

## Book Reviews

### **Second Philosophy: A Naturalistic Method**

PENELOPE MADDY

Oxford, Oxford University Press, 2007

x + 448 pp., ISBN 9780199273669, £42.00 (hardback)

This book is the culmination of Penelope Maddy's efforts, for more than a decade, to delineate a sensible version of naturalism in general philosophy and in philosophy of logic and mathematics. The name, 'Second Philosophy', is intended to emphasize its distinctive idea: a Second Philosopher is born native to scientific methodologies; she trusts scientific methods while admitting that they can be improved from within, but she rejects any demand to justify her scientific methods from outside. In contrast, a First Philosopher tries to justify sciences by transcendental and *a priori* methods.

The book consists of four parts. Part I contains a general characterization of the Second Philosopher's method, by comparing her account of knowledge and her answers to the sceptics with accounts and answers offered by Descartes, Hume, Kant, Carnap, Quine, and Putman. For instance, to respond to the Kantian idea that a transcendental investigation is required to identify the source and foundation of our *a priori* knowledge, the Second Philosopher recommends psychological investigations into human innate cognitive architectures selected by evolution, to see how much of human cognition is innately determined independently of experiences.

Part II of the book argues that the Second Philosopher can settle on disquotational truth and reference. Maddy admits that a word–world correlation is necessary to account for behaviours induced by beliefs, but she suggests that we do not need the truth relation for this. Instead, a 'reliable indication relation' is sufficient. An instance of the reliable indication relation is: my belief 'it's raining' is a reliable indication of the physical state that it's raining, because the latter physically causes the former.

Part III is a naturalistic account of logic. Maddy elaborates and defends three theses: the world has some logical structure (as recognized by humans); humans have some innate cognitive architecture allowing them to detect and represent this logical structure; this is a result of evolutionary selection. The logical truths thus innately represented belong to a rudimentary logic, which does not yet include all classical logical laws, mostly because there is indeterminacy due to vagueness in the world, which generates truth gaps in the representations. Then, Maddy discusses, in this naturalistic context, whether logic is universal, necessary, *a priori*, revisable, empirical,

analytic, and so on. She also discusses how the full classical logic comes out of that rudimentary logic as idealization.

Part IV offers some naturalistic views in philosophy of science and mathematics. Maddy first explains that, for the Second Philosopher, Van Fraassen's doubts about unobservable things are extra-scientific. Then, she argues against three attempts to infer the objective existence of mathematical entities or structures from mathematical applications: the Quinean indispensability argument based on confirmation holism, the idea that applicability is due to objective mathematical structures in the world, and the idea that the miraculous effectiveness of mathematics in applications must be due to the objective truth of mathematics. Then, on the positive side, Maddy recommends evaluating mathematical methods on their effectiveness for serving mathematicians' purposes, and she recommends Thin Realism and Arealism for the ontology of mathematics. Thin Realism holds that mathematical entities are exactly the sorts of things described by whatever mathematical theories accepted by mathematicians, *no more and no less*; Arealism explicitly denies the existence of mathematical entities. Maddy argues that there is no essential difference between these two positions, presumably because of thinness in Thin Realism.

The book contains fascinating discussions of many other topics. For instance, Part III contains an enlightening survey of cognitive psychological studies of logical and arithmetical cognition in human infants, and Part IV contains an instructive discussion demystifying the alleged miraculous effectiveness of mathematics. Besides, the book contains no (logical or mathematical) technical material and is easily accessible to general philosophical audiences. Maddy is best-known for her work in philosophy of mathematics, especially in the highly technical area of philosophy of set theory, but this book definitely belongs to general philosophy. It is about how to do philosophy in the *Zeitgeist* of naturalism.

