



## The German Connection: Merck and the Flow of Knowledge from Germany to the United States, 1880-1930

Jeffrey L. Sturchio and Louis Galambos

The pharmaceutical industry in Germany was very advanced in the second half of the nineteenth century, and it took advantage of this situation to export to the large, growing market in the United States. E. Merck of Darmstadt developed a distribution branch in America that eventually evolved into the large U.S. pharmaceutical firm Merck & Co., Inc. The authors chart the business and technical knowledge that flowed from Darmstadt to the United States and analyze the impact of World War I on those relationships. They suggest that E. Merck's strategy and culture as well as its technical/scientific knowledge helped build a foundation for Merck & Co., Inc.'s development as a leading American research-oriented company in the 1930s.

In recent years Americans have become accustomed to thinking of knowledge transfer largely in terms of a one-way flow from the United States to the less developed nations in Africa, Asia, Latin America, and the Middle East. Some substantial part of the transfer takes place through U.S. research universities, which have through the twentieth century remained open and indeed welcoming to foreign students; since the 9/11 terrorist attacks, problems in obtaining visas have increased, but the transfer continues nevertheless.<sup>1</sup> Although the knowledge transferred has been broad, the working definition of the knowledge has been narrow and has

<sup>1</sup>National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, *Rising Above the Gathering Storm* (Washington, D.C., 2005). See also National Research Council, *International Benchmarking of U.S. Chemical Engineering Research Competitiveness* (Washington, D.C., 2007).

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**Jeffrey L. Sturchio** <[jeffreysturchio@optonline.net](mailto:jeffreysturchio@optonline.net)> is president and CEO of the Global Health Council; **Louis Galambos** <[galambos@jhu.edu](mailto:galambos@jhu.edu)> is professor of history at the Johns Hopkins University.

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stressed technology and the closely related sciences.<sup>2</sup> In the following study of two pharmaceutical companies between the 1880s and the 1930s, we take a different tack: we study the flow of knowledge from Germany to the United States; and we define this flow in very broad terms that include technology and the related sciences but also bring in a variety of other business practices and values.

Though we glance from time to time at some of the other pharmaceutical firms with German origins, we will concentrate on E. Merck of Darmstadt, Germany, and its distribution center, the organization that evolved into Merck & Co., Inc. E. Merck had experienced a significant series of changes in its evolution from a pharmacy (the Angel Pharmacy) that had been in the Merck family since 1668.<sup>3</sup> In 1827, the pharmacy began increased production of various alkaloids, including morphine. By the 1840s, the expanded laboratory had given way to factory production, and by 1855, the firm was employing around fifty factory hands and office clerks and was already using steam power. Expansion of production within Germany was followed by new efforts to export the firm's products to other countries in Europe and North America.<sup>4</sup>

In our examination of this process of expansion and transfer of knowledge, we have three general questions that we want to answer: What, other than technical knowledge, did the relationship export to the United States? What happened when World War I severed the relationships between Germany and the United States? How did the developments prior to the 1930s relate to the pharmaceutical industry's role in the Therapeutic Revolution that took place in Europe and America in the 1930s and beyond?

### **First Efforts to Tap the U.S. Market**

Following the economic and political unification of Germany in the nineteenth century, the nation's industries experienced a significant series of expansions in which various branches of the chemical industry played an important role. E. Merck—which was in what was called “fine chemicals,” as distinguished from industrial chemicals—grew in two ways. The firm increased the volume of its production and also greatly increased

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<sup>2</sup> This is largely a product of the most popular approach of economists studying this and related questions. The approach stems in part from the productivity studies that stress the importance of the residue identified as technology.

<sup>3</sup> Ingunn Possehl, *Modern by Tradition: The History of the Chemical Pharmaceutical Factory E. Merck Darmstadt*, rev. ed. (1952; Darmstadt, 1994).

<sup>4</sup> Ibid., 46-56. This is not our first attempt to describe and analyze the history of Merck & Co., Inc. See also Louis Galambos and Jeffrey L. Sturchio, “Transnational Investment: The Merck Experience, 1891-1925,” in *Transnational Investment from the 19<sup>th</sup> Century to the Present*, ed. Hans Pohl (Stuttgart, 1994), 227-43; and by the same authors, “The Origins of an Innovative Organization: Merck & Co., Inc., 1891-1960,” a paper presented to the Society for the History of Technology, Uppsala, Sweden, 1992.

the number of products it was producing. By the late nineteenth century, E. Merck was making about 10,000 different products, including vegetable treatments and inorganic and organic drugs. The firm was also producing chemical reagents—that is, chemicals used to conduct other chemical reactions (they are the counterpart of machine tools in mechanical production).

