World War II and the Quest for Time-Insensitive Foods

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*by Deborah Fitzgerald**

ABSTRACT

When one walks around the local supermarket, one is often struck by the proportion of highly processed foods, or what some refer to as "the middle of the store." Yet to the military in the 1940s and 1950s, these same foods represented the apogee of scientific progress—the creation of time-insensitive foods suitable for the rigors of military combat. This article explores the social and technical development of a system for producing such things for the military in World War II, including the collaborations between the military, American food firms, and university scientists. While at the beginning of the war, military and civilian food systems were quite different, by the early 1950s the two systems had effectively merged. Thanks to the supercharged food research agenda of this period, focused on achieving maximum time insensitivity in military foods, Americans can now quite easily avoid eating time-sensitive foods entirely. Here I will explore the professional networks that made this possible in the mid-1940s, as well as the challenges of standardizing something as alive as fresh food.

> The serviceman—whether he is a soldier, sailor, or airman—is a unique type of consumer.[1]
>
> Food research is defense activity.[2]

On the morning of October 10, 1956, representatives of the leading American shrimp processors sat down with representatives of the Quartermaster Corps of the United States Army (QMC) to discuss alterations to the military ration. Several weeks later, business leaders of the QMC Committee on Vitamins and the Committee on Fat Spreads traveled to Chicago for their own meetings with Col. John D. Peterman, commandant of the Quartermaster Corps Food and Container Institute (QC F&CI); they were eager to be of service to their country and to cultivate long-term relationships with the federal government. Throughout World War II and the Korean War, the QMC organized commercial firms to advise its efforts in making military rations. Over the years, it worked very closely with several hundred firms whose business needed to be attuned not only to the latest consumption trends, or innovations in food science

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[1] J. D. Peterman, "Motivations for Department of Defense Research on Rations," *Food Technology* 10 (1956): 512.

[2] Editorial, *Food Technology* 1 (1947): 113.

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and technology, but to the peculiar needs of the military.[3] There was nothing unusual about such meetings. On the contrary, scientists and commercial firms had collaborated with military leaders for many years, so intertwined were their interests. In the early nineteenth century, Nicholas Appert developed a method of food preservation by thermal sterilization expressly for the French Navy. Similarly, Gail Borden developed condensed canned milk during the American Civil War, in part because of the dangerously common phenomena of problems related to milk contamination. Yet World War II differed from these examples in scale and scope, and ultimately led to an important and unprecedented convergence of military and civilian markets in the United States.[4]

Within the history of science, World War II has been seen primarily as an occasion for vastly increased funding for scientific research as well as the growing prestige and importance of scientists in setting an agenda—not only for their academic fields, but in many ways for the state itself. The urgent demands of the military—for up-to-date weaponry, ships, and sensing technologies, and for greatly expanded educational opportunities for military personnel—have immediately increased the pace of scientific and technological change throughout history. Yet, with few exceptions, historians have rarely explored how wars have provoked the food provisioning systems to produce more, and faster, to feed both the military and civilians during wartime.[5] While the food provisioning system is more mundane, and more offscreen, than most of the other scientific innovations that war has generated, its importance is hard to exaggerate. Why? For two reasons. First, wartimes have given the state unlimited power to commandeer the food supply, both the raw material farmers produce and the processed foods developed by industry. Deciding what gets grown, raised, treated, and made palatable for the military and civilians alike, has been a central concern of the state. Second, as with so many wartime innovations and "make-dos," those established in wartime provisioning have had a tendency to persist after the war. Arrangements made to accommodate the military were often simply applied to the civilian world when the war ended. In this, the American provisioning practices during World War II greatly accelerated the transition to a national, highly standardized food system that blurred the line between intense and emergency feeding under military conditions, and ordinary dining practices among civilians.[6]

[3] For shrimp processors, see folder "Minutes of the meeting of the Industry Advisory Committee on frozen breaded shrimp," 10 October 1956, 5–6, A. Stuart Hunter to Quartermaster General, 23 October 1956, and Hunter to Quartermaster General, 1 November 1956. On fat spreads, see A. W. Harvey to Quartermaster General, 29 November 1956. All preceding in Record Group (RG) 544 (Natick Laboratories Research and Development, Administrative), box 4, National Archives, College Park, Maryland (**hereafter** cited as NACPM). The best study of this subject is Kellen Backer, "World War II and the Triumph of Industrialized Food" (PhD diss., Univ. of Wisconsin, Madison, 2012).

[4] Stuart Thorne, *The History of Food Preservation* (Totowa, N.J.: Barnes and Noble, 1986), 28–42; Sue Shephard, *Pickled, Potted, and Canned: How the Art and Science of Food Processing Changed the World* (London: Headline, 2000).

[5] Important exceptions include Lizzie Collingham, *A Taste of War: World War II and the Battle for Food* (London: Allen Lane, 2011); Ina Zweiniger-Bargielowska, Rachel Duffet, and Alain Drouard, eds., *Food and War in 20th Century Europe* (London: Ashgate, 2011); Helen Zoe Veit, *Modern Food, Moral Food: Self-Control, Science, and the Rise of Modern American Eating in the Early Twentieth Century* (Chapel Hill: Univ. of North Carolina Press, 2013); Amy Bentley, *Eating for Victory: Food Rationing and the Politics of Domesticity* (Urbana: Univ. of Illinois Press, 1998); and Harvey Levenstein, *The Paradox of Plenty: A Social History of Eating in Modern America* (New York, N.Y.: Oxford Univ. Press, 1993).

[6] On the issues raised by the industrialization of food, see Gabriella Petrick, "'Like Ribbons of Green and Gold': Industrializing Lettuce and the Quest for Quality in the Salinas Valley, 1920-1965," *Agr. Hist.* 80 (2006): 269–95; Karin Zachmann and Per Ostby, "Food, Technology, and Trust: An Introduction," *Hist. & Tech.* 27 (2011): 1–10; and Roger Horowitz, *Putting Meat on the American Table: Taste, Technology, Transformation* (Baltimore: Johns Hopkins Univ. Press, 2006).

The very idea of standardizing food is, of course, slightly odd. Standardizing objects, like utensils, or shoes, or guns, was exceedingly difficult to accomplish in the nineteenth century, even with the help of scientists and mechanicians. A spoon that had been standardized for scaled-up production might not have seemed vastly different than a spoon made by the local metalsmith. Food that was standardized was typically an entirely different substance. What has given food its unique place in our day-to-day lives are its sensual characteristics—the sweet juiciness of a ripe plum, the smelly creaminess of aged cheese, the snappiness of fresh green beans, the earthy dampness of mushrooms, or the deep umami of beef stew. The smell, taste, texture, and even the sound of plants and animals, seem the very essence of our experience in eating and drinking. And yet, to a nation at war, the sensual pleasures of food fall way down the list of priorities in procuring food for millions of soldiers all over the world, for years on end. Indeed, this very aliveness of fresh and ripe food was the enemy of wartime provisioning, and the food industry worked hard with the military to arrest the development of foods, to make them inert and insensitive to the passage of time.[7] It is impossible to overstate the importance of time insensitivity to military concerns. Time-insensitive foods could sit in a warehouse until needed by the military; could be produced whenever the cost of the ingredients was low; and could be planned and requisitioned far in advance, avoiding last-minute deployment issues. Time-insensitive foods enabled the military to prepare for future wars far in advance, creating an ever-ready economy in at least this single respect.[8]

Here I propose to explore how military needs for provisions with this unique quality of time insensitivity were met by intense collaboration between the military and scientists in the food industry and academy during and after World War II. The process was not smooth, and the goals were not always entirely clear in the fast-moving wartime environment. But by war's end, new techniques and products were being introduced at a rapid clip. Further, by effectively merging the military and civilian food markets, time insensitivity became the key feature in standardizing food, and describes a huge percentage of what Americans eat today.[9]

