Delicious: A History of Monosodium Glutamate and Umami, the Fifth Taste Sensation

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
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2016

Abstract

My dissertation examines two interrelated objects: the global commodity and flavour enhancer monosodium glutamate (MSG), and umami (roughly translated from the Japanese as “deliciousness”), the fifth basic taste that MSG is understood to confer. This project situates umami within transmutations of the life sciences between Japan and the United States, and shows how the metabolics of taste are inseparable from global capitalisms. My research demonstrates how the infusion of molecular technique into taste psychophysics, food technology, and emerging arenas like gastrophysics has provided a boon to corporate producers and commercial users of MSG, who have toiled since the 1970s to forge consensus around the scientific validity of umami taste and thus equate MSG—which crossed the Pacific as a food technology for improving troop morale after World War II—with ‘natural’ sources of umami. In the United States, MSG has been heavily coded as East Asian, despite the fact that it has been used pervasively in iconic Anglo-American food products (e.g. Campbell’s soup, flavoured chips)—and is even now bound up in the international branding of Japanese cuisine. I suggest that MSG’s implication in a ‘symptom complex’ (ranging from numbness and tingling to asthma and indigestion) may indicate that the additive’s metabolism by humans is less well understood than regulatory standards reflect—and that all umami tastants may not be metabolically equivalent. I argue that monosodium glutamate and similar umami-conferring additives not only help to make possible, they make palatable, the hegemony of ‘Big Food.’ MSG helps to make unhealthy, cheap foods taste good, and as such it illuminates the insidious appeal and potential spread of processed foods in an increasingly food-scarce world.
Acknowledgments

I am forever grateful for the incomparable mentorship of Michelle Murphy, whose expertise, relentless integrity, and generosity have enabled my growth and success at every stage of my doctoral training. This dissertation is also a reflection of the rich network of scholars, collaborators, and friends I have enjoyed in the Greater Toronto Area. In particular, I am grateful to have been inspired by Shiho Satsuka, Elspeth Brown, Ritu Birla, Tanya Li, Anne-Emanuelle Birn, Scott Prudham, Natasha Myers, Matt Farish, Sue Ruddick, Jeffrey Pilcher, Brian Beaton, Carla Hustak, Sebastián Gil-Riaño, and so many others. A heartfelt thanks goes to my parents, Randy Tracy and Heather MacDonald, for always believing in me; to Sherry, Michael, Stephanie, and Reta; and especially to Ryan, for challenging me, inspiring me, and adding umami to my life. Charlie and Cora, this work is for you.
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Introduction
How to Bottle Deliciousness

A doctor should know something of the art of cooking,
"because whatever tastes good is easier to digest than other dishes
which may be equally as healthy."
~ Galen

From the taste of wheat
it is not possible to tell who produced it,
a Russian serf, a French peasant or an English capitalist.
~ Karl Marx

Introduction

In 2012, at the second MAD convention in Copenhagen, celebrity chef David Chang
famously declared to the assembled food enthusiasts, “Please assume I use MSG in my
restaurants.” An influential, not-for-profit research, collaboration, and outreach venture founded
by Michelin-starred chef René Redzepi, MAD has since 2011 provided a platform for innovative
thinking and doing about food across the culinary, scientific, policy, and industry worlds. Since
Chang gave this unapologetic endorsement of the maligned flavour enhancer monosodium
glutamate (MSG), his argument that fears of MSG toxicity have been grounded in American
culture and, in particular, xenophobic aversion to Asian foods, has been taken up across the
gamut of food commentary. His defense of MSG has been elaborated by recreational bloggers;

1 Mark Grant, Galen on Food and Diet (London and New York: Routledge, 2000), 131. Quoted in Julius Rocca,
“Galenic Dietetics” Review: Galen on Food and Diet, by Mark Grant Early Science and Medicine 8(1) 2003: 44-51.

2 Karl Marx, “A Contribution to the Critique of Political Economy,” in Karl Marx, Frederick Engels: Collected
Review (University of California, Davis 47 (2013): 602.

3 “MAD” is taken from the Danish for “food.”
respected journalists; chemosensory research scientists; the leading global producer of MSG, the Ajinomoto Co., Inc.; and the national lobby group responsible for forwarding the interests of glutamate producing and consuming companies in the United States, the Glutamate Association (GA).  

Chang and associates at his three-Michelin starred Momofuku group of restaurants (New York, Toronto, Sydney) have even been the reportedly stunned recipients of glowing official thanks for their advocacy from Ajinomoto’s public relations arm. One of the primary research questions of this dissertation is to explore how this exoneration of MSG among many cultural, scientific, and industry commentators has become possible, or been made thinkable.

In order to do that, this dissertation examines two interrelated objects: the global commodity and flavour enhancer monosodium glutamate (MSG) and umami (roughly translated from the Japanese as “savoury deliciousness”), the purported fifth basic taste sensation that MSG has since 2000 been understood to confer. What exactly is MSG, or monosodium glutamate? There are many ways to answers this question. The food additive is a white crystalline powder that greatly resembles white sugar or table salt. It is the sodium salt form of glutamic acid, a non-

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essential amino acid that is ubiquitous in the proteins that make up plants and animals. It is readily soluble in water, inert—that is, it does not destabilise other food ingredients—and neither absorbs humidity nor solidifies. Monosodium glutamate was first inspired by the flavouring properties of a type of seaweed called sea tangle (known as kombu in Japanese or Laminaria japonica to science) with historic roots in pan-Asian home cooking. It was crystallized in the sodium salt form in a process invented and patented by a Japanese biochemist named Kikunae Ikeda of the Imperial University of Tokyo (now Tokyo University) in 1909. In the intervening century, MSG has been produced industrially for use in processed foods due to its flavour enhancing properties when added to savoury foods like soups and other meat and vegetable-based recipes. The additive was first produced by extraction, in which the glutamic acid was extracted from a raw ingredient like corn, wheat, soybean, cassava, or sugarcane; however, around 1960, MSG production was greatly expanded due to the development of a production technique called industrial fermentation, in which modified bacterial strains excrete glutamic acid into a nutrient medium from which the glutamic acid is then harvested and crystallized into the sodium salt form.

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7 Amino acids are the building blocks of proteins. “Non-essential” refers to the fact that the body synthesizes glutamic acid on its own, so we are not reliant on dietary sources of this amino acid for our health and survival—i.e. it is not ‘essential’ that we meet bodily requirements of this amino acid through our diet.


In the early years of the twenty-first century, monosodium glutamate has been cited as one of the world's most widely used food additives.\textsuperscript{11} Its applications are said to be growing in the areas of convenience foods and for “increasing the acceptance” of new flavours.\textsuperscript{12} According to the \textit{IHS Chemical Economics Handbook}, world demand for MSG in 2014 was estimated at above 3 million metric tons and valued at $4.5 billion USD. Asia accounted for roughly eighty-eight percent of global MSG consumption in 2014, with China representing fifty-five percent of global consumption. The world’s largest producer and exporter of MSG by quantity, China produces approximately sixty-five percent of the world’s MSG and nearly forty-four percent of global exports of the additive.\textsuperscript{13} These figures represent a fifty-percent increase over the roughly 2 million metric tons (MMT) cited in 2009 in a leading scientific paper.\textsuperscript{14} The additive is part of a larger and multi-billion dollar global ‘fermentation products’ market that includes the industrial production of enzymes, other amino acids, and xanthan gum for use in foods, supplements, and pharmaceuticals. A little over the decade ago, the Ajinomoto Company, which claimed over 30


\textsuperscript{12} J. Prescott, “Effects of Added Glutamate on Liking for Novel Food Flavors,” \textit{Appetite} 42 2004: 143-150.


percent of the MSG market, aggressively expanded its own production, investing 9.5 billion yen (approx. $81 million US) to further develop facilities in Brazil, Vietnam, and Thailand.\footnote{Lindsey Partos, “Ajinomoto Ramps up MSG Production on Market Growth.” News Headlines Financial & Industry FOOD navigator.com/Europe 21/06/2005 <www.foodnavigator.com/news/ng.asp?id=57676> accessed 11/20/06. The company cites Brazil, with its vast supply of sugar cane, as having “the highest level of cost competitiveness of any of its products worldwide.”}

![World Consumption of Monosodium Glutamate - 2014](image)

**Figure 1(a). World Consumption of Monosodium Glutamate by Region, 2014.**

Why the enormous appeal of MSG? In the immediate postwar years when monosodium glutamate was successfully integrated into the world’s leading industrialized food system—that is, the United States—MSG appeared to be the scientific antidote for the downsides of industrial food production: diminished freshness and flavour, and thus the consumer perception of diminished food quality. MSG just made foods taste better. And it is this aspect that is driving MSG’s international growth still today—with rising incomes in countries like Thailand, Indonesia, Vietnam, Brazil and Nigeria, MSG has been described by one for-profit industry analyst as a newly “affordable luxury,” just as it was framed in its very first market a century
ago: Japan (a history I elaborate in chapter one). In an early twentieth-century climate of technocratic optimism, MSG quickly became a food industry staple throughout Japan, China, and parts of Southeast Asia. After MSG’s evident success in improving troop morale for the Japanese military, early adoption in the U.S. by such prominent companies as Campbell Foods, Libby, General Foods, Standard Brands, Nestle, United Airlines Food Service, Borden, Pillsbury, Gerber, and Oscar Mayer signalled the establishment of a new American food industry lifeline. While the most visible example of MSG use in the U.S. has been the table-top condiment Ac’cent, it was the incorporation of MSG into dominant food processing practices—that is, by industrial consumers, not households—that has characterized the integration of MSG into the American diet. Monosodium glutamate can be an appealing enhancement of home cooking; however, I focus largely in this history on how the additive has been invaluable to industrial food producers.

While MSG’s story is decidedly global, this dissertation focuses on the political and cultural dimensions of the additive and its underlying chemosensory science in the U.S. context, with attention to the formative dynamic of U.S.-Japan relations. I begin the story in Japan and foreground the politics of translating scientific knowledge in a post-colonial, critical science and technology studies perspective. Despite my interest in telling the broader story of MSG’s politicization around the globe, I focus on the United States here because: 1) in no other country has MSG been vilified to the extent it has in the U.S., nor does there exist elsewhere, to my


18 Sand, “A Short History of MSG.”
knowledge, a comparable archive of ‘adverse events’ (symptoms) among consumers; and 2) as the world’s leading economy and the site of much of the authoritative knowledge production and diffusion in both science and cuisine, American scientific and public opinion on MSG has great significance beyond its borders.¹⁹

I also trace how the twenty-first century scientific community has embraced the taste sensation long argued by Japanese scientists to be conferred by MSG: umami (‘savoury deliciousness’). In focusing on the United States as a center of gravity in MSG’s transnational career, I tell the story of the human relationship with this century-old technology gone blockbuster thanks to its cost-efficient production via fermentation of modified bacterial strains. MSG induces human sensory response, and as such it lends new salience to Foucauldian formulations of biopolitics, or the politicization of life and living capacities, and more specifically of biocapitalism. Biocapitalism names the way appropriations of “living nature—“literally capitalizing life” do not simply use living things, as in ancient practices of fermentation or agriculture. By contrast, they “format economic enterprises that take as their object the creation, from biotic material and information, of value, markets, wealth, and profit.”²⁰ Living things are made assets, liabilities, and proprietary technologies not only as individuals and populations, as Foucault pointed out, but at the level of microbes, molecules, enzymes, and


receptors.²¹ Monosodium glutamate is important not only because of its own history, but because it is part of an expanding paradigm in the food sciences, in which the molecular register of the human sensorium is of crucial interest to capital—not just the food product to be consumed. Within this particular biocapital regime of flavour enhancement, the most valuable corporate product is scientific knowledge of how to induce pleasure—and thus happiness—in the consumer. The amino acid-based product is an effect and a means of the primary site of corporate investment: the science of human chemosensation.

The Politics of Umami

Chemosensory scientists (or those who study the ‘chemical senses’ of smell and taste) have, since the 2000 identification of dedicated molecular receptors for savoury tastes in the mouth, described umami as the taste experience of rich, meaty, savoury deliciousness. This taste has been embraced across the world as umami, or the “fifth basic taste” sensation. This fifth basic taste, after sweet, salty, bitter, and sour, is said to be associated with the glutamate-content of foods. Ripe tomatoes and mushrooms are two examples of foods frequently cited as innately possessing high levels of glutamate. Parmesan cheese, soy sauce, fish sauces (Vietnamese *nam pla*, Indonesia *terasi*, Burmese *ngapi*, Philippino *bagoong*), sauerkraut, ketchup—even human breast milk—are other prominent foods identified as glutamate-rich. Long-standing techniques that involve the breakdown or denaturing of proteins through fermenting, pickling, searing, braising, toasting, slow-cooking, etc. are understood to all build umami taste—in that all of these

processes release glutamic acid from the protein in which it is usually bound, yielding what is called ‘free’ glutamate to be sensed by umami taste receptors. And people seem to be excited about it. In early 2016, a Google search of “umami” yields 4 million+ results, ranging from a Wikipedia entry, editorials, and blogs to the annals of industry lobby group the Umami Information Centre, and to websites of new, specialized restaurants like Umami Burger (with fifteen locations across California) and the Umami Café (New York). For perspective, a search for “sweet” generates upwards of 1.3 billion results. A current PubMed (MedLine) search for “umami” yields over 500 references—an exponential increase over the 86 PubMed references and the 4,000+ Google search results reported by one umami research group in 2000.22

Umami taste is often interpreted as serving the evolutionary purpose of signalling valuable protein content.23 Its public health merit is said to lay in providing high flavour without the need for high sugar, fat, or sodium content.24 The evolutionary biology interpretation is that, since time immemorial, humans have experienced glutamate as deliciously satisfying—hence, in part, the pervasiveness of these food-preparation techniques.25 The breakdown of proteins in food preparation results in a range of ‘cleavage products’ that elicit taste sensations that their compound forms do not. In other words, we eat complex fats, sugars, and proteins, but these do not ‘taste’ like anything to us; it is the substances they break down into that our body perceives on a hedonic register, or as a source of pleasure or disgust. Complex sugars or polysaccharides


24 For example, see Mouritsen, “Umami Flavour.”

25 In 2008, Helmreich interpreted this move as the presumption of a “primordial ontology upon which biocapitalism merely elaborates.” Helmreich, “Species of Biocapital,” 464.
are broken down by enzymes in our saliva into mono- and disaccharides (sweet tastes); proteins are broken down into what are called ‘free’ amino acids like glutamate and aspartate and substances such as the 5’–ribonucleotides (more on these in my final chapter). As a result, some nutritional experts and industrial producers/users of MSG have claimed that umami holds the key to understanding universal motivations behind human eating behaviour.26

So where is the downside? Long before scientists established an explanatory mechanism for MSG’s flavour enhancing property, the additive was materialized as a possible dietary toxin.27 In 1968, Robert Ho Man Kwok, M.D., a recent Cantonese migrant to the U.S., wrote in the *New England Journal of Medicine* the first published account of human symptoms arising from MSG ingestion: numbness, tingling, and tightness of the chest after eating at American-Chinese restaurants.28 This was immortalized in popular and scientific discourse as the “Chinese Restaurant Syndrome” in a decade characterized by landmark environmental, health, and product-safety movements, like the 1968 furor over the possible carcinogenicity of artificial sweetener saccharin, or the 1969 Food and Drug Administration (FDA) banning of cyclamate, another artificial sweetener found to be cancer-causing, and forcing the recall of millions of

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27 This verb is attributable to Michelle Murphy in *Sick Building Syndrome and the Problem of Uncertainty* (Durham: Duke University Press, 2006).

dollars of soft drinks. While the NEJM received a flurry of letters from readers who reported having similar reactions, many American experts laughed up their sleeves at both the possible science behind MSG reactivity and the public outrage over this most recent threat to the American body public. For instance, Dr. Herbert Schaumberg at the Albert Einstein School of Medicine commenced a study of MSG’s effects only in order, he noted sarcastically, to stem the “mounting hysteria and prevent the wholesale slaughter of Chinese restaurant owners.”

While much of this alarm has been ably problematized as a symptom of structural racism and fears among Americans of Western European background of contagion and immorality riding on East Asian immigration to the United States, anecdotal accounts of MSG sensitivity persist. Activists and critical scientists from the 1970s to the present have collected a body of adverse reactions to MSG. These include headache, migraine headache, fatigue, dizziness, depression, mood swings, anxiety, asthma, vomiting and diarrhoea, accelerated heart rate, hyperactivity, chest pain and tingling around the face, blurred or altered vision, excessive thirst, obesity, and theories of a connection to degenerative neurological disorders such as Parkinson’s, Lou Gehrig’s, and Alzheimer’s Diseases, as well as in post-traumatic stress disorder among troops fed on military rations heavy in MSG.


31 See Mosby, “That ‘Won-Ton Soup Headache.’”

Monosodium glutamate’s history, then, taps into the larger question of the medical significance of what we eat. This is an abiding conundrum whose history stems back through the postulations, for example, of Galenic medicine, Traditional Chinese Medicine (TCM), and Ayurvedic medicine on the health-making or denying capacity of edible matter. Pursuing food as constitutive of both health and harm, specifically in the form of chemical exposure, this dissertation detangles the ways that MSG is constituted as a “response” and “reaction” in the scientific research and regulatory regimes of the U.S. Since I believe there is no single facile, positive answer to the question of MSG’s ‘safety,’ I trace how experts, regulatory bodies, and politicized eaters have assembled the difference between food (additive) and drug, between responses that are coded as harnessable capacity (enhanced taste response with no associated adverse effects) and debility (‘inexplicable’ worsening of one’s asthma, for example). Following the work of Hannah Landecker, my analysis of MSG as a biocapitalist technology expands our understanding in science and technology studies (STS) of exposure by including eating as an important domain of exposure. I see this occurring not only through the persistence of pesticide residues but, first, through the self-selecting chemical character of industrially produced foods themselves (for shelf-life and ‘acceptability’ despite low input costs), and second, through the metabolism of flavour-additive xeno-substances (as compared to pharmaceuticals or industrial pollutants) like MSG. Xenobiotics or xeno-substances are understood as novel chemical

33 The categories “food” and “drug” are delineated in the Galenic tradition (Galen, c. 129 AD – 210) so influential in Euro-American thought. For Galen, to understand nutrition was to understand what the body does to the food it metabolizes (as nutriment); to understand pharmacology was to understand what the food (as drug) does to the body. As Owen Powell has established in his work on the Galenic corpus, this distinction is preserved in the modern pharmacological practice as the areas of pharmacokinetics and pharmacodynamics, respectively. For Galen, foods were those items assimilated into the body’s own tissues, whereas all others were considered drugs (pharmaka), some of which were ‘poisonous’ and some not. Owen Powell, Galen on the Properties of Foodstuffs. Introduction, Translation and Commentary, with a foreword by John Wilkins (Cambridge: Cambridge University Press, 2003).

34 For example, Hannah Landecker, “Food as Exposure: Nutritional Epigenetics and the New Metabolism,” BioSocieties 6 2011: 167-194.
substances located within an organism that are not normally occurring in or produced by that organism, or those that are present in much higher concentrations than are usual. These include such things as carcinogens, drugs, environmental pollutants, food additives, hydrocarbons, and pesticides.

In this dissertation I take up the intellectual project described by Kyla Wazana-Tompkins as redefining food studies as a “critical studies of eating.” Rather than reproducing the growing field’s inadvertent reproduction of a fixation on the commodity (fetishizing the food product), this historiographical move foregrounds the relations in which MSG and the consumer confer each other’s attributions of stimulant and stimulated. Science studies scholar Karen Barad theorizes this kind of co-production as *intra-action*, in contradistinction to the bumping up against one other of essentialized, discrete material entities.\(^{35}\) Anthropologist and philosopher Annemarie Mol has recently written that

> the eating self… does not control “its” body at all. Take: I eat an apple. Is the agency in the I or in the apple? I eat, for sure, but without apples before long there would be no “I” left. And it is even more complicated. For how to separate us out to begin with, the apple and me? One moment this may be possible: here is the apple, there am I. But a little later (bite, chew, swallow) I have become (made out of) apple; while the apple is (a part of) me. Transubstantiation… I will never master which of their sugars, minerals, vitamins, fibres are absorbed; and which others I discard. How to give words to this mode of being a subject? There is a lot of activity going on here, but no control… But [the subject] will not eat just anything. It only bites into what it trusts. It only chews on what tastes good… And the absorption of particles into its bloodstream is selective too. Neither tightly closed off, nor completely open, an eater has semi-permeable boundaries.\(^{36}\)


The impossibility of control—both pedestrian and experimental—evident in the history of MSG reveals the desperate insufficiency of our categories of drug, food, and toxin to clarify what it is that happens when something like MSG comes into contact with human saliva, the sodium molecule dissolves, and the glutamate ion is metabolised by the human body.

In this project I have to think of eating as a pharmacokinetic process, a term used in pharmacology (from the Greek pharmakon “drug” and kinetikos “putting in motion”) to describe what the body makes of the ingested substance. That substance’s ‘drugness’ only comes into being when the two or more entities intra-act, or when the body metabolizes the substance, transforming it and being transformed by it. It is my contention through this history of MSG that intra-action in eating is characterized fundamentally by plurality. Eaters are not universally fungible; their bodies are not mutually interchangeable, even as they are made statistically commensurate per, for example, the socioeconomic categories of the national census, or of chemosensory focus groups or target market demographics that subdivide research subjects or prospective consumers by factors like age, race, or gender.

The regulatory regime in the United States illustrates the importance of our critical attention to plurality. The USDA and FDA, for example, retain the ontological distinction (or working fiction) between foods and drugs while arbitrating questions of public health.\(^37\) In an era of omnipresent ‘functional foods,’ nutraceuticals, and other products marketed as ‘foods that work’ (probiotics, energy drinks, low-fat, sugar-free, zero-calorie, high-fibre, cholesterol-lowering,

\(^37\) Philosophers and critical scholars use the term “ontology” to signal a) that things are defined, understood, and manipulated in historically particular terms, and b) how those definitions matter. For example, my project traces how the definition of what MSG “really is” (its ontology) has changed: first it is a useful accoutrement of the modern Japanese kitchen, and then it is a wonder flavour enhancer and possible neurological stimulant; then it becomes a potential toxin; and by the twenty-first century, it is reborn yet again as the chemical agent of umami, the fifth taste sensation. For more on ontology, see Ian Hacking, *Historical Ontology* (Cambridge, MA: Harvard University Press, 2004) and Michelle Murphy, *Sick Building Syndrome*.\n
vitamin-fortified), the FDA reviews food products with far less rigour than they do official pharmaceutical products. In a distorting emphasis on episodic rather than quotidian exposures, regulatory procedures assume drugs pose greater risks than foods.

When the FDA reviews drugs, the safety and efficacy of the *entire product* is considered; however, when the agency considers foods, the safety of *individual ingredients* is evaluated rather than the food as a whole… in fact, food-based public health interventions—for example, supplementing milk with vitamin D and fortifying cereal with iron—may pose greater risks than many drugs because the reach of food is so vast. Even minor risks are significant when the majority of the population is exposed to them. 38

This astute commentary from regulatory insiders in 2010 provides context to the fact that monosodium glutamate has been considered Generally Recognized as Safe (GRAS) by the FDA since the inauguration of such legislation in 1958—and this despite persistent complaints of the additive’s uneven effects in the humans who consume it.

The intervention of this dissertation, then, is to illustrate the ways exposure is built into the capitalist food infrastructures that so many people in the United States—and increasingly more regions of the world—vita! depend upon. I argue that monosodium glutamate and other flavour enhancers not only help to make possible, they make *palatable*, the hegemony of ‘Big Food.’ Borrowing from the editors of a recent issue of *Limn* on food infrastructures, by Big Food I understand that “simultaneously varied and monolithic, indispensable and frightening” arrangement of scaling up food production and distribution with the end of “managing risk,

avoiding disruption, nourishing families, and transmitting pleasure." Flavour enhancers help make consumers crave highly processed and refined wheat, corn, soy, and sugar-based products that researchers have steadily linked to some of the most pervasive chronic health conditions of affluent nations: from obesity and gastrointestinal complaints like Irritable Bowel Syndrome (IBS) to affective disorders from clinical depression to ‘brain fog.’ MSG helps to make unhealthy, cheap foods taste good, and as such it illuminates the insidious appeal and potential spread of highly processed foods in an increasingly integrated and food-insecure world.