The reagents were particularly important because they had to be relatively pure in order to play their proper role in the chemical process. E. Merck had developed a strong reputation for the purity of its reagents and made good use of this reputation in its advertising. E. Merck stayed closely in touch with the medical sciences, and when the germ theory and serum treatments for disease were developed in the late nineteenth century, the firm was quick to set up a bacteriological laboratory and develop vaccines and diphtheria serum. These products, like the reagents, had to be free of contamination and were produced in carefully measured strengths. When E. Merck began to distribute abroad, it carried with its products a well-established reputation for quality.

Seeking to build on that reputation in markets outside Germany, E. Merck began to distribute its products in Britain, France, Austria, Russia, and America. The American market was growing rapidly, as were New York and other major U.S. cities. The United States was already one of the world's leaders in industrial output, but German businesses clearly had a big competitive advantage in fine chemicals. American firms lagged far behind German businesses in science-based industries like pharmaceuticals. The lag was directly correlated to the slow development in the United States of research universities and modern medical institutions. Without training facilities for scientists in organic chemistry, American firms could not expect to compete effectively against the leading German companies.<sup>5</sup> In the chemical industries, the United States was still an underdeveloped nation.<sup>6</sup>

Taking advantage of that situation, E. Merck tried to break into the U.S. market by working with a New York agent, F. W. Fink, who handled their goods on a commission basis from 1874 through 1887.<sup>7</sup> In an attempt to deal with what economists call the “agency problem,” E. Merck had turned to an individual already known to the company.<sup>8</sup> Fink, now joined

<sup>5</sup> Arnold Thackray, Jeffrey L. Sturchio, P. Thomas Carroll, and Robert F. Bud, *Chemistry in America, 1876-1976: Historical Indicators* (Boston, 1985).

<sup>6</sup> Later, the euphemism for this condition became “developing.”

<sup>7</sup> On the firm Lehn & Fink, see *Oil, Paint and Drug Reporter* 29, no. 23 (9 June 1886): 10; 31, no. 23 (8 June 1887): 9; 32, no. 17 (26 Oct. 1887): 10; 32, no. 23 (7 Dec. 1887): 51.

<sup>8</sup> On the agency problem, which deals with all of the participants in an enterprise, not just the commercial representatives, see Peter Temin, ed., *Inside the Business Enterprise: Historical Perspectives on the Use of Information* (Chicago, 1991); and Naomi R. Lamoreaux and Daniel M. G. Raff, eds., *Coordination and Information: Historical Perspectives on the Organization of*

in business with Louis Lehn, had handled Merck products in Germany before emigrating to the United States. Like E. Merck, Lehn & Fink stressed the purity of their products, including “pure cocaine.” As the *Oil, Paint and Drug Reporter* noted in 1887, “Samples of their cocaine we have seen were extra fine and absolutely pure.”<sup>9</sup> But the free-wheeling commercial environment in New York City had apparently undermined Fink’s integrity, because he and his partner began counterfeiting E. Merck labels and attaching them to inferior products.<sup>10</sup> A search of the Lehn & Fink agency produced convincing evidence of the fraud and persuaded E. Merck to tighten its control of marketing and sales in New York.<sup>11</sup>

### Once Burned, Twice Shy

Following this disappointing outcome, E. Merck set out to take over the wholesale operation itself—a form of vertical integration familiar to all of the business historians who make use of the late Alfred D. Chandler’s paradigm. The company set up its new office in New York City, where German pharmacists had already established a formidable presence.<sup>12</sup> In addition to the strong German presence in the pharmacy business, New York had excellent rail connections with the other leading American cities. The New York–New Jersey region would long maintain its leading position in the industry, rivaled only by Philadelphia for many decades.

No longer trusting America’s agents, E. Merck now employed Theodore Weicker to run the operation and restore any damage that might have been done to the reputation of E. Merck’s products. Unlike Fink, Weicker had spent many years working in the Darmstadt business. He had, as well, gained experience in Britain and other foreign marketing operations. Although he was only 26 years old, he had already served for a time as secretary to the head of the company. Deputized to settle the Lehn & Fink matter, he stayed in the United States as “Empowered Attorney and General Business Manager for E. Merck in the U.S.”<sup>13</sup> At first an employee, Weicker was taken into the firm to share in its profits two years later. He

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*Enterprise* (Chicago, 1995); and Oliver E. Williamson, *The Economic Institutions of Capitalism* (New York, 1985), especially 27–28.

