Journal of the History of Medicine and Allied Sciences, Vol. 73, No. 2, pp. 168–187
doi: 10.1093/jhmas/jry009
Advance Access Publication: February 24, 2018

OXFORD

Between Food and Medicine: Artificial Digestion, Sickness, and the Case of Benger's Food

LISA HAUSHOFER

Department of the History of Science, Harvard University, Science Center 371, 1 Oxford Street, Cambridge, MA 02138.
Email: haushofer@fas.harvard.edu

ABSTRACT

In the nineteenth century, food and diet became central to a public health increasingly focused on individual behavior and on the cost of sickness. Because of its potential to impact the economic uptake of food inside individual bodies, digestion became a crucial site of physiological investigation in this context. Out of physiological research on digestion emerged a group of medicinal food products based on digestive enzymes (then referred to as digestive ferments), so-called artificially digested foods. The paper examines the creation and significance of these products, focusing on the case of Benger's Food. It places Benger's Food in the context of shifting professional boundaries between physicians, pharmacists, and nurses and changing approaches to the pathophysiology of sickness. Contrary to previous enzyme-based products, Benger's Food was not imagined as a specific therapeutic targeted at a particular digestive disease, but as a universal solution to illness. To function as a public health tool, Benger's Food had to be broadly applicable and palatable, and be understood as a food rather than as a medicine. The paper uncovers the conceptual and material work involved in achieving this. By doing so, it shows the intersection between food and medicine as the result of a historically specific process of creation and management.

KEYWORDS: Physiology, Digestion, Public Health, Medicinal Foods, Consumer Culture

At the International Health Exhibition of London in 1884, a gold medal was awarded to Mottershead Company for their exhibition of "Peptonizing Fluids and Peptonized Foods," including a preparation by the name of Benger's Food."[1] In the accompanying exhibition handbooks, peptonized foods were described as "foods artificially digested

1 *The Health Exhibition Literature*, vol. 18 (London: Clowes and Sons, 1884), 58.

by the aid of the animal digestive fluids so that they should enter the stomach partially digested."[2] Benger's Food was one of several so-called artificially digested foods developed at the end of the nineteenth century. A diverse set of products that included so-called malted foods, dextrinized foods, and peptonized foods, artificially digested foods were united by the fact that they contained the so-called digestive ferments (today referred to as digestive enzymes). Far from a marginal dietetic curiosity, products of this kind not only drew praise from the organizers of the exhibition, but achieved a high degree of popularity in both Britain and the United States.[3]

This article explores the emergence of artificially digested foods as a new genre of commercial products. Our consideration situates itself at the boundary of food and medicine during the second half of the nineteenth century, and gives particular focus to the example of Benger's Food. At the International Health Exhibition, artificially digested foods were conceptually and spatially separated from conventional foods in a grouping referred to as "New Varieties of Food; food for infants and invalids, new concentrated foods of all kinds."[4] This category stood somewhat uneasily alongside the display of raw and prepared animal and vegetable substances used as food. Its liminal character drew commentary from the Viennese delegate to the exhibition who remarked that "we consider the malt preparations, peptones, mineral waters and related products, which rather have the character of dietetic remedies (*Heilmittel*), as going beyond the framework of a food exhibition, and therefore also of a hygiene exhibition."[5] Whether to place artificially digested foods within the category of food or the category of medicine was a matter of debate.

This paper suggests that the uncertainty surrounding the precise delineation between articles of diet and therapeutic products was informed by a profound rethinking of the mechanism of digestion, and through it, of the relationship between food and the body. This shift in understanding the role of digestion was motivated by physiological research into the digestive ferments and artificial digestion, and has largely been overlooked by the scholarly literature. Existing historical accounts that seek to characterize conceptions of the digestive body in the nineteenth century have either focused on the later part of the century and the role of germ theory, or have characterized the nineteenth century in terms of late-eighteenth and early-nineteenth century notions of digestive function and illness as a nervous or sympathetic process.[6] While these authors

2 *The Health Exhibition Literature*, vol. 4 (London: Clowes and Sons, 1884), 428.

3 Artificially digested foods and preparations of digestive enzymes were also popular in France and Germany, but the focus of this article will be on Britain, as much of the important research and commercialization of digestive enzyme products occurred here.

4 *Health Exhibition Literature*, 18:19.

5 "Als über den Rahmen einer Nährmittel-Ausstellung, also auch einer hygienischen, hinausgreifend, erachten wir die mehr den Character von diätetischen Heilmitteln habenden Malzpräparate, Peptone, Mineralwasser und verwandte Erzeugnisse." B. Kraus, *Bericht über die Internationale Hygienische Ausstellung 1884 in London* (Wien: Selbstverlag des Gemeinderaths-Präsidiums, 1885), 21.

6 For examples of the former, see James Whorton, *Inner Hygiene: Constipation and the Pursuit of Health in Modern Society* (New York: Oxford University Press, 2000); Nicholas Bauch, *A Geography of Digestion: Biotechnology and the Kellogg Cereal Enterprise* (Berkeley: University of California Press, 2016); for an example of the latter, see Ian Miller, *A Modern History of the Stomach: Gastric Illness, Medicine and British Society, 1800–1950* (Taylor & Francis, 2011).

point out the cultural significance of digestion, and note an increase in digestive diagnoses and digestive remedies at the end of the nineteenth and the beginning of the twentieth centuries, they only provide limited insight into why this digestive hype occurred when it occurred.[7] The profound impact of digestive enzymes as a motor for reimagining the process of digestion, and through it, digestive disease, therapeutics, and the relationship between food and the body, has largely been overlooked.

Changes in digestive thinking, in turn, prompted new ways of imagining the pathophysiology of sickness with digestion at its basis. Amid increasing concerns about sickness as a burden on the prosperity and industrial productivity of the nation, artificially digested foods, this article argues, were imagined not merely as specific therapeutics targeted at a particular digestive disease, but as a universal solution to illness. Artificially digested foods thus moved seamlessly between the laboratory and the sickroom, a flexibility which was reinforced by shifting professional boundaries between physicians, pharmacists, and nurses, and an increasing demarcation between the domestic and the medical realm, described in this issue by Juliana Adelman. The ability of products to move between realms and experts was not merely a passive diffusion of knowledge created in the laboratory, however; but rather the result of an active process of maintenance achieved through these products' therapeutic mechanism, materiality and promotional message.[8] My paper thus contributes to the theme of this special issue by showing that the intersection between food and medicine is not an unchanging and self-evident spillover of one realm into another, but the result of a historically specific process of creation and management.

THE PLACE OF FOOD

Benger's Food was conceived amid growing concerns about the roles of eating and digesting as an important facets of health. The International Health Exhibition, at which Benger's Food received its official recognition, reflected the important position that food had come to achieve in considerations of not only private but public health. The introduction to the food section in the exhibition's official catalogue announced that "food claims by right the first place in the economy of an Exhibition devoted to Health for our physical well-being is more affected by meat and drink than by any other

7 Miller argues that British concern with the stomach was largely the result of a preoccupation with the woes of civilization and urban society, while Whorton also refers to concerns about civilization but on the whole is mostly committed to showing "how thoroughly concern for inner hygiene has permeated Western health culture over the past 200 years," and is less interested in an explanation as to why. Miller, *A Modern History of the Stomach*, 25–31; Whorton, *Inner Hygiene*, xii.

