

pits] natural theology against science by asserting an incompetence of science" (p. 69). Barr suggests that "the older (and wiser) form of the design argument for the existence of God ... did not point to the naturally inexplicable or to effects outside of the course of nature, but to nature itself and its ordinary operations [which reflect] the power and wisdom of God" (p. 70), citing lengthy passages from the Book of Wisdom (c. 100 BC) and the Letter of Clement (c. AD 97).

As a unified collection of pieces published by a believing scientist over a sixteen-year period, this book is a useful resource, and I commend his sometimes provocative thoughts to readers of *PSCF*. I would have found the book more valuable, though, if it had contained sustained engagements with the responses which some of his pieces have garnered over the years.

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BIOLOGICAL INDIVIDUALITY: Integrating Scientific, Philosophical, and Historical Perspectives by Scott Lidgard and Lynn K. Nyhart, eds. Chicago, IL: The University of Chicago Press, 2017. 361 pages. Paperback; \$25.00. ISBN: 9780226446455.

The field of biology is a very broad discipline. Etymologically, biology (*bios* + *logos*) means the study of life. But what is it that biology actually studies? Life itself is not a concrete, physical thing; rather, it is a function of living things. The focus of biology is not only the study of life as a function of certain things, but also the nature of living things that display the function of life. How does life as a function of certain things actually come about? Put another way, how do certain things come to display life activity or function? Central to these questions is that of biological individuality. What are biological individuals? What are the boundaries of and for biological individuals? These types of questions have been at the center of biological study, research, and thinking for several centuries.

In this edited volume, Lidgard and Nyhart provide a valuable service in pulling together various analyses of biological individuality. Three foci are distinguished in such an investigation: (1) the fundamental philosophical questions of biological individuality; (2) the historical analysis of how biologists have thought about individuality; and (3) how their reflections have influenced not only their research programs, but also how research programs, in turn, influenced philosophical perspectives on biological individuality and the nature of living things. Edited

volumes sometimes suffer from a lack of coordination and a basic central theme, but the editors have dealt with that by providing an integrating introductory chapter, "Introduction: Working Together on Individuality," as well as an integrating philosophical analysis in a concluding chapter, "Philosophical Dimensions of Individuality," by Alan C. Love and Ingo Brigandt. The volume includes thirteen contributors spanning the spectrum of historians, philosophers, biologists, and sociologists.

The editors emphasize that although the concept of individuality is an important concept for biologists, there is no consensus on a definition of biological individuality. They even provide an extensive table (pp. 19–21) outlining the various definitional criteria for biological individuality as well as a graph (p. 23) indicating the year(s) of publications reflecting those definitional criteria and thereby providing a historical perspective.

There are a number of themes that arise in the consideration of biological individuality. One important theme is the evolutionary transitions in individuality (ETI). One such key ETI is that from unicellularity to multicellularity. The case study of the volvocine algae illustrates an attempt to understand this transition. This group of algae provides diverse examples of single-cell forms as well as colonial forms. In some forms, daughter colonies begin to form within the parent colony, raising the question of what constitutes an individual. Are the daughter colonies individuals only after they break from the colonies? In the transition from a unicellular form to a multicellular colonial form, what is the role of cell-to-cell communication and how many different forms of cell-to-cell connections and communications are there? Are such forms of communication fundamental features of the evolutionary transition from unicellularity to multicellularity? In some cases, the daughter colonies are actually clones of the parent colony so that we now have the introduction of levels of organization: one-celled organisms, colonies, and clones, potentially constituting three hierarchical levels. The matter of clones raises the intriguing question of whether all members of a clone, such as a cluster of beech trees sprouting from a single individual beech tree, actually constitute an individual. However, the concept of ETI might also be stretched in questionable ways as evidenced in the chapter by Andrew Reynolds, "Discovering the Ties That Bind: Cell-Cell Communication and the Development of Cell Sociology." Is the use of the term cell sociology a misapplication of the concept of sociology in order to provide some basis for the evolution of animal and human sociology?