This is all to say that umami science is conducted within a complex political ecology. My research has revealed that the infusion of molecular technique into taste psychophysics, food technology, and constituting emerging arenas like gastrophysics has provided a boon to corporate producers and commercial users of MSG. These actors have toiled since the 1970s to forge consensus around the scientific validity of umami taste and thus equate MSG—which crossed the Pacific as a food technology for improving troop morale after World War II—with ‘natural’ sources of umami. However, the political interestedness of umami science is occluded in a few important ways. The first is a dilemma of naming. Food science vocabulary is dense, and does not easily lend itself to easy precision in public discourse. As veteran journalist Sarah Elton advised me while preparing an April 2016 Macleans piece on MSG’s comeback in recent

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40 According to one expert, gastrophysics as a field combines leading theoretical, simulational, and experimental biophysical techniques to improve scientific knowledge of cooking, food processing, and the “quantitative aspects of the physical basis for food quality, flavour, and absorption into the human body.” Ole G. Mouritsen, “The Emerging Science of Gastrophysics and its Application to the Algal Cuisine,” Flavour 1(6) 2012.
years, “No big words, please—this is a lay audience we’re speaking to.” The word in question was *intrinsic*. Such is the current state of journalism—the public is information-saturated; editors want to run stories that are simple, sensational, and can be tweeted in 140 characters or less.

The difficulty for critical conversations about MSG is that MSG’s story is not a simple one. The notion of what MSG is and what biologies it interacts with have been unstable and plural over time and space. However, glutamate industry representatives, and many scientists, particularly since 2000, have worked hard to ontologize glutamate as a singularity—not by turns a flavour enhancer, a neurotoxin, and a universal taste sensation, as this historical account of MSG will attest. The assertion made throughout the educational literature of industry lobby groups is that, “Glutamate is glutamate, whatever the source!” MSG is science’s way of delivering the same thing nature does, so there is no need to worry about eating it—or even accurately labeling it. Speaking to why industry lobby groups like the Umami Information Center have launched campaigns to raise awareness of the many delicious ‘natural’ sources of umami, Kitty Broihier, a consultant for Ajinomoto Food Ingredients (a Chicago-based subsidiary of Ajinomoto Co., Inc.), stated in 2007: “We are hoping that eventually people will become familiar with why this flavor enhancer [MSG] is in our food—well, because it's giving my food the taste that I like.”


Industrial users and producers of MSG have a profound financial stake in flattening any potential metabolic distinctions between sources of glutamate. Gary Beauchamp, director of leading taste and smell research center, the Monell Chemical Senses Institute in Philadelphia, PA has used simple terms to illustrate why: “learning how receptor molecules work can lead to the development of less-expensive ingredients and flavor enhancers… [T]he food industry is very concerned with understanding why people consume what they consume.” Beauchamp has described his group’s research as falling into three basic areas: identifying receptors involved in umami taste; exploring how early experiences with umami affect later food choices, e.g. human breast milk high in glutamate; and inquiring into whether people are differently sensitive to umami, and how that may influence food choices. Scientific insights into the molecular mechanisms of flavour sensation and eating behaviour are of acute interest to those companies and individuals whose work it is to engineer food others will want to buy. In the words of two active—and industry-funded—umami researchers, 

the discovery of umami has contributed to the enjoyment of food at dining tables around the world. In the next decade, a better understanding of the molecular mechanisms underlying umami taste perception should be forthcoming. This information will aid in the better use of umami substances to improve the palatability of foods even further.

This discursive work by industry representatives is important because the acronym “MSG” has since 1968 been used imprecisely by consumers, companies, and commentators as a moniker for

45 “The authors gratefully acknowledge the helpful discussions and contributions by many research members and colleagues in Ajinomoto. Particular thanks are due to Takeshi Kimura for his help in the preparation of this paper.” Shizuko Yamaguchi and Kumiko Ninomiya, “Umami and Food Palatability,” *Journal of Nutrition* 130(4) 2000: 921S-926S.
not only monosodium glutamate, but for all forms of additive glutamate in food products.\textsuperscript{46} This shorthand matters—and not because of our present-day attention to provenance (thanks to foodie culture). It matters because MSG is not the only glutamate-based flavour enhancing food additive in use. Other common food additives that contain additive glutamate include: monopotassium glutamate, yeast extract, hydrolyzed protein, glutamic acid, calcium caseinate, sodium caseinate, yeast food, gelatin, hydrolyzed corn gluten, textured protein, yeast nutrient, and autolyzed yeast. Additives which sometimes contain additive glutamate include but are not limited to: carrageenan, bouillon or broth, stock (of any type), whey protein (concentrate or isolate), maltodextrin, citric acid, barley malt, pectin, protease (enzymes), enzymes or enzyme-modified products, malt extract or flavouring, soy protein isolate or concentrate, soy sauce (extract), protein-fortified products, ultra-pasteurized products, ‘seasonings,’ natural flavour(ing), or flavour(ing).\textsuperscript{47} So, not only has the ontology of MSG shifted historically, glutamate is also at any given point in time a promiscuous and diverse substance.

In the US context, the political currency—the name recognition, so to speak—of the term “MSG” has two important effects. It is used indiscriminately by industry representatives, food commentators, and journalists to describe all of the following: 1) the relatively high glutamate content of some raw foods (e.g. tomatoes); 2) artisanal or long-standing production techniques that break down protein to liberate glutamate to be sensed by the body (e.g. fermented miso or tofu, aged cheese, sun-dried tomatoes, cured meat); and 3) flavour enhancers produced by

\textsuperscript{46} Confusion also arises from the interchangeable or imprecise use of “glutamate” (which indicates glutamate’s presence in a compound, e.g. MSG, or in its ionised form upon the break up of that compound, to form what is called ‘free’ glutamate) versus “glutamic acid” (the amino acid as it occurs bound up in proteins).

\textsuperscript{47} Some of the commonly identified sources of additive glutamate have been compiled by consumer advocates at the Truth in Labeling Campaign—a more comprehensive and accessible list than the many trade discussion of hydrolyzed protein sources. TLC. “Names of Ingredients that Contain Processed Free Glutamic Acid (MSG),” Accessed November 11, 2015. www.truthinlabeling.org/hiddensources.html.
hydrolysis or industrial fermentation. Hereafter, I distinguish between the first two sources of glutamate (which I call *endogenous*) and the third (which I call *additive*). I have chosen the terms endogenous and additive, pulled from technical discussions dating from the late-1970s, because I find them to be the most technically accurate and least encumbered with political currency. 

*Endogenous* (originating from inside) glutamates are those that occur naturally in raw foods or are generated through small-scale food preparation techniques like curing, pickling, fermenting, or slow cooking, in which the glutamate is consumed in amounts delimited by the raw material’s intrinsic chemistry, and in conjunction with the other micro- and macronutrients also found in that plant or animal-based food. For example, tomatoes are commonly cited as being naturally high in free glutamate; drying or simmering tomatoes, for example, denatures its proteins and liberates even greater free glutamate to be sensed by the body upon consumption. In contrast, *additive* glutamates are those that have, since the 1910s, been used as food additives and have been produced industrially by either hydrolysis or fermentation (processes I discuss in detail in chapter two). Such additive glutamates are incorporated into processed food formulas in carefully calibrated proportions so as to optimize their flavour enhancing effect. This proportion is self-limiting, as there is a point of diminishing returns at which more MSG, for example, does not mean more deliciousness, and it often approximates the proportion in which endogenous glutamates occur in foods. However, when consumed in a cumulative fashion in numerous processed foods whose other ingredients are nutritionally defunct and do not naturally correlate to those amounts of free glutamate, the metabolic effects may indeed be different—and differently experienced by different people at different stages over their life.

The plurality of glutamate, in biological systems and in a range of additives in the food industry, is important from the standpoint of regulation because the FDA has officially
prohibited the practice of advertising ‘No MSG’ on labels when that product contains other additive glutamates as flavour enhancers. The Agency acknowledges that consumers have come to use “MSG” as a moniker for any added glutamate—that is, the kind understood to potentially cause adverse reactions. Thus, the FDA considers food products advertising "No MSG" or "No Added MSG" to be misleading if the food contains ingredients that are other sources of additive glutamate, such as hydrolyzed protein. This rule is routinely ignored.\(^48\) The USDA also requires food processors to uphold a minimum percentage of protein in processed meat products. By adding hydrolyzed protein as flavouring, manufacturers achieve a cost-efficient way to top up their protein content.\(^49\) This strategy is also misleading on another account. In the words of one vocal MSG critic from the 1980s, physician George H. Schwartz, “what could be better for us than protein? And everyone knows vegetables are good for us. Thus, ‘hydrolyzed vegetable protein’ sounds safe and even wholesome.”\(^50\)

So, the political currency—or name recognition—of “MSG” has the effect of inappropriately limiting the focus to monosodium glutamate alone. This is problematic because it provides a loophole for industrial consumers of MSG (processed food producers) to avoid MSG’s negative cachet by labelling products “MSG free” when they do contain other sources of additive glutamate or flavour-enhancing 5’-ribonucleoides, which work synergistically with glutamate to enhance savoury flavour. It also allows corporate public relations architects to capitalise on public misunderstanding by conflating MSG and other flavour enhancers with endogenous glutamates. As anthropologist Cori Hayden has observed in her work on the

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\(^{48}\) FDA Backgrounder August 31, 1995. “FDA and Monosodium Glutamate (MSG).”

\(^{49}\) Blaylock, *Excitotoxins*, 35.

\(^{50}\) Schwartz, *In Bad Taste*, 33.
lucrative branding of generic pharmaceuticals in Latin America, “[s]imilarity, likeness, and fungibility are raw material for, but also obstacles to the labor of making—and keeping distinct” in branding and advertising. A grilled steak does not equal raw sauerkraut does not equal instant ramen does not equal Doritos. Monosodium glutamate is not the same thing as a porcini mushroom and, in the words of two avowed umami junkies, umami is not the same thing as MSG. Yet this is precisely the slippage made throughout the literature of industry lobby groups, and it is often implied by culinary and foodie fans of umami—that MSG is just science’s way of delivering the same thing nature was providing anyway. So what’s wrong with a food additive, if it makes my food taste so good?

At issue in the naturalization of molecular technique—like that at work in MSG—in both ‘high’ and ‘low’ cuisine is its potential for glossing over glutamate’s complex roles in cognition, learning, memory, mood, digestion, and appetite-regulation. MSG is produced and consumed through what might be described as acts of metabolic violation. The commercial engineering of sensory response via food additives produced by laboratory bacteria modified to hyper-excrete glutamate presents ethical and health questions generally not associated by the everyday consumer with the discussion of food. In fact, flavour enhancers, artificial sweeteners, and a range of pharmaceuticals (e.g. Selected Serotonin Reuptake Inhibitors (SSRIs) used to treat

51 Hayden, “Distinctively Similar,” 604.
52 Kasabian and Kasabian, Fifth Taste, 15.
54 Studies to this effect are published continuously—take, for example, this very recent study examining the correlations between plasma levels of glutamate, glutamate-specific enzymes, and cognitive outcomes such as verbal and visual memory, recall, and attention/concentration. Y. Kamada, R. Hashimoto, H. Yamamori, Y. Yasuda, T. Takehara, Y. Fujita, K. Hashimoto, and E. Miyoshi, “Impact of plasma transaminase levels on the peripheral blood glutamate levels and memory functions in healthy subjects,” BBA Clinical 23(5) February 2016: 101-7.
depression) intervene in neurological responsivity in not dissimilar ways. My research has led me to conclude that flavour enhancers are more like what we call drugs than they are what we call foods. Our categories of ‘food’ and ‘drug’ and ‘toxin,’ then, are profoundly inadequate in the context of our post-genomic era of omnipresent biotechnological enhancement of the capacities of living things. Most immediately at stake with MSG is the fact that consumers are largely oblivious to the calculated manipulation of their embodied responsivity, of the cynical corporate evocation of their sensory pleasure and therefore their motivation for making future eating decisions. Attending to the distinctions between endogenous and additive glutamates and nucleotides enables us contextualize allegations of adverse health effects attributed to MSG. In the final estimation, what is perhaps the most fascinating to me is how little many people care about metabolic violation when it confers pleasure. The fact of MSG’s hedonic value makes it an even more insidious violation, in my mind, because its properties occlude critique—MSG is the “beer goggles of taste,” as one industry insider turned popular food writer has put it.\textsuperscript{55} It makes you want to consume what you might not otherwise.

In the words of the Glutamate Association (GA), “MSG has been, and continues to be, widely used as an effective means of \textit{making good food taste better}” [my emphasis].\textsuperscript{56} Historical evidence strongly suggests, however, that additive glutamates are so valuable because they make the most nutritionally deficient and unsustainable foods taste really good. In other words, MSG continues to be widely used as a very effective way of making \textit{bad} food taste good. Even an

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\textsuperscript{56} This exact phrasing, employed in 2006, has since been updated by the Glutamate Association. However, the messaging is the same: that glutamates are chemically and metabolically identical, and are reason for many foods’ tastiness—like tomatoes and breastmilk for infants. Glutamate Association. “MSG Facts.” Accessed October 16, 2016. \url{www.msgfacts.com/facts/msgfact02.html}.
\end{flushleft}
ardent umami fan and MSG proponent states: “The only concern for extensive use of these food additives seems to be the possibilities they open for disguising food of poor quality and of a dubious origin.” Moreover, the technical and moral dimensions of a processed food’s ingredient list leave tremendous space for incomprehension, manipulation, and misrepresentation. For example, food processors can conceal additives like MSG in ingredient listings like ‘natural flavouring,’ ‘seasoning,’ and even ‘spices.’ ‘Natural’ colours and flavours have, in recent years, been coveted by consumers, with an increasing preference for products with even more specific clean-label or health-conferring claims. Ajinomoto has taken pains to position MSG production as a ‘natural’ process, for instance personifying their fermentation raw material, sugar cane waste, as “Ko the Sugar Cane,” on his/her “Never-Ending Journey” or biocycle, rendered in sunny tones as part of Ajinomoto’s “Global Story”—with tabs called “Yummy Meal,” “Healthy Living,” and “Eco Activity.” Corporate users and producers of additive glutamate can actually sell MSG’s presence in a product (without naming it directly) by way of the product’s officially ‘natural’ derivation.

The Glutamate Association (GA)’s website provides the following in response to the question: “How does MSG enhance food flavor?”

Cooks around the world have always known that certain foods have more distinct and pleasurable flavor characteristics than others; that is why these foods often are used as ingredients in recipes. It has been noted that glutamate is an important element in the natural ripening process that results in full flavor. Perhaps this is why foods naturally

57 Mouritsen, “Umami Flavour,” 70.


high in glutamate (such as tomatoes, cheese and mushrooms) are often used for their flavorful qualities.

They go on to explain:

Monosodium glutamate *enhances the basic flavor* of many foods. New studies also show that MSG elicits a unique taste that is known as "umami" in Japan, and often described by Americans as a savory, broth-like or meaty taste. "Umami" may be the fifth basic taste, beyond salty, sweet, sour and bitter. As an *integral* part of cuisines *around the world*, this savory taste is common to the bouillons of Europe, the oyster sauce of China, the soy and fish sauces of southeast Asia, the pizza and lasagna of Italy, and the chowders and stews of America [my emphasis].

This explanation deploys the latest scientific research, which the glutamate producing and consuming industry has often directly or indirectly financed, to situate MSG in a globalizing history of idyllic culinary cosmopolitanism, in which unity manifests as variety, and deliciousness—or umami—is universal.

**Exposure meets Hedonics: Or, in which Pleasure beats Outrage**

In this dissertation I map this dynamic I call exposure meets hedonics. Inspired by the affective turn coming out of cultural studies, queer theory, feminist theory, and post-colonial studies and following the work of critics like Lauren Berlant and Sara Ahmed, I argue that the promise of future gastronomic pleasure forecloses critical engagements with the politics of food science (i.e. safety, ethicality). In a fascinating turn, scientific knowledge—not just craft practice—of food deconstruction and manipulation—or reverse engineering eating has surfaced


in the last twenty or so years as the gravitational field for a constellation of bourgeois, cosmopolitan subjectivities. Eating has become a site for performing aspirational culture and politics, with the effect of 1) subsuming the universal (everyone, everywhere who eats) into a promissory future of better eating through molecular science; 2) legitimating itself through empirical, laboratory-based science; 3) enabling capital accumulation for select individuals and corporations; and 4) turning potential dissenters into converts: neoliberal, aspirational subjects who make political investments in products more often than in congressional representatives or community organizing. Molecular techniques are elaborated not for maximizing nutrition, but for optimizing pleasure—or, in David Chang’s terms from this introduction’s opening paragraph, a culture of “reverse-engineering delicious flavour.” The challenge with culinary celebration of reverse-engineering deliciousness is that biocapitalism has already coopted delicious destruction (molecular breakdown for flavour, a concept I elaborate in chapter five), and continues to do so in part through technical elaborations (innovations in chemosensory science) that undo or dematerialize the plurality of glutamate. If leading chemosensory research validates the singularity of glutamate, then it becomes unscientific, implausible, even ridiculous for there to be regulatory or other critical scrutiny of engineering sensory responsiveness through food additives.

Monosodium’s conflation with endogenous glutamates, or umami as a biological universal, rests not only upon the implosion of science and capitalism, but also upon a collection of desiring, elite neoliberal subjectivities I abridge as metafoodie. The metafoodie is informed, aspirational, and sensuous, simultaneously discerning and mindless in their subversive embrace of the maligned additive as a savvy option for experiencing great flavour, killjoy harping of alarmists be damned. A high-profile metafoodie and Gen-X American of Korean parentage, self-consciously fusing “East” and “West,” Chang has been celebrated as one of the most innovative,
charismatic, and successful chef-restaurateurs in America. However, Chang and other celebrated chefs hot for molecular or avant-garde technique, such as René Redzepi, founder of Copenhagen’s Noma (currently the “third best restaurant in the world”), are not alone up there in the culinary stratosphere. 62 They are part of a widespread love affair with the artisanal in the United States (and elsewhere), courting the ghost of a pre-industrial mode of production, making small what modern agribusiness made big. 63 Neither my personal inclinations nor my training disposes me toward neologisms for their own sake; however, this orientation to eating reflects a sea change in both industry and popular food culture that merits thinking about as a distinct formation.

For affluent elites today—and by these I refer to not only the truly wealthy, but to aspiring middle-class professionals—the postmodern rejection of an industrial mode of food production, preservation, and marketing is all but omnipresent. Cultural theorists have identified the postmodern sensibility as the abandonment of a simplistic, ‘modern’ belief in benevolent technological and scientific progress, in a rejection of clear geopolitical centre-and-periphery, and scepticism towards the certainty of identity and allegiance. Beginning in the 1970s with its early elaborators, often considered to include Jean-Francois Lyotard, Ihab Hassan, and Frederic Jameson, the postmodern has been offered as an oppositional force to the modern—to utopianism, linear progress, singular truth, and grand narratives. In contrast, postmodernism has been characterised by its recourse to irony, nihilism, sarcasm, pastiche, deconstruction, and


relativism. Today we have inherited a lifetime’s worth of reading on what postmodernism and its aftermaths might mean. I interject myself in this philosophical quagmire because I believe a subject as big as eating merits thinking big—despite the ever-present risk of short-changing specificity and contestation.

Eating is a visceral mode of refusing to internalize ‘the modern’—especially its industrial and technologized forms. For food scholars, a postmodern disposition to eating (roughly concentrated in the last three decades of the twentieth century) is best caricatured as that first hippie to toss Wonder bread in favour of spelt, brown rice, and carob. It has been identified by food studies founder Warren Belasco and others, like cultural studies scholar Sam Binkley, as a key part of the 1960s-70s counterculture movement, in which much of middle-America questioned the rigid norms and corporate consumerism of post-war society out of a new ecological awareness and a desire for more “authentic” ways of being in the world.

Postmodernism in food, then, may be described as the ideological home of an evolving array of alternative, ethics-based eating schemes, the most elevated of which being the emergence of the nouvelle cuisine of the 1960s-70s. It encompasses what Sinologist and food historian Mark

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64 Jameson does not define postmodernism as a period or as a movement. For him, postmodernism is famously a “cultural dominant,” or a “structure of feeling” that within a given context is prevalent but by no means exclusive. Jean-François Lyotard, The Postmodern Condition (Manchester: Manchester University, 1979); Frederic Jameson, Postmodernism, Or the Cultural Logic of Late Capitalism (Durham, NC: Duke University Press, 1991); Ihab Hassan, The Postmodern Turn: Essays in Postmodern Theory and Culture (Columbus, OH: Ohio University Press, 1987).

65 Ecology names the scientific study of the relationships between organisms and their shared environments. Within ecology, the world is made up of systems of interrelationship characterized by complex mutual benefits and tensions. The idea is that more can be learned of our shared world by studying the relationships that make it up than by studying discrete organisms in isolation. Warren Belasco, Appetite for Change: How the Counterculture Took on the Food Industry (London and Ithaca: Cornell University Press, 1989); Sam Binkley, Getting Loose: Lifestyle Consumption in the 1970s (Durham, NC: Duke University Press, 2007).

66 For many food scholars this is a now familiar story, in which a young generation of cosmopolitan chefs abandoned the rigid prescriptions and decadence of French grande cuisine to focus instead on the provenance of
Swislocki has described as *culinary nostalgia*, or the “recollection or purposive evocation of another time and place through food.” Swislocki duly notes food’s ability to transcend time and space as a modernist truism dating back to Marcel Proust’s *Remembrance of Things Past*, in which the writer revisits his childhood by once again eating a madeleine with lime-flower tea (2009, 4). Neuroscientist Gordon Shepherd has popularized recent sensory research and argued that this ability for flavour to instantly conjure memory is attributable to our sense of smell bypassing the neocortex of our brains, home of language and conscious thought. In other words, we do not think about what we smell; we just feel it. See, for example, Gordon Shepherd, “Smell images and the flavour system in the human brain,” *Nature* 444 2006: 316-321; Gordon Shepherd, *Neurogastronomy: How the Brain Creates Flavor and Why it Matters* (New York: Columbia University Press, 2012); Charles Spence, Review: ‘Neurogastronomy: How the Brain Creates Flavor and Why it Matters’ by Gordon M. Shepherd, *Flavour* 1 2012: 21.

Today, these inherited sensibilities cohere in the figure of the “foodies,” a slippery category of identity which names as an individualistic—yet shared, and often performative—meditation on the hedonics and politics of food. The foodie thus personifies what has become a commonplace: that eating is a political act, a conscious set of choices that, for an aspirational middle-class, reflects one’s cultural capital and moral fibre. For example, take the slow food movement (Carlo Petrini and company); the popular industrial food exposé (*Fast Food Nation, The Omnivore’s Dilemma*); each iteration of locavorism (*locavore* was named the New Oxford American Dictionary Word of the Year in 2007), such as the renewed interest in community gardening and local farmer’s markets, “eat local, think global” campaigns; and the phenomenon that is Michael Pollan. It is behind our favourite hipster-run
dining hole boasting reclaimed barn board tables and shelling signature cocktails in the false modesty of bargain-table glassware. And fusion tacos. The postmodern sensibility is responsible for every fusion taco, ever.70

So, what do I mean by *metamodern*?71 Avant-garde cuisine, culinary and dining television programming, and food tourism have all increased the technical nature of gastronomic literacy. As food has become a popular site through which the aspirational class conveys cultural capital, the average early twenty-first-century gourmand has devoted an amount of emotional energy to the delight engendered by foam, spherification, and mouth-feel literally unthinkable to her/his counterpart of thirty years ago.72 As one 2012 *New York Times* opinion piece phrased it, food has become “a badge of membership in the higher classes, an ideal example of what Thorstein Veblen, the great social critic of the Gilded Age, called conspicuous consumption… Nobody cares if you know about Mozart or Leonardo anymore, but you had better be able to

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70 I elaborate the idea of metamodernism in eating in a paper currently under review with *Gastronomica*. For more on taco politics, see the work of Jeffrey M. Pilcher, for example “Was the Taco Invented in Southern California?” *Gastronomica* 8(1) 2008: 26-38, and *Planet Taco: A Global History of Mexican Food* (New York: Oxford University Press, 2012).


discuss the difference between ganache and couverture.”

