On the Virtues of Historical Entomophagy

by E. C. Spary and Anya Zilberstein[§]*

"Why *Not* Eat Insects?" inquires a short book, really a pamphlet, first published in London in 1885. Working against the common perception of bugs as pests—at best, an absurdly obvious nonfood, and at worst, a toxin—the author, Vincent M. Holt (who provided no autobiographical details that might establish his credentials) aimed at reversing his readers' general disdain for insects as low and troublesome forms of being, as well as the specific Western objection to entomophagy. Cockchafers, caterpillars, and grubs, he asserted in his opening pages, were "clean, palatable, and wholesome" foods. Indeed, as eaters, these insects were more discerning "than ourselves." It followed, therefore, that eating insects was *not* a form of pica (the mental and physiological disorder of consuming nonfood items); rather, refusing to eat them was merely a provincial prejudice of Europeans, born of ignorance about the consumption of insects, a practice Holt assured his readers was common around the world.[1]

We pose a variant of Holt's deceptively simple question by bringing to the fore the underlying provocation in his manifesto and critique: why *not* study food? Why hasn't food, or the knowledge and practices that surround its production, preparation, distribution, and ingestion, mattered much to historians of science, medicine, and technology? Arguably, the only universal historical constant of human existence (besides death and taxes) is the need to eat and drink. Yet, claims and practices surrounding food and beverages vary widely across time and space. The historicity of food embraces not merely geographic, economic, and political pressures, but also a wide range of claims—theological, legal, medical, traditional—that shape what can, should, or will be consumed by any person or society. Food has long been an object of serious study across the humanities and social

* Faculty of History, University of Cambridge, West Road, Cambridge, CB3 9EF, UK; ecs12@cam.ac.uk.

Many thanks to Anne Secord for giving me a copy of Holt, and Jim Secord for dinosaur advice; to Barbara Orland, Melissa Calaresu, and some of the contributors to this volume for long-standing and fruitful exchange and discussion; and especially to all the brilliant students (you know who you are) who have variously questioned, encouraged, and pushed the boundaries of my own research in this area over the last ten years. Last, but certainly not least, warmest thanks to my coeditor, Anya Zilberstein. I am privileged not only that she invited me to participate in this project (and return to a topic on which I felt the discipline had already heard quite enough from me), but also that it afforded an opportunity to work alongside her over many months of collaborative labor.

[§] Department of History, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, H3G 1M8, Canada; anya.zilberstein@concordia.ca.

Gratitude, first and foremost, to E. C. Spary for agreeing to work with me on the idea for a volume, although we were unacquainted, and teaching me so much in the process. Thanks to Molly Warsh, Danna Agmon, and Daniel Hershenzon for their critical input and encouragement, and to the Rosenfelds and Rivens for coincidentally reminding me of the pleasures of food.

[1] Vincent M. Holt, *Why Not Eat Insects?* (London: Field & Tuer, [1885]).

sciences, especially in anthropology and sociology.[2] Within the historical discipline, by contrast, most professional scholars long regarded food—from its procurement to the crafts of preparing and presenting it—as women's work, existing outside economic and political concerns, and hence low on the scale of serious cultural endeavor and unworthy of scholarly attention. With the important exception of commodity histories of individual ingredients or beverages, historical approaches to food have remained, until quite recently, largely confined to social histories of cooking or diet as aspects of everyday life, or else to cultural analyses or popular treatments of topics like traditional or ethnic foodways, food fads, and colorful chefs.[3] To take food seriously was to be pigeonholed as a scholar of the trivial and mundane.

Yet, from that position of disciplinary marginalization, food history has lately begun to mature into a robust subfield, something attested to by the appearance of edited collections and sourcebooks designed to facilitate teaching the subject; specialized journals such as *Petits Propos Culinaires, Food & History, Food, Culture & Society*, and *Gastronomica*; and international conferences such as the Oxford Symposia on Cookery or the biennial conferences of the Institut Européen d'Histoire et des Cultures de l'Alimentation.[4]

More recent collaboration among scholars with diverse methodological approaches and theoretical commitments—cultural studies, nutritional science, public health, restaurant management, and culinary arts—has generated an interdisciplinarity that makes food studies a thriving new area of inquiry.

From the standpoint of the historian of science, technology, and medicine, however, this very interdisciplinarity has also tended to perpetuate, if unintentionally, the naturalization of different forms of expertise about food. Scientific and medical practitioners' statements

[2] Among a large literature, see Bryan S. Turner, "Government of the Body: Medical Regimens and the Rationalisation of Diet," *Brit. J. Sociol.* 33 (1982): 254–69; John Coveney, *Food, Morals and Meaning: The Pleasure and Anxiety of Eating*, 2nd ed. (New York, N.Y.: Routledge, 2006); Jack Goody, *Cooking, Cuisine and Class: A Study in Comparative Sociology* (Cambridge: Cambridge Univ. Press, 1982); Daniel Miller, *Material Culture and Mass Consumption* (Cambridge, Mass.: Blackwell, 1987); Robert J. Foster, *Coca-Globalization: Following Soft Drinks from New York to New Guinea* (Houndmills, UK: Palgrave Macmillan, 2008); Jukka Gronow, *The Sociology of Taste* (New York, N.Y.: Routledge, 1997); and Elisabeth L. Fürst, Ritva Prättälä, Marianne Ekström, Lotte Holm, and Unni Kjærnes, eds., *Palatable Worlds: Sociocultural Food Studies* (Oslo: Solum Verlag, 1991).

[3] Among the best studies in this vein are Jean-Louis Flandrin and Massimo Montanari, eds., *Food: A Culinary History from Antiquity to the Present* (New York, N.Y.: Columbia Univ. Press, 1999); Susan Pinkard, *A Revolution in Taste: The Rise of French Cuisine, 1650–1800* (Cambridge: Cambridge Univ. Press, 2009); Priscilla Parkhurst Ferguson, *Accounting for Taste: The Triumph of French Cuisine* (Chicago: Univ. of Chicago Press, 2004); Paul Freedman, ed., *Food: The History of Taste* (Berkeley and Los Angeles: Univ. of California Press, 2007); Peter J. Atkins, Peter Lummel, and Derek J. Oddy, *Food and the City in Europe since 1800* (Farnham, UK: Ashgate, 2007); Jim Phillips and David F. Smith, eds., *Food, Science, Policy and Regulation in the Twentieth Century: International and Comparative Perspectives* (London: Routledge, 2016); and Adel P. den Hartog, ed., *Food Technology, Science and Marketing: European Diet in the Twentieth Century* (East Linton, UK: Tuckwell, 1997). For scholarship addressing the history of material culture, see, for example, Sara Pennell, *The Birth of the English Kitchen, 1600–1850* (London: Bloomsbury, 2016); on foodways, see Hasia Diner, *Hungering for America: Italian, Irish and Jewish Foodways in the Age of Migration* (Cambridge, Mass.: Harvard Univ. Press, 2003); as well as the journal *Food and Foodways*, published since 1984.

[4] Carole Counihan and Penny Van Esterik, eds., *Food and Culture: A Reader* (New York, N.Y.: Routledge, 1997); Ken Albala, ed., *The Food History Reader: Primary Sources* (London: Bloomsbury Academic, 2014); Raymond Grew, ed., *Food in Global History* (Boulder, Colo.: Westview, 1999); Peter Scholliers, ed., *Food, Drink and Identity: Cooking, Eating and Drinking in Europe Since the Middle Ages* (London: Berg, 2001); Jeffrey M. Pilcher, *Food in World History* (New York, N.Y.: Routledge, 2006); Albala, Joyce E. Chaplin, and Paul Freedman, eds., *Food in Time and Place: The American Historical Association Companion to Food History* (Oakland: Univ. of California Press, 2014).

about food, so far from being neutral, indisputable statements about matters of fact or nature, were always articulated within specific contestations over matters of governance, expertise, resources, and entitlements, and have frequently been overlooked in this burgeoning literature. Even the best cultural histories of food published in recent decades have taken changing claims about what constitutes an "adequate" or "appropriate" diet, or scientific and medical discourse about its content and nature, more or less at face value.[5] The same caveat often applies to work that considers food from the standpoint of the history of stimulants, or in terms of global or imperial commodity flows, the histories of capitalism and development, and their ecological precedents or consequences.[6]

For their part, while historians of science, technology, and medicine have recently confronted the production, application, circulation, or contestation of many forms of knowledge, food, cuisine, and eating have rarely featured among these. Apart from a 2012 forum in *Studies in History and Philosophy of Science* coedited by Spary and Barbara Orland, and a recent special issue devoted to "Food as Medicine, Medicine as Food" in the *Journal of the History of Medicine and Allied Sciences*, leading journals in the field have together published a mere handful of articles concerning the food sciences, and these have mostly been on dietetics, physiology, and metabolism.[7] Steven Shapin and Christopher Lawrence's 1998 edited volume *Science Incarnate* and Harmke Kamminga and Andrew Cunningham's 1995 collection *The Science and Culture of Nutrition* remain among the few works to draw the attention of historians of science, technology, and medicine to the exceptional role of food in the making of natural knowledge.[8] This neglect is the more surprising in that many, if not most, public and policy discussions about food or dietary legislation, regulation, innovation, and marketing rely upon knowledge claims arising out of past scientific and medical research that is often subsequently superseded. Yet, those discussions treat such claims as if they were transhistorical, rather

[5] For examples, see Stephen Mennell, *All Manners of Food: Eating and Taste in England and France from the Middle Ages to the Present*, 2nd ed. (Urbana: Univ. of Illinois Press, 1996); Rebecca Lee Spang, *The Invention of the Restaurant: Paris and Modern Gastronomic Culture* (Cambridge, Mass.: Harvard Univ. Press, 2000); and John A. Jakle and Keith A. Sculle, *Fast Food: Roadside Restaurants in the Automobile Age* (Baltimore: Johns Hopkins Univ. Press, 1999). An important exception is Joan Jacobs Brumberg, *Fasting Girls: The Emergence of Anorexia Nervosa as a Modern Disease* (Cambridge, Mass.: Harvard Univ. Press, 1988).

