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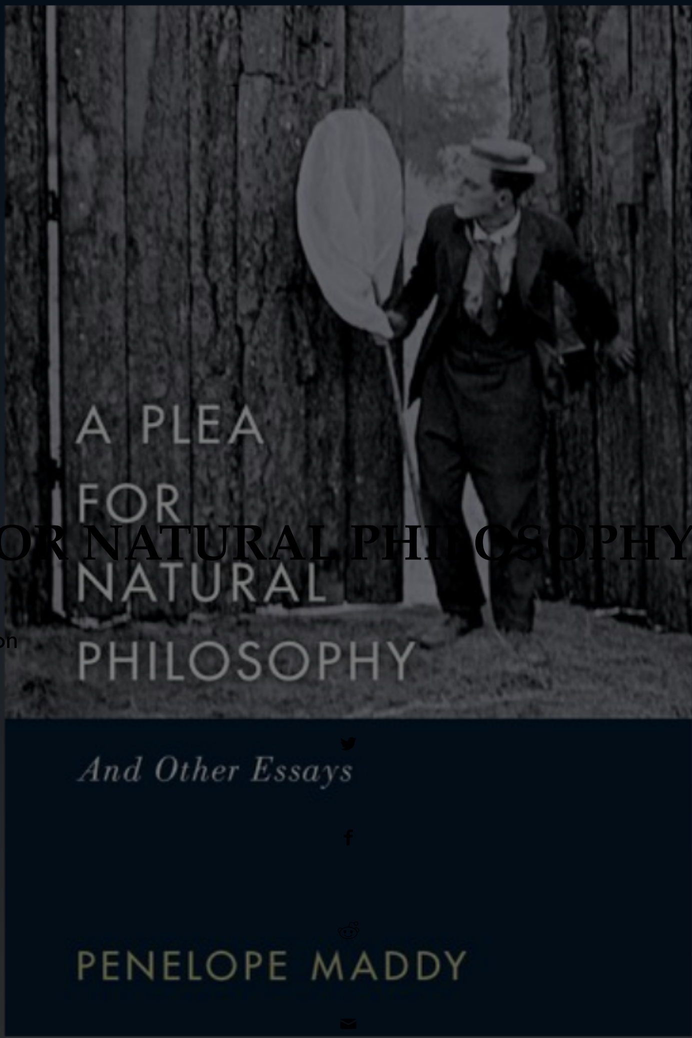
A PLEA FOR NATURAL PHILOSOPHY

Reviewed by Michael Liston



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This collection comprises Penelope Maddy's latest thoughts on second philosophy, a version of methodological naturalism she has been developing since the 1990s. In contrast with first philosophy, second philosophy eschews epistemological apriorism and transcendental approaches to objectivity, embracing instead the methods of science as the most reliable route to finding out about the world. Maddy characterizes the method by showing how an ideal inquirer with unlimited time and resources tackles philosophical questions: she begins with ordinary perceptual beliefs, proceeds to generalization and experimentation, and develops theories and techniques of confirmation, always revising as she goes. Maddy's own work embodies this ideal. The eleven essays, five new and six post-2010, are divided into four groups: method (essays 1 and 2), scepticism (essays 3–5), logic and language (essays 6–8), and mathematics (essays 9–11). Those familiar with Maddy's work will appreciate the novel developments here; those new to it will be rewarded by the light it sheds not only on methodological naturalism, but also on the various topics she takes up.

Essay 1 (new) situates second philosophy historically. Early-modern philosophers aimed to understand the world and our place in it, an aim that shaped the subsequent history of natural philosophy. The history bifurcated with Reid's common-sense and Kant's transcendental critiques of Hume. In our time, the former branch leads to second philosophy, exemplified in the piecemeal inquiries of philosophers working on interdisciplinary problems that overlap with science, whereas the latter branch leads to philosophy driven by extra- and über-scientific concerns that have lost their naturalistic roots. Maddy urges a return to those roots. She acknowledges that her quick history is a just-so story, but argues that it is better than alternatives.