One contemporary account of kitchen work cribbed the insight of Warren Belasco, who described this burgeoning foodie sensibility in the late 1980s as the “Berkeley ethos,” in which “your cuisine is your politics, and food is an ‘edible dynamic’ binding present and past, individual and society, private household and world economy, palate and power.”

Pierre Bourdieu’s formative notion of taste as a sign of distinction (cultural capital) is elaborated crucially for this discussion of biocapitalism in eating by sociologist Priscilla Parkhurst-Ferguson’s insight of cultural consumers as a market force. Reverse-engineering our food for improved taste was once the preserve of multinational food producers like Nestlé and General Mills. Now, sophisticated food technology techniques comprise the arsenal of the culinary elite and the vocabulary of the privileged consumer. Hence David Chang investing his time, money, and reputation in the amazing power of a ‘chemical’ food additive, anathema to the post-modern foodie, to make ordinary things taste extraordinary—and what is more, to stage popular conversations around the techniques and benefits of this proposition for not only leading chefs, but home cooks and anyone who likes to eat.

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In the words of one culinary instructor and food industry consultant, the high and low ends of eating have bent to meet one another in the last couple of decades:

Working in the [Campbell’s or Maple Leaf Foods] R&D department, you’re working with things like carrageenan and sodium alginate, which restaurants like elBulli and The Fat Duck were using as well… Ferran Adrià created melon caviar after visiting a factory where they were dropping sodium alginate-enhanced liquid into a calcium chloride bath, creating these little pearls… The same principle is used by companies to create invisible sausage casing and seafood nuggets. A lot of the techniques came from manufacturing that are used today at a lot of these restaurants.76

This same consultant has in entrepreneurial fashion created a side business selling things like Crisp Film (to enhance the brittleness of batters), calcium chloride and sodium alginate (for liquid spheres), and Versawhip (for foams) in small quantities for use by the amateur home cook. He is just one example of a phenomenon sociologist Gary Fine calls the emergent “culinary-industrial establishment,” in which high-end restaurant collections run by celebrity chef-proprietors have deep-pocketed corporate backers, e.g. Jean-Georges Vongerichten, Alain Ducasse, Gordon Ramsay, Daniel Boulud. David Chang could also be entered into this group of individuals food writer Juliette Rossant calls “Super Chefs:” a coterie of stars who have used their working class backgrounds as “a sign of authenticity”—and, I would add, with the effect of occluding the value of their work and of their brands (a theme I return to at the close of the introduction) to the Big Food practices they themselves critique. 77

Simply put, the contemporary foodscape in the U.S., at least, reflects an uptick or renewal of faith in the promise of science in technology in eating. Chang’s celebration of MSG’s


potential for building deliciousness exemplifies a mode of cooking and eating grounded in a strategic manipulation of microbiology and the chemosenses (smell and taste) to produce foods that are new and improved, as compared to both their supermarket and artisanal predecessors. Chang and company do not disavow the scientific advances of the twentieth-century in an attempt to pass over Big (Food) Science to recover a pre-modern, artisanal prior. Instead, they employ the techniques and insights of Big (Food) Science to make a better artisanal product than was ever possible before. This is artisanal 2.0; artisanal improved through cutting-edge scientific expertise. It is nostalgic and hopeful. This renewed fetish for the power of science is what distinguishes the metamodern foodie from the postmodern one, and it is what prompts me to argue that we are growing, eating, and Instagramming not only fusion, sustainable, or organic (postmodern) foods. We are also eating things like flavour profiles, aromatics, umami, and celebrity-designed novel Frito-Lay chip flavours, and we are doing so with a conscious abandon. Foodie culture in the United States exemplifies what Nikolas Rose theorized in 2007 as the “elective affinity” that molecular biocapitalisms can incite—coalescing in a set of open-ended or pluripotent (i.e. not just top-down biopolitical control of the masses) possibilities for embodying and buying into revelatory, even hopeful, molecular versions of present and future. We are craving Big (Food) Science in the service of future pleasure and as a sign of distinction. We are eating metafood.

I develop these arguments throughout the dissertation by bringing science and technology studies (STS) scholarship into conversation with food studies and sensory history. Since the 1980s, STS theorists like Bruno Latour and Donna Haraway have compelled humanities scholars and social scientists to follow the actors of scientific knowledge production, and to include the

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non-human in our analysis of human social phenomena. More recently, scholars like Hannah Landecker, Heather Paxson, Charlotte Biltekoff, Julie Guthman, Emily Yates-Doerr, and Harris Solomon have helped bring the politics of the metabolic, genomic, and otherwise molecular domains to the question of how we eat. At base, this emerging, integrated STS and food studies project reminds us that science has a history—a cultural, an economic, and a political context. And science is our de facto working language for reading the body and its encounters. Sensory studies scholars meanwhile remind us that our understandings of the senses (taste, sight, sound, touch) have a history, and they demonstrate how our sensory capabilities have moulded both past events and future possibilities. All of the above projects meet at the sensate body that eats, the vessel that absorbs and produces both meaning and matter.

It is my contention throughout this project that integrating these fields’ respective strengths is essential in light of the distinctly technical character of contemporary discussions of eating in the United States. While food studies scholarship has elaborated the material and


inmaterial food practices, or foodways, that spring up amidst people and the substances that sustain us, such discussions of the last two decades have typically stopped at our skin. That is to say, they have specialised in the messy externalities of food: culture, politics, and economics. My work, however, is concerned with what changes when we foreground the science—likewise messy—of bringing food inside. In particular, I suggest that how food makes us feel is perhaps the biggest driver of the future of the multi-billion-dollar global food industry. In both food-secure and -insecure sites, if you do not feel full, you are not. Now, science has long been integral to academic discussions of food’s moral and physiological dimensions, as the means to health, longevity, or an “ideal weight,” and food scholars have accordingly problematized the nexus of nutrition, cultural mores, and corporate interest. Nonetheless, food scholarship has yet to contextualize how the flipside of food—its hedonic, pleasurable dimension—has in the last twenty-odd years been likewise pervaded by the language of science. In an effort to do just this, I submit two things. First, that the scientific deconstruction of food-as-experience (rather than just fuel) is a key component of the contemporary American foodscape;

82 The concept of ‘foodways’ has been attributed to anthropologist John H. Honigman and, later, folklorist Donald Yoder. John Honigman, Foodways in a Muskeg Community: An Anthropological Report on the Attawapiskat Indians (Ottawa: Northern Co-ordination and Research Center, 1961); Daniel Yoder, Folk Cookery in Folklore and Folklife: An Introduction (Chicago: University of Chicago Press, 1972).


85 Nestle, Food Politics; de la Peña, Empty Pleasures; Levenstein, Paradox of Plenty.
and second, that the attachment to both gastronomic innovation and a critical food politics is the defining feature of an emerging metamodern orientation to eating.  

**Nation Branding, Race, and Culinary Tourism**

In the United States, monosodium glutamate has been heavily coded as East Asian, despite the fact that it has been used pervasively in iconic supposed Anglo-American food products (e.g. Campbell’s soup, hotdogs, frozen dinners, and flavoured chips)—and is specific not to any one culinary tradition but rather to an industrial food production paradigm. That is so important I will re-state it: MSG is not original, particular, or emblematic of a foodway attached to any national, racial, ethnic, or linguistic group. It is particular to industrialized food systems, and those have emerged out of modern, applied science and capitalism—a phenomenon whose particularities within the context of European settler colonialism, modernization, and technoscientific innovation in Asia I explore in detail in chapter one. Monosodium glutamate’s association in American culture with Asian cuisines reflects the additive’s first popular materialization as something associated with Chinese restaurants. Americans were eating the majority of their MSG by the late-1960s not through Chinese restaurants, but in the form of processed, prepared, and canned foods—they just did not know it. “People were afraid of MSG in a way that was kind of irrational,” food historian Ian Mosby has been quoted as saying. “They blamed it on Chinese

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86 Since I am trained as an Americanist, I restrict myself here to American foodways in the context of the world. This is not to say that my observations would not resonate with the foodways of other regions and nations connected by social media, the idolizing of celebrity chefs, and dining performativity. I am particularly interested in the case of Japan. For a discussion of the role of culinary nostalgia in defining contemporary identity in Shanghai, see the work of Mark Swislocki (2009).
restaurants when it was quite obvious that they were consuming MSG in other forms.\footnote{Jon Sufrin, “Why MSG’s Bad Rap is So Hard to Shake,” \textit{Globe and Mail}, Nov. 4, 2014.} I depart from this interpretation only to emphasize that, for many Americans in the 1960s, the sources of MSG in their diet were palpably non-obvious, and that is a reflection of a reactive—rather than precautionary—food regulatory regime and the privileging of proprietary corporate flavour and processing technique. Consumers were never meant to know on what flavour formulations their favourite food products were based.

I must close on one key dimension of twenty-first century discussions around umami in conjunction with MSG. Scientific, industry, and culinary commentators persistently describe umami as a patently Japanese, or more broadly Asian, taste. Culinary and cultural essentialisms, and their iterations within capitalism, are problematic and illusory, even when they are making positive claims—such as the refrain that Japanese cuisine is exceptionally healthy.\footnote{For an excellent analysis of the porous and shifting nature of contemporary Japanese cuisines, with particular influences from China and India, as well as Japan’s growing rates of obesity and heart disease, see Katarzyna J. Cwiertka, \textit{Modern Japanese Cuisine: Food, Power and National Identity} (London: Reaktion Books, 2006).} Culinary essentialisms have gained tremendous currency within the foodie turn of recent years, and are anchored scientifically by the notion of culturally specific “flavor principles and cooking techniques” first elaborated by famed culinary writer (and the wife and collaborator of influential psychologist of flavour Paul Rozin) Elisabeth Rozin in the early 1970s.\footnote{Elisabeth Rozin, \textit{The Flavor-Principle Cookbook} (Hawthorn Books, 1973).} These were said to constitute the characteristic or signature flavour of an ‘ethnic food.’ For example, Chinese food contains ginger, scallions, garlic, often stir-fried or steamed. Japanese cuisine is based in soy sauce, \textit{mirin} (sweet rice wine), and \textit{dashi}—the soup stock that according to industry legend, inspired Kikunae Ikeda to invent MSG. Moroccan cooking is characterized by cinnamon, cumin,
tumeric, ginger, paprika, coriander, saffron, anise, cardamom and other spices combined into Ras El Hanout. These recurring principles can reportedly be deployed to cultivate enjoyment of foreign or novel cuisines, for instance by preparing a new type of food in accordance with familiar food preparation techniques, like a familiar sauce. Barb Stuckey’s 2012 how-to book for squeezing the most flavour out of foods advises readers that they might encourage a Chinese person to try nutria (large semiaquatic rodents imported into Louisiana from South America for the fur-farming industry, now wild and considered “destructive pests”) by stir-frying them with ginger, garlic and scallions. Stuckey is one of many who describe umami as the defining feature of Japanese cuisine. In her words, umami is to the Japanese what terroir is to the French; “[t]hey get it” in a way that Americans presumably do not, or at least do not yet.

The international branding of Japanese cuisine today traffics in myths of Japanese culinary exceptionalism and culturally-specific taste acuity. These read suspiciously like a chemosensory ontology of biological race. For example, the Umami Info Council (NPO) released in 2009 a popular publication entitled “The Fifth Taste of Human Beings, Umami: The World” and written by Kumiko Ninomiya (of the Umami Info Center) and Elisabeth Rozin. This work ontologizes umami as the heart of universal flavour experience, yet celebrates the cleverness of the Japanese in identifying umami before ‘the West.’ It subtly attributes this feat to the umami-based character and innate nutritional superiority (these two attributes collapsed into one another) of the ‘Eastern’ traditional diet of “nutritionally balanced fermented food with plain steamed rice, or as

90 University of Toronto psychologist Patricia Pliner tested this theory in 1999, and found that when a novel food is paired with a familiar sauce (e.g. Indian vegetable parval), people were more likely to try it. A person’s adoption of that new food was also enhanced by enrolling “confederates” (like-seeming people) to model the eating of unfamiliar foods with apparent enjoyment. Stuckey, Taste What You’re Missing, 166.

a rich accompaniment to cooked rice.” This is, of course, compared favourably to the Western reliance on wheat, potatoes, meat, poultry, and dairy. They cite bouillon cubes as a long-standing ‘Western’ flavouring analogue for the MSG of ‘the East.’ The lionizing of Japanese cuisine’s nutritional superiority is a fascinating reversal of the denigration of Japanese foods by early nutritional scientists a century earlier. At the turn of the twentieth century, healthy bodies were thought to be built on wheat and meat—not rice and soy; several decades of Big Food later, and nutritional wisdom has made an about-face.

The most important point here is that flavour-enhancing technologies are not historically proper to Japan or China; they are historically proper to sites where applied science and industrial capitalism intersected in particular ways. That those most influential sites were Germany, Japan, and China was a contingent effect of many local and international factors that I trace in chapter one. The myth of a uniquely Asian knowledge of umami, however, is deployed to promote Japanese industry and cuisine in the globalized economy—and the story is compelling. It has even been regurgitated in a recent historical analysis appearing in a text called Nutrition and Sensation, edited by a psychiatrist-cum-entrepreneur named Alan R. Hirsch who features again in chapter five. Historian of taste Gabriella Petrick states that “Japanese cuisine, more than European or Eurocentric cuisines, is centered on umami as a foundational element and is a key taste in the Japanese palate.” She gives the examples of Japanese sources of umami:

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92 In chapter one, I discuss Swiss flour manufacturer Julius Magi who in 1882 manufactured bouillon cubes as an inexpensive way for the less affluent (for whom meat was a decadence) to make nutritious soup—and for an ambitious entrepreneur to capitalize on the decreasing time and increasing disposable income of the working and middle classes in an industrializing nation. The meaty flavour conferred then—and still today—by bouillon cubes is a function of the high free (additive) glutamate content of the hydrolyzed vegetable proteins they contain. Ninomiya and Rozin, 2009: 7-8.

konbu and bonito – two key elements in dashi – and umami flavour: soft bean curd (tofu), green seaweed (wakame) and soy sauce (high glutamic acid and salt). Swallowing industry histories whole, Petrick writes that, while inosinic acid and guanylic acid (the 5’-ribonucleotides that enhance glutamate’s flavour enhancing property) had been known to European scientists for generations, their roles in taste went unnoticed. She actually speculates that the “reluctance to classify umami as a new taste could in part be because the strongest umami flavors were endemic to the Japanese palate but largely anathema to American and European food cultures.” Petrick reproduces nationalistic narratives of Japanese scientific acumen dating from the 1970s, in which Japanese scientists were storied for their singular sensitivity to subtle tastes and flavors, while blunt Westerners were busy studying vision and hearing, because “frequencies… are common to everybody.” Unlike, that is, subtle umami taste, which is not universal but proper to the nuanced Japanese sensibility.94

Petrick unconsciously rehearses the American hubris I explore in chapter two, when their late recognition (in the immediate postwar years) of MSG’s flavour enhancing property was being acknowledged, with some chagrin, by American researchers. She states, “It did not strike many as odd that Japanese researchers found these compounds. American researchers continually emphasized the long history of eating foods high in glutamate across East Asia as the reason that glutamates were discovered [there].” She cites, for example, Joseph A. Maga, a food scientist at Colorado State University, who narrated: “For centuries, oriental cultures have used naturally occurring sources of flavour potentiators in their food preparations… Thus the… major flavour potentiators in commercial use today… were identified in naturally occurring products that

historically have been used… in Japanese food preparations.” Citing the notion of “sensory struggle” and the “foreignness of umami” as reasons why American researchers at the mid-twentieth century “literally could not taste umami,” Petrick concludes that it was “only after the seminars sponsored by the American Chemical Society and the Japanese Chemical Society (and the publication of Japanese research in English)” that umami began to be accepted. The reason for this, she states, was that umami flavours like those in tomato paste, Parmesan cheese, and deeply cooked mushrooms (all imported from Southern Italy) were not “integrated into the American society” but only existed in “ethnic and cultural enclaves” until after World War II. The assumption that it could be considered odd for the Japanese to have invented something before the Americans is an imperial dynamic I analyze in chapter one. The ridiculous assertion that there were no significant umami-based flavours in Western European or mainstream American culinary traditions before 1945 would be surprising to all the historians and devotees of French technique, which has elaborated more than a few (free glutamate-rich) soups, stocks, reductions, and gravies. Any early modern European peasant who relied on soup or potage as a cheap dietary staple was intimately familiar with glutamate-based flavour.

A more compelling insight from MSG’s small and recent historiography is Japanist Jordan’s Sand conclusion that industry efforts to proliferate a science of umami in the English language have been “yielding results.” He observes that using the Japanese term suggests “the flavour has some ineffable Japanese quality, encouraging people to imagine the product’s bad reputation [in


96 Petrick, “Tasting History,” 19-20. “Sensory struggle” is developed by historian Connie Chiang, who argues, “people can project their fears, desires, and prejudices on to smell… Radical and ethnic minorities and the working class often suffered the most from the negative connotation associated with the smell.” Connie Y. Chiang, “The Nose Knows: The Sense of Smell in American History,” *The Journal of American History* 95(2) 2008: 405-406.
the U.S.] might derive from a cultural misunderstanding that beneficial science will
overcome." In chapters four and five, it is precisely this investment in chemosensory science
conflating umami and MSG that I problematize. Sand argues that “[c]ommodity nationalism
embroiled MSG in battles in the streets of Shanghai in the 1930s (sometimes escalating to
physical violence),” when Japanese occupation of the Chinese coast involved the dismantling of
competitive MSG production facilities. In contrast, he states, competitive national glutamate
industries today continue battle with “the human body itself [a]s their turf.” While “the umami
taste receptors scientists are pursuing act as tiny physiological legitimizers for MSG,” he argues,
the additive “appeals to palates without respect for national origin and often without marketing
directly to consumers.”

A growing literature on nation branding and theories of the brand has recognized that
brands—for example, branded Japanese cuisine—are communicative acts. As such, they are not
the exclusive products of corporations. I elaborate in chapter four (on MSG’s ‘comeback’ among
many scientist and foodies) on the insight of Rosemary Coombe and Celia Lury, among others,
that consumers themselves are influential in “mobilizing brands, giving meaning to them, and
hence generating their value.” Building on the insights of Marxist theorist of post-industrial

99 Hayden, “Distinctively Similar,” 610-611. On nation branding, see also Melissa Aronczyk, Branding the Nation: 
The Global Business of National Identity (New York: Oxford University Press, 2013); Keith Dinnie, Nation 
Branding: Concepts, Issues, Practice (New York: Routledge, 2015); Fan Yang, Faked in China: Nation Branding, 
Counterfeit Culture, and Globalization (Bloomington, IN: Indiana University Press, 2015); Deven R. Desai, “From 
Trademarks to Brands,” Florida Law Review 981(64) 2012: 983-85; Celia Lury, Brands: the Logos of the Global 
Economy (Routledge, 2004), 8; On the global branding of Italy via migration and consumerism centered on the 
transatlantic space, see Mark I. Choate, Emigrant Nation: The Making of Italy Abroad (Cambridge, MA: Harvard 
University Press, 2008); Donna Gabaccia, Italy’s Many Diasporas (Seattle: University of Washington Press, 2000).
capitalism Adam Arvidsson, Cori Hayden sees brands as “a kind of crowd-sourced value.”

David Chang’s inadvertent metafoodie injection of value into the brand of Japanese cuisine as umami, and MSG as a particularly Asian technology and culinary tradition, is a generative force that dovetails with the power of chemosensory research to the benefit of the glutamate using and producing industry—what I have theorized as a global biocapitalist inducement of human sensation.

So, monosodium glutamate’s century-long career is not merely part of the history of food, nor of science, nor that of Japanese modernization, nor of British or American foreign policy in East Asia, or even of a peculiarly charged Japanese-American relationship. Its history is that of an evenly distributed privilege of eating from the cornucopian table of consumer capitalism; meditating on that practice as part of the reflexive exercise of modern subjectivity; and embodying the unintelligible stakes of exposure to novel chemical configurations whose effects our interested, applied biocapitalist science is poorly-suited to clarify. In the chapters that follow, I demonstrate how the question of flavour enhancement has both a material history and a historical ontology. The ways that glutamate has been ontologized, or brought into understanding and made manipulable, have changed over time. Stated another way, this dissertation has a dual aim of tracing a materialist sensory history and an historical ontology of human taste sensation, and how both of these have coalesced in the image of capital—as proprietary and/or applied technologies, and as lucrative brands that scientists, chefs, and eaters alike produce as they consume.

In the opening chapter, I situate monosodium glutamate’s isolation and patenting in Japan in 1908-9 in the context of the international exchanges that made up turn of the twentieth-century applied chemistry. The second chapter traces monosodium glutamate “going global” thanks to the cost efficiencies attendant upon the technical breakthrough of culturing optimal strains of microbes to “hyper-excrete” glutamic acid, or the process of industrial fermentation. In chapter three, I trace how, as is the case with many new pharmaceutical products, proponents of MSG began with its effect (of increased taste sensation) and only later—under critical pressure—worked backward towards explaining its possible causation. 101 I historicize the emergence of the “Chinese Restaurant Syndrome” in 1968 and the regulatory, scientific, and cultural ricochets of that materialization of MSG as a potential toxin, for instance, a lasting association of MSG in the U.S. with Asian foods, the ontology by the 1980s of glutamate as an excitatory neurotransmitter and—in an extension of that theory—as a theorized excitotoxin, which when present in excess amounts in the brain may over-stimulate nerve cells until they die. 102 I also consider the formation of the FDA’s Adverse Reaction Monitoring System (ARMS) in early 1985 as a archive of adverse reactions to common food additives.

In chapter four, I trace how over the last two decades or so, umami taste has come to be rhapsodized by scientists, chefs, and corporate communications personnel as evidence of the fact that humans have, since time immemorial, experienced the deliciousness of umami as a means of ensuring our intake of not only protein, but also a host of other micronutrients made more

101 To illustrate, the sweet-conferring capacity of certain forms of MSG’s chemical cousin and fellow amino acid, aspartic acid, was discovered entirely by accident when a researcher licked their finger (one would think, unwisely) after tinkering with the substance. A massive commercial application of artificial sweetening ensued. See, for example, the work of Jackie Orr, 2006 and, on artificial sweeteners, Carolyn de la Peña, Empty Pleasures.

bioavailable to us by virtue of having been already broken down chemically, or aged or fermented. Umami taste has been wound into a seductive universalizing narrative, in which humans everywhere register sensual pleasure in eating in tandem with the nutritional value of those foods. Could umami be the key, then, to understanding why humans like to eat what they do? Are we united by a shared sensory mechanism that provides the secret for health policy experts in search of foods that are both nutritious and delicious? In other words, is umami the key to getting making people happy eating what is good for them? In the final chapter, I develop the concept of metabolism in the context of MSG’s century-long history. I argue that MSG and other flavour enhancers are a biocapitalist co-optation of the phenomenon I term delicious destruction, in which long-standing practices of food preparation like fermenting, pickling, curing, and drying have for millennia broken food down in order to make them more delicious and longer-lasting. Finally, I conclude by framing MSG as a prompt for considering bell hooks’ notion of “eating the other” across species and scales of life. I do this by considering the costs of our reliance upon animal modelling in chemosensory research—namely, the immeasurable toll in animal life, and the problems with using animal study results (which demonstrate species-specific glutamate utilization) to underpin policy decisions about human food and pharmaceutical safety.

