

The Sacred Depths of Nature and Ursula Goodenough's Religious Naturalism

Phil Mullins

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ABSTRACT Key words: Ursula Goodenough, science and religion, religious naturalism, philosophy and biology, Michael Polanyi.

This review essay summarizes major themes in Ursula Goodenough's The Sacred Depths of Nature and in several of her recent shorter publications. I describe her religious naturalism and her effort to craft a global ethic grounded in her penetrating account of nature. I suggest several parallels between Goodenough's "deep" account of nature and Michael Polanyi's ideas.

Unlike the physical universe, which for most people becomes increasingly bleak and terrifying the better it is known, the biological world yields an increasing sense of sacredness the better it is known. The more we know about life, the more we can care about it.¹

What follows is a rough effort to chart the territory covered by Ursula Goodenough in her concise but rich 1998 book, *The Sacred Depths of Nature*. Many of the themes in her book are also treated in several articles in *Zygon* and other journals, published both before and after her book.² Where appropriate, I shall draw elements from these articles into the discussion as part of a somewhat broader effort to suggest the scope and coherence of Goodenough's ideas. My concern here is faithfully to outline Goodenough's project, not to criticize it. As material elsewhere in this issue of *TAD* indicates, Goodenough will be a featured speaker at the 2002 annual meeting of the Polanyi Society. My comments will, I hope, encourage those who are unfamiliar with Goodenough's work to take a look for themselves, for she is truly an interesting contemporary voice in science and religion discussions, one who appreciates some of the themes in Polanyi's writings.

Goodenough is a prominent cell biologist at Washington University in St. Louis. At the beginning of her book, she is straightforward about her interests and motivation for putting together this book. Her father was an intellectual deeply interested in religion and he sowed a seed that germinated about twenty-five years after she became a cell biologist: Goodenough's curiosity about why people are religious and why she was not religious in the same way led her to join some communities engaged in religious practices and in reflection about religion. In addition to a local Presbyterian church, Goodenough became a member of the Institute on Religion in an Age of Science. These new engagements seem to have stimulated her thinking and led ultimately to writing about science and religion, including *The Sacred Depths of Nature*.

Scientific Understanding As a Moral and Religious Resource

Religion and culture are seamlessly woven together in Goodenough's account of things. Religious diversity and ongoing change in the many religious traditions she takes for granted. Goodenough thinks religion is the human effort to respond to basic questions about how things are (cosmology) and what things are valuable (ethics). A religion struggles to integrate responses to these big questions so as "to render the cosmological narrative so rich and compelling that it elicits our allegiance and our commitment to its emergent moral understandings" (xiv). At this stage in the earth's history, Goodenough contends that it is important that a planetary ethic begin to emerge, but she thinks global conversations bog down as people stake out positions of national, cultural and religious self-interest. She thinks science can provide a culture-independent account of how things are and that this can provide a common worldview that can be a foundation for a global ethic.³ However she holds a scientific cosmology can unite people only if it works as a "religious cosmology" which "makes the listener feel religious" (xvi). Goodenough thus says the goal of her book is "to present an accessible account of our scientific understanding of Nature and then suggest ways that this account can call forth appealing and abiding religious responses—an approach that can be called religious naturalism"(xvii).

Although it is not altogether clear what Goodenough means when she points to "feeling religious" as the key to cashing out scientific understanding as a common global ethic, this is an interesting approach. One of her fellow scientist reviewers notes that an important novelty in Goodenough's perspective is that for her "'nature' encompasses not just our direct experience of the natural world but also our scientific understanding of it."⁴ At the end of her Introduction, Goodenough alludes to this view when she says the "story of Nature has the potential to serve as the cosmos for the global ethos" but this is the case "only if we all experience a solemn gratitude that we exist at all, share a reverence for how life works, and acknowledge a deep and complex imperative that life continue" (xvii). This sort of emotionally rich and empowering experience can come, she contends, from "an understanding of human nature and an understanding of the rest of Nature," or, to put it in a slightly different way, from a "perspective on how Nature is put together, and how human nature flows forth from whence we came" (xviii). Although she does not use Polanyi as a direct resource, Goodenough's brief discussions of understanding as impassioned and empowering offer an interesting parallel to Polanyi's views. As I studied some of her later treatment of human nature as the outgrowth and gift of a larger nature, I could not help but think of the fourth part of *Personal Knowledge* or the discussion at the end of the "Emergence" chapter in *The Tacit Dimension* where Polanyi points to circularity in noting accounts of evolution must make sense of what he terms an "afterthought to five hundred million years of pure self-seeking" (52). This "afterthought" is the human "moral sense and our respect for it" (52) which Polanyi holds "presuppose an obedience to commands accepted in defiance of the immemorial scheme of self preservation. . . ." (52). Goodenough attends to the same circularity of human belief—respectfully accounting for and appreciating human knowing in the context of the larger evolving cosmos—and, finally, also to questions about responsibility that Polanyi thought central.