THE QUARTERMASTER CORPS AND FOOD RESEARCH

Since the creation of the Continental army in 1775, the office of the QMC of the United States Army had been in charge of acquiring all the materials needed by military

[7] Susanne Friedberg, *Fresh: A Perishable History* (Cambridge, Mass: Harvard Univ. Press, 2009); Steven Stoll, *The Fruits of Natural Advantage: Making the Industrial Countryside in California* (Berkeley and Los Angeles: Univ. of California Press, 1998). There are several excellent studies of the history of food and the senses; see Christy Spackman, "Perfumer, Chemist, Machine: Gas Chromatography and the Industrial Search to 'Improve' Flavor," *Senses and Society* 13 (2018): 41–59; Nadia Berenstein, "Designing Flavors for Mass Consumption," *Senses and Society* 13 (2018): 19–40; Sarah E. Tracy, "Delicious Molecules: Big Food Science, the Chemosenses, and Umami," *Senses and Society* 13 (2018): 89–107; and Gabriela Petrick, "Tasting History," in *Nutrition and Sensation*, ed. Alan R. Hersch (Boca Raton, Fla.: CRC/Taylor and Francis Group, 2015): 1–22. Steven Shapin's study of the tension between objective and subjective measures of a wine's "goodness" is very helpful here; see Shapin, "A Taste of Science: Making the Subjective Objective in the California Wine World," *Soc. Stud. Sci.* 46 (2016): 436–60.

[8] John C. Fisher and Carol Fisher, *Food in the American Military–A History* (Jefferson, N.C.: McFarland, 2014).

[9] The pace of innovation, particularly in chemicals, new materials, and new mechanical processes, increased markedly during and after the war. See, as examples, trade press publications that listed sections titled "New Packages and Products" and "Patents" in *Food Industries* 13 (1941): 79–81, 112–17; and "Food Patents" in *Food Technology* 18 (1964): 56–9.

personnel. During World War II, it had to figure out how to purchase and transport in a timely manner all the uniforms, mess kitchens, boots, vehicles, spare parts, bedding, medicines, tools and machines, and food that the military needed, on bases as well as in the field, in twenty-three theaters of battle, for the duration of the war. This scale of operations, and the length and number of supply lines, had never been tackled before by the United States, and the food part of this effort alone was extremely complex. The QMC Subsistence Research Laboratory in Chicago was the hub of all food-related activity. Created in 1936 with three people, the lab was "authorized to test foods and design modern packaging of foods; to prepare drafts of proposed specifications and modify those which became obsolete; to conduct studies and make analyses of various reserve and emergency rations or components thereof; to prepare informative bulletins and maintain liaison with other government agencies."[10] As the war progressed, the lab ballooned in size and importance. Supported by a large staff of nutritionists, bacteriologists, chemists, and other scientific advisors, the lab developed the recipes for military rations, worked with industry on designing appropriate packaging, consulted with the surgeon general regarding what to include or avoid in the rations, figured out what to put in the various ration packages, solicited bids from firms that could produce the chile or coffee or caramels in the rations, contracted with each of these firms, took delivery of all the components, assembled the ration packages, and delivered them to military bases all over the world. In 1946, the lab was combined with the packaging part of the operation, and the whole thing was called the QMC Food and Container Institute (QMC F&CI).[11]

During World War II, the QMC committed itself to the unprecedented effort of feeding all the American troops no matter where on earth their service took them. This was not a small thing; over the course of the war, sixteen million people served in the American military. All soldiers in the field and those on base consumed primarily foods made and packaged in the United States. While the bases tried to provide fresh foods, combat soldiers lived on food that was entirely processed to withstand rough conditions. The ration names said it all—"Ration, frigid, high altitude" or "Ration, tropical," thereby describing not only the places American soldiers found themselves, but also hinting at the qualities that the rations required to maintain their edibility. Rations had to be acceptable in flavor, with the right texture and balance. They had to be free from rancidity, mold, and insect damage, and in packaging that had not been crushed due to a helicopter drop. They had to have not been rusted open due to landing on a beach; or broken due to poor metal seams, loose cardboard, or any number of other assaults; they had to be nutritious; and soldiers had to like them enough to eat them again and again. Thus, the food provisioners and the QMC had to consider not only the edibility and safety of the food, but also the security of the packaging, as they worked to keep the soldiers in fighting trim.[12]

By 1942, the QMC had assembled an extraordinary group of scientific advisors, corporate leaders in the food and packaging industries, engineers, chemists, and dietitians, in addition to farmers, packers, growers, and transportation experts, all of

[10] Fisher and Fisher, *Food in the American Military* (cit. n. 8), 181; C. O. Ball, "Scientists Will Run the Farms," *Food Technology* 1 (1947): 503.

[11] Fisher and Fisher, *Food in the American Military* (cit. n. 8); Roland F. Hartman, "Quartermaster Subsistence Training Keeps Pace with Food Industry Advances," *Food Technology* 10 (1956): 509–10.

[12] Fisher and Fisher, *Food in the American Military* (cit. n. 8), 148–80.

whom worked on provisioning problems small and large. As Merritt Roe Smith famously argued in describing the development of interchangeable parts manufacturing during the American Civil War, governments will pay any price to secure whatever is needed to prevail in war, and during World War II, food was one of those things. Indeed, the wartime food provisioning system was itself an urgent, very large-scale, and broad-based effort notable for corralling and managing impressive scientific and engineering expertise, and it profoundly shaped postwar developments in the university and commercial sectors. Like the better-known Manhattan Project, the food provisioning work was likewise invisible to the citizenry, shuttered away in a diffuse but massive collection of university labs, packing plants, canneries, packaging companies, fruit farms, and hatcheries.[13]

The newly named QMC F&CI represented very important institutional arrangements for both the war effort and the future of food. During World War I, the military had started collaborating with the food industry to develop rations, and began contracting with university science and engineering departments as well, "because . . . the demands for foods in enormous quantities for the millions of soldiers, greatly increased the interest and the actual demand for manufactured or treated foods."[14] Indeed, the war encouraged strong collaborations between the government and outside laboratories, not only to create new foods that could be mass produced, but also to develop new techniques that would ensure the "keeping quality" of highly processed new foods.

At the beginning of the war, the QMC built on the experiences of World War I, striving to ship field rations that were familiar, filling, and likely to be eaten by soldiers. Several different functional rations were developed. The field ration A was a field-prepared meal using fresh meats and vegetables. Ration B consisted entirely of canned and dehydrated foods; these were standard, commercially available foods that were adapted to the military. The C ration (C for combat) was the most ubiquitous ration, consisting of three meat (M) units and three bread (B) units, all packed in round twelve-ounce cans. The menu was bland overall. Chile con carne, ham and beans, beef and vegetable stew—the ration consisted of some kind of stew, crackers, juice powder, coffee powder, candy, canned fruit, crackers, and jam. In 1943, accessory packets containing cigarettes, gum, halazone water purification tablets, toilet paper, and a can opener were included.[15]

There were also a number of special rations designed to be used under particular circumstances. Meat bars, developed in 1942 and styled after pemmican, were made of dehydrated and compressed meat, something like a cold hamburger bar. They were intended for use in Arctic regions, developed by the United States Department of Agriculture and commercial firms, and tested in Alaska. While a success in terms of flavor, compactness, and ease of preparation, they failed in keeping quality. Emergency ration D, which was a fortified chocolate bar, typically made people sick with nausea and headaches, partly because it looked like a regular candy bar but had far more calories and bulk. Nonetheless, Pan Am Airlines expressed great interest in purchasing D bars as

[13] Merritt Roe Smith, *Harpers Ferry Armory and the New Technology: The Challenge of Change*, rev. ed. (1977; Ithaca, N.Y.: Cornell Univ. Press, 1980). On the Manhattan Project, see especially Daniel Kevles, *The Physicists* (New York: Knopf, 1977).