8 The concept of "maintenance" has recently been explored by two conferences titled "The Maintainers" at Stevens Institute of Technology in Hoboken, New Jersey, as well as a subsequently developed research network and blog. The core commitment is a focus on maintenance rather than innovation in the history of technology, with an emphasis on human actors. Building on this work, I use the term maintenance here to uncover the conceptual, material and professional work that went into upholding an ambiguous space at the intersection of food and medicine, as opposed to the demarcation work that has been highlighted by STS scholarship on boundaries. See, Lee Vinsel and Andrew Russell, "Hail the Maintainers," *Aeon*, April 7, 2016, https://aeon.co/essays/innovation-is-overvalued-maintenance-often-matters-more; "The Maintainers," *Aeon*, accessed June 20, 2017, https://aeon.co/partners/the-maintainers; "The Maintainers Blog," *The Maintainers*, accessed June 20, 2017, http://themaintainers.org/blog/.

essential of existence."[9] Displays of food and cooking which taught correct eating and preparation of food to visitors occupied the largest section on the exhibition floor.[10] The health exhibition literature, printed to further the educational mission of the event, also reflected this emphasis on food; three volumes of the nineteen-volume series were dedicated to health in diet.[11]

This emphasis on food in a health exhibition was itself a reflection of the degree to which health had come to be regarded as the outcome of healthful behavior. The mid-century focus of public health advocates on structural and legislative changes had given way to a movement intent on shaping instead individual habits in order to achieve a healthful nation.[12] In a contribution to the Exhibition Handbooks titled "Our Duty in Relation to Health," George Vivian Poore, a physician, medical officer, and a member of the exhibition's general council captured this sentiment by reminding his audience that the sick were, in the eyes of the nation, "a trouble and an expense." It was therefore the obligation of each individual to keep well in order "not to tax the patience, sympathy, or pockets of loving friends and relatives if we can possibly avoid doing so."[13]

Behind these calls to more responsible health behavior was a conception of sickness as an avoidable burden on the national economy. The idea that sickness was not an unchangeable woe of human existence, or even a necessary natural check on a population outgrowing its limits for subsistence, but a preventable consequence of public mismanagement, was of course not new. In the aftermath of the Crimean War, however, debates about the preventability of illness had gained a new urgency, and a new rhetoric. Critiques of sanitary conditions in the military during the war linked poor sanitation to losses of lives, and therefore, to military failure and unnecessary expense, which spurred investigations into the state of the army in Britain and parts of its empire.[14] At home, sanitarians capitalized on the shock of the Crimean experience by expressing the need to prevent sickness through a cost-benefit analysis. In his address at the International Health Exhibition, James Paget, renowned surgeon, physiologist and

9 *Health Exhibition Literature*, 18:189.

10 This assessment is made by estimating the surface of the exhibition floor covered by sections designated as belonging to the food category, and the section on "heating and cooking apparatus" of the Dwelling division. *Health Exhibition Literature*, 18:99–100.

11 *The Health Exhibition Literature*, vols. 4-6 (London: Clowes and Sons, 1884).

12 For accounts of nineteenth-century British public health focused on mid-century infrastructural interventions and legislative ambitions, see Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854* (Cambridge: Cambridge University Press, 1998); Anthony Wohl, *Endangered Lives: Public Health in Victorian Britain* (London: Dent, 1983); Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Oxford University Press, 1993); for the turn towards a more individual-focused public health even before the advent of germ theory, see Amy Ruth Partridge, "Public Health for the People: The Use of Exhibition and Performance to Stage the 'Sanitary Idea' in Victorian Britain" (Ph.D., Northwestern University, 2005); Jennifer Ruth Haynes, "Sanitary Ladies and Friendly Visitors: Women Public Health Officers in London, 1890-1930" [Ph.D., University of London, Institute of Education (United Kingdom), 2006]; see also Juliana Adelman's paper in this special issue.

13 Ibid.

14 David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993), 67–72.

pathologist, and one of the exhibition's vice-chancellors, calculated the magnitude of loss to the nation through sickness and death. Based on data gathered by the Friendly Societies, he determined that sickness cost the nation £11,000,000 sterling annually through time lost for productive work.[15] Such losses were all the more tragic, he insisted, since they were not considered inevitable. Indeed, "a very large proportion of the sickness and the loss of work" might be prevented, Paget suggested.[16]

Amid concerns about the economic burden of sickness, issues of food and diet were increasingly approached through the conceptual and material framework of political economy. From the late-eighteenth century, a growing group of scientifically trained experts placed food at the center of economic equations concerning the nourishment, health and productivity of the British nation. They sought to determine which components of foods nourished bodies most efficiently at the least cost. As a result of their efforts, British institutional dietaries, including the fare of workhouses, prisons, and hospitals, were reevaluated and reshaped according to cost-nutritiousness considerations.[17] But this new approach to nourishment also inspired the creation of a number of nutritional products that sought to combine maximum nutritive output with minimal cost. The most well-known such product was Justus Liebig's meat extract, but many similar transportable, nutritiously concentrated foods were created and marketed around mid-century.[18] Such products combined public health ambitions to a cost-efficiently nourished population with an incipient individual-centered and consumer-focused economy. Thus they accompanied and catalyzed the transition from an infrastructure-oriented public health to a more individual-focused sanitary and domestic science.

As a result of this preoccupation with the economy of food and the growing focus on the individual as the most promising locus of public health interventions, digestion came to the fore as a site of investigation, which could impact the economic uptake of food within bodies.[19] Reports on the dietary conditions of institutions began to point out the importance of taking the digestibility of foods into account if a full picture of their ability to nourish at a certain cost was to emerge.[20] Digestion was therefore a topic of great political and scientific interest during the second half of the nineteenth century. Despite its centrality to economic and political considerations, however, digestion and

15 *Health Exhibition Literature*, 18:6–10.

16 Ibid., 18:14.

17 I explore this development in chapter one of my Ph.D. dissertation.

18 On Liebig's meat extract, see Mark R. Finlay, "Early Marketing of the Theory of Nutrition: The Science and Culture of Liebig's Extract of Meat," in *The Science and Culture of Nutrition, 1840-1940*, ed. Harmke Kamminga and Dr Andrew Cunningham (Amsterdam: Rodopi, 1995), 48–74; William H. Brock, *Justus Von Liebig: The Chemical Gatekeeper* (Cambridge: Cambridge University Press, 2002), 215–38; on the development of health foods in general, especially on the conceptual break they represented with past nutritional conceptions, see Emma Spary, *Feeding France: New Sciences of Food, 1760–1815* (Cambridge: Cambridge University Press, 2014), 125–66.

