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Mansel G. Blackford, K. Austin Kerr. *B.F. Goodrich: Tradition and Transformation, 1870-1995.* Columbus: Ohio State University Press, 1996. x + 507 pp. $30.00 (cloth), ISBN 978-0-8142-0696-6.

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Insights from an American Industrial Experience

Blackford and Kerr's history of BFGoodrich traces the development of the company as it produced a changing range of products from 1870 to 1995. Through this history, the authors provide insights into several universal themes about industrial competition and organization of American manufacturers in the 1900s. Blackford and Kerr make no attempt to generalize conclusions beyond the experiences of Goodrich, but merely provide scholarly descriptions of the company's history in a way that addresses the universal themes. In American manufacture of automobile tires, BFGoodrich became the first producer when in 1896 it filled an order from the Winton Automobile Company of Cleveland. As automobile production expanded, Goodrich was well-placed to stay a leader in this profitable new market by branching out from bicycle tires and other rubber products into automobile tires. The company licensed key tire patents and helped set up the Clincher Tire Association and its system of production quotas. Yet the quotas spurred manufacturers with low allocated sales to develop alternative technologies. Worse, Goodrich management lagged in tire plant investment and improvement. By 1916, competitor company Goodyear surpassed Goodrich with a 21 percent market share in automobile tires, and Firestone too surpassed Goodrich by the mid-1920s. Although Goodrich hung on among the industry's "big four", its relative inattention to manufacturing meant that, from the 1920s on, high costs often plagued profits in the company's tire operations. After World War II, despite sporadic major investments in tire manufacturing, profits remained elusive. In 1988, Goodrich sold its tire interests.

The company had other products to rely on, some in lucrative growth markets. After tires, a second key product was polyvinyl chloride, PVC. In experiments to improve the bonding between metal and rubber, company scientist Waldo Semon in 1926-1927 stumbled on a means to turn the polymer of vinyl chloride into a flexible, jellylike plastic. Managers did little to commercialize plasticized PVC until the late 1930s. World War II highlighted PVC's advantages, as the military funded rapid construction of production facilities. A key initial use was the coating of electrical wires and cables. By around the end of the war, Goodrich apparently had a capacity to produce annually over 10 million pounds of PVC. By 1966, Goodrich's output reached 260 million pounds, and by 1971, 456 million pounds. Other firms also produced PVC, including Union Carbide by 1941, but through 1955 the firms involved reaped high profits through "unspoken agreements to maintain prices" (p. 236). Goodrich did not attempt to bar competitors from the market using patents; in any case alternative patents could easily be gained via minor chemical variations. In 1955, Dow Chemical began selling a key raw material that previously had to be produced as part of the PVC manufacturing process. Entry of new producers yielded twenty manufacturers by 1958, and prices plummeted. The easy flood of PVC profits ceased, although Goodrich managed to maintain less striking profits by pioneering new uses for PVC and by developing the industry's lowest-cost production facilities. Nonetheless, PVC as a commodity chemical became less attractive as a continuing line of business, and Goodrich sold most of its PVC operations in 1993.

Such juggling of product markets was typical for Goodrich, which began its existence in 1870 as a diversified rubber producer. By 1902 it produced rubber items such as bicycle tires, tubes and hoses, molded goods, druggist sundries, golf balls, and conveyor belts. From

its work on chemical additives (to make rubber longer-lasting and quicker to produce), synthetic rubber, and new means to use rubber, the company developed a range of chemical products that led to the formation in 1942 of a separate chemical division, and its reorganization as a wholly owned subsidiary in 1945. Provision of airplane tires, brakes, and other equipment beginning in 1909 led to a small aeronautics department in 1917, and eventually to an aerospace division. In addition to expanding internally, the company purchased firms in strategically related markets or with strategically key technologies. Especially from the 1970s on, executives used divestitures and acquisitions to reshape the company. In the 1980s and 1990s, Goodrich shed its mature markets, notably rubber products and PVC, in favor of two high-growth areas involving materials science: specialty chemicals and aerospace. The authors trace Goodrich's growing pains, organizational change and continuity, and managerial strategy as the company mutated through different markets over time.