[14] Samuel C. Prescott, "Beginnings of the History of the Institute of Food Technologists," *Food Technology* 4 (1950): 305–7.

[15] Fisher and Fisher, *Food in the American Military* (cit. n. 8), 148–9.

an emergency food. The QMC also thought this was a great idea and suggested that they contact Hershey, Nestle, and other manufacturers for further information. The K ration was a flat package designed for soldiers in action, such as paratroopers, and was used from 1942 to 1946; the Mountain ration and Jungle ration, which were designed for small groups of soldiers in unusual conditions, were only used in 1942 and 1943; and the 5-in-1 ration, designed for groups of soldiers driving through the desert, was used only for a few years. More specialized rations were also developed, including the Assault lunch and the Aircrew lunch (mostly candy since "during the initial 6 to 8 hour period in combat the soldier is emotionally upset, and does not desire nor have the time to eat."); Army Air Force Combat lunch; Parachute Emergency ration; and a hospital supplement ration. A Life-raft ration was developed in 1944, which consisted of mostly sweets, and was tested on various groups of POWs and conscientious objectors who were located either on a small island or on an actual life raft floating around the Gulf of Mexico. Despite these many special ration categories, the contents of all rations shared one central characteristic. They included only foods that were highly processed, both to withstand the passage of time and to deliver nutritional requirements.[16]

In many ways, submarines offered the biggest challenge to the QMC, given the close quarters and infrequent resupplies. Submarine kitchens were 6 by 9 feet, and were meant to keep provisions to feed 60 to 80 men for up to 75 days. Here is how one author described the challenge: "The food technologist makes his contribution to the submariner by removing the waste, peel, rind, skin, shell, water, grounds, bone, cores, pits, stems, pods, and unusable fat. He compresses the food into less space; molds it into a square storage space-saving shape, packages it in the best packaging material, reduces storage by chemical dips, irradiation, ultra-violet treatment, ozone, anti-ripening agents, anti-sprouting agents, and establishment of optimum storage temperatures and humidity." Submarines were an ideal test for new products and processes that could not be tried in the civilian market without considerable caution.[17]

The QMC also studied carefully the rations carried by soldiers from other countries. The French ration was considered very appealing, with chocolate, pate, soft cheese, strong coffee, and Gaulois cigarettes. In designing parachute rations, the QMC consulted with the former military attaché to Germany and Great Britain for guidance on making a lightweight but substantial package. The Norwegian rations, which included barley broth, blueberry soup, and porridge, were considered inappropriate

[16] On the Meat bar, see "Project Abstract, Deterioration in Dehydrated Pork," 20 July 1953, RG 92, entry 1003 (A-303-University of Missouri, External Research and Development Technical Reports), box 111, NACPM. The best historical account of pemmican is George Colpitt, *Pemmican Empire: Food, Trade, and the Last Bison Hunts in the North American Plains, 1780-1882* (New York, N.Y.: Cambridge Univ. Press, 2015). On the D bar, see "Results of Tests of Ration D on 100 Medical Students," 6 February 1942, RG 92, entry 1003 (Combat rations, WW II and Korea), box 70, NACPM; as one observer commented, "an improperly anchored tooth may be broken off once in a while when the D Bar is eaten." See Captain Louis A. Wright to J. H. Daugherty, 27 August 1943, RG 92, entry 1003 (Combat rations, WW II and Korea), box 71, NACPM. On Pan Am, see Purchasing Mgr., Pan Am to QM Subsistence R&D Labs, 1 February 1946; and Lt. Robert P. McLevitt to Purchasing Mgr, 8 February 1946; both in RG 92, entry 1003 (Combat Rations WW II and Korea), box 71, NACPM. On the Assault lunch, see "Proposal of Experimental Food Packet for Combat Personnel," February 1951, RG 92, entry 1003 (Combat rations, WW II and Korea), box 66, NACPM. On the Life-raft ration, see, as examples, Maurice E. Shils to William M. Fosdick, 21 October 1944; and Rohland Isker to Col. Louis F Kosch, 29 November 1944; both in RG 92, entry 1003 (Quartermaster Food and Container Institute Bulletins, Conference Files), box 2, NACPM.

[17] Arthur C. Avery, "More Miles Per Pound of Food," *Food Technology* 9 (1955): 533–5.

for American soldiers; the Turkish ration was considered far too spicy. But everyone admired the embossed cookies in a beautiful container, "like Lorna Doones," that were included in the Russian ration.[18]

Although the rations must have seemed cruelly unchanging to soldiers at the time, they were in fact frequently redesigned to accommodate soldiers' complaints and the unpredictable availability of both food and packaging materials. The QM constantly solicited feedback from the troops, and might have been chagrined by the repeated pushback from soldiers. One report from the Southwest Pacific in late 1944 offered scathing ratings for the meat and vegetable stew, corned beef hash, and dehydrated eggs, which soldiers called "slum rations." Canned vegetables were well liked—"they taste like home." Biscuits were very unpopular, and mess sergeants pleaded, "give us the components for baking our own bread!" Soldiers wanted more spaghetti and macaroni, a big surprise to the mess sergeant, as well as more peanut butter. Complaints were made of too much bully beef, and not enough cheese and chicken. Spam tended to be popular, unless it had spoiled in the can. "Lemon drink" was called battery acid by soldiers. In some areas of combat, these rations were served by the cooks on the bases, and they were repackaged in various ways. "Meat and Vegetable Stew can be improved by making a pie of it, but few cooks go to this trouble," one staffer reported. "Beef and gravy and pork and gravy are relatively new items hence popular. Few cooks take the trouble of taking off the large quantity of grease which will probably soon make these unpopular as well." Another said, "spaghetti is an old favorite and standby." One way to understand what soldiers did not like was to track what was left in inventory; according to this metric, corned beef and corned beef hash were loathed, and in some cases, as in Luzon (Philippines), accumulated to nearly one million pounds.[19]

What is especially intriguing about these arguments regarding rations is what they tell us about the military's assumptions about "standard" American eating habits. By the 1940s, distinct ethnic and regional food traditions were deeply ingrained, and proliferated all across the country. Especially before the interstate highway system and television linked people across regions, specific culinary traditions were locally supported with specialty grocery stores, restaurants, and community gatherings. The notion that there was a universal or standard American diet was, as food historians have demonstrated, a convenient myth, especially for those in charge of feeding masses of people at low cost. To some degree, American this included food norms became what the sixteen million military personnel ate during the war; food that, like Spam, was appreciated years later not only as a food item, but as one that marked a time of extraordinary challenge and emotional cost.[20]

[18] "Foreign rations, 1952" photograph, RG 92, entry 1003 (Combat rations, WW II and Korea), box 74, NACPM; Lt. Col. Paul P. I. Logan to Lt. Col. Rohland Isker, 2 June 1941, RG 92, entry 1003 (Combat rations, WW II and Korea), box. 61, NACPM; "Captured Foreign Food Items," QMC to Intelligence Branch, 26 August 1952, RG 92, entry 1003 (Combat rations, WW II and Korea), box 74, NACPM.

[19] On slum rations, see Lt. Col. D. B. Dill, "Report on Observations in Southwest Pacific and Pacific Ocean Areas, Oct.–Dec. 1944," RG 92, entry 1003 (Combat rations, WW II and Korea), box 58, p. 3, NACPM; on bread baking, see p. 6 of preceding report; on lemon juice see p. 21 of preceding report. On meat and vegetable stew, see Capt. Leo G. Voss to Capt. William R. Junk, 26 September 1945, RG 92, entry 1003 (Combat rations, WW II and Korea), box 59, p. 2, NACPM; on spaghetti, see Voss to Junk (preceding letter), p. 6.

[20] See especially Sidney Mintz, *Tasting Food, Tasting Freedom: Excursions into Eating, Power, and the Past* (Boston: Beacon, 1997); and Donna Gabaccia, *We Are What We Eat: Ethnic Food and the Making of Americans* (Cambridge, Mass.: Harvard Univ. Press, 2000).

