Review of:

Weintraub, E. Roy. How Economics Became a Mathematical Science. (Science and Cultural Theory.) xiv + 313 pp., bibl., index. Durham, NC/London: Duke University Press, 2002. $54.95 (cloth); $18.95 (paper).

Economists live a schizophrenic intellectual life. As everyone knows, they are loathe to give up their portrayal of the agents they model as super-rational, bending every situation to their advantage to squeeze out the maximal self-interest. And yet, if you can get them to comment on the most important trend in their discipline in the twentieth century, the escalating levels of mathematical formalism, they perversely become the most passive of agents, invariably insisting that, "The tools made me do it." If they have any concern for their history, it is conceived as a tale of the crudest sort of technological determinism, with mathematical techniques appropriated by young economists on the lookout for the next nifty technical innovations precipitated out from some Platonic heaven.

This account is incoherent, not to mention an historical travesty, and Roy Weintraub seeks to replace it with something more plausible. As he is aware, in the case of mathematics there is a large constituency in favor of treating its own history as monolithic and incremental, thus rendering any attempt to discuss ruptures, multiple pathways, false starts and outright failures in the appropriation of mathematics an uphill battle Weintraub sets out to neutralize the objection that "mathematics has no relevant history" through recourse to a distinction made by the historian Leo Corry between the subject matter of the mathematics discipline (which might be 'timeless' but is the sole prerogative of the practitioners) and the images of knowledge prevalent in the discipline (the province of research of philosophers, sociologists and historians). In practice, this methodological stance dictates that in the first six chapters of his book Weintraub does not discuss the details of actual mathematical formalisms so much as examine the various methodological and meta-mathematical statements made by some mathematicians and some economists over the course of the century, trying to indicate which "images" of formal knowledge succeeded, and which failed. While the rest of this review will engage his theses on that same meta-mathematical level, first I think it prudent to point out that this stance effectively permits a residual commitment to the technological determinism prevalent amongst economists, since a number of figures (Alfred Marshall, Cecil Phipps, and in chapter 7, the author's own father) are disparaged because their mathematics did not measure up to some notional cutting edge of contemporary sophistication.

Much of the book proceeds by isolating a sequence of individual controversies between economists and mathematicians over the legitimacy of some particular economic modeling strategy, and then explaining the lack of resolution by relegating the target protagonists to one of two very large "images" of mathematical research: one, called a nineteenth century materialist (or reductionist) strategy; and the other, referred to variously as "the production of axiomatic systems", Hilbert's axiomatic approach, or Bourbakism. For instance, in chapter one, Marshall's famous offhand comment to "burn the mathematics" after it serves as an inspiration for research is taken as exemplary of an older reductionist approach, whereas Francis Edgeworth's defense of "unnumerical mathematics" is portrayed as Hilbertian doctrine *avant la lettre*. In chapter two, Griffith Evans' rejection of neoclassical utility theory is also written off as the atavistic materialism imbibed at the knee of his hero Vito Volterra. Chapter three struggles with the nature of the Hilbert axiomatic program and the nature of its influence on economists, bringing to bear the new research of historians like Corry, David Rowe and others in retrieving a more faithful

reading of Göttingen formalist intentions. Chapter four reveals the Bourbakist underpinnings of Gerard Debreu; while chapter six relegates the mathematician Cecil Phipps to 19th century limbo for opposing publication of the famous existence proof for Walrasian general equilibrium by Debreu and Kenneth Arrow.

I think the author would concede that the portrayal of economists' success as solely a function of their interaction with the right (or victorious) mathematicians constitutes a limited basis for a narrative tracking how modern economists have negotiated their way through the briar patch of contending sciences and rival disciplinary methods; as he rightly insists in the final chapter, this is just one way of telling the story. After all, mathematicians still serve as the unmoved mover in his tale: why is it that much of the profession underwent a conversion to Bourbakism in mid-century, and further, how is it that they suffered such a loss of faith in the doctrine at century's end? Perhaps he would not concede, however, that positing the two monolithic "images" of mathematics is as effective and insightful narrative strategy for organizing some major turning points in the history of formal economics. The test case, it seems to me, is John von Neumann, about whom both I and Weintraub have gone on record as highlighting as the single most important figure in mathematical economics in the 20th century. Von Neumann, after suffering his own disaffection with the Hilbert formalist program, did not revert to the 19th century 'reductionism', nor did he become a Bourbakist convert, nor did he become an adherent of some lesser meta-mathematical position like intuitionism, but instead innovated his own special methodological response to the problem of the grounding of mathematics firmly within the network of novel (some would say 'cyborg') sciences. Among other precepts, this would dictate restricting mathematical inspiration to effective computational procedures, downplaying existence proofs and fixed point theorems, becoming relatively relaxed about whether something like neural networks or non-standard logics constituted "good mathematics", and reveling in the 'impurity' of mathematical inspiration. Moreover, von Neumann would not be situated on the side of the angels in Weintraub's book, since he flatly rejected neoclassical economics. On these grounds alone, it is difficult to accept Weintraub's assertion that, "Gödel's impossibility theorems thus did not touch the change in the mathematician's image of the activity of making mathematical knowledge more secure, and how to pursue new scientific knowledge in an organized and rigorous manner" (p.94). Rather, it clearly did so in the case of von Neumann, and the consequences continue to echo down the hall of fame of economic models down to the present. So perhaps instead the Bourbakist fascination amongst mathematicians was turned to *temporary* advantage in the rise of the American neoclassical orthodoxy, but that nevertheless it goes only a small distance to illuminate the issue broached in the title of this book, namely, How economics became a mathematical *science*.

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