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Twentieth-Century Product Innovations in the German Food Industry

Product innovation, a decisive factor in modern economies, is usually analyzed from one point of view—that of the producers. A more realistic approach to the subject would add at least four dimensions to a consideration of the topic: the perspective of consumers and the cultural context within which they form their views; the differences in how experts and consumers acquire knowledge about products; the increasing influence of retailers at the point of sale; and the technological options available to producers and households. Two twentieth-century German case studies—on the scientific innovation of yogurt and the preserving and canning of food—connect the often separate perspectives of business, consumers, and culture.

Product innovation is a decisive factor in shaping the dynamics of growth, wealth, and competitiveness in modern economies. Western societies that rely on knowledge and information, in particular, depend on a constant process of innovation, which follows from the interaction of scientists and engineers, entrepreneurs, and consumers.[1] In a "world made of knowledge," innovations emerge from situations that involve both cooperation and conflict. Thus, if we want to understand how innovation works, we must look not only at the actors involved, but also at their backgrounds.[2] This view challenges the dominant perspective of economists—and of at least some business historians—who maintain that product innovations arise only from a certain kind of producer–consumer relation.[3]

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[1] Nico Stehr, *Arbeit, Eigentum und Wissen. Zur Theorie von Wissensgesellschaften* (Frankfurt/ M., 1994).

[2] Nico Stehr, "A World Made of Knowledge," *Society* 38, no. 11/12 (2001): 89–92.

[3] Cf. Francois Caron, "Innovation," in *Entrepreneurship in Theory and History*, ed. Youssef Cassis and Ioanna Pepelasis Minoglou (Houndmills, 2005), 111–26; Roman Rossfeld, "Unternehmensgeschichte als Marketinggeschichte. Zu einer Erweiterung traditioneller

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Structural Problems of Product Innovation in Food Markets

While modern marketing theory maintains that product development occurs exclusively inside companies, there "is very little consensus as to the right or wrong way to manage the process."[4] Although market theorists differ in their views on particular elements of this process, they generally agree on certain basic steps: A company generates an idea, screens it, develops the concept, and then tests it. After conceiving a marketing strategy, the company conducts a business analysis, develops the product, then puts it on a test market, and, if it succeeds there, begins commercialization.[5] Despite variations, market theorists regard the steps as occurring at the initiative of the producer, and they tend to assume that innovation issues mainly from multidivisional companies.[6] These theorists reduce markets and consumer behavior to the quantitative and qualitative information gathered through market research. They attribute high failure rates to consumer irrationality and shifting fashions, when, in fact, inadequate understanding of product innovation itself is to blame.[7] In the German food industry, for instance, more than 25 percent of the thirty thousand products launched in 2004 failed immediately, and only seventy-five hundred were still available in 2006. Moreover, most consumers could not remember them: only 28 percent could name one or more new brands.[8] As a consequence, the German food industry has had to amortize €10 billion in mistaken investments every year. Such immense losses are one indication that a company-centered approach to product innovation is inadequate. Historical case studies can help to differentiate theoretical assumptions.

Ansätze in der Unternehmensgeschichtsschreibung," in *Marketing. Historische Aspekte der Wettbewerbs- und Absatzpolitik*, ed. Christian Kleinschmidt and Florian Triebel (Essen, 2004), 17–39; Hartmut Berghoff, ed., *Marketinggeschichte. Die Genese einer modernen Sozialtechnik* (Frankfurt/M., 2007). An example of intentional economic history that does not reflect the perception of products and symbols is Alexander Schug, "Missionare der globalen Konsumkultur. Corporate Identity und Absatzstrategien amerikanischer Unternehmen in Deutschland im frühen 20. Jahrhundert," in *Politische Kulturgeschichte der Zwischenkriegszeit 1918–1939*, ed. Wolfgang Hardtwig (Göttingen, 2005), 307–42.

[4] Alison Rudder, Paul Ainsworth, and David Holgate, "New Food Product Development: Strategies for Success?" *British Food Journal* 103, no. 9 (2001): 657.

[5] Philip Kotler, Gary Armstrong, John Saunders, and Veronica Wong, *Principles of Marketing*, 5th European ed. (London, 2008).

[6] Cf. Alfred D. Chandler Jr., *Strategy and Structure: Chapters in the History of the Industrial Enterprise* (Cambridge, Mass., 2001) and "The Enduring Logic of Industrial Success," Harvard Business Review 68 (Mar./Apr. 1990): 130–40.

[7] Cf. J. Hilary Green, Peter J. v. Bladeren, and J. Bruce German, "Translating Nutrition Innovation into Practice," *Food Technology* 60, no. 5 (2006): 26–30, 33.

[8] Daniela Rück, "Innovationsdruck," *Lebensmittelzeitung* no. 35 (2005): 29–30; Heinrich Olbrich and Alessandra Cama, "Innovationen richtig steuern," *Lebensmittelzeitung* no. 35 (2005): 42, 44; Daniela Rück, "Milliardenverluste mit Produktneuheiten," *Lebensmittelzeitung* no. 17 (2006): 51.

Economists first began to explore product innovation during the worldwide economic crisis of the late 1920s, when questions of economic growth and dynamics became crucial concerns. The relatively new concept of innovation was first popularized by Austro-American economist Joseph A. Schumpeter in the 1930s. He proposed a simple theory of product development made up of three phases: invention, innovation, and diffusion. His focus was on the role of entrepreneurs and groundbreaking patents, rather than, more generally, on the innovation process itself.[9] Economic and technological historians used Schumpeter's conceptual tool mainly to analyze basic inventions of the industrial age, such as the steam engine, the dynamo, and the automobile.[10] The results were mixed. On the one hand, historians began to study restrictions and alternative pathways; on the other, Schumpeter's linear concept had to be modified as it became obvious that innovations are characterized by conflicting repercussions and interdependencies among the three phases.[11] Additionally, comparisons of the ways in which innovation was handled in different countries revealed that economic, social, and cultural conditions were crucial to the success or failure of new products.[12]

While this awareness led to differentiation in company-centered innovation research, it did not expand the theoretical debate. Thus, it became important to consider both the distinctiveness of different business sectors and products and the companies' specific positions. The distinctions among science-based, production-intensive, and supplier-dominated companies, each approaching innovation in different ways, are well known.[13] In the last few decades, the food chain has become an established agricultural economic concept, one that is used as a macroeconomic tool to analyze the participants in the innovation process: retailers and consumers came to be recognized as decisive factors for success, alongside manufacturers.[14]

Moreover, market research has intensified and become differentiated in the last few decades.[15] Although agricultural economists continue

[9] Joseph A. Schumpeter, *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle* (Cambridge, Mass., 1936).

[10] The most advanced theory based on such research is Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Boston, 1997).

[11] Giovanni Dosi, "Sources, Procedures and Microeconomic Effects of Innovation," *Journal of Economic Literature* 26 (Sept. 1988): 1120–71.

[12] Helmut Braun, "Korreferat zu Mark Spoerer," in *Innovationsgeschichte*, ed. Rolf Walter (Stuttgart, 2007), 61–68.

[13] Keith Pavitt, "Sectoral Patterns of Technological Change: Towards a Taxonomy and a Theory," *Research Policy* 13, no. 6 (1984): 343–73.

[14] Barbara Stewart-Knox and Peter Mitchell, "What Separates the Winners from the Losers in New Food Product Development?" *Trends in Food Science & Technology* 14, no. 1 (2003): 58–64.

[15] Teresa Keller, *Produkte am globalen Markt. Nahrungsmittelhersteller zwischen Standardisierung und kultureller Anpassung* (Münster, 2005).

to work with traditional quantitative methods and mathematical models of consumer behavior, they are also turning more frequently to qualitative methods.[16] They regard customer and consumer orientation as indispensable to developing successful products.[17] Further, they view knowledge of consumers' problems and lifestyles as the foundation for creating desirable foodstuffs and products. But first, they must learn about the interactions between companies and consumers, and between the economy and the cultural environment, that comprise the innovation process.[18]

For historians, these theoretical debates indicate the changes that are necessary for analyzing historical innovations more adequately. To begin, we have to widen our focus. First, although companies are powerful players, the consumer perspective is also integral to the process of innovation, and not in a way that is primarily restrictive. Second, whereas economic and scientific rationality is important, we must learn to acknowledge the relevance of different outlooks when implementing and using new products. Third, we must integrate not only producers but also different economic players, especially retailers. Fourth, to judge alternatives correctly, we must analyze the technological options that were available to contemporaries.