Since I share with Maddy the conviction about naturalism, here I will only point out what I believe to be 'still not completely naturalistic' in the book. First, I would rather distinguish naturalism from anti-naturalism by their different views on the nature of a subject of cognition, not by the different methods they accept, scientific or transcendental. Is a subject a physical human body and brain, which is a result of evolution and physiological maturation, or is it a transcendental Mind, standing opposite to an External Reality, with some mental capacity not reducible to physical interactions for accessing that External Reality? Transcendental methods presuppose a transcendental Mind and they are meaningless for a brain, which can have physical interactions with environments only, but scientific methods are sometimes also understood as a transcendental Mind's only reliable methods for knowing things in that External Reality. I believe that the latter contains a potential inconsistency, but this is not a place to go into details. Here I will only recall that the illusion of a transcendental Mind is so deeply rooted in our thinking habits that even a steadfast naturalist may fall into its trap unconsciously. For instance, the sceptics' question 'how do you know ...' lures me to take myself as a transcendental Mind, not just this body and brain. Otherwise, my answer can be only a naturalistic description of (some aspects of) the structure and history of this body and brain. Now, if we consciously talk about

brains only, we may want to proceed slightly differently on some issues than Maddy did in the book.

For instance, we may want to treat characterizing truth as correspondence as a challenging *scientific* endeavour. Truth is supposed to be a relation between a neural state supposedly realizing a belief inside a brain and a physical state (e.g. there is a fire in the kitchen) outside the brain. Another physical state (e.g. fake smoke from the kitchen) may also cause the same neural state. Therefore, statistically and causally, that neural state is also a reliable indication of the latter physical state. Truth and the reliable indication relation are thus two different relations between physical things inside and outside a brain. Indeed, characterizing truth scientifically is much more difficult than characterizing the reliable indication relation. The latter is rather straightforwardly based on causal relations, but the former is intriguing because of the possibility of misrepresentation. However, these seem to be technical difficulties due to extreme complexity in the former. Since we are talking about brains, philosophical concerns such as ‘one cannot jump out of the Mind to compare Reality with the Mind’ are irrelevant. In a footnote, Maddy appears to admit that it is possible to differentiate between these two relations scientifically but claims that it doesn’t matter which one is the ‘true representation relation’ (226). However, suppose we can characterize these two relations scientifically and we find that one has the features that we intuitively attribute to truth and the other has the features that we intuitively attribute to the reliable indication relation. Then, we have good scientific reasons to claim that the former is truth. Maddy also cites examples to show that, in some special cases, that reliable indication relation already explains the effects of behaviours induced by a belief (154–156). However, this alone is not sufficient to show that truth is just redundant, because in many simpler cases where the reliable indication relation (e.g. smoke from kitchen) is present but truth (e.g. fire in kitchen) is absent, we apparently use both relations to explain the effects (e.g. picking up a fire extinguisher, running into the kitchen, but not using it). Things inside a brain can bear many relations with things outside the brain and truth is the most prominent relation in our intuitive (i.e. folk psychological) explanation of human behaviours. It is *prima facie* improbable that a trivial reliable indication relation alone is sufficient for a scientific explanation of such complex phenomena. The decision to avoid the truth-relation was perhaps influenced by that philosophical concern from the point of view of a transcendental Mind.

Similarly, we will not need Thin Realism. Looking into a brain, we see that some neural states bear the truth relation with physical states outside the brain. As for mathematical beliefs (realized as neural states) inside the brain, which do not bear the truth relation with any physical states outside the brain, we will naturally study their cognitive functions other than representing physical states. For instance, mathematical beliefs help the brain to organize and represent other beliefs and produce beliefs that do bear the truth relation with physical states outside the brain. With these, we already have a complete scientific description of the natural phenomena of the mathematical practices of *Homo sapiens*. It seems gratuitous to insist that those mathematical beliefs in brains ‘represent’ mysterious ‘thin entities’, which also derive from taking the

subjective stance of a transcendental Mind and speculating about a sort of 'thin existence' in the External Reality.

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### **The Software of the Universe: An Introduction to the History and Philosophy of Laws of Nature**

MAURO DORATO

Aldershot, Ashgate, 2005

xv + 158 pp., ISBN 9780754639947, £55.00 (hardback)

Mauro Dorato's monograph presents a theoretical account of scientific laws that is consistent with the application of laws in scientific practice. The book is introduced as suitable for readers who have no previous background in science or philosophy. However, the book requires at least a basic understanding of the various positions on scientific laws, and a rudimentary understanding of science would be beneficial. Thus, the book is more suitable for advanced undergraduates, postgraduates, and academic researchers.