One might also note that the QMC's yardstick for ration quality was likely quite different from that of the soldiers' themselves, and in two ways. First, as William Cronon has shown, Chicago was in the absolute center of the food industry. It was home to the largest concentration of grain, meat, and dairy concerns, as well as the stockyards, boards of trade, farming organizations, and longtime food processors and manufacturers. Here the QMC could easily take account of the raw materials needed to feed the military, and was able to meet the basic nutritional requirements of soldiers especially. Food that was fancy, unusual, or not easily mass produced was not very appealing to this operation. And second, we might consider how great food should be, how deliciously distracting, given the grisly business of war. As scholars have pointed out, the moral imperatives of "goodness" in nutritional advice, and the ambivalence people have long had about how "good food" should be either pleasurable or nutritious, but probably not both simultaneously, may have led the QMC to embrace a bland food regimen for the military.[21]

FOOD SCIENCE AND UNIVERSITIES

College programs in food science and technology were not new in World War II. In 1930, there were five such programs, but the numbers grew rapidly over the next two decades, and by 1950 there were about thirty departments. Most of them were located in the land-grant universities that had large departments of agriculture, science, and engineering, as well as in departments of home economics and nutrition. This concentration of specialties created an especially rich environment for training students in both traditional fields, as well as in more experimental, science-based techniques of food production and preservation. These were also perfect sites of recruitment for the expanding food industry, which had a nearly insatiable need for young, technically proficient graduates. And indeed, the relationship between the food industries and academic food science and technology departments was intimate from the beginning. At the Illinois Institute of Technology, for example, the Food Engineering program was in the Chemical Engineering department, and it had an advisory council comprised of representatives from leading food industries, including General Mills, American Can Company, Armour, Kroger, Beatrice Foods, Kraft Foods, General Foods, and so forth. Their goal was explicitly to "best serve the food industries."[22]

This activity closely mirrored the experience of other scientific and engineering disciplines that partnered with industry. Professors and administrators found such an arrangement appealing because it offered hands-on educational opportunities, greatly assisted departments in placing their graduates in industrial positions, and frequently created a new income stream for the university. At the Massachusetts Institute of Technology, Professor Samuel Prescott organized an academic program in food technology

[21] William Cronon, *Nature's Metropolis: Chicago and the Great* West (New York, N.Y.: W. W. Norton, 1992). On the morality of food see John Coveney, *Food, Morals, and Meaning: The Pleasure and Anxiety of Eating* (London: Routledge, 2006); Veit, *Modern Food, Moral Food* (cit. n. 5); and Gabriella Petrick, "'Purity as Life': H. J. Heinz, Religious Sentiment, and the Beginning of the Industrial Diet," *Hist. & Tech.* 27 (2011): 37–64.

[22] H. W. Schultz, "Educating Our Food Scientists and Technologists," *Food Technology* 18 (1964): 49–52; for a list of academic programs, see Editorial, *Food Technology* 1 (1947): 300; on Illinois Tech, see J. H. Rushton and M. E. Parker, "A Course of Study for Engineers for the Food Industry," *Food Technology* 4 (1950): 223–5.

and, in 1937, held a conference at MIT on the subject. The organizers hoped to attract about sixty people, and ended up with five hundred, an indication of the growing importance of and the opportunity presented by the new food sciences and technologies. In June 1939, the Institute of Food Technologists was established; in 1947, the trade journal *Food Technology* made its debut. Clearly, the war served to more closely align the interests of industry, the military, and university-based science and engineering.[23]

In both university and corporate food labs, scientists zeroed in on a set of processes and techniques that built time insensitivity into the foods themselves. One major effort underway at MIT concerned the irradiation of meats and vegetables. Getting fresh meats and vegetables to the war zones was expensive, as well as being an inherently inefficient use of shipping space, and was doomed to result in a great deal of loss from spoilage. One of the QMC's big priorities was finding a way to circumvent these problems with new preservation methods. Drying and dehydration were obvious and proven methods, but soldiers did not like most of the dried foods they were fed, and if they would not eat them, there was little point in sending them. Irradiation seemed like a very promising technology because when irradiated, food stopped aging for a long period of time, and, even without refrigeration, stayed "fresh." This was a very appealing solution for provisioning submarine kitchens, which were extremely small and lacking in much refrigerator space. Ultimately, irradiation was deemed a bust because it left an aftertaste in the food that was unpleasant and impossible to mask, even in bacon.[24]

Scientists were keenly aware, of course, that natural ingredients—butter, milk, whole wheat flour, cheddar cheese—were not time insensitive. They became rancid, lost their texture, separated, and underwent other unappetizing processes. As a result, food scientists increasingly looked toward both taking things out of natural food (e.g., removing fats from dairy and wheat germ from wheat to prevent rancidity), and putting things into natural food (e.g., stabilizers to keep things from separating). During the 1940s, a significant industrial capacity to meet these challenges grew in the form of chemical companies that produced food additives, either specifically for the food industry, or as an offshoot of other chemical work. Allied Chemical and Dye, for example, was a major producer of aniline, important in making dyes, photographic chemicals, and chemicals related to rubber, but a small part of the company focused

[23] It is very striking how much these food collaborations resembled those in physics and engineering. See David Kaiser, ed., *Becoming MIT: Moments of Decision* (Cambridge, Mass: MIT Press, 2012); and David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York, N.Y.: Knopf, 1977). There has not been a great deal of research on how dietitians, nutritionists, and other home economists might have been hired by these large food and packaging companies, but see Carolyn M. Goldstein, *Creating Consumers: Home Economics in Twentieth-Century America* (Chapel Hill: Univ. of North Carolina Press, 2012); Sarah Stage and Virginia B. Vincenti, eds., *Rethinking Home Economics: Women and the History of a Profession* (Ithaca, N.Y.: Cornell Univ. Press, 1997); Uwe Spiekermann, "Redefining Food: The Standardization of Products and Production in Europe and The United States, 1880-1914," *Hist. & Tech.* 27 (2011): 11–36; Amy Sue Bix, "Equipped for Life: Gendered Technical Training and Consumerism in Home Economics, 1920-1980," *Tech. & Cult.* 43 (2002): 728–54; and Sally Horrocks, "A Promising Pioneer Profession: Women in Industrial Chemistry in Interwar Britain," *Brit. J. Hist. Sci.* 33 (2000): 351–67.

[24] Nicholas Buchanan, "The Atomic Meal: The Cold War and Irradiated Foods, 1945-1963," *Hist. & Tech.* 21 (2005): 221–49; Karin Zachmann, "Atoms for Peace and Radiation for Safety: How to Build Trust in Irradiated Foods in Cold War Europe and Beyond," *Hist. & Tech.* 27 (2011): 65–90; Stuart Thorne, ed., *Food Irradiation* (Barking, UK: Elsevier Applied Science, 1991); Walter M. Urbain, *Food Irradiation* (Orlando, Fla.: Academic, 1986).

on making food dyes. Florasynth Laboratories made flavorings, aromatic chemicals, essential oils, and perfume compounds for the cosmetics, soap, and pharmaceutical companies, as well as for the food industry. The overlapping of processes and products for the food industry and the chemical industry only increased during and after the war; highly processed foods needed a lot of work to make them taste either "natural" or even "scientifically delicious"—that is, utterly fake but oddly addictive, like Cheetos.[25]

