MICHAEL POLANYI'S UNDERSTANDING OF FIELD THEORY

Walter B. Gulick

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ABSTRACT

Michael Polanyi introduced the concept of fields in the last several pages of Personal Knowledge. *In this essay I examine whether the last-minute addition of fields advances his explanation of anthropogenesis. Polanyi's view of the role of fields in solving problems and discovery plus their place in ontogenesis and phylogenesis is examined and found not to be wholly satisfactory. Alternative explanations of the factors advancing discovery and problem solving are advanced.*

[Editor's note: the Zoom conference mentioned at several points in this essay refers to a session sponsored by the Polanyi Society held on 6 March 2021. The materials are available at http://polanyisociety.org/2021Zoom/Zoom-Sessions-Mar.5&6-final.pdf.]

In *Personal Knowledge*, Michael Polanyi introduces the notion of fields in the process of bringing his discussion of personal knowing to a climax. Only in the last seven pages of the 405-page text do fields play a significant role in his comprehensive philosophical vision. Nowhere else in his corpus of non-scientific work are fields mentioned in such detail. What does Polanyi gain by bringing the notion of fields into play at the conclusion of his investigation into how we come to knowledge? More specifically, are fields useful concepts for illuminating how humans make discoveries, solve problems, and achieve comprehension? A second question follows: do fields play a role in other aspects of Polanyi's epistemology?

As an organizing scheme to address these and subsequent questions about fields in Polanyi's philosophy, I will make use of R. G. Collingwood's "logic of question and answer."[1] Collingwood thought much philosophical discussion was otiose because the interlocutors talked past each other. The question one discussant was attempting to answer was frequently different than the question the other discussant was attempting to answer. To try to minimize this sort of misunderstanding, I will list questions I am attempting to answer with respect to the nature of "fields" and their relation to Polanyi's philosophy.

1. How does Polanyi understand the notion of fields?

The term "field" has many interrelated meanings, but I would like to focus on what appears to be its etymological root plus two derivative meanings that would seemingly relate to Polanyi's thought: (1) A field is an open area of land, such as a field of wheat. Field in this basic sense is characterized by continuity and an extensiveness that generally is bounded by something different. (2) A disciplinary field is a category designating a common pursuit or complex of forces, such as the field of chemistry. Fields in this sense often have sub-fields and sub-sub-fields. Note that this notion of field functions as a non-perceivable organizational term with components characterized by thematic commonality and interconnectedness. (3) A field in the physical sciences denotes a force that acts at a distance like a magnetic, electrical, or gravitational field. Like fields in the second sense, such fields are not directly visible. Rather they are known by their effect as an attractive force.

Polanyi finds fields to be useful in illuminating how problems are solved. Problems, he suggests, attract intellectual effort. Thus, the third sense of "field" indicated above serves as the model for Polanyi's intuition that forces play a role in discovery, problem solving, and other ways of coming to comprehension. After addressing how fields support the process of reaching knowledge, he expands the reach of fields beyond his experience as a scientist to address broader philosophical and religious issues. He introduces the notions of a "generalized field," a "heuristic field," and a "cosmic field" as he builds toward the climax of his theory of anthropogenesis in Part IV of *PK*.

2. Is the analogy between physical fields and problem-solving fields convincing and fruitful?

Polanyi believes that intellectual problems exhibit field-like qualities. Fields have the property, unlike mechanical models of force, of action at a distance. In attracting thought toward a solution, problems function much like gravitational fields attracting material objects toward the field's material center. The model of a gravitational field seems more apt in thinking about discovery and problem solving than electrical or magnetic fields. Electrical fields have positive and negative poles, while magnetic fields have north and south poles. They serve to align electrical and magnetic objects into dipolar patterns rather than attract objects to a center the way gravity does.

However, gravity is a fundamental ontological feature of the physical world, whereas problems seem to be the products of human conception originating at certain times during a particular phase of cultural and intellectual history. When problems are solved, the field would seem to disappear, as the problem no longer exists. Similarly, when a person makes a discovery through an investigation, the person's founding curiosity and probing inquiry are sated, and what is discovered becomes part of what Polanyi calls "reversible" or routine knowledge (*PK* 75-76). The originating field of attraction would dissolve.

