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Book Reviews

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Both (4) and (5), however, are false according to RWR, since both contain as conjuncts simple affirmative statements involving an empty term—statements that Sainsbury's preferred free logic NFL counts as false.

Just how to understand such claims (and the many others that have led a growing number of philosophers to opt for a semantics invoking 'non-existent' objects, including claims that give the appearance of quantifying over such objects) remains a deep challenge for any theory that tries to be ontologically austere in the manner of RWR. (They are no less a problem for Millian attempts to deal with empty names.) My own hunch is that much more should be made of the intuition that in uttering such statements we speculatively engage with the commitments of those whose commitments we don't share. A related suggestion is made by Wiggins (although only in the context of simple negative existentials), and sympathetically discussed by Sainsbury (pp. 198ff). Applied more widely, I suspect such a suggestion would get us close to some kind of pretence theory. But Sainsbury adamantly turns his face against the kind of pretence theory that Evans, for example, offers us (he rejects the latter's refusal to count a name like 'Vulcan' as genuinely intelligible rather than merely quasi-intelligible), so it is not clear how RWR should go from here.

Whatever our view on this debate, one can't help but be impressed by RWR's single-minded focus, and, in particular, by the way it doggedly sticks to the view that names like 'Hamlet', Vulcan', and 'Pegasus' are genuinely empty (no place for even an ersatz Hamlet or Vulcan) and then tries to understand the semantic behaviour of such terms in a way that invokes nothing more than the semantic machinery and ontology needed for ordinary terms. These are abstemious foundations indeed! Even if one may doubt that RWR as it stands can deliver on its ambitions, Sainsbury should be congratulated for articulating this framework so clearly and honestly, and for pushing it as far as he has.

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Duffy, Simon, ed., *Virtual Mathematics*, Manchester: Clinamen Press, 2006, pp. x + 270, £45.00 (hard cover).

This book is important for philosophy of mathematics and for the study of French philosophy. French philosophers are more concerned than most Anglo-American with mathematical practice outside of foundations. This contradicts the fashionable claim that French intellectuals get science all wrong and we return below to a germane example from Sokal and Bricmont [1999]. The emphasis on practice goes back to mid-20th century French historians of science including those Kuhn cites as sources for his orientation in philosophy of science [Kuhn 1996: p. viii]. And the French often look to the experience, rather than the ideology, of Bourbaki. The Bourbaki group set out to dominate world mathematics by an encyclopedic treatment of the whole based on a general theory of *structure*. Their fantastic impact on mathematics left a divergent philosophical heritage: Anglo-American mathematical 'structuralism' goes back to the structured sets in Bourbaki [1949]. French philosophy of mathematics looks to the working experience of Bourbaki members and the failure of their structure theory in their own eyes [Patras 2001; Mashaal 2006]. This book should go far to heal that split. Other essays contrast Bourbakiste axiomatics to intuitively geometrical mathematics notably by Henri Poincaré (among much else the chief creator of topology and precursor to chaos theory). More philosophers should follow the example whereby no reference to mathematics in this book is anonymous. Each specifies which mathematics it means, done by whom, and to what effect, which makes the book livelier, easier to argue with, and more suggestive of further work. The essays centre on philosopher Gilles Deleuze without requiring prior knowledge of him. Simon Duffy introduces Deleuze along with key mathematical topics, notably set theory, algebraic topology, and category theory.

Alain Badiou makes a large and correct claim: 'the confrontation with mathematics is an absolutely necessary condition of philosophy itself, a condition that is at once descriptively external and prescriptively immanent for philosophy' [22]. Shrewd and often very funny observations show how Descartes, Spinoza, Kant, Hegel and Lautréamont each take this view. This is literal Platonism. Plato's Socrates constantly prescribes mathematics as preparation for knowing the good, yet describes it as the opposite of philosophy since mathematicians never criticize their hypotheses. Dialectic depends entirely on critique. So this fast paced sweeping essay argues in detail with leading set theorists over the philosophic meaning of set theory. It describes Hegel's insight into the nascent theory of the mathematical infinite in his time, and how Cauchy's and Cantor's reforms might reflect back on Hegel. It offers sheaf theory, a branch of analysis that had unexpected bearing on logic, as illustrating how 'philosophy must enter into logic via mathematics, and not into mathematics via logic' [24].