19 I analyze these developments in more detail in chapter two of my Ph.D. dissertation.

20 For example Edward Smith, *Dietaries for the Inmates of Workhouses. Report to the President of the Poor Law Board.* (London: Eyre and Spottiswoode, 1866), 33.

its wider significance during this period have received little scholarly attention.[21] Most existing accounts highlight earlier understandings of digestion as a part of the so-called cerebro-digestive axis, or jump to the end of the nineteenth century and focus on bacteriologically determined interpretations of digestive physiology and pathology. But a central motor for change in how digestion was understood was a physiological research endeavor on the so-called digestive ferments called "artificial digestion." Not only did artificial digestion provide new ways of imaging how food related to bodies, but it evoked hope that the variable of digestion might henceforward be better controlled.

ARTIFICIAL DIGESTION

Artificial digestion was originally developed as a research method probing the mechanism of digestion in the late-eighteenth century. At the heart of chemists' and physiologists' debates about the degree to which digestion was a mechanical transformation, a chemical reaction, or the result of some other yet unknown physiological or vital process, was the question to what degree digestion involved a transformation that was imitable by known laboratory methods, or whether the transformation of lifeless matter into the living substance of the body involved a different kind of process. From the late-eighteenth century, this question seemed to converge on the properties of the gastric juice. In his famous experiments on buzzards presented to the Académie des Sciences in 1752, Antoine Ferchault de Réaumur had taken advantage of the animal's regurgitation to insert pieces of meat in a perforated metal tube into its stomach. He observed that the meat had been reduced in size and weight, and concluded that the stomach's juice played an important role in digestion. By the same approach, he sought to obtain samples of the stomach fluid by inserting a sponge in the metal tube. He used the liquid gained in this way to examine its chemical characteristics, and to observe its dissolving properties outside the body. According to Frederic Holmes, Réaumur had not only devised a new method for studying digestion, but reconfigured the question of digestion as hinging on the discovery of the properties of the gastric juice.[22]

Equipped with this new method, a generation of German, English and French chemists and physiologists set out to ascertain the intricacies of the digestive process by examining which components of the stomach effected a digestive change and how. For example, British chemist William Prout proposed a prominent theory that suggested that digestion was occasioned by the gastric juice's hydrochloric acid in a process of chemical solution.[23] The investigations of Friedrich Tiedemann and Leopold

21 A notable exception is the work of Emma Spary, which focuses on France in the eighteenth century. On the political and economic dimensions of digestion, see in particular Emma Spary, *Eating the Enlightenment: Food and the Sciences in Paris* (Chicago; London: University of Chicago Press, 2012), 17–50.

22 René Antoine Ferchault de Réaumur, "Sur La Digestion Des Oiseaux," *Histoire de l'Académie Royale Des Sciences*, 1752, 266–307; 461–96; Frederic L. Holmes, *Claude Bernard and Animal Chemistry: The Emergence of a Scientist* (Cambridge, MA: Harvard University Press, 1974), 141–143.

23 Frederic L. Holmes, *Claude Bernard and Animal Chemistry: The Emergence of a Scientist* (Cambridge, MA: Harvard University Press, 1974), 151–52; William Prout, "On the Nature of the Acid and Saline Matters Usually Existing in the Stomachs of Animals," *Philosophical Transactions of the Royal Society of London* 114 (January 1, 1824): 45–49.

Gmelin challenged this theory. They had observed the presence of hydrochloric acid in processes of digestion, but doubted its digestive capacity. They also hypothesized that some of the transformations occurring during digestion were not merely chemical solutions, but the product of a "special disintegration" (besondere Zersetzung), which produced a qualitative change in digesting food substances, as opposed to a mere disintegration. In their experiments on starch digestion, they had observed that digesting starch lost its capacity to color iodine blue (a known marker for starch detection), and was instead transformed into sugar and gum. "Something similar," they speculated, "might also occur with a few other materials."[24]

Such a "special disintegration" had, in fact, been described in the vegetable kingdom. In 1816, Gottlieb Sigismund Kirchhoff had observed that a transformation from starch to sugar occurred in plants at a certain temperature and in the presence of gluten. Because of the proportional relationship between starch and sugar, and the small quantity of gluten required to produce the transformation, he concluded that gluten enabled the transformation of starch into sugar.[25] The disproportional quantities of substances distinguished this reaction from processes imagined to occur through chemical affinity, where a substance's components might enter into composition with those of another substance, but without an increase in quantity. In 1833, Anselme Payen and Jean Persoz set out to examine the transformation of starch to sugar more closely. While the process of malting had been used since antiquity to produce beer and spirits, Payen and Persoz pointed out that there was as yet "no economic means to extract the interior substance of starch."[26] Their interest lay in "knowing the active principle developed through germination" to which the transformation of starch into sugar might be attributed.[27] Through a series of experiments, they found a substance capable of producing this transformation, and described how it could be won. They gave it the name *diastase* to characterize its "remarkable power" to separate the soluble parts of starch (which they referred to as dextrin) from the insoluble coating, a power which could convert two thousand parts of starch through one single part of diastase.[28]

Building on this research, German physiologist Theodor Schwann began to conduct experiments on digestion in the 1830s, which ultimately allowed him to characterize pepsin, a digestive enzyme secreted by the stomach, which would become one of the most important digestive substances used in commercial products. Intrigued by the questions of which was the "digesting principle" (*das verdauende Princip*), and how it acted, he produced a solution from the third and fourth stomach of an ox cut in small pieces, added water and hydrochloric acid, left the whole to "digest" for twenty-four

24 Tiedemann and Gmelin, *Die Verdauung nach Versuchen*, 1:333; Holmes, *Claude Bernard and Animal Chemistry*, 149–59.

25 Holmes, *Claude Bernard and Animal Chemistry*, 153–54.

26 Anselme Payen and Jean-François Persoz, "Mémoire sur la Diastase, les principaux Principes de ses Réactions, et leurs applications aux arts industriel," *Annales de chimie et de physique* 53 (1833): 74.

27 Ibid.

28 Ibid., 75, 78; Needham, *The Chemistry of Life*, 17; Holmes, *Claude Bernard and Animal Chemistry*, 164; Graeme K. Hunter, *Vital Forces: The Discovery of the Molecular Basis of Life* (San Diego: Academic Press, 2000), 75.

hours, and filtered it through canvas and paper.[29] The result was a murky, yellowish liquid, which Schwann then added to pieces of egg white to observe its transformation. Having established that a characteristic transformation occurred, Schwann characterized the changing agent by demonstrating its physiological behavior against a set of reagents. He concluded that it was unlike that of any other substance known to be present in animal bodies.[30] The substance, Schwann reasoned, resembled the known process of fermentation, in that both processes occurred though a substance capable of producing decomposition at minimum quantities, and both processes entailed a degree of transformation of the transforming agent itself.[31] Rather than inventing a new name for this type of substance, Schwann therefore argued that it would be more useful to "extend the concept of fermentation" and define it as "the voluntary disintegration of organic material, occasioned through a substance acting at minimum quantity (through contact?)."[32] He coined the term "digestive ferments" to refer to the group of agents he had described. Since the specific substance he had characterized as the agent of digestion "truly effects the digestion of the most important animal foods," Schwann concluded that "one could rightly give it the name Pepsin."[33] Through his research on pepsin and the universal function he ascribed to it, Schwann had thus suggested that it might be possible to locate the entire life process of digestion in distinct physiological agents. He had also supplied a detailed method of obtaining these substances from the stomachs of animals. From here, it was a small step to imagine the entire digestive process as governed by digestive agents, separable from the body, and amenable to control.