I will close with a word on methodology. This dissertation is based on a review of numerous technical journals in addition to more popular-audience publications like Science, Bon Appetit, or Gourmet, the New York Times, and the Washington Post, which appear multiple times as references. These peer-reviewed scientific publications span diverse disciplines from

paediatrics, neuroscience, and ophthalmology to food chemistry, nutrition, and toxicology. For instance: Nature, Chemical Senses, Industrial and Engineering Chemistry, the American Journal of Clinical Nutrition, Journal of Agricultural and Food Chemistry, CNS Spectrums, Nature Neuroscience, Journal of Nutrition, British Journal of Nutrition, Journal of Biological Chemistry, Physiology and Behavior, Current Opinion in Food Science, Chemical Reviews, Trends in Food Science and Technology, Physiology and Behavior, American Journal of Physiology, Food Quality and Preference, New England Journal of Medicine, Flavour, Toxicology, Food Reviews International, Federation Proceedings (FASEB), Journal of Food Science. I reviewed literatures in which MSG has been discussed, the bulk of which falling between 1970-2015, as having a bearing on the question of food safety, food technology, and human health, and I have discussed those scientific studies alongside wider public discourse about that scientific knowledge. My focus has been to historicize the popularization of shifting, often contradictory, and politicized scientific knowledge as a cultural phenomenon—imbued with other societal dynamics. Most notable in the history of MSG is the confounding influences of mid-and late-twentieth century racisms in the United States—and also their derivative forms at the close of the twentieth century and spanning the twenty-first, namely, culinary essentialisms and culinary tourism.

I spent several weeks in spring 2012 at the National Archives and Records Administration (NARA) archives at College Park, MD, and I was able to comb MSG-related documents dated from roughly 1930-1980. However, for key chronological periods, like the late-1960s and early-1970s in the immediate wake of the Chinese Restaurant syndrome and unrest around MSG’s potential toxicity—there were no records made available to researchers. The docket files were pitifully sparse. Cataloguing of documentation related to MSG past the early-1980s had reportedly not been done in 2012. And when I submitted a request to the FDA for the
records generated by their Adverse Reacting Monitoring System (ARMS) instituted in the mid-1980s to tract self-reported instances of adverse reactions to food ingredients, I was not given any meaningful data on the nature of symptoms reported, nothing of the language submitted by citizens, and no information on follow-up steps taken by the FDA itself. What follows is therefore chiefly an analysis of the technical and lay discourses that mediated MSG’s many ontologies over the course of the twentieth and twenty-first centuries.
Chapter 1
Making MSG: The Birth of a Transnational Taste Technology

“Among the senses, olfaction and taste are regarded as the chemical senses proper. It is clear, therefore, that there must be a close relationship between the chemical structure of a substance and its smell and taste.”

~ Kikunae Ikeda, 1909

Introduction

The early history of the flavour enhancer monosodium glutamate (MSG) is part of a wider story about the transnational politics of nutrition science in the later-Meiji (1868-1912) and Taishō (1912-1926) periods in Japan. The additive was a product of the international scientific collaboration and trade integration of what historians of the United States typically periodize as the Gilded Age and Progressive Era (roughly 1880-1914). In Japanese history, this moment is periodized as the Meiji and Taishō, named for the ruling Emperors and characterized by a clamour for national progress in the form of scientific and technological modernisation and selective import of Western customs. In the Meiji period, Japan found itself under the sway of unwelcome trading partners from “the West” (Great Britain, France, the United States, Russia, and the Netherlands). Japanese reformers, eager to realize political and economic leverage comparable to that of the European nations against whom they found themselves at a disadvantage, recognized modern science as the means to achieve this end. Japan made the most of its unwelcome partnerships, and the nation’s military victories in the first Sino-Japanese War (1894-5) and the Russo-Japanese War (1904-5) resulted in an expanded sphere of Japanese influence in Korea and Northeast China.
Monosodium glutamate was born into this brave new world of a modern Imperial Japan, in which Meiji reformers envisioned Japan as the future centre of political, military, and cultural gravity in Asia. The emerging science of food processing and production in which this history situates MSG was thus driven by a paradoxically dynamic combination of international collaboration and competition. I see MSG as the product of the simultaneous inspiration and threat that came in the shape of a raced nemesis, or in the language of Edward Said (1978), a worthy Other—a curious mirroring evidenced in the actions of both the Japanese and the aforementioned West. Japanese modernist reformers were eager to emulate and surpass Western nations in scientific and technological innovation, and thence in political influence. Meanwhile, Industrialists from Britain and the U.S. were hungry to ‘open up’ lucrative East Asian markets such as Japan. To situate MSG’s origin in the formative decades of international nutrition science, I draw on the internal histories of the fields of nutrition and food science, and I plot their accounts through transnational science and technology studies, as well as cultural histories of food and nationalism in East Asia. I intervene in these bodies of literature by restricting this first chapter to a story of knowledge transfer and applied science—in effect, focusing on the implications of the routedness, rather than rootedness, of applied nutrition ideas and practices. In other words, I provide one account of what happens when science and capitalism, which both assume universal applicability, travel along the lines of national alliances, attach themselves to nations, or get held up at the boundaries of nations.

In the case of MSG, Meiji political and intellectual leaders determined that to fulfil the imperial destiny they envisioned for Japan, they would have to fight fire with fire—and they

104 See cultural critic James Clifford’s Routes: Travel and Translation in the Late Twentieth Century (Cambridge, Mass: Harvard University Press, 1997).
recognized that the fires of modernity burned in the laboratory. Throughout the nineteenth century, modern, scientific rationalism had claimed and named the world in its own terms.\textsuperscript{105} As a result, its informing European cultural and philosophical frameworks (e.g. Judeo-Christian theology, Cartesian dualism, representative democratic government, capitalist ‘free’ trade, evolutionary biology) formed the currency with which representatives of the nations of this story could exchange modern, scientific ideas and goods. In this chapter, I trace how a local cookery staple (sea tangle or kombu) got caught up in the politics of national identity and the translation of European—largely, German—protein science into a proprietary, applied Japanese technology, and from thence a long legacy of Japanese leadership in amino acid and fermentation technologies. At the turn of the twentieth century, when the inventor of MSG embarked on the path that would lead him to his momentous discovery, the question at hand was: how were Japanese reformers to make technological and scientific modernization Japanese? This chapter’s central research question is thus connected to the conundrum of its historical actors: how am I to provide a balanced account of scientific knowledge transfer and innovation, while examining a technology that is profoundly political, reflective of a historic national consciousness and now thoroughly globalized—and all of this while working in the English language? Since I am an Americanist and not a Japanist, I have relied on the excellent work of numerous scholars\textsuperscript{106} who likewise confront the challenges of transliteration, working with Japanese source material.


but writing in English for an English-language audience. This methodological challenge, I have learned, is critically instructive. It illustrates the key themes of this chapter: the myth and force of national boundaries; the universalizing character of modern scholarship; the teleology of expert knowledge as a means to progress as an end in itself; and the hegemony of English-language scholarship in the twentieth century.

I argue that MSG was conceived by its inventor Kikunae Ikeda as a modern, efficient, and affordable means of delivering the natural, essential taste of savoury deliciousness, or umami—not, as many have come to speak of it today in North America, as an additive or potential adulterant for use in otherwise ‘natural’ foods. MSG was not seen as an alternative to natural goodness, then, but its core. This thinking reflects long-standing principles in Japanese philosophy, religion, and aesthetics often understood by Western commentators as a studied minimalism.\textsuperscript{107} The choice of nomenclature for MSG’s founding corporate producer—\textit{Aji-no-moto}, or “the essence of flavour”—likewise reflects this deep-seated aesthetic in which art and cuisine were seen to achieve perfection when all extraneous form and detail had been removed. Aesthetic perfection was realized not so much through the expert balancing of additive ingredients—as is held by the celebrated birthplace of modern cuisine: France—but through a consummate \textit{precision in reduction}.\textsuperscript{108} It was not about how expertly things had been put together, then, but how perfectly excess had been stripped away. The nature of a thing was its essential core, and the mid-to-late nineteenth century discoveries in Germany of how to isolate


\textsuperscript{108} On the interface between science and modern European cuisine, see for example, Rachel Laudan, “A Kind of Chemistry,” \textit{Petits Propos Culinaires} 62 1999, 8-22 or Priscilla Parkhurst-Fergusson, \textit{Accounting for Taste: The Triumph of French Cuisine} (Chicago, IL: University of Chicago Press, 2004). For more on Japanese cuisine and aesthetics, see Michael Ashkenazi and Jeanne Jacob, \textit{The Essence of Japanese Cuisine} (Surrey: Curzon Press, 2000), 42. Ashkenazi and Jacob’s detailed historical treatment of Japanese cuisine is, however, absent of any mention of \textit{umami}. 
the amino acids comprising proteins provided the means for MSG’s inventor, Kikunae Ikeda, to access the chemical essence of a savoury delicious taste if which he was professedly so fond. MSG’s invention promised to modernize what he would come to call a signature feature of Japanese cuisine: the taste sensation umami. And Japan was going to profit from it.

Making MSG

The tale of MSG’s discovery has been told and retold in science trade journals, medical exposés, and popular food writing since the 1980s. 109 The core of the story proceeds something like this: in 1899, a physical chemist at Imperial Tokyo University (now University of Tokyo) named Kikunae Ikeda (1864-1936) embarked on an international exchange. As a new associate professor, Ikeda was invited to study at the laboratory of Wilhelm Ostwald in Leipzig, Germany. During his three years there, Ikeda was exposed to not only the global epicentre of chemistry research, but also to European culture. The experience of German foods, such as tomato, asparagus, cheese, and meat, reportedly had a large impact on his later comparative research on the chemical composition of European and Japanese soup flavour bases. 110 But in 1899, Ikeda had yet to arrive at these insights. At the time, William Ostwald was a prolific writer and


organizer, a luminary in the prominent field of physical chemistry (and later Nobel Prize winner (1909) for his work on catalysis, chemical equilibria, and reaction velocities). When Ikeda came to Germany, he inherited not only Ostwald’s insights, but research by individuals like Karl Heinrich Ritthausen (1826-1912), who in 1866 had isolated the amino acid glutamate while studying the protein composition of wheat, which he had broken down using sulphuric acid. Identifying extremely high quantities of this particular amino acid, he named “glutamic acid” after the bread protein, gluten. Ritthausen’s larger legacy to protein chemistry was originating this experimental method of acid hydrolysis followed by the precipitation of barium or calcium salts of certain amino acids with the use of an alcohol. This process of isolation would provide Ikeda with the technical foundation for producing monosodium glutamate. Ikeda would have also learned that another famous German chemist named Hermann Emil Fischer (1852-1919) had sampled glutamic acid, but had found its taste unique but, ultimately, sour and “insipid.”

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Continental Europe was at this time a hotbed for the study of applied techniques in food preparation and processing, including potential applications for protein-based isolates like glutamic acid. The monosodium glutamate we know today is the product of this era of industrial capitalist expansion and formalization of the physical sciences—two interconnected, formative processes that integrated many countries to a degree then unprecedented in modern history. When Ikeda came to Germany, the leading lights of science in Germany, France, Britain, and the United States were self-consciously embroiled in the quest to reveal the hidden chemistry of keeping human bodies alive and well. Fields such as physical chemistry, microbiology, and experimental physiology and, in the early twentieth century, biochemistry and nutrition, applied emerging methodologies to the shared mandate of deciphering the active constituents of food. Their findings were instrumental in informing how governments (particularly militaries) could most efficiently and effectively invest in that most valuable of natural resources: their labour force.


Ikeda would have been all too aware that the practical stakes of this research were enormous. Another prominent German organic chemist, Justus von Liebig, had recently earned a fortune manufacturing an innovation called beef extract—a dark, viscous, and pungent reconstitutable liquid that proved a breakthrough in fuelling not only the German army, but households as well.\textsuperscript{116} Liebig’s work was foundational to what would later become nutrition research, directly linking agricultural yields and human health to the action of the chemical constituents of vegetable and animal food sources. Publishing his evolving theories for a “rational system of diet” in the 1840s,\textsuperscript{117} Liebig promoted meat as essential to muscle development and exertion, or work. Liebig was compelled as a ‘matter of conscience’ to urge the governments of Europe, specifically Germany and Britain, to develop cheap and portable meat products for the support of workers, travelers, sailors, and soldiers. Liebig himself developed meat extract, bringing meaty satisfaction to, as Mark R. Finlay writes, “the millions who could not afford European beef.”\textsuperscript{118} Ikeda professed project, as we will see, was similarly inflected with a sense of moral urgency—an obligation to apply physical chemistry on nitrogenous substances (or what is now called protein, that nutrient associated with savoury flavour and satiety) to directly improve the health and prosperity of his fellow Japanese.

\textsuperscript{116} Liebig’s most influential work as a science popularizer was 1840’s \textit{Chemistry and Its Applications to Agriculture and Physiology}. This influence of Liebig’s work on Ikeda is touched upon in Gabriella Petrick, “Tasting History,” in \textit{Nutrition and Sensation}, ed. Alan R. Hirsch, MD (CRC Press, Taylor & Francis, 2015), 12.

\textsuperscript{117} \textit{Animal Chemistry} was published in 1842 in Germany and Britain, and \textit{Researches on the Chemistry of Food} in 1847.

Further evidence of the vogue for commercial condiments and cooking/flavouring aids can be found in period accounts from both East Asia and Europe. In her history of the formation of Japanese national cuisine, Katarzyna Cwiertka recounts the advice of a British traveller by the name of Miss Isabella Bird, who adjured her fellow countrymen in the 1870s to bring along with them “Liebig’s extract of meat” to supplement a diet of “rice, tea, and eggs, with the addition now and then of some tasteless fresh vegetables”—preferable to the “the fishy and vegetable abominations known as ‘Japanese food.’”¹¹⁹ In 1869, a Swiss entrepreneur named Julius Maggi (1846 – 1912) converted an inherited hammer milling business into a collaborative venture with a physician named Fridolin Schuler, with the aim of “improving the nutritional content of meals for the labouring classes” through packaged food products based on milled pulses or legumes. Maggi marketed an inexpensive bouillon cube in 1882 in an avowed bid to make nutritious, protein-rich soup accessible to the poor. A ready-to-use soup product followed in 1886, a special flavouring powder later in the year, and then subsidiary locations in Paris, Berlin, Singen, Vienna, Bregenz and London, plus a representative office in the US.¹²⁰ Both of these early food science blockbusters—bouillon cubes and instant soup mix—were designed to provide an inexpensive, efficient protein-rich (a.k.a. healthy, for the prevailing wisdom in Europe at the time was that strong populations were built on protein and wheat) food source for the masses. Maggi noodles, for example, are now an inexpensive convenience food eaten all over the globe.


¹²⁰ Kumiko Ninomiya, “Science of Umami Taste: Adaptation to Gastronomic Culture,” Flavour 4:13 (2015). Maggi is a currently a leading international brand; its seasoning sauce and bouillon cubes have been incorporated into local cuisines in Eastern Europe, Latin America, East Asia, Southeast Asia, South Asia, and the Middle East. Maggi became a Nestle brand as of the 1940s. Nestle is the largest food company in the world, as measured by revenues.
Ikeda was thus one among several individuals captivated by the demonstrated promise of science-based innovation for food production and improvement. His was an era in which science was bringing within reach previously unimaginable production efficiencies, safety controls, and profit margins. In Japan, Ikeda worked in a climate of fierce modernization in the name of “civilization and enlightenment” or bunmei kaika. The reformist Meiji government that rose to power in 1868 had foremost in its view the acquisition of the scientific and technical expertise that would enable Japan to rival the European powers that had humbled the nation in the ‘unequal treaties’ of 1858. To achieve this end, the Meiji government embarked on a campaign to acquire mastery of all things Western, with the view that the nation’s leading scholars and entrepreneurs would then improve this knowledge base through domestication, or by making them Japanese. As Mark Driscoll points out in his recent work on the Japanese imperial periphery in the first half of the twentieth century, Meiji-era Japanese intellectuals were divided on how to interpret and execute Japan’s modernization. What many did hold in common was a belief in a) a future where Japan would replace China as the epicenter of Asian geopolitical power, and b) the necessity of realizing this goal through “controlled exposure” to the toxicity of Western-style modernity. In the 1880s, reform leader Fukuzawa Yukichi charged Japan with “catching measles” from Euro-America. For Driscoll, Japanese modernization rolled out with a vicious pragmatism, in which Japan would “immunize” itself from the hazards of the West with a calculated acquiescence that its intellectuals rhapsodized with a maxim of the late

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121 In 1858, Commodore Matthew Perry of the United States Navy levelled his fleet’s guns in the port of Edo (now Tokyo) and compelled the ruling bakufu government (the Japanese Emperor ruled only in name) to sign the ‘unequal treaties,’ opening Japan to trade on terms favourable to the Five Nations (the United States, Great Britain, France, the Netherlands, and Russia). Western trade in Japan had previously been strictly curtailed, limiting Western presence to a small outpost in Deshima (or Dejima) in Nagasaki Bay, or the far western corner of the country. These treaties provided for privileged international trade tariffs, designated trade settlements in the treaty ports of Hakodate, Nagasaki, Kanagawa, Niigata, and Hyogo, and legal jurisdiction over settlers by their own countries’ consuls—not the Japanese government. Cwiertka, Modern Japanese Cuisine, 16-17.
nineteenth century: wakon yosai or “Japanese spirituality, Western technology.”\textsuperscript{122} This sentiment contains within it all the contradictions of Japanese encounters with the foreign West: aversion and fascination, repudiation and fetishism, craving and distaste—buffered by the myth of science’s technical objectivity.\textsuperscript{123} Japanese were not becoming Western; Western science was just a means to an end. Science’s presumed objectivity—culturally void, politically neutral—was the balm for the sting of bringing the barbarian inside. Japan had to be compromised in order to get better. And Ikeda went abroad to figure out how to help realize that goal.

\textbf{Deliciousness for National Strength}

In 1901, Ikeda returned from Germany and was promoted to full professor at Tokyo Imperial University. As enshrined in industry legend, he then set out to investigate the flavour properties of \textit{kombu} (kelp), a staple of the dishes of his native Kyoto and a key flavouring base of \textit{dashi} stock.\textsuperscript{124} Ikeda suspected that in addition to the scientifically accepted four basic tastes—sweet, sour, bitter, and salty—there was another taste dimension lurking in savoury dishes. In 1907 he began studying \textit{kombu}’s properties in earnest, aided by the great availability of the common and long-harvested sea weed. Using aqueous extraction (extraction, isolation, and purification), removal of large-scale contaminants mannitol, sodium chloride (\textit{NaCl}), and

\begin{itemize}
\item \textsuperscript{122} Mark Driscoll, \textit{Absolute Erotic, Absolute Grotesque: The Living, Dead, and Undead in Japan’s Imperialism, 1895-1945} (Durham and London: Duke University Press, 2010): 4-5.
\item \textsuperscript{124} Kikunae Ikeda, “New seasonings,” \textit{Nippon kagaku zasshi} [Journal of the Tokyo Chemical Society] 30 1909: 820-836. Japanese original made available in English translation and shortened to 75\% by Yoko Ogiwara and Yuzo Ninomiya, trans. \textit{Chemical Senses} 27 2002: 847-849. \textit{Dashi} stock is a long-standing flavour base in certain types of Japanese cuisine; it is made with glutamate-rich \textit{kombu} and \textit{bonito} flakes (or slowly dried, fermented, and smoked skipjack tuna). 
\end{itemize}
potassium chloride (KCl) by crystallization, lead precipitation, low-pressure evaporation, and other techniques, Ikeda isolated glutamic acid from kombu, and tasted it in the form of salts of Na (sodium), K (potassium), and Ca (calcium). He ultimately settled on the taste of a stable, crystallized substance with the mass formula C5H9NO4, or the sodium salt of glutamate.  

What differentiated Ikeda’s work on glutamate from his counterparts in Germany is that he not only isolated glutamic acid, he then prepared and tasted it in a compound or soluble salt form. Decades previously, Fischer had tasted the organic acid, i.e. glutamic acid, alone. What subsequent research has since established is that it is the salt form of glutamates that elicit the umami taste sensation, not the acid alone. (The reasons behind this are explored in more detail in chapter five). Various soluble salts of glutamate may elicit a savoury taste, for example sodium (Na), potassium (K), or calcium (Ca) salts. When Ikeda tasted the sodium salt of glutamate he isolated from *kombu*, he was convinced that humans must exhibit “at least one other additional taste” (distinct from sweet, salty, sour, and bitter)—the chemical source of which he felt he had succeeded in identifying. He described this new taste as “*umai*” (delicious), and felt it was most truly reflected in the Japanese staple broth *dashi*. In 1909, Ikeda published his findings in the *Nippon kagaku zasshi (Journal of the Tokyo Chemical Society)*. He wrote, “While [umai] is based on a subjective sensation, many people who are asked always agree to this conjecture either immediately or after brief consideration. Consequently, there can

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126 He wrote then that the pH of most foods approximates neutrality, and at a neutral pH, endogenous glutamates exist almost exclusively in foods in a salt form. Ikeda, “New Seasonings” and “On the Taste of the Salt of Glutamic Acid.” *International Congress of Applied Chemistry XVIII* (1912): 147.  
be little doubt that another taste exists... [and] I propose to call this taste ‘umami’ for convenience.” Mi is translated from Japanese as “essence.” Some current food writers claim that “umami” is also occasionally used by Japanese speakers to describe any food believed to have achieved a state of perfection in preparation—in effect, to have cultivated the essence of (good) taste. In Ikeda’s words,

Many people may recognize that the palatability of ionic glutamic acid increases remarkably when a sufficient amount of salt (NaCl) is present. This is because meals usually contain salt (NaCl). People thus have a habit of tasting ‘umami’ and a salty taste at the same time. A weak salty taste, however, does not enhance the ‘umami’ intensity... The fact that the salty taste is especially related to ‘umami’ is an interesting issue for taste research.

Conversely, Ikeda noted that the sweetness of sugars is “rarely affected by the taste of ionic glutamic acid,” and that in fact, “strong sweetness weakens the taste of ionic glutamic acid and makes ‘umami’ indistinguishable.” While sweetness increases in proportion to the sugar concentration of a dish, he added, the “taste intensity of ionic glutamic acid... does not increase in proportion with an increase in concentration of the ion.” In other words, it could not be said that MSG was to savouriness what sugar was to sweetness. Ikeda hinted here at an important area of continued scientific ignorance: the specific mechanisms of sweet—and, as he proposed, umami—taste perception. I return to this question in chapter five; however, it is important to the longer history of MSG to point out that, at this early juncture, Ikeda was already cognisant that, whatever the nature of those sweet and savoury taste mechanisms, they were different from one

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The metabolism of MSG is understood, then, to be even more complicated than that of refined sugar.

Ikeda argued that umami, his theorised fifth basic taste, was an adaptation that enabled organisms to detect biologically valuable sources of protein. This evolutionary mechanism was not so different from that believed to drive humans toward the sweet tastes that accompany ready sources of carbohydrate calories (see chapter two for more on the history of evolutionary interpretations of sweet and bitter tastes). He hoped that commercialising monosodium glutamate would lead to the improvement of nutrition in Japan—and, as discussed previously, meat and meatiness were central to nutritional wisdom at the time. Inspired by an article written by the first (Western-trained) Japanese medical doctor Miyake Hide (alternately spelled Hiizu), who claimed that good taste facilitates digestion, Ikeda wrote, “Having always regretted the poor diet of our nation, I had long contemplated how it might be remedied, but had found no good idea until I read this article. It then occurred to me that manufacturing a good, inexpensive seasoning to make bland, nutritious food tasty might be a way to accomplish my objective.”

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133 The extent of the equivalence Ikeda draws between sugar and MSG is captured here: “Had we nothing sweeter than carrots or milk, our idea of the quality of 'sweet' would be just as indistinct as it is in the case of this peculiar quality. Just as honey and sugar gave us so clear a notion of what sweet is, the salts of glutamic acid are destined to give us an equally definite idea of this peculiar taste quality.” Ikeda, “New Seasonings,” 847.