During a Zoom conference discussion of the above description of physical fields, Eduardo Beira suggested that a mathematical model would provide a more accurate understanding of Polanyi's notion of fields than a physical model. In calculus, a nonlinear equation can specify how a rate varies over time. Both differentiation, which calculates the rate of change at a particular point in time, and integration, which determines the total achievement accomplished during an indicated period, proceed to solution by imaginative use of ever closer approximations. This approximation process is analogous to experiencing "the approach of a recollection for which we have been racking out memory" (*PK* 400). In sum, mathematical procedures, such

as mapping vector fields by differentiation, can model how solutions are found, while physical fields like gravitation can model a solution's attractive power.

Furthermore, what is a problem for one person may not be such for anyone else. Does the very formulation of a problem create a field between an investigator and the problem? Or does a field connected to a potential problem exist whether or not a human recognizes its existence? But what sense would it make to say a field exists before recognition since it would seem to have meaningful existence only once a human is concerned about it. Human intentionality seems inextricably connected to problem solving in Polanyi's model of the attraction exerted by a problem.

Everyday experience suggests that Polanyi's model of attractive fields, based on his scientific experience, does not apply to all the types of problems we encounter. Does it make sense to postulate fields for such evanescent and common processes as indecision about what is right to wear for the theater or how to address an alienated friend? Low-grade discoveries emerge and often surprise us in everyday life. Similarly, solutions to problems are often found without intentional effort. In any case, the subjectivity inherent in human discovery and problem solving makes any scientifically valid correlation between relatively stable physical fields and protean mental fields seem, at best, to be strained, if not fatally flawed.

But maybe I am taking Polanyi's use of "fields" too literally. Perhaps there is enough in common between a gravitational field and problem solving to sponsor a metaphor or simile, such as, "In attempting to solve a problem, we feel an attraction to a solution similar to the pull a gravitational field exerts on physical objects." This still raises the question as to whether attractive power is always resident in problems, or whether even when attraction exists, it is human curiosity that generates the attraction. From a phenomenological standpoint, some problems are seen merely as irritants that one wishes to dispose of and forget. The resolutions of daily life's little dilemmas are subject to conflicting desires, changing circumstances, social conventions, ambiguous assumptions, and much else such that a seeming resolution one moment may well be undermined by new evidence moments later. Do such problems still exist in fields, but in some hidden form?

Jon Fennell, in responding to this paper, wrote that "discovery is an act of cooperation in which essential activity occurs on both sides. It is a joint exercise in achieving meaning." Of course, much discovery results from previous discoveries and from the joint activity of fellow investigators. But Fennell asserts that the objects of discovery somehow aid in the solution. I disagree. How did the world actively contribute to Einstein's general theory of relativity? Fennell further states that "the personal alone has never been sufficient" for discovery. True. The discoverer certainly relies upon integrating all kinds of environmental clues in making a discovery; she is not locked into her intellect alone. Serendipitous events can aid discovery. My complaint is with saying the clues *actively* contribute to new knowledge. I am comfortable saying that in its dynamism, aspects of the world reveal themselves—but not as fellow agents in a cooperative venture.

Rather than getting lost in niggling questions, let us see if understanding Polanyi's larger purpose in writing *Personal Knowledge* is helpful in seeing the place of fields in his thought.

3. What factors motivate Polanyi to conduct his epistemic investigations?

Some background information about Polanyi's interests will help us answer that question. Born in 1891, Polanyi considered the world he encountered prior to World War I to be a period of cultural excellence. Then the Great War initiated a period of catastrophe after catastrophe. Polanyi became a distinguished scientist in the field of physical chemistry during the 1920's and early 1930's, but he was increasingly troubled by the human toll of the traumas of war, economic depression, and tyranny in Western civilization.

He felt impelled to shift his attention away from scientific to normative issues. He started trying to comprehend the reasons for the century's disasters and on that basis find solutions that would return Western civilization to the status it enjoyed prior to the first World War. Thus, he shifted his attention from the hard sciences to the social sciences and then later to philosophy.