[6] Notably, see Wolfgang Schivelbusch, *Tastes of Paradise: A Social History of Spices, Stimulants, and Intoxicants* (New York, N.Y.: Pantheon, 1992); Nelson Foster and Linda S. Cordell, eds., *Chilies to Chocolate: Food the Americas Gave the World* (Tucson: Univ. of Arizona Press, 1992); Sidney W. Mintz, *Sweetness and Power: The Place of Sugar in Modern History* (New York, N.Y.: Elisabeth Sifton Books and Viking, 1985); David Hancock, *Oceans of Wine: Madeira and the Emergence of American Trade and Taste* (New Haven, Conn.: Yale Univ. Press, 2009); and Akhil Gupta, *Postcolonial Developments: Agriculture in the Making of Modern India* (Durham, N.C.: Duke Univ. Press, 1998).

[7] Julia Adelman and Lisa Haushofer, eds., "Food as Medicine, Medicine as Food," *J. Hist. Med. Allied Sci.* 73 (2018): 127–222; E. C. Spary and Barbara Orland, eds., "Assimilating Knowledge: Food and Nutrition in Early Modern Physiologies," special issue, *Stud. Hist. Phil. Biol. Biomed. Sci*. 43 (2012). Among articles, see Elizabeth A. Williams, "Neuroses of the Stomach: Eating, Gender, and Psychopathology in French Medicine, 1800–1870," *Isis* 98 (2007): 54–79; Vanessa Heggie, "Why Isn't Exploration a Science?," *Isis* 105 (2014): 318–34; Ian Higginson and Crosbie Smith, "'A Magnified Piece of Thermodynamics': The Promethean Iconography of the Refrigerator in Paul Theroux's *The Mosquito Coast*," *Brit. J. Hist. Sci.* 32 (1999): 325–42; Sally Horrocks, "A Promising Pioneer Profession? Women in Industrial Chemistry in Inter-war Britain," *Brit. J. Hist. Sci.* 33 (2000): 351–67; and Anita Guerrini, "The Ghastly Kitchen," *Hist. Sci.* 54 (2016): 71–97.

[8] Christopher Lawrence and Steven Shapin, eds., *Science Incarnate: Historical Embodiments of Natural Knowledge* (Chicago: Univ. of Chicago Press, 1998); Harmke Kamminga and Andrew Cunningham, eds., *The Science and Culture of Nutrition, 1840–1940* (Atlanta, Ga.: Rodopi, 1995).

than the outcome of specific agendas and debates, disciplinary conventions, or professional struggles.[9]

The contributions to *Food Matters*, ranging from early modern dietetics to modern Ayurvedic recipes, from analyses of hungry model organisms to the dining rituals of Silicon Valley entrepreneurs and their patrons, show that such neglect is unwarranted. Our collection seeks to bring the methodological tools developed within the history of science, technology, and medicine over recent decades to bear upon knowledge about food, from the claims of individuals to those asserted by larger collectives, such as government agencies, prisons, armies, cities, or international corporations. Because food ties the body directly to collective life, knowledge about food—as it developed from early modern regimen advice, via the emergence of food chemistry in the eighteenth and nineteenth centuries, into a scientific subdiscipline in its own right—has always raised epistemological, ontological, and definitional questions. These queries have been mediated by macroscopic programs for the management of resources, by taboos and proscriptions, and by individual preferences. We argue that it is only by studying the complex and often contested circumstances under which knowledge claims about food came into being and gained status as authoritative, seemingly transparent reflections of scientific facts about nature that we can begin to understand these past and present debates.

Food Matters opens a broad perspective, one that goes beyond current dietary concerns or political peccadilloes surrounding the food supply. It encourages attention to the importance of a wide range of issues for studying the history of food, including spatiality, disciplinarity, political economy, globalization, translation, gender, practices of cooking and eating, and definitions of "naturalness," "need," or "health." The articles in our collection explicitly reflect upon the methodological potential and problems of food as a central subject for historians of science, technology, and medicine and vice versa, as well as upon the way that our tools, approaches, and preoccupations can be used to investigate the history of food.

TRAJECTORIES OF FOOD GOVERNANCE SINCE 1500

The contributions to this collection form a chronological arc, from early modern medico-theological understandings of ritual foodstuffs or projects of territorial conquest and resource management, via the emergence and elaboration of the food sciences as formal disciplines, to postmodern questioning of the limits of expertise, selfhood, and embodiment. They show that food has long been a focus of inquiry, experimentation, contestation, standardization, quantification, (self-)disciplining, governance, and public concern. As historians well know, it is difficult to overstate the explanatory, institutional, commercial, and broadly political power of modern science, technology, and medicine. Indeed, the prominent role of scientific knowledge claims and expertise in areas as diverse as agriculture, livestock management, the food trade, manufacturing, public health, cooking, eating, and drinking is a prime example of one possible "big picture" we might have of the history of science: a narrative about the increasing purchase of Western scientific knowledge over the daily lives of more and more people across the globe, both in their relationship with governance and in their understanding of themselves.

[9] For examples, see Rima D. Apple, *Vitamania: Vitamins in American Culture* (New Brunswick, N.J.: Rutgers Univ. Press, 1996); and Matthew Smith, *Another Person's Poison: A History of Food Allergy* (New York, N.Y.: Columbia Univ. Press, 2015).

Much of the historiography of modern food hinges on a familiar narrative that presents science and technology as progressively discovering solutions to problems of mass consumerism created by industrialization and urbanization—first in Western Europe and the United States, and eventually elsewhere in the world. These solutions included the mechanization of food production, processing, and packaging; the preservation of foodstuffs for long-term storage and long-distance transportation; a greater reliance upon chemical preservatives, colorants, synthetic flavors, and fragrances; and the rise of quantitative nutrition policies, large agribusiness, food conglomerates, globally integrated food chains, fast food, and advertising campaigns.[10] Yet, the contributions to our volume resist any smooth or linear trajectory from "prescientific" or "unscientific" forms of folk knowledge, based on local, familial, or customary practices, to our modern scientific world. Rather, we argue, individual tastes, locally distinctive foodways, and governmental regulation of food have been inseparably entangled with learned knowledge claims from the very earliest scholarly efforts to account for diet.

The extended historical viewpoint adopted by *Food Matters* points to certain crucial relationships between political, economic, and intellectual interventions into the food supply, formulated long before the modern period or well outside conventional arenas of scientific or technical innovation, which made later developments possible. Taken together, the articles in this collection demonstrate the inextricability of the history of food from myriad developments in the sciences more generally. Starting in the late sixteenth century, as Bradford Bouley's article shows, new enterprises of food knowledge emerged from the application of new kinds of natural knowledge to questions of religious dietary proscriptions, agricultural practice, the nature of food and drink, and management of the food supply.[11] The governmentalization of food through the sciences began in this period. From then onward, practitioners of the sciences, engineering, or medicine were prominent in debates between lay, expert, commercial, and governmental food knowledge and practice. Early modern manuals of medicine and rustic economy included medico-culinary recipes serving to feed or cure people and livestock alike, and the science of husbandry embraced food. Rulers and courtiers used food and drink as a way to assert sovereignty or express ownership of lands, both within Europe and in their conquests overseas. The question of how to master and enhance the earth's fertility preoccupied a long series of natural philosophers, beginning in the seventeenth century with Royal Society chymists like Samuel Hartlib, his collaborators, and their princely patrons, as Ted McCormick's article reveals.[12] Such priorities drew scientific practitioners to the problem of how to turn marginal land or wasteland, fallow ground, and swamps into productive spaces. Since the Creator communicated with humanity by blighting a crop or conferring marvelous productivity upon farm animals, techniques to assess soil fertility and fruitfulness were promoted as essential to making

[10] 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); Jessica J. Mudry, *Measured Meals: Nutrition in America* (Albany: State Univ. of New York Press, 2010); Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals* (New York, N.Y.: Penguin, 2006); Pollan, *In Defense of Food: An Eater's Manifesto* (New York, N.Y.: Penguin, 2009).