134 Beauchamp, “Sensory and Receptor Responses to Umami,” 723S.


136 Hide/Hiizu’s influence on Ikeda has been accounted in Ikeda’s 1933 memoir, in Ajinomoto corporate histories and affiliated scientific studies, e.g. Ninomiya 2015, and is noted by Japanist Jordan Sand in his reading of Japanese-language accounts of MSG’s invention in “A Short History of MSG,” 38; Hirota Kozo, Umami no hakken
Ikeda’s progressive goal of improving Japanese nutrition sounds uninterested, altruistic even. I surmise that Ikeda himself would not have seen the public service implied in his innovation and its capitalist mode of delivery to have been at odds with one another. Ikeda immediately commercialized his discovery as a flavour enhancer. How better to bring it to the Japanese people, and to stimulate Japanese economic activity all at the same time? He registered his monosodium glutamate isolation process in 1908 in Japan under patent number 14805, as “A production method of seasoning mainly consists of salt of L-glutamic acid,” and joined forces with former pharmacist Saburosuke Suzuki, proprietor of the Suzuki Seiyakusho Company (and precursor of the present-day Ajinomoto Corporation, Inc., still the largest producer of MSG in the world). Suzuki was an obvious choice, since his prior business expertise was in extracting medicinal iodine from seaweeds. According to the company’s records, they began production of MSG out of a Zushi-based factory, and entered the product in the first “Japanese Invention Exhibition”—at which MSG won the bronze medal. In May of the same year, he and Suzuki launched in Japan the patented product they named Aji-no-moto, literally “the essence of flavour,” claiming that this new consumer product elicited the previously unknown fifth taste sensation: umami. With an eye to lucrative export markets, they also registered their invention...
under both British (1910) and American (1912) patent law. In making proprietary the sodium salt form of Ikeda’s glutamic acid formulation, Ikeda and Suzuki had, for Japan, literally bottled deliciousness.

Figure 2(a). Head office of Ajinomoto Honpo, 1909. Figure 2(b). Aji-no-moto product, as of launch, 1909.

In order to produce deliciousness on an industrial scale, Ikeda proposed extracting glutamate from wheat gluten because it had the highest content of L-glutamine (which becomes L-glutamic acid after protein hydrolysis) among the raw materials “industrially available”—that

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is, in sufficient supply and at a sufficiently low cost for profitable use in production.\textsuperscript{142}

Ajinomoto’s early production process was an extraction method referred to as hydrolysis (a common chemical process in which a substance is broken down through interaction with water molecules), which in this case refers to the disruption of the peptide bonds that make up protein by treatment with hydrochloric acid. L-glutamic acid hydrochloride was then isolated from this material and further treated to secure chemically pure MSG.\textsuperscript{143}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{hydrolysis.jpg}
\caption{Hydrolysis using Domyoji-game vessels in the Zushi factory (Kanagawa Prefecture, Japan). Wheat gluten was placed in Domyoji-game pots along with concentrated hydrochloric acid. The slurry was}
\end{figure}

\textsuperscript{142} Sano, “History of Glutamate Production.”

\textsuperscript{143} J.E.S Han, “Monosodium glutamate as a chemical condiment,” \textit{Industrial Engineering Chemistry} 21 1929: 984. This early production process has also been described for a contemporary audience in popular articles, such as M. McLaughlin, “A New Taste Sensation.” \textit{The Wall Street Journal}, December 8, 2007.
stirred with a pole and heated for twenty hours to promote hydrolysis. The Domyoji-game pots were made in Tokoyame (Aichi prefecture), Japan, famous for ceramic wares manufactured from very fine, local clay and very resistant to acid and high temperature. Reproduced with permission from *Aji wo kiwameru*—Ajinomoto eighty years' history: Ajinomoto Co. Tokyo, Japan: Toppan Printing Co, 1990: 75.\(^{144}\)

The selection of raw material from which MSG was to be sourced was partly a product of the market for its “co-products,” or the prospects for profitable sale of what was leftover after MSG was taken out of the raw materials. Ajinomoto initially used wheat protein, extracting wheat gluten from which to then isolate MSG. This practice had the benefit of yielding wheat starch as a valuable co-product. In other words, companies in this era—and still today—make a point of maximising profitability and minimising “waste” (a liability that is costly to dispose of) at all stages of production. According to the Ajinomoto company, they began to sell wheat starch to spinning companies in 1912.\(^{145}\) Production by 1933 was estimated at 10,000,000 pounds a year, with Japanese exports of “seasoning materials” (mostly MSG) totalling 2,268,000 pounds in 1934, most of this destined for other countries in Asia.\(^{146}\) In 1935, in response to the uncertainty of wheat starch sales within Asia, Ajinomoto switched to “de-oiled soybean flakes,” which allowed a “diversification of co-products:” edible oil, alcohol, liquid seasoning, and fertilizer; technical optimization of extraction from this source was realized in 1937. According to the company, such decisions reflected a balancing act between ensuring “adequate supplies of raw materials,” the “successful movement” of co-products, and “proper management of

\(^{144}\) Sano, “History of Glutamate Production.”


environmental issues.\textsuperscript{147} Protein secured from Manchurian soya meal was cheaper than gluten separated from wheat, and its waste or co-product of de-proteinized soya was easy to sell to neighbouring countries as low-grade fertilizer—unlike the little-desired wheat starch left after gluten removal.\textsuperscript{148}

As has been gleaned from Ajinomoto corporate histories by Japanist Jordan Sand, the company initially struggled to find a consumer base. In Japan, Ajinomoto was rejected by soy sauce brewers and restauranteurs, and as a result the company switched its attention to final consumers—specifically, to a new breed of modern, bourgeois housewife schooled in the hygiene, economy, and scientific nutrition of the Meiji reform era.\textsuperscript{149} One company marketing strategy was to send a sample bottle and cookbook to every graduate of the women’s higher schools,\textsuperscript{150} which offered U.S.-inspired home economics programs training Japan’s elite daughters to efficiently preside over modern homes as “supervisory housewives” (\textit{shufu}). As has been analysed by scholars like Sand (1998, 2003) and Dina Lowy (2007), the turn of the twentieth century and the advent of the Taishō period (1912-1926) marked a shift in Japanese gender roles. The growth of industrial capitalism and wage-labour transformed the three status groups (\textit{zokushō}) of the Meiji era (\textit{kazoku}, or the imperial family and its courtiers; \textit{shizoku}, the former samurai class; and \textit{heimin}, or commoners) into a small elite presiding over a growing “new middle class” drawn from the lower ranks of samurai and the farmers and townspeople-
turned-proletariat. This evolution included the emergence of what some scholars have described as a new, “practical housewife” modelled after Western notions of domesticity, wherein a masculine “work sphere” was complemented by a feminine “domestic sphere.”

This newly hands-on and isolated housewife imbibed not only Western rationality but also a fierce culture of frugality made necessary by the rapid increase in costs of living in Japan from World War I (1914-1918) and increasing into the 1930s. It was into this fraught national climate of re-invention, thrift, and ambition that Ajinomoto successfully sold its proposition of a hygienic, efficient, and modern flavouring aid for home cooking: a single shaker bottle that could transform cheap ingredients (e.g. cucumber, sweet potato, rice, tofu, pork, mutton, and wheat bread) into satisfying meals. According to Ajinomoto’s corporate magazine, by 1939 a prominent Japanese chef had confessed that MSG had become indispensable in restaurant cooking, as people were so accustomed to its flavour that they no longer enjoyed dishes without it.

During the 1910s-30s, company histories recount that Ajinomoto renewed their patent term, expanded domestic operations (production facility in Kawasaki), and brought MSG to the new Japanese territories of Korea and Taiwan (1910), the coastal cities of eastern China (1914, Shanghai sales office in 1918, Harbin, Tianjin, Shenyang, Dalian), Singapore and Hong Kong (1927), and even the United States (1920 or 1926)—many of which were closed during the later

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years of World War II. Ikeda and Suzuki had filed an application for a patent in the United States, which they were granted in 1912 and 1913. The company and its staple product were reincarnated several times over this period, Japan’s table-top glass bottles distinct from MSG’s best-selling format in Taiwan: the street vendor and noodle shop staple of square, gold, kilogram-cans. Chinese competitive products emerged in the 1920s (and were exported to Hong Kong, Singapore, and along other routes of Chinese immigration in Asia and the west coast of the U.S.). These marketed themselves as a proudly domestic alternative to Ajinomoto (which, in the eastern coastal cities of mainland China, tasted strongly of Japanese imperialism of entirely vegetable derivation—appealing to the strong mainland influence of Buddhism’s abstention from meat-eating. Despite steep competition on mainland China, by 1933 Ajinomoto had achieved Japanese production levels of ten million pounds annually. Most relevant for the longer history of MSG’s Pacific migration is the shift in marketing (target

154 Kikunae Ikeda and Saburosuke Suzuki, “Separating glutamic acid and other products of hydrolysis of albuminous substances from one another by electrolysis,” U.S. Pat. 1,015,891, January 31, 1912. Chemical Abstracts 6 1912: 717. The U.S. also granted patent to a comparator product out of Germany to an individual named Graf; however, this was reportedly a solution of impure monosodium glutamate derived from casein; see also, J.E.S. Han, “Monosodium Glutamate as a Chemical Condiment,” Industrial and Engineering Chemistry 21(10) 1929: 985; Sand, “A Short History of MSG,” 38.


157 Schwartz, In Bad Taste, 6-7.
consumer and delivery format) trialled in this period. Table-top MSG was embraced in Taishō Japan as a symbol of bourgeois modernity and progress, or “cultured living” (*bunka seikatsu*) for reasons I will elaborate at the end of this chapter. The same sales proposition did not resonate in Taiwan and mainland China, and as a result, Ajinomoto re-marketed their product in a bulk format for use by street vendors, restaurants, and large-scale food producers—not home consumers. It would be in this format that MSG would largely be taken up in the United States, invisible to the final consumer but soon indispensable to industrial food producers such as the Campbell’s Soup Company.

### Exporting Umami, Universal Taste Sensation No. 5

The distribution of MSG as a food commodity is one dimension of this history; the other half of the story I trace throughout this project is the stilted movement of the sensory and protein science that underwrote MSG’s commercial production. Ikeda’s discovery and its enormous commercial value helped to put in motion Japanese global leadership in food science research. However, in the early twentieth century, the amino acid science and “fermentation products” coming out of Japan went relatively unappreciated in European and American scientific circles. Why was Ikeda’s work only published in Japanese? Did he submit to English, German, or French-language publications? If so, why was his work rejected? Why was there not more demonstrated curiosity about his theory of umami from the centres of scientific learning in Europe and the United States at the time? What lay...

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158 The political currency of *bunka seikatsu* is discussed in numerous accounts of Taishō culture, but see for example, Barak Kushner, “Imperial Cuisines in Taishō Foodways,” in Rath and Assmann, *Japanese Foodways*, p. 149.

159 For a very readable and brief cultural history of early MSG consumption in the Pacific world (East Asia – west coast U.S.), see Sand, “A Brief History of MSG,” e.g. 42-44. For more context, see also Shoko Higashiyotsuyanagi’s “The History of Domestic Cookbooks in Modern Japan” in *Japanese Foodways*, 129-144. Also, according to one early account of MSG’s early commercialization, the production of glutamic acid in America and Europe was as of 1929 restricted to research purposes, with “crude production of monosodium glutamate [application unspecified] in the form of solution and paste” only. Han, “Monosodium Glutamate,” 985.
behind the fact that his work’s uptake was largely limited to Japan, given that it was inspired by transnational collaboration—and Ikeda was personally acquainted with some of the leading physical chemists in Europe? These are questions I follow through chapter two and the close of World War II.

In 1912, Ikeda gave a speech at the Eight International Congress of Applied Chemistry in New York in which he introduced glutamates “having the general formula C5H8NO4M’” and a taste distinct “from all other well defined taste qualities hitherto known.” In the published abstract from his talk, it is clear that he proposed to call his finding the “glutamic taste,” or that conferred by the “monovalent glutamate ion C5H8NO’4,” which he likened to other flavouring substances that would have been familiar to his audience, namely the “meat-extract and allied preparations.”160 To be clear, Ikeda did not try to sell an English-speaking audience on the Japanese term umami; instead, he used the more technical-sounding term “glutamic taste,” a decision I speculate was intended to convey the taste’s scientific, and thus universal, character.161 Ikeda claimed his preparation to have a far superior “taste-imparting power,” since a “pure glutamate is much to be preferred,” with a taste threshold value recorded for the salts of sodium, potassium, magnesium, calcium, and barium of 1/2500 for all five salts.162 He reported that the production of this sodium salt of glutamate had been successfully advanced in Japan, and he predicted with “hardly any doubt that the glutamate will come to be manufactured in a large


161 I would also flag the implicit understanding that English terminology would have been viewed by his audience in D.C. as more universally applicable than Japanese.

scale in Europe and America.”¹⁶³ The raw material needed was the hydrolytic products of proteins, and he tempted his audience with the promise that the chemical industry of these products could be “much advanced” through the production of his flavouring agent.¹⁶⁴

According to internal (food science) histories, Ikeda’s prophetic declaration fell rather flat. The dominant English-speaking scientific community received news of the discovery of a new taste sensation out of Japan with scepticism. As one account relates, “[m]any, especially in English-speaking countries, remained unconvinced,” a reaction attributable in part to the fact that Ikeda’s work had only been published in any detail in Japanese.¹⁶⁵ Another hindrance that present-day industry commentators parse is that umami taste is relatively mild even at high concentrations; also, it is often the case that high concentrations of glutamate, an anion, occur simultaneously with cations, which have a salty or sour taste and may confuse umami’s perception.¹⁶⁶

One of the rare, early English language publications on MSG as a flavour-enhancer describes glutamic acid as a “rare chemical found only in research laboratories in America.” Its sodium salt form, is “freely used like salt and sugar by housewives, restaurants, Buddhists, vegetarians, etc. in the Far East.” In a text highlight, the author informs his readership that in China, $1,130,000 worth


of “this chemical condiment” was consumed in 1928 alone, evidence of how “the chemists in the Orient have magically transformed this rare chemical into an everyday necessity.”\(^{167}\) The author, John Han of Shanghai, describes how amino acids were retrieved from proteins in hydrolysis via acid, alkali, or steam, with an effect very similar to that of the processes by which proteins are broken down in digestion. He relays that glutamic acid is known to be “harmless,” and when administered as food, ninety-six percent is absorbed, part of this used up in protein synthesis and the rest oxidized to urea.\(^{168}\) The strength of MSG’s “meatlike taste” in solution he compares favourably with other common condiments: at one part dissolved in 3000 parts water just perceptible to taste, in comparison with 1:200 and 1:400 for cane sugar and table salt, in turn. The author also establishes that the positive correlation between quantity of the condiment and quantity of the taste quality, as found in table salt, is contradicted with MSG—twice the MSG does not equal twice the meaty taste. In fact, he claims that the “highest flavouring efficiency” is realized when glutamate is used in soup and other dishes with relatively little salt. Other salts of glutamic acid (in which only one hydrogen is displaced by metal), like monopotassium glutamate KC5H8NO4 and acid calcium glutamate Ca(C5H8NO4)2, can be used in similar fashion, but are less suitable for general use, being more difficult to crystallize and less stable in moist air.\(^{169}\) The technical complexity of MSG taste perception had thus already been reported in the first two decades of the twentieth century. I consider this subject in detail in chapter five; however, it is important to flag how long it has been observed that MSG’s “flavour potentiating” potential does not work in a linear fashion—in the indefinite way, for example, in which more added sodium chloride gives greater salty taste, or more added refined sugar equals greater sweet taste. MSG works synergistically with other flavour

\(^{167}\) J.E.S Han, “Monosodium glutamate as a chemical condiment,” \textit{Industrial Engineering Chemistry} 21 1929: 984.


\(^{169}\) Han, “Monosodium Glutamate,” 984-5.
components of food, and at a certain point of diminishing returns, MSG stops making a dish any more savoury or delicious.

**Nutrition for Civilization**

Ikeda’s perception of the Japanese diet as long deficient was consistent with the prevailing wisdom of the nascent nutritional community centered in continental Europe at the turn of the twentieth century. A Japanese intellectual- and state-endorsed programme of scientific eating for social improvement reflected an international investment in civilizationist thinking. Defined in basic terms, civilizationist thought in the late-nineteenth and early-twentieth century was an ethos of modernist, competitive investment in science, technology, industry, and social hygiene. In the latter half of the nineteenth century, historically unprecedented degrees of industrialization, urbanization, and immigration—and, in the East Asian context, the forcible ‘opening’ of Japan and China, as two important examples, to European and American commerce—caused tremendous social tension and cross-cultural comparison.

The unprecedented wealth of information about the natural world and tremendous population pressures in urban centres propelled evolution-inspired theories of a natural hierarchy of civilizations. Theories of natural hierarchy (most infamously, the social Darwinism forwarded by influential European men like Herbert Spencer) were supported by the current, uneven geopolitical distribution of global power. These intellectual, social, and political factors informed the civilizationist thought that scholars in the postwar period would later reject as dis coloured by
virulent national racisms and reductionist environmental determinism.\textsuperscript{170} In early twentieth
century Japan, this type of civilizationist logic was best exemplified in the influential ecological
theorist Tetsurō Watsuji (1889-1960), whose concept of \textit{fudo}, literally “wind and earth,”
expressed his understanding of time and space, history and natural environment as interlinked.\textsuperscript{171}
Inspired by his reading of Heidegger’s \textit{Zein und Seit} (1927), Watsuji outlined three types of
‘climates’ to describe what he sees as varying ways of living, or being in the world, as well as to
engage the current state of political relations between nation-states. He designated monsoon
(India, China), dessert (Arabia), and meadow (Europe). For Watsuji, Japan uniquely possessed a
combination of monsoon and meadow, exhibiting the strengths of both the tropical belt and the
frigid zones: the monsoon’s characteristic receptivity, resignation, and passivity as well as the
cold zones’ steady tenacity and resoluteness—a nation singularly disposed to modern, global
leadership.\textsuperscript{172}

Is geopolitical competition and the teleology (the assumed self-evidence and
inevitability) of modernization sufficient to explain how MSG came to be chemically isolated,
commercialized, and marketed? Yes, and no. Scholars of Japan have specified the cosmologies
active in Japan in the early-twentieth century. They have demonstrated that Japanese philosophy

\begin{flushleft}
\footnotesize
\textsuperscript{170} Environmental determinism names the premise that a country (geography) and its citizens (people) were
inseparable and could thus be explained—and improved, or not, in keeping with prevailing distributions of global
power and the writer’s position within this distribution—by elucidating the natural laws which governed both. The
signature example being geographer Ellsworth Huntington (1876-1947)’s \textit{Civilization and Climate} (New Haven:
Yale University Press, 1915).

\textsuperscript{171} For influential treatments of Watsuji’s work, see Augustin Berque, \textit{Japan: Nature, Artifice, and Japanese
and Arne Kalland, eds. \textit{Japanese Images of Nature: Cultural Perspectives} (Richmond Surrey, UK: Curzon, 1997),
112; Watsuji, \textit{Fudo}, 192.

135-8.
\end{flushleft}
has long considered humanity as a *part of*—rather than *observer of*—material profusion.\footnote{173 For example, Asquith and Kalland 1997, Morris-Suzuki 1998, and Thomas 2002.}

Thus, as a basic starting point, it is important to specify turn-of-the-twentieth-century Japanese cosmologies (in particular, their place for the human within nature) as distinct from the Euro-American nature-culture binary.\footnote{174 Pamela Asquith and Arne Kalland, eds. *Japanese Images of Nature: Cultural Perspectives* (Surrey: Curzon Press, 1997); Julia Adney Thomas, *Reconfiguring Modernity: Concepts of Nature in Japanese Political Thinking* (Berkeley: University of California Press, 2002); Tessa Morris-Suzuki, *Re-inventing Japan: Time, Space, Nation* (New York: M. E. Sharpe, 1998).} Japan’s major religions at the time, Shinto and Buddhism, characterized the natural as encompassing—even tending intrinsically toward—improvement, or to the realisation of a thing’s purest essence.

Japanese cosmologies must be distinguished from those that birthed Europe’s Enlightenment (the long eighteenth century) and Romanticism (late eighteenth century onward), wherein a pure Nature was rhapsodized as lying outside of modernity and technology, an imagined prior space to anchor the disaffections of modern citizens. The derivative notions of environmentalism and conservation—which likewise assume a nature/culture dichotomy—gained currency in Japan later in the twentieth century; however, they do not illuminate the inherited conceptions of nature that Japanese scientists brought into our formative moment in the history of science in Japan. MSG as a technoscientific object helps us to provincialize Europe in our accounts of how modern science is 1) inextricably enmeshed in the politics of European colonialism and capitalist expansion, and 2) a set of historically- and culturally-specific codifications of knowledge about the material world that exceed and confound the teleology of a world comprised of scientific leaders and stragglers. In other words, modern science’s philosophical assumptions and methodological commitments must be considered in the context
of their Classicist-European derivation; however, this situatedness is insufficient to address the twentieth-century instances of science pursued in societies with different intellectual heritages. How, then, do we talk about technoscientific innovation undertaken by Japanese, in Japan, in direct conversation with the scientific breakthroughs of continental Europe, and largely driven by the desire to mitigate European influence and enable Japanese self-determination?

In the latest issue of *East Asian Science, Technology, and Society* (EASTS), scholars of science and technology are provoked to consider how “We [in East Asia] have never been latecomers!?” In a repudiation of what he terms “the latecomer thesis,” sociologist of Taiwanese high-tech industry Dung-sheng Chen writes that

The mentality cultivated by the latecomer theory gives local scholars [in Taiwan] an expectation of follower status, which results in a particular pattern of academic practice. In other words, when these researchers perceive themselves or their societies as a follower in science and technology, they will develop a certain kind of academic discourse to characterize technological development in their own societies to fulfill this expectation.175

Following Wen-yuan Lin, Chen advocates not automatically looking, for example, for the choice by Taiwanese researchers *between* modern or Chinese medicine.176 He instead urges scholars of STS to trace how researchers employ a “comingling of various modes”—that the range of theories and practices available to today’s diverse STEM researchers are not mutually exclusive.177 Thus, I offer MSG’s story as one more way to arrest the force of Eurocentric


177 Chen, “We Have Never Been Latecomers,” 391.
interpretive conventions—for example, of a trend- and tone-setting West (or, as the case may be, Global North), and a delinquent East (or Global South)—in our transnational accounts of science and technology. MSG’s life through the twentieth century contradicts this paradigm, and I contribute its history to an emerging theorization of global technoscience in which innovation takes many forms, is assumed proper (i.e. natural, proprietary) to no raced, gendered, or geographically-bounded population, and is, throughout the world, similarly but unevenly drawn into the imperative of capitalisation.

In the case of Japan, the need for this theoretical work has been made clear in scholarship like that of anthropologists Pamela Asquith and Arne Kalland. They trace a correlate of Chen’s disavowed “latecomer theory”—juxtapositions between Eastern and Western cosmologies that often subtly reflect a ‘Green Orientalism’ which posits ‘non-Western’ cultures and values as passive recipients of Western technological solutions, or as atavistic fodder for devising sustainable alternatives to Western instrumentality. Asquith and Kalland argue that Japanese intellectuals have ontologized the natural world in such a way that the human individual is indivisible from their surrounding relationships and topographies. In effect, the modern Western nature-culture duality (most frequently identified with the philosophy of Descartes) does not hold. In its place is the concept of “nature” as an ideal form—a ‘should’ rather than an ‘is,’ and one that includes human agency within the compass of the natural. In other words, the nature of a thing is its most pure essence, or the divine ideal abiding within the natural form (from the principle of kami in Shinto), an ideal which may be already manifest or which may be revealed

by deliberate human cultivation. In this worldview, human technology is not the antithesis of a Romantic notion of nature-as-wilderness. Nor is nature-as-ideal the same thing as environmental preservation or ecological awareness (which are derivative of nature-as-wilderness and likewise Romantic). Rather, technology is part of a deep-seated aesthetic of minimalism in which art, poetry, and natural forms (e.g. the bonsai tree) are idealized in their barest perceptible form. In such a tradition, biological objects symbolize human emotion, e.g. the crane signifies soaring happiness, the pine tree, waiting. This sensibility has been described as ‘wrapping,’ ‘cooking,’ or ‘binding’ nature. This remaining section of this chapter argues that MSG was a technology for binding what lay at the core of an emerging myth of national Japanese cuisine: the taste sensation umami, or the essence of a delicious, modern, and patently Japanese taste.