Dorato places the marginal debate about laws of nature at centre stage in philosophy of science. He proposes that the laws of nature are to be identified with the 'software' of a physical system whose hardware (e.g. quantum particles and fields) is governed by algorithms that compress complex information. Ultimately, Dorato rejects this software metaphor. Alternatively, laws of nature describe a central and irreducible ontological factor, the notion of causal power (disposition). This notion can be applied across all scientific disciplines, which entails that the laws of all the sciences are *ceteris paribus* laws. This supports the *methodological* unity of the sciences because all scientific disciplines can be treated homogeneously (e.g. physics, chemistry, biology, psychology, sociology, economics, and so on). Consequently, the concept of law of nature is key to the comprehension of *all* empirical knowledge.

The monograph poses three questions about the laws of nature: (1) the *ontological* question concerning what the laws of nature are; (2) the *methodological* question concerning the domain of their application; and (3) the *epistemic* question of how we come to know about them. Chapters 2, 3, and 4 deal with the first question, and chapter 5 with the second question. An answer to the third question arises naturally from the answers to the first two.

Chapter 1 attempts a chronological account of the concept of laws of nature, charting its development from the Hellenistic age through the medieval age to the end of the scientific revolution. Dorato correctly justifies this opening discussion by his claim that there is no precise historical consensus as to how the concept of laws developed. However, the remedy provided is vague, as we might expect it to be, since charting such

a development in a single chapter is indeed ambitious. Dorato claims from the outset that the modern understanding of laws in science is as a mathematical relationship between properties of a physical system. This is refreshing, since the subject is actual scientific laws as they appear in scientific practice, a marked departure from the theoretical discussions of laws more common in philosophy of science.

Chapter 2 argues that the progress of our scientific knowledge of nature has evolved from the qualitative classifications of natural phenomena to their quantitative descriptions in mathematical equations (i.e. laws of nature). This poses the question why mathematics is so reliable in predicting and explaining the natural world. Dorato proposes the software metaphor as an answer to his question, viewing laws as mathematical algorithms, expressing experimental data quantitatively as a result of measurements (e.g. differential equations). He explains that mathematical formulae are economic reductions of enormous sequences of data on changes of the state of the world. However, a closer examination of actual scientific laws reveals a problem for the software metaphor: identifying laws as algorithms construes all laws as laws of succession. Some (arguably) indispensable laws in science are clearly laws of coexistence (e.g. the law of universal gravitation or Boyle's law).

Nevertheless, laws of coexistence presuppose instantaneous causal action excluded by contemporary field theories, which ban action at a distance. Therefore, it may be possible to reject laws of coexistence altogether or at least consider them reducible to laws of succession. However, Dorato argues persuasively that laws of coexistence are not reducible to laws of succession, because not all laws of coexistence presuppose action 'at a distance' (e.g. Gauss's law). He concludes that until physics forces us to reintroduce signals propagating faster than light, laws of coexistence must be considered as fundamental as the laws of succession. Dorato concludes that the notion of laws as algorithms is not sufficiently general to capture laws of succession.

Nevertheless, mathematics is construed as an effective instrument because the world exhibits regularities, which can be described independently of our qualitative classifications of the world, by means of forms that can be studied mathematically and then reapplied for the purpose of scientific prediction and explanation. Dorato does not reject the importance of the qualitative classification of nature in taxonomy (e.g. natural kinds). All sciences necessarily pass through a qualitative classification of nature of classification using taxonomy, followed by a comparative stage, and only lastly in maturity achieve quantitative concepts of nature.

Chapter 3 discusses the normative criteria often discussed in theoretical accounts of laws of nature and deemed *a priori* necessary for a generalisation to count as a law (e.g. prediction, universality, truth, necessity, causality, counterfactuality, explanation, and symmetry). He claims that none of these criteria is decisive for an analysis of the concept of law of nature. The attempt to identify *a priori* necessary conditions that laws must satisfy results in theories of laws that practicing scientists would neither recognise nor endorse. In contrast, faithfulness to the practice of science should be the primary criterion in any theoretical discussion of scientific laws. The notion of laws of nature is primitive, irreducible to both modal and non-modal notions.