A NEW THERAPEUTIC FRONTIER

The profound impact of the identification of agents of digestion cannot be overstated. They seemed not only to provide explanations for the complex transformations of substances in individual bodies, but opened up entirely new avenues of research into digestive pathology and therapeutics, and ultimately, into digestive public health. Ideas about the practical applicability of digestive ferments to intervene in digestive disease emerged almost simultaneously with their description through physiologists. In 1841, a

29 Theodor Schwann, "Ueber Das Wesen Des Verdauungsprocesses," *Archiv Für Anatomie, Physiologie Und Wissenschaftliche Medicin*, 1836, 90.

30 Ohad Parnes has rightly drawn attention to this moment as an important and early manifestation of a larger conceptual shift towards a physiology of life processes based on the notion of material causal agents. Ohad Parnes, "From Agents to Cells: Theodor Schann's Research Notes of the Years 1835-1838," in *Reworking the Bench: Research Notebooks in the History of Science*, ed. F. L. Holmes, J. Renn, and Hans-Jörg Rheinberger (Dordrecht; Boston: Kluwer, 2003), 119–39.

31 By contrast, a "special disintegration" or transformation "by contact," which was also discussed in the context of digestive transformative agents, would cause change in the substance acted on, without an alteration of the transforming agent itself.

32 "die freiwillige Zersetzung organischer Materien, hervorgerufen durch einen schon in einem Minimum (durch Contact?) wirkenden Stoff." Schwann, "Ueber Das Wesen," 110.

33 Schwann, "Ueber Das Wesen"; Parnes, "From Agents to Cells: Theodor Schann's Research Notes of the Years 1835-1838"; Holmes, *Claude Bernard and Animal Chemistry*, 160–72; quotation Schwann, "Ueber Das Wesen," 136.

German physician reported that he had used Pepsin on himself and on a patient for a persistent "weakness of the digestion after nervous fever."[34] French physician Lucien Corvisart suggested the use of a so-called "poudre nutrimentive" in 1854, a combination of pepsin and acid prepared for him by a pharmaceutist named Bouchard. Corvisart had imagined ferments as the transformative agents that turned useless raw substances into valuable nourishment. Pepsin was "an entirely physiological medicine" (*un médicament tout physiologique*), and under its influence, azotized (nitrogen-containing) aliments underwent the same kind of transformation as they would through contact with gastric juice in the stomach. Corvisart reported on a number of cases in which he had administered the poudre nutrimentive directly and specified conditions for its use.[35] In the years after Corvisart's publication, pepsin, gastric juice, and hydrochloric acid featured in medical journals and textbooks under different names (Chymosin, Gasterose) and for different indications, including convalescence from febrile diseases, loss of appetite, and general digestive incapacity.[36] So popular was the use of pepsin that by 1861, a German pharmacopoeia exasperatedly introduced the drug with the words, "[Pepsin] has been mass produced for a decade and consumed in great quantities in those places where people are least capable of cooking and eating sensibly – in England and in the United States."[37] While the numerous and often differently composed preparations of pepsin made it difficult to agree on a standardized drug which could be included in pharmacopoeias, there was no doubt that pepsin deserved a place among official medicines. In a discussion of an appendix to the British Pharmacopoeia in 1873, committee member Theophilus Redwood voiced his opinion that "all persons seemed to agree that the time had arrived when it was imperative upon them to recognize pepsin as a therapeutic agent," as it was a "really efficacious and very important medicine."[38]

The overarching idea of these orally applied therapeutic products was that a compromised digestive function could be substituted through the ingestion of digestive ferments. Whereas previous conceptions of digestive pathology had relied on qualitative notions of dysfunction or had emphasized nervous or sympathetic implications of the digestive organs in general disease, digestive ferments contributed to an increasingly quantitative notion of digestion and of digestive pathology.[39] The emergence of

34 "Zeitung," *Haeser's Repertorium für die gesammte Medicin* 3, no. 6 (1841): 308.

35 Corvisart, "De L'emploi Des Poudres Nutrimentives (pepsine Acidifiée), Ressources Qu'elles Offrent à La Médicine Pratique."

36 H. M. Aschenbrenner, *Die neueren Arzneimittel und Arzneibereitungsformen* (Erlangen: Enke, 1861), 320–21.

37 Ibid., 42–43.

38 "The Proposed Appendix to the British Pharmacopoeia," *The Pharmaceutical Journal and Transactions* 3 (March 8, 1873): 716–17.

39 On premodern theories of digestion, see Ken Albala, *Eating Right in the Renaissance* (Berkeley; Los Angeles: University of California Press, 2002), 54–66; Evan Ragland, "Experimenting with Chemical Bodies: Science, Medicine and Philosophy in the Long History of Reiner de Graaf's Experiments on Digestion, from Harvey and Descartes to Claude Bernard" (Ph.D., Indiana University, 2012); on the eighteenth century, see Spary, *Eating the Enlightenment*, 17–50; Spary, *Feeding France*, 89–93; for an interpretation of digestive thought focused on nerves and sympathy drawing on eighteenth and early nineteenth century sources, see Miller, *A Modern History of the Stomach*, 11–38.

quantitative terms such as oligopepsia and apepsia in the context of digestive ferment therapy, supplementing and at times replacing the more qualitative concept of dyspepsia, reflects this subtle change. But the impact of digestive ferments extended beyond a narrow reconfiguration of digestive pathological thought. Catalyzed by the professional collaboration between a pharmaceutical chemist, a physiologist, and his wife, digestive ferments were soon enlisted in transforming ideas about sickness more generally, and thereby were imagined to contribute to the health and economic prosperity of the nation.

A PROFESSIONAL COLLABORATION

The emergence of Benger's Food and similar products is closely linked not only to evolving conceptions of digestion, but also to changing professional dynamics in the field of healthcare, leading to new demarcations between medicine, pharmacy, nursing, and domestic science. Benger's Food was the brainchild of a close collaboration between pharmaceutical chemist Frederick Baden-Benger, physiologist William Roberts, and his wife Elizabeth Roberts. William Roberts was a medical doctor and physiologist who had trained at University College London under William Sharpey. After his medical studies, Roberts became a House Surgeon at the Manchester Royal Infirmary and began lecturing at Manchester University and Owen College in anatomy, physiology and medicine. In Manchester, he had met Benger, a graduate of the prestigious pharmaceutical school in Bloomsbury Square, London. Benger and his business partner Standen Paine had taken over the Mottershead Company, a well-established laboratory supply company in Manchester, in 1866. Building on his experience as a chemist and laboratory supplier, Berger prepared the gland extracts that Roberts used in countless experiments on the digestive ferments and translated Roberts' ideas for practical application of ferments into concrete therapeutic products.

