The Man Behind the Microchip: Robert Noyce and the Invention of Silicon Valley. *By Leslie Berlin.* New York: Oxford University Press, 2005. xi + 402 pp. Index, notes, bibliography, appendix, photographs. Cloth, $30.00. ISBN: 0-195-16343-5.

Reviewed by Jeffrey R. Yost

Leslie Berlin's biography of Robert Noyce is a thorough and much needed examination of one of the most influential and understudied inventors and entrepreneurs of the second half of the twentieth century. The book is well written, engaging, and as enjoyable to read as it is informative. Berlin presents the story of Noyce's life with such skill and fluidity that the deft analysis and meticulous research underlying her study can at times go unnoticed. In addition to conducting numerous interviews with Noyce's family, friends, scientific colleagues, and business associates, and making judicious use of published material, Berlin, as she writes, had to collect and compile much of the archival resources from the basements of Noyce's family and associates. Despite her admirable, and largely successful, efforts to piece together much documentary evidence on Noyce and his enterprises, and to supplement these records by conducting many interviews, some events and brief periods of Noyce's life, or the context surrounding them, remain uncertain when the memories of the principal actors contradict each other. In such cases, Berlin presents the different possibilities and interpretations and assesses their relative likelihood, but she avoids succumbing to easy answers or extending such scenarios beyond the evidence.

In addition to writing an excellent and comprehensive biography of an influential inventor-entrepreneur, Berlin has given business historians an important analysis of the formation, management, strategic planning, and evolution of Fairchild Semiconductor Corporation, the firm that Noyce co-founded and led. This enterprise brought together and developed many who would eventually leave the firm to found or join new companies and aid the broader development of the region's semiconductor industry—the area on the peninsula south of San Francisco that in the 1970s came to be called Silicon Valley. She also details and adds to the existing historiography on the inner workings and managerial culture and practice during the early years of the Intel Corporation. Her

book offers a richer internal look at both Fairchild and Intel than Ernest Braun and Stuart Macdonald's outstanding broad study of semiconductor technology and the semiconductor industry, *Revolution in Miniature* (1978). At the same time, Berlin examines more fully the managerial elements of Intel and the personalities involved than Ross Bassett did in his impressive monograph, *To the Digital Age* (2003), a path-breaking study that yields many insights on Intel's R&D and Metal Oxide Semiconductor (MOS) technology.

While Berlin does not overlook any major developments, she surprisingly pays little attention to the long series of patent battles and appeals waged by Noyce and Fairchild against Jack Kilby and Texas Instruments over the invention and manufacturing of the integrated circuit during the first half of the 1960s. Nevertheless, Berlin correctly points out that this battle led Fairchild to focus single-mindedly on Noyce and his patent (for Fairchild's sake) at the expense of the contributions made by other Fairchild engineers—especially Jean Hoerni's use of silicon-oxide layers to develop the planar process that facilitated the successful manufacturing of workable (uncontaminated) integrated circuits. Fairchild's preoccupation with Noyce's patent was a case of corporate goals and legal prudence overshadowing scientific and engineering credit for the good of the firm—a development that trumped the fact that Noyce, though highly competitive, was often gracious in crediting his colleagues and competitors (including, later in his life, even the work of Kilby).

Though the overall attributes of Berlin's book dominate, her title and subtitle perhaps overstep in implying that a single hero was responsible for the trail-blazing technology of integrated circuits and for bringing Silicon Valley (and its creativity, technology, risk aversion, and venture capital) into being. Kilby's early technical work in developing integrated circuits, though less complete (especially with regard to creating a workable product), was equally as impressive as Noyce's. And while it would be difficult to argue that any other individual was more influential in creating and promoting Silicon Valley, a number of people and many factors (most of which Berlin mentions, albeit briefly) were fundamental. Some of these include the legacy bequeathed by Stanford University professor of electrical engineering and provost Frederick Terman to the region's industrial infrastructure and to university–industry collaborations; William

Shockley's reputation, decision to relocate to Palo Alto, and ability to inspire some top talent (Noyce, Gordon Moore, and many others) to join him; and the funding provided by Fairchild Camera and Instrument to the "group of eight" defectors from Shockley's firm (despite the fact that the parent company, Fairchild Camera & Instrument, as Noyce believed and Berlin details, often held Fairchild Semiconductor back). Moreover, San Francisco's long-standing reputation as a center for amateur radio enthusiasts in the interwar period, coupled with the microwave and power-grid tube companies that grew up there during this time, created a technological and entrepreneurial infrastructure in the region's early post–World War II period. The totality of these developments was critical for the evolution of Silicon Valley and perhaps deserves a bit more space in Berlin's study.

While some business historians, management theorists, and economists might have hoped for more discussion of Fairchild, Intel, and its various competitors than Berlin provides, she intersperses considerable business and technical analysis throughout her impressive narrative. She succeeds admirably in creating an intriguing, insightful, and highly original biography of an inventor turned manager, whose invention and innovation deeply influenced the development of information technology and whose establishment and leadership of pioneering corporations and industrial organizations were critical as well. Perhaps Berlin's most original contribution is her examination of Noyce's leadership in broadly promoting the U.S. semiconductor industry and emphasizing its importance to the emerging information economy in various arenas, particularly to members of the U.S. Congress. In this discussion, and throughout the book, Berlin aptly demonstrates Noyce's charisma, his inventive mind, and his evolution from a highly talented and creative engineer into an influential executive—albeit one who was more successful as a leader of smaller research-and-development operations, or start-ups, than as a director of the giant multidivisional firms that Fairchild, and particularly Intel, became.

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