Other themes that recur at various points throughout the book include price collusion and antitrust investigation, reasons for and consequences of laboratory research, difficulties in capturing the monetary returns to important product improvements and patents, strategies in developing distribution networks, influence of personalities on corporate strategy and change, labor unions and strikes, and the thwarting of takeover attempts. These themes may not be addressed as deeply as many readers would like, and clearer thesis statements about them, and comparisons with typical American industrial experience, might have helped the authors focus their information gathering and presentation. However, the authors perhaps can be forgiven these weaknesses, since desirable information may be difficult or impossible to obtain. Moreover, the Goodrich story often provides thought-provoking insights on these themes. A startling insight of this sort is the role of U.S. firms' infighting over the new radial tire technology in contributing to those firms' loss of market share to Michelin and other foreign competitors. When Goodrich realized through European subsidiaries that Michelin's radial tire was an important advance, Goodrich developed its own version of the radial. However, its major competitors Goodyear and Firestone were not ready to produce radials. Goodyear characterized radials as being problematic and promoted its own "bias/belted" tires to customers, thus slowing development of radial sales in the US; moreover, major automakers would not install radials as original equipment on cars unless at least two large manufacturers could supply them. As a result the U.S. manufacturers held back from investments in radials. Also, Goodrich blocked attempts by Goodyear to purchase firms in Holland and New Zealand that would have given radial technologies to Goodyear; again U.S. tire makers' move into radials was slowed. Earlier investments in radials could have helped defend against international competition by radial makers that eventually cut deeply into U.S. firms' sales.

One issue that is little addressed is the relative importance of in-house engineering work versus the purchase of equipment in lowering firms' manufacturing costs. Blackford and Kerr portray Goodrich's profitability troubles in automobile tires as resulting, seemingly most importantly, from its laggardliness in improving manufacturing processes. This portrayal seems reasonable given others' findings on the subject.[1] However, the authors come across as implying that lowering costs was mainly a matter of purchasing new equipment, and they do not analyze the relative proportion of in-house engineering work required for cost reduction. (They do mention a specific case, converting tire building machines for radial tires, in which in-house conversion of equipment seems to have been less appropriate than purchasing new equipment. Nonetheless, this does not demonstrate that in-house engineering work was the less promising approach at other times or for other aspects of the manufacturing process, and it stills leaves open the question of engineering costs required to learn about and install equipment from suppliers.) Hard evidence about the size and activities of production engineering and related workforces is difficult to come by, so the contribution to cost reduction of equipment purchases versus in-house engineering remains an open question in economic and historical research.

The book is organized not by themes of this sort, but by chapters corresponding to historical eras, with subdivisions into a lengthy string of product categories. This layout is more prolonged than many readers will care to bear. Fortunately, the subheadings and index provide a means to investigate product markets and some key themes by reading selected chapters. And to their credit, the authors manage to write most of the subsections in a way that invites interest. In occasional instances, ambiguities make readers uncertain about what to believe (e.g., how specifically might Goodrich's 1954 acquisition, the Sponge Rubber Company, have begun "to fail in the face of management controls imposed from Akron", p. 225; in what manner did Goodrich's 1971 divestitures of various rubber products and of its subsidiary Motor Freight cost "about $10 million", p. 301). But such ambi-

guities are rare, a tribute to the care with which the book was written.

The research throughout appears scholarly and unbiased. Blackford and Kerr enjoyed full access to Goodrich's company archive, record books from executive meetings, and other sources. Of course, they also draw on relevant books, trade journals, archives, and interviews. BFGoodrich funded their research, and the company's chairman and CEO John Ong commented on drafts at the authors' request, but Ong stressed to them that "the decision about what to say in the book was (the authors', and (the authors') alone" (p. ix). Publication via Ohio State University Press apparently was a mandate of the project.

Blackford and Kerr's *BFGoodrich* is likely to interest not only persons concerned with BFGoodrich, and not only business historians, but also academics concerned with industrial organization economics, corporate strategy, and organizational studies, plus management practitioners more broadly. It could provide an interesting catalyst for discussion if used as a course text. More importantly, it is a catalyst for all readers to reflect on important themes of industrial experience.

Note

[1]. For a general overview of factors affecting competition in U.S. tire manufacturing, see French (1991). Excellent early studies of labor productivity improvements in US tire manufacturing, and their correlation with the installation of new equipment, are by Gaffey (1940) and Stern (1933). Regarding the nature of technological changes taking place in the tire industry's manufacturing processes, and their relation to firms' profits and survival, see especially Warner (1966) and Klepper and Simons (1997).

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