BOOKS: INFORMATION SCIENCES

Libraries in the Digital Future

Michael A. Keller

In many circles of the computer and information sciences (hard) and library science (soft), digital libraries have become idées fixes. For these scholars, reputations have risen (though, as yet, few have fallen), grant monies have been offered and lured, and new organizations have been designed to "do" R&D on figments and fragments of what possible digital libraries might do or to construct digital libraries satisfying one definition or another. *Books, Bricks and Bytes: Libraries in the Twenty-First Century* is a collection of essays gathered to mark the 1996 centennial of the New York Public Library, which appeared in 1996 as a special issue of *Daedalus*. (The editors Stephen Graubard and Paul LeClerc are, respectively, the journal's editor and the library's president.) Read in 1998, the collection wavers from implied and explicit defenses of traditional libraries to straightforward descriptions of programs and intentions for developing digital extensions of such libraries. One might now surmise that it was also intended to defend librarians' ownership of the idea of libraries against the challenges presented by the Digital Libraries Intiative (DLI), a program massively funded by the National Science Foundation for computer scientists that began in 1994, and numerous similar efforts in industry and abroad.

Books, Bricks, and Bytes
Libraries in the Twenty-First Century
Stephen R. Graubard and Paul LeClerc, Eds.
Transaction Publishers, New Brunswick, NJ, 1998. 379 pp. Paper, $24.95. ISBN1-56000-986-1.

Truisms, platitudes, jeremiads, and institutional self-promotion aside, some notions presented in the essays deserve more and better attention. In her effective foray onto the battlefields of intellectual property (copyright and licenses), Okerson concludes that sustaining actual communication in a world of virtual and physical libraries should be the essence of the debates. Most of us who are concerned primarily with the needs of readers and users rather than protection and punishment would find prescient Young's definition of post-modern digital libraries as "fluid and flexible," as well as customizable. His job description for digital librarians as "knowledge navigators...or...cyberspace organizers" presents new opportunities and challenges. Numerous contributors attempt to cope with the problem of "haves and have-nots" and all conclude that additional money for technology (especially in public libraries) will ameliorate it. Only Marcum, however, brings some science as well as some prophecy to the question—quoting from an extensive survey that demonstrates widespread agreement among Americans with Andrew Carnegie's notion that public libraries are "the people's universities." Contributors from abroad offer some particularly interesting perspectives. Sant'Anna, Brazil's national librarian, gives compelling anecdotes on the powerfully beneficial effects of reading and on the potential for libraries to promote reading. The other voices from developing economies (South Africa, Russia, and India) testify to the pervasive belief in the potential of information technology in libraries to improve national programs by leap-frogging over current circumstances. The two German contributors document an orderly and practical—if initial—national effort to implement a particular vision of a digital library. One problem with the vision is that it posits the continuity of existing roles for publishers, readers, and librarians.

Strangely, despite the Digital Libraries Initiative having made six major grants in 1994, the only mention of it (and that in passing) is by Lehman of the Deutsche Bibliothek. There has been sufficient debate on the R&D goals of the original DLI (data capture; software for browsing, searching, and combining digital objects; use of networked resources), so the follow-up initiative—dubbed DLI2—has been given a broader focus (extend testbed activities, include digital content, create new services for users, and consider interactions between humans and digital libraries). In concert with other efforts by research libraries (as in the Digital Library Federation), scholarly publishers, and high technology industries, this new program should yield some useful results.

Possibly impeding—even threatening—scientific communication is the confusion in the minds of many members of Congress between software piracy and fair use, which is discussed in the recent policy forum by Gardner and Rosenbaum on database protection and access to information (*1*). Such has been the haste of certain commercial interests in scholarly communication to portray themselves as victims of software piracy and to avoid public debate on the issue, that the newly proposed legislation could direly affect even the most prosaic of the many visions of digital libraries expressed in the Graubard and LeClerc book. Fair use, a provision of the current copyright law, is a limitation on the rights of copyright holders that permits use of otherwise protected publications for education and research. Despite overwrought assertions in the press, the scholarly community at large (not just the library world) seeks merely to continue these limitations for information purveyed on the network. This position is derived from the constitutional mandate for Congress to stimulate creativity and to promote progress by providing limited rights for writers and inventors (*2*).

Aside from passing references by LeClerc and Leskien, only Lehman addresses the question of whether there will be a permanent record of impermanent digital editions. His taxonomy of the notable features of digital publications that confound those attempting to design long-term preservation is clear. But the fundamental social question of organizational responsibility for the archival functions, and related issues on methods and money remain unresolved.

Long-term preservation and access to digitally born and networked information have been central concerns of the Commission on Preservation and Access (*3*). Issues of institutional responsibility include whether research libraries and publishers can negotiate terms that continue and extend the distributed mode of preservation for printed materials to digital ones. Finally, although we live in a "both/and" world (one in which traditional print publishing is burgeoning and digital publishing is growing fast), there is a need for resources to provide the kind of perpetual custodianship traditionally supplied by libraries. Everyone expects libraries to continue to furnish long-term care for carefully selected portions of all the printed and manuscript material around, but who will pay for and reliably operate the archive for digital publications and information?

The defense of the evolving role of librarians and the claims of such professionals in the book is incomplete, as it is a response to the unexpressed opposing view (mainly of some computer science researchers in the DLI projects and their fellow travelers) that librarians will become obsolete. Apologists for each side still con-

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tend, albeit in isolation from one another. Schatz has predicted a declining role for librarians as scientists use increasingly powerful search engines themselves to search distributed network information resources (*4*). Lesk, however, sees great potential in the role of librarians as navigators (*5*).