One of the most important additives used during the war was vitamins. The QMC tried hard to ensure that the rations were sufficient in calories and nutritional value and, given soldiers' constant need for strength and stamina, was inclined to use food as a vehicle for vitamins and other additives deemed important. Natural foods alone were seen as insufficient for general health, largely because those who worried about such things, like the QMC, or the surgeon general, could not control which natural foods people actually ate. With the rise of highly processed foods in the 1950s and 1960s, which often replaced natural foods, this problem became even more urgent. Soldiers in the field were known to throw canned food away, so the QMC used every means available to put vitamins and other nutritional elements in everything soldiers ate. So-called enriched foods could in this way deliver the nutrition that would otherwise be lost. One scientist pointed to the elimination of pellagra in the American South in the late 1930s by the compulsory addition of niacin to grits and cornmeal, which seemed like an important lesson in public health.[26] But there was no guarantee that this technique would work. The QMC developed a synthetic lemon powder meant to taste like lemonade in the rations, and its purpose was to give the soldier vitamin C. Many reported, however, that it was usually thrown away. The difficulty of getting soldiers to take nutrition seriously was a constant challenge, and Dr. Russell M. Wilder, chair of the Food and Nutrition Board of the National Research Council, which advised the QMC, commented that "what is needed . . . is insurance of the vitamin adequacy of the staple foods so that diets, no matter how carelessly chosen, will be fool-proof." Giving soldiers tablets of, say, iodized salt, was not likely to work because "a soldier of average intelligence" would think that "there is no use taking medicine because I am not sick." This was evidently what happened when trying to give soldiers quinine while serving in the tropics. If the additive was a stand-alone item not mixed into the food, and looked like medicine, it would be thrown away. And indeed, this is how manufacturers looked at it also. In trying to sell the QMC on a fortified biscuit for a ration, Quaker Oats noted that the cost of these biscuits might be a little higher than usual, but "such a product falls almost into the category of pharmaceuticals."[27]

[25] Allied Chemical and Dye Corporation, 35th Annual Report (1954), Wilmington Trust Co. Papers, Acc. 2118, box 1, p. 21, Hagley Museum and Library, Wilmington, Delaware (**hereafter** cited as WTCP). On Florasynth, see *Food Technology* 9 (1955): 44.

[26] Daphne A. Roe, *A Plague of Corn: The Social History of Pellagra* (Ithaca, N.Y.: Cornell Univ. Press, 1973).

[27] H. W. Bruins, "Protein-rich Foods for Overcoming Nutritional Deficiencies: The Industrial Viewpoint," *Food Technology* 18 (1964): 51–3. On lemon powder, see Brig. Gen. Georges F. Doriot to Surgeon General, 7 April 1945, RG 92, entry 1003 (Combat rations, WW II and Korea), box 62, NACPM. On vitamins, see Russell M. Wilder to National Research Council (NRC) Subcommittee on Nutrition, 17 September 1940, RG 92, entry 1003 (Combat rations, WWII and Korea), box 60, NACPM. On using salt tablets, see Lt. Col. Rohland A. Isker to Dr. Russell M. Wilder, 7 November 1940; on Quaker Oats see W. G. Mason to Quartermaster, 24 September 1940; both in RG 92, entry 1003 (Combat rations, WWII and Korea), box 60, NACPM. See also Rima Appel, *Vitamania: Vitamins in American Culture* (New Brunswick, N.J.: Rutgers Univ. Press, 1996).

Dehydration was another important way to render foods time insensitive. It was discovered by accident around 1900 in a German plant that was evaporating potatoes; however, simply drying foods (as in fruits) was a very old technique of preservation. In the United States, the earliest commercial dehydrating occurred in 1910, and World War I depended heavily upon dehydrated foods. By World War II, over four hundred companies worked on vegetable dehydration alone, although coming up with a single, universal technique proved elusive, as each fruit and vegetable required slightly different treatment. But by the mid-1950s, scientists had figured out how to dehydrate meat, and this discovery opened a vast new world of frozen-dehydrated meals: "The advice furnished by the Industry Advisory Committee on Dehydrated Meat has been very helpful in the development of new products for Armed Forces use. . . . Precooked freeze-dehydrated meat and seafood products are being developed for use in instant type meals. These include such products as a chili with beans, chicken and rice, chicken stew, turkey a la king, clam chowder, beef stew, Swiss steak, frankfurters and beans, shrimp cocktail, and others." By 1959, the four primary methods of dehydrating were fairly well established: spray drying (for liquids); hot air drying (for vegetables); vacuum drying (for juices); and freeze drying, which was very new.[28]

COLLABORATING WITH FIRMS

The QMC's process of working with the food industry was elaborate. Scientists at the Subsistence Research Lab developed the list of things each ration unit should include, and sent recipes and specifications to companies for bid. Companies bid on what it would cost to produce, say, ten thousand cans of beef stew or one million packets of soluble coffee in six weeks time. Some items already existed and could simply be purchased from manufacturers—loose cigarettes, plastic spoons, chewing gum—but other things needed to be created specifically for the military. These included virtually all the food items. In assembling the K ration in 1943, for example, the QMC developed a stable of companies that were willing and able to produce some portion of the eighteen million rations needed over a six-month period. No single firm could handle the entire order, but small and large firms could commit to deliver several times over this time period at the rate of anywhere from tens of thousands to millions of units. Records from 1950, when the QMC was supporting the Korean War, indicate this scale clearly. In producing 1,500,000 units of the C-6 ration, Carr-Consolidated Biscuit Company agreed to ship 82,500 pounds of sandwich cookies in September, October, and November. The Sol Café Manufacturing Company agreed to ship 3,175,000 packages of soluble coffee in September and October, and 1,675,000 in November. Stokely-Van Camp sent 91,664 cans of ham and lima beans, and 183,328 cans of spaghetti and ground meat, in each of

[28] For a history of this process, see W. D. Farnum, "What is the Matter with Dehydration?," *American Food Journal* 18 (1923): 171–3; and S. C. Prescott, "Food Technology and Defense," *Food Technology* 3 (1949): 3. On the difficulty of standardizing, see *Food Technology* 18 (1964): 117–20. For a description of dehydration techniques, see L. E. Clifcorn, "An Appraisal of New Processing Methods for Military Foods," *Food Technology* 13 (1959): 176; for quotation on dehydrated meat, see "QM Food and Container Institute Activities FY 1956, Animal Products, Research and Development, Minutes of the meeting of the Industry Advisory Committee (IAC) on QM F&CI Items, 12 July 1956," RG 92, entry 1004 (Records of IAC, Minutes of Meetings 1952–1962), NACPM. For more information on the emerging infrastructure for these brave new foods, see Shane Hamilton, *Trucking Country: The Road to America's Wal-Mart Economy* (Princeton, N.J.: Princeton Univ. Press, 2008); and Hamilton, *Supermarket USA: Food and Power in the Cold War Farms Race* (New Haven, Conn.: Yale Univ. Press, 2018).

these months. In all, sixty-two firms participated in producing these eighteen million K rations in the summer and fall of 1942. Thus, each item in the ration was the result of a very complex provisioning system developed expressly for wartime needs.[29]

Given the intense production schedule, it is not surprising that the QMC tried to specify what kinds of firms might get contracts. In addition to having "a reputation for fulfillment of contracts and agreements, both verbal and written," and being "financially responsible," potential partners had to have an assembly line and packaging equipment, as well as room to store a week's worth of rations. Further, "the firm needed to be geographically located in accordance with any Army plan for distribution of the Ration"; this meant the company's locations had to be convenient to military shipment points around the country. Clearly these requirements disqualified any small firms, and instead favored large, national firms that had production capacity, experience with large orders, a proven organizational structure, and often a distributed manufacturing operation. Offering contracts to geographically distributed firms was also beneficial in spreading the work around to many congressional districts, but also because shortages of materials like sugar or tin plate affected firms differently, and a firm that could meet production one week might not be able to do so the next. It is unclear if such requirements pushed small producers out of the market entirely, but it is difficult to imagine how they would hold on during the war without state support.[30]

Not surprisingly, there were problems. The QMC was a very fussy customer and often rejected ration items that seemed poorly made. The Baker Importing Company was chastised for their poor packaging of soluble coffee packets; the Campbell Soup Company was told their stews were too thin and the "meat particles" too small. Comments like, "If you are still following the practice of grinding frozen meat as you were about six months ago" suggest that the QMC exercised a high degree of visitation and oversight at each of their contractors' plants. In deciding which chewing gum to put into the rations, QMC staff asked for the following: "Specification CQD No. 324, gum, chewing, requires that all types of gum shall contain a sufficient amount of flavor to impart a pleasing taste sensation. There shall be a primary flood of flavor and a residual characteristic flavor after one-half hour of constant chewing." While the QMC went to great lengths to ensure that the rations were as high quality as possible, the depredations of distance, weather, climate, and the rough-and-tumble of shipping made the end product less than ideal much of the time. In World War I, scientists had developed a "hedonic scale" that measured "a continuum of preferences" and tried to zero in on what soldiers liked and disliked. And by the early 1960s, Cornell University scientists were developing a variety of mechanisms that tested the appeal of various processed foods, including a machine that "wears metal molars to test the 'chewability' of vegetables" and an "electronic nose that gives an objective measure of vegetable flavors."[31]

[29] For a description of this process, see, for example, Captain MacDonnell to Colonel Logan, 29 June 1942, RG 92, entry 1003 (Combat rations, WW II and Korea), box 77, NACPM.