These four additional perspectives widen the frame for analyzing historical product innovation, allowing us to understand that the processes involved were embedded in a particular culture of consumption.[19]

Before presenting two case studies drawn from the German food industry, I will outline four points that are necessary for understanding the peculiarities of this sector and field of research:

Food Producers. These representatives of the most powerful consumer industry must come to recognize the *cultural context* of consump-

[16] Leslie Gofton, "British Market Research Data on Food: A Note on Their Use for the Academic Analysis of Food Choice," in *'The Nation's Diet': The Social Science of Food Choice*, ed. Anne Murcott (London, 1998), 302–10; Immanuel Stieß and Doris Hayn, *Ernährungsstile im Alltag. Ergebnisse einer repräsentativen Untersuchung* (Frankfurt/M., 2005), 8–13.

[17] David Goodman, "Rethinking Food Production-Consumption: Integrative Perspectives," *Sociologia Ruralis* 42, no. 4 (2002): 271–77 and "The Qualitative 'Turn' and Alternative Food Practices," *Journal of Rural Studies* 19, no. 1 (2003): 1–7.

[18] Cf. S. J. Sijtsema et al., "Consumer Orientation of Product Developers and Their Product Perception Compared to That of Consumers," *Trends in Food Science and Technology* 15, no. 10 (2004): 489–97.

[19] See Frank Trentmann, *Beyond Consumerism: New Historical Perspectives on Consumption* (London, 2002); Michael Prinz, "'Konsum' und 'Konsumgesellschaft'—Vorschläge zu Definition und Verwendung," in *Der lange Weg in den Überfluss: Anfänge und Entwicklung der Konsumgesellschaft seit der Vormoderne*, ed. Michael Prinz (Paderborn, 2003), 11–34; Hartmut Berghoff, *Moderne Unternehmensgeschichte* (Paderborn, 2004). The term "embedded" is closely linked to a social framework of economic institutions like markets, see Mark Granovetter, "Economic Action and Social Structure: The Problem of Embeddedness," *American Journal of Sociology* 91, no. 3 (1985): 481–510.

tion and eating habits.[20] Modern food history has shown that successful product marketing must reflect national and/or regional food traditions, must be transferable from purchasable products to edible dishes, and must adopt central symbols of foodstuffs and product components.[21] However, this is only one side of the coin: consumption and its objects. The other side is the home economy, which even today is an important, partly determining, factor in consumer societies. In economic terms, household production in Germany had a value of €820 billion in 2002—more than industry, trade, traffic, and gastronomy combined.[22] People purchase, cook, and eat in ways that fit their lifestyles.[23] They have to match their own skills and resources to the challenges posed by tradition and family, gender and age, social norms, and cultural expectations. Consequently, attitudes toward scientific concepts like "rationality" differ from country to country, and from culture to culture.[24] Innovations will fail if this everyday logic is neglected.

Knowledge. The varying attitudes toward food and eating are based on different *forms of knowledge.* Eating is a concrete practice of everyday life.[25] People possess practical knowledge that combines tradition and taste, individual skills, and resources. But they also incorporate

[20] Due to statistical problems, resulting from an unhistorical separation of agriculture, handcraft and industry, food production is an underestimated branch. For details and data see Karl-Peter Ellerbrock, *Geschichte der deutschen Nahrungs- und Genußmittelindustrie, 1750–1914* (Stuttgart, 1993); Derek J. Oddy, *From Plain Fare to Fusion Food: British Diet from the 1890s to the 1990s* (Woodbridge, 2003); Harvey Levenstein, *Revolution at the Table: The Transformation of the American Diet* (New York, 1988).

[21] See Eva Barlösius, *Soziologie des Essens* (Weinheim, 1999); Uwe Spiekermann, "Eßkultur heute—Was, wie und wo essen wir?" in *Gesunde Ernährung zwischen Natur- und Kulturwissenschaft*, ed. Rainer Wild-Stiftung (Münster, 1999), 41–56; Peter Scholliers, "Meals, Food Narratives, and Sentiments of Belonging in Past and Present," in *Food, Drink, and Identity*, ed. Peter Scholliers (Oxford, 2001), 3–22; Warren Belasco, "Food Matters: Perspectives on an Emerging Field," in *Food Nations: Selling Taste in Consumer Societies*, ed. Warren Belasco and Philip Scranton (New York, 2002), 2–23.

[22] Data from Statistisches Bundesamt, ed., *Wo bleibt die Zeit? Die Zeitverwendung der Bevölkerung in Deutschland 2001/02* (Berlin, 2003), 11–13. See Duncan Ironmonger, "Household Production," in *International Encyclopedia of Social & Behavioral Sciences*, vol. 10, ed. Neil J. Smelser and Paul B. Baltes (Oxford, 2001), 6934–39.

[23] See Uwe Spiekermann, "Rationalitäten im Widerstreit. Bildung von Präferenzen am Beispiel des deutschen Lebensmittelmarktes im 20. Jahrhundert," in *Wirtschaftsgeschichte als Kulturgeschichte. Dimensionen eines Perspektivenwechsels*, ed. Hartmut Berghoff and Jakob Vogel (Frankfurt/M., 2004), 197–217.

[24] Joseph Henrich et al., "'Economic Man' in Cross-Cultural Perspective: Behavioral Experiments in Fifteen Small-Scale Societies," *Behavioral and Brain Sciences* 28, no. 6 (2005): 795–855.

[25] Consequently, evidence-based food campaigns mostly fail because they believe that transfer of objective knowledge leads to a change of people's behavior. See Anthony Worsley, "Nutrition Knowledge and Food Consumption: Can Nutrition Knowledge Change Food Behaviour?" *Asia Pacific Journal of Clinical Nutrition* 11, suppl. no. 3 (2002): S579–S585.

forms of objective knowledge.[26] Information about markets and business opportunities is conveyed through internal and external marketing; and scientific discoveries about processing and human metabolism increasingly determines food production itself.[27] In addition, political awareness affects food innovations directly as governments attempt to guarantee safe and inexpensive products for their constituencies or to support producers in other nations. Successful producers find the right combination of these various strands of knowledge. In the knowledge-based societies that first emerged when science became professionalized in the late nineteenth century, innovations will fail if producers do not integrate these heterogeneous forms of knowledge into product development.[28]

Producers' Influence. In the twentieth-century, German producers experienced *diminished influence and market power*, because retailers dominated the food market from at least the 1970s. In response, suppliers seeking to strengthen and stabilize their economic position became more innovative, a trend that was supported by saturated markets and creative food technology.[29] Clearly, producers look less intently at consumers than at retailers when developing new products. Retailers mark the point of sale, so their technology, equipment, and listing effectively form a bottleneck that can stifle innovation.

Technological Feasibility. More than in other sectors, food products are restricted by *technological feasibility.* In spite of the efficiencies offered by modern processing and food design, consumers often combine diverse and conflicting expectations. They want dishes to be not only low in fat but also fresh and tasty, or else they want cheap and storable food that is also natural and highly nutritious.[30] On the other

[26] Nico Stehr, *Wissen und Wirtschaften. Die gesellschaftlichen Grundlagen der modernen Ökonomie* (Frankfurt/M., 2001) and, on the concept of incorporation, Jakob Tanner, "The Arts of Cooking: Modern Times and the Dynamics of Tradition," in *Changing Tastes: Food Culture and the Process of Industrialization*, ed. Patricia Lysaght and Christine Burckhardt-Seebas (Basel, 2004), 18–32.

[27] Stephan Leibfried, *Nutritional Minima and the State: On the Institutionalization of Professional Knowledge in National Social Policy in the U.S. and Germany* (Bremen, 1992); David Smith, "The Discourse of Scientific Knowledge on Nutrition and Dietary Change in the Twentieth Century," in *'The Nation's Diet': The Social Science of Food Choice*, ed. Anne Murcott (London, 1998), 311–31.

[28] See Joel Mokyr, "Why 'More Work for Mother?' Knowledge and Household Behavior, 1870–1945," *Journal of Economic History* 60, no. 1 (2000): 1–41.

[29] Michael Breitenacher and Uwe Christian Täger, *Ernährungsindustrie. Strukturwandlungen in Produktion und Absatz* (Berlin, 1990); David Hughes, "Building Partnerships and Alliances in European Food Industry," in *Economics of Innovation: The Case of Food Industry*, ed. Giovanni Galizzi and Luciano Venturini (Heidelberg, 1996), 101–117; Tim Lang and Michael Heasman, *Food Wars: The Global Battle for Mouths, Minds and Markets* (London, 2004).