[11] Bradford Bouley, "Digesting Faith: Eating God, Man, and Meat in Seventeenth-Century Rome," in this volume.

[12] Ted McCormick, "Food, Population, and Empire in the Hartlib Circle, 1639–1660," in this volume.

good on the providential contract to husband the earth, and to ensuring more efficient and profitable exploitation of resources.[13]

A century on, early modern cornucopian fantasies of guaranteed abundance had become targets for new social critiques arising in connection with new sciences of population and resources.[14] Enduring practices of governmentality applied to food then assumed new forms as relations of production and consumption altered. In turn, new forms of knowledge emerged to account for the place of food in these relations, as Stefan Pohl-Valero's article on Colombians' shifting perceptions of the social utility of the beverage *chicha* reveals.[15] Attempts to subject food matters to quantification, instrumental logics, discourses of objectivity, and the like were being worked out on shipboard and on land across the colonized spaces of South America, South and East Asia, and Oceania, as the contributions of Joyce E. Chaplin, Rebecca J. H. Woods, Pohl-Valero, Di Lu, and Projit Bihari Mukharji show.[16]

In the nineteenth century, nutrition science emerged alongside, and thanks to, new experimental sciences of physiology, animal chemistry, and metabolism, which coalesced in the later part of the century to form what Corinna Treitel calls "nutritional modernity."[17] Analytical chemistry, in the hands of Giessen chemistry professor Justus von Liebig and his networks of students throughout the world, became an increasingly high-profile form of public expertise from the 1830s. The scientific history of water is exemplary of these shifts in approaches to potable and edible substances, as Chaplin's article shows.[18] For early modern Europeans, water had been a plural thing—"waters"—comprising a range of material and intangible forms or purposes. After the late eighteenth century, chemists, physicians, and dieticians, particularly those working in the service of the British Empire, increasingly began to conceive of water as a singular, pure fluid, or one that could attain an ideal, purified state through chemical interventions, such as distillation. Elemental analysis largely changed the terms of the debate; sanitary officials and medical professionals no longer devoted attention, as their early modern counterparts had, to the question of whether air or water are inherently nourishing.

Cognate changes took place in scientific accounts of the body. The new science of experimental physiology made possible not only experimentation upon hunger, but

[13] Louise Hill Curth, *The Care of Brute Beasts: A Social and Cultural Study of Veterinary Medicine in Early Modern England* (Boston: Brill, 2010); Simon Schaffer, "The Earth's Fertility as a Social Fact in Early Modern England," in *Nature and Society in Historical Context*, ed. Mikuláš Teich, Roy Porter, and Bo Gustafsson (Cambridge: Cambridge Univ. Press), 124–47; Richard H. Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (New Haven, Conn.: Yale Univ. Press, 2000).

[14] Fredrik A. Jonsson, "The Origins of Cornucopianism: A Preliminary Genealogy," *Critical Historical Studies* 1 (2014): 151–68; Jonsson, John Brewer, Neil A. Fromer, and Frank Trentmann, eds., *Scarcity in the Modern World: History, Politics, Society, and Sustainability, 1800–2075* (New York, N.Y.: Bloomsbury Academic, 2019); Alison Bashford and Joyce E. Chaplin, *The New Worlds of Thomas Robert Malthus: Rereading the Principle of Population* (Princeton, N.J.: Princeton Univ. Press, 2016); Emily Pawley, "Feeding Desire: Generative Environments, Meat Markets, and the Management of Sheep Intercourse in Great Britain, 1700–1750," *Osiris* 33 (2018): 47–62.

[15] Stefan Pohl-Valero, "The Scientific Lives of *Chicha*: The Production of a Fermented Beverage and the Making of Expert Knowledge in Bogotá, 1889–1938," in this volume.

[16] Joyce E. Chaplin, "Why Drink Water? Diet, Materialisms, and British Imperialism"; Rebecca J. H. Woods, "The Shape of Meat: Preserving Animal Flesh in Victorian Britain"; Pohl-Valero, "Scientific Lives" (cit. n. 15); Di Lu, "Local Food and Transnational Science: New Boundary Issues of the Caterpillar Fungus in Republican China"; Projit Bihari Mukharji, "Historicizing 'Indian Knowledge Systems': Ayurveda, Exotic Foods, and Contemporary Antihistorical Holisms"; all in this volume.

[17] Corinna Treitel, "Nutritional Modernity: The German Case," in this volume.

[18] Chaplin, "Why Drink Water?" (cit. n. 16).

also laboratory-produced definitions of need, as demonstrated by the articles of Ulrike Thoms, Treitel, Dana Simmons, and Deborah Fitzgerald.[19] Public assertions about the desirability of particular foods can be given a far more rigorous dressing down today—by recourse to experiments, clinical trials, and books of nutritional data and official food standards—than early modern physicians with their humoral exhortations were able to do.[20] The laboratory could become a vantage point from which claims about adequate nourishment were either given or denied scientific standing. It was also a place, from the late eighteenth to the twenty-first century, from which scientific parameters of what counted as "food" could be credibly produced.

The scale of the transformation accomplished by experimentalizing food science is both broad and deep, extending from our self-knowledge as individuals and our personal or familial relations, right up to the way governments engage with questions of the food supply, resource distribution, and foreign aid. Scientific knowledge, expertise, and technological innovation relating to food have often shifted in response to political, economic, or military crises. Such shifts created problems to which new fields of research and new groups of scientific, medical, or technological experts claimed to possess uniquely effective solutions. The long time span covered by *Food Matters* shows how many key features of modern nutrition science were first conceived in earlier moments of profound change or conflict, such as political and religious clashes and colonial encounters, or improvised in response to the exigencies of warfare. Projects for the management of land, resources, and the body enrolled food long before modern nutrition science emerged, and even before what some scholars have dubbed the "nutrition transition" that rendered European eaters dependent upon nonlocal foods.[21] These practices and models flourished over ensuing centuries in a variety of institutional settings, from victualing for the Royal Navy in the eighteenth century, to the New Nutrition research of the Munich School of Metabolism, to the US Army Quartermaster's Subsistence Research Laboratory that was established during the Second World War. They were particularly prevalent in spaces of bodily discipline, from hospitals and poorhouses to prisons and plantations. From the eighteenth century onward, in Europe and North America in particular, scientific food experimentation was also carried out in relation to more ambitious proposals for circumscribing the food entitlement of the hungry poor, always with the end goal of efficiently converting indolent bodies into laboring bodies. One of the best-known manifestations of this phenomenon was the work of American polymath Benjamin Thompson, Count Rumford, whose program of "poor soups" for institutionalized populations was widely taken up around Europe and across the Atlantic world. Based on the principle of minimizing waste, it sought to develop underused materials like animal fodder or bones for human

[19] Ulrike Thoms, "The Technopolitics of Food: The Case of German Prison Food from the Late Eighteenth to the Early Twentieth Centuries"; Treitel, "Nutritional Modernity" (both cit. n. 17); Dana Simmons, "Hungry, Thinking with Animals: Psychology and Violence at the Turn of the Twentieth Century"; Deborah Fitzgerald, "World War II and the Quest for Time-Insensitive Foods"; all in this volume.

[20] Elizabeth Neswald, David F. Smith, and Ulrike Thoms, eds., *Setting Nutritional Standards: Theory, Policies, Practices* (Rochester, N.Y.: Univ. of Rochester Press, 2017); John Burnett and Derek J. Oddy, eds., *The Origins and Development of Food Policies in Europe* (London: Leicester Univ. Press, 1994); Alexander Fenton, ed., *Order and Disorder: The Health Implications of Eating and Drinking in the Nineteenth and Twentieth Centuries* (East Linton, UK: Tuckwell, 2000); Thoms, *Anstaltskost im Rationalisierungsprozess: die Ernährung in Krankenhäusern und Gefängnissen im 18. und 19. Jahrhundert* (Stuttgart: Steiner, 2005).

[21] For a definition, see especially Chris Otter, "The British Nutrition Transition and Its Histories," *Hist. Comp.* 10–11 (2012): 812–25.

consumption.[22] Casting the development of useful knowledge about food as a form of social "improvement" was a priority of scientific inquiry among seventeenth-century clerics, eighteenth-century ameliorationist plantation physicians, and the mid-nineteenth-century laboratory of Glasgow physicist William Thomson, Lord Kelvin.[23] Similarly, experimental protocols devised in field, laboratory, or institutional settings during the nineteenth and twentieth centuries became the core of policies designed for the management of publics in the face of new challenges posed by changes in consumption practices, problems in provisioning networks, or programs of population engineering.