The collaboration between Benger and Roberts, a pharmacist and a physician, was not unusual, and reflected the particular professional pressures of both fields in the 1870s and 1880s. Benger was an active member of the Pharmaceutical Society and of the Manchester Chemists and Druggists' Association, whose meetings he attended regularly. The association's records of this period reflect the peculiar position created for the pharmaceutical profession through the Pharmacy Acts of 1852 and 1868. A paper read at a meeting of the Manchester Chemists and Druggists Association in 1869 expressed frustration that the acts had established the dispensing and preparing of medicines as the primary task of pharmaceutical chemists, and yet as a result of distrust on the part of the medical profession against pharmacists, the dispensing of medicines could at present be only a minor part of a pharmacist's business. To make matters worse, many physicians still took to dispensing their own medicines. In the Manchester area, for instance, only 46 out of 234 physicians and surgeons wrote prescriptions, while 188 dispensed their own medicines. This was bad news for the 246 chemists and pharmacists in the area. As a result, interest in pharmaceutical education was in fact decreasing; "educating a host of young men at this time to a Bloomsbury Square proficiency," the paper lamented, "is something like teaching navigation to a sailor without giving him the chance of seeing the ocean, or of ever being afloat." The paper concluded by warning that this would lead to the stagnation of progress in pharmaceutical science, and it also called for cooperation between physicians and pharmacists. In the following discussion, Benger pointed out that even if chemists had all the prescriptions, this would amount only to about ten prescriptions a day; the majority of professionals would therefore still depend on other sources of income.[40] The group of highly educated pharmaceutical chemists, to which Benger belonged, was therefore not only lacking opportunities to put their sophisticated Bloomsbury knowledge into action, but it also had to be increasingly resourceful and collaborative, as a business built merely on dispensing was less and less likely to survive.

As for Roberts, he was keen to find practical uses for his laboratory knowledge, and to distinguish his own products developed for commercial distribution against other preparations of digestive ferments. In a series of lectures delivered before the Royal College of Physicians (of which he had become a Fellow in 1877), Roberts combined his dedication to practical applicability with sharp criticism of existing pepsin preparations. Most of these were based on the digestive ferment of the stomach, Roberts declared, but his own research had suggested that the pancreatic ferments actually had a stronger digestive effect when it came to particular foods. In his experiments, he had compared the effect of pepsin and the pancreatic ferment trypsin on milk and egg-albumen, and had found that milk was more readily digested by the pancreatic than by the gastric juice; the process was more rapidly completed and left less residue than when performed with gastric juice.[41]

The existing extracts of the stomach were also limited in their range, Roberts lamented. The stomach ferment seemed to be only capable of digesting proteid matter, whereas extracts of the pancreas could digest both proteid matter and starchy food. "The pancreas excels the stomach as a digestive organ," Roberts declared, "in that it has power to digest the two great alimentary principles, starch and proteids; and an extract of the gland is possessed of similar endowments. This double power is a manifest advantage in dealing with vegetable aliments, which contain both starch and proteids."[42]

The final problem of existing pepsin preparations concerned the effect of pepsin on the food character of food. Roberts warned that "if you subject any native article of food- say milk, bread, egg, or meat – to artificial digestion with pepsin and hydrochloric acid, you destroy more or less completely the grateful odour and taste, and the inviting appearance, which made it desirable as food, and convert it into an unsavoury mess, from which the human palate turns away with disgust."[43] The source for the

40 Robert Hampson, "The Condition and Prospects of Pharmacy in Britain in Its Relation to the Medical Profession," *Pharmaceutical Journal* 11 (1870): 404–8.

41 The opposite was the case for egg-albumen; Roberts found that it was the gastric juice that occasioned a speedier and more complete transformation of egg-albumen than the pancreatic juice. William Roberts, "The Lumleian Lectures on the Digestive Ferments, and the Preparation and Use of Artificially Digested Food: Lecture II," *British Medical Journal* 1, no. 1007 and 1008 (1880): 575-577; 614-616.

42 William Roberts, "The Lumleian Lectures on the Digestive Ferments, and the Preparation and Use of Artificially Digested Food: Lecture III," *British Medical Journal* 1, nos. 1009 and 1010 (1880): 648.

43 Ibid.

unpalatable sensory quality of artificially digested foods, Roberts believed, was the formation of "by-products" which accumulated during digestion. The by-products of gastric digestion were especially bitter, but only the later stages of pancreatic digestion accumulated unsavory by-products. Pancreatic digestion, if controlled, was therefore preferable for the creation of products that had the potential to be used on a day-to-day basis by ordinary consumers.

Roberts therefore championed the use of the pancreatic ferments as therapeutic digestive agents. For this purpose, Benger had produced an extract of the pancreas, not only for use in Roberts's experiments, but for commercial distribution. The "Liquor Pancreaticus" was one of the first products developed by Mottershead Company based on the digestive ferments. But Roberts's research had also suggested that any oral application of digestive ferments might potentially be ineffective, as ferments were themselves digested through the gastric juice. This was a blow to any aspirations of exploiting the ferments for practical purposes applied directly in medicinal preparation. "If the gastric juice destroys these ferments," he reasoned, "it is evidently useless to administer pancreatic preparations by mouth during digestion, because they would be rendered inert by the acid contents of the stomach."[44]

This problem could be circumvented, however, if the entire digestive process was instead outsourced. Roberts therefore embarked on a line of research to explore the possibilities of an externally completed process of digestion, with the intention of producing a number of artificially digested products.

A NEW MECHANISM OF DIGESTION

These practical motivations to create artificially digested food products paralleled theoretical considerations of the digestive mechanism itself, which provided a new way of imagining the pathophysiology of sickness. While Roberts's research consolidated the notion of ferments as active agents of physiological processes, he also reconceptualized this agency in terms of energy. As opposed to other constituents, Roberts argued, ferments did not "derive their marvelous endowments from their material substance." He further explained that they "give nothing material to, and take nothing material from, the substance acted on." The relationship between material composition and immaterial force was akin to that involved in magnetism. "The albuminoid matter which constitutes their mass," he noted,

> is evidently no more than the material substratum of a special kind of energy-just as the steel of a magnet is the material substratum of the magnetic energy – but is not itself that energy. This albuminoid matter of the ferment may be said to become charged, at the moment of elaboration by the gland-cells, with potential energy of a special kind, in the same way that a piece of steel becomes charged with magnetism by contact with a pre-existing magnet. The potential energy of the ferment is changed into the active form (i.e. becomes

44 Ibid., 575–6.

> kinetic) when it is brought into contact with the alimentary substance on which it is designed to act.[45]