In 1941 Polanyi published an article entitled "The Growth of Thought in Society." The title describes an important motif that came to drive Polanyi's thought. Ideas, individually and in fields, provide the scaffolding upon which social movements grow and have power. Much attention has been devoted to his view that a misrepresentation of science as the only true knowledge undermined the traditions and values that held society together. They were seen as merely subjective and arbitrary. So, part of his mission was to deconstruct the putative objectivity of science and retrieve the significance of the arts, humanities, and religion. The problem was not with science itself, but with scientism that sees the hard sciences as the solution to all problems. Personal knowing was shown to underlie all the disciplines, science included. Thus, a basic aim of Polanyi's philosophy is to describe how reliable and significant knowing can take place. The notion of fields is introduced to aid understanding about how comprehending, discovery, and problem solving arise.

If scientific problems could be solved with the intellectual support of field theory, then perhaps social problems with their ideological underpinnings could be as well. Polanyi rejected "Mach's principle of 'mental economy,' according to which science is the simplest description or the most convenient summary of the facts" (*PK* 166). Science uncovers physical facts and relations. Accordingly, Polanyi seems, at least initially, to intend that his field theory articulate epistemic and ontological truth. Assessing the adequacy of his account of how fields function thus is a facet of evaluating the cogency of his epistemology. Ideally then, the niggling questions raised above may be shown to be irrelevant if it can be shown that fields contribute helpfully to Polanyi's larger intentions in writing *Personal Knowledge*.

4. How successful is Polanyi's epistemic use of a field to explain the processes of comprehending, problem solving, and discovery?

In *Personal Knowledge*, part IV, Polanyi makes the bold claim that *all* skillful acts of comprehension or knowing can be brought to completion because their striving takes place within fields offering guidance,

> All the operations of the 'tacit component' (whether self-centered or seeking universality, whether conscious or unconscious) will be subsumed under this field conception. All mental unease that seeks appeasement of itself will be regarded as a line of force in such a field. Just as mechanical forces are the gradients of a potential energy, so this field of forces would also be the gradient of a potentiality: a gradient arising from the proximity of a possible achievement (*PK* 398).

Does Polanyi's claim that *all tacit operations* have a field character move the discussion to a more inclusive arena that satisfactorily overcomes the niggling concerns? Since tacit operations underlie all thought, fields should be ubiquitous. But in what sense might the complex, shifting array of various influences and processes operative in the tacit dimension constitute a field? Polanyi seems to be struggling here to articulate the subsidiary-focal distinction and the from-to structure of consciousness that he developed subsequent to writing *Personal Knowledge*. In his later understanding of tacit knowing, fields have no place. His theory

is compelling without tacit fields. Hence he sets aside his earlier claim that all tacit operations have a field character.

What about the more restricted role of fields within Part IV of *Personal Knowledge*? Do they make useful contributions to understanding how we know? Most pointedly, does a problem have attractive power within a field? Power seems evident in two components of the analogy: in gravitational force and in the person seeking a solution. The power resident in a solution is but a projection of the investigator's interest. The process of discovery has even less need to ascribe power to some center of attraction. A problem to solve has a known center of attraction, whereas a person seeking a discovery does not know what the desired outcome is like. The inquirer is the lone center of power.

Alas, the importance of a striving personal center is partially muted in some of Polanyi's statements. For instance, he appeals "to the evidence provided by various fields of biology (including psychology) which seem to cry out for the acknowledgement of a field as the *agent* of biotic performances" (*PK* 402, my emphasis). Along this line, he equates the process of coming to comprehend a solution with the process of physical development of an embryo and a child. "Comprehension and the somatic process which accompanies comprehension, represent therefore a kind of equilibration that can be defined only in terms of *intellectual rightness*. Morphogenesis, operating under the direction of a morphogenetic field, is a somatic process of the same kind, but following *morphological rightness* as its standard of achievement" (*PK* 398). The process of reaching comprehension is seen as a somatic process equivalent to the process of developing the right body form. Next, he claims, "The morphogenetic field (or its organizer, if there is one) is then defined as the agency of this success [of reaching the right body shape] and as that which has failed if success is not achieved" (*PK* 398). It follows from his analogy that the *field of comprehension* (or its organizer, if there is one) is the agent responsible for reaching comprehension.[2]

To be fair to Polanyi, however, it is important to note, as Jean Bocharova suggested in the Zoom discussion, that most often Polanyi speaks of the quest for intellectual solution to be an affair in which the lure of a solution *evokes* effort by a living agent. He states that "unformalizable regulative functions, linked to the animal's mental processes, are the predominant, comprehensible agency of animal life (*PK* 401).