<sup>9</sup> *Oil, Paint and Drug Reporter* 31, no. 23 (8 June 1887): 9.

<sup>10</sup> *Ibid.*, 32, no. 23 (7 Dec. 1887): 51.

<sup>11</sup> *Ibid.*, 33, no. 2 (11 Jan. 1888), 36; and 32, no. 16 (19 Oct. 1887): 44; we are indebted to Elizabeth G. Hayward, who compiled documentation on “The Early History of Merck in America, 1887–1908,” Merck Archives [hereafter, MA].

<sup>12</sup> David L. Cowen, “The Nineteenth Century German Immigrant and American Pharmacy,” in *Perspektiven zur Pharmaziegeschichte*, ed. Peter Dilg (Graz, 1983), 13–28. See also Armin Wankmuller and David L. Cowen, “The German Apothecary Societies of New York,” *Pharmacy in History* 22, no. 3 (1980): 3–10; Arnold Thackray, et al., *Chemistry in America*.

<sup>13</sup> *Oil, Paint and Drug Reporter* 32, no. 17 (26 Oct. 1887): 9.

would remain with the organization until 1904, when he left to start his own business.

When it established its new U.S. branch at 73 William Street in New York, E. Merck transferred to the United States an experienced business executive, capital to start the business, an important link to the advanced medical science of Germany, and the thousands of products developed by E. Merck over the previous three decades. The headquarters also transferred the practice of reaching out to the medical and scientific communities by providing information on innovations in the field and best practices in chemical analysis.<sup>14</sup> This was a form of advertising suited to a professional audience. The branch office published its first issue of *Merck's Bulletin* in 1887, a two-page statement about "A New Remedy for Diseases of the Heart." The "Remedy" was derived from a plant found near Victoria Falls in Africa and marketed by E. Merck as Tinctura Strophanthi and Strophanthin. Other *Bulletins* followed on a regular basis. Two years later, the branch brought out its first issue of *Merck's Index*, a compendia of the Materia Medica that prompted a glowing review in the *Oil, Paint & Drug Reporter*.<sup>15</sup> Thus far, however, E. Merck had not transferred to the United States any substantial body of technical information on production; the branch was merely a distribution center for goods manufactured in Darmstadt.

Along with the E. Merck publications and products came a conservative business culture that was in many ways unusual in America during the late nineteenth century.<sup>16</sup> In the pharmaceuticals of that day, the most dynamic part of the industry was in patent medicines, not the types of fine drugs and reagents that E. Merck was sending across the Atlantic. E. Merck avoided the patent medicine market and, insofar as possible, continued to identify its products by their chemical names. The firm clearly staked out its territory in the "ethical" branch of the pharmaceutical business, rather than in the unruly marketplace of proprietary nostrums so welldescribed by James Harvey Young in *The Toadstool Millionaires*. Instead of looking to consumer markets, the young Merck & Co., like its parent company in Germany, was resolutely focused on the professional markets among chemical firms, public health laboratories, hospitals, pharmacies, and wholesalers to the medical and pharmacy professions.<sup>17</sup> The company's conservatism was also reflected in an

<sup>14</sup> Possehl, *Modern by Tradition*, 52-54.

<sup>15</sup> *Oil, Paint & Drug Reporter* 35, no. 10 (6 March 1889): 10-11, explained that the "valuable publication" had "been promised to the drug trade and pharmaceutical profession for a year past. . . ."

<sup>16</sup> The first temporary office was at 62 Wall Street, but the firm soon established its headquarters on William Street.

<sup>17</sup> James Harvey Young, *The Toadstool Millionaires: A Social History of Patent Medicines in America before Federal Regulation* (Princeton, N.J., 1961). See also Jonathan M. Liebenau, *Medical Science and Medical Industry: The Formation of the American Pharmaceutical Industry* (Baltimore, Md., 1987).

emphasis upon confidentiality—a characteristic that appears to have been re-enforced by the fact that German patent law protected processes, but not products. The firm was also conservative about debt and about returns to its family owners, patterns of business that would become extremely important to the firm when it faced a threat to its existence in the early twentieth century.