This conception of ferments as energy-transmitting substances informed Roberts's research questions and experimental set-up. He investigated the relationship between ferment quantity and transformative effect, including its duration and exhaustibility. Measuring the weight and volume of pancreatic diastase required to transform a specified amount of starch in a given period of time, he arrived at the "astounding result that pancreatic diastase is able to transform into sugar and dextrin no less than forty thousand times its own weight of starch." The proportions shown in the experiment suggested a whole new kind of physiological mechanism. "This mode of action," he affirmed, "differs entirely from what is seen in the operation of ordinary chemical affinity." The starch, Roberts, observed, appears "entirely passive in the process; all the energy is on the side of the diastase, and this energy can only be liberated gradually." The activity of ferments thus emerged as a powerful but finite and dose-dependent energetic process, akin to that of physical work.[46]

With the idea of ferments as energetic agents, digestion was reconfigured as an energy intensive process. This notion was supported by empirical observations such as that sick patients often had no appetite; that is, their powers of digestion were reduced as the body's energy resources were otherwise engaged. The pathophysiology of sickness, therefore, was increasingly expressed as a process of energy expenditure linked to digestion. The suddenness of this shift was not lost on contemporaries. Andrew Smith, a physician at New York's St Luke's Hospital, remarked in 1879 that at some point in the last thirty years, it had "somewhat suddenly dawned upon the profession, that disease is a burden imposed upon the economy, which can be sustained and ultimately thrown off only by an expenditure of vital energy." The work-energy conception of the relationship between digestion and sickness found its way into popular advice literature for invalids in the form of suggestions not to overtax the system with the intake of food. "The food should be given little by little," advised Jane Stoker, a lecturer in *domestic economy* in London's Stockwell Training College, "for in sickness the whole of the bodily organs are weak, and cannot do the amount of work of which they are capable during health. If much food is taken at once, the stomach will make a violent effort to digest it, which effort will be a waste of energy, and will have on the whole the same effect as if the patient had attempted some manual toil which his limbs were too weak to perform."[47]

Anson Rabinbach has described the shift from a science of the human motor as a means of increasing productivity to a growing "anxiety of limits" catalyzed by the looming prophecy of the exhaustible nature of energy as given by the second law of

45 Ibid.

46 Ibid.

47 Jane Stoker, "Domestic Economy for Pupil Teachers," in *The Teachers' Assistant and Pupil Teachers' Guide* (London: W. Stewart, 1878), 33.

thermodynamics.[48] In the physiological research of digestion involving the digestive ferments, anxieties about the body's limited energetic resources were translated into concrete therapeutic products economizing the waste of energy through digestive work. Artificially digested foods promised to outsource the energetically taxing process of digestion, and thereby provide a solution for all invalids, not just for sufferers of a specific digestive pathology. Indigestion, physiologist William Darby affirmed in his publication announcing one of the first artificially digested foods, was not only a frequent condition but the root of sickness in general, "not only predisposing to disease but actually originating diseases, change of structure, loss of, or imperfectly performed functions, and is really at the bottom of half the diseases included in our nosologies." By outsourcing digestion, artificially digested foods promised to "relieve the enfeebled stomach of its main burthen, and enable it to complete the process of digestion without overtaxing its energies."[49]

This new conception of sickness as avoidable energy expenditure enabled Roberts and Benger to intervene in the national anxiety around sickness. Consequently, they sought to fashion their products as broadly applicable solutions to all stages of sickness, not as narrowly purposed medicinal products. "If artificially digested food is to be employed on the large scale, and among all classes," Roberts announced, "means must be found to bring the preparation of it within the range of culinary operations and the apparatus of the kitchen and sickroom."[50] Using the Liquor Pancreaticus supplied by Benger, Roberts created an artificially digested or "peptonized" milk - a milk in which the proteid component had been digested through the addition of pancreatic extract to the state of peptones, in Robert's opinion the end product of protein digestion.[51] Digestion had been outsourced to take place within the milk, outside the body, and the peptonized milk could therefore be consumed without requiring any additional bodily energy for its digestion.

But Roberts also understood the importance of a therapeutic product administered as a food to be palatable, and to resemble known culinary dishes. To this purpose, he had enlisted the expertise of his wife Elizabeth. "In this endeavor," he confessed, "I have been assisted by a member of my family, who has succeeded beyond my expectations. She has been able to place on my table soups, jellies, and blanc-manges, containing a large amount of digested starch and digested proteids, possessing excellent flavour, and which the most delicate palate could not accuse of having been tampered with."[52] He recorded recipes for peptonized gruel and peptonized milk-gruel, the latter of which was the most successful product in his clinical practice. It had the advantage of supplying both starch and proteid matter in a pre-digested form, since the pancreatic extract acted on both through diastase and trypsin. The peptonized milk-gruel, Roberts

48 Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: University of California Press, 1990), 12.

49 Stephen Darby, *On Fluid Meat* (London: Churchill, 1870), 9, http://archive.org/details/b22298344.

50 Roberts, "Lumleian Lectures III," 647; Roberts, "Observations on the Digestive Ferments and Their Therapeutical Uses," 685.

51 Roberts, "Lumleian Lectures III," 648.

52 Ibid.

concluded, "may be regarded as an artificially digested bread-and-milk, and as forming by itself a complete and highly nutritious food for weak digestions."[53] Several of these recipes were taken up and distributed by the Mottershead Company, who supplemented their Liquor Pancreaticus with several food preparations, including a peptonized beef jelly and a product based on the concept of Robert's peptonized milk gruel, a "pancreatised, farinaceous self-digestive food," in short, Benger's Food.

Benger's food thus blended several types of professional expertise. It simultaneously represented a highly technical supplement developed through male laboratory and pharmaceutical expertise, and a profoundly empirical and improvised dish originating in the kitchen, developed through female creativity, and building on familiar culinary recipes. While commentators to the International Health Exhibition, which awarded a gold medal to Benger's Food in 1884, were trying to draw a distinction between medicinal products and traditional foods, company advertisements suggest that the producers relished this ambiguity, and worked actively to maintain it. This was achieved in great part through the fictitious character of the Benger nurse, who appeared continuously in virtually all the advertisements of Benger from the early 1900s, and who personified the juncture between professional and private expertise, between the laboratory and the kitchen, and between the hospital and the home. As Juliana Adelman's paper in this special issue suggests, nurses occupied an ambivalent position when it came to invalid diets. While textbooks for nurses regularly provided instructions for invalid food preparation, they also often emphasized the physician's role in overseeing the domain of food in the hospital. "I need not remind you that a patient's diet is a question for the medical attendant alone," warned James Wallace Anderson in his 1883 "Lectures on Medical Nursing."[54] A similar sentiment was conveyed by Charles Cullingworth in his nursing manual of the same year. "The kind and quality of the food, and the frequency with which it is to be given," he specified, "are in every case determined by the medical practitioner in attendance."[55] Both texts also featured detailed instructions on peptonizing, or preparing artificially digested foods. Texts in which peptonized foods and peptonizing instructions circulated also contrived a new role for the nurse, one that was neither cook nor physician, but a specialized and subordinate dietary technician.[56] Such a character was a perfect mascot for a product which tried to maintain the instability of the boundary between food and medicine. The Benger's Food nurse became so popular that her presence was finally eulogized in 1925: "There is a certain lady I have been meeting constantly for 30 years or more," reminisced the text. And this lady, familiar to everyone, was "just Mr Benger's nurse."[57]

53 Ibid, 649.

54 James Wallace Anderson, *Lectures on Medical Nursing: Delivered in the Royal Infirmary, Glasgow* (Glasgow: James Maclehose, 1883), 65.

