Many other interesting topics are dealt with in the book as they are important issues to be handled in relation with reference theories of natural kind terms, whether descriptivist, causal or descriptive-causal — namely, essentialism, theoretical identities, reference change, the semantics of artifactual kind terms, two-dimensionalism, experimental semantics, macroscopic and microscopic properties, the *qua* problem, and so on. In this review, I have chosen to emphasize what, in my opinion, is the most significant contribution of the author to the debate between descriptivist and causal reference theories. Fernández Moreno has managed to offer here a balanced analysis and criticism of the main theories about the reference of natural kind terms and, at the same time, a harmonized view, i. e. the descriptive-causal theory he proposes.

I find his proposal very wise, because he has been able to recognize what is worth and valuable in the two main perspectives that analyze natural kind terms. And given that this book on the reference of natural kind terms is so well written, with exquisite attention to the use of technical concepts and nomenclature, with many remarks and information, and with such great honesty, we expect –following the clue he has given to the readers in the last line of the book– that in the future the author will complete the task of giving a general account of natural kind terms by writing a new book on the meaning of such terms.

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Making and Breaking Mathematical Sense: Histories and Philosophies of Mathematical Practice, by ROI WAGNER, PRINCETON, PRINCETON UNIVERSITY PRESS, 2017, pp. 256.

In this book, Roi Wagner proposes a theoretical framework to analyse mathematical practices that seems close to the one developed by other authors, particularly Ferreirós (2016), but including some ideas from French post-structuralism.

This theoretical framework is presented in the first chapter as a 'Yes please! Philosophy of Mathematics'. The main idea is that all philosophical positions in some of the old and current debates in the philosophy of mathematics have something important to say about mathematical practice. Some historical developments can be understood in a Platonic sense, as it is showed in the second chapter in relation to negative and positive numbers as different species of numbers; but, at the same time, it can be understood in a fluid non-Platonic sense, because negative numbers can change their essence in the calculus. Wagner concludes that mathematics' is just a label to comprehend different things at the same time.

In the second chapter, Wagner shows some important conclusions that can be deduced following his 'Yes please! Philosophy of Mathematics' studying how some new entities – unknowns and negative – emerge in a concrete historical context. On the one hand, some mathematical fields and entities did not emerge from scientific context but from economical and practical needs, such as the emergence of algebra in the 14th and 15th century with abacus masters, or the introduction of mathematical notation by Benedetto following the structure of a transactional book. On the other hand, Cardano and Bombelli present both negative numbers in the solutions, but the former thought that these new entities were alien to reality, and had a distinct nature from that of the positives; the latter, uses them in an instrumental approach, and uses some geometric methods to present solutions – a more acceptable field. It is important that Cardano's ideas did not success because the theological authorities preferred the old order and not to introduce new species – negative number s–; and Bombelli's triumph depended in the use of a terminology and practice close to Diophantus, who was a classical authority. In the third chapter, Wagner proposes two important characteristics of his philosophy of mathematics that try to answer some of the main features that have interested intellectuals of all time: demotivation and formalization.

Demotivation refers to the fact that mathematics does not have a necessary link with empirical results, because some mathematical developments emerge from branches without applications. However, this same mathematical result could later describe some empirical results, concluding that the emphasis in the philosophy of mathematics should not be in this particular topic.

Formalization explains the great consensus that is characteristic of mathematics and situates it in a privileged place compared to other forms of knowledge. In essence, this consensus is reached thanks to a contemporary feature of mathematics, the adhesion to an axiomatic method. This method makes possible for any well-trained mathematician to check whether an argument is valid by following well-established shared rules. In this sense, formalization stands as an arbiter capable of closing any dispute as long as it is formalizable.

A direct consequence of this formal method is the fluid semantic interpretation that mathematical signs possess. Mathematicians use signs with an interpretation, which can be contradictory to other mathematicians' interpretation of the same sign. The mathematical practice does not follow some rigorous and formal use of signs, unless two mathematicians come into contention, and then the formal method plays his role of arbiter. Wagner uses Derrida's iterability concept to explain this topic.

Related to mathematical reality, Wagner proposes in the same chapter that the only real thing are mathematical institutions and practices; paying special attention to the restrictions imposed by both. On the one hand, mathematical institutions refer to journals, universities, and so on; and the idea is clear: if a mathematician does not publish, her/his results will not be known by anyone, and therefore will not really exist. Besides, some institutions allow some people to acquire the formal language that will make them good mathematicians capable of obtain better results. On the other hand, human cognitive resources and body capacities limit mathematical practices.

