a substantial and cumulative advantage. Moreover, since the most successful research parks were located in regions already endowed with research universities and substantial technology activity, one must question whether the university or the preexisting industrial cluster, rather than the research park, accounts for regional economic prosperity.

The case studies are the most provocative part of *Technology in the Garden*, as they offer the historical and contextual detail that is often lost in statistical analysis. These brief portraits underscore a diversity of institutional arrangements in technology regions that begs for further analysis. Research Triangle Park, for example, is key to North Carolina's ability to attract the branch plants of multilocational corporations, whereas the research park in Salt Lake City appears less important than the University of Utah in spawning a proliferation of entrepreneurial ventures. And the Stanford Research Park is now largely irrelevant to the continued technological dynamism of the Silicon Valley economy.

Ironically, Route 128 does not appear in Luger and Goldstein's analysis, although the directory of research parks in their appendix lists the University Park at M.I.T., which was established in 1982. Rosegrant and Lampe makes no mention of this park either; apparently it is one of the many research parks that never got off the ground, despite its presence in one of the nation's leading technology regions.

Though these books have added nuance and detail to our understanding of technology regions, theory continues to lag practice. We still lack a clear understanding of the sources of regional dynamism. Until we fully grasp how relations between firms and local and national institutions privilege some industrial clusters over others in the competitive markets of the 1990s, policymakers will continue investing in costly and misguided efforts to replicate the past.

AnnaLee Saxenian
Department of City and Regional Planning, University of California, Berkeley, CA 94720

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After the Wall

Research and Technology in the Former German Democratic Republic. RAYMOND BENTLEY. Westview, Boulder, CO, 1992. xvi, 234 pp., illus. Paper, $32.

Events in eastern Europe have unfolded so rapidly and unpredictably since November 1989 that most of the mass of books and articles about the collapse of the German Democratic Republic (GDR) and German unification are outdated shortly after (if not before) publication. Raymond Bentley's study of research and technology in the GDR is one of the exceptions. Although it, too, was written to address immediate concerns, which are notoriously liable to change (the last citations in it are from early 1992), it also employs a longer term perspective based on extensive analysis of newly available documents and statistics. On that basis, Bentley offers a persuasive interpretation of the changing political and economic context of research and technology in the GDR since 1945 and the role of research and technology in the country's demise.

Bentley was in a particularly good position to write this book. His pioneering 1984 study *Technological Change in the German Democratic Republic* used statistics from the GDR and from Western sources critically and creatively to explain both East Germany's impressive technological and economic performance within the eastern bloc and its relative lag compared to West Germany. He was already hard at work on a follow-up to the first book when, as a guest of the GDR Academy of Sciences during early November 1989, he was present in East Berlin when the Wall fell so suddenly and unexpectedly. He used his good luck, prior preparation, and extensive contacts in the GDR to uncover unpublished statistical and documentary materials that form the basis of the new volume.

Bentley's general findings will surprise few now that the decrepitude of the East German economy has become common knowledge. He argues that the GDR was behind the Federal Republic of Germany in terms of inputs into and output from research and development from its very beginnings in 1949, and that it fell further behind in the 1980s. He terms the country's R&D output by the late '80s "unimpressive" (p. 136) and its research facilities utterly "inadequate" (p. 108). The novelty in this study lies in its documentation of just how far behind the East Germans were, its differentiated analysis by industry, and its assessment of the political, economic, and ideological obstacles to improvement in GDR research and technology.

The book's first major chapter is a historical overview of "industrial innovation and diffusion in the centrally planned economy," 1945–1989. Bentley identifies bureaucratic ineptitude and ill-conceived economic plans as the main culprits in lagging GDR research and technology. He outlines periodic efforts at reform, but contends that the GDR's

Science in Japan: Some Books

日本の科学

The literature on what we know as science in non-Western societies has focused largely on the distant past of the Arab world and, especially through the work of Joseph Needham, on China. But there do exist in English some accounts of the enterprise as practiced in Japan. Below are listed some such works that have been reviewed in *Science*.

