BOOKS: MATHEMATICS

A Most Influential Problem Set

Fernando Q. Gouvêa

The Honors Class
Hilbert's Problems and Their Solvers
by Benjamin H. Yandell
A. K. Peters, Natick, MA, 2002. 496 pp. $39. ISBN 1-56881-141-1.

In a year "lying at the meeting of the centuries" it is natural to take the long view. Thus, it is not too surprising that David Hilbert decided to dedicate his lecture at the 1900 International Congress of Mathematicians to an attempt to "lift the veil behind which the future lies hidden." Though he was only 38 at the time, Hilbert had already made his mark on mathematics. His work before 1900 included important contributions to invariant theory, the theory of algebraic numbers, and the study of the foundations of geometry. The only mathematician of comparable stature was Henri Poincaré; because Poincaré had spoken at the first International Congress in 1897, it was almost inevitable that Hilbert would be invited to speak at the second, three years later.

Hilbert's talk highlighted the importance of hard, unsolved problems in the development of mathematics. Problems reveal the gaps in our knowledge, and in order to solve them mathematicians often have to construct deep and powerful abstract theories. When those theories lead to the solution of the problem that was their initial motivation, this success serves as confirmation that we are on the right track, that we have indeed discovered something new. By focusing on important unsolved problems, Hilbert attempted to predict, and perhaps also to direct, the future course of mathematics.

At the 100th anniversary of Hilbert's talk, it was again inevitable that his attempt to chart the future course of mathematics would be remembered, studied, and imitated. Realizing that no single person can be fully aware of the vast sweep of modern mathematics, groups of mathematicians got together to assess where the discipline stood at the end of the 20th century, and to share their guesses as to where it is likely to go in the future. Several books containing the results were published in 2000 and 2001 (*1*, *2*).

In addition to looking forward, it is natural to look back. Benjamin Yandell's *The Honors Class* is the second book in the last couple of years to take on the Hilbert Problems and their history. Jeremy Gray (*3*) used the problems to help trace the history of mathematics in the first half of the century. By contrast, Yandell uses the problems mostly to paint a portrait of the mathematics community and the people who inhabit it.

David Hilbert.

In his talk at the International Congress, Hilbert had time to mention only ten problems, and those in attendance seem not to have been too impressed. When the text of the lecture was finally published, however, it included a list of 23 problems, which were treated with varying levels of detail. Some of the problems were quite specific, while others were closer to research programs, vague and imprecise. Many of them were directly related to Hilbert's own research interests.

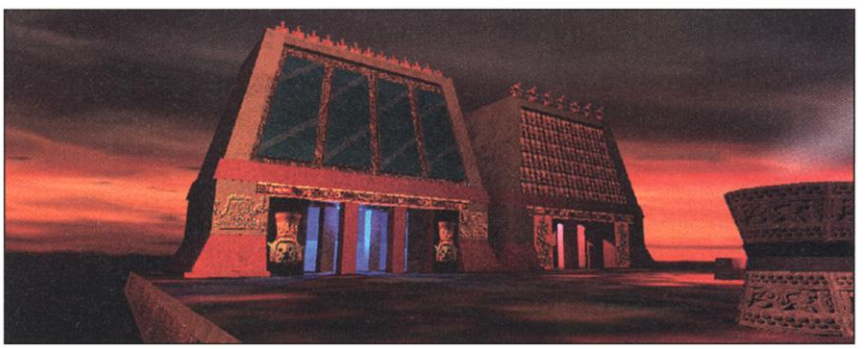
As the century progressed, the influence of Hilbert's list of problems began to grow. In part, this was simply because Hilbert himself was influential. Many of his students worked on the problems, and that helped make the problems more visible. But the most crucial factor was probably the fact that here was a list of specific problems attached to a very big name in mathematics; solving one of them would be a way to establish one's reputation. As more and more talented mathematicians worked on them, the prestige of Hilbert's problems grew. Hermann Weyl eventually would say that solving one of them gained the solver admission to "the honors class of the mathematical community."