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The editors also introduce four problems, we might call them themes, related to the question of biological individuality: individuation, hierarchy, temporality, and constitution. Individuation concerns the identity and unity of a living thing. All living things display some form of metabolism and generally also some form of growth. Through all this change of material composition, what guarantees the identity of the individual so that its identity and unity as an individual is retained? Another illustration of individuation is in speciation and the concept of species as individuals. At what point is a species as individual distinct from another species?

Hierarchy is another important theme that reflects the nature of the levels of organization of living things. During the nineteenth century, there was a very active debate between two basic schools of thought: vitalism and reductionism. Vitalism emphasized a holistic view of living things whereby the whole individual is greater than the sum of its parts. Reductionism emphasized the view that the individual can be understood by examining the mechanistic functioning of the constituent parts. This debate was continued in the twentieth century by organicism and systems thinking in biology, which emphasized a holistic view replacing the earlier vitalist views. Central to this discussion is the question of how the entities of one level are related to the entities of a higher level. Are the entities at each level to be considered as integral wholes or are the entities merely part of a higher level? Expressed another way, are we dealing with part-whole relationships or with whole-whole relationships as in enkaptic hierarchies? Olivier Rieppel in his chapter, "Biological Individuality and Enkapsis: From Martin Heidenhain's *Synthesiology* to the *Völkisch* National Community," lays out how the theory of enkapsis was used by some to argue for individuals to sacrifice themselves for the good of the whole national community in Nazism. Ingo Brigandt, in the chapter "Bodily Parts in the Structure-Function Dialectic," makes a case for considering functions or activities as entities that were proposed to become integrated into the levels of hierarchies. However, doing so would bring into question whether functions can really be independent of entities and whether this would obscure the fundamental meaning of hierarchical levels of structure.

Temporality is another theme that addresses the evolution or emergence of biological individuality. How do individuals at one stage of evolution relate to subsequent stages of evolution? A further issue concerns the units of selection and whether species are individuals, and thus, are possibly considered to be subject to selection. Temporality also relates to devel-

opmental stages and how stages relate to the identity of a biological individual. One very intriguing and significant historical discussion concerns the alternation of generations. For living things that display a remarkably distinct alternation of generations such as between haploid and diploid generations, to what extent are we dealing with distinct biological individualities? Are the alternate generations a single biological individual or are they separate biological individuals?

A fourth theme is that of constitution: what constitutes a biological individual? This is also related to the questions of part-part, part-whole, and whole-whole relations that are important considerations of hierarchical levels of structure. Additional fascinating aspects to this theme include parasitism and symbiotic relations. Parasitism involves intimate relations between host and parasite such that the parasite typically exists within the boundary of the host organism. In such a relationship, what constitutes the individual? Are they to be seen as a single individual or as two distinct individuals that are at least for a time intimately connected to each other? This is perhaps even more complex with regard to symbiotic relationships, especially with regard to obligatory symbiotic relationships. One clear example is the case of intestinal bacteria in human digestive systems. It is reported that 30% of our blood metabolites are bacterial products. Without such beneficial intestinal bacteria, human survival is at stake. The bacteria are considered to be biological individuals in their own right. So how does that affect human individuality? Another example is lichens, which are obligatory symbionts of specific fungi integrated with a specific form of algae. We intuitively recognize lichens as biological individuals. Is this perhaps an example of a whole-whole relationship?

This introduces a new concept of biological individuality, that of holobionts. Holobionts are biological individuals that encapsulate autonomous or semi-autonomous individuals into a functioning organism, as illustrated in the examples of symbiosis given above. Perhaps the process of endosymbiosis in which prokaryotes became incorporated into other eukaryotic cells is an early form of holobionts. Holobionts may also have impacts on genetic activity (viral insertions into a host's genetic makeup) and immunological recognition of self and nonself.

