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Book Review

Labyrinth: A Search for the Hidden Meaning of Science. Peter Pesic. Cambridge, MA: MIT Press, 2000, 186 pp.

The “Human Meaning” of Science¹

Peter Pesic deserves praise for this readable presentation of his research on “the human significance of science.”² In the first section of my review I outline Pesic’s story about the role a particular metaphor—that “nature has secrets”³—has played in the history of science’s evolving “human meaning.”⁴ I organize this outline around my claim that, Pesic’s own protestations notwithstanding, his book should be taken as a genuine piece of philosophy. In the second section of the review I argue that Pesic’s work, philosophical though it may be, nevertheless suffers from some significant structural tensions—in particular between the legitimacy of the “secrets in nature” metaphor and the justification for attending as he does to the *literary* details of scientific work.

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So, this book is not a work either of the history of science or of the philosophy of science in their usual modern senses. ... I will read scientific works as if they were works of literature, attending to nuance and tone as much as to surface meaning, trying to be faithful to them. These are works of thought and feeling that call for the evocation of their largest questions.... Like great works of literature, great scientific writings have a compelling integrity and imaginative force that call for sensitive reading. In this spirit, I try to find the living center of human concern as it emerges in the scientific endeavor. Though I cannot claim to be a philosopher in the deepest sense, I invite the reader to a philosophical quest.⁵

Perhaps Pesic hesitates to call himself a philosopher because he lacks the professional philosopher’s conceptual toolbox, but I propose that he deserves the title anyway. He deserves it not because his book is thoroughly successful at accomplishing his goal of finding “the living center of human concern as it emerges in the scientific endeavor”—in fact, I think it is not. Rather, he deserves the title on the basis of his ability to write in a multi-layered way about questions of general human significance.

By calling Pesic’s work multi-layered (and thus, in my view, philosophical), I mean that it is written for as encompassing an audience as possible. While the book is in the first instance a

popular work in what looks like intellectual history—Pesic traces the evolution of the “hidden meaning” idea through the history of science from about the mid-16th Century through the 20th—it is based on scholarship of staggering breadth, apparently designed to appeal at once to the casual reader as well as to the scholar. Pesic seems consciously to give the reader a broad spectrum of avenues to pursue for further study, even while keeping his prose almost fiercely accessible. Thus, the work is multi-layered in the sense that, unlike most academic popularizations, it tries to embrace both the professional and the non-professional audience at once,⁶ functioning as inspiring story about scientific discovery for some readers, and for others as scholarly research into something like the psychology of scientific advancement. I think Pesic counts as “a philosopher in the deepest sense” because he writes for such a wide audience about an activity that has such significance in our cultural milieu.

Pesic restricts his attention to six main players—William Gilbert, the 16th Century inventor of the scientific study of magnetism; François Viète, the 16th Century mathematician who helped introduce algebra to the Western world, and who was one of the first to develop systematic codebreaking methods; Francis Bacon, the Lord Chancellor of England, pioneer of scientific methodology in the late 16th and 17th Centuries, and the main protagonist of *Labyrinth*; and the more widely-known scientists Johannes Kepler, Isaac Newton, and Albert Einstein.

Though *Labyrinth* features some detailed investigations of the above-mentioned scientists’ more literary works (sometimes these are just journal or notebook musings), the book is organized topically. Pesic, a tutor and musician-in-residence at St. John’s College in Santa Fe, calls his book a “triple fugue, an interweaving of three distinct but finally interrelated themes concerning the character of the scientific enterprise and the deep effects it has on human character.”⁷ The themes are supposed to spell out three ways in which scientists who regarded nature as harboring secrets have conceived of and practiced their craft. The first theme concerns the mutual struggle between the scientist and nature; the second concerns the effect this struggle has on the scientist; and the final theme concerns the rise of symbolic mathematics.

There is not an inkling of *Labyrinth*’s lynchpin claim, however, until more than halfway through the book. The claim is that it was through the parallel developments during the 16th and 17th Centuries of formal methods in cryptanalysis (codebreaking) and in symbolic mathematics, especially algebra, that the metaphor of “secrets in nature” finally manifested itself in concrete scientific practice.⁸ In the book’s most intriguing chapter, and perhaps its most speculative as well, Pesic contends that Bacon’s experimental “tables and arrangements of instances”⁹ of phenomena were patterned after similar tables commonly used in cryptanalysis.¹⁰ He devotes the rest of the book to exploring the role of cryptanalytic techniques in the development of formal mathematics, and the role of formal mathematics (and thus of cryptanalysis) in science.¹¹

It is this juxtaposition of early scientific method with early work in cryptanalysis that finally clarifies what it is for scientists to view nature as if it has “hidden secrets.” But it is also this juxtaposition that raises questions about Pesic’s justification for trying to understand scientific practice via its “human significance.”

