


BOOK REVIEW

## Alma Steingart, *Axiomatics: Mathematical Thought and High Modernism*

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The American mathematics that attained global pre-eminence in the middle of the twentieth century is best known for two seemingly opposed phenomena. On the one hand, mathematicians in the United States pushed formal abstractions to new extremes, generalizing their unworldly concepts almost beyond recognition. On the other hand, researchers across numerous disciplines, from economics and sociology to operations research and computing, developed ever more worldly uses of mathematical abstractions.

In this erudite intellectual and social history, Alma Steingart argues that these two manifestations of modern American mathematics were two sides of a single turn to axiomatic methods. The most significant transformations of mathematics and its uses in this period had little to do with quantification or calculation. Rather, elite mathematicians' drive to deracinate their theories simultaneously produced esoteric heights of conceptual unification and a compelling methodology for rendering the human and natural world mathematical.

Historians of most any twentieth-century science will value Steingart's perceptive and accessible historicizations of central terms, including modernism, abstraction and axiomatics. She is particularly successful at connecting science and its philosophy and methodology to contemporary developments in art and cultural criticism, and these connections furnish both nuanced historical distinctions and productive analytical interventions. Among the latter, Steingart makes an especially valuable contribution with her characterization of high-modernist mathematics in the terms of Fredric Jameson, as a project of perpetual rewriting. The philosophy and methods of Nicolas Bourbaki, the most iconic figure of this period of mathematics, famously centred on rewriting mathematics from the ground up. Steingart's wide-ranging investigation of this theme shows its manifold implications and limitations across a range of modernist mathematical endeavours, not just among mathematicians.

The modernism and axiomatics at the heart of Steingart's history both come quite specifically from epistemic ruptures around the turn of the twentieth century. Modernism, in this specific sense, was associated with a crisis in referentiality and a new divide between signification and the perceptible world. Axiomatics, in a similar break from its epistemic mooring, had begun to refer to a study of essentially arbitrary systems of reasoning rather than a process of deriving necessary truths from self-evident foundations. Steingart emphasizes the role of European thinkers, including many who migrated to the United States, in these terms' genealogies. The analysis complements, for example, Ellen Abrams's identification

of earlier homegrown agendas and ideologies that prepared the ground for an efflorescence of American axiomatic mathematics in the middle of the twentieth century.

The book's chapters follow the values, rhetoric, conditions and consequences of axiomatic thinking (along with its criticisms and contradictions) from mathematics to other disciplines and back again. Steingart suggests that mathematically averse readers may skip Chapter 1, on algebraic topology and category theory and the generational conflicts they produced, but the chapter's rich slice of the cultural history of elite American mathematical research edifies irrespective of one's desire to tangle with the modicum of mathematical details she includes. The next chapter explains how elite mathematicians' frustrated attempts to contribute to the American war effort of the Second World War helped to cement a new emphasis on formulation as their discipline's critical activity. When game theory emerged as an iconic post-war mathematical science, Steingart explains, it was principally in the mould of mathematics as axiomatic formulation, not as a science of numbers or algorithms.

This version of mathematization, in turn, underwrote new approaches to theory and method in the post-war social sciences. Steingart's examination of landmark writings as well as institutional developments and debates from these fields contrasts productively with accounts of this period that stress social scientists' evolving interests in data and quantification. The epistemic ramifications of this view of mathematics prove critical in the book's remaining chapters, which return to mathematicians and their variously convincing attempts to define their practice as artistic or humanistic, their internecine conflicts over the meaning and place of 'applied' research, and their relationships with the history of their field and its concepts. These chapters focus especially on elite American mathematicians' justifications for the autonomy of mathematics, both institutionally and intellectually.

Steingart's interest in elite discourse is notably effective for contextualizing the changing conditions of funding and training at the highest-profile centres of research. Unpacking elite ideology in the committee reports and correspondence of the discipline's establishment furnishes, for instance, an explanation for the strange hegemonic persistence of a particularly abstract model of mathematical inquiry at a time of immense government investment in computing and applications. These same sources provide the book's limited but significant view of the big picture of postwar mathematical sciences, as the dominant figures at Harvard, Princeton, New York University and a few other centres of authority saw them. The simplifications and omissions in the resulting characterization of postwar mathematics faithfully track the distorted views of their fields that some of the most influential mathematical researchers held. The book accordingly succeeds most strongly as an analysis of the high culture of mathematical high modernism, rather than as an analysis of what the subject meant to and how it was pursued by the mathematical masses.

The specificity and idiosyncrasy of axiomatic views of mathematics are crucial for understanding the peculiar mathematical inflections of elite science and culture in the American mid-century. Steingart's project of historicization strikingly situates her subjects' diverse projects of universalization and abstraction. Her chapter on conflicting conceptions of the role and methods of the history of mathematics provocatively examines and, indeed, historicizes the cross purposes that distinguish this history from the epistemic objectives of mid-century axiomatic thought. In this regard, the book contributes not just a necessary specificity to historians' interest in the role of (particular kinds and images of) mathematics in twentieth-century science and culture, but also a compelling reflexivity about what it has meant to know and think historically and mathematically.