Even the sensation of hunger and responses to it have a scientific history, as Simmons argues.[24] Over time, the rise and consolidation of bureaucratic, technocratic forms of statecraft generated new efforts to manage the food supply, determine the "minimum needs" of individual bodies or social groups, and standardize dietary regimens.[25] Expert claims about food have often replicated or supported prevailing social orders, so that inequalities in resource entitlement have been built into the production of scientific knowledge about nutrition. Yet, much mainstream writing, not only in history but also in related disciplines, such as physical anthropology or archaeology, takes "biological need" for granted, accepting categories of analysis developed by and for modern nutrition science (often based on experimentation upon nonhuman model organisms) as tools for constructing accounts of past human embodiment and experience.[26] To take just one influential example from within the fields of demographic and social history, Robert William Fogel's *The Escape from Hunger and Premature Death* uses measures of adult height as a marker for the success of past societies in meeting individual nutritional needs, thereby proceeding as if the cultural definition and experience of hunger are historical constants.[27] Historians of science, technology, and medicine are well positioned to question the epistemological foundations of such approaches by addressing experiences of hunger and appetite as elastic concepts, contingent on complex

[22] Sandra Sherman, *Imagining Poverty: Quantification and the Decline of Paternalism* (Columbus: Ohio State Univ. Press, 2001); E. C. Spary, "Economic Eaters," chap. 1 in *Feeding France: New Sciences of Food, 1760–1814* (Cambridge: Cambridge Univ. Press, 2014); Paul Warde, *The Invention of Sustainability: Nature and Destiny, c. 1500–1870* (Cambridge: Cambridge Univ. Press, 2018); Simon Werrett, *Thrifty Science: Making the Most of Materials in the History of Experiment* (Chicago: Univ. of Chicago Press, 2019).

[23] On Lord Kelvin, see M. Norton Wise, "Work and Waste: Political Economy and Natural Philosophy in Nineteenth-Century Britain (III)," *Hist. Sci.* 28 (1990): 221–61.

[24] Dana Simmons, *Vital Minimum: Needs, Nature and Inequality in Modern France* (Chicago: Univ. of Chicago Press, 2015); see also Carla Cevasco, "Hunger Knowledges and Cultures in New England's Borderlands, 1675–1770," *Early Amer. Stud.* 16 (2018): 255–81.

[25] Wise, "Work and Waste" (cit. n. 23); Anya Zilberstein, "Bastard Breadfruit and other Cheap Provisions: Early Food Science for the Welfare of the Lower Orders," *Early Sci.& Med.* 21 (2016): 492–508; Philip Gibbes, *Instructions for the Treatment of Negroes*, 2nd ed. (1786; London: Shepperson & Reynolds, 1797).

[26] For important exceptions, see E. P. Thompson, "The Moral Economy of the English Crowd in the Eighteenth Century," *Past & Present* 50 (1971): 71–136; and James Vernon, *Hunger: A Modern History* (Cambridge, Mass.: Belknap Press of Harvard Univ. Press, 2007).

[27] Robert William Fogel, "The Persistence of Misery in Europe and America before 1900," chap. 1 in *The Escape from Hunger and Premature Death, 1700–2100* (Cambridge: Cambridge Univ. Press, 2004). See also, for example, Roderick Floud, Kenneth Wachter, and Annabel Gregory, *Height, Health, and History: Nutritional Status in the United Kingdom, 1750–1980* (New York, N.Y.: Cambridge Univ. Press, 1990). The demographic approach to food as a historical object forms its own subgenre, exemplified by works such as Lucile F. Newman, ed., *Hunger in History: Food Shortage, Poverty, and Deprivation* (Cambridge, Mass.: Blackwell, 1995); Robert I. Rotberg and Theodore K. Rabb, eds., *Hunger and History: The Impact of Changing Food Production and Consumption Patterns on Society* (Cambridge: Cambridge Univ. Press, 1985); and Floud, Wachter, and Gregory, *Height, Health and History* (this note).

circumstances—including the experimental milieu within which such concepts were tested—rather than reducing them to anachronistic calculations of body-weight averages, calorific requirements, and vitamin content. The common ground between the history of food and the history of science, from the early modern period to the present day, lies in large part in the ways individual bodies—both of people and of other animals—have repeatedly been mobilized within this emerging complex of knowledge and governance. Their combined methodologies therefore have the potential to transform how food is invoked as a causal factor in much broader historical narratives.

POLICING THE BOUNDARIES OF APPETITE

Bringing the critical apparatus developed within the field of the history of science, technology, and medicine to bear upon historical questions of diet and nutrition allows us to reinsert scientific accounts of food within their specific cultural circumstances of production and reception, and to evaluate what is at stake in universalizing concepts, recipes, and prescriptions stemming from particular historical conjunctures of knowledge and power. Holt's advocacy of insect eating was only one among many past proposals for the radical transformation of what was locally considered adequate or ordinary diet, breaching the divide between "purity" and "pollution" that has been explored by Mary Douglas and others in the anthropological domain.[28] It is no coincidence that Douglas would later turn her attention to problems of consumption, including eating and drinking.[29] Amid the mass transformation of diet in the modern West that has occurred since around 1700—the rise of industrial food manufacturing, the "nutrition transition," and the global application of modern nutrition science—we can discern, in palimpsestic form, the traces of other knowledge systems.[30] Today's culinary practices and preferences still enshrine practices drawn from early modern recommendations for healthy eating: adding spices as warming or preserving elements, frying cold, moist fish, or dressing salads with oil and vinegar are quotidian culinary practices that all have roots in humoral and iatrochemical dietetic recommendations.[31] The transition described by historians of medicine, from early modern humoral theory to modern nutrition science,

[28] Mary Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (London: Routledge and Kegan Paul, 1966).

[29] Mary Douglas and Baron Isherwood, *The World of Goods: Towards an Anthropology of Consumption* (New York, N.Y.: Routledge, 1996); Douglas, "Deciphering a Meal," chap. 18 in Douglas, *Implicit Meanings: Selected Essays in Anthropology* (New York, N.Y.: Routledge, 1999), 231–51; Douglas, ed., *Constructive Drinking: Perspectives on Drink from Anthropology* (New York, N.Y.: Routledge, 2002).

[30] For a model study of such complex hybridizations of food knowledge and practice, see Marcy Norton, *Sacred Gifts, Profane Pleasures: A History of Tobacco and Chocolate in the Atlantic World* (Ithaca, N.Y.: Cornell Univ. Press, 2008).

[31] The literature on these developments is extensive, but key sources include Hans-Jürgen Teuteberg and Günter Wiegelmann, *Der Wandel der Nahrungsgewohnheiten unter dem Einfluß der Industrialisierung* (Göttingen: Vandenhoeck & Ruprecht, 1972); Alexander Fenton, ed., *Order and Disorder: The Health Implications of Eating and Drinking in the Nineteenth and Twentieth Centuries* (East Linton, UK: Tuckwell, 2000); Jack Goody, "Industrial Food: Towards the Development of a World Cuisine," in *Food and Culture: A Reader*, ed. Carole Counihan and Penny Van Esterik (New York, N.Y.: Routledge, 1997); and Stephen Mennell, Anne Murcott, and Anneke H. van Otterloo, *The Sociology of Food: Eating, Diet and Culture* (Newbury Park, Calif.: SAGE, 1992). On the early modern debts of today's cuisine, see Jean-Louis Flandrin, "Assaisonnement, cuisine et diététique," in *Histoire de l'alimentation*, ed. Flandrin and Massimo Montanari (Paris: Fayard, 1996), 491–509; Rachel Laudan, *Cuisine and Empire: Cooking in World History* (Berkeley and Los Angeles: Univ. of California Press, 2013); and Ken Albala, *Eating Right in the Renaissance* (Berkeley and Los Angeles: Univ. of California Press, 2002).

thus turns out to apply only within particular epistemological confines. Forms of old and new knowledge coexist rather than being mutually exclusive, so much is lost in pitting alleged vernacular against expert food knowledge in domains as varied as dietetics, gastronomy, agronomy, biotechnology, chemistry, economics, genetics, physiology, population theory, nutrition, psychology, or thermodynamics. Foods that are deemed to breach boundaries offer particularly interesting cases for historians of science, technology, and medicine to investigate. The caterpillar fungus in Lu's article straddles tradition and innovation; the cultured meat in Benjamin Aldes Wurgaft's account is neither wholly natural nor wholly artificial; and the artificially colored sausages in Carolyn Cobbold's contribution are variously judged to be both authentic and fake.[32]