[30] Felix Escher and Béatrice Conde-Petit, "Die Rolle der Lebensmitteltechnologie in der Ernährungswissenschaft," in *Die Zukunft der Ernährungswissenschaft*, ed. Gesa U. Schönberger and Uwe Spiekermann (Berlin, 2000), 103–113; Barbara Orland, "Haushalt, Konsum und Alltagsleben in der Technikgeschichte," *Technikgeschichte* 65, no. 4 (1998): 273–95.

hand, new technologies depend on household skills and equipment.[31] Since food today is often produced in high-tech ways, it may require high-tech equipment to prepare, such as microwaves and Espresso machines. This factor in product innovation is often overlooked, but it is one that applies to other sectors as well.

Two new products show these general considerations at work in the twentieth-century German food industry: yogurt and canned food. Both products were developed in response to the new urban consumers' demand for both preserved and healthy foods. The case studies described here represent broad and steadily shifting groups of consumer goods. By tracking the course of these innovations over the long term, we can see how they alternately succeeded and failed in relation to changing conditions.[32]

When Science Did Not Take Charge: The Example of Yogurt

In Germany, yogurt became one of the most successful product innovations of the twentieth century. More than a hundred years ago, it was unknown; today, the average German consumer eats 17 kilograms per year, far exceeding the yogurt intake of their British (10 kilograms) or American counterparts (4 kilograms).[33] Yogurt was a scientific innovation.[34] It has been recognized both commercially and by the larger public since 1906, when the Franco-Russian Nobel Prizewinner Elie Metchnikoff promoted its consumption.[35] Metchnikoff had heard about the advanced ages reached by Bulgarian peasants, so he decided to analyze their food habits. Combining bacteriological and epidemiological expertise, he concluded that their health and long life expectancy resulted from eating yogurt. He backed this assertion by isolating a healthy ingredient in yogurt that he called *bacillus bulgaricus,* positing a theory

[31] See Sue Bowden and Avner Offer, "The Technological Revolution That Never Was: Gender, Class and the Diffusion of Household Appliances in Interwar England," in *All the World and Her Husband: Women in Twentieth-Century Consumer Culture,* ed. Victoria de Grazia and Ellen Furlough (Berkeley, 1996), 244–74; Karin Zachmann, "A Socialist Consumption Junction: Debating the Mechanization of Housework in East Germany, 1956–1957," *Technology and Culture* 43, no. 1 (2002): 73–99.

[32] Business history has primarily concentrated on successful companies and their brands. See Hans-Gerd Conrad, *Werbung und Markenartikel am Beispiel der Markenfirma Dr. Oetker von 1891 bis 1975 in Deutschland* (Berlin, 2002); Hans Jörg Gilomen et al., eds., *Innovationen: Voraussetzungen und Folgen—Widerstände und Antriebskräfte* (Zürich, 2001).

[33] Landesanstalt für Entwicklung der Landwirtschaft und der Ländlichen Räume, ed., *Agrarmärkte 2007* (Schwäbisch Gmünd, 2007), 217.

[34] For other examples, see Uwe Spiekermann, "Functional Food: Zur Vorgeschichte einer 'modernen' Produktgruppe," *Ernährungs-Umschau* 49, no. 5 (2002): 182–88.

[35] See Scott Podolsky, "Cultural Divergence: Elie Metchnikoff's Bacillus Bulgaricus Therapy and His Underlying Concept of Health," *Bulletin of the History of Medicine* 72, no. 1 (1998): 1–27.

of war between good and bad bacteria inside the human intestine. Eating yogurt, Metchnikoff argued, helped the good bacteria to replace the bad ones, prevented constipation and intestinal decay, and led to a healthy life.[36] In other words, this physiologist reduced the healthy lifestyle of Bulgarian peasants to one element, yogurt, translating his findings to an urban and industrial context in order to improve the modern way of life.

German scientists and many consumers embraced his scientific explanation of yogurt's benefits, and demand for the food grew quickly.[37] Two developments contributed to its success. One the one hand, yogurt became a profitable by-product for milk producers. Local dairies (most of which combined manufacturing and retail operations) started to produce yogurt in 1907 with the help of the yogurt enzymes, or "ferment," first distributed by the Parisian Institute Pasteur.[38] But manufacturing yogurt was expensive, as it required separate production rooms that had to be maintained according to high hygienic standards. Moreover, the failure rate was high, because the quality depended on milk quality, climate, and hygienic glass bottles. The necessary vacuum production of milk—another new technology—was complicated, too.[39] Additionally, yogurt had to be sold and eaten quickly, as shops and homes lacked cooling equipment for storing the fresh product.

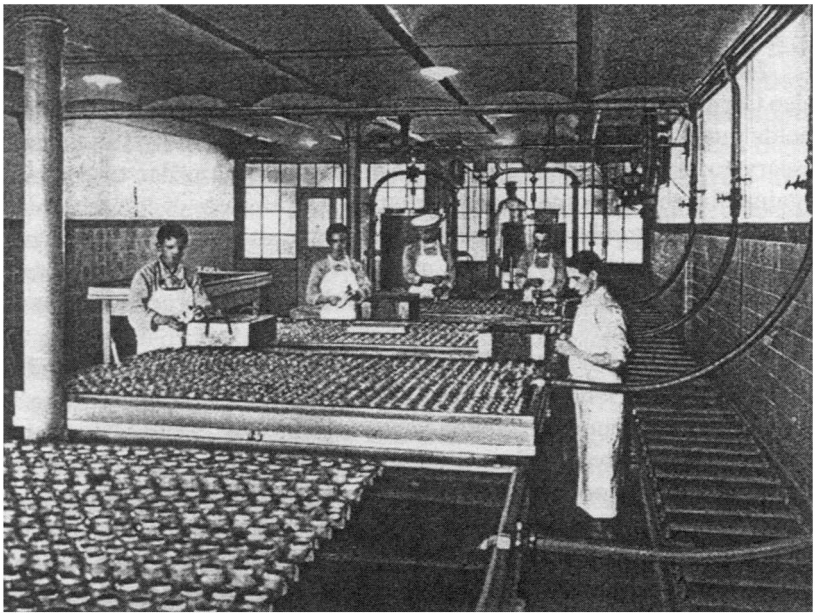
To overcome these drawbacks, specialized medical mail-order companies, such as Dr. Trainers in Dresden, Dr. Klebs in Munich, or Dr. Mühlrad in Berlin, produced and distributed dried ferment to individual households, thereby delegating the task of yogurt preparation to consumers. These companies created demand with simple, informative advertising, concentrating on people's desire to lead long and healthy lives. The ferment built the basis for expanding the number of yogurt breeders and creating a market for equipment that consumers could use to produce the ferment at home. New products were developed: yogurt came as a chewable pill, and the ferment was added to other foods,

[36] Gabriel Bertrand and Gustave Weisweiler, "Action du ferment bulgare sur le lait," Annales de l'Institute Pasteur 20 (1906): 977–90; Elie Metchnikoff, "Etudes sur la flore intestinale. Deuxième Mémoire. Poisons intestaux et scleroses," *Annales de l'Institut Pasteur* 24 (1910): 755–70, pl. XI–XIII; George Herschell, "On the Use of Selected Acid Bacilli and Soured Milk in the Treatment of Some Forms of Chronic Ill-Health," *Lancet* 175 (1908): 371–74.

[37] See Ludwig Reinhardt, "Metchnikoff's Theorie des Alterns und der Yoghurt," *Die Umschau* 10 (1906): 281–84; Wilhelm Hanauer, "Der Yoghurt als Schutz- und Heilmittel," *Die Gesundheit in Wort und Bild* 5 (1908): 86–87.

[38] Adolf Reitz, *Die Milch und ihre Produkte* (Leipzig, 1911), 102; Wilhelm Kirchner, *Handbuch der Milchwirtschaft aus wissenschaftlicher und praktischer Grundlage*, 6th ed. (Berlin, 1919), 680–81. In 1914, nearly twelve thousand dairies existed in Germany. See Kurt Friedel, "Die Milch in ihrer wirtschaftlichen Bedeutung," in *Deutsche Milchwirtschaft in Wort und Bild*, ed. Kurt Friedel and Arthur Keller (Halle a.S., 1914), plate V.

[39] Ludwig Eberlein, *Die neueren Milchindustrien* (Dresden, 1927), 70–74.