Religiopoiesis

In a recent *Zygon* article, “Exploring Resources of Naturalism,” Goodenough describes *The Sacred Depths of Nature* as a “contribution to present-day religiopoiesis” (562). She distinguishes religiopoiesis from more traditional theological reconstruction that works to incorporate new insights into traditional myths, rituals and theology. Religiopoiesis is a crafting of religion, a finding of ways to tell a story—the scientific story in her case—to convey meaning and motivation. It operates between two poles, the more reflective or theological pole and the more spiritual or feeling-directed pole. In the end, Goodenough seems to think a scientific understanding of life, what she calls the “Epic of Evolution” (xix) in her book, is capable of producing belief with a capital “B” which she takes to be a constellation of compelling theology and satisfying spiritual experience. When this happens, she believes that scientific accounts will help us find “our capacity to walk humbly and with gratitude in their presence” (565). As the quotation I have used above as an epigram suggests, understanding life scientifically also then will invoke “awe and wonder” which serves as “its own inherent reward” (565).

Goodenough thinks that this kind of empowering understanding of the scientific account of things can become commonplace only if, in the “process of religiopoiesis,” we

open ourselves to metaphors: those in our traditional religions, those in the poetry and art of past and present times, and those that emerge from our articulation of scientific understandings. . . .The goal is to come up with such a rich tapestry of meaning that we have no choice but to believe in it (“Exploring. . .” 566).

Metaphor, for Goodenough like Polanyi, has “cognitive and emotional valence” (“Reflections. . .,” 233) and is a key to religiopoiesis: “If the universe story is to compete with other stories for human attention, we need to offer human-friendly analogies for those who best understand scientific concepts through experiential referents” (“Reflections. . .,” 235). But Goodenough is also quite wary about metaphors and analogies in science and religion. Clearly, she does not think a watchmaker or intelligent designer God is an appropriate inference from nature; here analogy leads to a misunderstanding of nature. Contemporary claims about matters such as “irreducible complexity” garner no support from her. Goodenough insists in her book and in several other publications that she should not be understood as a theist, although she is equally insistent that she is religious. What she seems to be resisting with the term “theist” is all claims for a supernatural agent. She does not seem to imagine that there might be other interesting and illuminating ways to think about gods and their relations to human beings—ways that are not chained to the anchor of supernaturalism.

Goodenough is also critical of metaphORIZING scientists like Brian Swimme who are not religious conservatives but opt for metaphors primarily clever and charming to recast earlier religious narratives. Goodenough holds that good metaphors must “ring true with science” (“Reflections. . .,” 235) in the sense that they deeply reflect an understanding of the scientific concept they represent. They must carry over core truths. But they must also be words that (borrowing from another scholar’s account of native Americans) she says foster “cosmological personalism, words steeped in moral character and a sense of the sacred, words that

invite—indeed insist upon—our anthropocosmic participation” (“Reflections...,” 237).

To see Goodenough’s skill in drawing metaphors, the reader only has to plunge into the main body of *The Sacred Depths of Nature* which has twelve chapters that treat the stages of the “Epic of Evolution.” Each chapter discusses a development in the life of the universe with most chapters concerned with biology “at the level of molecules and genes and cells, since this is what cries out to be understood” (xix). Goodenough’s discussions are condensed but clear and here she carefully chooses metaphors and analogs for a lay scientific audience. Following the presentation of a particular scientific topic is what Goodenough terms a “religious response” (xx) to that topic, completing the chapter. She says this response is “personal, describing the particular religious emotion or mental state that is elicited in me when I think about a particular facet of the evolutionary story” (xx). Obviously, the pattern through which matters unfold in her book is both an overt expression of Goodenough’s personal commitments about the way things are and an illustration of how she believes that understanding the story of science can produce (paraphrasing her comment quoted above) gratitude that we exist at all, reverence for how life works, and a deep and complex imperative that life continue. In short, *The Sacred Depths of Nature* models the claims that it and other Goodenough writing sets forth about the potential of scientific understanding to shape the ethos.