Historians of food and the sciences should be particularly alert to such processes of exchange and assimilation between localized, scientific knowledge claims and collective cultural practices. Such fusion or "overwriting" of one system of dietary knowledge and practice by others has occurred repeatedly and under varied historical conditions. One of the best-known cases, characterized by the anthropologist Claude Lévi-Strauss as the "raw and the cooked," in fact owes much to Jean-Jacques Rousseau's figurative critique of French courtly society in terms of its diet. A very similar politics of eating is identified by Timothy Morton in the poetics of Percy Bysshe Shelley's opposition to meat eating as a rejection of capitalism.[33] Recombination of earlier dietary systems continues to occur. For example, experimental diets such as the so-called "paleo" or fasting diets, though advertised as "alternative" or "new," are often indebted to Judeo-Christian, Romantic, or Fascist back-to-nature claims about proper regimen. Even Holt's suggestion that Europeans eat insects as a thrifty and rational use of nutritive resources was not new in the late nineteenth century; insect eating had been proposed in the eighteenth century by the astronomer Jérôme de Lalande.[34] Seen as an eccentricity for over two centuries, entomophagy has begun to gain credibility in more recent times, thanks in large part to widespread public concern about the ecological consequences of meat eating. British schoolchildren can now enjoy the odd locust lollipop on a museum field trip, while shuddering at tales of cultures around the world where insects and arachnids are normal dietary components. A new microlivestock industry in the United States and Thailand, developed by a Harvard University-sponsored start-up, cultivates crickets for use in pulverized form as the basis of snack foods.[35] Increasing public commitment to

[32] Lu, "Local Food" (cit. n. 16); Benjamin Aldes Wurgaft, "Meat Mimesis: Laboratory-Grown Meat as a Study in Copying"; Carolyn Cobbold, "The Introduction of Chemical Dyes into Food in the Nineteenth Century"; both in this volume.

[33] Claude Lévi-Strauss, *Introduction to a Science of Mythology*, I: *The Raw and the Cooked*, trans. John Weightman and Doreen Weightman (London: Cape, 1970); Timothy Morton, *Shelley and the Revolution in Taste: The Body and the Natural World* (Cambridge: Cambridge Univ. Press, 1994).

[34] On Lalande, see E. C. Spary, "Eating Beyond Reason" (unpublished manuscript, 2019).

[35] The question of insect eating provoked lively debate in the early 2010s press. See "Why Not Eat Insects?," *Guardian*, 3 December 2010, https://www.theguardian.com/science/punctuated-equilibrium/2010/dec/02/2; Stefan Gates, "Why Not Eat Insects?," Food Blog, BBC, 11 March 2011, http://www.bbc.co.uk/blogs/food/2011/03/why-not-eat-insects.shtml; Joseph Milton, "Why Not Eat Insects? I'll Give You a Couple of Reasons," *Creatology* (blog), *Sci. Amer.*, 29 August 2011, https://blogs.scientificamerican.com/creatology/why-not-eat-insects-ill-give-you-a-couple-of-reasons/; and Krystal D'Costa, "What's Stopping Us from Eating Insects?," *Anthropology in Practice* (blog), *Sci. Amer.*, 24 July 2013, https://blogs.scientificamerican.com/anthropology-in-practice/whats-stopping-us-from-eating-insects/). These followed a public talk by the ecological entomologist Marcel Dicke, "Why Not Eat Insects," filmed on 15 July 2010 at TEDGlobal 2010, Oxford, TED video, 16:34, https://www.ted.com/talks/marcel_dicke_why_not_eat_insects). Former Harvard student Rose Wang's start-up "Chirps" sells insect-based products; see https://eatchirps.com/; and https://innovationlabs.harvard.edu/meet/student-story/rose-wang/.

environmentalism and efforts to address the legacies of colonialism, coupled with the vogue for molecular gastronomy of the early twenty-first century, generated conditions under which a long-lived knowledge claim about the edibility of insects—often discounted in the past as illegitimate because of its associations with food cultures of the southern hemisphere—has now penetrated into cosmopolitan realms of the gustatory-experimental imaginary, and from there into regimes of regulation and commerce.[36]

Because food is both matter taken *into* the body and a medium of relations *between* individuals (within households or wider polities), studying it allows issues of governance to be linked to questions of embodiment and self-fashioning. Taste provides an important locus of resistance to significant transformations in diet or the food supply, something that is particularly apparent when consumers encounter new foods. The many food experiments carried out by scientific and medical practitioners, governments, and businesses, especially in attempts to supplement or substitute customary foods with novel substances, have often met with opposition or indifference, or else have taken decades—or even centuries—to lose the whiff of suspiciousness and inferiority. Well-known examples of this phenomenon include eighteenth-century efforts to reduce dependence on wheat by promoting breadfruit, potatoes, and wild rice across the British Empire; or the use of treacle, vegetable oil, and chicory as *ersatz* foods during wartime shortages of sugar, butter, and coffee. At best, the imposition of such surrogates produced uncertain success. While historians often treat the history of alternative foods as ornamental appendages to more profound transformations in subsistence patterns or provisioning networks, these stories raise the same problems as Holt's pamphlet. Under what circumstances can or should a new food come to be accepted by consumers? What is the legitimate scope of the state's authority to intervene in the food supply, and how far should the law constrain food merchants and manufacturers? These questions, of great interest both historically and in the present day, show why food can be such an inflammatory topic: it is a site of direct encounter between individuals and larger social structures, or transformations, over which they may have little power.[37]

Because no form of matter is more directly relevant to the body and the self than food, dietary choices are indexical and constitutive, and play an integral role in cultures of self-fashioning, as well as in attempts by intellectuals, officials, and medical or religious authorities to classify individuals into groups. Some substances, such as red meat, have been alternately stigmatized and favored for their effects upon physical, mental, national, or spiritual health. Particularly in colonial societies, consuming or abstaining from an unfamiliar food might enhance or undermine one's social status, or worse, threaten the integrity of one's constitution and identity.[38] As new scientific

[36] Hervé This, *Molecular Gastronomy: Exploring the Science of Flavor* (New York, N.Y.: Columbia Univ. Press, 2002); Monica Bodirsky and Jon Johnson, "Decolonizing Diet: Healing by Reclaiming Traditional Indigenous Foodways," *Cuizine* 1 (2008), https://doi.org/10.7202/019373ar; for Food and Agricultural Organization (FAO) forecasts about insect farming, see their web page, "Insects for Food and Feed," http://www.fao.org/edible-insects/en/.

[37] Spary, *Feeding France* (cit. n. 22); Anya Zilberstein, "Inured to Empire: Wild Rice and Climate Change," *William Mary Quart.* 72 (2015): 125–56; Rebecca Earle, "Promoting Potatoes in Eighteenth-Century Europe," *Eighteenth-Cent. Stud.* 51 (2017): 147–62; Hans-Jürgen Teuteberg, "The Birth of the Modern Consumer Age," in Freedman, *Food* (cit. n. 3), 233–62.

[38] Rebecca Earle, *The Body of the Conquistador: Food, Race, and the Colonial Experience in Spanish America, 1492–1700* (New York, N.Y.: Cambridge Univ. Press, 2012); Jeffrey M. Pilcher, *The Sausage Rebellion: Public Health, Private Enterprise, and Meat in Mexico City, 1890–1917* (Albuquerque: Univ. of New Mexico Press, 2006); Anita Guerrini, "Health, National Character and the English Diet in 1700," *Stud. Hist. Phil. Biol. Biom. Sci.* 43 (2012): 349–56.

and medical accounts of food emerged in tandem with new agendas for the government of human and other animal bodies, they played a leading role in generating modern economic models of the circulation of resources throughout society, serving to reinforce or recreate social hierarchies. It should not be surprising, then, that scientific models of diet also become enrolled in policing social relations, colonial and national boundaries, and the role of households or consumers within the polity. Dietary choice, where it has been an option, can indicate consumers' priorities for corporeal or mental self-fashioning, as well as the ways commercial agents have trafficked and translated food knowledge between separate domains such as the laboratory, law court, and kitchen, as the articles of Guerrini and Shapin show.[39]

Taste, the Ultima Thule of historical investigation, has been especially distant from the usual themes embraced by historians of science. Yet, it is a topos of scientific concern, both for food manufacturers interested in making their products more appealing to consumers, and for scientists studying the senses and phenomena of embodied cognition. Thoms, Treitel, and Fitzgerald, addressing themes such as the interplay between the emergence of new food categories or standards and the engineering of new processes of food production, show how these were based on contemporary presumptions about the universality of taste or faith in scientists' ability to define a "standard consuming body."[40] Yet, as the Oxford chemist Charles Spence notes, "A growing body of scientific research now suggests that our experience of taste and flavor is determined to a large degree by the expectations that we generate (often automatically) prior to tasting."[41] The vast body of research conducted on different foods and drinks by the chemist Rose Marie Pangborn at the University of California, Davis, from the 1960s onward, for example, has yet to receive any historical attention.[42] Aron's and Cobbold's articles in our collection offer two case studies of how the definition of the taste of *terroir* in French viniculture on the one hand, and the regulation of artificial food additives on the other, became entangled in debates about authenticity, fraudulence, and the reliability of science in appraising or changing food composition.[43] Studying food knowledge, discourse, and praxis allows us to ask questions that are otherwise difficult to approach historically, such as how embodied experience articulates with scientific knowledge claims; how traditions bear upon political or ecological concerns; or how gastronomic experimentation confronts culturally localized senses of danger or disgust.[44]

Sciences of food engage with precisely such questions about boundaries and connections, and so afford a valuable entrée into how big categories such as "nature,"

[39] Anita Guerrini, "A Natural History of the Kitchen"; Steven Shapin, "Breakfast at Buck's: Informality, Intimacy, and Innovation in Silicon Valley"; both in this volume.