Gilles Châtelet discusses metaphor, diagram, and formalization in two cases. 'Recent spectacular developments in knot theory' [35] combine pictures with matrix tensor equations to produce a highly successful theory of knots, which also serves in current efforts to find a General Relativistic Quantum Theory. Grothendieck's *scheme theory* gives abstract algebra quite concrete geometric meaning. Philosophers will enjoy the mathematics and can benefit by agreeing or disagreeing with Châtelet's interpretation.

Jean-Michel Salanskis describes how analytic philosophy and phenomenology reject mathematics. Most phenomenologists reject it outright even though Husserl studied with two top mathematicians of his time, Weierstrass and Kronecker. Analytic philosophy often makes 'mathematics' a mere rubric for issues in logic and reference. Never denying that mathematics can bear on those, Salanskis looks at how Plato and Kant take mathematics itself seriously. To show how this might be done today he explains dynamical systems and Galois theory, absolutely not as themselves answering problems of philosophy, but for their articulate insights into individuation and differentiation. To give our own example, the great problem of identifying logical individuals in natural language in (Hale and Wright [2003]) is unlikely to be *simpler* than the narrow problem of identifying points in current geometry as described by Châtelet [41–3] and throughout Plotnitsky's essay. Perhaps it will not yield to simpler conceptual tools than that has required.

While arithmetic foundations for calculus get much attention in Anglo-American philosophy of mathematics, Simon Duffy explores the historically productive geometric issues in the foundations of Poincaré's theory of differential equations. That work was decisive in the origins of topology and modern mathematical physics as well as lying behind chaos theory. Duffy gives a nice introduction to the mathematics and to the way Deleuze used detailed historical studies of differential calculus 'to develop the logical schema of a theory of relations characteristic of a philosophy of difference' [143].

Sokal and Bricmont claim Deleuze's 'lucubrations' on the differential merely mix 'banalities with nonsense' since 'the classical problems in the conceptual foundations of differential and integral analysis' were all 'solved by the work of d'Alembert around 1760 and Cauchy around 1820' [1999: 160–1]. But compare the actual mathematics. The reference to d'Alembert is idiosyncratic. He is just one of many people who advanced the calculus in some way. Cauchy was a major figure in formalizing calculus with limits instead of infinitesimals, but that was for analysis. Quite different ideas from Hermann Weyl and Élie Cartan extended this to differentials in differential geometry as, for example, the curved space-time of General Relativity. Then radical reformulations produced a surprisingly intuitive geometric theory of differentials in number theory where Cauchy's limits cannot even be defined (see e.g. Grothendieck, Hironaka, Mumford, Deligne, and Faltings in [Monastyrski 1998]). Several essays here refer to that work, especially under the name of Grothendieck. The 1982 Fields Medal geometer William Thurston gave the derivative as 'an example that practising mathematicians understand in multiple ways.' He lists seven quite different conceptions of derivative indispensable today. One is a ratio of infinitesimal changes (which Sokal and Bricmont class as nonsense). Another is a purely symbolic operation on powers of variables (cf. Deleuze's quote of Hegel, treated as meaningless by Sokal and Bricmont [1999: 160]). Yet another is the Cauchy definition. 'Unless great efforts are made to maintain the tone and flavour of the original human insights, the differences start to evaporate as soon as the mental concepts are translated into precise, formal and explicit definitions' (Thurston [1994: 163]). All of this shows – what should be obvious in any case – that one good formalization of a concept neither obviates reflection on its meaning, nor even precludes other equally good quite different formalizations. Sokal and Bricmont do what Badiou warned against in his essay. They approach mathematics through logic, and specifically approach the derivative through one formalization. Mathematics is much larger than its logical devices.