[30] Quotations in attachment to ibid., p. 1.

[31] On the Baker Importing Company, see Capt. Charles G. Herman to R. K. Baker, 21 January 1941; on Campbell's Soup Company, see Woodrow W. Bailey to C. D. Trombold, Campbell Soup Co., 18 August 1943; both in RG 92, entry 1003 (Combat rations, WW II and Korea), box 61, NACPM. On chewing gum, see M. Bollman to W. C. Winokur, 11 October 1948, RG 92, entry 1003 (Combat rations, WW II and Korea), box 63, NACPM. For the hedonic scale, see David R. Peryam and Francis J. Pilgrim, "Hedonic Scale Method of Measuring Food Preferences," *Food Technology* 11 (1957): 9–14, on 9. On mechanisms for measuring the appeal of foods, see *Food Technology* 16 (1962): 97; and Herbert L. Meiselman and Howard G. Schutz, "History of Food Acceptance Research in the U. S. Army," *Appetite* 40 (2003): 199–216.

The cooperating firms had their own headaches. Hershey Chocolate, a major supplier of D ration bars, was unhappy when the military recalled a large quantity of D bars and asked the company if they could reuse them somehow. Hershey suggested that the military work them into cake mixes, ice cream, or chocolate beverages in the military kitchens; because it was so difficult to find workers, the company did not want to waste precious time unwrapping all those bars itself. Hershey was also aggrieved when the military sharply reduced its purchase of cocoa beverage powder right after the firm invested a great deal of money in new machinery for its manufacture for the wartime contract. Likewise, when pharmaceutical company Smith Kline & French did not receive their labeling machine in time, they could not complete their order for one hundred thousand bottles of water purification tablets, resulting in rations that had half as many tablets as usual. When packers who had the equipment to pack hamburger and sausage patties could not be found, the military had to quickly replace that order with more easily packable stews, a maneuver that had repercussions all down the line.[32]

Standardization was not only a trope of military life; it was a recurring theme of wartime provisioning as well. Obviously, the very idea that an organization could produce eighteen million cans of beef stew or packages of cookies presupposes a high degree of standardization and, by 1942, mechanization of production. But because there was never a single producer of all of these units, true standardization was often lacking. As one packer put it, "in spite of strict compliance with the requirements of the specifications governing the components, no one here has ever seen samples of what you may term the perfect product or an acceptable product." And indeed, when five companies each followed the recipes and instructions exactly, their final products could still look and taste different. The rations themselves were constantly changing as well in response to shortages of certain ingredients or packing materials; slowdowns in the factories; problems coordinating the production, assembly, or shipping processes; or strong negative responses from soldiers. Rations frequently lacked some item or had lots of something else—no crackers, all cookies, for example, or cigarettes but no matches, no spoons, and so forth.[33]

It was not just foods that were transformed by military rationing; packaging was similarly challenged and changed. It is likely that the demand for strong and secure packaging had never been as intense as it was during World War II. Further, the shortage of tinplate forced packers to explore alternative packaging materials, leading to such innovations as pouch-packing, waxed paperboard, and individual-unit containers, to name but a few. All packaging, from the tiny cellophane packets holding lemonade powder, to the round cans holding beef stew, to the pallets dropped from helicopters onto beaches and into jungles, had to be "weatherproof, waterproof, resistant to air pressure changes and capable of withstanding the weight of a person sitting on the package." Two examples can illustrate. The first were round twelve-ounce cans that held most components of

[32] On Hershey Chocolate, see S. F. Hinkle to Capt. Louis A. Wright, 20 April 1945; Col. Rohland Isker to Quartermaster, 2 May 1945; both in RG 92, entry 1003 (Combat rations, WW II and Korea), box 71, NACPM. On Smith-Kline, see Lt. Col. J. S. Kusanski to Commander, 21 February 1951; and Lt. Col. William A Warner to Chief, QM Purchasing Division, 24 January 1951, RG 92, entry 1003 (Combat rations, WW II and Korea), box 65, NACPM.

[33] For quotation, see Theodore Phillips, Phillips Packing Co., to Rohland Isker, 29 January 1945, RG 92, entry 1003 (Combat rations, WW II and Korea), box 62, NACPM. On the lack of standardization, see, for example, "Amendments for Ration, Individual, Combat, c-4," 12 July 1950, RG 92, entry 1003 (Combat rations, WW II and Korea), box 65, NACPM.

the C ration. Soldiers were supposed to consume two cans at each of three daily meals when away from base. They had to carry them in their pack or in their pockets, along with the other things they needed, including water, ammunition, clothing, maps, and so forth. And the cans were heavy; the meat stews were full of liquid, meat, and vegetables, and after a few days of these meals, and often exactly the same meals, it was little wonder that soldiers tended to throw them away to lighten their load. To the QMC, this was a dangerous thing to do, because a soldier who was not adequately fed was a cranky and weakened fighting unit. Soldiers and their superiors recognized a much better packing idea when they inspected Norwegian and French rations; these were comprised of flat cans much like sardine cans. Soldiers pleaded with the QMC to switch to flat cans that could fit into a pocket, but in the midst of war it was difficult not only to retool the machinery that produced cans, but also to replace the canned stews with something equally nutritious and familiar. As early as 1941, the military grappled with what turned out to be a big challenge. The only two companies that produced the round cans—American Can and Continental Can—were strongly opposed to the change because all their production momentum was invested in round cans. Round cans were cheaper to make, factory equipment was designed to produce round cans, and there were very few factories that had the requisite machinery for closing the square cans; those that did were working round the clock making cans for Spam! As one military man put it, although "it has been clearly understood for a long time that the sardine type can is a better container than the cylindrical can as far as soldiers are concerned," industry was not interested in shifting over because it was a big expense and headache. The industry probably also did not believe that the postwar civilian market would be interested.[34]

The second challenge was the collapsible metallic tube, which again was found in foreign rations and contained cheese, pate, and jam. United States soldiers and commanders alike were very keen to adopt these tubes for the ration kits, and they were strongly suggested to the QMC as early as 1943. Yet not much happened until the mid-1950s, when the Collapsible Tube Manufacturers Council organized and began a campaign to put condiments, cheese, meat pastes, peanut butter, and caviar into tubes. In 1959, the American Can Company experimented with putting meat pastes in tubes for fighter pilots. Yet, despite its seeming convenience and practicality, the metal tube failed to catch on in either the American domestic or the military market.[35]

For many industrial firms and food companies, World War II offered both an opportunity and a challenge. Most companies were very happy to have the government's business, even if it could be difficult at times. After all, the rationing of foods for civilians not only cut into their expected profits, but also threatened to disrupt the

[34] A. H. Anderson, "Past, Present and Future of Packaging Processed Foods," *Food Technology* 18 (1964): 153–7; Walter Maclinn to Col. D. B. Dill, 5 December 1942, RG 92, entry 1003 (Records of the Office of the QM General, QM Food and Container Institute, Conference files), box 1, NACPM. On flat versus round cans, see, for example, Charles G. Herman to Col. Harry Keeley, 5 August 1941, RG 92, entry 1003 (Combat rations, WW II and Korea), box 61, NACPM. Quotation in Col. Charles S. Lawrence to QM, 12 December 1946, folder "Rations, 5-in-One, 1946 and 1947," RG 92, entry 1003 (Combat rations, WW II and Korea), box 73, NACPM. By 1942, six companies, including Underwood, were producing square cans for the Jungle ration; see Lt. Woodrow Bailey to Col. Rohland A. Isker, 29 August 1942, RG 92, entry 1003 (Combat rations, WW II and Korea), box 75, NACPM.