I wholly affirm the importance of evocation in the search for meaningful solutions. Nevertheless, I find Polanyi's use of fields in *Personal Knowledge* to be rather muddled. Take the parallelism he suggests between comprehension and morphogenetic development. The latter is an expression of an orchestrated program of genetic expression and regulation carried out by DNA and RNA. As we saw, he claims morphogenesis follows a pre-existing "directing field." Unlike morphogenetic development, though, the solution of a problem or the coming to comprehension need not (and generally does not) follow some pre-existing program. Different investigators might bring unique assumptions and procedures to a problem, yet still be able to reach a solution.

Problem solving seems best understood as a skill orchestrated by a person as agent who both formulates the problem and attempts to solve it. The factors that make up the problem constrain the scope of investigation and in this sense help guide one to a proper solution. Ingenuity and originality are evoked in relation to the details of the problem. I find it surprising that occasionally Polanyi reverts to the apparent objectivity of a field to explain comprehension when his basic theme of personal knowing is that knowing is an *unformalizable* skill carried out *by a person*.

Polanyi recognizes the crucial importance of originality for problem solving. He asserts that a "generalized biological field" includes three stages of originality.

5. Do the three stages of originality that Polanyi claims are fostered by biological fields reveal the usefulness of field theory?

Previously Polanyi spoke as if each problem existed in its unique field, but on *PK* 398 it appears that these little fields exist within the purview of a generalized biological field. How is one to understand a biological field when, it will soon be evident, it includes species that are different in kind? A biological field seems to be a disciplinary field as defined in the second definition offered above. What the three subfields have in common is embodiment and its physiological processes.

First, "there is the originality of a resourcefulness manifested in achieving something clearly foreseeable" (*PK* 399). I take it that by "clearly foreseeable," Polanyi means problem solving within a framework in which knowledge is reversible. He states, "An inference guided by a fixed framework can always be traced back to its premises, and such 'reversibility,' Piaget points out, may be regarded as a characteristic feature of disciplined thought" (*PK* 75). A mathematical solution resulting from skillfully manipulating numbers and relationships according to previously defined mathematical rules would be an example of rule-based discoveries. Wisdom employed to solve everyday problems in our complex non-linear world would also seem to be an example of this type of problem solving insofar as wisdom is based on applying the lessons of previous experience. Such wisdom, drawing upon disciplinary fields, is a step towards solving social problems. Polanyi describes such wise regulative performances as "a purely skillful knowing, a connoisseurship" (*PK* 342).

6. Within this first stage of originality, does Polanyi adequately cover the diverse types of human intellectual ingenuity that might solve significant problems?

In short, the answer is "no." Richard Gelwick quite appropriately terms Polanyi's comprehensive thought a "heuristic philosophy."[3] Discovery is a central theme in Polanyi's thought, so it is surprising that the full range of intellectual discovery is truncated when he summarizes ways thought may be original within the biological field of embodied activity.

The first and most dramatic form of discovery Polanyi does not discuss is that which alters the frameworks through which we perceive reality. This radical change does not occur through ordinary foresight within normal frames of reference. Copernicus and Einstein may be referenced as among the few thinkers who initiated such new frameworks of understanding. The notion of a framework shift (a Kuhnian paradigm shift) seems more apt for describing their achievement than a broad reference to fields.

Newton's formulaic description of the factors governing force, F=ma, would be a second additional type of discovery not described by Polanyi. Its formulation represents the discovery of a law-abiding relationship that was vaguely sensed beforehand. That is, it does not exactly represent a new vision of reality such as provided by Copernicus and Einstein, but neither is it clearly foreseeable as described in Polanyi's first type of originality. Rather, this type of scientific discovery articulates a previously unrealized fit between human understanding and the phenomena of matter-energy activity. But this type of ingenuity need not be restricted to the sciences; novel social theories and artistic creation would sometimes fit as well. The course by which these types of discovery arise seems most adequately described by the description of the alternating ventures of imagination and intuition Polanyi offers after the publication of *PK*.

Technological innovation and the creating of machines represent a third type of originality not discussed by Polanyi in this summary statement, although he describes them earlier in *PK*. Contriving and

experimenting expand thought beyond what is foreseeable. Ironically, technological contrivances seem more liable than the other types of originality to benefit from analogy to gravitational fields because technological innovations are usually designed to fulfill a telic target and thus have a stable center of attraction comparable to the center of a field.