Some Central Scientific Ideas and Their Implications

I cannot here systematically discuss the scientific account or the religious implications of the account that Goodenough builds chapter by chapter. It must suffice to sketch only very roughly the contours of the story that she lays out, moving from the origins of the earth through the origins of life and the development of life’s complexity. She treats not only how organisms and evolution work, but she discusses the biology of topics such as awareness, emotions and meaning, sex, sexuality, multicellularity and death and speciation. These are all matters central to the “Epic of Evolution” and all, in her view, stimulate “religious emotions” that help reshape the ethos.

Goodenough succinctly outlines the evolution of the cosmos from Big Bang. Life evolves after the laws of physics are in place. She notes that her first confrontation with physics left her staggered at the immensity and incomprehensibility of the universe but she “found a way to defeat the nihilism that lurks in the infinity and the infinitesimal”(11) by coming to see the universe as a locus of mystery. Although she does not link this mystery with God, she says the mystery generates wonder and produces awe and this allows her to “join the saints and the visionaries in their experiences of what they called the Divine”(13). As the plot of the scientific story moves on to the matter of the origins of life, Goodenough summarizes her account around two points:

First, a system got thrown together, apparently quite by chance, that allows biomolecules to be synthesized by a sunlight-driven chemistry that is not at all left to chance. And, second, the instructions for constructing this system acquired the ability to be copied and inherited. That is, life emerged from nonlife. The stages that were traversed, the trials and errors, the near-extinctions, the struggles to recover, all these have been erased, sup-

planted by our intimate understanding of the ultimate winner, the first progenitor cell from whom all creatures flow (27).

Goodenough emphasizes that life can be explained by its underlying chemistry (and chemistry by its underlying physics) but “the life that emerges from the underlying chemistry of biomolecules is something more than the collection of molecules” (28). She identifies the interaction of molecules residing inside cells as capable of generating new processes and such new processes “have no counterpart at simpler levels. These new, life-specific functions are referred to as emergent functions”(28). The origin of life is an emergent function and the development of more complex functions in life are emergent processes. Goodenough summarizes her view of emergence thus as “something more from nothing but” (28). She suggests that emergence is “the near-inevitable consequence of our thermal and chemical circumstances”(28).

Goodenough notes that the Anthropic Principle has gotten much attention lately, but such thinking leaves her unsatisfied. Her own approach is to “respond to the emergence of Life not with a search for its Design or Purpose but instead with outrageous celebration that it occurred at all”(29-30). She regards as “miraculous” the property of emergence: “Life does generate something-more-from-nothing-but, over and over again. . .”(30). She says for the religious naturalist that the “tales of natural emergence” are “far more magical than traditional miracles. Emergence is inherent in everything that is alive, allowing our yearning for supernatural miracles to be subsumed by our joy in the countless miracles that surround us” (30).

Life works, in Goodenough’s account, in terms of biochemistry and biophysics. Biophysics is concerned with “electrochemical gradients” and the physics through which “channels and pumps” work to “span the cell membrane” (40) and thus allow the chemical processes of the cell to work. Basic biochemistry is all about the shapes of proteins, particularly enzymes, and the sequences of shape changes or cascades which are the processes through which a cell perceives or interacts with that which is external. The “cell is set up to optimize the flowing of cascades”(42): that is, proteins that will interact with one another have “domains, called addresses, that target the proteins to the same cellular location” and each “destination proves optimal for particular biochemical reactions” (44). This means that “a cell is like a community, its inner workings segregated into interacting compartments, its outer membrane defining its interactions with the rest of the world.” (44).

In a way somewhat reminiscent of Polanyi’s account of hierarchy, Goodenough thinks of the operation of the cell by moving up and down through a hierarchy of levels. Her analog of this movement is the case of a Mozart sonata. We can think about the sonata as a lovely piece of music (as a whole) but we can move down through the levels to think about the production of sound that is sequenced by successively hammering piano keys. It is a matter of where the person wishes to focus attention. The down and up motion of analysis is a movement of reducing and then synthesizing. We can understand things we appreciate at a higher level in terms of activities at a lower level: for example, Mozart’s sonata modulates at some point into a B-flat and that is done with the intricacy of a particular chord that makes the change.