In the late 1880s, however, the American economy was experiencing rapid economic growth, as was the New York drug trade and E. Merck's branch office.<sup>18</sup> Responding to the recent problems with the Fink agency, the branch now assured its customers that they were getting "genuine standard quality . . . in the *genuine original packages*."<sup>19</sup> This assurance seemed to be successful: although the business had located at 73 William Street recently, Weicker already found it necessary in 1889 to lease an additional building to handle the growing trade.<sup>20</sup> Wholesale druggists like Towns & James or Balton Drug Company sent "basket boys" to the Merck buildings each day to carry their orders back to their Brooklyn offices. In addition to the twenty-five or so wholesalers and drug brokers in New York, there were about sixty-five wholesalers outside New York whose orders had to be shipped.<sup>21</sup>

### Solidifying the Family Firm

In an effort to solidify its thriving branch and bring it into even closer alignment with the Darmstadt operations, E. Merck decided to send young Georg Merck to America. Georg's father Wilhelm was running the production at Darmstadt, and he had ensured that his son would have a proper introduction to the business. Georg had gained experience in the company's export operations in France and England before he was assigned the new position in New York.

Although Georg was only 22 years old at the time, he apparently objected to having Weicker as a partner. His father, Wilhelm, explained:

The affair of Weicker seems to excite you some but it is simply a matter of form and unavoidable. Our house in New York cannot, according to American law, be considered an American business, and receive consideration and the necessary protection unless a partner in the firm is resident there. This has been verified by other German firms who are represented in New York. Theodore Weicker has had for some time the authority to sign [for us] and also full power to execute financial transactions of any kind. To have created him a partner in New York has granted him no further rights—it was simply a matter of form.<sup>22</sup>

<sup>18</sup> *Oil, Paint and Drug Reporter* 33, no. 16 (18 April 1888): 55-56.

<sup>19</sup> Italics added. *Ibid.*, 32, no. 17 (26 Oct. 1887): 36.

<sup>20</sup> *Ibid.*, 36, no. 21 (20 Nov. 1889): 10.

<sup>21</sup> Memorandum by John Taglieber, 20 March 1953, MA.

<sup>22</sup> Wilhelm Merck to Georg Merck, 14 Sept. 1889, MA.

What Wilhelm did not say was that E. Merck was a conservative business. It wanted to take advantage of Weicker's "flair for advertising and publicity," but it wanted to use Georg to protect itself from Weicker's "rather flamboyant character." Weicker's tendency to "spend money with a rather free hand" had caused concern in Darmstadt, so Georg was being sent as a constraint and a direct link from the New York "house" to the German family.<sup>23</sup>

The initial tiff notwithstanding, Georg (who became George after arriving in New York in 1891) and his slightly older partner continued to make a success of the enterprise, now organized as Merck & Co. The strategy of the new company was still dictated by the Darmstadt model. The focus was on providing brokers and wholesalers, as well as other customers, with fine chemicals they could sell or use with complete confidence in their purity. All of the publications of the U.S. branch were designed to establish the technical, scientific expertise of a company that maintained analytic laboratories available to examine milk samples for tuberculosis bacteria (for \$3) or water supplies for typhoid germs (for \$25). Merck and Weicker, astute entrepreneurs, were responding to the demand for diagnostic tests that would determine the safety of milk and water—two key commodities vital to public health in the expanding metropolis. Merck's reputation for quality and technical expertise assured customers that the milk and water were free of two of the dread diseases of that time. The business grew in spite of the difficult economic conditions in America between 1893 and 1897 and was employing 180 people by 1896.<sup>24</sup> For a time, the partners had to allow their most trusted customers to delay payment, sometimes as much as three to twelve months. As the economy recovered, however, the firm required payment within thirty days.<sup>25</sup>

So far as we can tell, Merck & Co., in New York only made one serious blunder during its early years. This involved an attempt to extend the firm's vertical integration by opening (March 1, 1897) a beautiful and relatively expensive new pharmacy on the corner of University Place and Eighth Street. As described in *Merck's Report*, the pharmacy offered "an imposing architectural display," and the available pictures confirm this evaluation.<sup>26</sup> Not all the observers were awed, however, and a group of German pharmacists, the *Deutsche Apotheker Verein*, protested against the competition Merck was creating for some of its best customers. Merck

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<sup>23</sup> Interview with Charles A. Darius, 9 April 1952, MA. Georg, shortly George, proved true to his conservative heritage. For a time, in fact, he rode a bicycle to work from his temporary quarters at the German Club on West 59<sup>th</sup> Street. Memorandum by John Taglieber.