7. What does Polanyi's second type of biological originality tell us about the usefulness of fields for improving life?

The second type of biological emergence described by Polanyi takes ontogenetic maturation, not intellectual discovery, as its model. This type of emergence, already discussed above in terms of morphogenesis, is different than the first type of originality because it is not discovered; it is biologically pre-programmed. Ontogenetic maturation, he states, "represents a series of achievements, each producing a new field by which the next higher achievement will be performed. Such emergence—defined as an ordering principle capable of producing operational principles which the system had not previously possessed—has been adequately illustrated by the process of ontogenetic maturation" (*PK* 399). This claim raises three questions. First, while each adult matures into a unique personality, it stretches the concept of originality to say the biological program inscribed in DNA and RNA to produce adult human bodies from egg and sperm represents a stage of originality. Physiological maturation occurs again and again in roughly the same way. Second, to postulate the creation of a new field for each step of maturation seems unnecessary, adding nothing to existing biological explanation. Third, why does the embedded program of maturation require the existence of an ordering principle—an abstraction—to facilitate the emergence of each step of the programmed process? These unanswered queries lead to Polanyi's third stage of biological origination.

8. Does Polanyi's third stage of originality, phylogenetic emergence, provide support for the concept of fields in relation to contemporary evolutionary theory?

Polanyi's third type of emergent originality, phylogenetic emergence, is in many respects the most problematic of his three stages. He calls the origination of new species to be the product of a biotic field following a gradient of achievement (*PK* 399-400). He states that "we are *driven* to assume that the maturation of the germ plasm is *guided* by the potentialities that are open to it through its possible germination into new individuals" (*PK* 400). In these formulations, Polanyi seems to grant a degree of intention to the highly complex, temporally extended process of speciation. It is called an achievement. The embodied memories and skills an individual relies upon when achieving comprehension are quite different than complex environmental circumstances and genetic adjustments responsible for speciation. The notion of a common biological field linking the three stages of origination tends to obscure some very important differences between them.

An implication of Polanyi's explanation of evolution as taking place in a telic field involving unprecedented leaps across logical gaps between levels is that he rejects Neo-Darwinian thought. He thinks the incremental gradualism generated by mutation and selection is incapable of explaining how evolution is responsible for ever "higher" biotic achievements (*PK* 382-385). If Polanyi had said that natural selection and mutations are not solely responsible for evolutionary change, that would be accurate. Such factors as geographical isolation, genetic drift, horizontal gene transfer, response to catastrophe, and gene flow contribute to evolutionary change and speciation.

Unfortunately, Polanyi's attempt to explain evolution relies on extrapolating from his concept of dual control and its related concept of ontological levels. Again, for any comprehensive entity, he claims there is a logical gap between its principles as a higher-level entity and the rules governing its lower-level components. True enough; comprehensive entities are not mere aggregations of parts that are subject to the same rules as govern the whole. He denies "that any entirely accidental advantages [from natural selection] can ever add up to the evolution of a new set of operational principles, as it is not in their nature to do so" (*PK* 385). But is the language of unique "operational principles" and levels, language that is helpful with respect to machines and physiology, appropriate for describing the evolution of a new species from its ancestor?

In cases of geographical isolation over time, response to distinct ecological pressures may result in speciation, that is, the loss of the ability of the isolated species in a different environment to reproduce successfully with its ancestor species. Yet the two species may have DNA and physiological processes that are 99.99% the same. Similarly, the related species may have operational principles that are essentially the same. True, over vast periods of time, an emergent species may become quite different from its ancestor species. Take *homo sapiens* in contrast to their ape ancestors of 6 million years ago. However, if one applied dual control theory to interpret the difference between "higher level" human ability and "lower level" ape ability, one would artificially eject the two species from the vast temporal, ecological, and genetic processes that provide the basis for explaining their difference.