Monosodium glutamate did not only reflect the Meiji era impetus to accrue scientific and technological expertise; it was also consistent with an emergent vision of a modern Japanese exceptionalism. Japanese culture—from poetry (haiku), landscape and flower arrangement (ikebana, e.g. bonsai and bonkei), to formal dining and tea ceremony (kaiseki ryori and chanoyu)—valorised brilliance in simplicity and subtle nuance. Japanese cosmologies understood cultivation, i.e. by human ingenuity, of the material world not as good or bad, but as a fait accompli. The physical world in Japan was seen as intrinsically technological—and it was by virtue of being natural creatures that humans had technological capability. Modern

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179 Nature-adoration in Japan (frequently romanticized by Westerners) as a form of worship and reverence stems from Japanese mythology, in which the ancestors are believed to reside in natural/material spaces or landscapes, and so must be propitiated through ritual and offerings. Asquith and Kalland recall that the global trend toward ecological awareness, conservatism, environmentalism retains the Cartesian dualism that allows humans to observe nature as a separate entity (to be consumed and stewarded) and is not native to Japanese cosmology. Asquith and Kalland, eds. Japanese Images of Nature.

scientific technique, then, while originated in Euro-American instrumental rationality, was likewise compatible with Japanese natural philosophy. The adoption of foreign technologies or scientific techniques was seen not as ideological invasion but, to paraphrase Mark Driscoll, Pamela Asquith, and Arne Kalland, as the selective inoculation of Japanese society with new tools compatible with an extant Japanese cosmology.181

How does this ‘cooking’ of nature come to bear on Japanese cuisine, and particularly on the industrial food product of MSG? Scholars of Japanese cuisine Michael Ashkenazi and Jeanne Jacob have similarly broken down the aesthetics of Japanese cuisine as best represented by three principal activities: kakusu (hiding), shinobu (disguising), and kezuru (shaving). These principles are pursued in a dish’s restrained multisensory attributes: choice of ingredients, resulting flavours and textures, order of service, service/plating, colour, configuration, etc.182 Ashkenazi also emphasizes that Japanese typically conceive of the natural as “something that is in its place, something that acts appropriately”—or that is part of a perceived proper order of things. The implication is that there is no hard and fast boundary between the natural and the artificial.183 He argues that the nature that is significant culturally is a “construct which conveys the flavour of nature, its essence rather than its presence,” as exemplified by bonkei (miniature rock scenery on a tray), bonsai (artificially dwarfed trees), and ikebana (flower arrangements). These reflect an

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“artifice that goes beyond artificiality,” depicting nature as *contextual, rather than absolute*. The nature that is understood to matter is the nature or abstract property lying at the root of a thing, and it is on this basis that food products like prepared beverages are sold, Ashkenazi writes—for their healthful *essences*, e.g. ginseng, algae, or vitamins. \(^{184}\)

Given these insights, the manner of Ajinomoto’s branding and incorporation as a new fixture on the Japanese industrial and cultural landscape was not accidental or exceptional. To commercialize and institutionalize the essence of a flavour by offering a standardized, packaged form of the “essence of delicious” reflects a deeply held Japanese mode of engagement in the material world. MSG as a novel scientific proposition and product offering was not construed domestically as a food “adulterant” or “artificial additive,” as has been discussed in histories of “snake oil” food and drug hucksterism in the Progressive Era United States. It was instead conceived as a means to realize a modernist project of social uplift and as a distillation of the essential goodness already reflected in local culinary technique, e.g. the preparation of *dashi* stock. Ajinomoto’s commercialization of MSG reflects a convergence of distinct but compatible domestic and imported ideas about the nature and value of edible material. In sum, MSG was a product of Japanese sensibilities, European sensibilities, and modern scientific techniques that were forwarded in both cultural contexts. Contrary to the philosophizing of Meiji reformers, the ‘Western’ scientific rationality that many Japanese embraced in the early twentieth century was never value-neutral. On the contrary, key dimensions of science’s European ideological freighting (of human dominion over the natural world, of the inevitability of improvement) were

\(^{184}\) Ashkenazi, “Can-nonization of Nature,” 216.
in effect compatible with existing Japanese philosophies, and together these helped to inform what it would mean to be—and eat—as a modern Japanese.

Finally, it is worth concluding with a note on the birth of Japanese culinary exceptionalism that will play out in English language food science and nutritional advice beginning in the 1980s (to be discussed in chapter four). The myth of Japanese exceptionalism has a particular currency within early twentieth-century discourses of Japanese modernization. The reformist Meiji government, comprised of low-ranking samurai who overthrew the powerful Tokugawa shogunate (1603-1868), unified the nation in part by re-centring the Imperial family in national politics and elaborating a mythology around a Japanese imperial dynasty stemming back, unbroken, two thousand years to the great-grandson of the sun goddess Amaterasu, Emperor Jinmu. Imperial mythology was actively incorporated into the constitution of Japan’s modern government (constitutional monarchy), with justifications of Japanese militarism and imperialism encoded in law and incorporated into educational curricula. Geologist and science scholar Scott Montgomery has argued that Japan is a particularly revealing example of how modern science has been informed by linguistic and conceptual processes of translation or ‘making-native.’ For Montgomery, Japan’s contemporary composite worldview (indebted to Shinto, Buddhism, Confucianism, and occidental science) is a product of the country’s geopolitical relationships with China and the West. The Meiji embrace of Western knowledge as “technique” was the product of a desire to assert national self-sufficiency and to overcome Japan’s sense of historic (cultural, linguistic, intellectual/spiritual) indebtedness to neighbouring

185 Mizuno, Science for the Empire, 2-3.
China. Modernist thinkers in Japan sought to abandon both the dependence on Chinese metaphysical thought of Japan’s past and the political subordination to Western industrial and military might of Japan’s present. This shift was to be enabled by a translation of Japan’s future in the terms of modern instrumentalist thought, or what Montgomery has described as a ‘freeing’ of technical thought from moral thought, a transition from knowledge-as-virtue to knowledge-as-progress.

This “rendering technical” was essential to the operation of Japanese modernization in all realms of life, including practices of food production and consumption. Modern scientific ideas and practices were interpreted by Meiji reformers far less as the cultural impositions of an economic imperial oppressor, than as ideologically-neutral “techniques” which could be legitimately transposed onto Japanese soil, and metamorphosed by what they depicted as innately superior Japanese aesthetics, sensibilities, and norms. Intellectual and cultural historian of Japan Hiromi Mizuno has recently argued that it was in the 1910s—the transformational decade in which MSG was successfully manufactured and exported—that experts in Japan

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186 Due to the monopoly access of Dutch Jesuits during the shogunate, 17th-18th centuries, then after the ban on Western writings lifted in 1770, following leaders in Western scientific thought: Germany, France, England, then USA in 20thc, especially through postwar period; precursors to the mind-matter separation in Japanese thought: the Chu-His school of neo-Confucianism in Tokugawa Japan = Confucian metaphysical concepts for explaining the nature of the universe and humans’ place in it: 1) li (Japanese ‘ri’) as the ultimate ontological and moral principle determining order in the universe, and 2) ch’i (Japanese ‘ki’) as vaguely described notion of primal energy of movement and appearance, which became increasingly associated in Japanese neo-Confucian thought with the material world – goal was spiritual, means were material). Montgomery argues that the Japanese perhaps adopted a modernizing orientation more readily than the Chinese because of the shogunate’s censorship policies: Jesuit scholars working in China or in Chinese prevented the adoption in China of a heliocentric universe due to the Church’s repudiation of Galileo and Copernicus – led to particularly aggressive ‘translation’ or re-writing of Western scientific thought into Chinese. He reads these inputs through the form and structure of the Japanese language, which reflected the multiplicity of the nation’s influences (exhibiting considerable profusion and confusion of ideograms (hiragana) and phonetic renderings of words (katakana) in the Roman alphabet, and meanings attributed thereto). Scott Montgomery, “Record of Recent Matters: Translation and the Origins of Modern Japanese Science” in Science in Translation: Movements of Knowledge through Cultures and Time (University of Chicago Press, Chicago, IL: 2000), 189-226.
assimilated scientific thinking, methodology, and industrial infrastructure.\textsuperscript{187} Mizuno employs the term \textit{scientific nationalism} to signal the degree to which science and technology were seen as “the most urgent and important assets for the integrity, survival, and progress of the [Japanese] nation” in her characterization of the early decades of the twentieth century.\textsuperscript{188} Thus, The scientific essence of taste, as a commodity, was popularized at the same moment that science ceased to be a foreign incursion and became a naturalized feature of an emerging Japanese modernity. Perhaps the most emblematic evidence of this domestication of science in Japan was the rise of the first generation of Japanese faculty to take the helm of science and mathematics university instruction in Japan—not Europeans or Americans teaching “Western mathematics” in English, French, or German, but Japanese teaching just plain “mathematics” in the Japanese language.\textsuperscript{189} Mizuno situates this national internalizing of science as part of the notion of \textit{kokutai}, which translates literally to the “national polity” or “national essence,” which encapsulated the Meiji institutionalization of imperial mythology, modernist Japanese exceptionalism, and justification for the military build-up and imperialism that would culminate in World War II.

\textsuperscript{187} Mizuno, \textit{Science for the Empire}, 12.
\textsuperscript{188} Mizuno 2009, 11.
\textsuperscript{189} Mizuno attributes the nativization of science to the experience of World War I. Frequently accounted in Japanese histories as a relatively minor war, Japan nonetheless acquired the former German territories of Tsingtao and South Pacific islands (\textit{nanyō}) as a result of fighting alongside the Allied powers due to the 1902 Anglo-Japanese Alliance. World War I also shifted the emphasis of Japan’s industrial production from textiles and spinning to heavy and chemical industries fuelled by a growing energy sector, exemplified by the construction of large-scale hydroelectric power stations. It also prompted an unprecedented degree of investment scientific research and development (into domestic production, or \textit{kokusan shōrei}) by a Taishō government galvanized by the loss of German imports, in particular, during the war (e.g. industrial chemicals, pharmaceuticals, and precision instruments). Mizuno, \textit{Science for the Empire}, 12-5.
What matters for the history of MSG is how these broad forces influenced the science and culture of eating in turn of the twentieth century Japan. In her study of modern Japanese foodways, anthropologist Katarzyna Cwiertka argues that the acquisition of Western modes of food preparation and consumption, or *yoshoku*, was central to the Meiji programme for “civilization and enlightenment.” Besides demonstrating mastery of alien tableware, seating, manners, and dress, reform-minded Japanese elite made a point to adopt and display—albeit unevenly—a palate expanded to accommodate Western staples like the long-taboo meat, especially beef, as well as dairy products and wheat bread. In the words of playwright Kanagaki Robun in a 1871 satirical book of monologues, *Aguranabe* (*Sitting around the Stewpan*), “In the West, they’re free of superstition. There it’s the custom to do everything scientifically, and that’s why they’ve invented amazing things like the steamship and the steam engine.”

Ikeda’s research into MSG was undertaken in an era in which a scientific vision of what foods would most benefit a newly invigorated, newly modernized Japanese populace was of acute interest to government and also *de rigeur* among Japan’s fashionable urban set. The generally larger stature and the colonial power of Europeans in the period suggested meat and wheaten bread (staples of Europe but largely absent in Japanese cookery) were somehow ideal for growth and strength. The field of nutrition science at the turn of the twentieth century crystallized out of an international interest in determining precisely what balance of the newly identified macronutrients—fat, protein, and carbohydrates—to prescribe for the optimal nutrition

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of a modern race.\textsuperscript{191} For example, Japanese intellectual Fukuzawa Yukichi was one proponent of meat-eating for racial strengthening; he saw meat consumption as the route to greater physical nourishment, but thence to superior moral and intellectual capacity. However, prepared grains have been discussed as the bedrock of civilizations (as a staple of the labouring classes, as currency and tribute, and as a cultural form and source of pride) in traditions of thought as disparate as Confucianism, originated in Han China (206 BCE – 220 CE), and Malthusian political economy in early nineteenth century England.\textsuperscript{192} In Japan, the availability of polished white rice for nationwide consumption was a key marker of a new era of modernity, or “civilization and enlightenment”—for in the Tokugawa era, white rice had been a luxury reserved for the elite. The fraught, forty-year history of research into the etiology of beriberi disease (vitamin B deficiency associated with a diet comprised mainly of white rice), or Japan’s “national enemy,” was only the sharpest instance of suspicion over rice and other ‘Oriental’ staples and the privileging of a ‘Western’ diet based on wheaten bread, milk, and meat within the emerging international nutritional establishment of the early twentieth-century.\textsuperscript{193}

Social reformer Murai Gensai was an early celebrant of MSG. He wrote a blockbuster serial novel called \textit{Shokudōraku} (The Gourmet’s Delight) that Japanist Jordan Sand has described as no less than a “call to arms for social and moral reform the Japanese nation,

\textsuperscript{191} I retain this antiquated use of ‘race’ (considered unscientific and offensive since roughly World War II) deliberately, as it was the default language of reform experts of the period. Races were seen to be self-evident, natural categories that mapped roughly onto modern nation states, the obvious sites for programmes of scientific (physiological, sociological, etc.) inquiry and schemes for rational improvement.


\textsuperscript{193} For more on the domestic and international politics that animated beriberi research, see Alexander R. Bay, “Beriberi, Military Medicine, and Medical Authority in Prewar Japan,” \textit{Japan Review} 20 2008: 126.
beginning in the kitchen.”¹⁹⁴ In addition to praising MSG as “indispensable,” “extremely convenient,” and an “admirable” flavour boost to miso soup, Gensai advocated greater protein consumption and dietary variety, and a philosophy of breaking down food in the cooking process, so as to minimize the physiological burden of doing so during digestion (much more on this theme in chapter five).¹⁹⁵ Colonial possessions in Korea, Manchuria, and Southeast Asia were seen by Japanese reformers as not only a sign of international prestige but as a vital “steady pipeline of food for the mother country;” in other words, they were essential for Japan’s increase in geopolitical influence relative to China and the Western powers. A deep Japanese ambivalence toward animal flesh, a shortage of rice (and the prohibitive expense of beef, for example, for the majority of Japanese in the 1910s), the import of Chinese food customs (noodles and pork) due to long-standing exchanges and then twentieth-century century Japanese colonization, and a scientific discourse of functionalist nutrition in the name of national strength and civilizational merit made more nourishing foods an imperative.¹⁹⁶ As an “instant seasoning,” MSG had the potential to increase palatability of grain-based, repetitive, and bland meals, and had the invaluable appeal of being a Japanese innovation. While Ajinomoto did not claim that MSG itself had nutritional value, the additive carried the cachet of modern, scientific eating. It was one of many tools of hygiene and convenience with which the new, modern housewife could prepare the savoury and nutritious meals that characterized an enlightened and affluent nation—and which Japanese food commentators would later recommend to Western nations burdened with


overweight, diabetes, and cardiovascular disease (see chapter four).\textsuperscript{197} This marked the first instance in which MSG became a technology and commodity invaluable to the disparate schemes of nation-building (through military, economics, and nutrition), middle-class consumer convenience, and democratising access to luxury dining—all through the promise of making more meals more delicious.

\textbf{Conclusion}

Monosodium glutamate’s story links a growing body of English-language scholarship on transnational science and technology and transnational foodways, as these have emerged in the context of modern nationhood and international trade. How do scholars of food and science specify modernization in a “non-Western” context? Much excellent work has abandoned binary juxtapositions of Western and Eastern notions of life, nature, and humanity, troubling Orientalist interpretations which characterize Asia—Middle, South, Southeast, and East—as a bedrock of ancient tradition and innate spirituality, the beneficiary of modern advancements originating in the West. Neither may a thoughtful treatment of Japanese science and foodways fall back on a romanticized notion of hybridity, celebrating cosmopolitan nuggets of innovation from the

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\begin{itemize}
  \item An oscillation between intrigue, fetish, disgust, and aversion to Western food seems to have predominated in the treaty ports of Japan and China. Mark Swislocki’s recent account of foodways in Shanghai is rich with accounts from British ex-patriots who revealed contradictory feelings about what a modern, ‘civilized’ diet should look like. George Wingrove Cooke lamented the raw appetite for meat among his compatriots in the communal, masculinist ‘messes’ where Western labourers in treaty ports typically ate, describing much of the fare of Englishmen in Hong Kong and Shanghai as “English cookery in its worst possible form,” “a slice of red flesh and a crudely prepared vegetable,” and “the food of man in a state of nature.” He despairs: “sedentary and dyspeptic men of every race will think with the Chinese, that legs, shoulders, loins, heads, limbs, directly suggestive of the living animal, are common only to the banquet of an Englishman and a beast of prey.” George Wingrove Cooke, \textit{China: Being “The Times” Special Correspondence from China in the Years 1857-58} (New York: Routledge, 1859), 236, cited in Swislocki, \textit{Culinary Nostalgia}, 103.
\end{itemize}
margins. In this chapter, I have purposefully characterised MSG’s origin not as a story of essentialist Japanese cuisine—or proprietary flavours—intermingled with leading-edge Western scientific technique. Instead, in the entirety of this project I aim to historicize when and how this particular framing emerged, and to interpret what effects it had among scientific practitioners and citizens—and, from the late-1960s-onward, citizen-consumers—knowingly consuming or avoiding MSG. I view the discovery of MSG as an innovation born of tense geopolitical encounter. MSG is a transnational and nationalized product, the result of a formative period in modern Japanese and Euro-American history—a period that formed the foundation of Japan’s century-long global leadership in amino acid science and a contemporary who’s-who of flavour enhancers, food modifiers, and preservatives. Monosodium glutamate does not allow us to rehearse the history of science and technology story of time-honoured local tradition being exported, technologized, and capitalized by modern, expert Westerners.

The invention of MSG traced here was part of the transnational history of applied nutrition (specifically, protein chemistry) and early twentieth century geopolitics. This chapter’s temporal span has been roughly the 1890s-1930. MSG was created in the context of a vibrant era of international collaboration, a moment when modern science was bright and shiny and new. At the same time, the early history of MSG was animated by wider discourses of race, nation, and modernity in Japan. MSG would come to hold a symbolic and strategic significance as a domestic food technology and commercial export during Japan’s period of imperial expansion and even into the twenty-first century. In chapter two, I take up the additive’s spin-off technologies and, together with MSG, their iterations as a military provisioning technology: the application that would catalyse MSG’s passage to America and to the rest of the Western Hemisphere, far beyond and outlasting the territorial ambitions of Imperial Japan.
Chapter 2
Exporting MSG: Deliciousness Goes Global

"There is hardly any doubt
that the glutamate will come to be manufactured
in a large scale in Europe and America.
As the raw material for the manufacture is the hydrolytic products of proteins,
there is a prospect that the chemical industry of these products will be greatly developed,
bringing in its train numerous problems of great interest."
~ Kikunae Ikeda, 1912

Introduction

In the spring of 2012, I took a subsidised cab ride over the Delaware River separating
downtown Philadelphia from Camden, NJ: the location of the global headquarters of the
Campbell’s Soup Company. Traveling alone, visibly young, white, female, and pregnant, I
toured Campbell’s global HQ, sprawling and square, advertised by its grandeur and isolation as
an institution of significance. The facility, I learned, had been massively upgraded over the last
ten years. It was rich in natural light, and featured an expansive interior green courtyard,
countless stylish break rooms equipped with what appeared to be complementary beverage and
snack bars, and a huge, full-service cafeteria boasting one of (former President and CEO) Doug
Conant’s pet projects: a ‘soup bar.’

I was scheduled to meet with John Faulkner, then Director of Brand Communications,
whom I awaited in the cavernous, glass-walled cube that was the facility’s reception area.
Faulkner materialized with minimal delay, a tall, middle-aged white man later revealed as the

198 Kikunae Ikeda, “On the Taste of the Salt of Glutamic Acid.” In Proceedings of the 8th International Congress of
https://archive.org/stream/eighthinternational17interich#page/146/mode/2up.
parent of a child with a disability, and an individual willing to humour the halting inquiries of an early career historian. Faulkner toured me through the facility, and I enjoyed a moment of demystification standing outside a nondescript industrial kitchen-cum-laboratory: one of the hand-full of rooms in which I was informed all of the company’s global product research and development was conducted. Faulkner informed me that in his then thirteen year tenure with the company, he had witnessed consumers become much more self-aware ‘eaters.’ Since people now “care[d] more about food,” Campbell’s faced a dilemma compounded by the rate of communication via social media: how was the company to curate their corporate image and messaging, particularly in light of food safety fears like those around bisphenol-A (BPA) in food packaging, with all these other opinion-makers in the mix?\footnote{\textit{At the time, Campbell’s had on staff one corporate historian/archivist. The “archive” I was allowed to glimpse— but not conduct research in—was a single-room facility featuring visual displays of historic advertising images; promotions and products from corporate campaigns; random memorabilia and posters; corporate-sponsored histories and a Campbell’s sponsored children’s picture book; a few aisles of filing cabinets; and a small workspace for then archivist, Jonathan Thorn. John Faulkner, Personal interview with the author, May 2012.}}\footnote{\textit{For example, Campbell’s Vegetable Soup’s number of vegetable ingredients has decreased from double digits in the 1960s to just six (carrots, potatoes, peas, and—occurring in lesser quantity than potato starch, a thickener—green beans, cabbage, and celery). The company makes available online the nutrient profile and ingredient list of many of their products. Campbell’s vegetable soup also contains six ‘additives’: monosodium glutamate, yeast extract, hydrolyzed protein (soy, corn, wheat), flavour, spices, and caramel. “Products,” Campbell’s Soup Company.}} I asked about the future direction of the company, and Faulkner explained that while overseas markets were a big area of interest (since there are, he told me, “too many people to ignore” in China), the company’s “healthy products” portfolio was an important area of development, valued then at $3 of their $8 billion U.S./year overall product portfolio. He explained their challenge as finding the sweet spot in balancing costs of production (and selling price for consumers), ease of preparation, taste, and health profile. For instance, if a product’s sodium was too low, nobody would buy it; if they reduced the variety (and, for this, I also read, quality) of ingredients to decrease cost, they lose out on flavour and have to compensate with additives.\footnote{\textit{However, additives now have a}}
distinctly sour flavour, to speak, with the consumer. So, Faulkner’s small global communications team—fewer than ten full-time staffers, half of whom were administrative support, and half public relations—was in 2012 stuck somewhere between a rock and a hard place. Consumers wanted a cheap product, and one that was easy to prepare (and relatively appetizing) by reconstituting with water. Consumers also wanted something tasty, but they did not want too much salt. And they apparently did not want MSG. What was a multibillion-dollar food company to do?

Sixty-four years prior to my erstwhile infiltration of Campbell’s command centre, the Soup Company was one of several food industry representatives to attend a pivotal symposium on the potential of MSG for American food production. On March 4, 1948, in the Stevens Hotel of Chicago, IL, the Chief Quartermaster and Associates of the Food and Container Institute for the U.S. Armed Forces presided over a conference that changed the face of American food processing. Intrigued by the Japanese use of MSG in army rations during World War II, military leaders in particular were drawn to the idea of an additive that would eliminate the “tinny taste of canned foods,” to “suppress undesirable flavours,” “create a lingering flavour reaction,” and to “enhance acceptability” of a product.\(^\text{201}\) In his introduction to the publication of the first symposium papers, Chief of the Food Acceptance Branch of the Quartermaster Food & Container Institute W. Franklin Dove, cited one of the many communications he had received since the event:

The results of this Symposium will prove to be of much value not only to the monosodium glutamate producing industry but to a much greater extent to the consuming industry. I sincerely hope that ways and means may be devised whereby this movement, which you have initiated, may be continued with increasing emphasis.”

The growth of this movement—that is, the proliferation of research and capital investment into MSG by American military and industrial consumers, and the scientists in their orbit—most certainly came to pass. Dove’s introductory comments are revealing of the terms with which MSG came to be embraced in the American market. The pivotal first Chicago symposium, which has been mythologized in multiple accounts of MSG’s migration to the United States, from trade histories to critical accounts, is an important historical window into the cross-Pacific transmutation of MSG: from the slender, feminized glass bottles of the Japanese market to the ten-pound tins distributed to industrial, rather than household, consumers in the United States.

