNA within its junk code. Furthermore, research demonstrates that the DNA helix is more vulnerable to mutations in some segments more than in others. Lastly, some environmental factors can turn on embryonic processes that would otherwise remain dormant. In sum, embryonic development is filled with "biases" favoring certain lines of mutations while impeding others.[28] This then is the archway that Wallace Arthur uses to join the dual pillars of random mutations and survival of the fittest.[29] In sum, evo-devo intends to revise Darwin as follows:

> All biologists agree that natural selection can only work when there is variation for it to use. Yet the supply of variation has been much less investigated by evolutionists than the selective process that acts upon it. The variation is not random, as is sometimes claimed. Rather, it is structured in various ways, at both genetic and embryological levels.[30]

Evo-devo thus provides one possible interpretation for the morphogenetic fields that Polanyi spoke of as guiding embryonic and evolutionary development. This branch of biology has the advantage that it is looking at organisms as living systems and not reducing life to biochemical reactions. It also incorporates Polanyi's intuition that embryonic development is intimately connected with evolutionary development. Finally, it is revealing the hidden causes for an orderly development which cannot be found in chance events. Once again, Polanyi is vindicated when he surmised that chance events could release the ordered mechanisms that guided evolution but it could never account for them as such.

---

[28] Beth A. Montelone, Ph. D., **Mutation, Mutagens, and DNA Repair** (1998); originally written as a supplement to BIOL400, Human Genetics. www-personal.k-state.edu/~bethmont/mutdes.html

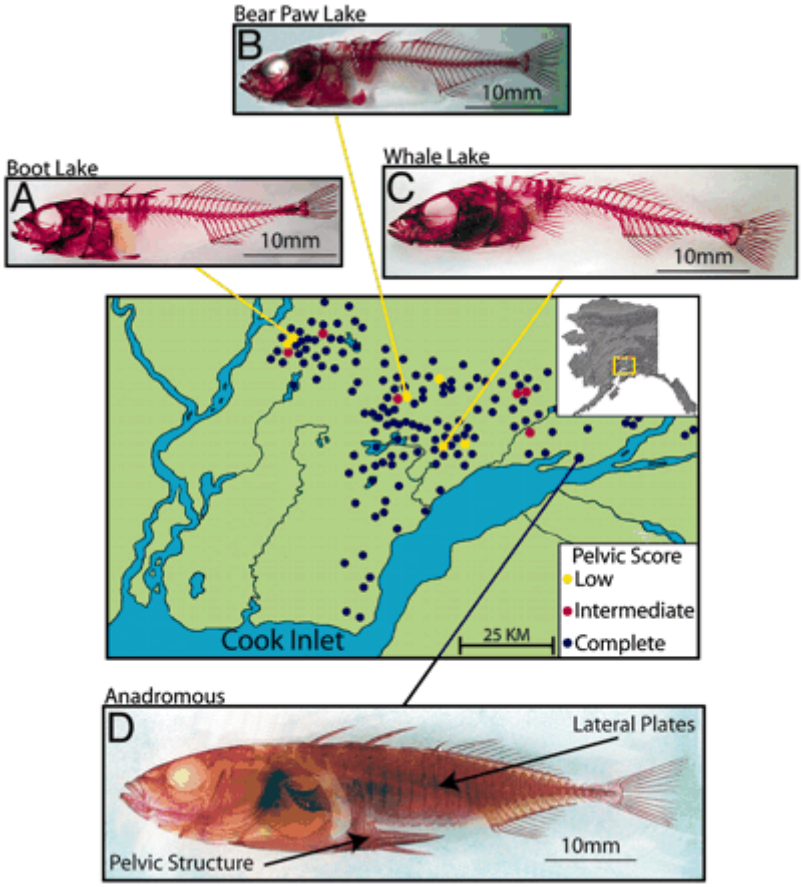
[29] Wallace Arthur, **Biased Embryos and Evolution (**Cambridge: University Press, 2004)

[30] Wallace Arthur, **Creatures of Accident** (Farrar Straus & Giroux, 2006) cited on www.creaturesofaccident.com/contents.htm. Also: "Experimental evidence exists that in some instances the rate of specific mutations arising is greater when they are advantageous to the organism than when they are not," http://en.wikipedia.org/wiki/Mutation

## Three Case Studies

**Case Study #1:** Polanyi prophetic claims here have been confirmed by recent genetic researchers such as Lev Yamolsky and Arlin Stolzfus (University of Maryland Biotechnology Institute) who have shown that "simple mutational biases" found within genes enable us to account for how "randomness is skewed" toward favorable outcomes.

**Case Study #2:** Three papers, one in *Science*, one in *Nature*, and one in the *Proceedings of the National Academy of Science* (Colosimo *et al.*, 2005; Shapiro *et al.*, 2004; and Cresko *et al.*, 2004) appeared in 2004 and 2005 showing that dramatic morphological changes have appeared *independently* in a number of populations of freshwater threespine sticklebacks that have all evolved since the end of the last glaciation (i.e., between 9,000 and 14,000 years ago). Some (perhaps even most) of these populations are thought to be new species.



*"Had evolution been entirely dependent upon natural selection, from a bacterium only numerous forms of bacteria would have emerged."*[31]

Case Study #3: Michael Ruse is Lucyle T. Werkmeister Professor of Philosophy, Florida State University. In his latest book, Ruse shows how Darwin expelled design (of the kind dear to William Paley) from biology; however, he also shows how the design metaphor has strong emotional and intellectual resonance when biologists describe how certain functions of organism give them survival value.