<sup>24</sup> Ad for the Merck Analytic Laboratories, 1897, MA.

<sup>25</sup> Memorandum by John Taglieber.

<sup>26</sup> *Merck's Report: A Practical Journal of Pharmacy, Materia Medica, and Chemistry* 7, no. 7 (1 April 1898): 212, with a facing picture.

protested. But the struggle continued, and in 1899, Merck closed its elegant pharmacy.<sup>27</sup>

Merck & Co.'s other ventures in integration were substantially more successful, and those undertakings launched a second phase in intellectual transfer from Germany to the United States. In 1903, Merck acquired the Herf & Frerichs Chemical Company of St. Louis, Missouri, a business owned by two German immigrants. That same year, Merck built a new production site in Rahway, New Jersey. These two operations provided Merck & Co., with the capacity to make its own fine chemicals, but made the business dependent on getting process information from Darmstadt.<sup>28</sup>

In the first instance, the necessary information came in the form of experienced employees willing to move from Darmstadt to America. While the new manufacturing program was in the planning stage, George Merck and his partner were joined by Dr. Ernest Kauder, who had substantial experience in Darmstadt with the manufacture of morphine and cocaine, two of E. Merck's important products. Others followed, with an expert for each of the two major manufacturing facilities. They came along with some experienced shop floor workers. Batch production, which was the common technology of that day, involved a considerable amount of handwork, as did packaging, pill-making, warehousing, and handling of supplies. On the shop floor, there was a "manufacturing chemist" in charge of each separate process. Here Merck & Co. was following a generation of best practice in the German chemical and pharmaceutical industries. Companies like Badische and Bayer, as well as E. Merck, employed trained chemists to improve manufacturing processes, to test raw materials, and, from time to time, to develop new products.<sup>29</sup>

These were not mass production, continuous-process facilities.<sup>30</sup> There was a great deal of expensive handwork involved, and some of the raw materials for the firm's most lucrative products (morphine, codeine, and cocaine) had to be imported from Darmstadt. So too with much of the equipment: "centrifuges, stills, kettles, filter presses [and] glassware. . . ."<sup>31</sup> As a result, the company's rare alkaloids had mark-ups as high as 150

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<sup>27</sup> William C. Alpers to M. K. Laurent, 20 Nov. 1897; and "Draft of Closing Circular to the Public, June 22, 1899: both in MA.

<sup>28</sup> Agreement between the Herf & Frerichs Chemical Company and Merck, 30 July 1903, MA. Jeffrey L. Sturchio, ed., *Values & Visions: A Merck Century* (Rahway, N.J., 1991), 15-17. Merck began buying the land for its manufacturing facility in New Jersey in 1900 and 1901; deeds in MA.

<sup>29</sup> Georg Meyer-Thurow, "The Industrialization of Invention: A Case Study from the German Chemical Industry," *Isis* 73 (Sept. 1982): 363-81; Carsten Burhop, "Pharmaceutical Research in Wilhelmine Germany: The Case of E. Merck," *Business History Review* 83 (Autumn 2009): 475-503.

<sup>30</sup> See Philip Scranton, *Endless Novelty: Specialty Production and American Industrialization, 1865-1925* (Princeton, N.J., 1997), on batch production as opposed to mass production and mass distribution.

<sup>31</sup> Interviews, Dr. William Engels, 17, 21, 28 April and 1 May 1952, MA.

percent, although other products such as various bismuths and salicylic acid had to be sold with tighter margins.<sup>32</sup>

By 1913, George Merck had made a success out of his expanded operation. His partner Theodore Weicker had left the company to organize his own pharmaceutical company.<sup>33</sup> The former branch office had now become an exporter in its own right after opening an office and warehouse in Montreal, Canada.<sup>34</sup> Between 1891 and 1913, annual sales increased from \$480,000 to almost \$4 million. New products were housed in new buildings at Rahway, with each building designated by a letter in the German tradition. The letter for the bismuth building was "W" for the German word "wismuth." Shortly, however, German words would become a liability and the firm's steady progress would be interrupted by events far beyond George Merck's control.