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Pesic's scholarly approach is marked by a laudable attempt to use methods drawn from opposed camps in science studies. For instance, his work is clearly informed by "outsider" sociology and history of science insofar as he wants license both to study aspects of scientific practice (like the role played by human desire) that the scientists themselves may have thought irrelevant to supporting their larger projects,¹² and also to arouse in the reader a fresh sense of wonder at stories which may already be familiar.¹³ But yet he is not willing to abandon the "insider" perspective, occasionally detouring into basic but technical details of such things as Viète's algebraic inventions¹⁴ and the cipher Bacon developed as a young man.¹⁵

To give another example, Pesic has clearly been influenced by three prominent feminist readings of Bacon¹⁶—in particular, by their common insistence on studying Bacon's literary devices as a way to understand his vision of a new scientific method. But Pesic has at the same time been influenced by two *criticisms* of these feminist interpretations,¹⁷ and wants to hold that Bacon's vision of a new science is not ultimately gender-biased.¹⁸

However, Pesic is in some ways too aware of his own methodology. He seems bent on making the work overly self-referentially consistent, in the sense that the book is supposed to exhibit some of the methodological features of science as codebreaking that the work itself discloses. He writes:

As befits someone groping through a maze, I do not feel restricted in the way I search for the center. The word *clue* originally meant the thread guiding one through a maze, and I will present the clues as I find them, whether in Gilbert's account of magnetism or Bacon's retold fables or Viète's codebreaking. I will not present a continuous history or offer an overview of scientific theories, although I will recount some elements of history and of scientific theory along the way.¹⁹

But it is *science* that is supposed to resemble "groping through a maze", and it's far from clear why a book in the *history* of science must follow scientific methodology. It would be as though we held that the only way to write a history of jazz would be to play more jazz.

Actually, by itself this is not a criticism of *Labyrinth*—surely a successful history of scientific method might employ the very methods it discloses, just as a musical performance *could* conceivably be successful in some way at telling a historical story. The problem is that Pesic's "groping" style turns out to hinder rather than help his project. The book feels like it is patched together out of loosely connected essays, and the reader is left at the end without knowing quite what to make of Pesic's analysis. What were we supposed to get out of this? Are Pesic's conclusions supposed to have some normative force for contemporary readers, such that we are being implored to practice science *ourselves* as if it were an act of codebreaking? If so, Pesic does not make it clear why it might somehow be helpful to use this metaphor when actually doing science. If not, why should we care about this project? Is the book meant to be of interest only to history buffs? I fear that a clear answer to these issues is sacrificed for the sake of Pesic's desire to "grope" around where his interest leads him rather than to find the resolve to pursue a clearer set of research goals.

In the passage I cited at the beginning of my review, Pesic writes, "I will read scientific works as if

they were works of literature, attending to nuance and tone as much as to surface meaning, trying to be faithful to them.” Another way to see the problem with Pesic’s “groping” style is to point out that scientific works are usually *not* taken to be works of literature in the usual sense of the word—so what is the justification for reading them “as if” they were? With the arguable exception of some of Bacon’s more fanciful pieces (like *The New Atlantis*), even after reading Pesic these works seem not to emerge as particularly interesting pieces of literature in their own right.²⁰ The scientific works may provide some interesting clues to the *psychology* of some prominent scientific and mathematical pioneers, and at least in this respect Pesic’s work is quite clever. But *Labyrinth* is not supposed to aim at a psycho-history of science, and if it were he would have done better to focus more steadily on traditionally biographical sources rather than looking to “literary” works alone. Again, the reader wonders whether Pesic’s style of meandering where his interests lead don’t, over the course of a book-length work, generate a rather aimless whole.

Pesic might reply that he did not set out to convince us that these scientists’ respective works could be redefined or fully understood as works of literature. Maybe he set out only to use the literary features of scientific writing to help us understand *science* as a human enterprise—perhaps we were not supposed to value these writings as literary works in their own right at all. But here we run into what I take to be a more serious problem with the work: the very metaphor of science as an attempt to decode nature seems to go along with a hard-headed realism about the aim of science, and it is difficult to reconcile this realism with a view that we have to understand the *human significance* of scientific practice in order to understand science.