Essay 2 (new) contrasts second philosophy with the methodological approaches of van Fraasen and Stanford to the question of realism. Maddy relies only on science and takes Perrin's arguments to have shown that atoms exist. She rejects both extra-scientific justifications for belief (like realists' appeals to scientific success) and extra-scientific limits on belief (like van Fraasen's argument that we need not believe only what theories say about observables). Stanford and Maddy agree on methodology—only scientific evidence based on experiment and reasoning that is contextually particular, local, and ground-level counts. Nevertheless, they disagree—she thinks atoms exist, he thinks they are merely a useful instrument—because they disagree on the import of historical failures, which he sees as warranting anti-realism about difficult-to-access domains and she sees as recommending fallibilism and epistemic caution. The essay's conclusion is not entirely clear. At times, Maddy suggests that her differences with Stanford are merely differences of emphasis: he denies that atoms exist because he is countering general criteria for distinguishing good from bad inductions that selective realists use to respond to pessimistic meta-inductions, whereas she accepts that atoms exist to show how Perrin's experimental reasoning could resolve a particular local dispute (pp. 89–90). At other times, she suggests that Stanford is wrong: Perrin's reasoning showed that atoms exist.

Essay 3 on scepticism compares Hume's science of man with Reid's common-sense philosophy. By initially restricting his methods to looking only at inner sense, Hume was led via arguments from perceptual relativity and illusion to his theory of ideas and, in turn, to external world scepticism. Reid took a path more in line with second philosophy: he rejected Hume's reasoning (because it led to a scepticism that violated common sense), allowed the use of inner and outer experience to fix method, and argued that we can rely on multiple evidential sources to explain relativity and illusion and to show that perception, though sometimes erroneous, is largely reliable. Moreover, Hume's reliance on introspection is no more trustworthy than Reid's reliance on common sense and our faculties in general; our faculties sometimes err, but that does not impugn their general reliability. God (for Reid) or nature (for Maddy) supplies us with faculties that are fallible yet reliable enough to find our way. Maddy concludes that Reid, not Hume, is the true ancestor of naturalism.

Essays 4 on Moore and 5 on Wittgenstein (new) extend the idea that ordinary reasoning is neither infallible nor unreliable. Moore's proof of the external world, Maddy argues, aims to show that the sceptic demands a proof that his hand exists *sans* appeal to any of his other beliefs. While that demand cannot be met, this does not undercut the force of his ordinary evidence that his hand exists, evidence which he has every reason to believe is reliable though not infallible. Relatedly, Maddy rejects hinge proposition interpretations of Wittgenstein's *On Certainty*, according to which the proposition that there's a hand before me must be presupposed for there to be any evidence at all. Instead, she argues for a therapeutic interpretation that 'shows' us that we have all the ordinary evidence we need: I know there's a hand in front of me since I can see, feel, and move it.

Essay 6 (new) explores the role played by truth and reference in explanations of the contribution of language to successful action. Maddy's response is two-faceted and puzzling (more anon). On the negative side, she sides with disquotationalists who argue that truth and reference are merely trivial, expressive notions that cannot underwrite such explanations. On the positive side, she agrees that informative word–world connections play a role in such explanations.

Essays 7 and 8 explore historical answers to questions about logic and propose second-philosophy answers to them. The exploration covers many views (Kant, Frege, Mill, Wittgenstein, Carnap, Ayer, Quine, Putnam) yet is insightful and nuanced. The answers are provided by an account of what enlightened common sense and the sciences tell us about logic and our belief-forming processes. We can identify a three-valued logic (rudimentary logic), which yields a class of inferences that are reliable in any application that has an appropriate Kant–Frege structure of indeterminate objects and relations. We have good common-sense and scientific reasons to believe that the macro-world is so structured. Since our primitive cognitive mechanisms evolved in the macro-world, we have a natural capacity to detect and represent those logic-supporting features of that world. (Studies in developmental psychology indicate that we pre-linguistically detect such features.) Human minds are thus naturally fitted for rudimentary logic. Answers to various philosophical questions ensue. What makes logic correct is objective structure in the world, not convention or the nature of our minds. Logic is not necessary *a priori,* nor unrevisable in principle, though our minds are preset to believe it is. Finally, while rudimentary logic 'describes' Kant–Frege structures in the macro-world, it is unwieldy and difficult to apply, because the structures accommodate truth–value gaps. So, second philosophy (following scientific practice) idealizes away its gap-making features to obtain standard, classical first-order structures that support a more effective logic that is safe when applied carefully.