Polanyi acknowledges that selection plus mutations can produce changes over time, such as producing protective coloration of a species, but he denies [augmented] neo-Darwinian evolution can produce the differences in kind typical of separate species. "Lower levels do not lack a bearing on higher levels: *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's emphasis). To account for speciation, Polanyi thinks an "ordering principle" attuned to novelty is needed, just as a similar ordering principle was responsible for the origin of life. But surely there is a difference between the dramatic origination of life, perhaps best understood in terms of autopoiesis and self-organization, and the temporal process of life's evolution.[4] I understand the human desire for explanation that makes an abstract principle attractive, but I think actual explanation needs to refer to the tiny, multi-faceted actual events occurring over vast eons of time—actual causality that is far, far too detailed to make for comprehensible explanation. Complexity theory, rather than an ordering principle, would seem to provide the abstract set of processes that would best supplement the needed microsteps that would fully explain evolution.

I conclude that Polanyi's version of evolution fails not only in its reliance upon some active phylogenetic field, but also for his inappropriate generalization of dual control and his inappropriate attempt to account for the many factors driving evolutionary change with an abstract principle. I do not mean to depreciate his heroic attempt at explaining anthropogenesis; I am merely suggesting its culmination falters in some respects.

9. If field theory as developed in *Personal Knowledge* has little explanatory power with respect to the processes for solving problems and achieving discoveries, in his later work does he offer a more successful account?

Let me make clear that, although I have been critical of Polanyi's philosophical explanations at the conclusion of *Personal Knowledge*, I find most of Polanyi's epistemology uniquely insightful.[5] In later writings

he fine-tuned his thought about how discovery and problem solving should be understood in two major ways. Later I will describe an additional resource he often suggests but never fully explicates.

First, already in *Personal Knowledge* Polanyi argued that the key to expanding scientific understanding is relying upon tacit sensitivities, intimations of coherence, and imagination rather than explicit logical reasoning, which explicates what is already known. His account of how discovery takes place relies upon tacit intimations that cannot be reduced to rules. "[D]iscovery, far from representing a definite mental operation, is an extremely delicate and personal art which can be but little assisted by any formulated precepts."[6] The initial step in establishing a scientific research program is honing in on an appropriate problem, one that is significant but appears neither too simple nor too complex to solve. "[W]e may describe the obstacle to overcome in solving a problem as a 'logical gap,' and speak of the width of the logical gap as the measure of the ingenuity required for solving the problem" (*PK* 123).

Crossing of the logical gap to a scientific discovery relies, Polanyi avers, upon a delicate dance involving imagination and intuition as partners. "Guided by our intuition, our imagination sallies forward and our intuition integrates then what the imagination has hit upon."[7] Tacit clues are felt that may originally have influenced the scientist to feel the problem is a candidate for solution. These inspire an imaginative thrust. In formulating a possible solution, the imagination creates a vision evoking a further intuitive act, namely, the spontaneous integration of the particulars that would render the vision coherent. *Voila*, a discovery!

Second, in *The Tacit Dimension*, Polanyi's thought can be interpreted as allowing a shift of the notion of a field away from imputed similarity to a physical field, the third definition.[8] "This part of the universe, in which man has arisen," he states, "seems to be filled with a field of potentialities which evoke action" (*TD* 90-91). The "field of potentialities" denotes a comprehensive collection. It thus echoes aspects of both the first and second definitions of a field. Human cognition exhibits the capacity of grasping potentialities that produce discovery and solve problems. Deeper grasp of beneficial processes and structures of reality grant humans the satisfactions of expanded meaning.

To be sure, in *TD* Polanyi still clings to the notion of a problem's field, but it can be shown that fields are not essential to his explanation. He states that the field evoking and guiding discoveries "is not that of a more stable configuration but that of a problem" (*TD* 89). But isn't the point of seeking discovery or the solution to a problem to find the stable state of mind—the more inclusive meaning—that insight or solution brings? Any striving for discovery or solution must take into account the configuration of things that comprise the problem. Those factors are what evoke and guide a search. There is no need to include the notion of a field of attraction. The search for deeper meanings and resultant satisfactions is sufficient for explanation.

In this later account, Polanyi deflates the power of fields found in some of his statements in *PK*. Fields are grounded in focused human inquiry into more illuminating possibilities of meaning. They can be envisioned in either epistemic or ontological terms. Their function when located is to evoke and guide rather than control. Shared insights tend to endure and may evolve into disciplinary fields. Potentialities for insight exist in the arts and humanities as well as in science. In their humbler role, fields of potentialities can focus and guide thought to resolution. They can support Polanyi in his battle against the skepticism about values and reliable knowledge that contributed to the twentieth century's calamities.