The real unit of life in Goodenough’s account is the organism, which is treated in the central fourth chapter, “How an Organism Works.” This is the intermediate level of emergence, the locus of “biological

patterns”(50) concerned with ““how the biochemistry and biophysics are organized, arranged, played out in space and time to produce a creature that grows and divides and is” (49). Goodenough explains such patterns in terms of the expression (rarely or frequently) of genes, a process by which instructions for making a protein are read. Thus the lactase gene that creates the lactase enzyme that metabolizes lactose for an amoeba is either switched on or off according to whether or not an amoeba crawls into a lactose-rich puddle. This switching is a function of lactose receptor proteins in an amoeba’s cell membrane, which bind or fail to bind to molecules of lactose in the environment. Binding causes receptors to shift shapes and this sets off “a signal-transduction cascade that eventually brings about a shape change in an activator protein” (53). An amoeba has hundreds of gene activators and repressors and each is a protein encoded by its own gene and elements often work together in complicated ways. Mutations affect things like whether activators can recognize shapes and thus can affect the entire complicated system. Genes are switched on and off as a response to environment and in terms of internal clocks, but regulation of gene expression also occurs in space. About a billion years ago, genetic instructions emerged that allowed two-celled organisms — and later, instructions for multicellular organisms —eventually to evolve. Multicellularity brings specialization:

Our two-celled organism, for example, might be programmed to switch on a set of light-detection genes in cell #1 and a set of motility genes in cell #2. We could now have an organism in which the motile cell is found pushing its light-sensitive cell ahead of it like a tiny eye. The four-celled organism might expand this idea. . .(57).

Multicellularity in humans means a trillion cells each with a full set of genetic instructions for making a human being, although each cell reads only some of the code and thus reproduces specialized cells.

What does Goodenough conclude about the human organism, given this scientific account of the incredible intricacy and complexity of functioning levels constituting the comprehensive entity? For her, chance and complexity have conspired to produce an entity to whom she must bear witness with affection, tenderness and respect: “I have come to understand that the self, my self, is inherently sacred. By virtue of its own improbability, its own miracle, its own emergence.” (59). She says “to the extent that I know myself, I am known” and this leads her to “sing my own song, with deep gratitude for my existence” (60). In a sense, Walt Whitman comes fully home in the enriched modern biological perspective of Goodenough’s affirmation that “I sanctify myself with my own grace” (60).

Goodenough’s chapter on evolution is lucid: “Evolution can be minimally defined as changes in the frequencies of different sets of instructions for making organisms” (64). In order to understand evolution, one must understand mutation (“how the instructions become different”) and natural selection (“how the frequencies of those instructions are changed”[64]). Goodenough’s discussion of both mutation and selection is well fitted to the discussions in earlier chapters of how cells and organisms function. Selection, she suggests, poses two questions: “Does the new protein or promoter work better, worse, or the same as the old one? And, how important is this difference to the organism?” (66). For amoebae dependent on lactose for food, a deleterious lactase mutation will likely be fatal. Such a “new gene will fail to spread, whereas a beneficial mutation may allow it to grow and divide more rapidly and hence the new gene may come to be more

prevalent than the old one” (66-67). Goodenough provides an illuminating example (the rise of the flagellum of modern bacteria) that shows how complex traits get started and evolve. She summarizes her evolutionist account of cumulative change and emerging complexity thus: “increasing complexity entails selections of selections” (71). But she also points out that evolution is conservative: “once a complex trait is established, like a signal transduction cascade or a metabolic pathway or an embryonic induction, it also tends to be used again and again, with appropriate embellishments to suit the circumstances” (72). In the final analysis, it is the “deep interrelatedness, our deep genetic homology, with the rest of the living world” (72) that is the lesson that most impresses Goodenough about evolution:

And now we realize that we are connected to all creatures. Not just in food chains or ecological equilibria. We share a common ancestor. We share genes for receptors and cell cycles and signal-transduction cascades. We share evolutionary constraints and possibilities. We are connected all the way down (73).

The web of life in the understanding of a sensitive scientist like Goodenough really is transformed into a new creation: about the many living forms, she says,

I no longer need to anthropomorphize them, or value them because they are beautiful or amusing or important for my survival. I see them as they are; I understand how they work. I think about their genes switching on and off, their cells dividing and differentiating in pace with my own, homologous to my own (74).

