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Book reviews

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IAN HACKING, **Why Is There Philosophy of Mathematics at All?**, Cambridge: Cambridge University Press, 2014. Pp. xv + 290. ISBN 978-1-107-65815-8. £17.99 (paperback).
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Ian Hacking came of age as a philosopher in a distinctive Cambridge University milieu marked by the newly collected and newly fashioned remarks of the likes of Ludwig Wittgenstein and Imre Lakatos, and by an important but idiosyncratic conception of the philosophy of mathematics, the subject of Hacking's doctoral thesis. Since then, Hacking has returned repeatedly, if irregularly, to the philosophy of mathematics as part of a distinguished career featuring many signal interventions across the history and (especially) philosophy of science. A 2010 series of lectures gave Hacking occasion to revisit some themes from his dissertation in light of his own and others' substantial work in the intervening half-century, but with a twist. Rather than tackle the philosophy of mathematics directly, in his 2010 lectures and a series of talks and essays that followed them Hacking instead posed the question in his title, namely why certain questions about mathematics seem to have become a perennial preoccupation for certain philosophers. The result is not a book of philosophy (or history) as such, but rather what Hacking terms 'a book of philosophical thoughts' (p. xiii), part meditation, part conversation, part (albeit minutely and obliquely) philosophical memoir.

The basic answer to Hacking's titular question is straightforward, and more perspicuously and suggestively posed in the short 2011 article Hacking published with the same title. Here, Hacking sketches his two-part answer in his third chapter. First, Hacking argues, philosophers since ancient times have generalized (likely with excessive exuberance) a compelling experience felt in encounters with a particular and unrepresentative kind of mathematical proof. Second, philosophers since Kant have attempted to explain the seemingly miraculous applicability of mathematics, by which Hacking means not just the use of mathematics in the physical sciences but more broadly the experience of finding applications or analogies connecting mathematical knowledge to a wide range of mathematical, physical and other phenomena. He prefaces this answer with a chapter introducing these key notions of proof and application, and another chapter surveying a range of definitions of mathematics itself. After answering his primary question, Hacking devotes a chapter each to challenging the inevitability of proof and application, at least in the forms that have fascinated certain philosophers, first by pointing out the range of conceptions of proof that have been present or absent in different settings in the history of mathematics, and second by historicizing the disciplinary and philosophical distinctions between pure and applied mathematics. A final pair of chapters poses a series of contemporary and historical debates that frame a variety of interpretations of Platonism and its multiple converses that, Hacking suggests, represent the philosophical stakes and motivations of philosophers' engagement with mathematics and mathematicians' engagement with philosophy.

The book is laden with observations that seem banal but turn out to be profound, and vice versa. Most significant of the banal-seeming profundities, perhaps, is the simple fact that the experiences of mathematics that some philosophers and more mathematicians have found so moving and have often been stipulated to be universal are, as a matter of history and sociology, rather unusual and limited. The tension between idiosyncrasy and generalization recurs frequently and to significant effect in this book, but often seems missing where it could be most informative – where Hacking tends to slip uncritically into the collective philosophical 'we' in his tour of mathematical and philosophical experience. As an example of a profound-seeming banality, Hacking professes

repeated astonishment at a range of applications (in his expansive sense) of mathematics, but in expanding upon their diversity and philosophical interpretations he seems to lose the thread of why they should have been so central to the philosophy of mathematics or why (apart from some provisional hypotheses from cognitive science and a few other lightly developed rationales) they should be so astonishing in the first place.

Part of the trouble is the book's meditative genre, heavy on suggestive digressions but short on the sort of synthesis and argument for which Hacking is frequently and justly praised. Where in other texts Hacking's tangle of foreshadowing, deferral and cross-reference signals a dense and multi-layered explanation that rewards a reader's close attention, here it appears to reflect the book's piecewise elaboration through a series of shorter expositions in other formats. Hacking exhibits a frustrating habit of mentioning a provocative topic and then disavowing it as peripheral to his main quarry. A generous and scrupulous writer, Hacking devotes considerable attention to doing his contemporary and historical interlocutors justice, even when it sometimes comes at the expense of his own cogency.

There is much to praise here. Hacking's perambulatory reflections about the philosophy of mathematics teem with insight and provocation. He displays his habitually impeccable ear for delectable quotes and original aphorisms, enriched by his characteristic close attention to nuances of usage and interpretation. Hacking's perspective on the development of a range of themes in the philosophy of mathematics over the last century and a half is markedly well informed and frequently illuminating. His laudable commitment to engaging with recent and forbiddingly difficult mathematical work has mixed results, but stands out in a field whose practitioners (as Hacking discusses) often seem overly preoccupied with fanciful or simplistic examples that are scarcely connected to what mathematicians do. On their own, these features may satisfy a great many readers. As elements of a larger intervention in the history and theory of philosophy, they tend to accentuate the volume's disappointingly persistent lacunae.

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Victor J. Katz and Karen Hunger Parshall, **Taming the Unknown: A History of Algebra from Antiquity to the Early Twentieth Century**. Princeton: Princeton University Press, 2014. Pp. xiii + 485. ISBN 978-0-691-14905-9. £34.95 (hardback).
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As with the technical terms of any field, the word 'algebra' has undergone several changes of meaning throughout its history, as the subjects to which it has been attached have developed. The book under review traces this process from ancient times up to the modern day. The word 'algebra', we are told, first emerged in western European languages as a corruption of part of the title of a ninth-century text by the Islamic scholar al-Khwārizmī (fl. 800–847). Since this work concerned the solution of polynomial equations (in modern notation, any equation of the form

$$a_n x^n + a_{n-1} x^{n-1} + \ldots + a_2 x^2 + a_1 x + a_0 = 0,$$

which is to be solved for x, and where n is an integer and $a_n, \ldots, a_0$ are known numbers), the term 'algebra' subsequently became the new name for the (much older) subject in which solutions of such equations are sought.

Although al-Khwārizmī limited himself to quadratic equations (those of degree 2: that is, $n = 2$ in the above equation), the centuries following his work saw the extension of his methods to equations of higher degree: solutions for degrees 3 and 4 were discovered in sixteenth-century Italy, for example. However, efforts to extend known methods still further failed, and, by the eighteenth