Essays 9 and 10 explain how we come to have arithmetical beliefs even though they may not be about anything. Worldly Kant–Frege structures contain objects and properties, including number properties (two birds on one tree, for example). Current science suggests that we, like some other animals, possess native cognitive mechanisms enabling us to track information about the number properties of small Kant–Frege collections of objects. Language sets humans apart. Children learn to combine their proto-numerical know-how with the native linguistic know-how involved in counting: they learn to count by rote while seeing small sequences of objects and to recognize that a newly counted object corresponds to the next counting numeral. Finally, relying on their innate recursive linguistic abilities, they grasp the generative character of numeral formation and realize that the counting process can be continued without end. Maddy hypothesizes that this is the basis of our full numerical knowledge: belief in the infinity of numbers is based on belief in the infinity of numerical expressions. If this is correct—a big if, as she acknowledges—it follows that while identity and bounded-quantifier statements of arithmetic may be about number properties of ordinary objects, the standard model of arithmetic, which we all share and is definitive of arithmetic, is merely an intuitive picture that does not depend on whether the world is finite or infinite, and whose coherence and uniqueness we are convinced of, mainly because of our innate cognitive architecture. It follows that our *a priori* conviction that arithmetic is consistent falls short of an iron-clad guarantee; moreover, while elementary arithmetical truths are true of the actual world, full Peano arithmetic is but a story that effectively systematizes the elementary truths (p. 261).

Essay 11 (new) formulates and defends an enhanced if–thenist account of mathematics and paves the way for arealism (the statements of mathematics are not objectively true of anything). If–thenism claims that mathematics is merely the study of logical consequences of mathematical axioms. If-thenism is problematic, and Maddy's defence includes an extensive review and rebuttal of objections. I postpone a couple of these objections and for now discuss the most important problem in her estimation: were if–thenism correct, any consistent theory should be as good as any other; but in practice only some consistent sets of axioms are chosen for elaboration. Realists avoid this result by claiming that acceptable axioms must be true of a structure and not merely logically consistent. Maddy's if–thenism is enhanced primarily to circumvent this problem. What makes the axioms or 'if' parts of the if–then conditionals acceptable is that, unlike their non-mathematical consistent cousins, they are selected because they provide systematizations or definitional settings that best meet internal goals set by mathematical practice. Thus, for example, axioms of set theory on Maddy's view are selected because they provide an all-inclusive arena in which all coherent structures are realized. In a nutshell, enhanced if–thenism has it that mathematics is just the study of the logical consequences of axioms selected for specific mathematical jobs. The axioms need not be true to be good; they need only be fit for purpose and not lead to trouble.

I conclude with a few critical reflections.

Maddy's views on truth (essay 7) spring from different and not easy to reconcile motivations. Motivated by deflationary considerations, she favours disquotationalism about truth and reference, arguing that they are too thin to play any role in explaining the contribution of language to successful action. However, the arguments seem misguided. When Pierre finds a rabbit for dinner in response to Jean's utterance, 'Il y a un lapin dans le jardin', part of the explanation of his success is that Jean's utterance is true and his tokening of 'un lapin' refers to Pierre's dinner to-be. In particular, it seems wrong, *pace* disquotationalists, to insist that such an explanation (as opposed to its English expression) has anything to do with translatability into English. Pierre would have been just as successful had there been no English speakers. Moreover, disquotationalism is hard to square with non-deflationary features of Maddy's views: she holds that some sentences are true of concretely realized Kant–Frege structures; she endorses the Maddy–Wilson principle that when a model enjoys success, there will often be reasons for that success (p. 82) that are best understood in terms of the worldly supports and guiding directivities proposed in (Wilson [2006]). But that proposal is motivated not by deflationary scruples that arguably spring from traditional philosophical worries about word–world relations, but by the reasonable conviction that Tarski truth and reference are too simple to deal with complicated semantic phenomena.

Few naturalists would, or should, disagree with Maddy's claims that 'ordinary science is where our inquiry into what's true or what exists begins' (p. 160). But she hesitates to extend objectivity beyond the concrete. She accepts the existence of tables and atoms, but questions the existence of mathematical objects: essay 10 suggests that there is no fact of the matter about mathematical truth and existence; essay 11 defends if–thenism as an arealist alternative. Perhaps naturalists should grant more objectivity to mathematics than Maddy countenances. To see why, consider her responses to two apparent problems with enhanced if–thenism.

Problem 1: Applications of mathematics in science, especially physics, are often taken to support objective mathematical truth and thus undermine if–thenism. Physicists believe that the Sun attracts the Earth with a force given by the law of universal gravitation, a belief that cannot have objective content if numbers and functions, which are part of the content of the belief, are fictions. Maddy responds that physicists need only think model *M* (an ideal system of two geometric objects related by an inverse-square relation) structurally resembles the Sun–Earth system sufficiently well for their purposes. But *M* need not be true, just as *King Lear* need not be true to help us describe the familial dynamics involving an ageing patriarch.