[35] *Food Technology* 9 (1955): 40; L. E. Clifcorn, "An Appraisal of New Processing Methods for Military Foods," *Food Technology* 13 (1959): 176. Tellingly, the military packaged the K ration in flat cardboard boxes that were more easily carried, having shifted from metal cans to cardboard to avoid American Can's issues.

hard-won relationships between companies and their other best customers—the housewives of America.[36] During the war and after, these companies focused on fulfilling their military contracts while at the same time preparing for postwar markets. American Can Company is a case in point. Incorporated in 1901 by consolidating over sixty can-making companies, American Can by 1944 was the largest one in America. During World War II, the company faced a severe tin shortage due to the lack of domestic sources, but was able to keep its machines running by filling orders for the military. It produced not only the cans used in soldiers' rations, but also torpedoes, TNT containers, parachute flare cases, incendiary grenades, smoke-screen pots, and more.[37] Acknowledging that "American Can had flexed its muscles for the first time during World War I," the company assiduously followed both military and domestic markets in a constant search for new processes and uses for its expertise and equipment. Like other industrial firms, particularly those involved in chemical processes, American Can developed a research staff of around three hundred people by 1947 who worked in "bacteriology, biochemistry, food chemistry, food inspection, general engineering, industrial hygiene, metallurgy, non-metallic containers, organic coatings, packaging, sealing compounds, and thermal engineering." With this deep reserve of talent, and the demands placed on producers by the tin shortage, the company developed fiber milk containers, fiber frozen food boxes, and cans for motor oil, vacuum-packed coffee, and acid fruits and juices; these were all products whose properties required special coatings in the cans themselves. They also developed the individual beer can, an important social innovation in that it replaced the draft beer only available in taverns. With this, people could drink in the privacy of their own homes, an appealing dimension of the new suburban lifestyle; however, some may have given up the pleasures of neighborhood camaraderie (especially men) as part of the bargain. In 1953, canned beer accounted for half of the company's growth over the previous seven years.[38] American Can also reached deeply into the emerging habits of young people through its Home Economics Department, sending brochures and "instructional materials that explain the nutritive values and exciting menu possibilities of canned foods," as well as a forty-eight-page "High School Manual on Commercially Canned Foods." Employing the time-honored practice of having children persuade their parents of a product's value, American Can left no doubt: "As the twig is bent, so the tree is inclined."[39]

Likewise, the Container Corporation of America, which was incorporated in Delaware in 1926, dominated the nonmetal container market, specializing in folding cartons, boxboard, and corrugated shipping containers, but also cellophane, polyethylene, glassine, foil, and spiral-wound paperboard cans, to name but a few of its products.

[36] See, for example, Susan Strasser, *Satisfaction Guaranteed: The Making of the American Mass Market* (New York, N.Y.: Pantheon, 1989).

[37] While Standard and Poor said that American Can consolidated "over 60 companies," the company itself claimed the number was 123; see Standard and Poor, "American Can Company," (Investment Fact Report), 6 March 1944, acc. 2118, box 2, WTCP; American Can Company Annual Report, 1948, acc. 2118, box 2, WTCP. On sources for tin, see H. C. Wainwright and Co., "Report, American Can Company," 28 November 1951, acc. 2118, box 2, WTCP; and W. W. Geddes, "Report to Securities Committee—Container Industry (Metal)," 31 May 1949 (folder, Container Industry, 1949–1953), acc. 2118, box 15, WTCP.

[38] Lawrence M. Marks and Co., "American Can Company," 6 March 1947, acc. 2118, box 2, WTCP; Argus Research Corporation, "Can Manufacturers American Can Co. and Continental Can Co.," 30 October 1953, acc. 2118, box 2, p. 4, WTCP.

[39] American Can Company, "Annual Report" 1954, acc. 2118, box 2, pp. 29–31, WTCP.

Through vertical integration, CanCo, as it was known, was able to buy hundreds of thousands of acres of forest land from which to make cardboard, and it was energetic in buying smaller companies that possessed packaging materials and techniques that could be used to expand their market. But during the war, "a considerable portion of production consisted of specialized packaging for military equipment and supplies, and lend-lease shipments."[40]

Another company that grew up with the military was Borden. The company got its start during the American Civil War, when Gail Borden figured out how to reduce the water content of milk under vacuum by about 60 percent. The resulting milk was called either evaporated milk or condensed (if sugared), and was sold as a completely reliable and safe form of fluid milk at a time when "fresh" milk was not pasteurized and thus often carried bacteria and worse. Like the packaging companies, Borden invested early in research staff, and by 1937 was selling a dizzying number of milk-related products in a wide variety of markets. Fluid milk, in fact, declined in sales strength, but that was made up for with sales of things like dry milk, used by bakers; Dryco, an infant formula with vitamin D; beta lactose (milk sugar, which had a number of industrial uses); Casco glue and liquid cement; ice cream; caramels; a cheese flavoring that was sprayed on popcorn (Gobbles); and animal rations, to name but a few. Like a sausage maker that used "everything but the squeal" of a pig, Borden was tireless and ingenious in developing and promoting its many specialized products. For example, Borden built a major exhibit at the 1939 World's Fair in New York City, featuring a Walker-Gordon Rotolactator, "the milking Merry-go-round." This also marked the debut of Elsie the Cow, called a "trade character," who was featured across the country in dramatic promotions for Borden's products.[41]

But as one analyst astutely observed, when companies boasted about their research efforts, they were really talking about market creation. Given a company's areas of expertise and reputation, its existing physical plant, including machinery, its capitalization, and its geographic location and advantage, the question was how this company could continue to make new things that people would want to buy. Whereas innovation in many early twentieth-century industries has been described as "problem solving," innovation in the midcentury food industry could better be described as creating needs and desires in people that had not been there before, and then fulfilling them. A lot of this was packaging—fiberboard rather than glass milk containers, individualized packets of sugar, coffee, and other condiments, and cellophane wrapping of foods that shoppers wanted to inspect, such as carrots and radishes. But often it was things that no one needed until a company created and marketed them as solving

[40] Standard and Poor, "Investment Fact Report, Container Corporation of America," 19 March 1945 (folder, Container Corporation of America, 1944–54), acc. 2118, box 1, WTCP; Container Corporation of America, "Annual Report" 1951 (folder, Container Corporation of America, 1944-1954), acc. 2118, box 15, WTCP.