Although there is quite a bit of mathematics in *The Honors Class*, the main focus stays firmly on the mathematicians. After an introductory chapter about Hilbert himself, Yandell looks at the problems and what became of them. In some cases, a solution was found by one individual and the author profiles the solver. In most cases, however, the solution (where one has been found) came about through the work of many mathematicians, and Yandell tells us their stories. For the few problems that remain unsolved, we can read about the mathematicians who obtained partial solutions or did related work. A few others have been proven to be unsolvable, and that counts as a solution in mathematics.

Inevitably, some of the people that Yandell discusses are more interesting than others. He seems to realize this, and as a result the biographical treatments vary greatly. Some are very short and formal; others are long and full of anecdotes. Yandell writes well and has done a good job of researching these stories, supplementing the standard written sources with interviews and photographs. The result-

The author is in the Department of Mathematics, Colby College, Waterville, ME 04901, USA. E-mail: fqgouvea@colby.edu

BROWSINGS


CREDIT: (BOTTOM) A. SERRATO-COMBE/COURTESY UNIVERSITY OF UTAH PRESS

The Aztec Templo Mayor. A Visualization. *Antonio Serrato-Combe.* University of Utah Press, Salt Lake City, 2002. 208 pp. $45. ISBN 0-87480-690-9.

In an effort to better understand how the Aztecs saw their world, Serrato-Combe uses archaeological data and computer-graphics technology to recreate the Templo Mayor and its surroundings, the ceremonial center of the Aztec capital Tenochtitlán. He explores architectural topics ranging from the layout of the site to the decorative details of the buildings. The book is filled with stunning digital images, such as this view of the shrines to the gods Tláloc and Huitzilopochtli that shared the most sacred space atop the temple.

ing profiles are interesting, readable, and insightful. Along the way, the reader gets some of the actual mathematics, but the most important message is really about the people: how brilliant they were, how passionate about mathematics, and sometimes how strange and eccentric, as well.

Near the beginning of his book, Yandell offers the reader some advice on how to read it. He explains that mathematicians develop a very high tolerance for not understanding everything they read. They learn to keep going in the hope (often, in fact, fulfilled) that what comes later can help shed light on what came before, or at least that what comes later might be understandable and interesting. "Skip a bit if you want," he says, "the biographical narrative will pick up again." That is good advice. Readers who follow it will find that *The Honors Class* is a pleasant way to learn more about mathematicians and what they do.

References

1. V. Arnold, M. Atiyah, P. Lax, B. Mazur, Eds., *Mathematics: Frontiers and Perspectives* (American Mathematical Society, Providence, RI, 2000).
2. B. Engquist, W. Schmid, Eds., *Mathematics Unlimited: 2001 and Beyond* (Springer, Berlin, 2001).
3. J. Gray, *The Hilbert Challenge* (Oxford Univ. Press, Oxford, 2000).

BOOKS: HUMAN BIOLOGY

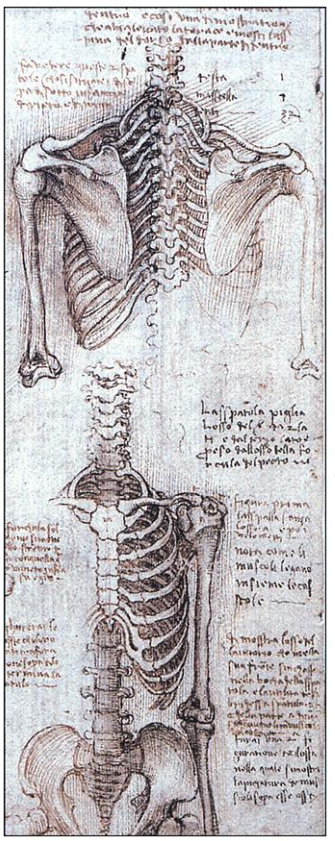
Habeas Corpus

Steven Vogel

Developed as a project of the Physiological Society, *The Oxford Companion to the Body* fills an area around whose borders one might find a medical dictionary and textbooks of human anatomy, physiology, anthropology, and mythology. The title's "Body" refers to the human corpus, but the volume's million or so words provide an eclectic mix of biology, medicine, history, and culture. The book duplicates—or even resembles—no other. What might be its mission?