In this chapter I outline the research that followed on Ikeda’s theory of ‘umami’ in Japanese and ‘glutamic taste’ for English-language audiences. The most important successor innovations were the identification by Japanese researchers of other flavour-enhancing compounds that worked synergistically with monosodium glutamate to improve the palatability of certain foods. I map the technical paradigms of the MSG production industry as they emerged painstakingly in the U.S. from the 1930s-50s and, by the 1960s, internationally, by virtue of the cost efficiencies of industrial fermentation. I use the word transmutation, rather than translation or migration, to signify how MSG was materially and conceptually recast within geographical space and the distinct cosmologies of Japanese and Euro-American scientific, military, and


business communities. In other words, what follows is an accounting of how MSG came to “go
global” by the 1950s-60s; and of how the additive’s production science hopped national borders
in the wake of World War II, while the additive’s underlying sensory science—a five-part
ontology of human taste physiology—stopped short at Japanese shores. Between the close of
World War II and the late 1960s, Americans came to eat MSG in large amounts indirectly,
through the canned, frozen, and snack foods that came to be synonymous with American
cornucopian and convenience cuisine. However, American food scientists and industrial
producers simply understood MSG as a technology for improving “feeling,” “overall
satisfaction,” and “mouthfeel.”

I attribute this conceptual divide in part to the cultural cachet of the ancient, Aristotelian
four-taste tetrahedron in Euro-American physiology, and to the expert authority of a credible,
homegrown alternate ontology of MSG flavour enhancement. These two forces combined to
readily overwhelm the challenge of not only a linguistic hurdle, but the tremendous national
antipathy that characterized the U.S.-Japanese relationship in the 1930s-1940s—one coloured by
competitive regard, the mass violence of World War II, and anti-‘Oriental’ racism in the United
States. Monosodium glutamate came to be known in this period to the American food
establishment as a ‘flavour enhancer’—something with profound implications for the American
food industry, but with little bearing on the question of basic human taste physiology. Just as
importantly, monosodium glutamate became highly cost-effective to produce in the late-1950s,
thanks to the long-sought technique of ‘biosynthesis’ or industrial fermentation, in which
specially selected, carefully conditioned bacteria could excrete glutamic acid in the vast
quantities that catapulted MSG’s consumption in the U.S., and all without the need for a foreign
term called umami.
**America Buys MSG—not Umami**

It is clear that MSG was being used in commercial food processing, some restaurants, and by some home consumers in the United States by the 1930s. According to historian of Japan Jordan Sand, Henry Low’s *Cook at Home in Chinese* (published in New York in 1938) included MSG in every recipe. Described as “gourmet powder,” Low listed it as one of the five “Chinese staples” necessary for the American cook to get a start in learning how to prepare Chinese meals. Similarly, Buwei Yang Chao’s classic *How to Cook and Eat in Chinese*, first published in 1945 (with an introduction by Nobel Prize-winning (1938) writer and advocate of minority and women’s rights Pearl Buck), made a point of stating the author’s distaste for “the widespread use of taste-powder in recent years,” which she felt had prompted “a lowering of the standard of right cooking and a leveling of all dishes to one flavor.”

For the period of the 1930s-40s, the archives of the Food and Drug Administration (FDA) contain numerous letters from American business owners inquiring after the regulation and availability of “sodium of glutamate” or “sodium glutamate” in foods, and even the occasional letter from a housewife concerned about the presence and possible actions—particularly on “the stomach”—of monosodium glutamate.

As Sand and historian of Chinese food in the U.S. J.A.G Roberts have pointed out, these were decades in which many “white Americans” made their first forays into Chinese restaurants. American perceptions of China in general were softened during the Japanese invasion and due to diplomatic overtures between Chiang Kai Shek and the U.S. as new allies against an aggressor.

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204 See for example, Correspondence between Mr. I. Manasewich of Kims Chow Mein (Rochester, N.Y.) and L.D. Elliott, Acting Commissioner of Food and Drugs, October 29, 1942 and December 1, 1942 & Mrs. F. A. Malliband (New York, NY) and J.K. Kirk, Acting Chief, Interstate Division, March 4, 1946 and March 14, 1946; Monosodium glutamate flavour, including sodium glutamate and glutamic acid, 1938-1945: 462.92; Flavors and Extracts—General, 462. Records of the Food and Drug Administration (FDA), Record Group 88; National Archives and Records Administration (NARA)—College Park, MD.
Japan. Similarly, more white Americans were venturing into Chinatowns, and buying Chinese food from Chinese-American owners of diners and grocery stores.\(^{205}\)

Despite many attempts by Japanese, Chinese, and American entrepreneurs in the 1930s to establish operations in the U.S., the glass shaker of Japanese bourgeois table tops failed to catch hold in the United States. And yet, according to Ajinomoto corporate archives, from the mid-1930s to 1941, the United States bought more of their signature product than any other country outside of Japan and Taiwan.\(^{206}\) How, then, was MSG getting into American foods if not through direct-to-consumer advertising? As of roughly 1930, MSG came to North America in crates of ten-pound tins bound for industrial customers in a country whose food system was more industrialized than anywhere else in the world. This disproportionate industrialization of the food system in the United States has been attributed to “technology transfer from an increasingly high-tech military” adapted for the realm of food processing. Monosodium glutamate’s international migration followed closely on the stilted movement of imperial armed forces—first the Japanese, and then the American.\(^{207}\) As food historians have remarked, the imperatives of military mobility were key catalysts in the development of modern techniques of food engineering, such as the Napoleonic wars and Nicholas Appert’s first canning techniques. MSG was popularized in the U.S. due in part due to the military demand for technologies to make dehydrated, pasteurized and canned, shelf-stable, and portable (read: not tasty) foodstuffs taste good. It was in the immediate post-war period that military and corporate representatives in the


\(^{206}\) Sand, “A Short History of MSG,” 43; Ajinomoto enkakushi, graph opposite page 512, 513.

\(^{207}\) Sand, “A Short History of MSG,” 43.
United States seized upon MSG as a panacea for the drawbacks of mass food manufacture. Two early symposia were held in 1948 and 1955, both under the auspices of the US Army Quartermaster Food and Container Institute, which, in Sand’s words, “assembled an industrial brain trust” to discuss potential applications of the flavour enhancer. After all, in the words of Colonel John D. Peterman, quartermaster of the Food and Container Institute for the armed forces, “flavorless rations can undermine morale as quickly as any other factor in military life.”

The MSG Symposia: “Derived from food and returned to the food”

In March of 1948, the Chief Quartermaster of the Food and Container Institute for the U.S. Armed Forces convened the first symposium on monosodium glutamate use in industrial food production and military food provisioning in Chicago, IL. Attendees at this event represented the Food and Container Institute, the food industry, and the food science and technology community. For example, food science and technology representatives came from Arthur D. Little, Inc., the International Minerals and Chemical Corporation, the food technology or research departments of a few universities, the National Livestock and Meat Board, and the Brewers’ Yeast Council—and (in a foreshadowing of the chapter to come on glutamate metabolism) future pharmaceuticals giant Merck and Company and the Laboratory of Vitamin Technology. The food industry was represented by some of its most prominent members: Nestlé, General Mills, Inc., Campbell Soup Company, H. J. Heinz Company, General Foods, the Borden

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The introductory remarks for this gathering of power-hitters was provided by the Commanding Officer of the Quartermaster Food and Container Institute, Colonel Charles S. Lawrence, who opened the proceedings “that we have all been awaiting with great expectations” with the cool misogyny of a wife joke. Relaying the anecdote of a friend who had inscribed a cookbook he gifted to his wife on the occasion of their first anniversary, “To Louise with John—with great expectations”—Lawrence assured his audience that the “distinguished” character of the symposium’s participants would surely prevent the disappointment that occasioned poor, storied John, whose sentiment backfired when Louise, “like a woman scorned,” responded with “fury” to what she perceived as dissatisfaction with her culinary efforts.

What is it like to be a part of this select gathering of American science, military, and industry luminaries? First, participants’ expertise and entrepreneurial vision are affirmed by Lawrence’s conjuring of a day-long technical safari, for which a five-fold agenda “encircle[s] the game that [you] are after.” Attendees entertain little doubt that they will, collectively, “flush some interesting things to shoot at in the course of the day.” Their targets? The production of glutamate; its use as a flavoring agent; its relation to the browning reaction; the pharmacology of glutamic acid; and the thresholds of glutamate perception. Trophy hunters thus gathered, the


212 Lawrence, “Introductory Remarks,” 3.
President of Rumford Chemical Works, Albert E. Marshall, rehearses the audience in the history of glutamate production (to which they have been curiously peripheral). Sourced from wheat gluten and, later, soya bean protein, they learn that glutamate has become a significant industry in Japan, and to a lesser extent in China, as a “pleasing modifier of the customary monotonous diets of the Orient.” They are thus assured. MSG came to America in the 1920s, from a place where food is naturally boring and where its attributes were more urgently needed. They learn that American researchers have, by dint of perseverance and opportunity (spanning 1926-1936—more on this to follow), developed a new method of hydrolyzing glutamate from beet sugar residues. Marshall reminds listeners that whenever MSG’s history as a “flavour builder” is reviewed, “speculation arises as to why, for more than forty years, the many workers in the field of protein chemistry isolated glutamic acid, prepared its salts, and studied the chemistry…without ever exploring other than their purely chemical aspects.” He admits that realizing the sodium salt of glutamate’s potential for flavouring “has to be accorded” to Kikunae Ikeda of Tokyo, Japan. Ikeda’s innovation has “placed the Suzuki company in a dominant position in the glutamate industry,” and led Ikeda to, either directly or through assignees, secure patents on glutamate production processes in most countries around the world. The good news for American chemical and food producers left lagging behind in this high-growth area? These basic Suzuki-Ikeda patents expired in 1929, and already there are a reported seventy-odd small, competitive manufacturers of glutamate in Japan eroding Suzuki and Company’s monopoly of

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the flavour-enhancing market (and never mind that Suzuki and Company still accounts for more than half of Japanese production of MSG).216

Due to Suzuki and Company’s erstwhile attempts to market Ajinomoto seasoning in the United States, a few domestic producers have emerged—two important examples are the Huron Milling Company of Harbor Beach, Michigan and James E. Larrowe of Mason City, Iowa. Here is the current status of production techniques: according to current nomenclature, three modifications can be made of glutamate: L-, D- and the DL- (an equal or what is called a racemic mixture of the L- and D- forms). The L-glutamate enantiomer (the configuration of the molecule that is a mirrored version of the D- version) occurs in nature and is the only one with a flavour enhancement capacity. In other words, L-glutamate works; D-glutamate does not. Manufacturers only want to make L-glutamate, but various hydrolysis techniques stubbornly turn up the useless D-version. This is a problem. Liberating the glutamic acid always starts with a hydrolysis, either via enzymes or by heating in the presence of an acid or an alkali (the hydrolyzing agent). These latter two are the ones currently used.217 James Larrowe has managed to reevaluate an investment in thousands of tons of worthless sugar beet wastewater (prized during the war as a source of potash salts to be used in fertilizer, and a wash now that the war has ended). On the advice of a Pittsburgh scientist at the Mellon Institute of Industrial Research, who identified high amounts of glutamic acid in the wastewater, Larrowe constructed a commercial


laboratory next to his feed mill in Rossford, Ohio. S. Suzuki and Company dispatched their managing director, Chuji Suzuki, after learning of Larrowe’s intentions to commercialize the potash, betaine, and amino acids present in his waste water (published in a scientific journal), to negotiate a joint venture. One knowledgeable commentator suggests that the agreement concluded by Suzuki and Company and Larrowe on May 20, 1926 was highly favourable to the former—with fixed prices contributed by Suzuki and Company and a provision prohibiting Larrowe-Suzuki’s sale of glutamate “for use in human food” to anyone other than Suzuki and Company. Specializing in the manufacture of various special starches, including wheat, Huron Milling began developing a process in 1929 under Director of Research Mr. A. J. Patten, who was familiar with amino acid technology from his work with Kossel, pioneer of amino acid chemistry at Heidelberg. Production per this process commenced in 1934, using a starting material of wheat gluten and hydrolysis via hydrochloric acid, and signalling a new American expertise in manufacturing using hydrochloric acid-resistant plastics, ceramics, and metal alloys (because it is pretty hard to be a MSG producer when your expensive plant equipment corrodes within weeks).

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218 Marshall, “A History of Glutamate Production,” 8-9. WWI cut off the United States’ main source of potash for fertilizer—ninety percent had been imported from Germany; therefore, it became highly profitable for American companies to extract potassium salts from “Steffen’s wastewater,” named after the man who developed the processing of sugar from sugar beets. Of course, after the war ended, potash again became available from Germany, and domestic prices for potash plummeted, converting a lucrative war windfall into commercial dead weight.

219 Production was halting from 1927-1929 at the Rossford, Ohio plant, as the Larrowe-Suzuki company’s hydrolyzing agent of choice, hydrochloric acid, wreaked havoc on the plant’s pipes, pumps, and lines. At this point, the symposium’s resident glutamate historian notes that he was called in as a consultant on this challenged production process.


In light of this illustration of the twin challenges of American MSG production—outwitting both hydrochloric acid and the wily Japanese—Marshall advises gathered industry representatives as he advised Larrowe. The success of MGS production in America hinges upon the development of a better technique for unlocking glutamic acid from raw material. Marshall himself has presided over research that contravenes the then current textbook wisdom on amino acid chemistry, which holds that a) when a protein is hydrolyzed by alkali, the constituents, with the exception of glycine, will be racemized (the combination DL- version that is useless for flavour enhancement), and that b) glutamic acid is especially sensitive to hot alkalis, in which cases racemization is inevitable. Marshall has tweaked alkali concentration, temperature, and time, and finds a process in which no racemization occurs! Patents are filed in all countries with a beet sugar industry, and Marshall notes that even the Patent Office in Germany (home of the world’s best chemists) has to yield to his experimental proofs after eight years of holding up his 1932 patent application. Resulting escalation of American MSG production has ensued since 1931 under the name of the Amino Products Corporation and without Suzuki and Company involvement. This operation, of which Marshall was “vice-president and a small stockholder” until December 1942, was sold to International Minerals and Chemicals Company.222

Meanwhile, from the 1920s through to the present Food and Container Institute conference on MSG (1948), Marshall concludes that proprietary methods of separating and purifying glutamic acid and converting it into a crystallized monosodium glutamate remain “jealously guarded secrets” within the industry.223

<table>
<thead>
<tr>
<th>Company</th>
<th>Raw Material$^{224}$</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huron Milling Company</td>
<td>wheat gluten</td>
<td>Harbor Beach, MI</td>
</tr>
<tr>
<td>General Mills, Inc.</td>
<td>Wheat gluten</td>
<td></td>
</tr>
<tr>
<td>International Minerals and</td>
<td>Beet sugar solution, then wheat and corn glutens</td>
<td>Rossford, OH San Jose, CA</td>
</tr>
<tr>
<td>Chemicals Corp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staley Manufacturing Co.</td>
<td>Corn gluten</td>
<td>Decatur, IL</td>
</tr>
</tbody>
</table>

Figure 2(a). Producers of food-grade MSG in the U.S. in 1948.$^{225}$

Such post-war negotiations between leaders of Japanese and American analytical and industrial chemistry were a mutual exercise in capitalist exploitation. Both would-be Japanese exporter and would-be American industrial consumers of MSG approached the exchange of knowledge with wary respect and avarice for a lucrative foreign market. The effect of this encounter is a different ontology of glutamate and the ‘bio’ in which the molecule holds meaning. The sensing body materialized in Japan in chapter one with Ikeda’s theorization of umami taste is not the sensing body that populates the United States at mid-century. There is no

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$^{224}$ From Marshall: raw materials used in hydrolysis with alkali include in the U.S.: wheat gluten (38), corn gluten (7, 76), and the sugar beet (53, 54, 70); soy bean protein is also used “in the Orient” (12).

$^{225}$ Adapted from Manning and Buchanan, “Quality Production of Glutamate,” 17-18. Staley was, as of April 15, 1927 correspondence with FDA, AF 7-928, manufacturing per processes disclosed in patent No. 2,306,646, use of methyl alcohol in patented preparation of monosodium glutamate; Monosodium glutamate flavour, including sodium glutamate and glutamic acid, 1938-1945: 462.92; Flavors and Extracts—General, 462. Records of the Food and Drug Administration (FDA), Record Group 88; National Archives and Records Administration (NARA)—College Park, MD.
universal bio, and the glutamate in the steel drums, tins, and glass bottles is plural. Among a small circle of experts in Japan it confers a taste called umami; within a comparable circle of Americans, glutamate is a valuable food additive that will be appropriated into the armamentarium of American industry. This formative moment in the international history of MSG manufacture illuminates how biocapitalist technologies—technologies in which capital value is generated by engineering the living capabilities of organisms themselves—have mediated the science of how we understand bodies to work. This is the crucial insight of theorists working with framing of biocapital: that our facts are refracted through the lenses of capitalist exchange and geopolitical competition. This snapshot of MSG’s transmutation in the United States illustrates in particular the hubris of postwar American global outlook, in which the content—but not the form—of the Japanese technoscientific and military build-up of the previous generation would be used to forward American interest. Postwar Japan is a worthy adversary quelled and co-opted as a strategic ally and trade partner. The two nations are violent intimates subsisting in a relation of roving, extractive opportunism.

**Brave New World of Industrial Flavour Enhancement**

The Chicago symposia in 1948 and 1955 illuminate in microcosm the painstaking and politicized character of international food technology at mid-century. Improving monosodium glutamate production was one of many decades-long projects uniting biochemists, entrepreneurs, and state representatives (and other experts) under the universalizing banner of modernization through commercial growth. Just five years after Ikeda’s identification of glutamate as the flavour component of *kombu* (kelp), his student Shintaro Kodama discovered another source of
umami taste in *dashi* stock.\textsuperscript{226} In 1913, Kodama isolated a component of another *dashi* staple, *katsuobushi* (bonito flakes)—the 5'-nucleotide inosinate\textsuperscript{227}—which he determined to also confer a savoury-meaty taste. This compound, whose effect is more subtle than that of MSG, has come to be added in foods in the form of disodium inosinate (IMP) or E631 in the European Union, and has the chemical formula \( C_{10}H_{11}N_{4}Na_{2}O_{8}P \).\textsuperscript{228} The first technology for hydrolyzing fish, in either alkali or acid, in order to isolate inosinate was patented in 1917, and in 1921, Suzuki and Yamamoto devised a new combined processes, patented in Japan in 1923, for hydrolyzing fish first in alkali and then again with acid. This combined extraction product was then combined with a solution of monosodium glutamate for optimal flavour-enhancing synergy.\textsuperscript{229} Meanwhile, Ajinomoto was experimenting with the most cost-effective raw material for its hydrolysis processes for MSG production. In 1935, in response to unpredictable wheat starch (left-over after glutamic acid was extracted from wheat) sales, Ajinomoto switched to “de-oiled soybean flakes.” Working with soybean enabled Ajinomoto to “diversif[y]” its “co-products”—or maximize the profitability of its leftover materials after MSG manufacture.\textsuperscript{230} Switching from wheat to de-

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\textsuperscript{226} Shintaro Kodama, “On a Procedure for Separating Inosinic Acid,” *Journal of the Chemical Society of Tokyo* 34 1913: 751–7. Japanese scientific culture was patriarchal and even feudal in its inherited culture of tribal insularity; students were ferociously loyal to the legacies of their mentors, even to the point of disregarding valid evidence contravening a proprietary theory. For a discussion of scientific politics in Taishō Japan, see Alexander R. Bay, “Beriberi, Military Medicine, and Medical Authority in Prewar Japan,” *Japan Review* 20 2008: 111-156.

\textsuperscript{227} According to current understandings, nucleotides are the building blocks of nucleic acids (DNA, RNA), comprised of a base (adenine, thymine, guanine, or cystosine), plus a molecule of sugar and a molecule of phosphoric acid. Nucleotides are important metabolic agents as energy-transporters in cells, and also take part in cell signaling and enzymatic reactions (as part of reaction co-factors).


\textsuperscript{229} John E.S. Han, “Monosodium Glutamate as a Chemical Condiment,” *Journal of Industrial and Engineering Chemistry* 21(10) 1929: 985. Han’s is one of the earliest authoritative technical explanations of MSG production and application in English. His references to Yamamoto and Suzuki’s early patents are details I am still tracking.

\textsuperscript{230} Ajinomoto Co., Inc., “Ajinomoto Group History.”
oiled soybean flakes enabled co-products like edible oil, alcohol, liquid seasoning, and fertilizer was one point in the on-going dance of industrial chemistry manufacturers balancing a dependable supply of their raw materials, acceptable sales of co-products, and minimizing the waste that would otherwise become a liability—financial and/or environmental. \(^{231}\) In contrast, the fledgling American and European MSG-producer communities from the 1920s-50s, the challenge of production economy was answered by extracting a form of glutamic acid from a waste product of the domestic beet sugar industry: pyroglutamic acid (5-oxo-L-proline). \(^{232}\)

After the end of US occupation of Japan in the 1950s, Japanese researchers were able to resume umami research and promote it as a fifth basic taste. \(^{233}\) In 1960, Akira Kuninaka, a researcher at Japan’s oldest and most renowned soy sauce producer, Yamasa Shoyu Company in Choshi, Japan, identified guanylic acid, now typically listed as disodium guanylate (GMP) or E627, as another flavour-enhancing compound. Kuninaka determined this during a study of ribonucleotide production through biochemical degradation of yeast RNA. \(^{234}\) This flavouring agent was not of marine origin, but was identified as a component of broths made from dried black shitake mushrooms and used widely in Japanese and Chinese cooking. \(^{235}\) It was then that Kuninaka (1960, 1964) made the pivotal finding that glutamate and the 5’-ribonucleotides when


\(^{232}\) Sano, “History of Glutamate Production,” 730S.


combined increased exponentially the flavour enhancing effect. This was elaborated influentially in the *Journal of Food Science* by a researcher at the Ajinomoto Central Research Laboratory, who described the sensory phenomenon as “the synergistic effect of taste” between MSG and the 5’-ribonucleotides. This study determined that the 5’-ribonucleotides and MSG each produced a distinct taste enhancing effect, but combined, the resulting taste enhancement was greater than the sum of its parts. As a result, food processors in the 1960s began to use GMP, IMP and MSG together in a range of industrially produced foods, following a typical ratio of MSG to GMP/IMP of 95:5, a formula that was determined to produce a six-fold increase in flavour. As we will see by the end of this chapter, MSG became a ubiquitous additive in the 1960s in part because it was so much less expensive to produce than the 5’-ribonucleotides, and because its effect could be amplified to such great effect by the addition of a very small amount of these fellow flavour enhancing additives.

It is vital to emphasize here that in the 1960s when this taste synergism was being researched at the Ajinomoto laboratories, there was no use of the word umami to describe technologies for taste enhancement. Thirty-three years following this report, the same Ajinomoto researcher would describe the phenomenon reported in 1967 as “the synergistic taste effect” as the capacity for glutamate and the 5’-ribonucleotides together to provide as much as “a thirty-

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237 This phenomenon is considered to be unique among the ‘basic tastes;’ saltiness and sweetness, for example, are amplified arithmetically—not exponentially—by the combination of multiple salts or sugars. Taste perception is a relentlessly elusive object. For example, countless trees and careers have been expended chasing the question of how saltiness enhances perception of sweetness or blocks perception of bitterness. I survey this taste psychophysics literature in chapter three.

238 Kuninaka 1964, 1966; Maga 1983; Petrick 2015.
fold increase in umami taste.” So, what was a discussion about glutamate in the 1960s was, in the year 2000, a conversation about umami. In the mid-1960s, in the technical communities bridging the Pacific and dialoguing in English, no one was researching umami. They were researching taste physiology as it related to commercial flavour enhancers—not trying to expand the canon of basic human taste sensations.