Moreover, when the role of dual control is no longer generalized into a stratified universe, no ordering principle is needed to explain evolutionary change, nor need Neo-Darwinian thought, as augmented in recent years, be rejected. In the dynamically changing world, familiar habitats disintegrate, and novel niches

become manifest. These new niche conditions can function as open boundary conditions. Those animals with the traits that best take advantage of the new conditions will most likely thrive, and their distinctive traits will tend over time to become dominant within the niche. To use in a less abstract form Polanyian language I have criticized, it's as if newly altered niche conditions function as novel lower-level boundary conditions evoking slightly changed operating principles that allow resident animals to survive.

10. When possible solutions are elicited in the process of inquiry, are there standards of intelligibility that help guide thought to meaningful culmination?

Polanyi speaks of mental unease concerning an unresolved issue to be a motivating force in leading a person to seek a solution. True; we humans seem often to have a distaste for disorder and chaos. We feel more secure when we understand our surroundings. When we achieve greater order in our lives and in our thoughts, we feel a sense of satisfaction. A primary marker of intellectual order is coherence. We have seen that following a gradient of increasing coherence is essential to Polanyi's theory of discovery. Coherence is a kind of relational standard used to assess a situation's adequacy rather than an empirical item. It functions as a judge of how well parts fit together, and as such it is at core an aesthetic term. Consequently, I see the search to solve puzzles, to gain new knowledge, or to understand a problem as being guided in large part by an aesthetic sensibility.

Polanyi writes that "whether thought operates indwellingly within a universe of its own creation or interprets and controls nature as given to it from outside…there is present a personal component, inarticulate and passionate, which declares our standards of values, drives us to fulfil them and judges our performance by these self-set standards" (*PK* 195). An experience of coherence arises from a judgment of proper fit, whether occurring within thought or in relating thought to the perceived world. It is therefore expressible in an articulate judgment. Judgments of harmony and proportion are also largely relational, although perhaps imbued with greater subjectivity than judgments of coherence. Judgments of beauty, however heuristically pregnant, are less subject to precise explanation. They are not so much judgments of the relationships of parts to meaningful whole, as they are immediately attentive to the quality of the whole. Thus, in the visual arts, the quality of color alone can sometimes give birth to an uplifting experience of beauty. "The affirmation of a great scientific theory is in part an affirmation of delight. The theory has an inarticulate component acclaiming its beauty, and this is essential to the belief that the theory is true" (*PK* 133). Even the identification of a species of worm by a scientist is affirmed as an instance of "aesthetic recognition" (see *PK* 351). Judgments of beauty, coherence, harmony, and proportion—such aesthetic judgments are what bring imagination and intuition to satisfying conclusions regarding a discovery or a theoretical solution.

11. In conclusion, are fields useful concepts for illuminating how humans solve problems, make discoveries, and achieve knowledge?

I started by arguing that Polanyi's use of physical fields is limited in its ability to illuminate how discovery, problem-solving, and comprehension in general take place. Close examination of the analogy between the attractive power of a physical field and human response to a solution reveals problems of fit. Moreover, the notion that either the solution's winsomeness or the field itself is the agent producing a solution seriously overlooks the role of a responsible person as the truly active agent in identifying and solving problems. When intellectual prowess is demanded for solution, as in science, Polanyi convincingly shows that researchers

typically reach a discovery or solution with the aid of imagination, intuition, and aesthetic concepts. The metaphor of a field of attraction has some purchase within this arena. However, problems are cloaked in many forms, and it is doubtful that fields, physical or metaphorical, have much to do with such dilemmas as resolving interpersonal tensions or overcoming bureaucratic blockages.

In speaking on ontogenetic and phylogenetic fields, Polanyi endows fields with powers that seem at best superfluous and at worst misleading. Perhaps technological inventions have stable centers of achievement such as fields may exhibit. However, even in this case, introducing the notion of a field seems to add an unnecessary metaphysical claim to a process that can be more simply explained. A similar comment is applicable to Polanyi's use of "ordering principles." Occam's statement that one should not multiply entities without necessity seems to apply in these cases.