By the “outpouring of biological diversity” (86), humans (one of 30 million species existing today with many more millions having passed away) should be made humble, Goodenough thinks. We are called to acknowledge our solidarity with and our dependency on the web of life. As a religious naturalist, Goodenough holds it only fitting to locate deference to the divine “somewhere within the Earthly whole” (87).

Goodenough’s chapter on awareness is one that both distinguishes and links human self-awareness and awareness of other sorts in humans and other organisms. Awareness is biologically rooted in the fact that the first cells needed energy to carry out their biochemistry. Evolution favors receptors of use and early awareness systems focused on physical and chemical properties of the environment and eventually on other organisms. Early animals “devised the neuron, a cell type specialized for awareness, and this made possible the avenue of awareness called consciousness” (91). In the long course of evolution, complex nervous systems and brains, localized neuron centers, emerge; mammalian brains are particularly interesting since they are much different than that of organisms with more hard wiring. Self-awareness or consciousness, in Goodenough’s account, is “awareness of awareness” (99) which seems to be a witnessing of mental activity represented in symbolic forms in the working memory. She contends that an “I-ness” is primary for humans and, although not a theist, she links traditional western and eastern mysticism with this sense, Goodenough affirms what she calls “immanence” (102) which is immediate, experienced and known. She identifies immanence with that “part of my self that I most cherish and value” (102-103). Her response to immanence is to open herself “to its blessing”: “I give myself over to my mystic potential, to the possibility of becoming

lost in something much larger than my daily self, the possibility of transcending my daily self” (102). Goodenough’s broader reflections here on awareness are but one of many places in her book where echoes of William James can be heard; she acknowledges her debts to James in her book’s prefatory materials (xiii).

The Sacred Depths of Nature outlines a brief but provocative biology-based account of emotions and meaning. The evolution of awareness has brought organisms that value things perceived and attach meaning to what they are aware of. Humans, with our capacity to think and act symbolically, can integrate ideas and emotions and place them in working memory. Thus symbols have for us “cognitive and emotional resonance” (105) and we can “extrapolate our understanding of ourselves to the experience of other creatures” (106). Goodenough describes emotional responses as a function of a complex nervous system which is really a part of the evaluation processes all living things have and which operate in terms of shape changes induced in receptors and signal transduction cascades and biochemistry. Many emotional responses in humans seem to be “ancient and hardwired survival systems that mediate our behavioral interactions with the external world” (107). Animals without self-awareness likely experience emotions such as fear, but not feelings (“a conscious response to the unconscious fact of having had an emotional system activated” [107]) such as that of being frightened. Goodenough acknowledges that there is much that science has not understood about complex feelings which she suspects “represent elaborate combinations and syntheses of ancient emotional circuits, experienced by us in new ways. Anguish and elation may be reconfigured versions of anger and lust, without in any way being the less compelling or important” (110).

In a way somewhat reminiscent of Polanyi’s discussions, Goodenough discusses meaning as an element common to life. “Meaning” for an amoeba operates in terms of using receptors to note chemoattractant molecules that help the amoeba move toward food. Unicellular sexual organisms have similar “meaning systems” (111) using pheromones to note mates in the vicinity. Indexical meaning systems (that point like a finger) are frequently found in nature. But the most flexible and rich meaning systems use symbols and Goodenough thinks it likely that only humans have real capacity to construct and manipulate symbols. Working memory can produce an intricate integration of thought and feeling. Thus one can remember grandmother’s smile while recalling her admirable energy and annoying fussiness and at the same time be sorrowful that grandmother is dead.

Goodenough holds that emotion, feeling, meaning and symbolism come together in human religious frameworks. She contends that we only have to look at religious art from any culture to see this. Humans have a capacity “to apprehend the meaning and the emotion embedded in symbols that endows us with our capacity for empathy”(114). Empathy paves the way for the feeling we know as compassion and from compassion, which is always “in mortal conflict with out insistent sense that we should win,” emerges “our haunting sense that things should be fair”(115).