The philosopher Bas Van Fraassen gives the following influential, minimal formulation of scientific realism:

Science aims to give us, in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true. This is the correct statement of scientific realism.²¹

Without entering into debates about realism and anti-realism in science, it seems uncontroversial that the *aim* of science, for a realist, is to give us “a literally true story of what the world is like.” Now, Pesic’s metaphor of science as an attempt to uncover secrets in nature presupposes that there is some one story about “what the world is like” that is literally true, and that it is the aim of science to discover that story. He writes:

The thread linking physics and religion [for Newton] seems to be finding the center of an enigma through gauging the significance even of the smallest phrase. . . . In Newton’s “Rules for interpreting the words and language in Scripture” neither prophecy nor its interpretation was in any way rhapsodic or irrational. Among these self-imposed rules Newton includes “to assign but one meaning to one place of Scripture, unless it be by way of conjecture. . . . To keep as close as may be to the same sense of words, especially in the same vision.”²²

For Newton, Scripture contained some one hidden meaning that had to be uncovered, and Pesic argues that Newton, like many of the other scientists he discusses, saw nature in the same terms.²³

But now let us raise the question again of what significance Pesic's study is supposed to have for contemporary readers. I have been assuming that Pesic's work is supposed to be more than an interesting story about the psychological profiles of some prominent scientists through history. Let us suppose this reading is correct. Then science should be practiced in a way that is somehow analogous to codebreaking, and scientists must be realists—science should be an inquiry into what is literally true about the world. Why? Because even if you don't accept Pesic's reading of Newton or any of his other subjects, the view that there could be, say, multiple distinct "useful fictions" about some one phenomenon is incompatible with the codebreaking metaphor—if you "break" the code and find that your solution is ambiguous between two possible messages, you haven't really broken the code.

But then the crucial question again arises about the nature of Pesic's project. If the codebreaking comparison is to be taken seriously, what do we learn about *science* by studying its "human significance"? With few exceptions, "one true story" stories must make matters of justification independent of human interests—independent of "the merely personal", in Einstein's phrase.²⁴ If these stories are right, studies about science's "human significance" will be irrelevant to our understanding of how science functions, and Pesic's work must be treated as of merely psycho-historical interest.

Perhaps I have been wrong to assume that Pesic's work is meant to be directly relevant to our understanding of scientific practice. But again, as psycho-history, *Labyrinth* falls short. And then we are left where we began, with the question of what interest his book is supposed to have for us at all.

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Despite my criticism, it is not as clear as I have pretended it to be that a "one true story" picture of science is necessarily incompatible with anything but a view of justification that leaves human motives out altogether. In fact, I think the relationship between science as a human enterprise and science as a hard-nosed investigation into what the world is like (into breaking nature's code, if you like) is a very pregnant philosophical issue—one that Pesic's research begs us to raise anew.

In the end, this issue is left to his readers, and maybe that is not so unreasonable. *Labyrinth* is well worth reading—it is exhaustively researched, makes some truly original connections between seemingly disparate areas of the history of science, and leads its readers on a genuine philosophical adventure.

Alexander Klein
Indiana University

Notes

1. I benefited greatly from a discussion about Pesic's book with Steve Crowley, who also helped me to situate the book with respect to contemporary Bacon scholarship.

2. Peter Pesic, *Labyrinth: A Search for the Hidden Meaning of Science* (Cambridge, MA: MIT Press, 2000) 150.

3. Pesic, *Labyrinth* 1.

4. Pesic, *Labyrinth* 1.

5. Pesic, *Labyrinth* 6.

6. For example, the main text has no footnotes or endnotes in the conventional sense of words or sentences that are flagged by numbers that refer the reader to a separate section of notes. The premise seems to be that footnotes intimidate or maybe annoy non-academic readers who may care nothing about the body of secondary literature on topics broached in the text. However, Pesic includes an extensive section of *free-standing* notes at the end of the book, arranged by the pages to which they correspond in the text. The effect is that readers who want to find out more about Pesic's sources for some particular passage have to work a little harder than usual to find the relevant reference in the notes section, but that non-academic readers don't have to be bothered by all those little numbers dotting the text.