Worthy of particular mention is Dorato's discussion of the necessity criterion. He claims that, because nomic realism is not necessarily linked to modal realism about the necessity of laws, necessity is not a necessary criterion for laws. However, the possibility of holding a position that is both antirealist about modal necessity and realist about laws *qua* regularities is hardly a definitive argument against necessitarian positions about the laws of nature.

Chapter 4 discusses the chief theoretical accounts of laws (the regularity theory, the nomic necessitation theory, eliminativism, and the dispositional account). Dorato argues for a dispositional view of laws, where causal powers are real essential properties of natural kinds. On this view, all laws, including those in physics, are *ceteris paribus*. Dispositions are considered dependent upon or reducible to the microscopic structure of the entities manifesting them. (For example, the fragility of glass, one of its macroscopic dispositions, depends upon the molecular bonds essentially characterizing glass at the microscopic level.) Nevertheless, Dorato denies the *ipso facto* reduction of dispositions to underlying dispositional or categorical properties. Instead, he motivates an identity theory of the macroscopic dispositional properties with underlying molecular structure, such that both can be said to exist. It is disappointing that Dorato does not satisfactorily locate his account of dispositions in contrast to other theorists on causal powers. The reader is left wondering whether the only contribution that is made here is that the argument for dispositional essentialism is achieved from the point of view of scientific practice, or whether Dorato is after something more, namely a novel theory of dispositions. The monograph leaves this ambiguous, and the reader is therefore tempted to conclude the former.

Dorato defends his ontology of dispositions by claiming that it satisfies the practice and general aims of science, which he has deemed his number-one criterion. First, the manifestation of dispositions described by scientific laws involves relations (causal and functional) between different properties, in accordance with the fact that the kind of knowledge permitted by science is essentially relational and structural. Therefore, the dispositional account of laws applies to both laws of succession and laws of coexistence. Secondly, the ontology of matter at the atomic and subatomic level as it is described in contemporary quantum mechanics is essentially dispositional. This confirms the choice of a theory of laws founded on the notion of causal power. Thirdly, the dispositional theory of laws as isomorphic relationships described by mathematical models also motivates an epistemic account of scientific knowledge, namely, epistemic structural realism. Therefore, the ontology of dispositions provides Dorato with answers to the ontological and epistemic questions posed at the beginning of the monograph.

In chapter 5, Dorato answers the methodological question posed at the beginning of the monograph. He argues for the methodological unity of the sciences, claiming that the distinction between physics and the special sciences should be rejected. This is primarily because all sciences involve *ceteris paribus* laws, where the latter are understood as generalisations that are not spatio-temporally universal but that contain inevitable idealizations and approximations. The discussion of the different special sciences and the application of his view to them is a valuable addition to the monograph. However, in the end we might ask what methodological unity really amounts to. What would happen

to Dorato's *ceteris paribus* laws and the dispositions that underwrite them, in the event that fundamental physics reaches the ultimate point of mathematical precision, achieving a complete isomorphism with reality? Are the *ceteris paribus* laws described by Dorato merely placeholders for the laws of physics? Could methodological unity be replaced by ontological unity? The possibility is not discussed at the conclusion of the book.

Overall, this is an interesting addition to the literature on the laws of nature, refreshing in the candidness of its attempt to respect the general practice of science and novel in its discussion of laws as mathematical algorithms. However, the majority of the book is concerned with convincing the reader of the superiority of the dispositional approach over the theoretical alternatives, and in the end the theory of dispositions underwriting *ceteris paribus* laws is not new. The real contribution of this book is in chapters 2 and 3, the discussion of laws in the context of why mathematics is so reliable in predicting and explaining the natural world.

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### **Le Tout et les parties dans les systèmes naturels**

THIERRY MARTIN (Ed.)

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An assembly of coupled oscillators, like neurons, cardiac cells or fireflies, exhibits patterns of organization with a global dynamics that cannot be anticipated from the oscillatory dynamics of the individual oscillators. The properties of the whole of the assembly are not a mere addition or juxtaposition of the properties of the elements of the assembly. But more generally, if the whole can have properties that its parts do not have, where do these properties come from and under what conditions will certain elements be legitimately recognized as parts, and some not? Or else, if we start from elements, according to which principle will the set of those forming a whole be circumscribed?