[41] The Borden Company, "82nd Annual Report," 1939; "80th Annual Report," 1937; "81st Annual Report," 1938; "83rd Annual Report," 1940, p. 9; all preceding in acc. 2118 (Borden), box 7, WTCP. Elsie also had a philosophical side, as when she confided to shareholders, "Of course you know that when I say 'I' went to these places, I really mean the cows that play my part . . . I can't go by myself because the truth is that I am not a real cow at all, but an idea—or a character something like Alice in Wonderland or Snow White"; see The Borden Company, "84th Annual Report," 1941, acc. 2118 (Borden), box 7, WTCP. See also Anna Thompson Hajdik, "A 'Bovine Glamour Girl': Borden Milk, Elsie the Cow, and the Convergence of Technology, Animals, and Gender at the 1939 New York World's Fair," *Agr. Hist.* 88 (2014): 470–90.

the problem of convenience and time pressures. Crystallized orange juice, frozen dinners, and pancake mix were just some examples; there was seemingly no end to the surprising forms of new food that industry could put on supermarket shelves.[42]

Borden had several products made especially for the military market after the War between the States. The first was called "KLIM," or milk spelled backwards. It was the spray-dried milk developed for World War I, and used heavily in World War II because it could withstand the high temperatures of the South Pacific as well as the low temperatures of the alpine regions. This product found a ready market with civilian bakeries in the years after the Second World War. The company also adapted its dehydrating equipment so that it could be used to dry not only milk, but also orange and lemon juice, eggs, coffee, and soup. As early as 1942, Borden was making plans for the possibilities of the postwar market.[43]

Second, Borden made a variety of cheeses, or cheese products as we would now call many of them. From 1941 to 1945, much of the cheese went to the military and the Lend-Lease program, through which the United States supplied the Allies with much-needed food and other necessities. However, there were also specialty cheeses, such as "Military Brand Camembert and Brie, Liederkranz, and Borden Cocktail Spreads." This was a real investment in the future; as company officials admitted, half of the company's cheese production was bound for the military and Lend-Lease markets. Americans were not big cheese eaters in the early 1940s, but Borden hoped to create that market once the war was over. Similarly, ice cream was not a household treat before the war; it was consumed in drug store soda fountains exclusively. But during the war, Borden made a big push to supply ice cream to servicemen, building a belief that ice cream was a comfort food and "morale builder." After the war, a confluence of events, including the rise of self-service grocery stores, the invention of home freezers, the difficulty that soda fountains had in hiring people, and the huge popularity of ice cream among returning servicemen, all led to the normalization of ice cream as a year-round food that, like beer, could be purchased in small, even individualized units, and enjoyed in the privacy of one's home.[44]

CONCLUSION

The years following World War II and the Korean War were extraordinarily busy for the food industry. Huge, sudden surpluses of cheap grain led to imaginative new foods; these were what we have come to call convenience foods, many of which featured novel spray-on flavors, nutritional additives, and lots of salt and fat. Foods formerly reserved for the military entered the civilian market in decidedly more stylish packaging. The cocoa powder in rations became Nestle's Quick in 1948; freeze-dried

[42] W. W. Geddes, "Report to the Securities Committee—Container Industry (Metal)," 31 May 1949, "Container Industry, 1949-1953," acc. 2118, box 15, WTCP. On the expansion of the mass food market, see, for example, Richard Tedlow, *New and Improved: The Story of Mass Marketing in America* (New York, N.Y.: Basic, 1990); Shane Hamilton, "The Economics and Conveniences of Modern-Day Living: Frozen Foods and Mass Marketing, 1945-1965," *Bus. Hist. Rev.* 77 (2003): 33–60; and Harvey Levenstein, *Paradox of Plenty* (cit. n. 5).

[43] The Borden Company, "85th Annual Report," 1942, acc. 2118 (Borden), box 7, pp. 9, 24, WTCP.

[44] The Borden Company, "84th Annual Report," 1941; "86th Annual Report," 1943, p. 25; "81st Annual Report," 1938, p. 10; "85th Annual Report," 1942, p. 7; "Annual Report," 1953, pp. 12–13; all preceding in acc. 2118 (Borden), box 7, WTCP.

coffee and orange juice followed soon after thanks to new vacuum technology developed for medical uses during the war; and corn and wheat became new kinds of snacks, cereals, and filler in bakery mixes. Although these trends existed before the Second World War, the years following the war offered the food industry—already sufficiently prepped following its intense war-related work—an unmatched opportunity to capitalize on the knowledge, new materials, and new techniques developed during the conflict. And by 1950, a number of companies that had supplied the military with rations could count notable growth: National Biscuit (which became Nabisco) grew by 26.4 percent, Borden by 27.7 percent, General Foods by 21.6 percent, and Corn Products by 23.6 percent. Surely, much of this growth stemmed from war business, but one might surmise that there was a little more to it. In 1949, Samuel Prescott at MIT had been studying the military-commercial nexus for many decades when he proposed "a more integrated relation between foods for defense and food fully acceptable for commercial distribution and broad civilian consumption." He added: "After all, the consumers all have the same nutritive requirements, and approximately similar tastes. Moreover, the buying public is already familiar with many types of concentrated or condensed foods." Indeed, the editor of the leading trade journal summed up the changes that had made all this possible: first, "the greater portion of our food supply no longer goes directly from agricultural producing centers to the consumer," but detours through the processing industry; second, "discoveries in nutrition science have shifted attention from preservation to conservation"; and third, food processors had started to recognize that "they can all use the same basic unit operations irrespective of the raw materials with which they start." This last was a good insurance policy in uncertain times for the company seeking maximum flexibility. In other words, the extraordinary expansion of the processed food and flavor industry was not an accidental and surprising outcome of the war—it was baked into the planning all along.[45]

The linkages between the food industry and the military continued to tighten in the 1950s and 1960s. Prescott's vision seemed to have come together. The government found that by having the food industry intimately connected to evolving military needs, the industry itself could develop "items suitable for both Navy and commercial use . . . at moderate cost to the government." In 1966, this arrangement was formalized in the creation of Research and Development Associates, a group of 250 representatives of industry, universities, government agencies, and the military that helped "the civilian food and container industries cooperate in meeting military feeding needs." From the point of view of the military, this was a brilliant and possibly unavoidable strategy. The government had no capacity to produce food itself, and depended upon the food industry to generate the rations. For the food industry, what could be better than a customer dedicated to time-insensitive foods, foods that had no "sell-by" date and could be sold to citizens as well as soldiers? It was the perfect market match. Yet, it is striking how easily commentators conflated the entire American population with eighteen-year-old

[45] On the effects of military demands on the civilian market, see, for example, Anastacia Marx de Salcedo, *Combat-Ready Kitchen: How the U.S. Military Shapes the Way You Eat* (New York, N.Y.: Comment, an imprint of Random House, 2015). On growth, see Laurence M. Marks and Company, "Food and Dairy Profits and Security Prices," 13 January 1950, acc. 2118, box 20, WTCP. Prescott quotation from Samuel C. Prescott, "Food Technology and Defense," *Food Technology* 3 (1949): 3. On the three big changes, see E. H. Harvey, "Food is Fundamental," *Food Technology* 1 (1947): 303.

soldiers, as if the infamous "training table" for high-school and college athletes could be smoothly transferred to families of women and men, children and grandparents, without consideration of differing nutritional needs and preferences. The tastes and demands of young men were converted into norms for everyone. The tacit assumption that soldiers and athletes are somehow "model organisms" in designing food availability and policy might have made sense for the military, but not so much for everyone else.[46]

The biggest innovation in military food during World War II did not really involve the food itself, although that would come later. It was instead generating the system of creating, producing, and distributing the food, which included overseeing the industrial production and packaging that were specifically designed to merge military and civilian needs, thereby making the food provisioning system more seamless and less reliant on fresh produce and meats. This generated a nearly unstoppable barrage of research into such products and resulted in a mammoth engine of scientific and technological prowess in the years following the war. This effort also created tight links between the military, universities, home economists and dieticians, farmers, the food industry, and entities responsible for feeding masses of people—hospitals, schools, prisons, and NGOs sponsoring food relief around the world. It should probably come as no surprise that the mass feeding of the military during the war precipitated the mass feeding of other groups as well, most of whom were even further from the eighteen-year-old soldier norm than the rest of us.

[46] First quotation from Milton E. Ryberg, "The Navy's Food and Equipment Needs Outlined by the U.S. Naval Supply Research and Development Facility," *Food Technology* 15 (1961): 15. On civilian industries, see *Food Technology* 20 (1966): 59–61.