Yogurt production at Bolle, Berlin, ca. 1913. (Source: "Gründung und Entwicklung der Meierei C. Bolle, Aktien-Gesellschaft," in Kurt Friedel and Arthur Keller, eds., *Deutsche Milchwirtschaft in Wort und Bild* [Halle a.S., 1914], 114–33, p. 122.)

such as cocoa, butter, or bonbons.[40] These yogurt-related innovations led to new and profitable niche markets, but the record of yogurt sales failed to meet the soaring expectations of dieticians and doctors who thought it held the key to health and long life.

There were several reasons for yogurt's limited success. The cost of the complex technology forced producers to charge relatively high prices, because small and middle-sized dairies could not implement mass production. At that time, yogurt was sold primarily to middle-class customers as a health product. Profitability, especially among the mail-order companies, was high, but consumption figures remained low.[41] Because the dairies did not create brands, their yogurt was healthy and refreshing but remained generic, although it became standardized in the remarkably

[40] See, for instance, "Hahns Yoghurt-Kakao," *Die praktische Berlinerin* 9, no. 11 (1912/13): VI; "Joghurt-Butter," *Vegetarische Warte* 46 (1913): advertisment-suppl., s.p.; "Yabs Yoghurt Bonbon," *Die praktische Berlinerin* 11, no. 36 (1914/15): 9.

[41] Due to the lack of milk production figures for imperial Germany, there are no detailed data. But this estimation was backed by most contemporary publishers, like, for instance, Viktor Brudny. See Heinz Gräf, "Über Joghurtkuren," *Die Umschau* 15 (1911): 1066–67.

short period of seven years.[42] The mail-order companies put their trust in academic titles, not in the symbolic world of a food innovation.

However, this positioning reflected not only market strategies but also German food culture. Since most producers knew that many households made their own curdled milk from fresh milk, they found it necessary to promote their yogurt's health benefits in order to compete against the cheap, homemade alternative. The absence of cooling equipment and the problems involved in using sour milk resulted in the traditional German fare of curdled milk—a rational and economic consequence. This domestic practice imposed limits on yogurt's success in imperial Germany.[43]

During World War I, milk and yogurt production collapsed—and in 1919, American scientists disproved Metchnikoff's physiological theory.[44] Many dairies did not reestablish yogurt production in the early 1920s; it seemed to have been a short-lived fashion.[45] But then scientists—once again, not producers—created new yogurt products. The relative success of yogurt before World War I led to intensified bacteriological research, primarily in the United States and Germany. The Prussian and Bavarian states financed the development of the drinkable yogurt product acidophilus milk, which received a further boost from a government policy that favored milk production.[46] Bacterial cultures that survived in the body and had proven effects on the intestinal flora were isolated. Building on earlier agricultural marketing, manufacturers introduced the new products partly as a health food, partly as new brands, to distinguish them from traditional yogurt.[47]

Although the acidophilus milk products of the time, like Acimil or Miltela, appear to have been comparable to contemporary products, they were different in that they were predominantly science-based inno-

[42] "Was ist Joghurt? Urteil des Reichsgerichts vom 27. Oktober 1913," *Deutsche Nahrungsmittel-Rundschau* (1914), 9.

[43] For the development in the United States, see C. Larsen and William White, *Dairy Technology: Treating of Market Milk and Ice Cream* (New York, 1914).

[44] This was a common argument of skeptical German scientists from 1907/08. See Artur Luerssen and M. Kühn, "Yoghurt, die bulgarische Sauermilch," *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten* 2, sect. 20 (1908): 234–48; Ernst Rosenberg, "Kritik des Yoghurt und die Indikationen für seine Anwendung," *Archiv für Verdauungs-Krankheiten* 15 (1909): 458–68; Paul Heuberger, *Der Yoghurt und seine biochemischen und therapeutischen Leistungen* (Bern, 1913).

[45] Yogurt production was not mentioned in *Die Lage der deutschen Milchwirtschaft. Verhandlungen und Berichte des Unterausschusses für Landwirtschaft* (II. *Unterausschuß*), Bd. 15 (Berlin, 1931); Reichs- und Preußische Ministerium für Ernährung und Landwirtschaft, ed., *Die deutsche Milchwirtschaft in der Gegenwart* (Kempten, 1933).

[46] Wilhelm Henneberg, "Über Bacillus acidophilus und 'Acidophilus-Milch' (= Reform-Yoghurt)," *Molkerei-Zeitung* 40 (1926): 2633–35; Spieker, "Joghurt in der Theorie und Praxis," *Milchwirtschaftliche Zeitung* 34 (1929): 1505–8.

[47] J. L. P. Spohr, "Acidophilus-Milch," *Molkerei-Zeitung* 41 (1927): 604–5.

vations.[48] Their entry into the market was made possible by laboratory research work. Mass production of health yogurts was not tested, nor did producers conduct thorough market research. Before the invention of the market, this was yet one more example of product orientation that ignored food habits and consumer desires. Advertisers based their promotions of the new yogurt on fundamental human desires—like health and youthfulness—not on the requirements of designated social groups or according to gender or age.[49] The message emphasized that modern science could produce healthy products, and consumers should trust in the wisdom of experts.[50] New brand names and innovative packaging supported this hierarchical view. One good example was the acidophilus milk with the brand name "Saya," created as a functional food in 1929.[51]

Yogurt's positioning as a science-based health food severely limited its commercial success. First, since yogurt was still being hailed as a pure and "natural" product, consumers considered it to be something they should eat for their health; thus they did not expect it to be delicious. Innovative combinations of yogurt and fruit flavors failed in the late 1920s. Yogurt with fruit jam was introduced in 1935, but its sales were limited by high pricing.[52] Yogurt's image as something to be endured for the sake of one's intestinal health, its close link to German scientific research, and its skim-milk content contributed to its endorsement by

[48] See, for example, "Konzentrierter Miltela-Yoghurt," *Zeitschrift für Biochemie* 26 (1927): 22. Miltela was easy to spread and should be healthier than margarine and cheaper than butter.

[49] See Lutz, "Die Bedeutung der Joghurtmilch bzw. des Reformjoghurts für die Volksernährung und Volksgesundheit," *Landfrau* 50 (1928): 2; Karl J. Demeter, "Über Acidophilus- und Joghurt-Milch," *Milchwirtschaftliches Zentralblatt* 59 (1930): 190–91.

[50] For detailed information on yogurt products, see Julius Kleeberg and Hans Behrendt, *Die Nährpräparate mit besonderer Berücksichtigung der Sauermilcharten* (Stuttgart, 1930).

[51] Since the mid-1920s fermented milk was used by Bavarian doctors to treat dyspepsia and tuberculosis. Many of the bacteria cultures causing fermentation were analyzed by chemists and bacteriologists of the South-German Experimental and Research Station at Weihenstephan near Munich. The most promising bacteriological cultures were isolated to begin standardized test production in the laboratory, and afterwards, a large number of animal experiments were conducted to study health effects. Finally, the technological know-how was patented, and a new firm, Saya G.m.b.H., Munich, was established to produce and promote the most advanced brand "Saya" (which was the name of a traditional Russian fermented milk). For details see F. Kieferle, Karl J. Demeter, and A. Forster, "'Saya,' ein neues Sauermilchpräparat," *Süddeutsche Molkerei-Zeitung* 50 (1929): 101–2; A. Forster, "'Saya' ein neues Sauermilchpräparat," *Deutsche Nahrungsmittel-Rundschau* (1929): 83–85.

[52] "'Yarom,' der neue süße Joghurt mit Fruchtaroma," *Molkerei-Zeitung* 41 (1927): 1329; Max E. Schulz, "Joghurt und Joghurt-Kulturen," *Die Milchwissenschaft* 4 (1949): 208. The new fruit yogurt was successfully introduced in Vienna and Prague, although the 200 gr. tub was 5 to 7 Pfg. more expensive than the common "natural" dish. On the other hand, yogurt was successfully combined with cheese, mainly camembert, to improve the flavor and to reduce the fat content.

The image of a healthy, scientific food product: Saya bottle, 1929. (Source: *Milchwirtschaftliches Zentralblatt* 58 [1929]: 358.)

Nazi health officials.[53] Second, the innovations of the late 1920s failed because they were too ambitious and had grown out of scientific dreams rather than consumer demand. The new bacteria cultures required complicated production methods, such as the maintenance of constant temperatures and humidity levels. In addition, the commercial infrastructure was not established, and consumers were unable to visualize any direct benefit to be derived from these expensive brand yogurts.[54]

Nevertheless, consumption of "old" plain yogurt gained a strong foothold during the 1930s and early 1940s. In Nuremberg-Fürth, one of the few regions to have recorded valid data, yogurt sales increased from 600,000 tubs in 1933 to 2.3 million in 1939 and 7.3 million in 1944.[55] Scientists and entrepreneurs attributed this success to the new forms of advertising that were targeting specific consumer groups.