When Polanyi introduced fields at the end of *Personal Knowledge*, it seemed that he believed he had identified a force that could help illuminate how investigations reach a satisfactory conclusion. If that was his hope, it was not clearly realized. Eventually he used "field" in all three of the senses originally discussed, and the physical notion of field seems to have issued in the most ambiguous tangles. In *Meaning*, I believe Polanyi (and Prosch) describe a factor that augments solutions achieved by imagination and intuition and indeed illuminates what motivates the search for solutions as a whole. In the following quotation, I will replace the notion of "becoming converted" with the notion of why we seek solutions, discoveries, and greater knowledge in general. My paraphrased insertions are indicated in italics.

> It seems clear that we do not *value solving problems or gaining insights*—whether to a political party, a philosophy, or a religion—by having the truth of what we *have discovered* demonstrated to us in a wholly logical or objective way. Rather, what happens when we *find a true solution or insight* is that we see at some point that the *solution or insight* or epistemology or world view (or even scientific theory) in front of us holds possibilities for the attainment of richer meanings than the *previous view* we have been getting along with. (*M* 180)[9]

ENDNOTES

[1]R. G. Collingwood, *An Autobiography* (London: Oxford University Press, 1939), 37.

[2]Although I will not here develop this notion, I have wondered whether attractors within complexity theory have the potential to better take into account, at least analogically, the incredibly diverse factors influencing decision making than field theory does. Like any mathematical theory, though, attractor theory can consider only influences that can be identified and ideally translated into qualitative terms. Furthermore, because attractors are so sensitive to initial conditions, and the initial conditions of a person's thought process fluctuate so readily, attractor theory may be of little use. Anyway, Polanyi's proper insistence that discovery has inarticulate and indeterminate influences effectively demonstrates the limitation of attractor theory or any other accurate mathematical rendering of such embodied processes as thinking and learning.

[3]Richard Gelwick, *The Way of Discovery: An Introduction to the Thought of Michael Polanyi* (New York: Oxford University Press, 1977), xv.

[4]See Walter B. Gulick, "On the Adequacy of Neo-Darwinism: A Reply to Daniel Paksi," *Tradition and Discovery* 38:2 (2011-2012), 56-60 for further details of my critique of Polanyi's rejection of Neo-Darwinian thought.

[5]Among the articles in which I emphasize different aspects of Polanyi's theory of knowing as based on tacit processes are the following: "Polanyi's Theory of Meaning: Exposition, Elaboration, and Reconstruction," *Polanyiana* 2:4 & 3:1 (double issue, 1992-93), 7-42; "Signals, Schemas, Subsidiaries, and Skills: Articulating the Inarticulate," *Tradition and Discovery* 33:3 (2006-07), 44-62; "Polanyi and Langer: Toward a Reconfigured Theory of Knowing and Meaning," *Tradition and Discovery* 36:1 (2009-10), 21-37; "Polanyian Biosemiotics and the From-Via-To Dimensions of Meaning," *Tradition and Discovery* 39:1

(2012-13), 28-33; and "Understanding, Not Knowing, as the Core of Polanyi's Philosophy," *Polanyiana* 26:1-2 (2017), 83-115—all available online.

[6]Michael Polanyi, *Science, Faith, and Society* (Chicago: University of Chicago Press, 1946), 34.

[7]Polanyi, "Creative Imagination" in Michael Polanyi, S*ociety, Economics & Philosophy: Selected Papers*, ed. R. T. Allen (New Brunswick, NJ: Transaction Publishers, 1997), 260.

[8]Polanyi (and Prosch) make much the same points as found in *TD* in *Meaning* (Chicago: University of Chicago Press, 1975, 175-178). Polanyi seems to revert to an ordinary discipline-based notion of fields that is found in his thought prior to the ending sections of *PK*. For instance, in the concluding lecture of his Gifford Lectures in 1952, "Intelligence and Responsibility," p. 17, Polanyi states, "If something is said to be an organ this implies that it can function rightly, which sets up a field of enquiry, namely physiology, studying the principles of operation in healthy organs." In this passage a disciplinary field is established in response to a human need for understanding. It no longer has a kind of autonomous power.

[9]In his written response to the Zoom version of this paper, Jon Fennell suggests that "without fields there is no meaning." As indicated in this last quotation, I agree with Fennell's emphasis on the importance of meaning, but I do not understand why he thinks meaning is necessarily dependent on fields.