In this sense, mathematics has a pragmatic reality, because something would be real as long as it was developed by a human society; and mathematics would be that knowledge resulting from the priorization and organization of the aforementioned constraints. The emphasis is in the mathematization of our societies, as well as the ethical and political consequences that this entails. For that reason, Wagner proposes a philosophy of mathematical practice as a multicultural discourse where mathematicians, philosophers and non-specialist discuss in how mathematics affect and limit our life.

In the fifth and sixth chapter, some current results from mathematical cognition are presented. In particular, two of the most famous theories about these issues. On the one hand, Deahene and Walsh theories that highlight the existence of some innate cognitive capacities. That is, the number emerge thanks to some neural circuits situated in a specific area of the brain. On the other hand, Lakoff and Núñez's theory about conceptual metaphors, where is stated that some conceptual domains founded in our experience are significant to our mathematical cognition, allowing some neural mechanisms to use an inferential structure from a conceptual domain – source domain – to reason about other, target domain.

History cannot tell us whether algebra or geometry emerged first. In fact, history shows that these two fields were always mixed, fighting to integrate and separate themselves from the other. Thus, history cannot tell us if the number concept emerged first and separated from geometry – in relation to Deahene and Walsh theories –, nor which is the conceptual domain.

Another problem with Lakoff and Núñez's theory is that, as Wagner shows in the sixth chapter, when two domains are connected, not only inferences are transferred but also entities, epistemological status, knowledge organization, and so on. For example, he tells that when Bombelli represented algebra equations with geometric methods, these two domains became equivalents, and the epistemological status transferred between them.

He proposes an alternative neural picture that follows Walter J. Freeman III theory on cognition, inferred from studies in rat's olfactory system. The most important conclusions were that neural activity takes place in a large area of the olfactory bulk, and not in a little group of neurons. Besides, the neural activation of a recognizable pattern depends on some important features: the rats need training to recognize the same smell, the response was not automatic but context dependent, if a rat is hungry, for example, and subject-dependent, two rats do not share the same representation to the same smell. This neural representation, moreover, changes when a new smell is introduced into the experiment.

This theory is proposed as a better allegory of what mathematical cognition would be, not as an empirical model to be tested. The most important conclusion that can be inferred is that to think about mathematical concepts, it is necessary to think about the fluid interrelations of neural mechanisms, embodied actions, uses of tools and signs, as well as mathematician's personal and cultural history. There is not a hierarchy in the development of mathematics from concrete to abstract, nor a particular neural structure that affect isolated mathematical branches.

An example is proposed about cognition and the use of diagrams. A tension exists between what is painted in the reality, and what is conceived in the intention. The former is imprecise, while the latter is codified mathematically. But, it is important to note that to paint, a pen or a stick is required, that is, our body action, and it is not only the result of an abstract mental state. Moreover, some noise can be introduced in the action of drawing the diagram; external noise as erase and redraw, or internal noise in mathematician thoughts. Remarkable to Wagner is that noise can be incorporated in a new structure between what is drawn and what is thought.

Then haptic vision, following Deleuze uses of this concept, is proposed to understand this process. We are not seeing a static object, but a chain of dynamic interpretations. That is, we see a diagram as the different past diagrams that were drawn, the intentional diagram, the noise, and all integrated in the drawing. Thus, haptic vision results as our eye with some of the power of the hand. For example, when it is said "Let a chance point be taken on *AB*", it is imagined a random point thanks to the previous experience that is accumulated, and lines and points are felled without draw with our hand.

In the seventh and last chapter it is presented a famous problem in philosophy of mathematics that even some authors title of 'unreasonable effectiveness of mathematics', that is, how mathematics fit with empirical reality so well. This topic is developed following some post-Kantian philosophers – Ficthe, Schelling and Cohen – arguments.

With Ficthe it is stressed that mathematics occurs when mathematicians do things with mathematical signs, as a real activity carried out by human beings. This kind of reality is experienced for example when an exercise is solved by someone, and she feels that she is doing something with that signs. Schelling highlighted the products of mathematics, such as tools, practices and technologies. These instruments can be used to shape and transform our world, and ourselves. In addition, human existence in this world constraints mathematical practice too. Therefore, mathematical practice and the world are co-constructive. Finally, Cohen points to mathematical concepts used to construct our experience. For example, some scientific instruments are built and calibrated with the help of mathematical developments, and the reality observed and measured with these instruments is mathematized. Looking at these different proposals, it can be claimed that there is no such mystery in the relations between mathematics and empirical reality.

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