### War and the German-American Connection

When war began in Europe in 1914, the tight links between Darmstadt and Rahway were gradually sliced away as the British fleet tightened its blockade of Germany. On one occasion, Merck was able to ship ninety-two crates of drugs on the *Deutschland*, a large German submarine able to sail under the British ships. But that was the ship's last successful trip to the United States.<sup>35</sup> A bad situation became impossible for the company after President Woodrow Wilson took America into the war on the side of Britain and France. The Alien Property Custodian in Washington, D.C., seized German property, including pharmaceutical businesses and their intellectual property. Fortunately, George Merck had become a U.S. citizen in 1902, and he was able to keep control of his enterprise.<sup>36</sup> The

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<sup>32</sup> Interview, Charles A. Darius, 9 April 1952, MA.

<sup>33</sup> Press release, 30 June 1904, MA. In 1908, the former partnership was reorganized as Merck & Co., Inc. "Corporate Changes," MA. See also the press release in re Theodore Weicker Company, 1 July 1904, MA. Later, he took over E. R. Squibb & Sons; press release, February 1905, MA.

<sup>34</sup> Interview, George E. Anderson, MA. Since E. Merck already had an established reputation in Canada, the new Merck branch emphasized "Representing E. Merck, Darmstadt" in the sign on its building. The firm had opened a "house" in Chicago, but it moved that office to St. Louis after the agreement between the Herf & Frerichs Chemical Company and Merck, 30 July 1903, MA. Sturchio, ed., *Values & Visions*, 15-17.

<sup>35</sup> Possehl, *Modern by Tradition*, 73. See also <http://www.colorantshistory.org/SubmarineDeutschland.html>, with pictures of the ship.

<sup>36</sup> Petition for American Citizenship no. 3279, 25 July 1902; petition—George Merck to the Alien Property Custodian—3 April 1918; both in MA. Actually, George Merck had maintained his close links to Germany and had served as an officer in the German army. But he had meanwhile established a residence and family in New Jersey, and the U.S. government concluded that he was well and truly committed to America. Not so with all of his employees, one of whom had to

portion of the business belonging to the German family firm, however, was auctioned off by the Alien Property Custodian.

George Merck was allowed to bid on the property, and his conservative financing helped him muster enough support to buy the business back.<sup>37</sup> It is also very likely that a sense of community among the German-American pharmaceutical manufacturers constrained the bidding process as old guild/cartel traditions came into play. At any rate, Merck & Co. emerged from the war intact, still under the control of George Merck, legally independent of Darmstadt.<sup>38</sup> The strategy of the company was still the E. Merck strategy of producing and marketing high-quality “fine chemicals” to wholesalers, to pharmaceutical manufacturers, and to other organizations that needed reliable chemicals, including reagents.

### **The Twenties: Something New? Something Old?**

Although Merck & Co., was no longer tied financially to E. Merck, evidence suggests that German blood was thicker than the strict rules of corporate governance. In the early 1920s, George Merck appears to have still worked the lines to E. Merck. In brief, the flow of ideas from Darmstadt continued on an informal basis until George Merck’s death in 1926.

By that time, he had handed leadership of the firm to his son, George W. Merck, who had become a vice-president of the firm in 1915 and a director the following year. In 1925, when his father became chairman of the board, George W. Merck became president of the company.<sup>39</sup> Under the son’s direction, the company appears to have adopted a new business strategy. The links to Germany and E. Merck appear at last to have been broken, and a thoroughly American corporation emerged. Through acquisition and then through a new approach to research and development, the new president of the business internalized functions that had for forty years been provided by E. Merck. The acquisition of Powers-Weightman-Rosengarten of Philadelphia gave Merck the process information it needed to round out its line of alkaloids, including morphine and quinine. The acquisition also gave Merck a larger revenue base to fund R&D. George W. Merck, who had studied chemistry at Harvard University, appreciated the importance of links to university and medical center research. In 1929, he reached out to establish a working relationship with Dr. Alfred Newton Richards, an eminent pharmacologist at the University of Pennsylvania,

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be sent back to Germany after he cheered the sinking of an unarmed American ship by a German submarine.

<sup>37</sup> The repurchase was financed by Goldman, Sachs & Co. and by Lehman Brothers, which purchased 35,000 shares of 8% cumulative preferred stock. Corporate History, Merck & Co., 1908-1927, MA.

<sup>38</sup> In a curious twist of fate, the Merck board authorized an application in 1918 for licenses “to manufacture drugs and chemicals covered by enemy owned [that is, German] patents.” Corporate History, Merck & Co., 1908-1927, MA.

<sup>39</sup> Later, he became treasurer. Corporate History, Merck & Co., 1908-1927, MA.

and then with Dr. Randolph T. Major, an organic chemist at Princeton University.