Poincaré relied heavily on the fact that, given a smooth differential equation, nearby states of the system usually just flow along in parallel. A qualitative theory of system behavior can focus on 'singular points' where the lines originate and/or converge to shape the overall flow. Poincaré knew how intricate these points can be, a topic pursued in chaos theory, but he focused on cases where they are sparse and serve in simple qualitative descriptions of systems. Manuel DeLanda's essay locates Poincaré's ideas in Deleuze's philosophy where isolated singularities are decisive for directing otherwise regular behavior. DeLanda emphasizes Poincaré's tie to Karl Weierstrass, but this suggests a further point to explore: Poincaré knew the great precedent for his qualitative focus on singular points was Bernhard Riemann's geometric approach to complex analysis as opposed to Weierstrass's analytic approach (see e.g. [Gray 1998]). Riemann and Weierstrass figure in many essays in the book.

Daniel Smith's essay promotes the Bourbakiste [156] claim that axiomatics is a secondary kind of mathematics which arises from problem solving and supposedly *not vice versa*. I cannot agree. Already in antiquity great problems of arithmetic and geometry grew out of efforts to axiomatize the subjects. Bourbaki's axiomatics led to new problems. But I have sharpened my ideas by arguing with myself over Smith's essay and I recommend the experience to others.

Arkady Plotnitsky goes to the central challenge of Deleuze: 'the danger of citing scientific propositions outside their own sphere' [190, quoting Deleuze]. The mathematics is masterly and very current and especially emphasizes an article from the *Bulletin of the American Mathematical Society* that everyone interested in mathematical conceptions of space should know [Cartier 2001]. Plotnitsky finds Riemann 'the most significant mathematical presence in and influence on' Deleuze's work [187] because Riemann produced 'conceptual' mathematics as Deleuze seeks 'conceptual' philosophy. In each case the decisive tool is not deduction or calculation but creation of apt concepts. It goes without saying that Göttingen mathematics under David Hilbert emphasized exactly this idea of conceptual mathematics, crediting it largely to Riemann and Peter Lejeune Dirichlet [Minkowski 1905]. Plotnitsky relates Deleuze to the relentless and on-going expansion of conceptions of space begun by Riemann. He questions whether fractals deserve the attention they get compared to other kinds of space that produce more actual work [208]. He also questions whether Deleuze undervalues the conceptual role of calculation [191]. The huge amount of mathematics and philosophy in this essay should stimulate a huge amount more.

Nothing in this book (or in this review) is to deny the value of formal logic in mathematics or philosophy. Nor is the book against analytic philosophy. Duffy's opening essay cites the rather analytic [Corfield 2003] extensively. The book argues that mathematics, which relies on logic, is yet larger than that, and philosophy must confront it.

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Fricker, Miranda, *Epistemic Injustice: Power and the Ethics of Knowing*, Oxford: Oxford University Press, 2007, pp. 208, £27.50 (cloth).

This is a well-argued, thought-provoking book that makes an important contribution to the literature in ethics and epistemology. The book explores how prejudice and the discrimination or marginalization of groups (e.g., gender, race) can harm individuals in their capacity as knowers. Fricker identifies two significant ways in which prejudice and discrimination result in 'epistemic injustices' – testimonial and hermeneutical. The former occurs when prejudice causes a hearer to give less credibility to a speaker than he/she rightly deserves (i.e., credibility deficits). The latter occurs when individuals, who are members of a marginalized or discriminated group, are unable to properly understand and communicate their experiences (e.g., postpartum depression) associated with their social identity. A large part of the book analyses the wrong and harm caused in these two cases, although Fricker focuses primarily on the testimonial rather than the hermeneutical case. The positive account that emerges from this analysis is a novel virtue account of the epistemology of testimony and an account of the genealogy of the virtues associated with these two forms of injustice.

In the early chapters, Fricker develops a framework that links prejudice to power and social identity. Here she distinguishes different ways in which prejudice affects testimonial exchanges (e.g., incidental vs. systematic, credibility deficit vs. credibility excesses, culpable vs. non-culpable, etc.) in order to identify and motivate the significance of the kind of testimonial injustices that are her primary interest – systematic testimonial injustices which occur when a hearer, as a result of prejudice, gives less credibility to a speaker than is rightly deserved. The systematic nature of the prejudices and injustices means that they affect all aspects (e.g., employment, personal, etc.) of a person's life.