Whatever its starting point—organism, neuronal system or coupled oscillators—the unfolding of the debates opposing holist conceptions of systems and reductionist ambitions seems doomed to a common central antagonism. According to the latter, properties of the whole will eventually be completely understood in terms of the properties of the parts, while according to the former, the whole is a distinct level of organization characterized by new, emergent, properties. But asking whether acquiring knowledge of the parts is enough to claim knowledge of the whole, or whether there is more to the whole than there is to the parts, presupposes as given the identification of the whole and of its parts.

The problem, as this collection shows in many ways, is that, in empirical sciences, that much is not given. So if the argument for either position is to prove relevant to the

development of scientific knowledge, to illuminate or even provide any normative guidance to scientific investigation, general considerations, even though needed to clarify what the issues and options are, will fall short. The conditions under which a set of things can be seen as forming a whole, under which a property can be reduced to other properties or can be considered as emergent, the conditions under which the distinction between whole and part is not only possible but fruitful and why that is so, will all have to be newly specified in accordance with each specific object of investigation.

The 19 papers written in French gathered in this volume were presented to the conference that the Société de Philosophie des Sciences organized in 2005 on the theme 'Le tout et les parties dans les systèmes naturels' ('The whole and the parts in natural systems'). By addressing specific cases pertaining to different disciplinary domains, this collection gives an interesting overview of the diversity of issues in which the whole/parts distinction may arise and of the different forms it can take.

The collection is divided in five parts corresponding to the following disciplinary domains: ecology, with a special focus on the concept of ecosystem; biology, with particular attention to the concept of function and to the contrast between structural and functional organization regarding for instance the immune and memory systems; medicine, with the tension between individual and statistical approaches; material sciences, with essays discussing the concept of mixture in chemistry, representations of the universe, and models of the Galaxy; and finally, epistemology, with three essays reformulating in terms of whole and parts three different philosophical views on knowledge.

An introduction by the editor provides a quick overview of the collection with substantial abstracts of the papers, but regrettably hardly any perspective on the essays, the theme or the collection. The editor's sole attempt to take some distance is to draw a demarcation between the essays according to the level of application of the distinction between whole and parts: the object of knowledge, the method to acquire knowledge or knowledge itself. Unfortunately the new categorization thereby created is too reductive and even sometimes misleading. Why that is so reveals something important about the formulation of the part/whole distinction. First, among the papers said to apply the distinction to *method* is the paper by Jérôme Goffette and Marie Flori, which contrasts statistical and individual approaches in medicine but applies, in fact, the part/whole distinction to statistical population and individuals. Second, it is among the papers most naturally seen as applying the distinction to *objects*, for instance to ecosystems by Patrick Blandin, or to chemical mixture by Bernadette Bensaude-Vincent, that we find the most reflective discussions on the tension and interplay between objective and methodological interpretations of the distinction between whole and parts. The question whether the part/whole distinction is methodological or objective should rather be understood, it seems, as an issue internal to the specific context in which this distinction is elaborated and elucidated.

There are two further important conclusions the reader can draw: to make the distinction between whole and parts philosophically fruitful, and not merely rhetorical, is a real task—it doesn't come for free. And to do this involves putting relations centre stage.

For the part/whole distinction to have some philosophical work to do, there must be some characteristics that the whole has and not the parts, while at the same time the characteristics of the parts have to be essentially involved, in one way or another, in the realization of those characteristics of the whole. It is in the specification of this involvement that the notion of relation comes to the fore and helps resolve the paradoxical situation.

As Blandin's survey of the historical development of the concept of ecosystem clearly illustrates, a major difficulty is to spell out what it is for the parts to be essentially involved and to specify what counts as an emergent property. Like Donato Bergandi, also discussing this concept, Blandin proposes a transactional conception of ecosystem where the existence of emergent properties is grounded in the genetic co-evolution and co-adaptation of individuals. The emphasis on the dynamics of the relations between the parts is equally central to the interpretive proposal by which Bensaude-Vincent concludes her historical exploration of the paradoxes attached since Aristotle to the concept of mixture in chemistry.