[53] Michael H. Kater, "Die 'Gesundheitsführung' des Deutschen Volkes," *Medizinhistorisches Journal* 18, no. 4 (1983): 349–75. For a general view, see David Welch, "Nazi Propaganda and the Volksgemeinschaft: Constructing a People's Community," *Journal of Contemporary History* 39, no. 2 (2004): 213–38.

[54] For this, the fate of "Saya" is a good example. It failed mainly because of severe technological and distributional problems. See Traugott Baumgärtel, "'SAYA' ein spezifisches Milchgärprodukt?" *Milchwirtschaftliches Zentralblatt* 59 (1930): 137–39; Käte Kunze, "Über das Sauermilchpräparat Saya," Phil. Diss., Leipzig, 1932.

[55] Walter Streck, "Erfolgreiche Werbung in der Milchwirtschaft," *Die Milchwissenschaft* 4 (1949): 216–17.

Yet the main reason for the increase in yogurt consumption, aside from war rationing and agricultural policy, was the milk law of 1930, which mandated the pasteurization of milk and, unintentionally, halted traditional home production of curdled milk.[56] Again, we have to recognize the close links between household and commercial production to understand the embedded innovation process. Yogurt consumption increased, not because modern marketing and scientific arguments were persuasive, but because technological changes in milk production brought about the replacement of a common household product. Producers did not discuss this consumer-induced aspect of consumption, nor did business historians, who tended to adopt the perspective of companies. Both scientists and producers presented pasteurization as an important step toward improving hygiene and centralizing milk production. Consumers, on the other hand, had to decide whether to purchase raw milk from small suppliers and risk contracting bovine tuberculosis—more than a third of German cattle were infected during the 1930s—or to buy the more expensive hygienic milk from dairies, even though doing so meant they could no longer make homemade curdled milk as a cheap yogurt substitute.[57] The innovation of yogurt was embedded in this broader framework of technological and scientific change, which halted the old tradition.

After World War II, innovation in yogurt production was renewed. New bacteria were isolated and new products, such as the Bioghurt yogurts, were introduced from publicly financed laboratories, in 1957.[58] But the increasing differentiation of food-consumption patterns restricted the market potential of these products. Not until marketers stopped positioning yogurt as a health food and started projecting the image of a tasty and convenient snack did its success story begin. The "natural" plain variety lost its leading position to fruit yogurt, which became a success in milk bars in the late 1950s; mass consumption of yogurt began in the early 1960s.[59] Yogurt's success could be attributed to a variety of factors: innovative technology; increased concentration of the milk industry; the acquisition of more refrigerators by self-service

[56] Olav Skar, "Die Pasteurisierung der Milch," *Milchwirtschaftliches Zentralblatt* 61 (1932): 173–77, 185–90.

[57] Barbara Orland, "Cow's Milk and Human Disease: Bovine Tuberculosis and the Difficulties Involved in Combating Animal Diseases," *Food & History* 1, no. 1 (2003): 179–202; Hellmuth Niemeyer, "Rohe oder erhitzte Milch?" *Der öffentliche Gesundheitsdienst* 1 (1935/36): Part B, 232–34.

[58] Inold Hans Mainzer, "Verkaufserfolge mit BIOghurt-Schwedenmilch," *Die Molkerei-Zeitung. Welt der Milch* 12 (1958): 1001; Friedrich Wasserfall, "Bioghurt," *Milchwissenschaft* 15 (1960): 383–92.

[59] Wennemar Storck, *Milchmischgetränke und Sauermilchgetränke einschließlich Joghurt und Bioghurt* (Hildesheim, 1959).

shops and homes; advances in nutritional science and policy; and mass distribution by producers and retailers.[60] Household production was no longer an alternative to the commercial manufacture of a product that appealed to consumers' sweet tooth and to their desire for a healthy treat.

In the last two decades, however, health has once again become the main selling point for a new wave of innovative products, led by the temporary success of Nestlé's premium LC1-yogurt in 1995.[61] Food and supplements containing live bacteria or yeasts, called "probiotics," were predominantly purchased by urban, middle-class women, and their scientific origins were promoted, just as they had been before World War I or in the late 1920s.[62] But, in contrast to those earlier schemes, the marketing was now based on detailed research. Although scientific evidence to support the claims of health benefits was thin, the advertising for these products drew from the old dream that eating scientifically based nutritional products could lead to healthy living.[63] Integration of science into their research and development structures became a strategic marketing device for big companies. Still, sales of probiotics did not succeed to the degree that marketing experts expected. Even today, most consumers prefer cheaper conventional yogurt to probiotics, because they do not believe in the health benefits promised by modern science and marketing.[64]

[60] F. Wasserfall, "Sauermilchprodukte und ihre Bedeutung als Nahrungsmittel," *Ernährungs-Umschau* 19 (1972): 155–58; Jan-Benedict E. M. Steenkamp, "A Consumer-Led Approach to Marketing of Foods in the EU: The Case of Yoghurt," in *European Research towards Safer and Better Food* (3rd Karlsruhe Nutrition Forum), ed. V. Gaukel and W. E. L. Spieß (Karlsruhe 1998), 274–83.

[61] LC1 yogurt lost its market leadership in the early 2000s to Danone's Actimel yogurt, and was sold to the German firm Müller-Milch. Today, Germany's €500 million probiotica market is dominated by Danone's brands Actimel and Activia. See Claudia Bär, "Wellness portionsweise," *Lebensmittelzeitung* 9, no. 9 (2007): 42–43.

[62] For detailed information on modern marketing, see Uwe Spiekermann, "Der Markt für Functional Food. Überblick, Bedeutung, Perspektiven," *Internationaler Arbeitskreis für Kulturforschung des Essens. Mitteilungen* 8, no. 8 (2001): 25–36 and "Zwischen Wissenschaft und Alltagskost. Funktionelle Lebensmittel auf dem Prüfstand," *Ernährung/Nutrition* 31, no. 9 (2007): 364–71. For different cultural attitudes cf. ACNielsen, "Functional Food and Organics: A Global ACNielsen Online Survey on Consumer Behavior and Attitudes, November, 2005" (n.p., 2005).

[63] Michael Heasman and Julian Mellentin, eds., *The Functional Foods Revolution: Healthy People, Healthy Profits?* (London, 2001); Franck L. B. Meijboom, "Trust, Food, and Health: Questions of Trust at the Interface between Food and Health," *Journal of Agricultural and Environmental Ethics* 20, no. 3 (2007): 231–45.

[64] Lotte Holm, "Food Health Policies and Ethics: Lay Perspectives on Functional Foods," *Journal of Agricultural and Environmental Ethics* 16, no. 6 (2003): 531–44; Hartmut König, "Verbraucherschutz und Verbrauchereinstellung heute," in *Functional Food—Forschung, Entwicklung und Verbraucherakzeptanz*, ed. Kurt Gedrich, Georg Karg, and Ulrich Oltersdorf (Karlsruhe, 2005), 35–52. In 2003, global sales added up to 0.71 million tons or less than 5 percent of total production. See *Desktop Study into Demand for Dairy Products: Final Report for Daily Supply Chain Forum* (London 2004), 95.

Product Orientation versus Innovative Household Practice

Yogurt illustrates all the elements of embedded innovation: notably, the relevance of cultural context and household production; the quarrel between scientific and practical forms of knowledge; the influence of distribution methods; and the impact of technology at home and in production. The following case study, which covers a different time span and is supported by different details, will further support my broader concept of embedded innovation.

Canned food was not widespread in Germany during the nineteenth century, although a French chef and winemaker, Nicolas Appert, and an English engineer, Bryan Donkin, had disseminated information on preserving food with heat earlier in the century.[65] The first factories were built in the late 1840s, but industrial canning did not begin until the 1870s, and even then it progressed more slowly than in Great Britain and the United States. The late start resulted from peculiarities of the German situation: agriculture made up a relatively large share of the economy; and Germany's population was denser, and its growing industrial centers still largely received their food directly from the countryside.