James R. Bartholomew, *The Formation of Science in Japan: Building a Research Tradition*, reviewed **247**, 223 (1990)
Hiroshi Fujita, Ed., *History of Electron Microscopes* (focusing on Japanese contributions), reviewed **237**, 667 (1987)
Masao Watanabe, *The Japanese and Western Science*, reviewed **253**, 457 (1991)
Hideki Yukawa, *"Tabibito" (The Traveler)*, the autobiography of the physics Nobelist, reviewed **220**, 822 (1983)

On a more pragmatic front, the "competitiveness" issue that has developed in recent years has given rise to a much larger literature concerned with Japanese practices. A sampling of that literature as represented in *Science* is also listed here.

Michael A. Cusumano, *Japan's Software Factories: A Challenge to U.S. Management*, reviewed **254**, 589 (1991)
Martin Fransman, *The Market and Beyond: Cooperation and Competition in Information Technology Development in the Japanese System*, reviewed **253**, 212 (1991)
James R. Lincoln and Arne Kalleberg, *Culture, Control, and Commitment: A Study of Work Organization and Work Attitudes in the United States and Japan*, reviewed **252**, 728 (1991)
William D. Wray, Ed., *Managing Industrial Enterprise: Case Studies from Japan's Prewar Experience*, reviewed **248**, 889 (1990)

emphasis on self-sufficiency, the isolation of its leadership from the economy and society, and Erich Honecker's stress in the '80s on consumption above all else ultimately led to fatal deterioration of the system. Historians and others will find this overview useful but should note that Bentley has a tendency to downplay the complexities of the issues he addresses. In describing the situation in the '50s, for instance, he does not mention that problems associated with overemphasis on self-sufficiency and isolated leadership had already arisen. Nor does he mention that some of the elements of the reformism of the '60s, in particular the emphasis on long-range, "perspective" planning and evaluating plant performance in terms of "profits," had already come into wide use in the earlier decade. Making sense of these apparent contradictions remains a task for future historians of GDR technology.

Chapters 4 through 6 are the heart of the book and assess the GDR's R&D infrastructure and its output on the eve of the country's collapse. Much of the material here is statistical. In less able hands, this may have been very dull indeed, but Bentley masters the statistics (rather than the reverse) and presents them in lively prose, supplementing them frequently with qualitative evidence.

Bentley's final chapter deals in part with the R&D potential of the "five new Länder" in what used to be the GDR. It is here that his analysis could be improved somewhat. The West German Science Council's 1991 assessment of the R&D potential of the former east was often much more positive than the picture Bentley paints. Admittedly, as Bentley argues, the Council investigated at the micro level, it was in part politically motivated, and it assessed potential rather than past performance. But Bentley shares its optimism about the long-term prospects of technology and research in the area of the old GDR. One wonders, then, what are the sources of such rich potential in such a disastrous system? Readers should be able to formulate plausible answers to this question on the basis of the material presented in Bentley's book, but direct and sustained attention to it from the author would have improved the book substantially.

This is, however, a minor flaw in a first-rate study. Bentley's book should have broad and long-lasting appeal to those interested in the problems and potential of the contemporary German political economy, to policy-makers, to scholars in technology studies, and to historians.

Raymond G. Stokes
Department of Science and Technology Studies,
Rensselaer Polytechnic Institute,
Troy, NY 12180–3590

