BOOK REVIEWS

Technomiracles Revisited

Route 128. Lessons from Boston's High-Tech Community. SUSAN ROSEGRANT and DAVID LAMPE. Basic Books, New York, 1992. xvi, 240 pp. $45.

Technology in the Garden. Research Parks and Regional Economic Development. MICHAEL I. LUGER and HARVEY A. GOLDSTEIN. University of North Carolina Press, Chapel Hill, 1991. xxii, 242 pp., illus. $39.95; paper, $13.95.

The Pyramids Technology Valley now being developed in northwestern Egypt is one of the more exotic attempts to reproduce America's high-technology regions. Research parks and science cities now span the globe, from Thailand to Toronto. The French government has created some 40 "technopoles," Japanese legislators have designated 19 regions as "technopolises," and planners in aspiring U.S. locales have adopted names like Silicon Prairie and Bionic Valley.

These initiatives have been inspired in part by the work of scholars who discovered technology regions more than a decade ago. They viewed the rapid growth and technological dynamism of California's Silicon Valley and Massachusetts's Route 128 as harbingers of a new industrial era based on pristine technologies and highly skilled workers. Celebratory books and articles with titles like *Silicon Valley Fever*, *The Massachusetts Miracle*, and "Growing the Next Silicon Valley" captured the buoyant mood of the early 1980s. In a classic case of practice outpacing theory, public and private investors poured resources into attempts to replicate the regional first-comers.

By and large, it hasn't worked. Efforts to recreate dynamic technology regions have been expensive and frustrating. The two books reviewed here represent a second generation of thinking about technology regions. More sober in their assessments of the realities and possibilities of high-tech growth, both reflect the lessons of the 1980s. Though the works differ greatly in approach, both recognize that technology industries suffer many traditional problems and have generated several of their own. The authors agree, for example, that the electronics industry is not the job machine it was once thought to be; indeed, it is not even recession-proof. They agree that technology regions are vulnerable to a host of social, environmental, and distributional problems. And they concur that even regions with enormous resources and skilled leadership may be unable to replicate the dramatic successes of the region that pioneered the new technologies.

Yet if both books provide a more balanced view, they still fall short of illuminating how technology regions are structured and how they function. *Route 128* provides a wealth of historical details on a single case but makes claims that are impossible to evaluate without evidence from other regions. *Technology in the Garden* is explicitly comparative, with statistical analysis of a large-scale cross-sectional data set and three case studies, but it addresses such a narrow question that it too leaves the underlying dynamics of innovative regional economics unexplained.

Route 128 is well written and a pleasure to read. It begins with the passage of the Morrill Land Grant Act in 1862, positioning the evolution of Massachusetts technology industry in a broader sweep of industrial history than is usual in such accounts. Readers interested in the origins and development of the regional economy will find an illuminating overview of the relations among Boston's universities, industry, and the federal government during the 18th and 19th centuries, as well as a wealth of information on the more commonly studied period from the Second World War to the present.

But a theoretical tension runs through the text. The promise of the subtitle, to provide "lessons" for other regions, is undermined by a recurrent suggestion that the Route 128 experience is unreproducible. Starting with an epigram from George Santayana, that "miracles are propitious accidents, the natural causes of which are too complicated to be readily understood," the authors pay frequent tribute to the importance of "Yankee ingenuity," an "entrepreneurial spirit," and "unexpected" outcomes.

The resulting "lessons" are a weak brew. The authors proclaim that the secret to Route 128 dynamism is the creative interplay among academia, industry, and the federal government. Yet if the interaction of these three institutions alone generates innovative industrial regions, miracles should abound. Chicago and Pittsburgh are both endowed with the requisite triad—why haven't they taken off? And why is there a prosperous high-tech sector in Orange County, California, which lacks a strong university base, or in Research Triangle Park, North Carolina, where the state, but not the federal, government has been a key actor?

Few would debate Rosegrant and Lampe's call to strengthen America's research and educational infrastructure, or their exhortation to other regions to capitalize on their own strengths and encourage experimentation without overmanaging. But regional planners and policy-makers need to know more precisely how local universities and industry are organized and work with each other and the federal government to promote innovation. Without systematic comparisons with other regions, it is difficult to draw definitive lessons from the Route 128 experience.

The book's ambiguities are compounded by its reluctance to explore the causes of Route 128's current difficulties. The authors set out to write a book about the "Massachusetts miracle"—but ran up against the Massachusetts bust. More than 50,000 high-tech manufacturing jobs were lost in the state between 1984 and 1991, and even today the region shows few signs of recovery. As the crisis of the region's leading minicomputer producers deepens, Rosegrant and Lampe appear naively optimistic. They devote a mere ten pages to the downturn. A deeper analysis of the sources of the region's dynamism would, presumably, provide more penetrating insights into the causes of the crisis as well.

Technology in the Garden offers comparative cross-regional insights of the sort that would have strengthened *Route 128*. It also poses a far greater challenge to the reader unfamiliar with formal social science theory and methods. This systematic analysis of the role of research parks in U.S. regional economic development combines the findings of an econometric analysis of survey data from 72 research parks and case studies of three of the most successful parks—Research Triangle Park, Utah Research Park, and Stanford Research Park.

Luger and Goldstein conclude from their painstaking analysis that research parks by themselves are not a wise investment for most regions and that they rarely generate the income or employment that their founders expect. Though increasingly popular as an economic development strategy during the 1980s (84 of the 116 research parks that existed in 1989 were established after 1981), new parks were not as successful as parks of older vintage such as Stanford Research Park and Research Triangle Park, founded in 1951 and 1959 respectively. Evidently the first movers in research parks enjoy

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.

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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)

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