Two developments shaped the innovation of canned food in Germany. On the one hand, industrial production was tied closely to technological innovation. Basic machines—like seamers, which were pressure- rather than heat-operated, and the autoclave—were introduced in the 1870s and 1880s.[66] Companies were oriented primarily toward production. While entrepreneurs were proud to produce high-quality food, they did not establish brands, norms for standardized quality did not exist, and consumers had to have trust in the producer's good name.[67] On the other hand, industrial production required a commercial infrastructure. Department and chain stores and consumer cooperatives began to build this infrastructure in the early 1890s, and they used

[65] Cf. Ellerbrock *Geschichte der deutschen Nahrungs- und Genußmittelindustrie*, 375–76, although he used the misguiding term "era of canned food"; Uwe Spiekermann, "Zeitensprünge: Lebensmittelkonservierung zwischen Haushalt und Industrie 1880–1940," in *Ernährungskultur im Wandel der Zeiten*, ed. Katalyse e.V. and Buntstift e.V. (Cologne, 1997), 30–42; Martin Humbert, diss., Hamburg, 1997.

[66] For detailed information on technology, see Hermann Flick, "150 Jahre Konservenindustrie: Ein geschichtlicher Überblick über das Wesen und Wachsen der Konservennahrung," *Die industrielle Obst- und Gemüseverwertung* 45 (1960): 86–100; Paul Nehring, "50 Jahre Konservendose—Ein Rückblick und Ausblick," *Die industrielle Obst- und Gemüseverwertung* 50 (1965): 300–5; "120 Jahre Gemüse- und Obstkonserven," *Die industrielle Obst- und Gemüseverwertung* 50 (1965): 241–93.

[67] Such problems were discussed early but without any relevant result. See Friedrich Renk, "Conservirung von Nahrungsmitteln," *Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege* 13 (1881): 36–50.

canned food to symbolize cheap and convenient shopping.[68] Canned vegetables and fruits were sold as generic products, and because labels often failed to identify the producer, shoppers had to trust the retailer's name. The dominating role of retailers in innovation could be attributed to the abundance of small businesses (in 1901, nearly four hundred such firms existed), seasonal production, and the small amount of capital.[69] Retailers often bought a producer's total output, paying for it directly.[70] At the same time, the producers believed in the quality and functionality of their convenient products. They were convinced that canned food was ideal for urban citizens who had no gardens and no time for tasks that had traditionally been carried out in the home. A sharp drop in price, driven primarily by department stores, helped to spread the acceptance of canned foods.[71]

At first glance, canned foods represented a success story. In 1900, nearly one kilogram of canned fruits and vegetables was sold per capita, and, by 1913, consumption had doubled.[72] Technology improved, and a cooperatively financed branch laboratory was founded. Yet German levels of canned-food consumption remained much lower than those in Great Britain and the United States, partly because canned food there had a bad image. It had come to symbolize artificial and unhealthy fare.

To explain why the same commodities are viewed differently in Britain, the United States, and Germany, we must again analyze the differing perceptions of each country's experts and laymen and look at how their industrial practices and home economies varied. The mistrust

[68] See Friedrich Meinecke, *Die volkswirtschaftliche Bedeutung der deutschen Gemüse-Konservenindustrie* (Braunschweig, 1914). Before 1914 canned foodstuffs, especially beans, were affordable for skilled workers, principally. But market range aimed at middle-class consumers. The consumer-cooperatives, as part of the labor movement, did not start their canning plants until the 1920s.

[69] Bruno Hempel, "Deutschlands Konservierungs- und Nahrungsindustrie," *Die Konserven-Industrie* 19 (1932): 231; cf. Franz Stegemann, "Die Konservenindustrie," in *Handbuch der Wirtschaftskunde Deutschlands*, vol. 3 (Leipzig, 1904), 830–44.

[70] Curt Wagner, *Konserven und Konservenindustrie in Deutschland* (Jena, 1907).

[71] The average price for 1 kilogram of canned peas dropped from 2 M in 1872 to 1 M in 1902; for canned beans, from 1 M to 30 Pfg. See Henry Ed. Thoms, "Die volkswirtschaftliche Bedeutung der Obst- und Gemüsekonservenindustrie," *Monatsschrift für Handel und Industrie* 16 (1906): 341. During that period the nominal yearly wages of skilled workers rose from ca. 500 M to ca. 800 M, while real wages increased probably more than 40 percent. See the different calculations in Toni Pierenkemper, "The Standard of Living and Employment in Germany, 1850–1980: An Overview," *Journal of European Economic History* 16, no. 1 (1987): 66. The problems in interpreting such average data are discussed in Uwe Spiekermann, "Die Ernährung städtischer Arbeiter in Baden an der Wende vom 19. zum 20. Jahrhundert. Monotone Einheit oder integrative Vielheit?" *Internationale wissenschaftliche Korrespondenz zur Geschichte der deutschen Arbeiterbewegung* 32, no. 4 (1996): 453–83.

[72] B. H. Barg, "Konservierte Nahrungsmittel," *Zeitschrift für Volksernährung* 13 (1938): 57. Canned meat was less important, mainly after the tariff reform of 1902, which closed the German market to cheaper U.S. imports. Meat dishes were canned either as luxuries or for consumption by the armed forces.

felt by the German public stemmed from the disparities among producers, the generic nature of the products, and the paucity of details on the product labels. After the economic crises of 1901, many companies manipulated the net weights listed on the labels, and they canned lower-quality foods, adding to the public's unease. Product quality dropped, and mistrust continued to grow, even though the majority of producers and retailers fixed quantitative standards. Three consumer fears overshadowed the others: First, there was a growing fear of poisoning. The number of fatalities from eating canned food was comparatively low—there were only three hundred cases in forty years—but newspapers and magazines often reported food scandals related to canning.[73] Second, the preservatives and artificial colors used in canning came to be regarded as a potential risk.[74] After the turn of the century, many of these chemicals were forbidden by law, but they continued to be discussed, fanning fear and suspicion.[75] Third, the public debate over canned food, which had affected consumer perception even before World War I, focused more frequently on doubts about its nutritional value. This debate intensified in the 1920s, when information about vitamins became widespread.[76]

The canning industry did not take these fears seriously.[77] Death and illness rates from contaminated canned food were declining and were lower than the rates for home-produced preserved food. Yet, at home, people could protect themselves by canning carefully, whereas they could not feel secure about purchasing canned foods. Although a small number of fatalities still occurred, their number was shrinking; producers regarded them as an unavoidable outcome of the method of production, but did not see these deaths as a principal problem. Their rational interpretation of the advantages and risks inherent in the division of labor further undermined public trust, as did their insistence on

[73] Examples are Max Schottelius, "Giftige Konserven," *Die Umschau* 10 (1906): 781–85; Dagobert v. Gerhardt-Amyntor, "Warum in meinem Hause keine Konserven gegessen werden," *Blätter für Volksgesundheitspflege* 8 (1908): 33–35; Adolf Reitz, "Konservengifte," *Kosmos* 7 (1910): 21–22.

[74] In 1902 and 1904, many preservatives were forbidden for meat and meat products. See "Technische Begründung des vorstehenden Bundesraths-Beschlusses über gesundheitsschädliche und täuschende Zusätze zu Fleisch und dessen Zubereitungen vom 18. Februar 1902," *Zeitschrift für Untersuchung der Nahrungs- und Genussmittel* 5 (1902): 333–52.

[75] "Die Borsäure im Reichstag," *Zeitschrift für öffentliche Chemie* 9 (1903): 85–89, 105–112, 125–29; Max Schottelius, "Konserven als Volksnahrung," *Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege* 42 (1910): 59–77 (incl. discussion).

[76] Hydor (pseudonym), "Verdorbene Nahrungsmittel, ihre Erkennung und Wirkung," *Der Zeitgeist* 5 (1912): 504–7; "Gefahren in Lebensmitteln," *Blätter für Volksgesundheitspflege* 12 (1912): 20–22.

[77] See Uwe Spiekermann, "Die Normalität des (Lebensmittel-)Skandals. Risikowahrnehmungen und Handlungsfolgen im 20. Jahrhundert," *Hauswirtschaft und Wissenschaft* 52, no. 2 (2004): 61–63.

using cheap, unhealthy preservatives—against even the advice of leading scientists—thereby limiting the market for canned food.[78]

Conversely, home canning was just beginning an astonishing career. To be sure, consumers themselves, not industry, produced home-preserved goods. Nevertheless, industry innovations spurred this development as well. Although home canning began in the 1870s, the introduction of systems like the jar-based Weck system came in the late 1890s.[79] These inventions were consumer oriented and were mainly promoted in small cookbooks, in advice brochures, by direct selling, through testing in schools, and by demonstrations in public halls, rather than through the use of posters and print ads. [80]

Weck, the most successful company, established the canning magazine *Die Frischhaltung* (Maintaining Freshness), which boasted ten thousand subscribers at the height of its popularity. At first, the relatively high price of the equipment limited the practice of canning to middle-class households, but German housewives were proud to own it, and took pride as well in their skills, their homemade food, and their well-stocked pantries.[81] Although home-canned food required standardized, industrially manufactured equipment, it still carried a personal note, allowing German housewives to convey dedication to their husbands and children.[82] During the Weimar Republic, canning became even more important as the urban working classes adopted the new technology. Home preservation outpaced the output of the canning industry.[83] This is astonishing, because during this period, the rate of par-

[78] "Kupferhaltige Konserven," *Deutsche Nahrungsmittel-Rundschau* 2 (1904): 59–61; "Giftige Konserven?" *Deutsche Nahrungsmittel-Rundschau* 9 (1911): 171, 181.