In short, this book on biological individuality is relevant to biological research and helps one develop a richer philosophical understanding of the nature of living things. It may also assist in reminding readers of the limits of reductionist and mechanistic understandings of the nature of life as a function of living

things. Reductionist and mechanistic views are heavily dependent on a philosophical materialism, which is opposed to a deeper Christian, theistic view of reality.

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TECHNOLOGY

RE-ENGINEERING HUMANITY by Brett Frischmann and Evan Selinger. New York: Cambridge University Press, 2018. 295 pages + foreword, five appendices, detailed notes, bibliography, index. Hardcover; \$29.95. ISBN: 9781107147096.

In his 1954 classic, *The Technological Society*, Jacques Ellul explored the concept of “technique,” a way of thinking in which optimizing productivity and efficiency becomes an end, not a means. Joseph Weizenbaum’s 1976 book, *Computer Power and Human Reason*, introduces the “imperialism of instrumental reason,” a way of thinking that seeks to frame all problems in the language of computation. Weizenbaum argues that not all problems can be framed in this way—justice, for example—and that it is not the case that all things that matter are amenable to measurement. *Re-Engineering Humanity* belongs to this same literary genre (critiques of technological thinking). It explicitly seeks to extend Weizenbaum’s analysis to the impact of the internet.

Frischmann and Selinger develop two key concepts. The first concept, “techno-social engineering,” consists of processes in which technologies and social forces align and affect how people think, perceive, and act. “Engineered determinism” is the second concept and “entails techno-social engineering of humans, often through the construction of smart techno-social environments that render humans within the environments increasingly predictable and programmable” (p. 220). They add that engineered determinism is “... the grand hubris that we can socially construct a perfectly optimized world if we only have the data, confidence in our tools, and willingness to commit” (p. 53).

The book is primarily a warning against techno-social engineering. Frischmann and Selinger assert that “as we collectively race down the path toward smart techno-social systems that efficiently govern more and more of our lives, we run the risk of losing ourselves along the way” (p. 1). They add that their “concern is with the social costs associated with rampant techno-social engineering that diminishes and devalues human autonomy and sociality” (p. 62). They argue that our humanity can be taken away,

that it is at risk of deterioration by pervasive techno-social engineering. The basic capabilities at risk are thinking capacities, the ability to socialize and relate to each other, free will, autonomy, and agency.

These are strong assertions and the authors develop the case for them with some care. They examine a number of examples. For instance, to some people iPhones become part of themselves, yet the phone is designed to give access and control privileges to others; Facebook’s algorithms determine who can see a post; global positioning systems can be used so easily that people lose a sense of where they are; furthermore, the data such systems generate can be exploited. The authors also point out that the internet has vastly increased the reach, interconnection, and continuity of techno-social engineering into homes and public places. They examine the internet of things, a means for ubiquitously distributed sensors to gather, exchange, and act on data. It can enable the providers of those sensors to engineer people’s beliefs, preferences, and emotions.

They are careful about the structure of their argument. For instance, they acknowledge that they are making a slippery slope argument and devote most of one chapter to exploring the question of when such arguments might be legitimate. Since they assert that our humanity is at risk, they take time to examine what it means to be human and how one might detect that our humanity is being lost. To do that they reverse the classic Turing test for whether a machine can think like a human and ask how we might detect that a human is thinking like a machine.

Re-Engineering Humanity presents a dire picture of our current situation. So, the authors strongly argue for the “freedom to be off.” They suggest three strategies toward this end. First, engage in critical analysis. For instance, Weizenbaum said that things that matter normatively are not necessarily amenable to measurement. Frischmann and Selinger extend that by pointing out an additional assumption often made, namely, that a common denominator for such measurements exists. Second, create friction on the slippery slope. Suggested methods include preserving net neutrality, using air gaps (places in software that are intentionally not optimized), using obfuscation techniques to disrupt surveillance, and anonymizing data. Third, challenge the logics of minimization and maximization.

It’s hard to know how to evaluate a warning as serious as this. On one hand, the argument is carefully developed and the response strategies are worthy of consideration. However, the experience of reading the book is like looking at a room through a key hole