The Oxford Companion to the Body
Colin Blakemore and Sheila Jennett, Eds.
Oxford University Press, Oxford, 2001. 778 pp. $55, £40. ISBN 0-19-852403-X.

Alphabetical arrangement of entries, arbitrary but usefully familiar, declares a book as a source for reference: else why give up narrative or other logical organization? So what do we ask of a reference book? Its information should be accurate, accessible, and comprehensive; its coverage should be predictable. Accuracy matters most, and *Body* passes muster. Not that one can't find errors. The book disseminates examples of "Diffusion" that are, in reality, overwhelmingly convective instead; and, on "Gaits," it runs in entirely the wrong direction. But such howlers remain blessedly infrequent.



Leonardo da Vinci's *Orthogonal views of the skeleton* (circa 1510).

Accessibility, likewise, gets good-but-not-great marks. The writing is clear; the level of explanation is suitable for a first-year college science student or, for that matter, any regular reader of *Science*. The index works well, and most articles provide ample cross-references. Still, the figures, while engaging, only occasionally help to explain things. Most articles appear deliberately contrived not to need such assistance, although we're expected (for instance) to envision the way myosin and actin contribute to muscle action with no diagram of a sarcomere. Tables and graphs are all too few.

Comprehensiveness and predictability of what is covered are problematic. What's here and what's not follow no contemporary convention. One user might find nothing but frustration; another might find the book a model of effective interdisciplinarity, a marvelous integration of the human and the humanistic. A sequence of entries, omitting the conventionally biological, gives some sense of its coverage. We find Spontaneous human combustion, Stunts, Suicide, Taboos, Tattooing, Theatre, Third eye, Thumb sucking, Tickling, and Toilet practices. And there are also Baldness, Ballet, Baptism, Bathing, Beauty contests, Belly button, Body politic, Body snatchers, Brassière, and Bride burning. A column on the mythology behind the term "Achilles heel" precedes a page with an admirable account of Acid-base homeostasis.

The focus, although human, is nonmedical (pathologies are parenthetical), and the tone is nondidactic. Still, one gets useful advice on diet and exercise, on managing migraines and aging. The articles provide an excellent (by which I mean informed but skeptical) perspective on the various aspects of alternative medicine.

Many of the entries supply suggestions for further reading. To the credit of the contributors, these avoid excessively technical accounts—they truly are the suggestions they claim to be. Conversely, the works that are mentioned rarely supply documentation for the articles' content. And the short lists are uneven at best. Thus "Evolution" could be augmented by better material than Dennett (1995) and Darwin's origin(al). For "Extrasensory perception" we find nothing later than J. B. Rhine's statement of 1934. For a general account, "Cannibalism" refers the reader only to Arens (1979), a book that's nothing if not controversial among anthropologists.

But perhaps judgment by the usual standards misses what makes this book engaging in ways quite unanticipated among carefully compiled, accurate, and accessible sources of specific factual information. A few reference books transcend the normal bounds of the genre—Fowler's *Modern English Usage* has invited browsing through its three editions and 75 years. I think the *Companion to the Body* should gain admission to this select company. Its style of writing invites browsing, and its content does so even more. Where else would one find a notable integration of the biological basis and the social history of farting? And where else would one find a tidy paragraph on the word "bobbitry," referred to as a specific kind of social penicide—not, as might be better, penectomy? (Conversely, would one think to turn to this book after finding no mention of the word in the *Oxford English Dictionary*?) Still, as with Fowler's, attractiveness to the browser entails at least a minimal compromise of the volume's function as reference work for quick provision of specific information or resolution of a specific question.

What's best here are those "aha!"s of erratic edification about everyday items: why one can't tickle oneself, why gargoyles are grotesque. Only the dullest of readers will fail to find on any randomly chosen page some bit of information whose acquisition gives pleasure. However memorable, most books I review never regain my attention. This one will not share that fate. "Companion" it will remain.

The author is in the Department of Biology, Box 90338, Duke University, Durham, NC 27708, USA. E-mail: svogel@duke.edu