Goodenough’s chapter on sexual reproduction points out how this process generates enormous variety in genetic information: “although parents each contribute half of their genetic endowment to a child, they basically end up with a stranger” (121). As an evolutionary strategy, each sexual generation produces a whole new card game in which the genetic deck has been shuffled. While asexual reproduction “makes as many

specialized organisms as you can before the niche changes—the strategy of bacteria” (126), sexual reproduction “makes enough different kinds of organisms in one generation that at least some survive the vagaries of the niche and make enough different kinds of new organisms that the whole enterprise keeps going” (126). Goodenough’s broader reflections on the biology of sex point to another element of what she calls “caring”(127). Above I have sketched two elements of care: she acknowledges “our deep genetic homology with all of life and the affinity, the fellowship that emerges from that acknowledgment” (127); she also celebrates “our capacity to experience empathy with other creatures and respond to their concerns as our own” (127). Understanding sex makes us “encounter our biological imperative to nurture our offspring, sacrificing, if need be, our lives on their behalf” (127). Goodenough contends that she finds in herself “inherent maternal altruism” and “joy attends this kind of knowledge” (128). She links parental instincts with the emotions associated with evolutionary affinity and compassion; all three elements of caring also are tied to developing fitting responses to the earth:

It seems likely that the emotional circuits invoked when we contemplate our deep evolutionary affinity with other creatures, and when we are infused with compassion, will turn out to map closely onto the circuits that drive our parental instincts, emotions that generate such feelings as tenderness and warmth and protectiveness. These same emotions extend to our understanding that the Earth must be nurtured, an understanding embedding in many religious traditions (128).

The chapter on sex in *The Sacred Depths of Nature* is complemented by a chapter on sexuality, a topic about which Goodenough provides much complex biological detail as well as some conclusions about religious matters. What is especially interesting here (as in her treatment of several other complex biological topics) is the way in that Goodenough convincingly draws together different levels of description. Sexual creatures have complicated lives since they produce gametes that must “find, recognize, and then fuse with gametes of the same species and opposite gender. . . (131). The strategies of sexuality require relationships, some simple, but some—those built upon simpler ones—are complex and involve “elaborate emotional networks” (132). Goodenough sketches the range of attraction mechanisms and practices. For animals with nervous systems, “behavioral possibilities for sexual attraction” are taken “to every possible limit. Fireflies pulse, houseflies beat their wings, moths send out musk, fish dance. . .” (132-133). This leads Goodenough to conclude “if this is a planet shimmering with awareness, then a great deal of that awareness is focused on the sexual signals that creatures send to one another”(133). Humans rely on other human beings for care and nurture of offspring and much of this occurs in social groups; we exhibit a wide range of sexual behaviors. Like other animals, we need to attract mates. Goodenough suggests that whether or not humans alone consciously experience this need, “what we experience is an awareness of emotional pathways that have deep evolutionary roots” (134). She links affections for parents to “emotional networks that establish parent-offspring bonds in other mammals” (134) but such emotional responses, at least in early years, are “thoroughly wondrous, thoroughly compelling, and deeply joyous“(135). With parents, we eventually must separate and yet try to remain intimate, but all intimate relationships, perhaps especially those with mates, are “inherently fraught with conflict” (135).

Goodenough's broader reflections on human intimacy suggest a link between our needs and desires and the attractions of religion. Western monotheistic traditions "offer the opportunity for intimate relationship with deity. Indeed, they suggest that the most stable and fruitful outlet for passion and dependency is in relationship with the Divine" (136). A personalized deity who is both an object and a source of love, Goodenough acknowledges, is a deeply appealing--although not a viable--option for her:

I lack the resources to render my capacity for love and my need to be loved to supernatural Beings. And so I have no choice but to pour these capacities and needs into earthly relationships, fragile and mortal and difficult as they often are (140).

Goodenough is quite self-consciously not a supernaturalist, but she seems content to allow those who can entertain and love a supernatural God to do so. She does note that in fact she finds, from talking to thoughtful theists, that between theism and non-theism there is a spectrum rather than a polarity. Opportunities are everywhere for non-supernaturalists "to open ourselves to human relationship and hence to fill our lives with the religious experience of love" (140). She finds in monotheistic traditions "challenging and enchanting images and evocations for how to best love" (140).

The final chapters on multicellularity, death and speciation round out issues in basic biology that Goodenough treats in her book. Multicellular organisms evolved from single-celled organisms and are sexual but in a fundamentally different way than single-celled sexual organisms. Embryogenesis involves differentiation and part of this is the specialization of germ-line cells: "The dichotomy between germ-line cells and the remaining somatic cells effectively parcels out the job of being alive" (145). During embryogenesis, cell death is programmed in and, in fact, the whole soma dies. Thus with complex multicellular organisms,

once you have a life cycle with a germ line and a soma, then immortality is handed over to the germ line. This liberates the soma from any obligation to generate gametes, and allows it to focus instead on strategies for getting gametes transmitted (148).

