

his convictions but also the force of character to pursue the case in the face of outspoken opposition from the secretaries of defense and commerce and doubts expressed by the President. His hand was strengthened by the fears of AT&T's counsel that the trial judge would find the company guilty and order a drastic vertical dissolution if the parties did not reach a settlement first, and by the threat of legislation pending in Congress designed with cavalier inconsistency both to end AT&T's monopoly and to protect the cross-subsidization of local service. (Temin is unduly kind in his discussion of the irresponsible and opportunistic behavior of leading members of Congress in this affair.)

On 8 January 1982, a settlement along the lines advocated by Baxter was agreed to and filed. With some modifications, it was accepted by the court the following May. And thus the restructuring of December 1983 was set in motion.

Temin's study was sponsored by AT&T, and his underlying sympathy for the company is clear throughout. Nevertheless, his analysis of the events and of the behavior of the various participants, especially the Bell culture's inability to cope with a changing environment, is thorough, unsparing, and objective. Among the most admirable features of the book is the clarity and precision with which Temin explains complex and changing aspects of technology, pricing, and politics that shaped this environment. "Businessmen contemptuous of government," he concludes, "would do well to contemplate AT&T's institutional rigidity and the role it played in the fall of the Bell System" (p. 351).

Temin ends his study with a relatively brief and inconclusive assessment of the likely effects of the dissolution. He notes that stockholders, who received shares in each of the seven successor operating companies as well as in the new AT&T in exchange for their shares in the old company, have benefited from the restructuring. Thus, the financial market must have judged the break-up favorably. Yet Temin is dubious, observing that "divestiture may well have sacrificed long-run gains in the quest for short-run goals" (p. 362). He identifies a number of potential long-run problems, of which three seem most significant.

For one, as a result of the trial judge's concern for the financial viability of the operating companies, Baxter's bright line between regulated and free-market activities has been blurred. The right to issue the Yellow Pages was reassigned from AT&T to the operating companies. The operating companies are allowed to sell customer-premises equipment. And the judge left the

operating companies free to petition his court for permission to engage in yet other competitive activities. Second, Bell Labs has been weakened both by the smaller resources of the new AT&T and by being removed from direct vertical integration with the operating companies, thus eliminating economies of scale and scope that made the Labs one of the nation's greatest research institutions. And third, Baxter's hope that the new AT&T, freed from regulatory restraints and able to pursue new lines of business, would offer domestic competition to IBM was "based on a total lack of understanding of the internal operations of the two firms" (p. 361). Rather, Temin expects IBM to remain a full-line computer manufacturer with only a minor interest in telecommunications, while AT&T will run a national telecommunications system and concern itself primarily with computers involved in performing network switching functions.

As an objective historical analysis of a major economic event, describing what happened and why, this book is admirably thorough and lucid. But Temin has chosen not to formulate any specific standards of economic performance by which he can evaluate the actual performance of the old Bell System, the likely future performance of its successor firms, and the objectives sought by Bell managers, regulators, and politicians as societally good or bad, thus refraining from the sort of analysis that most economists consider a major comparative advantage of their discipline with respect to other social sciences. Perhaps, as an economic historian, he has given too little weight to this principle of comparative advantage and too much to another venerable precept of economics, division of labor.

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Pharmaceuticals

Medical Science and Medical Industry. The Formation of the American Pharmaceutical Industry. JONATHAN LIEBENAU. Johns Hopkins University Press, Baltimore, MD, 1987. x, 207 pp. \$35. Henry E. Sigerist Series in the History of Medicine.

Few readers of *Arrowsmith* will forget Sinclair Lewis's sardonic portrait of the Dawson T. Hunziker Company, the drug manufacturer that celebrated its antitoxins in full-page advertisements while peddling cancer cures and complexion creams on the sly. The fictional Hunziker Company would not have been out of place in the medical

marketplace of turn-of-the-century America. Even the best pharmaceutical houses sold ancient nostrums and house elixirs side by side with the products of the new science of Koch and Pasteur; few saw more than advertising value in a scientific laboratory. By the 1920s, however, when Lewis was writing, major American makers of pharmaceuticals had left Hunziker behind. Manufacturers, of course, had not lost the capacity for hypocrisy, but they had culled product lines, improved quality control, and embarked on systematic and sustained efforts to develop new drugs; they had, that is, thoroughly incorporated science and scientific standards into their operations.