With Major as his science administrator and Richards as his primary advisor, George W. Merck began to transform an organization that had depended on the German connection for both products and processes into a business that would internalize the research and development functions at Rahway.<sup>40</sup> Now Merck had a base in organic, medicinal chemistry, and it built on that base in 1933 by opening a new consolidated research laboratory to develop new products and improved processes and the Merck Institute of Therapeutic Research to conduct safety tests on its fine chemicals. An analytical control laboratory continued to monitor the quality of the products. In the next few years, Major, Richards, and Merck's president rounded out the research staff, adding several talented researchers, including Dr. Karl Folkers (from Yale University) and Dr. Max Tishler (from Harvard University), to the laboratory. Tishler, who did some important original work on vitamins and animal health, took a particular interest in the pilot plant, the interface between the discovery and development steps in chemical innovation. Given the financial conditions that existed in America after the collapse of the stock market in the fall of 1929, this was a bold initiative. It was facilitated by the same conservative financial practices that had enabled George W. Merck's father to buy back the company following World War I.

But was this turn into internalized R&D actually anything new? We're certain that George W. Merck, his brother-in-law George W. Perkins (chief operating officer), and their chief advisor, Alfred Newton Richards, all saw this as a new and challenging strategy. But in reality, all that Merck & Co., Inc., was doing was what Emanuel Merck had done in Darmstadt in the early nineteenth century. He had reached out to Justus Liebig, an eminent professor of chemistry (at Giessen, then at Munich), and had conducted his own research into alkaloids (especially opium). He had established a network of personal scientific relationships, a tradition that continued with his sons, Carl Wilhelm (1823-1885) and Georg Franz (1825-1873), who were partners in the manufacturing firm as of 1850.<sup>41</sup>

Even more telling was the manner in which E. Merck responded to the germ theory of disease and the innovations in serum treatments for infection in the late nineteenth century. To many in healthcare, these innovations were difficult to accept. Many American physicians persisted in denying that infectious diseases were a product of bacterial infections.

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<sup>40</sup> This is a common pattern of development for large American corporations. DuPont, AT&T, General Electric, and Eastman Kodak, among others, followed this path. What is different about Merck is the relatively long delay in moving toward internalization, a delay that seems related both to the fact that E. Merck was very advanced and still available for assistance and the fact that American universities were slow to develop first-rate programs in organic chemistry.

<sup>41</sup> Possehl, *Modern by Tradition*, 22-45.

E. Merck, however, moved quickly to adopt treatments based on the newest theory of disease coming from French and German scientists.

In the 1930s in the United States, Merck & Co., Inc., was replicating the business experiences of its German parent. The people were different. The universities were American, not German.<sup>42</sup> The science was more advanced. But the basic business strategy of getting close to advanced medical science, developing internal capabilities as well as elaborate external networks, and stressing the purity of the products and the scientific nature of the processes were all familiar, well-tested E. Merck strategies. This was a deeply planted business tradition, not an institutional innovation unique to the United States in the 1930s.

So when, then (if ever), did the company break decisively from its German origins in E. Merck of Darmstadt? We would suggest that this happened finally in 1953 when Merck & Co., Inc., acquired Sharp & Dohme, a Philadelphia firm that used Merck fine chemicals to make, market, and sell pharmaceutical products to druggists, hospitals, and other institutions.<sup>43</sup> It was not easy to combine the two organizations. There were two different business cultures involved; two different organizational structures; two different styles of leadership; two different sets of products and processes; and above all, two different histories.<sup>44</sup>

Sharp & Dohme had emerged from a Baltimore drug store to become a large producer and distributor of a wide variety of pills, elixirs, and similar products. In the late 1920s, the company acquired H. K. Mulford, a well-established biological company, and then moved its operations to Philadelphia, one of the two leading national centers for pharmaceutical production. Unlike that of Merck, Sharp & Dohme's business strategy stressed distribution, both overseas and in the United States. Less strict than Merck about opportunities in patent medicines, Sharp & Dohme sold a number of products (Pan-Peptic Elixir Tablets, for instance) that crossed the line into products more noted for their advertising than their therapeutic qualities. Many of these products would disappear from the firm's order book after the U.S. government began requiring that drugs be tested for efficacy as well as safety. Reorganized in the 1930s, Sharp & Dohme had set out to establish "a stricter ethical policy, [and] more research to

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<sup>42</sup> But even the university setting was not entirely different. Alfred Newton Richards, for instance, had studied in Europe, as was common with American scientists interested in chemistry.