The brain, the locus of human self-awareness, is part of the soma. Its specialized functions as a center of perception and feelings are actualized only as specialized cells die and ultimately the brain itself dies. This is a matter that Goodenough finds deeply significant:

So our brains, and hence our minds, are destined to die with the rest of the soma. And it is here that we arrive at one of the central ironies of human existence. Which is that our sentient brains are uniquely capable of experiencing deep regret and sorrow and fear at the prospect of our own death, yet it was the invention of death, the invention of the germ/soma dichotomy, that made possible the existence of our brains (149).

Religious naturalism, Goodenough says, recognizes empathy and compassion which allows humans in all cultural contexts to "experience unmitigated loss and grief" (150). Religious naturalism also accepts the inevitability of death and finds meaning in it: "my somatic life is the wondrous gift wrought by my forthcoming

death” (151). The American poet Wallace Stevens (in his famous poem “Sunday Morning”) succinctly summarized matters in a way that Goodenough would likely approve: “death is the mother of beauty.”

Biologically, speciation concerns the segregation of organisms according to those that will and will not mate with one another and this, in turn, allows species to develop distinctive traits and greater biodiversity. Goodenough sketches the dynamics of speciation in terms a card-playing metaphor:

Speciation creates a new deck of shuffling genomes. If the new deck has only recently become isolated from the old (parental-species) deck, the two will share a great many alleles. But because they are not being shuffled together and are subject to different kinds of natural selection, the two decks will come to have quite different frequencies of alleles. Importantly, new decks will also come to contain new cards—new genetic ideas that endow the new species with distinctive sexual and adaptive traits not present in the parental species (155).

She discusses primate speciation: recent evidence makes it clear that humans branched off much more recently (five million years ago) than was earlier thought (fifteen million years ago) and that human evolution was not a separate affair from the rest of primate speciation. The chimps and bonobos diverge after humans, and we have a common ancestor. She sketches a genetic perspective on the likenesses and differences between humans and our fellow primates. Goodenough explains how both the evolution of novel genes and mutations that affect the timing of switching genes on and off can have large consequences:

Chimps, humans and bonobos emerged as very similar species with some very important differences. In particular, our lineage has come up with the symbol systems that allow our language and self-awareness, apparently the only time in evolutionary history that such capacities have developed. Accompanying this has been a huge amplification in the number of neurons and neuronal connections in the human cerebral cortex and prefrontal cortex, a change evident in the fossil record of skull size about 2 million years ago—about the time we encounter the first tools. The genetic changes that generated our big brains were perhaps not very complicated, but the results are complicated (163-164).

Goodenough offers a meditation on what human distinctiveness entails and calls for. She draws certain moral implications from her evolutionary account. Humans share the planet with our “next of kin, oranges and gorillas and chimps and bonobos” (164). We can learn from one another, and the preservation of habitat and dignity emerges as a commandment” (164). Within our own gene pool with a large number of alleles (“a few concentrated in particular geographic groups we call races”[164]), each is distinctive but all are “members of the human species and hence share the distinctiveness of our species” (165). Goodenough says that as environmentalists we learn to defend the diversity of the species and as a religious naturalist one is called “to celebrate human distinctiveness with the same full-throated thanksgiving that we celebrate the whale and the spotted owl” (165). In her catalog of elements of human distinctiveness there are echoes of points Polanyi touched in his discussions of this topic: (1) humans as a symbol-using species communicate

in language and this allows us capacities of abstract thought that seem unparalleled (e.g., planning the future, articulating and transmitting our cultural lore); (2) humans have the capacity to go beyond minimal interpretation of perceived reality, since they have the capacity to analyze reality—we can ask and answer questions and, among other things, this leads to science and humanistic knowledge; (3) humans have the capacity to create art and it "as we respond to understandings and feelings inherent in our art that we acquire much of our truth, much of our nobility and grace, and much of our pleasure" (166); (4) humans are *Homo religiosus* and, for Goodenough, this implies that

We need answers to existential questions. We need to believe in things, to structure and orient our lives in ways that make sense and offer hope, to identify values and ideals, to transcend and interconnect. And happily, we have the capacity to transmit our accumulated religious understandings to one another and to our children through our languages and our arts, allowing them to endure and evolve (166).