[40] Thoms, "Technopolitics of Food" (cit. n. 19); Treitel, "Nutritional Modernity" (cit. n. 17); Fitzgerald, "Time-Insensitive Foods" (cit. n. 19); all in this volume.

[41] Charles Spence, "On the Psychological Impact of Food Colour," *Flavour* 4 (2015): 1–16, https://doi.org/10.1186/s13411-015-0031-3; R. Deliza and H. J. H. MacFie, "The Generation of Sensory Expectation by External Cues and Its Effect on Sensory Perception and Hedonic Ratings: A Review," *Journal of Sensory Studies* 11 (1996): 103–28. This kind of investigation began in the late 1950s.

[42] For Panghorn's papers, see https://www.researchgate.net/scientific-contributions/2065837658_Rose_Marie_Pangborn, accessed 29 September 2018.

[43] Alissa Aron, "Perceptions of Provenance: Conceptions of Wine, Health, and Place in Louis XIV's France"; Cobbold, "Chemical Dyes" (cit. n. 32); both in this volume.

[44] On disgust, see Carolyn Korsmeyer, "Delightful, Delicious, Disgusting," *J. Aesthet. Art Crit.* 60 (2002): 218–25; Korsmeyer, *Savoring Disgust: The Foul and the Fair in Aesthetics* (Oxford: Oxford Univ. Press, 2011); Lauren Janes, "Exotic Eating in Interwar Paris: Dealing With Disgust," *Food & History* 8 (2010): 237–56; and Christopher Forth, "Fat, Desire and Disgust in the Colonial Imagination," *Hist. Workshop J.* 73 (2012): 211–39.

"culture," "knowledge," and "power" have been generated through the manipulation of the material world, epistemic communities, and bodily practices. In the realms of recipe composition, ingredient selection, food processing, preservation and storage, or cookery and baking skill, for example, we might ask about the effects upon food knowledge of the separation of laboratory and industrial spaces from domestic sites of production, about when and how those distinctions emerged, and about how new forms of expertise (and new groups of experts) gained or lost credit. We might also consider the perpetual interplay between what counts as "archaic" and what counts as "modern" food technology. The French company St. Dalfour makes its fruit preserves according to a "Traditional French Recipe," using grape syrup rather than cane sugar as a sweetener. As historians, we can pinpoint this tradition fairly precisely; it originated in efforts by the French emperor Napoleon I to promote indigenous substitutes for cane sugar during the Continental Blockade, which cut French consumers off from colonial trade.[45] Out of a very specific political crisis emerged an experimental innovation—grape syrup—implemented in factory production as an early industrial food during the 1810s, only to be replaced by the beet sugar industry before coming to be recycled as "traditional French cuisine." Studying historical cases points to a common tension in the relationship between food and the sciences: scientific and medical claims are constantly being commodified by food producers, even while the sciences of physiology, food processing, and nutrition are themselves constantly in flux in response to changes in legislation, food technology, or consumer preference. Such feedback loops contrive to blur the separation between "lay" and "expert" food knowledge and practice, forcing us to reconsider category boundaries and recognize the plurality of forms of expertise involved with food, which in turn lead to varied definitions of needs, salubrity, pleasure, or ethical relations.[46]

A similar troubling of boundaries occurs if we consider the circumstances under which particular foods are allocated to (or withheld from) specific groups of eaters, such as "hospital patients," "prisoners," or "children." Likewise, the classification of substances into categories—food/nonfood, healthy/junk, food/medicine, or food/drug—is historically fraught, the outcome of extensive prior work to establish and police such boundaries. The nonobvious and reversible nature of this process is strikingly apparent if we consider substances that have migrated from being seen as waste or nonfood to the realms of the edible, or vice versa. Exploring such changing boundaries between food and nonfood shows why, even as food governance has become ever more tightly coupled to scientific knowledge claims, the reputation of any particular food product or ingredient as "healthy," "safe," or "authentic" has tended to have a limited shelf life. When past experimenters set out to replace one food with another (or otherwise intervene in established dietary practices), whether at home or in colonial situations, they usually needed to take up a position on what the "essence" of a particular ingredient or dish, or indeed, of food in general, was. In making such claims, they provoked debate

[45] Spary, "The Empire of Habit," chap. 8 in *Feeding France* (cit. n. 22).

[46] Similar cases of the appropriation of tradition and localism to enhance the value of high-tech, scientifically based food production have been described by Steven Shapin in "Cheese and Late Modernity" (review of *Camembert: A National Myth*, by Pierre Boisard), *London Review of Books*, 20 November 2003; "Hedonistic Fruit Bombs" (reviews of *Bordeaux*, by Robert Parker; *The Wine Buyer's Guide*, by Robert Parker and Pierre-Antoine Rovani; and *Mondovino*, directed by Jonathan Nossiter), *London Review of Books*, 3 February 2005. On tensions between localism and the environmental politics of global food networks, see Anna L. Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, N.J.: Princeton Univ. Press, 2015).

not only about the unique power and qualities of specific foods, but also about their own expertise.

Policies to restrain fraudulence in the food supply, legal prohibitions against particular foods, or advice about proper diet, often presented as self-evident measures by scientific or medical practitioners, almost invariably point, on closer inspection, to the historical circumstances of their coming-into-being. During the shortages of the Napoleonic era, for example, the British government strongly encouraged the consumption of artificial wine manufactured by chemists and druggists using wild fruits. But within a few decades after the conclusion of hostilities, a book by the German chemist Friedrich Accum on the adulteration of commercial food and beverages recast artificial wine as frightful evidence of British grocers' involvement in fraudulent practices.[47] Accum's book was written at a juncture when analytical chemists were struggling to assert the supremacy of their discipline's expertise over the wealth and social authority of grocers. It proved persuasive; its many readers became convinced of the dire state of the food trade and invoked the book in calls for legislation to restrain the food industry. New laws governing food production, so far from being milestones of "progress" in food safety, are complex negotiations, the product of contestations for authority over food production and knowledge. As Alessandro Stanziani brilliantly shows, late nineteenth-century French law banned the sale of admixtures of butter and margarine, even though the sale of each of these foods on its own was permitted.[48] Scientific and expert claims about food, in other words, have often been interventions in, or debates about, a hierarchy of forms of expertise in relation to the public domain. The foods produced and marketed in a given time and place were the artifacts of these contests.

FOOD SCIENCES, IN AND BEYOND THE LABORATORY

These attempts to forge or reform expert knowledge in relation to food and beverages have long escaped scholarly scrutiny, *Food Matters* suggests, in significant part because of the lingering influence of the dualist tradition, which largely excluded matter, practice, and embodiment from the scope of the history of science, technology, and medicine. This has cast an especially long shadow over cooking, eating, and drinking, perhaps because of their associations with pleasure, the baser senses, and the passions, rather than with reason.[49] The conceptual dichotomy between mind and matter—upon which histories of the sciences long rested—was reinforced by the consolidation of laboratory science as a standard means of making natural knowledge. That development further relegated food to the realm of impure, applied, and feminized craft knowledge, as distinct from pure and manly sciences devoted to original discovery. It can seem surprising that

[47] Friedrich Accum, *A Treatise on Adulterations of Food, and Culinary Poisons, Exhibiting the Fraudulent Sophistications of Bread, Beer, Wine, Spirituous Liquors, Tea, Coffee, Cream, Confectionery, Vinegar, Mustard, Pepper, Cheese, Olive Oil, Pickles, and Other Articles Employed in Domestic Economy. And Methods of Detecting Them* (London: Longman, Hurst, Rees, Orme, and Brown, 1820).

[48] Alessandro Stanziani, *Histoire de la qualité alimentaire: XIXe—XXe siècle* (Paris: Seuil, 2005); Frederick Filby, *A History of Food Adulteration and Analysis* (London: Allen & Unwin, 1934). On artificial wine projects, see Spary, *Feeding France* (cit. n. 22), 6–7, 161; and Benjamin R. Cohen, *Pure Adulteration: Cheating on Nature in the Age of Manufactured Food* (Chicago: Univ. of Chicago Press, 2020).