It is this transformation of the American pharmaceutical industry that forms the subject of *Medical Science and Medical Industry*. According to its author, Jonathan Liebenau, these changes were neither the result of a revolution in the values of management nor the automatic response to the progress of medical science, but rather arose from competitive pressures in a changing market. Two events emerge as critical in his analysis. The first is the appearance of new biological drugs, especially diphtheria antitoxin, in the 1890s. Among the first fruits of modern bacteriology, diphtheria antitoxin could not be made without the supervision of scientists who possessed up-to-date laboratory experience. In the 1890s such expertise was not to be found in pharmaceutical firms. Rather, it was in such public agencies as the New York Board of Health that bacteriologists, fresh from German universities, organized the first commercial production of antitoxins in the United States. Stimulated by the specter of a government monopoly on a lucrative market, drug makers warmed to the task of making serums, often buying the requisite talent from their public sector competitors. Once in operation, the pharmaceutical industry mobilized its advertising and political resources to restrict or eliminate commercial production by government agencies. Later, anxious to build public confidence in their products and to stamp out competition from small producers, the major makers of biological drugs lobbied on behalf of federal legislation to impose standards on the industry. The resulting Biological Controls Act of 1902, by imposing licensing controls on the sale of vaccines and serums, both led to consolidation in the industry and gave legal definition to scientific practice. Thus, while fighting government competition with one arm, the industry embraced government regulation with the other.

The introduction of biological drugs led to sporadic research on other antitoxins, efforts to educate physicians in their use, and

new and complex relations with government agencies and university scientists. It did not, however, result in systematic efforts to exploit science. The pharmaceutical industry had grown dependent on scientists for their contributions to production and quality control but continued to rely on Europe, especially Germany, for ideas and innovative products. World War I, the second critical event in Liebenau's story, decisively changed this. Lucrative government contracts supplied the capital necessary to underwrite a wave of mergers. More important, disruptions in commerce caused severe shortages of the comparatively sophisticated drugs monopolized by German producers: barbitals, benzocaine, and salvarsan, among others. To duplicate these products of the synthetic art called for more than simply the information available in German patents; it was also necessary to expand and intensify research efforts. Created during the war, this research capacity was turned to work on product development after the armistice. The ethical drug industry thus had come to approximate its modern form.

Neither business nor medical historians will find major surprises in this story. Liebenau does correct those who see the modern pharmaceutical industry as a product of the antibiotic era, but we are accustomed to thinking of 19th-century public health services as important innovators, of the movement of persons as crucial to the transfer of technology and science, of regulatory legislation as a tool wielded by big firms against small, and of World War I as a watershed in the development of industrial research in America. *Medical Science and Medical Industry* then is not original in big ways, but rather in small, especially in the author's skillful use of new detail, much of it drawn from corporate archives, to illustrate these familiar and important themes. It thereby adds significantly to our knowledge of the history of one of the first science-based industries.

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Changes in Sea Level

Sea Surface Studies. A Global View. R. J. N. DEVOY, Ed. Croom Helm, Beckenham, U.K., and Methuen, New York, 1987. xiv, 649 pp., illus. \$95.

The specter of a worldwide rise in sea level in the next century, perhaps in excess of 1 meter, makes the topic of sea-level change attention-catching. This volume, despite its

opaque title, provides a much-needed report of our state of knowledge of sea-level changes ranging from the effect of continental drifting on continental freeboard to expected annual rise due to the greenhouse effect. As a contribution to the International Geological Correlation Program's Project 200, editor R. J. N. Devoy has assembled an excellent array of 19 review papers by 15 authors from 8 countries.