Some naturalists might question this response. Why do hydrogen atoms count as physical content, because their existence is experimentally confirmed, while their quantum states do not so count, since they are merely features of 'a mathematical model' (p. 229)? Leaving such worries aside, the response misses a deeper point: we cannot easily treat the entire mathematical apparatus of currently accepted physics as fiction. Putnam ([2012]) argues that all physicists believe that physical systems have states whose temporal evolution is governed by differential equations *E* (like Newton's or Dirac's) or by equations that *E* approximate extremely well, and this commits them to the claim that these equations have solutions in real numbers (or, in some cases, complex numbers) for any given real value of the time parameter, *t*. Physicists commit themselves to the truth of statements like 'the solution of *E* at *t* is *r*'.

Moreover, Putnam argues, truth in this context differs from human deducibility from axioms. For the general three-body problem and other chaotic systems, for example, even if the governing equations plus initial conditions determine a unique solution for all future states of the system, it may be humanly impossible to calculate distant future states, since arbitrarily small changes at one time may lead to arbitrarily large changes later on. Relatedly, open questions, whether in mathematics or physics, seem to be questions about truth rather than about verification (provability or testability). Before Wiles's proof, Fermat's last theorem was an undecided conjecture that could be clearly understood as true or false of the natural numbers. But there was no corresponding clear question about its provability from axioms. Mathematicians disagree, for example, about the strength of the axioms needed to support Wiles's proof, some arguing that it relies on systems as strong as or even stronger than ZFC and others arguing that much weaker systems suffice. For such reasons, naturalists ought not to replace truth in mathematics with what follows from axioms that stipulate some fiction. Otherwise, distinctions that scientists and mathematicians regularly make would not exist.

Problem 2: Pre-nineteenth-century mathematics, excepting geometry, did not proceed from axioms; so, if–thenism cannot be a comprehensive account of mathematics. Maddy agrees: pre- nineteenth-century mixed mathematics was not axiomatized and was guided by physical applicability; post-nineteenth-century pure mathematics is axiomatized and guided by its own concerns, without regard to concrete applicability. She offers if–thenism only as a philosophy for pure mathematics-now.

The alignment between the two distinctions, pure/mixed and mathematics-now/mathematics-then, is not straightforward. Mathematics-now includes applied mathematics and mathematical physics—consider the uses of number theory to devise and certify cryptographic systems or of topology to investigate the stability of dynamical systems. Moreover, mathematics-then included lots of pure mathematics. From its outset, it went beyond applications to natural phenomena, since very few systems of differential equations are amenable to exact solution and indirect methods of solution using approximating series were not well understood. For such reasons, it became important to develop a better understanding of the solutions of differential equations (for example, the difference between continuity and differentiability) and of methods of solution (for example, the series representation of functions, the difference between convergence and divergence). These eighteenth- and nineteenth-century developments are pure mathematics rooted in the need to understand modelling equations and to devise, understand, and justify the tools needed to extract useful numerical information from them. Even the origins of set theory and topology, epitomes of pure mathematics-now, are connected with this tradition: Cantor's initial work on set theory, point-set topology, and the Heine–Cantor theorem sprung from his interest in the uniqueness of Fourier series representations of real-valued functions, and Poincaré's ground-breaking work on topology sprung from his interest in solving the *n*-body problem.

This suggests an alternative view of historical development that sees a diachronic, dynamic unity in mathematics and an 'ever-recurring interplay' between the pure and applied (Hilbert [1902]). New mathematical structures are jointly shaped by that interplay and the creative exploitation of hidden connections in known mathematical structures.

Maddy's naturalism tends to restrict representation and belief to concrete objects. A less restrictive naturalism requires only that we follow the best methods of science. But the best methods of science, I am suggesting, include the study of mathematical structures that we exploit to describe nature and assess our reasoning about it. Those structures are abstract, not concrete, but nothing in science *per se* urges avoidance of *abstracta*.

The foregoing summary is too brief to do justice to the depth, richness, and detail of Maddy's thought. The essays are striking in their range, erudition, clarity, and philosophical honesty. The historical essays are textually nuanced interpretations, philosophically interesting in their own right, independently of naturalist concerns. The essays on language, logic, and mathematics update Maddy's views and should be essential reading for anyone interested in these matters, especially Maddy's attempt to redeem if–thenism. Whatever reservations I have expressed amount at most to a suggestion that an alternative, perhaps better, naturalist path might be taken.

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