55 Charles James Cullingworth, *A Manual of Nursing, Medical and Surgical* (London: J. & A. Churchill, 1883), 24.

56 Steven Shapin, "The Invisible Technician," *American Scientist* 77, no. 6 (1989): 554–554.

57 Benger's Food Limited, *Benger's Food and How to Use It* (Manchester: Benger's Food, unknown), 63–64.

THE MENTAL GYMNASTICS OF MAINTENANCE

While Benger's food thus brought together different kinds of expertise in its advertisement, it also blurred the boundaries between food and medicine on a deeper level. Considerable intellectual work went into maintaining a conceptual continuity between the realm of medical therapeutics and the realm of food and eating. In his writings, Roberts carefully negotiated the naturalness of artificially digested foods, seeking to extend their reach from the laboratory to the kitchen and the sickroom. The first strategy he pursued was to question the association of cooking with a natural process. "The practice of cooking," he declared, "is in reality as complete a departure from the ways of untutored nature as artificial digestion would be." Cooking was in fact one of the signs of the advancement of human civilization; humans were the only species that cooked their food, and man had therefore been declared "the cooking animal." The changes brought about by cooking were by no means merely for the purposes of "mechanical disintegration," but included chemical changes. The connective tissue of flesh meat, for instance, was "chemically converted into the soluble and easily digested form of gelatin." It was therefore only natural to think of cooking as an extension of the digestion process. "The changes impressed on food by cooking," Roberts argued, "form an integral part of the work of digestion."

Roberts supported his nuanced plea for continuity between cooking and digestion further by portraying cooking as a process essentially in service of the digestive ferments. For this purpose, Roberts had conducted experiments comparing the action of digestive ferments on a solution of raw versus cooked egg-albumen. "In the raw state," he found, "this solution is attacked very slowly by pepsin and acid, and pancreatic extract has almost no effect on it; but, after being cooked in the water-bath, the albumen is rapidly and entirely digested by artificial gastric juice, and a moiety of it is rapidly digested by pancreatic extract."[58] Cooking foods was a prerequisite for optimal digestive function, and the activity of digestive ferments observed in the laboratory continued and extended the work begun in the kitchen.

Roberts also strengthened his claim of continuity between cooking and digestion by adopting a distinction drawn by Claude Bernard between the "exterior digestion" and the "interstitial digestion." Exterior digestion was the process that occurred "exteriorly at the surface of the organism," and in the case of humans, this was the surface of the digestive tract. Here, food was readied for absorption into the actual interior of the body. Interstitial digestion, by contrast, was the transformation of stored nutrients into available nutrition, and occurred "in the interior of the organs and tissues."[59] The physiological conception of digestion as a process linking the exterior with the interior of the body was captured in an illustration of Thomas Lauder Brunton's *On Disorders of Digestion, Their Consequences and Treatment.* The image shows a cylindrical pipe with an interior and an exterior surface, which are continuous with one another. "The body may be roughly compared to a cylindrical box," Lauder Brunton explained, "through the centre of which runs a tube, open at both ends, but not communicating with the

58 Roberts, "Lumleian Lectures III," 647.

59 Roberts, "Lumleian Lectures 1," 539.

cavity of the box. Here, it is evident that anything put into the tube, remains as much outside the box as if it were laid against the outer surface."[60] The idea of continuity between the outside and the inside of the body strengthened Roberts's case for the naturalness of artificially digested foods. "It must also be borne in mind," he stressed, "that the digestive process carried on in the alimentary canal is, strictly speaking, executed on a doubling of the exterior surface, and not in the true interior of the body."[61] Artificially digested foods were therefore merely externalizing an already externally located physiological process.

Finally, Roberts drew on certain culinary customs to suggest that ferments had already reached the dinner table. While cooking pre-empted and supported the work of ferments, the empirical selection of foods to be consumed in a raw state confirmed the importance of ferments for the digestibility of foods. Sugar, for instance, was consumed in a state that was already absorbable; it existed naturally in its digested state. Even more compelling was the case of the oyster, which, according to Roberts was the only animal substance eaten raw. Its "liver" (digestive diverticulum) consisted of glycogen, but the oyster also contained the appropriate digestive ferment for glycogen, the hepatic diastase, separate from the liver. The ferment was brought into contact with its substrate when it was crushed through chewing. Here was a case of a naturally occurring artificially digested food. "The oyster in the uncooked state," Roberts concluded, "is, in fact, self-digestive."[62]

Taken together, these reflections furbished Roberts with a justification for producing artificially digested foods. "If we take all these considerations into account," he concluded, "it will appear, I think, not unnatural that we should try to help our invalids by administering their food in an already digested, or partially digested, condition. We should thereby only be adding one more to the numberless artificial contrivances with which our civilised life is surrounded."[63]

MAINTENANCE THROUGH MATERIALITY

The ambiguous nature of this new category of dietetic medicines was also maintained through the product packaging, the mode of administration, and the different contexts in which the products were used. Whereas Liquor Pancreaticus came in a small transparent glass bottle, Benger's Food was sold in a tin can with a brown paper label. The packaging of the Liquor might have been an artifact of its origin in a laboratory context, and the tin can of Benger's Food might have been selected primarily for its preservation qualities. But the production of both products coincided with an emergent display culture of products as packaged objects. Changes in glass production made larger shop windows possible, while professional pressures eroded traditional distinctions between the dispensing and displaying sections of pharmacists' shops. As a result, the shop windows of British pharmacies began to feature proprietary products aside the traditional

60 Thomas Lauder Brunton, *On Disorders of Digestion* (London: Macmillan, 1886), 4.

61 Roberts, "Lumleian Lectures III," 647.

62 Ibid.

63 Ibid.

decorated imitation jars.[64] Images of products were also increasingly featured in advertisements of products in magazines and journals. Whereas the earliest advertisements of Benger's Food had been in a traditional "list" style, and featured text only, later advertisements included images of the products' containers.