[49] Viktoria von Hoffmann, *From Gluttony to Enlightenment: The World of Taste in Early Modern Europe* (Urbana: Univ. of Illinois Press, 2016).

well-known men of science like André-Marie Ampère or Kelvin conducted extensive research into food, even while simultaneously penning the laws of physics. Their involvement is little known to historians, in part because both they and their biographers often downplayed the significance of such activity.[50] Lalande's habit of eating spiders, originally undertaken as a corporeal demonstration of the power of reason over prejudice, would later be appropriated as a stratagem for discrediting and ridiculing him.[51] Ironically, a deliberate move by professional women scientists in Europe and North America at the turn of the twentieth century to establish the new discipline of "domestic science" (or home economics, as it was later known) as an avowedly feminine domain of expertise served only to reinforce cultural and historiographical prejudice about the relatively peripheral place of food in the history of science.[52]

Yet, as Guerrini's and Shapin's articles make clear, spaces of food procurement, preparation, and consumption are also spaces of knowledge production and circulation.[53] Close attention to spaces in which recipes or technological ideas circulated can show how many apparently autonomous scientific principles, practices, and inventions—some seemingly distant from food per se, such as taxonomical descriptions of birds or pitches for high-tech start-ups—in fact may emerge from cooking experiments in household kitchens or conversations over meals in a diner.[54] One example that should resonate with historians of science illustrates this ongoing permeability between the spaces of food and experimentation. The Huguenot physician Denis Papin, fleeing Louis XIV's sanctions against Protestantism in France, found refuge in London working as a technician to Robert Boyle, natural philosopher and cofounder of the Royal Society. Papin's digester has attracted interest within a "Scientific Revolution" historiography as a key device within the experimental tradition surrounding the steam pump.[55] But contemporaries like the French academician Henri Justel quickly appropriated the digester as a culinary device first and foremost, a way to render matter as hard as an "ivory Ball" soft enough to eat.[56] Experimentation on cuisine

[50] On Ampère, see Spary, *Feeding France* (cit. n. 22), 18; on Kelvin, see Wise, "Work and Waste" (cit. n. 23).

[51] Spary, "Eating Beyond Reason" (cit. n. 34).

[52] Sarah Stage and Virginia B. Vincenti, eds., *Rethinking Home Economics: Women and the History of a Profession* (Ithaca, N.Y.: Cornell Univ. Press, 1997); Maresi Nerad, *The Academic Kitchen: A Social History of Gender Stratification at the University of California, Berkeley* (Albany: State Univ. of New York Press, 1999); Yuriko Akiyama, *Feeding the Nation: Nutrition and Health in Britain Before World War I* (London: I. B. Taurus, 2008); Carolyn M. Goldstein, *Creating Consumers: Home Economists in Twentieth-Century America* (Chapel Hill: Univ. of North Carolina Press, 2012).

[53] Guerrini, "Natural History of the Kitchen"; Shapin, "Breakfast at Buck's" (both cit. n. 39).

[54] See also Elaine Leong, *Recipes and Everyday Knowledge: Medicine, Science, and the Household in Early Modern England* (Chicago: Univ. of Chicago Press, 2018); Leong and Alisha Rankin, eds., *Secrets and Knowledge in Medicine and Science, 1500–1800* (Burlington, Vt.: Ashgate, 2011). For domestic experimentation more generally, see also Pamela H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: Univ. of Chicago Press, 2004); William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton, N.J.: Princeton Univ. Press, 1994); William R. Newman and Anthony Grafton, eds., *Secrets of Nature: Astrology and Alchemy in Early Modern Europe* (Cambridge, Mass.: MIT Press, 2001); Tara Nummedal, *Alchemy and Authority in the Holy Roman Empire* (Chicago: Univ. of Chicago Press, 2007); and Werrett, *Thrifty Science* (cit. n. 22).

[55] For example, see David Wootton, *The Invention of Science: A New History of the Scientific Revolution* (New York, N.Y.: HarperCollins, 2015), 492–508.

[56] Henri Justel to John Locke, 10 January 1680, Electronic Enlightenment Scholarly Edition of Correspondence, https://doi.org/10.13051/ee:doc/lockjoOU0020146a1c; see also Spary, "Making More out of Meat," chap. 6 in *Feeding France* (cit. n. 22).

and on natural processes have rarely, if ever, been distinct enterprises. Conversely, food has often played a central role in the making of scientific, medical, or technological knowledge and authority, often via the locus and manner of its consumption. Eating together in the home, coffeehouse, diner, or lab affords opportunities for sociability, the creation of networks, and the brokerage of knowledge, skill, and credit, whether at the famous Victorian dinner inside the Crystal Palace iguanodon, or among the Silicon Valley venture capitalists studied by Shapin in this volume.[57]

Critically examining the culture and politics of eating further allows historians of science, technology, and medicine to understand how and why certain epistemic developments or technical innovations in food and diet have met with vigorous, organized opposition. When universal standards for nutritional intake, universal accounts of foods' nature and effects, and universal claims about the homogeneity of all matter are exported outside the laboratory, a common reaction has been the reinvention of localism.[58] Whether it be the courtiers of Louis XIV's day (discussed by Aron) who fell back on *terroir* to defend their local power and distinctiveness against the French Crown's attempts at cultural hegemony; the nineteenth-century defenders of regional cuisine against industrialization and urbanization; or today's fears of genetically modified or irradiated produce and embrace of "slow food," these projects of resistance have commonly endorsed forms of food knowledge that were explicitly nonuniversal or antimodern.[59] Such campaigns disclose the food politics that gestures of universalism conceal.[60] The phrase "food miles" began to become current soon after 2000. It emerged directly out of environmentalist calls for a revised economics that included ecological impact within the cost of producing and consuming a given commodity.[61] This move has reshaped the priorities of today's supermarket shoppers, forging a new relationship between food and spatiality. Rising public pressure on food producers to disclose the place of origin of foods has then fused, not always benignly, with exhortations to buy only foods produced within national boundaries, or with attempts to prohibit the consumption of "foreign" foods.[62]

These two trends of localization and globalization have worked dialectically over centuries, producing a repeated remapping of the actual and imagined geography of

[57] J. A. Secord, "Monsters at the Crystal Palace," in *Models: The Third Dimension of Science*, ed. Soraya de Chadarevian and Nick Hopwood (Stanford, Calif.: Stanford Univ. Press, 2004), 138–69, on 150–3. The dinner was described in *Illustrated London News*, 7 January 1854, 22. It copied the genre of Victorian scientific dining clubs such as the X-club; see Roy M. MacLeod, "The X-Club: A Social Network of Science in Late-Victorian England, *Notes Rec. Roy. Soc. Lond.* 24 (1970): 305–22.

[58] Richard Drayton and David Motadel, "Discussion: The Futures of Global History," *J. Glob. Hist.* 13 (2018): 1–21.

[59] Aron, "Perceptions of Provenance" (cit. n. 43).

[60] Julia Abramson, "Legitimacy and Nationalism in the *Almanach des Gourmands* (1803–1812)," *J. Early Mod. Cult. Stud.* 3 (2003): 101–35; Julia Csergo, "La constitution de la spécialité gastronomique comme objet patrimonial en France (fin XVIIIe – XXe siècle)," in *L'Esprit des lieux: Le patrimoine et la cité*, ed. Daniel J. Grange and Dominique Poulot (Grenoble: Presses Univ. de Grenoble, 1997), 183–93; Csergo, "The Emergence of Regional Cuisines," in Flandrin and Montanari, *Food* (cit. n. 3), 500–15.

[61] Stephen Bentley, *Fighting Global Warming at the Farmer's Market: The Role of Local Food Systems in Reducing Greenhouse Gas Emissions*, 2nd ed. (Toronto: FoodShare, 2005), https://foodshare.net/custom/uploads/2015/11/Fighting_Global_Warming_at_the_Farmers_Market.pdf; see also Craig Sams, *The Little Food Book* (Bristol: Alastair Sawday, 2003), 51; William Lockeretz, *Ecolabels and the Greening of the Food Market* (Boston: Friedman School of Nutrition Science and Policy, Tufts University, [2003]), 69; and Giovanni Rebora, *Culture of the Fork: A Brief History of Food in Europe*, trans. Albert Sonnenfeld (New York, N.Y.: Columbia Univ. Press, 2001).