That these many questions remain as open now as they were several years ago may seem promising; after all, it suggests that some options have not yet been consigned to oblivion. Wrong turns—in allocating primacy to certain views on the right of citizens to see and use information, the archival question, and the future of libraries and librarians—could substantially hinder scientific investigation. Articles in this book hint at the evolution of libraries, a process still underway. But, with few exceptions, they fail to grasp the nettles of the future.

References and Notes

1. W. Gardner and J. Rosenbaum, *Science* **281**, 786 (1998).
2. See http://fairuse.stanford.edu
3. Now a program of the Council on Library and Information Resources; see http://www.clir.org/programs/cpa/cpa.html
4. B. R. Schatz, *Science* **275**, 327 (1997).
5. M. Lesk, *Practical Digital Libraries: Books, Bytes, and Bucks* (Morgan Kaufmann, San Francisco, 1997).

BOOKS: GEOSCIENCES

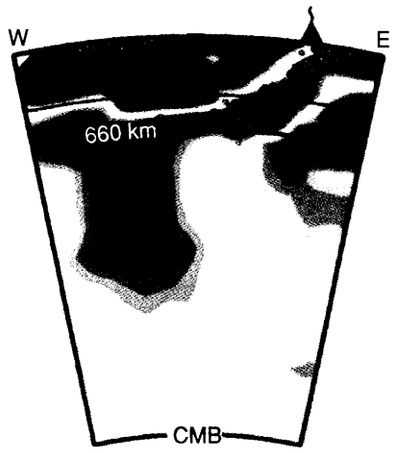
The World Between Crust and Core

David J. Stevenson

In many areas of science the "big" questions remain unanswered even though we have much knowledge and a plethora of models. The study of the mantle, which constitutes 70% of Earth's mass, is a good example. Here the important remaining questions include: What is the mantle made of? Where did the material come from as Earth formed? How was it altered during and after delivery? Is the mantle well stirred? How do mantle convection and its surface manifestation, plate tectonics, really work? How have these processes, and the mantle's composition and structure, varied through geologic time? Such questions were the central concerns of Ted Ringwood, a giant among earth scientists to whose memory *The Earth's Mantle* is dedicated. The book, written largely by his Canberra colleagues at the Australian National University's Research School of Earth Sciences, admirably conveys our current understanding of these questions, the range of possible answers, and the methods by which they are addressed.

The Earth's Mantle
Composition, Structure, and Evolution
Ian Jackson, Ed.
Cambridge University Press, New York, 1998. 592 pp. $130, £80. ISBN 0-521-56344-5.

The book's 11 chapters, contributed by 20 authors, are grouped in three parts of approximately equal lengths: The first section examines the accretion and differentiation of Earth. The second considers the dynamics and evolution of the mantle, and the third reviews the structure and mechanical properties of the present-day mantle. A recurrent theme in all three parts is the extent to which the mantle is layered. To geophysicists, "layering" means the degree to which convection is prevented from being whole mantle (that is, from top to bottom, preventing internal boundary layers). To mineral physicists, it becomes the question of whether seismic data indicate changes with depth of the mantle's elemental composition (not to be confused with undisputed mineralogical changes). And to geochemists, it means the extent to which the mantle has been degassed (of primordial noble gases or argon-40) or deprived of its large ion lithophile atoms (now residing in the continents). The personal views expressed by the contributors also represent perspectives widely held within the three communities. Geophysicists are largely agreed that the mantle is stirred from top to bottom, though with various partial impediments. Most mineral physicists see no difficulty with mantle homogeneity (for example, Ringwood's pyrolite composition), but geochemists believe that the evidence consistently favors poor stirring.



Going down. The *P*-wave velocity structure beneath the Tonga arc provides evidence for penetration of colder material (blue, showing higher-than-average wave speeds) into the lower mantle (below the 660 km discontinuity). CMB, the core-mantle boundary, is located just below 2800 km.

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The disagreement between physical and chemical arguments partly reflects the orthogonality of what is measured. Geophysicists mostly deal with a snapshot of how the current Earth functions and must rely on models of uncertain validity to extrapolate over geologic time. Geochemists are usually interested in the outcome of some integral over time, but the integrand of this expression is exceedingly uncertain because it depends on processes that are even less well understood than convection (outgassing, for example, or how continents are made). Reconciliation is suggested (as in Geoffrey Davies' chapter) by saying that the deep mantle is more sluggishly stirred than the upper mantle, and that the endothermic phase transition 660 kilometers below the surface was a greater impediment to whole mantle flow in the past than it is now. Although this explanation is suggested by theory, one is struck by the lack of a well-quantified reconciliation, here or elsewhere in the literature. One recognizes the difficulty of reconciliation by noting that most researchers believe much of Earth's heat must originate deep in the mantle, and that it must get out by mass transport if the mantle convects from top to bottom. Such mass transport would seemingly violate the geochemical constraints, especially as the heat flow was larger in the past than now. This is a good book from which to gain an appreciation of the many aspects of the problem.

In the first, and by far the longest, chapter Hugh O'Neill and Herbert Palme summarize the bulk composition of Earth and its relationship to meteorites. They discuss elaborate models for the materials from which Earth accreted (different compositions for late-arriving impactors, for example). One cannot help but suspect that this problem is insufficiently well constrained to be solvable at present. (Needed are more lab data, including those from high temperatures and pressures.) The chapter is, however, an excellent source of information on the topic. Shorter but well-crafted chapters on isotopic and noble gas constraints follow, showing how these data restrict models for the differentiation of Earth. The substantial coverage of convection, mantle plumes, and the petrology of pyrolite is predictable, given the strengths of the Canberra school. The models of partial melting (including some advocacy of high "typical" mantle temperatures) of-

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