A growing consumer market encouraged increasingly visible product differentiation, and with it came the possibility of responding to, and utilizing, consumer expectations about particular product packaging. Historical archeologists use the shape of a bottle to determine its function, a process known as bottle typing or typology. According to Bill Lindsey of the Society for Historical Archeology, "most bottle shapes were closely associated and identified with a certain product or products as 'form follows function' to a large degree in bottle shape and styles."[65] This archeological practice is predicated on the fact that from the nineteenth century, manufacturers largely catered to consumer expectations regarding product types and shapes. "Consumers of the time – just like today – looked for certain products in certain shaped packages," Lindsey suggests. "Because of this most users of bottles used some accepted or standard shape for a given product."[66] With its transparent glass, small size, and round shape, the flask of Liquor Pancreaticus is reminiscent of pharmacists' prescription bottles or bottles used in a chemical laboratory context. Contemporary catalogs of pharmaceutical supply companies list this style of bottle as a traditional prescription bottle. Such a bottle would have been used for dispensing medicines prescribed by a physician. The 1880 *Druggists' Chemists' and Perfumers' Glassware Catalogue* of the Whitall Tatum Company, for instance, lists the narrow-necked round transparent prescription style used for Liquor Pancreaticus as "in use by some of the first Pharmacists."[67] This type of bottle is also found in laboratory supply catalogs, particularly for chemical apparatus.[68] The can of Benger's Food, by contrast, fit within a category of classic food containers. Its cylindrical shape distinguishes it clearly from the largely flat shape of medicinal or cosmetic tins of the same period.[69]

Maintenance work was also performed by the products' modes of administration and spatial contexts of use. The method of peptonizing foods using digestive liquids such as Liquor Pancreaticus was featured in medical textbooks and instructional texts for nurses. Physicians experimented with the use of peptonization for the preparation of enemata and the creation of physiological rinsing solutions.[70] Peptonizing was

64 Stuart Anderson, *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals* (London: Pharmaceutical Press, 2005), 118–19; In an article comparing the display culture of British pharmacies to those of the United States, Robert Howden mentioned the emphasis on the shop window as one of the characteristic features of British pharmacies. Robert Howden, "Pharmacy in the United States," *The Pharmaceutical Journal and Transactions* 1 (December 10, 1870): 461–63.

65 Bill Lindsey, "Bottle Typing (Typology) and Diagnostic Shapes," *Historic Glass Bottle Identification & Information Website*, 2010, http://www.sha.org/bottle/dating.htm.

66 Ibid.

67 Whitall Tatum Company, *Druggists,' Chemists' and Perfumers' Glassware*, 1880, 14.

68 John Joseph Griffin, *Chemical Handicraft: A Classified and Descriptive Catalogue of Chemical Apparatus* (London: J. J. Griffin and Sons, 1877), 158.

69 David Zimmerman, *The Encyclopedia of Advertising Tins* (D. Zimmerman, 1994), 243–47.

70 P. McBride, "Operations on the Mastoid Process," *British Medical Journal*, September 1, 1888, 474–76; W.H. Spencer and J.E. Shaw, "Two Cases of Gastric Ulcer Treated By Peptonised Enemata," *The Bristol Medico-Chirurgical Journal* 2 (1884): 41–44.

popular in hospital cooking, where nurses were instructed in preparing peptonized foods with peptonizing liquids.[71] The process of peptonizing was portrayed as demanding a certain expertise, however, and was taught to amateur nurses with caution. "The amateur nurse may have some difficulty in knowing how to prepare this," warned a Domestic Economy textbook.[72] But medical practitioners also wrote to Benger to obtain products for experiments.[73] Liquor Pancreaticus thus moved easily between the laboratory and the hospital. A brochure by the company targeted to medical practitioners contained guidelines for the correct prescription of the product, for example that it must not be prescribed with alkaline substances.[74] A brochure intended for lay users, by contrast, suggested Liquor Pancreaticus as an easy additive to regular meals, simple and convenient.[75]

Where the instructions for use of Liquor Pancreaticus largely affirmed its laboratory origin and medicinal purpose, the mode of preparation of Benger's Food demanded both, traditional kitchen equipment and processes as well as a more scientific vocabulary and setting. The food featured in medical and nursing textbooks and the repertoire of hospital kitchens, but popular brochures also featured everyday recipes that used Benger's food as a cooking ingredient.[76] Medical case reports mention the use of Benger's food regularly for such diverse indications as typhoid, constipation, emaciation, gastric ulcer, rickets and insomnia.[77] Nurses were instructed in the preparation of "nutrient enemata," a method of feeding that used the same process of pre-digesting the food, but was administered by a different mode, and was given in cases in which patients were unable to digest even pre-digested food.[78] The ambivalence of artificially digested foods' consumer messages thus suggests that medicine, science and public health were not diametrically opposed to the development of a medical consumer culture, but were readily enlisted in the process of bringing a medical product to market.

CONCLUSION

The story of Benger's Food and artificial digestion is at its core a story about a therapeutic product that might have been. For a brief time, physiological research into the digestive ferments seemed to open up new therapeutic frontiers within a context of

71 See for example, Anderson, *Lectures on Medical Nursing*, 83–84; Laurence Humphry, *A Manual of Nursing* (Philadelphia: P. Blakiston, Son, & Company, 1894), 242; E. M. Worsnop, *The Nurse's Handbook of Cookery: A Help in Sickness and Convalescence* (London: Black, 1897), 96–100; James Kenneth Watson, *A Handbook for Nurses* (Philadelphia: W.B. Saunders, 1900), 83–84.

72 Marion Greenwood Bidder and Florence Baddeley, *Domestic Economy in Theory and Practice: A Text-Book for Teachers and Students in Training* (Cambridge: Cambridge University Press, 1901), 192.

73 Joseph MacGregor Robinson, Letter to Benger's Food Company, Jan. 1, 1988. Benger's Food Archives, Museum of Science and Industry, Manchester.

74 Benger's Food, Ltd., Manchester, *Alimentary Enzymes in Theory and Application: With Special Reference to Their Use in Treatment and Dietetics* (Manchester: Otter Works, 1912), 98.

75 Benger's Food Limited, *Benger's Food and How to Use It*, 53.

76 Anderson, *Lectures on Medical Nursing*, 208–10.

77 I have been able to locate Benger's Food in the case records of St Thomas Hospital, Guy's Hospital, Westminster Hospital and the Royal London Homeopathic Hospital.

78 Netta Stewart, *Gynaecological Nursing* (New York: William Wood, 1903), 134.

increasing biomedical specificity and the growing prominence of the laboratory. But by the latter decades of the nineteenth century, digestive ferment research was largely driven by hopes for its practical applicability to the condition of sickness more generally. The medicinal food character of Benger's Food was the direct result of this desire to create a broadly applicable product. At the same time, the product also embodied a new conception of sickness informed by changing conceptions of digestive ferment activity itself.

Thus, the case of Benger's food and similar products inspired by the scientific and therapeutic fashion of artificial digestion in the late nineteenth century allows us to examine a particular moment in the history of the intersection between food and medicine. It was a moment characterized by fluid professional boundaries in the domains of medicine, pharmacy, and nursing, as well as by changing practices of product development and display in an emergent scientific consumer culture. The products created within this context responded to historically specific social and economic concerns about the cost of sickness. As such, this case allows us to appreciate the historically contingent and unstable nature of the intersection of food and medicine. This instability is neither self-evident nor effortlessly obtained, and the case of Benger's food reveals the conceptual and material work that goes into creating and maintaining it.