At the very end of her book, Goodenough summarizes her themes around what she dubs four "emergent religious principles" (167): (1) Human beings raise big questions about the universe and her response is "to articulate a covenant with Mystery" (167). Responses to questions of ultimacy are deeply personal and beyond proof or refutation, but she suggests that asking questions of ultimacy "is to generate the foundation for everything else" (169). (2) Goodenough suggests that the religious naturalist holds thankfulness to be a basic human response. The attitude of a sensitive evolutionist should be "we arrived but a moment ago, and found it to be perfect for us in every way. And then we came to understand that it is perfect because we arose from it and are a part of it" (169). What Goodenough says is important is that "gratitude flows from our beings" (169) and not whether it is directed to God, Mystery, Cosmic Evolution or some other being, direction or object. (3) Evolution, as Goodenough has portrayed it, is a deep and sacred story that calls forth reverence. As a religious naturalist, she says "we are called to revere the whole enterprise of planetary existence, the whole and all of its myriad parts as they catalyze and secrete and replicate and mutate and evolve" (170). (4) Goodenough proposes that evolution can be thought of not only as "about prevalence, about how many copies there are of which kinds of genomes" but in a "more germinative" way as "being about the continuation of genomes" (170). Evolution has already produced creatures with awareness that acknowledge value and purpose. This implies that in future evolution "genomes must dictate organisms that are aware of their environmental circumstances, evaluate these inputs correctly and respond with intentionality" (171). She claims as an article of "Faith" that "existence of all this complexity and awareness and intent and beauty, and my ability to apprehend it, serves as the ultimate meaning and the ultimate value" (171). In the final analysis, Goodenough says,

The continuation of life reaches around, grabs its own tail, and forms a sacred circle that requires no further justification, no Creator, no superordinate meaning of meaning, no purpose other than that the continuation continue until the sun collapses or the final meteor collides. I confess a credo of continuation." (171).

Michael Polanyi expanded philosophy of science in a way that showed it must be woven with *Lebensphilosophie*. Ursula Goodenough makes much the same move in the account of biology provided in *The Sacred Depths of Nature*. I suspect that anyone who has read Polanyi's work deeply will find an intriguing resonance in Ursula Goodenough's thought.

Endnotes

¹ Ursula Goodenough, "What Science Can and Cannot Offer to a Religious Narrative," *Zygon* 29:3 (September 1994): 327.

² In addition to the essay cited above for the epigram, the following are of interest: "Creativity in Science," *Zygon* 28: 3 (September 1993): 399-414. "The Religious Dimensions of Biological Narrative," *Zygon* 29:4 (December 1994): 603-618. "Biology: What One Needs to Know," *Zygon* 31: 4 (December 1996): 671-680. "Reflections on Science and Technology," *Zygon* 35:1 (March 2000): 5-12. "Reflections on Scientific and Religious Metaphor," *Zygon* 35:2 (June 2000): 233-240. "Exploring Religious Naturalism," *Zygon* 35:3 (September 2000): 561-566. "Causality and Subjectivity in the Religious Quest," *Zygon* 35:4 (December 2000): 725-734. "'Religious Naturalism' and a New Planetary Ethic: Barbara Forrest Interview with Ursula Goodenough," *Free Inquiry* 20:3 (Summer 2000):45-47. References hereafter to any of these articles are by title abbreviation and page number.

³ There is something a bit naive or at least incomplete about Goodenough's claim that science is culture-independent, a point that she does not try to develop and clarify in her book. Polanyi, of course, suggested that culture is complex and its bearing on scientific work is very complicated. He argued that science is deeply dependent on culture, particularly political culture. Civil liberties, fairness and tolerance are noted as critically important to science. He also argued that science has many overlapping neighborhoods and is governed by scientific opinion; science is a community endeavor reliant on creative individuals and it in many ways generates its own particular culture nested with a larger cultural framework. Polanyi however was eager not to slip into a "two cultures" view like that of Snow. Indeed, he rejected Snow's view. Polanyi argued for a spectrum of sciences and humanistic study running from physics to study of historical figures. He tried both to link and to distinguish different areas of study. Goodenough touches on a few of these matters in "Creativity. . ." but her thesis about the cultural independence of science seems to need a good deal more substantive development and refinement.

⁴ Barbara Smuts "Reviews and Commentaries: Sanctifying the Cosmos," *Scientific American*, May 1999: 100.