The same point applies to Alexis Bienvenu's elucidation of Reichenbach's statement that 'each singular prediction is associated to the whole of experience' and Delphine Chapuis-Schmitz's holist interpretation of Schlick's conception of natural laws. Bienvenu explains how Reichenbach not only distinguished between different levels of inductive procedures, each induction being based on inductions of the previous level, but proposed a method of evaluation of the relation of mutual support between inductions of two successive levels. And Chapuis-Schmitz explains how, for Schlick, law statements describe natural structures but are meaningful only as parts of a theory, through their relations with other statements of the theory.

By contrast, in the discussions devoted to the concept of biological function it is rather the dynamics of the relations between whole and parts that is put forth, as when Philippe Huneman questions the thesis according to which a certain function can be realized in different ways, or when Françoise Longy reveals the conceptual confusions threatening the analysis of the function of a system in terms of functions ascribed to its parts.

But it is not always clear what the philosophical benefit of the part/whole distinction is meant to be regarding the understanding or clarification of the phenomenon discussed. For instance, both types of relations mentioned above (parts-parts and whole-parts) may well be relevant to the size-effect phenomena regarding scale models or living bodies that Jean-Marc Drouin describes, but *how* is left to the perspicacity of the reader. Likewise, in his essay 'The Whole and the Parts of Memory', Jean-Claude Dupont outlines the different strategies of functional or structural analysis of memory and the difficulties that confront them, but what are the parts and what is the whole and even what to do with the distinction is left to the reader to speculate.

This sort of problem becomes even more acute with essays that, rather than explore the distinction between whole and parts from within a certain concept or problem, apply this distinction as if afterwards to a particular issue so as to reformulate it in these terms. Not only is the fruitfulness of the distinction then sometimes dubitable but even whether it is appropriately stated. For instance, Goffrette and Flori criticize,

regarding a specific case of medical decision, the primacy of statistical considerations at the expense of the experience of the patient and the patient–physician relation. They certainly make an important point and are probably right about it. But their interpretation of this tension as an asymmetric relation of influence between a perspective on the whole and a perspective on the parts is not really convincing. Beside the fact that this construal doesn't add much to their analysis, is it really a statistical population that a patient is part of? Does an abstract statistical population have parts that are flesh-and-blood individuals?

The same sort of flaw threatens the otherwise very interesting paper applying the part/whole distinction to models of the Galaxy. After explaining that there are two models of the Galaxy, both in agreement with the observations even though they postulate different structures, Stéphanie Ruphy concludes that the predictive accuracy of the whole of a model is not grounds for a realist interpretation of its parts. It is not clear what this reformulation adds to the more common notion of underdetermination, but the real problem is elsewhere. What these elements, which cannot be interpreted realistically, are parts of is the whole structure, but is it the structure that accounts correctly for the observations? Isn't it rather its mathematical description? The equivocation with 'model', like previously with 'population', invites a confusion of categories. The relation between the equation, which is the predictive instrument, and the elements of the structure it describes is not one of whole and parts.

Incidentally, an alternative interpretation of this underdetermination is suggested by the conception of structure proposed by Piaget and mentioned by Blandin in his paper. Conceiving of a structure, as Piaget does, as characterized by some emergent properties may open up an account of the predictive accuracy of the two descriptions in terms of emergence at the level of the two structures of similar properties, despite the difference in the properties of their respective parts. But making the part/whole distinction fruitful would still need a real demonstration.

And that holds also when this distinction is used, by Thomas Lepeltier, to reformulate the distinction between Milne's method of construction of a cosmological model, from very general kinematic considerations, and relativistic models. The contrast, as the author himself aptly remarks, is between rationalist and empiricist epistemic strategies. It remains unclear how the part/whole distinction could help better understand this epistemological issue.

In fact, a general explanation of these shortcomings might simply be the surprising, and sometimes frustrating, brevity of most of the essays. But despite, or even because of, the mixed reactions it prompts, the collection, as a whole, is an exciting and valuable demonstration of the philosophical importance and heuristic potential of the distinction and relation between whole and parts.

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