[62] Joanna Bourke, "Pubs Giant JD Wetherspoon to Stop Selling Jägermeister in Drinks Shake-Up Before Brexit," *Evening Standard* (London), 12 September 2018.

food environments. From debates about the components of *terroir* to proprietary practices of selective breeding of livestock or edible plants, the aims and methods employed in experimental laboratory and field programs in the food sciences have been informed by, and have helped to shape, an array of institutions, labor regimes, cultural practices, and ethical commitments. This is particularly visible in Woods's discussion of the sources, quality, and regulation of preserved meat exported from New Zealand in the nineteenth century, and in Wurgaft's exploration of recent investment in the use of stem-cell technology to produce lab-grown meat.[63] A similar politics of resistance has underlain the development of "alternative" diets, which often use radical, scientific knowledge-claims about food to critique the status quo—an example here being the marginal status accorded to vegetarianism over many centuries.[64] Explaining these connections in turn helps to explain how it is that sciences of food have underpinned projects as disparate as purifying individual bodies, reforming the poor, or saving the environment.

CONCLUSION

Eating well, as Bryan S. Turner underlined in a now classic study, has been the subject of scholarly writing for millennia, not just centuries.[65] It is what Claude Fischler terms the "paradox of the omnivore": because what is eaten becomes part of the eater, the alien qualities of food persistently threaten to overwhelm, disfigure, or supplant identity.[66] The historical study of food knowledge provides ample matter for contending that the question of which foods are "good" or "healthy" has never been the subject of universal consensus, from the early modern period right up to the present day. Nor has this judgment ever been free of political significance. Throughout recorded history, diet and eating have been the subject of profound disquiet. During the Renaissance, as Ken Albala shows, food became a particularly charged arena of temptation, offering an unsettling prospect of potentially uncontrolled transformation of the self, which had to be harnessed by right eating, temperance, and self-discipline.[67]

Considering the three and a half centuries from that period to the present day, perhaps the most striking feature of the emergence of the food sciences is the way that the physiological, neurochemical, and biomedical understandings of food that emerged in the nineteenth century, in particular, are now deeply imbricated in the way most people in late modernity understand themselves.[68] The vast shift in self-understandings over the period covered by this collection is brought home to students when they are asked to say whether they have ever weighed themselves or been weighed, and then to reflect

[63] Woods, "Preserving Animal Flesh (cit. n. 16); Wurgaft, "Meat Mimesis" (cit. n. 32).

[64] Tristram Stuart, *The Bloodless Revolution: A Cultural History of Vegetarianism from 1600 to Modern Times* (New York, N.Y.: Norton, 2007); Corinna Treitel, *Eating Nature in Modern Germany: Food, Agriculture, and Environment, c. 1870–2000* (New York, N.Y.: Cambridge Univ. Press, 2017); Fenton, *Order and Disorder* (cit. n. 20); Joshua Specht, *Red Meat Republic: A Hoof-to-Table History of How Beef Changed America* (Princeton, N.J.: Princeton Univ. Press, 2019).

[65] Bryan S. Turner, *The Body and Society: Explorations in Social Theory*, 2nd ed. (London: SAGE, 1996).

[66] Claude Fischler, *L'Homnivore. Le goût, la cuisine et le corps* ([Paris]: Editions Odile Jacob, 1993).

[67] Albala, *Eating Right* (cit. n. 31). See also Sandra Cavallo and Tessa Storey, *Healthy Living in Late Renaissance Italy* (Oxford: Oxford Univ. Press, 2013).

[68] Coveney, *Food, Morals and Meaning* (cit. n. 2); Chris Shilling, *The Body and Social Theory* (London: SAGE, 1993); Gronow, *The Sociology of Taste* (cit. n. 2).

on how that self-knowledge now shapes their sense of *who they are*. The rise of the calorie, the language of personal virtue as the default way to talk about dietary choices, and anxieties about the relationship between these choices and one's body mass index, turn out to be the end product of vast arrays of scientific, medical, and technological enterprises that have reshaped selfhood in profound ways, and have become integral to late modern individuals' self-image and self-fashioning.[69]

Bringing together articles written by a group of scholars exploring these and many other related questions, this collection thus sets out to establish the significance of the history of food as a growth area within the history of science, technology, and medicine. It suggests how rich the history of food can be as a subject area for the historian of science, technology, and medicine who is interested in the nexus between material culture, technology, taxonomy, ethics, aesthetics, embodiment, identity, and authority. Yet, until now, few studies have explored the historical processes through which scientific and medical knowledge claims gained such power to shape at once the political, financial, and technical contours of local and international food supply chains, and the cultural and personal dynamics of consumer choice. By highlighting how the historiographies of food and of science, technology, and medicine connect with one another, *Food Matters* should also help readers to identify many other prospective topics that have yet to receive sustained attention within the field. For this collection does not lay claim to exhaustive treatment of a topic of such breadth and depth. Inevitably, many domains remain as fruitful prospects for further inquiry. The culture and politics of labor in the food sciences, including historical changes in farming and cooking practices, as well as in the associated *savoir-faire* or skill, and the gender, ethnic, and socioeconomic dynamics underlying divisions of labor, are all areas that merit further intensive research.[70] Some of the most interesting work in the sciences of food in recent decades has emerged from anthropological methodologies that attend to material culture, ritual, status, and display, offering resources for current explorations of ways in which materiality and spatiality shape the production of natural knowledge, the relationship between gestural or tacit knowledge, the embodiment of gender and social standing, and the extension of "thing theory" to consumed substances.[71]

[69] Lucia Dacome, "Living with the Chair: Private Excreta, Collective Health and Medical Authority in the Eighteenth Century," *Hist. Sci.* 39 (2001): 467–500; Anita Guerrini, *Obesity and Depression in the Enlightenment: The Life and Times of George Cheyne* (Norman: Univ. of Oklahoma Press, 2000); Steven Shapin, "Trusting George Cheyne: Scientific Expertise, Common Sense, and Moral Authority in Early Eighteenth-Century Dietetic Medicine," *Bull. Hist. Med.* 77 (2003): 263–97; Michael Stolberg, "'Abhorreas pinguedinem': Fat and Obesity in Early Modern Medicine," *Stud. Hist. Phil. Biol. Biomed. Sci.* 43 (2012): 370–8. For modern weighing programs, see Lawrence T. Weaver, "In the Balance: Weighing Babies and the Birth of the Infant Welfare Clinic," *Bull. Hist. Med.* 84 (2010): 30–57; and Roberta Bivins and Hilary Marland, "Weighting for Health: Management, Measurement and Self-Surveillance in the Modern Household," *Soc. Hist. Med.* 29 (2016): 757–80. On fatness and self-image, see especially Peter N. Stearns, *Fat History: Bodies and Beauty in the Modern West* (New York, N.Y.: New York Univ. Press, 2002); Sander Gilman, *Fat: A Cultural History of Obesity* (Cambridge: Polity, 2008); and Georges Vigarello, *Metamorphoses of Fat: A History of Obesity*, trans. C. Jon Delogu (New York, N.Y.: Columbia Univ. Press, 2013). On the emergence of the calorie, see especially Dietrich Milles, "Working Capacity and Calorie Consumption: The History of Rational Physical Economy," in Kamminga and Cunningham, *Science and Culture of Nutrition* (cit. n. 7), 75–96; Nick Cullather, "The Foreign Policy of the Calorie," *Amer. Hist. Rev.* 112 (2007): 336–64; and Corinna Treitel, "Max Rubner and the Biopolitics of Rational Nutrition," *Cent. Eur. Hist.* 41 (2008): 1–25.

[70] Sophia Roosth, "Of Foams and Formalisms: Scientific Expertise and Craft Practice in Molecular Gastronomy," *Amer. Anthropol.* 115 (2013): 4–16.

[71] Lissa Roberts, ed., *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation* (Chicago: Univ. of Chicago Press, 2008); Paula Findlen, ed., *Early Modern Things:*

The history of knowledge about food—as well as the knowledge produced in the processes of making, sharing, and arguing about it—has always raised vexing questions about the shifting definition and boundaries of expertise between traditional recipes and experimental protocols; between domestic craft skill and laboratory procedure; and between the distribution of resources throughout the social body on the one hand, and the subjective experiences of individual bodies on the other. At a moment when the authority of science is being questioned by a variety of publics, *Food Matters* is a timely reminder that such tensions were always present in food-related domains of knowledge; indeed, debates over food have expressed the historical circumstances under which modern science became a prevalent force in many areas of public and private life. Appropriately, perhaps, the plan for this volume came into being electronically and transatlantically, but first acquired substance over soup and bread at the ICA Café in London—a space of moody artworks, abstract figurations of dancers' bodies, and healthy food, located a stone's throw from the Royal Society.

Objects and their Histories, 1500–1800 (London: Routledge, 2012); Harry Collins, *Tacit and Explicit Knowledge* (Chicago: Univ. of Chicago Press, 2010); Hjalmar Fors, Lawrence M. Principe, and H. Otto Sibum, "From the Library to the Laboratory and Back Again: Experiment as a Tool for Historians of Science," *Ambix* 63 (2016): 85–97; E. C. Spary and Ursula Klein, eds., *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago: Univ. of Chicago Press, 2010).