[79] F. Stengele, "Das Eindünsten von Obst und Gemüse nach J. Weck's (verbesserte Dr. Rempel's und Hüffner's) Methode," *Wochenblatt des Landwirthschaftlichen Vereins im Großherzogthum Baden* (1898): 358–59, 380–82.

[80] W. D. Müller, "Aus der Werbegeschichte des Hauses, Weck,'" *Mitteilungen des Vereins Deutscher Reklamefachleute* (1915): 280–82.

[81] The price of Weck's basic standard equipment (pot and jar holder) was ca. 13 M, depending on size and material. A 1 kg. glass jar cost 0.85 M, a rubber band 0.10 M (*Weck Preisliste* Nr. 18 [Öflingen, 1913], s.p.). Hundreds of household advice books and cookbooks reflected and presented home canning as a standard skill of German bourgeois housewives. See Inga Wiedemann, *Herrin im Hause: Durch Koch- und Haushaltsbücher zur bürgerlichen Hausfrau* (Pfaffenweiler, 1993). Over time, Weck diversified the range of products. Smaller equipment sets were offered for as little as 5.10 M, competitors sold even cheaper machines, and—apart from the inflation period—fixed prices steadily reduced the relative costs of home canning.

[82] Bärbel Kuhn, "'. . . und herrschet weise im häuslichen Kreise': Hausfrauenarbeit zwischen Disziplin und Eigensinn," in *Verbrecher, Strafen und soziale Kontrolle: Studien zur historischen Kulturforschung 3*, ed. Richard v. Dülmen (Frankfurt/M., 1990), 238–77, 301–6. Jars and canning machines were durable consumer goods, which one could expect to use for several decades. Only rubber rings and locks needed to be replaced after about six uses.

[83] Although jars were the containers predominantly used for preserving food, more than 50 million cans were also produced in German households in 1930. This was 50 percent of the whole output of the canning industry. See Bruno Hempel, "Immer breitere Basis der Herstellung von Gemüse- und Obstkonserven in Deutschland," *Die Konserven-Industrie* 19 (1932): 56.

Advertisement (1905) for home canning. (Source: *Braunschweigische Landwirtschaftliche Zeitung* 73 [1905]: 83.)

ticipation by German women in the labor force climbed from 30.4 percent in 1907 to 35.6 percent in 1925, reaching 36.1 percent in 1939.[84] Home canning expanded, despite rising opportunity costs. And although real incomes were lower than in Great Britain and the United States, most German households still bought expensive canning equipment. Germans accepted canning but kept their distance from mass-produced canned products.

Leaders of the canning industry analyzed these developments and came up with new products in the 1920s. Improved technology made it possible to produce ready-to-serve foods that simplified the preparation not only of daily servings, but also of meals prepared on weekends and for sporting events. Prepared foods also eased the lives of bachelors. Consumer acceptance grew, but the overall impact was limited.[85]

[84] Angelika Willms, "Grundzüge der Entwicklung der Frauenarbeit von 1880 bis 1980," in Walter Müller, Angelika Willms, and Johann Handl, *Strukturwandel der Frauenarbeit 1880–1980* (Frankfurt/M., 1983), 35. In the prewar and early postwar periods German women's employment rates exceeded those in the U.K. and the U.S.

[85] See H. Saul, "Die Gemüse- und Obstkonservenfabrik der GEG in Stendal," *Konsumgenossenschaftliche Rundschau* 24 (1927): 116–17; Fritz Sierakovsky, "Der Erweiterungsbau der Konservenfabrik der GEG in Stendal," *Konsumgenossenschaftliche Rundschau* 26 (1929): 402–3.

Although bigger companies reorganized their promotions to comply with the recommendations put forth in early marketing theory, the industry was unable to overcome public mistrust and establish strong brands. The companies standardized production and the quality of raw materials, increased vitamin content, and reduced the number of preservatives.[86] Yet even though they communicated these improvements to consumers in advertising campaigns, their sales figures remained disappointing: by 1929, canned-food consumption had only reached the 1913 level—two kilograms per capita per year—one eighth the level attained in America.[87] The early path taken by the canning industry established the frame for its later development. Producers complained about consumers' unwillingness to adopt their goods, and they blamed the industry's failure to embed the innovation processes before World War I for buyers' reluctance. Consumers persisted in regarding inexpensive canned foods as nutritious but not particularly healthy fare, since many items had a high level of saturated fats and were low in complex carbohydrates.[88] They viewed them as appropriate for side dishes, but not for the main meal, which required that only fresh and home-canned products be served. Meanwhile, home canning continued to grow in importance during the 1930s and World War II, reaching its peak in 1941. By then, nearly every German household was using heat preservation: 90 percent stored homemade fruit, and 92 percent stored vegetables. Even in big cities, the figures were high at 93 percent and 73 percent, respectively.[89] The figures for industrially canned goods, however, remained low: only 5 percent of households purchased canned fruit, and 3 percent bought canned vegetables.

Nevertheless, industrial canning made progress in Germany after 1933.[90] This was a result partly of innovative technology, especially in fish canning, and partly of the government's rearmament policy.[91] Enlarging the armed forces pushed canned-goods production as demand for storable foods increased. Yet even the Nazi government was aware of both the unfavorable image of canned food and the foreign-currency problems inherent in importing tinplate. Consequently, the four-year-

[86] "Konservierung und Vitaminzerstörung," *Die Volksernährung* 4 (1929): 252–54; Hans Kirchhof, *Ratgeber für Dosen-Konservierung im Haushalt und Kleinbetrieb* (Braunschweig, 1936).

[87] E. Winkler, "Welchen Umfang nimmt die Konserve in unserer heutigen Ernährung ein?" *Zeitschrift für Ernährung* 1 (1931): 307–12.

[88] "Die Konservengegner," *Die Volksernährung* 5 (1930): 112–13; Heinrich Fincke, "'Gift in der Nahrung,'" *Deutsche Nahrungsmittel-Rundschau* (1931): 112–15.

[89] Data from "Ergebnisse einer Untersuchung über die häusliche Vorratshaltung," *Markt und Verbrauch* 14 (1942): 81 and 72.

[90] "Die Konservenindustrie im Jahre 1937," *Wirtschaft und Statistik* 18 (1938): 595–96.

[91] "Vollkonserven—die Zukunft der deutschen Fischkonserven," *Deutsche Fischerei-Rundschau* (1933): 331–34.

Frozen food, 1940: "fresh," healthy, but not readily available. (Source: Hans Mosolff, ed., *Der Aufbau der deutschen Gefrierindustrie: Handbuch der Tiefkühlwirtschaft* [Hamburg, 1941], 50.)

plan of 1936 incorporated the goal of establishing a new freezing industry. Thirteen large companies produced frozen food, primarily for the German army; brand names were introduced for the new products; and shops with refrigerators distributed them.[92] These products were high in vitamins, contained no preservatives, and produced no poisoning incidents. To be sure, many consumers still did not yet partake of frozen foods, but they did consume them vicariously, reading about them in newspapers and viewing them at the official exhibitions that were mounted in the late 1930s. As a result, the poor image of canned food became fixed in the public mind.[93] In 1938, Germans consumed three kilograms of canned fruits and vegetables per capita, compared to seven kilograms in the United Kingdom and more than twenty kilograms in the United States.[94]

Consequently, the market for canned food in Germany did not change structurally in the 1950s. Consumption increased to nearly nine kilograms per capita per year at the end of the 1950s, but this came about principally because more expensive vegetables, mainly asparagus

[92] Hans Mosolff, "Der Aufbau der deutschen Gefrierindustrie," *Der Vierjahresplan* 5 (1941): 596–600; Eduard Emblik, "Die Bedeutung der Gefrierkonserve in der europäischen Großraumwirtschaft, ihre Herstellung und ihr Transport," *Zeitschrift für die gesamte Kälteindustrie* 50 (1943): 89–93.

