another. Such an impression could have been avoided by including a figure such as the (admittedly German Swiss) life-reformer Max Bircher-Benner, who greatly influenced German life-reform debates, whose career stretched from Wilhelmine Germany to the Nazi era and who, in his prolific writings, touched upon many of the issues discussed here, including national degeneration, health and diet, exercise, eugenics and alternative therapies. The historical context within which these debates took place is also rarely discussed in detail, and a prior basic knowledge of German social and economic history is helpful for a full appreciation of Hau's arguments. Despite these minor irritations, *The Cult of Health and Beauty in Germany* ranks as a valuable contribution on the complex cultural discourses of science in late nineteenth- and early twentieth-century Germany.

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LEO CORRY, **David Hilbert and the Axiomatization of Physics (1898–1918).** Archimedes New Studies in the History and Philosophy of Science and Technology. Dordrecht, Boston and London: Kluwer Academic Publishers, 2004. Pp. xvii+513. ISBN 1-4020-2777-X. $179.00 (hardback).
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Like the mathematics and science they describe, the history of mathematics and the history of science resolve one mystery only to open another. They do this most often when, as here, they are displayed at their best.

Corry's story is very much a German one, almost exclusively a Göttingen one, with the addition of one important visitor: Albert Einstein. Within Göttingen the dominant figure was that of David Hilbert, famous today for his work on algebra, number theory, integral equations, axiomatic geometry and the foundations of mathematics. This widely disseminated picture of him lacks one aspect, however. Among the one hundred volumes of Hilbert's lecture notes that grace the lobby of the Göttingen mathematics library, a considerable number record Hilbert's lengthy involvement in mathematical physics. It is the many volumes of Hilbert's lectures on physics that form the basis for Corry's reconstruction of this significant dimension of the life of the dominant mathematical department of its time, a story that culminates in the famously tangled tale of the struggles by Hilbert and Einstein to create a general theory of relativity.

Hilbert's wish to establish an axiomatic theory of branches of physics is sometimes seen as a hopeless, even foolish, quest. Physics is supposed to move too fast, with new and entirely unexpected discoveries making it impossible to codify the subject. This was arguably Hermann Weyl's view, and if Hilbert's finest student, who contributed significantly to both relativity theory and quantum mechanics, felt that way, the objection is surely a strong one. Corry shows that the matter is more complicated, and more positive, than that. For a start, Hilbert was not so presumptuous. After geometry, which he saw as ultimately the simplest branch of physics, Hilbert took up topics which either seemed well understood, such as mechanics, or could benefit from the generality an axiomatic treatment could offer. He argued that a clear logical structure was always of benefit, not least when novel experimental results had to be incorporated into existing theory, and that it might be possible to axiomatize a theory without committing oneself to a particular physical model (atomistic, electrodynamic and so on).

In the end – and this subject occupies the larger second half of Corry's book – the fundamental question was the nature of matter. Hilbert's great friend Minkowski, who died unexpectedly in 1909, started this line of enquiry with his geometrization of Einstein's special theory of relativity. Corry shows that Minkowski did much more than simply cast Einstein's theory in geometrical language, and that his contribution is indeed an example of what Hilbert meant an axiomatic theory of a branch of physics to look like. After his friend's death, Hilbert continued, moving into radiation theory and then towards Mie's electromagnetic reductionism. By 1913, when Einstein was misled by the apparent implications of the notorious hole argument, Hilbert was looking for his own variational theory, and Einstein found that the Göttingen mathematicians (Hilbert, Klein and Emmy Noether especially) gave him a better hearing than did his own colleagues in Berlin. Almost too good, in fact, for there was a moment of discomfort when Einstein and Hilbert both came to submit their papers at the same time, at the end of 1915. Corry deals in detail with this episode, and shows that there was no direct influence either way in the final stages, and that the two theories are indeed significantly different.

Corry has confronted and solved a number of difficulties in the course of this study, some of which illuminate this part of Hilbert's work, some of which are more general. Hilbert was a remarkable optimist, prone to making sweeping claims that required much more proof than he offered. Sometimes a proof was forthcoming later, or could be given; sometimes, as with the general theory of relativity, the claims were simply wrong. Hilbert would revise his ideas from paper to paper, but generally give the impression that nothing fundamental had changed and that the work was simply cumulative. He did the same with the physics, too, opening himself up to criticisms, not always satisfactorily resolved, that he did not properly understand the science he was seeking to tidy up. He was completely wrong on the question of what constitutes a law of energy conservation in the general theory of relativity.

Hilbert could operate as he did because he was the unquestioned leader of the Göttingen mathematical community. He had bright, even gifted, assistants keeping him informed, and he edited the *Mathematische Annalen*, so he was exempt from the usual refereeing process. Indeed, he could manipulate it, as he did in 1915. The striking concentration of talent at Göttingen openly practised 'nostrification', the reworking of other people's ideas in a fashion that they preferred, and Corry discusses this at some length. He might have gone even further. Making somebody else's ideas your own is the best way to understand them; what is remarkable about Göttingen and due in fair part to Hilbert is that it was done so well in Göttingen.

This fine book anchors its discussions in a rich historical context, especially in the early period when Hilbert was responding to existing debates. It is very well illustrated and handsomely produced (as it should be at the price). The mystery it opens onto is the relationship of all of this work to contemporary physics. Corry shows that the physics department at Göttingen was not always receptive, and that people there worked in areas of physics that would often be immune to Hilbert's grand approach because they were more subtle or experimental. Corry looks when he can at the reception beyond Göttingen, for example at the axiomatic theory of thermodynamics produced by Carathéodory and revised by Max Born, but which does not seem to have caught on.

This is an issue worth confronting. We need to know more about how it can be that a good mathematical theory may leave physicists cold. Is it the difficulty of the mathematics? The abstractness and remoteness from the laboratory bench? The differing priorities of the two groups? Are there, indeed, only two groups? Most likely there are several. This separation is apparent today in many places where the history of mathematics and the history of science are practised, and the different specialists do not always quite talk each other's language. It has implications for the philosophy of science, too. Recent work on Hermann Weyl has directly and profitably taken up the challenge, and if it were to be taken up with Hilbert and Einstein too, Corry's book would have doubled its importance. Even as it stands, it is a major work that should change forever our understanding of Hilbert, Göttingen and the life of mathematics from 1890 to 1920.

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