7. Pesic, *Labyrinth* 3.

8. Pesic, *Labyrinth* 60-71. See also his more detailed article on the same subject, "Secrets, Symbols, and Systems: Parallels between Cryptanalysis and Algebra, 1580-1700," *Isis* 88 (1997): 674-692. He also cites his (somewhat hard-to-find) "The Clue to the *Labyrinth*: Francis Bacon and the Decryption of Nature," *Cryptologia* 24.3 (2000): 193-211.

9. Bacon's words, quoted in Pesic, *Labyrinth* 69.

10. The chapter is speculative because there seems to be no direct evidence that Bacon himself saw a link between cryptanalysis and his tabular method of scientific data-analysis; or at any rate, Pesic doesn't offer any in the chapter. He seems to be hedging when he concludes: "From the earliest sources on, cryptography had relied on such tabular arrays to give the visible key for the encipherment and, later, decryption. Given Bacon's detailed knowledge, it seems very likely that either he himself tried his hand at cryptanalysis, saw such work in progress, or heard accounts of it," Pesic, *Labyrinth* 70. The best indirect evidence Pesic offers of Bacon's awareness of cryptanalysis is that he *developed* a cipher, or code, as a young man (pp. 65-67), and that his brother Anthony was involved with cryptanalysis (p. 164). Note, though, that inventing a cipher is not cracking one—Pesic's conclusion would be on much firmer footing if Bacon had had experience with formal methods of *cryptanalysis*, not just cryptography. I note that David Kahn, who wrote the classic history of cryptography, and who Pesic praises as an authority, writes: "Cryptography and cryptanalysis are sometimes called twin or reciprocal sciences, and in function they indeed mirror one another. What one does the other undoes. Their natures, however, differ fundamentally. Cryptography is theoretical and abstract. Cryptanalysis is empirical and concrete," in *The Codebreakers: The Story of Secret Writing* (London: Weidenfeld and Nicolson, 1967) 737. He outlines some methodological differences between cryptography and cryptanalysis on 737-762.

11. The connection between cryptanalysis and formal mathematics in the work of François Viète is made in Pesic, *Labyrinth* 73-83. The following and final three chapters trace the formal mathematics and the idea of science as codebreaking in the respective work of Kepler, Newton, and Einstein.

12. Pesic, *Labyrinth* 39-55.

13. Pesic, *Labyrinth* 1.

14. Pesic, *Labyrinth* 80-1.

15. Pesic, *Labyrinth* 65-68. On the relative merits of “insider” and “outsider” approaches to science studies, Pesic cites Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985). He writes: “My approach has something of the ‘outsider’ as well as of the ‘insider’ Both perspectives are helpful and important. The outsider does not take science for granted, and is able to see what is strange and remarkable more readily than someone long habituated to scientific ways. The insider is more familiar with the lived experience of science, through intimacy and (one hopes) through love,” at Pesic, *Labyrinth* 7.

16. Carolyn Merchant, *The Death of Nature* (San Francisco: Harper & Row, 1980) 29-41, 164-191; Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale University Press, 1985) 33-42; and David F. Noble, *A World Without Women* (New York: Knopf, 1993).

17. Alan Soble, “In Defense of Bacon,” *A House Built on Sand*, ed. Noretta Koertge (New York: Oxford University Press, 1998) 195-215; and Iddo Landau, “Feminist Criticism of Metaphors in Bacon’s Philosophy of Science,” *Philosophy* 73 (1998): 47-61.

18. Pesic, *Labyrinth* 41.

19. Pesic, *Labyrinth* 6.

20. In his influential *Literary Theory: An Introduction* (Minneapolis: University of Minnesota Press, 1983), Terry Eagleton suggests that “literature” can be understood as writing that is “highly valued” in some particular way, without trying to specify some one way all literature is valued. He adds that “Just as people may treat a work as philosophy in one century and as literature in the next, or vice versa, so they may change their minds about what writing they consider valuable. They may even change their minds about the grounds they use for judging what is valuable and what is not” (pp. 10-11). To put the matter simply, Pesic is not very convincing that we *should* take these works as literature, though I don’t have space to defend my view here. Thanks to Natalia Ermolaev for bringing Eagleton’s book to my attention, and for being so nice.

21. Van Fraassen, *The Scientific Image* (Oxford: Clarendon, 1980) 8.

22. Pesic, *Labyrinth* 118-119.

23. Pesic, *Labyrinth* 120-122.

24. Pesic, *Labyrinth* 139.