[93] Hartmut Berghoff, "Enticement and Deprivation: The Regulation of Consumption in Pre-War Nazi Germany," in *Politics of Consumption: Material Culture and Citizenship in Europe and America*, ed. Martin Daunton and Matthew Hilton (Oxford, 2001), 173.

[94] "Europa als Markt für konservierte Nahrungsmittel. Zusammengestellt von der Firma J.A. Schmalbach," *Die industrielle Obst- und Gemüseverwertung* 43 (1958): 466.

and pickles, were produced in canned form more often, and inexpensive canned tropical fruits, sold by big retailers, were being imported.[95] Although growth rates were remarkable, they remained lower than those that had been reached in Great Britain and the United States decades before.[96] Home canning continued to be widespread, although it began to lose ground in the late 1950s.[97] Even today, more than 40 percent of German households preserve food.[98] The decisive innovation was the market for frozen food, which was launched at the end of the 1950s and rapidly expanded when a chain of cold-storage units was set up and home refrigerators became the norm.[99] Frozen-food consumption overtook Nazi levels in 1961, and in 2007 German citizens bought thirty-eight kilograms of "healthy" frozen food per capita per year.[100] In addition, more innovations sustained the success of frozen food: household equipment was modernized to include freezers and microwaves; and frozen fast food, such as pizza or French fries, was integrated into home-made meals. The German canning industry, meanwhile, was unable to improve the image of canned food and to establish familiar brands. Although general consumption had risen to eleven kilograms of canned vegetables and six kilograms of canned fruit by 2004–05, cheap imported goods now dominate the market.[101]

Summary and Perspectives

The examples of yogurt and canned food demonstrate that a producer-centered approach to innovation ignores important elements of historical change. The two case studies described here illustrate the four aspects of product innovations listed in the first section.

[95] Paul G. Kirsch, "Mehr als eine Milliarde in Konserven: Die Einfuhr macht zu schaffen," *Der Volkswirt* 16 (1962): 2524–26.

[96] See Bärbel Heinecke, *Nahrungs- und Genußmittelindustrie: Strukturelle Probleme und Wachstumschancen* (Berlin, München, 1964), 84–87; Jan Müller, *Entwicklung der Konzentration in der Ernährungsindustrie in der Bundesrepublik Deutschland von 1962 bis 1970*, vol. 2 (Munich, 1973), 6–40; Michael Breitenacher and Uwe Christian Täger, *Ernährungsindustrie. Strukturwandlungen in Produktion und Absatz* (Berlin, 1990).

[97] In 1954, 75 percent of German households preserved food. See Hans Mosolff, J. E. Schwenzer, and E. Andersen, *Marktanalyse über Zucker* (Bonn, 1954), 65.

[98] Ruth Kirchmann, *Einmachen in Deutschland* (Bonn, 2002).

[99] For a comparative view, see Shane Hamilton, "The Economics and Convenience of Modern-Day Living: Frozen Foods and Mass Marketing, 1945–1965," *Business History Review* 77 (Spring 2003), 33–60; David Davies and Alf Charr, *"When It's Time to Make a Choice": Fifty Years of Frozen Food in Britain* (Grantham, 1998).

[100] Original data from http://www.tiefkuehlinstitut.de. On product innovation, compare to Heike Pawlik, *Die Nachfrage nach Tiefkühlkost—Struktur, Bestimmungsgründe und Perspektiven* (Hamburg, Berlin, 1993).

[101] Data from *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* 50 (2006): 217 and 223. The market share of German cans was 12 percent (vegetables) and 33 percent (fruit).

First, consumers did not simply play a retarding role in innovation; they also contributed to the development of new processes. Modern industrial food technologies challenged traditional practices of using residual milk or preserving foods. In the case of yogurt, homemade curdled milk was the main competitor, not other companies. The milk was cheap and easy to prepare, and it constituted an integral component of household economies. When compulsory pasteurization of milk in the 1930s seriously impacted this everyday culture, consumers had little choice but to turn to marketed yogurt products, causing consumption rates to increase. Canned food seemed ideally suited to urban consumers at the end of the 1890s, yet its success remained limited because of its unhealthy image. Consumers chose home canning instead, using the same process of heat sterilization as the commercial manufacturers, but with the ability to control it personally. Scientifically, the quality of such homemade goods has always been worse than industrially produced food. Yet these household products, which required considerable effort to make, conferred a sense of identity and personal responsibility, reinforced social relations, and extended cultural traditions.

Second, the product histories of yogurt and canned food exemplify the ways that the objective rationality of science and economics interacts with the subjective logic of everyday life. Although canned food was rarely contaminated, and was even safer than many other food products, consumers' mistrust was a rational response to potential risks, grounded in observations of the insufficient labeling and awareness that they could not personally determine the products' safety. Since the late nineteenth century, consumers have only gradually, and with a sense of ambivalence, delegated responsibility for food to experts. Frozen food, however, offered consumers more control: it was labeled, its quality was regulated by companies and the state, and it caused no fatalities during the periods of innovation that took place in the late 1930s and 1950s. Moreover, it tasted better than canned food and contained more vitamins. All these factors contributed to its success. Yogurt consumption, on the other hand, rose quickly because it was promoted as beneficial to health. But, after World War II, its healthy image and high price limited its marketability, as consumers found it unpalatable. In the 1960s, the market expanded as sugar and fruit were added, transforming yogurt into a healthy, refreshing, and tasty product. In the 1990s, advocates of probiotics once again began to stress the health benefits of yogurt, but this time without neglecting the subjective perception of taste.

Third, both examples show that retailers were essential for innovation. The lack of cooling equipment in many shops restricted the distribution and consumption of yogurt. In the 1930s, this situation changed

somewhat, but not until the 1960s, when retailers invested in self-service shops with new refrigerators, did yogurt consumption boom. However, brands did not become an important factor for yogurt sales until the 1980s, whereas canned foods adopted brand names as early as the 1890s, enabling department stores to sell store brands as a way of underscoring their low-price image. This functional strategy for canned food delayed the implementation of quality standards, which were needed to allay public mistrust. By the 1920s, when producers became emancipated from retailers, it was too late to change the market structure. In the 1950s, larger retailers spurred the rise of cheap, imported canned goods, while German producers targeted the niche market for high-quality food.

Fourth, both cases demonstrate the interplay of product innovation and technology by companies, retailers, and households. Home-canning equipment offered a homemade alternative to store-bought canned foods. The sale of tens of thousands of home-canning kits, especially in rural areas, caused the German canned food industry to stagnate, and thus to trail behind the United States and Great Britain. The introduction of frozen food changed the situation; yet, in the late 1940s and 1950s, frozen foods could not be produced at the existing capacity, because shops and households did not have enough refrigerators and deep freezers. In the case of yogurt as well, breeders presented a functional alternative to prepared yogurt, because consumers and retailers lacked refrigerators. Finally, the poor sales of acidophilus milk demonstrate the problems of direct technology transfer from laboratory to factory.

In sum, around 1900, innovative small and mid-sized companies normally had little capital and no research capacities, and their knowledge of consumers and the market was limited. During the processes of innovating both yogurt and canned food, the emerging images of these products have carried over even to today's markets. Yet the performance of the products on the German market resulted not so much from entrepreneurs' activities as from the cultural context of consumption and consumers' practices. Consumers did not merely passively accept or reject new products coming off the production line; they selected alternatives to market offerings on the basis of their own household resources and practical skills.

These case studies show us that while competition is a constant process of discovery, consumers' input is also an integral component of the consumer–producer interaction and product innovation. Product- and company-centered studies neglect this interaction, often underestimating the relevance of market participants who are more familiar with consumers' practical needs than the celebrated inventors, and thus

are able to devise functional alternatives that fit better into household culture.

Over time, the influence of home technologies waned, giving way to the influence of retailers. Yet the arrival of these later players on the scene also illustrates that analysis of innovation must include the knowledgeable agents who are familiar with the culture. Moreover, any analysis must integrate the technology of firms, supply chains, and households, which is often as decisive as the products themselves in determining market success. Understanding how product innovations are embedded in a specific culture of consumption presents challenges for business historians, who must track down sources, set their own boundaries, and broaden their theoretical framework. But such research helps to connect the often separate perspectives of business, consumer, and cultural history, yielding a more complex and realistic appreciation of how innovation takes place.