The book is divided into five sections that treat the mechanisms of sea-level change, the evidence for change, current knowledge of sea-level history, coastal processes and management, and some economic implications of sea-level changes.

The following themes weave through the book: sea-level changes are caused by an extremely complex mixture of simultaneously occurring phenomena; the record of simultaneous sea-level changes varies widely from continent to continent; the study of near-future sea-level rise needs more input from paleo-sea-level studies; coastal response to sea-level change is perhaps as complicated as the cause of sea-level change; and our understanding of all these phenomena is rudimentary.

Eustatic sea-level changes may be caused by glaciation (with accompanying glacial and water isostasy), tectono-eustasy resulting from plate motions, geoidal eustasy due to changes in gravity related to changing distributions of crustal mass, and dynamic sea-surface changes related to climate. Nils-Axel Mörner argues that geoidal eustasy causes changes with sufficient speed to be responsible for the lack of a global eustatic sea-level curve for the Quaternary. Devoy, however, notes that the geoid explanation of rapid sea-level change is "not necessarily supported unreservedly" by other workers. The practice of averaging sea-level trends from different continents and the general applicability of Peter Vails's "Exxon" sea-level curves come under fire from several authors owing, they say, to the override of local factors on the global sea-level change signal. John Chappell argues that "there seems to be little to be gained by averaging sea-level records on different continents, except for late-Quaternary changes and changes on the scale of continental drifting (200 million years)." Ian Shennan discusses the assumptions behind projections of near-future sea-level rise, especially the widely used Environmental Protection Agency model, and the need for more input from past sea-level-change history. By way of example he notes the evidence from the northwest coast of England of a catastrophic (7-meter) sea-level rise over a 200-year period as a result of the breakup of the Laurentide ice sheet. The melting or breakup of the

portion of the West Antarctic ice sheet positioned over the Antarctic continental shelf will determine sea levels in the next century or two. There is some indication that this ice mass, like the Laurentide of 7500 years ago, may today be in a condition of threshold instability. J. Orford sorts out prevailing views on the response of different types of coast to sea-level rise and emphasizes the danger of using simple models such as the Bruun rule to predict shoreline change.

In one of the more innovative papers, R. W. G. Carter presents an overview of societal responses to sea-level change. He compares the "loose" U.S. system of pleading with people to evacuate before a storm with the rigid, disciplined approach of the Dutch. In contrast, citizens of Bangladesh may willingly suffer through a cyclone in anticipation of post-storm government aid.

The extensive bibliography, averaging 80 entries per paper, together with the useful though brief index, makes this an excellent entry into the sea-level literature. No one even peripherally concerned with sea-level changes should be without access to this book.

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Interstellar Physics

Interstellar Processes. DAVID J. HOLLENBACH and HARLEY A. THRONSON, JR., Eds. Reidel, Dordrecht, 1987 (U.S. distributor, Kluwer, Norwell, MA). xiv, 807 pp., illus. \$139. Astrophysics and Space Science Library, vol. 134. From a symposium, Grand Teton National Park, WY, July 1986.

Physical Processes in Interstellar Clouds. G. E. MORFILL and M. SCHOLER, Eds. Reidel, Dordrecht, 1987 (U.S. distributor, Kluwer, Norwell, MA). x, 554 pp., illus. \$92. NATO Advanced Science Institutes Series C, vol. 210. From an institute, Irsee, F.R.G., Aug. 1986.

The interstellar medium is the breeding ground of stars. It is also their burial ground, most of the stellar mass and a modest but significant fraction of the nuclear energy release being returned into the interstellar medium. The ecology of interstellar matter involves continuous recycling and chemical evolution and is affected by both local environmental events and global processes. Although interstellar clouds are more diffuse than a laboratory vacuum, the vastness of interstellar space provides appreciable column densities of gas and dust whose absorption and emission properties are studied over wavelengths spanning the gamma ray and the radio spectral regions.