<sup>43</sup> E. Merck had begun producing pharmaceuticals as well as fine chemicals during World War I, when the finished products were no longer available as imports and were badly needed by the military. Still, the bulk of its products were sent to other firms to be used in finished products.

<sup>44</sup> The Powers, Weightman-Rosengarten acquisition created hardly any problems because both firms were in the same "fine chemicals" business.

develop new products . . . ,” but it continued to be a firm with a stronger reputation for skillful marketing than for innovative research.<sup>45</sup>

Nevertheless, Merck & Co., Inc., needed Sharp & Dohme’s capabilities and institutional framework for distribution throughout the world. Merck was being squeezed out of fine chemicals by companies integrating upstream into their own chemical production. Meanwhile, the firm had been pushed out of the vitamin market by a European company that had achieved very impressive economies of scale. It was also facing fierce price competition in antibiotics from businesses like Pfizer, which had significant capabilities in the production of drugs through fermentation. The combination with Sharp & Dohme—also one of Merck’s largest customers in 1952—promised to solve those problems so long as Merck & Co., Inc., could make a success of the new business strategy.

Not everything in that strategy was new. Merck kept an emphasis on high-quality products, on science-based research and development, and on high ethical standards in marketing and sales. Post-acquisition improvements in distribution helped the integrated firm deal with a more diverse set of customers and a more demanding regulatory environment. This transition would take some years to complete. But by the 1980s, Merck & Co., Inc., would be a leader in the global pharmaceutical and biological industries and would become for several years *Fortune*’s most admired American corporation.

## Conclusion

We find especially interesting the transfer of business knowledge, a particular business strategy, and a powerful business culture from Germany to the United States when E. Merck began investing in the large, growing American market. Certainly, scientific and technological information was transferred, as were important products for medicinal and research use in America. But over the decades in which E. Merck was shipping products, intermittently perhaps, to America, the science and technology shifted dramatically. So too did the comparative balance of knowledge and scientific institutional frameworks of the two nations. By the 1930s, the United States was rapidly catching up with the more advanced German medicinal sciences, in part of course because so many American scientists and physicians had received part of their training in Germany.

But what persisted long after the United States had reached the level of scientific/technological development of Germany was the E. Merck pharmaceutical model of firm strategy and culture. This suggests that

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<sup>45</sup> Sharp & Dohme, Dedication of New Medical Research Laboratories, 12 May 1952; Sharp & Dohme, *Annual Report*, 1953: both in MA. Between the 1930s and the 1953 merger, Sharp & Dohme had, however, achieved some success in developing various sulfa drugs and then penicillin, making it an even more attractive firm to Merck.

scholars need to look beyond science-based technology when they evaluate the process of knowledge transfer within and between organizations, and within and between societies. Capabilities are based on more than technology and science. They are based as well on organizational patterns of behavior, leadership, and deeply planted value systems.

As we saw in the Merck history, a war that the businesses had not anticipated temporarily separated the German manufacturer, E. Merck, from its American distribution and manufacturing branch, Merck & Co. If E. Merck had anticipated the war, the firm would not have invested in the United States and certainly not in France. As a result of World War I, the flow of technical information, capital, and skilled labor coming from Germany to the United States was abruptly cut off. Thanks in part to George Merck's early decision to become an American citizen—a lucky break for the company—he was able to keep control of his firm during and after the war. Part of the responsibility for that outcome can also be credited to the conservative business strategy that George had brought with him from Germany and his early experience in E. Merck. Being in and staying in a relatively conservative position on debt helped George Merck and his son guide the business through the war and postwar experiences. While some transfers of knowledge were probably recreated in the 1920s, the aftermath of the war was an increasingly independent American firm, Merck & Co., Inc.

That firm became one of the leaders in the American industry in the 1930s and 1940s, as the United States began to experience first-hand the Therapeutic Revolution. When George W. Merck, the new president, expanded the firm and internalized the R&D functions, he was successfully following the E. Merck model. When he continued to stress the quality of the firm's products and the science-based nature of its laboratories and pilot plant, he was expressing values that had in the previous generation been imported from Darmstadt. So too when he reached out to establish close relations with the institutions developing the medicinal sciences and pharmacology in America. It is in that sense that we conclude that German business practices, culture, and history helped lay the foundation for America's climb to leadership in world pharmaceuticals after World War II and for Merck & Co, Inc.'s achievements in those decades as an innovative and profitable corporation.