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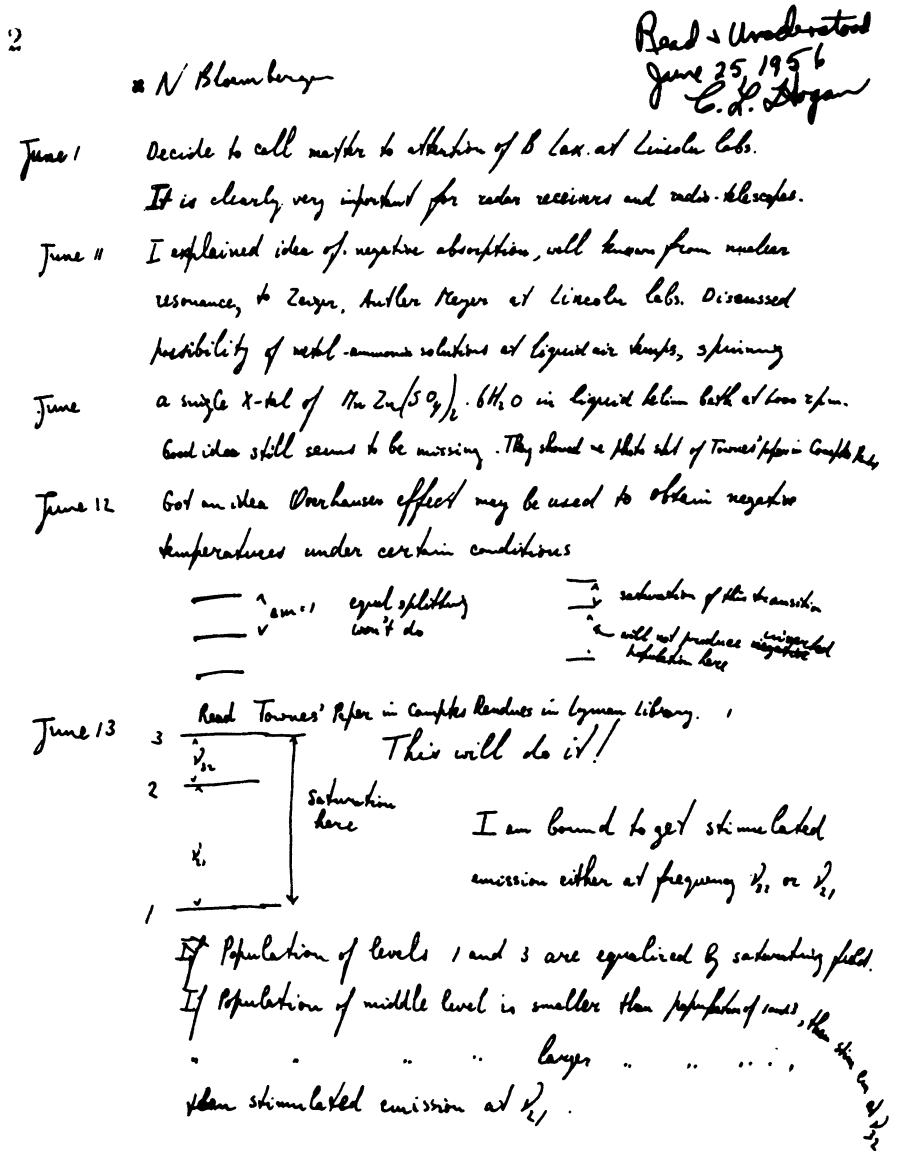
An Era of Electro-Optics

The Laser in America, 1950–1970. JOAN LISA BROMBERG. MIT Press, Cambridge, MA, 1991. xvi, 310 pp., illus. $32.

The laser is one of the great technological developments of this century. Based on a simple but elusive principle, it has found application in a wide variety of spheres from home entertainment to advanced military systems. A large cast of scientists and engineers contributed to the development, with many dramatic moments. The central part of this story is told in this thoroughly researched and clearly written book.

In 1982, four societies—the American Physical Society, the Quantum Electronics and Applications Society (now the Lasers and Electro-Optics Society) of the Institute of Electrical and Electronics Engineers, the Laser Institute of America, and the Optical Society of America—established the Laser History Project with historian Joan Lisa Bromberg as director.



A page from Nicolaas Bloembergen's 1956 research notebook. "On June 12 and 13 the 'good idea' came. He would use a molecular system with three unequally spaced energy levels and would pump systems from the lowest to the highest level, supplying energy at a rate that would make the number of systems in the highest state (level 3) equal to the number in the lowest state (level 1). . . . Then either the middle level (level 2) would have a smaller population than the other states, in which case he could get stimulated emission from level 3 to level 2, or it would have a larger population than the others, in which case he could get stimulated emission from level 2 to level 1. The fact that the pumping transition was divorced from the masing transition in the three-level maser allowed continuous action and lifted the limitation to materials with long reaction times." [From *The Laser in America, 1950–1970*; courtesy N. Bloembergen]