> There is no reason to think that biology calls for special life forces over and above the usual processes of physics and chemistry. Nor is there reason to think that biology is little more than complicated physics and chemistry... There does seem to be something distinctive about biological understanding--something having to do with purposes and ends in evolution... We treat organisms--the parts at least--as if they were manufactured, as if they were designed, and then we try to work out their functions. End-directed thinking--teleological thinking--is appropriate in biology because, and only because, organisms seem as if they were manufactured, as if they had been created by an intelligence and put to work... Darwinism does not have design built in as a premise, but the design emerges as Darwinism does its work and some organisms get naturally selected over others. (p. 268-9)

While Ruse agrees that the God hypothesis is out-of-place in science, he defends "the respectability of design in science and rescues it place in philosophy."[32]

## Conclusion

Michael Heller, a priest and a physicist, describes the "moral choice" made by scientists—namely, "to search for answers concerning the world and ourselves in terms of arguments and demonstrations, without looking for help 'from outside.' "[33] Heller regards this "moral option" as tenable and noble, even while he recognizes it as hazardous and cloaked with the sense of mystery:

---

[31] Cited from the Japanese geneticist Susumu Ohno, *Evolution by Gene Duplication*, 1970. www.creaturesofaccident.com/centralidea.htm
[32] William S. Stone, "A Summary of Michael Ruse's *Darwin and Design*," **Zygon** 37/2 (2002) 446.
[33] Michael Heller, *Creative Tension: Essays on Science and Religion* (Philadelphia: Templeton Foundation Press, 2003) 161.

> Only outsiders and mediocre scientists believe that in science everything is clear and obvious. Every good scientist knows that he is dancing on the edge of a precipice between what is known and what is only feebly felt in just-formulated questions.[34]

Within the final chapters of PK, I consequently believe that the evolutionary question was not open, for Polanyi, to any easy affirmation of the God of the gaps. Polanyi faulted neo-Darwinian theory because it was a defective scientific theory which concealed a process that Polanyi firmly believed stood behind the ascent of more complex forms culminating in the conscience awareness and commitments of humans. This is significant, because, in no other scientific arena did Polanyi oppose a reigning theory due to his post-modernist philosophy.

I would risk speaking for Polanyi in saying that a biologist settling for random mutations and survival of the fittest to explain the ascent of man was no better or worse than religious Fundamentalist insisting that God intervened to make it all possible. In both the former (a scientific dogmatism linked to the genius of Darwin) and the later (a religious dogmatism linked to the divine inspiration of Genesis), their respective dogmatisms simply keep them from suspecting and exploring the nature of the mechanisms that stand poised to produce the feat of evolution.

Given Polanyi's moral choice for naturalism and given his relative ignorance of microbiology, Polanyi was not in a position to expose what he intuited was there. He was even unable to define the programmatic research that would lead to the truth that he sought. He borrowed the notion of field theory simply because it was a leading theory in his day for accounting for embryonic development. In Polanyi's mind, however, every embryonic development encapsulated the phylogenetic development that had been embedded in the genetic code over millions of years of evolutionary development. And when it came to phylogenetic development, it was just as ridiculous to imagine that Nature rolls the dice and tries everything at random as to imagine that a scientist tries everything at random when pursuing a discovery. Polanyi's commitment to his post-modernist philosophy of science, consequently, played a substantial role in setting him in opposition of neo-Darwinism.

---

[34] Ibid.

Polanyi states this more clearly while making free with the familiar lingo of Christianity:

> We cast off the limitations of objectivism in order to fulfill our calling. . . . Those who are satisfied by hoping that their intellectual commitments fulfill their calling, will not find their hopes discouraged. . . . Commitment [to the process of free inquiry] offers those who accept it legitimate grounds for the affirmation of personal convictions with universal intent. . . .
>
> The stage on which we thus resume our full intellectual powers is borrowed from the Christian scheme of Fall and Redemption. Fallen man is equated to the historically given and subjective condition of our mind, from which we may be saved by the grace of the spirit. The technique of our redemption is to lose ourselves in the performance of an obligation which we accept, in spite of its appearing on reflection impossible of achievement. We undertake the task of attaining the universal in spite of our admitted infirmity . . . because we hope to be visited by powers of which we cannot account in terms of our specifiable capabilities. This hope is a clue to God, which I shall trace further in my last chapter. . . . (PK:324).

Redemption is not achieved by a God entering the human condition and dying on the cross. Nor is it achieved in a divine guidance that overwhelms those who humbly and persistently wait upon God as their redeemer. Rather, the awaited "grace" is that of the intellectual passion "which strives to break through the accepted frameworks of thought, guided by the [tacit] intimations of discoveries still beyond our horizon" (PK:199). The total devotion of a scientist pursuing a discovery is thus akin to the surrender of a Christian worshipping God (PK:198).

I submit, therefore, that Polanyi took what was most familiar and dear to him, namely, the pursuit of discovery, and cloaked it in the sanctioned language of Christianity. In effect, he is affirming his faith that every scientist like himself has known what Christians call "grace" and "redemption" through the self-sacrificing pursuit of discovery. For him, the "cosmic calling" is the "divine calling" and the "cosmic field" that urges us forward despite our seeming incapacity is the most profound religious act of worship that he can envision. In an act of poetic imagination, Polanyi cloaks the most arduous and hazardous pursuit of humans in religious language and thereby tacitly says to his

colleagues, “We have been to the top of the mountain.” Christianity, mired as it is in “an absurd vision of the universe,” (TD:92) has little of consequence to offer us, but, be assured, meanwhile, that we are the true disciples that walk steadfastly in the way of the cosmic calling that Christianity has so badly misunderstood.