After World War II, ever-increasing demand for MSG drove research into a more efficient production processes, one that eventually came in the form of an entirely new paradigm of glutamate manufacture: biosynthesis or industrial fermentation. In 1957 methods of producing glutamate in appreciable quantities through microbial fermentation was first reported by a few different researchers working in corporate laboratories in Japan. By industrial fermentation I mean the large-scale, economical production of commercially valuable substances by causing select microbial cultures to grow in containers of cheaply available raw materials. Researchers at the Tokyo Research Laboratory, Kyowa Fermentation Industry Company or Kyowa Hakko Kogyo Co, Ltd. are generally credited as reporting the first industrial fermentation technology


240 While glutamic acid synthesis had been a known process since 1890 (a L. Wolff used a starting material of levulinic acid), compared with glutamate production from protein (hydrolysis and isolation), it was much more expensive, and the resulting product was usually the inactive, racemized form that is difficult to convert to the dextro configuration, or L-glutamate. However, in the 1960s, new techniques made direct chemical synthesis more feasible, and from 1962-1973, acrylonitrile was used as the starting material, and optical resolution of DL-glutamic acid was achieved with a process called preferential crystallization. Marshall, “History of Glutamate Manufacture,” 5; Paul D. V. Manning and B. F. Buchanan, “Quality Production of Glutamate,” Flavor and Acceptability of Monosodium Glutamate: Proceedings of the Symposium (Quartermaster Food and Container Institute for the Armed Forces, and Associates, Food and Container Institute: 1948), 15-16. Yamaguchi and Ninomiya, 2000.

for L-glutamate, in which select bacterial strains excreted large quantities of L-glutamate in exchange for being fed relatively little in the way of carbohydrate and ammonia food sources.\textsuperscript{242}

Since that report, many organisms similar to that originally employed (which Asai, et a. called \textit{Micrococcus glutamicus}), have been identified for use in MSG production. These include \textit{Corynebacterium glutamicum} (formerly \textit{Micrococcus glutamicus}), \textit{Brevibacterium lactofermentum}, and \textit{Brevibacterium flavum}. These glutamate-producing bacteria are all coryneform bacteria, which are gram positive, non-spore-forming, and non-motile and require biotin for growth. However, the hyper-production of glutamate occurs only under biotin-limited conditions. The requirement for biotin limitation prevented the use of standard raw materials such as sugar molasses because these all contained high levels of biotin. A tremendous amount of research investment was made into overcoming this challenge of engineering the ecological conditions for optimal glutamate harvest. Ultimately, researchers determined that the addition of a surfactant or of penicillin or the use of microorganisms auxotrophic for (that can produce the amounts needed for their own growth of) glycerol or oleate, prompted the bacteria to produce large amounts of glutamate without the requirement of biotin limitation.\textsuperscript{243} This mechanism of excessive glutamate production by such bacteria is still not completely understood. While scientists have hypothesized as to the cause since the 1960s, no theory has been accepted.\textsuperscript{244}

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\textsuperscript{242} The metabolite, which is 2-oxo-glutarate (2-oxo-pentanenedioic acid), is isolated through reductive ammonia fixation using the enzyme glutamate dehydrogenase, a “normal cellular constituent.” Sano, 2009: 730S; As will be discussed briefly in chapter four, other species of glutamic acid bacteria were found discovered to be able to utilize hydrocarbons as a sole carbon source for growth—a fact that I understand to be the inspiration for consumer objections in the 1980s-90s in Japan that \textit{ajinomoto} was made from petrochemicals. These strains are discussed in S. Kinoshita, “Glutamic acid bacteria,” \textit{Biotechnology Series} 1986.

\textsuperscript{243} Sano, “History of Glutamate Production,” 730S.

\textsuperscript{244} According to one authoritative report, support emerged in the 2000s for the theory of an active transport mechanism existing in glutamate-producing cells (by which the cell exports the amino acid into the nutrient medium) has grown with the identification of a glutamate export protein and its gene, \textit{yggB} (NCgl1221), a homolog of a mechanosensitive channel, which by sensing alterations in membrane tensions, modulates the release of
What is clear is that, since the 1970s, fermentation via bacterial cultures has been the production method preferred by manufacturers. The advantages of the fermentation method were so great that they prompted a paradigm shift in glutamate production—practically all glutamate manufacturers employ industrial fermentation, methods, due to enormous reductions in production cost and environmental load. Harvesting the metabolic excretions of modified bacterial strains facilitates production economies impossible to achieve when relying on hydrolysis or organic synthesis. Ajinomoto itself cites the profitability of the fermentation method as having provided the “great impetus for expanding the amino acid market.”

Thus, the mass production—and consumption—of flavour-enhancing MSG was realised through rationalizing and exploiting the metabolic pathways of bacteria. The first patents on mutant strains of glutamate-producing bacteria emerged in the 1970s, and a reported 4000 patents and patent applications have since appeared to employ mutated microbial strains for producing amino acids, nucleosides, and nucleotides.

In an eerily quaint echo of earlier paradigm shifts in MSG’s production history, this same industry insider predicted: “future production growth will likely require further innovation.”

osmoprotectants into the medium. Coryneform bacteria are thought to contain yggB which functions in a similar way under the customary conditions of glutamate fermentation. Sano, “History of Glutamate Production,” 730S.


246 Two important related products that bear further research: L-lysine, a flavorant made using C. glutamicum strains (main use is in animal feed, production estimated at 2.1 million metric tons in 2013; and L-γ-Glutamyl-L-valyl-glycine, the newly discovered “kokumii” flavour enhancer (of the sweet, salty and umami tastes), translated as “heartiness” or “mouthfulness” and speculated to enhance perception of thickness, fattiness, and after taste and thus have great potential application in low-fat food formulations. Takeda & T. Iguchi, US3616214, 1971; T. Hirasawa et al., in Reprogramming Microbial Metabolic Pathways, Vol. 64, Springer, 2012, 261-281; Y. Lv et al., Journal of Bacteriology 193(21) 2011: 6096-6097; T. Ohsu, et al., Journal of Biological Chemistry 285 2010: 1016–1022; T. Ohsu et al., US8106020, 2012 H. Nozaki et al., EP2765190, 2014.

247 Sano, 2009: 731S.
The move to biosynthesis or industrial fermentation of MSG by the 1960s was echoed across the food and pharmaceutical industries. Some of the most important commercial fermentation products developed before MSG include lactic acid (using *Lactobacillales*) by Louis Pasteur as early as 1857; citric acid (using *Aspergillus niger*) by James Currie in 1917 and commercialized by Pfizer in 1919; penicillin (using *Penicillium notatum*) by Alexander Fleming in 1944 and commercialized by the U.S.A. War board in 1944; and Streptomycin (using *Streptomyces griseus*) by Selman Waksman in 1944 and commercialized by Merck and Co, Ltd. in 1944. On a technical level, industrial fermentation has been based in painstaking trial and error manipulations of numerous factors like dissolved oxygen levels, nutrient levels, and temperatures within fermentation tanks, as these bear on the manipulation of the micro-organism itself. The majority of microbial species used in large-scale fermentations are strains mutated by design (that is to say, gene mutation is encouraged by manipulation of some of the above conditions, e.g. nutrient-deficiency), or they are genetically altered so as to secure a strain that is particularly efficient at producing the desired substance. These naturally differ significantly from “wild-type” strains or cells that are contained in a multicellular organism (in the case of plant or animal cells used similarly to microbial cells in homogenous culture). The Ajinomoto Company, founder and top global producer of the flavour enhancer monosodium glutamate (MSG), has been fermenting glutamic acid from modified bacterial strains since roughly 1960.  

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Recent work by scholars like anthropologists Heather Paxson and Stefan Helmreich have illuminated the techniques and the stakes with which biocapitalist formations configure and value the microbial—and not just the human bodies and the ‘charismatic mega-fauna’ that commonly represent the non-human in our imagination: e.g. elephants, seals, pandas, orcas. Since the 1950s, microbes and other less-complex organisms have been enormously leveraged in the chemical, food, and pharmaceutical industries. In fact, without the exploitation of these micrological systems, modern production levels in many industries would be prohibitively expensive—which is to say the modern food system as we know it would be impossible.

Biosynthesis or industrial fermentation is conducted not only by bacteria, viruses, fungi (including yeast and actinomycyes), protozoa and algae, but also by plant and animal cells. Microorganisms are biochemically similar to plant and animal cells; however, they are usually single-cell organisms with much simpler nutrient requirements, these usually limited to air, carbon dioxide, and inorganic salts or inorganic salts supplemented by simple sugars. In the realm of food, industrial fermentation is responsible for bringing us many common preservatives (e.g. citric acid) and emulsifiers (which keep oil and water from separating, e.g. soy lecithin), as well as MSG. These end products are excreted as part of the fermenting organism’s regular life processes (i.e. primary metabolites), or in response to some environmental stressor, such as a lack or excess of a necessary nutrient (i.e. secondary metabolites). The metabolites can be

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extracellular (excreted naturally by the cell) or intracellular (the cell wall must be ruptured and the organism killed in order to harvest the substance).  

The following schematic provides an example of industrial fermentation, in this case of the organic acid, citric acid.

![Citric acid Production](image)

Figure 2(b). Citric acid production by industrial fermentation.

Reactors, or the vessels in which the organisms or cells are incubated, are often stainless steel or glass-lined carbon steel and range in size from fifty-odd to hundreds (or even thousands) of

252 Biotech fermentation also yields what are called secondary products, e.g. bioconversion or biotransformation products (steroid biotransormation, L-sorbitol, etc.), enzymes (amylase, lipase, cellulose, etc.), or recombinant products (some vaccines, hormones like insulin and growth hormones, etc.) Biotechnological fermentation is also used to harvest the “biomass” or the fermented organisms (viable cellular material) themselves, for instance with baker’s yeast, lactic acid bacteria starter cultures for cheese, or silage (animal feed). Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin, eds. Food Biotechnology (2nd edition) (Taylor and Francis Group, 2008); Dubasi Govardhana Rao, Introduction to Biochemical Engineering (New Delhi: Tata McGraw-Hill Education, 2010).

gallons. They have a few different configurations, designed to accommodate processes with the least to the most active management.\(^{254}\)

At the end of the fermentation process, the desired end products are not yet ready to be used by customers or downstream manufacturers (other companies who use the chemical products to manufacture their own consumer goods). The valuable metabolites have to be recovered from the substrate in what is called the *downstream processing* steps of fermentation. Downstream processes of “recovery,” or the isolation and purification of the desired end product, typically are the most expensive and time-consuming of the entire operation. For example, the recovery of organic and amino acid fermentation accounts for as much as sixty percent of the fixed costs of a typical fermentation plant. These involve the mechanical separations of cells from fermentation broth; disruption of these cells; extraction; preliminary fractionation procedures; high-resolution steps; concentration; drying. Common microbes used in industrial fermentation include: Bacteria: *Acetobacter, Streptococcus, Lactococcus, Leuconostoc, Pediococcus, Lactobacillus, Propionibacterium, Brevibacterium, Bacillus, Micrococcus,*

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\(^{254}\) In ascending order, these include *batch* (e.g. antibiotics), *fed-batch* (e.g. baker’s yeast), *repeated draw-off*, and *continuous* single or multiple stage (e.g. biomass for feedstock) or continuous with recycle/step feeding (e.g. biomass for waste treatment, such as municipal water systems). Batch production describes a sterile container with a stirrer and an insulating jacket, in which the substrate and the starter culture are combined and then sealed off for the ideal amount of time. This method is best suited to smaller scale productions, with the batch equipment being adapted to different uses. It is prevalent in the antibiotic industry, since the most efficient antibiotic-producing organisms are highly mutated and as such are readily out-competed by the hardier but less “efficient” antibiotic producers that are more likely to thrive in (or contaminate) a continuous culture, in which it is harder to control microbial populations. A continuous process is similar to the above; however, reactants are added and products are removed from the reactor at a constant rate, such that the total reactor volume remains constant. These continuous reactors have a continuous stirrer or a piping system that pumps reactants into the reactor, where they mix and react in the turbulent flow before being piped out. Such reactors are typically large-scale, requiring significant automation and capital expenditure, suitable to well-established products with relatively consistent market demand. Mohammad Farhat Ali, “Introduction: An Overview of the Chemical Process Industry and Primary Raw Materials.” In *Handbook of Industrial Chemistry. Organic Chemicals*, edited by Mohammad Farhat Ali, Bassam M. El Ali, and James G. Speight, (New York: McGraw-Hill, 2005): 7-8.
Staphylococcus; Moulds: Aspergillus, Penicillium, Rhizopus, Mucor, Monascus, Actinomucor; and Yeasts: Saccharomyces, Candida, Torulopsis, Hansenula.

Monosodium glutamate’s “going global,” then is part of a broader shift in which biological research into organisms, whether human or single-celled, must necessarily be innovation—and innovation as valuated within capitalist relations of exchange. Because research requires capital, and capital requires a return. Hannah Landecker has employed the term ‘technologies of living substances’ as a more capacious analytic than ‘biotechnology,’ in recognition that the contemporary biotechnologies that order our lives are part of a much longer human enterprise of employing organisms for “the production of valuable substances.” Not unlike the instrumental relations that preceded them (e.g. selective breeding of domesticated animals, hybridizing corn varieties), recent biotechnologies like MSG’s industrial fermentation, necessarily harness the autopoiesis (self-making) or ability of living cells to perpetuate themselves and their boundaries. For Landecker, such technologies depend upon the productive and reproductive capacity of cells, which can be translated into the generation of ‘biologically important substances:’ enzymes, antibodies, DNA, RNA, viruses—or, in the case of MSG, L-glutamate. Thus, the bacterial body becomes “an important economic entity, patentable and productive… [which operates] within well-established systems of labor and exchange… [and is] normalized in and by these systems.” Yet, as Landecker notes, cultured cells and organisms have also come to represent “profound and recent change to a new state of being, as

255 Landecker, Culturing Life, 2.

routine tools, alienable commodities, and sites of production.”\textsuperscript{257} Considering MSG as a ‘technology of living substance’ in a longer continuity of human husbandry of the material world is important; however, it is important for the MSG-consuming public that any critical research into industrial food production attend to the importance of not only food production—but flavour production—as a capitalist formation.

In her work on bioprospecting in Mexico, Cori Hayden explores intellectual property-mediated modes of laying claim to access to resources. In the contemporary “knowledge” or “information economy,” she writes, intellectual property has come to be seen by some as the great engine of industrial development, decentralizing older forms such as monetary capital, natural resources, and land.\textsuperscript{258} This presumable capitalization of knowledge, she writes, accompanies the commodification of a new kind of nature: “something Franklin, after Foucault, sees to be called ‘life itself’: DNA, genetically modified organisms, gene sequences.”\textsuperscript{259} Hayden sees patent law as a tool of exclusion, which generates singular rights to an idea, technique, or process, and which provides a key instrument for ‘securing value’ from biological matter.\textsuperscript{260} Issued by the state, patents as serving not only individual and corporate reward structures, but also the project of nation-building through the “production and protection of national storehouses of intellectual capital and innovation.”\textsuperscript{261} Informed by Lockean notions of property in the self, or “the idea that one should benefit from the fruits of one’s labor,” the patent is a legal recognition of the joining of human creative, intellectual

\textsuperscript{257} Landecker, \textit{Culturing Life}, 3.


\textsuperscript{259} Hayden, \textit{When Nature Goes Public}, 23.

\textsuperscript{260} Hayden, \textit{When Nature Goes Public}, 23.

\textsuperscript{261} Hayden, \textit{When Nature Goes Public}, 23.
labour with something “taken out of its ‘natural state.’” Requiring three criteria: novelty, nonobviousness, and utility, “patent claims on substances derived from nature revolve around an emphasis not on what life is but on what life does [my emphasis].” Before the “products of nature” doctrine of the 1980s and the ground-breaking U.S. Congress’s Bayh-Dole Act of 1980, before the emergence of ‘biotechnology’ proper, the pharmaceutical and food chemical industries were fuelled by decades of patents—of which MSG was one—on enzymes, chemical compounds, and microbiological processes “isolated” or otherwise “purified” in the laboratory.

Microbial life thus presents an interesting dilemma of ownership and possession to capitalist societies. Ambiguously perceived and valuated by humans, are microbes and other micrological stuff part of “the common heritage of humankind,” as anthropologist Stefan Helmreich so eloquently phrased it? If we own them, they also ‘own’ us. For this reason, Helmreich’s concept of the alien is vital to making sense of the contradictory ways microbes are commodified as biotechnologies. As Helmreich observes of the ocean microbe, microbial life is “neither fully self nor other.” Within the international networks of biocapitalism, the tiny microbe churning out citric acid, penicillin, or L-glutamate is represented by no human advocacy group, and yet remains “a constellation of uncertain evidence in motion.” Infinitely accessible and yet elusive and dangerous, the “significance of


[microbial] life forms... for secular, civic modes of governance... becomes difficult to determine or predict.”

Thus, as Landecker writes, the flies, mice, cells, and in this case, the \textit{C. glutamicum}, of biological research—are altered to do things they would not without our intervention. They are the denizens of an “edge habitat” where organisms with “their own natural histories come into contact with and are shaped by a human effort to regularize both “the innate flux and variation of living things” and the objects of scientific research. Pausing here at the mid-century high-watermark of “biological modernism,” I follow Landecker in pointing out the tendency for living substances to present unanticipated consequences to the best lain of human plans. Researchers and entrepreneurs from the 1930-60s demonstrated great assurance in their understanding of MSG’s production by bacteria and consumption by humans, but should they have done?

\textbf{Glutamate Just Makes Things Better}

One of the reasons given in food technology, culinary, and historical accounts for umami’s rejection in the United States was the influential verdict of perhaps the most prominent flavour scientist of his generation, E.C. Crocker, a scion of the influential flavour laboratory Arthur D. Little Inc., located next to the MIT campus. So let us return to our seats at the first symposium on monosodium glutamate in Chicago, Illinois, 1948. Crocker presents the

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267 Helmreich, \textit{Alien Ocean}, 16.
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conclusion of a formal “taste panel” investigation as to the “truth or falsity of the impression that monosodium glutamate has a meaty or ‘chickeny’ taste.” Working with his Arthur D. Little colleague, L.F. Henderson, Crocker “felt well enough satisfied” he could adequately reproduce glutamic taste by combing other tastes—solutions of sugar, salt, tartaric acid, and caffeine—in various ways and thus that glutamate “operat[ed] only through the usual four kinds of taste buds.” Based on his notion that meat flavour is derived from odour, rather than taste, Crocker asserts that “pure glutamate has taste but essentially no odors [and thus] cannot substitute for meat. It is not meaty, or chicken(y), and the Ikeda’s discovery of a “glutamic taste” has been due to “wishful thinking, for meat was a scarce and much-appreciated food, or gain the claim may have been allowable within the limits of advertisers’ license.” He claims that the idea has “come to this country along with the glutamate,” and that thought still persists. As an alternate authority to Ikeda, Crocker reminds listeners of a ten-year study conducted by United States Department of Agriculture (USDA) researchers on “The Flavor of Meat and Meat Products” (1937)—which dismissed MSG as a mode of conferring meaty flavour. Crocker concludes that MSG’s alleged meat flavour, “if present in the original compound, must be due to the impurities present rather than to glutamic acid or its monosodium salt.”

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274 Crocker, “Meat Flavor,” 25. Since Crocker believed meat flavour to be an effect of odour (rather than taste), he argued that the “association of early lots of glutamate with meatiness” was ascribable to the “strong odor of the crude glutamate then available” (versus the pure glutamate available in 1948). See P.E. Howe and N.G. Barbella, “The flavor of meat and meat products,” Food Research 2 1937: 197-202 Joseph S. Fruton, G.W. Irvin, and M. Bergmann, “Preparation of a (-) glutamic acid from DL-glutamic acid by enzymatic resolution” Journal of
homegrown, ontology of MSG taste was considered authoritative among taste researchers in the U.S. until the 1970s. However, Crocker also asserts that there is a thing called a “glutamic effect”—or the addition of a “psychological” dimension to the experience of eating. He finds that glutamate exceeds the register of taste into that of tactility and satiety, with “the capacity for stimulating the feeling nerves of mouth and throat to produce the sensation describable as ‘satisfaction.’” He and Henderson found that MSG conferred a “tingling feeling in addition to the four ‘usual’ kinds of tastes,” and a “marked persistency of taste sensation” in the whole mouth region and throat, which he calls a “feeling of satisfaction.” They were not able to simulate this effect with other compounds in laboratory tests. In other words, glutamate is “unique in [its] capacity” to be stimulate “feeling” as well as taste.

Monosodium glutamate was ontologized as a flavour enhancer in the United States, and therefore in much of the world, at mid-century in large part due to Crocker’s advocacy against the idea of there being a fifth ‘basic taste.’ Crocker’s theory was thickened in a second series of studies likewise convened by the Quartermaster Food Container Institute in Chicago and

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*Biological Chemistry* 133 1940: 703-705. I write elsewhere on Crocker’s other fascinating contributions to the science of savoury, meaty flavour as conferred by the odours produced in “ripening,” aging, and heating or “pyrogenic flavour production” of meat. See “Delicious Destruction: A Short History of Fermentation, Enzymes, and Flavour” (as yet unpublished).

275 O’Mahony and Ishii, 1986.


278 Crocker, “Meat Flavor,” 26. He describes MSG as a possible “functional amine” that reaches and stimulates nerve endings in the buccal cavity, a mechanism highly specific to molecular constitution, with isomers and homologs mostly inactive. He assesses pH of glutamic acid at 3.3 and MSG at 7.0 in concentrations of about 0.2% as might be used in foods. The pH of most foods will be between these two points, he avers, and finds it “probable that both the mono-acid and di-acid glutamate ions (HG- and G--) are present.”
published in 1955. The main focus of one key study was to test the usefulness of MSG in recipes of the Army’s master menu.279 The study continued for eighteen months and involved ~2150 individuals in preference tests of fifty foods and recipes. Meat dishes, fish and canned vegetables were most often improved, whereas cereals, milk products and sweet-flavoured recipes were not.280 The other key areas of interest at this second symposium was the new and exciting arena of frozen foods, and the seemingly limitless potential for MSG to enhance the competitive offerings of a growing number of family restaurants across the United States.281 The idea of MSG as a flavour enhancer or potentiator was elaborated in work that established MSG’s effect in terms of flavour “amplitude,” “mouth fullness,” and “bloom” — a science of taste paradigm that persisted until the close of the twentieth century.282 At risk of over-simplifying the complex set of actors, forces, and epistemological modes at play in the immediate post-war period, it seems to me that there was little incentive among American researchers to expand the four-part ontology of human taste sensation. What mattered was that they had, thanks to Japanese innovators, stumbled upon a technology that worked. It was enough that studies were demonstrating MSG to be a reliable and highly useful additive for approving the appeal of a growing proportion of the foods comprising the modern, American diet.

I conclude with a few final notes on those hopeful American MSG producers and consumers. The only and well-known comparable product to table-top Ajinomoto in the American market in the post-war years was a bottled condiment sold after 1947 in the U.S. with the trade name of Ac’cent. While it failed to win the “pride of place” of Ajinomoto in Japanese households, it was nonetheless produced in significant quantities by the aforementioned James Larrowe’s Amino Products Corporation, which was in short order purchased by a larger company, International Minerals and Chemical Corporation (IMC).283 Within a scant ten years of MSG being relatively unknown in the United States, ‘amino products’ were one of IMC’s six major business groups. By the mid-1950s, plants in San Jose, California and Rossford, Ohio surpassed Japan’s 1933 level of production, with an output of 11 million pounds of monosodium glutamate a year. That IMC achieved this volume, despite increased price competition from new domestic and foreign producers of MSG, suggests a high level of growth and acceptance of the additive among both industrial and household consumers.284 IMC’s Ac’cent was purchased by American food processors and final consumers alike, as well as exported to Europe and Asia. In a 1956 industry report, Ac’cent reportedly had “earned an essentiality rating in the processing of numerous food products” as an additive that “many good cooks in the institutional field and at home alike insist they wouldn’t cook without.”285

283 Sand, “A Short History of MSG,” 44.
284 “IM&C’s Sales up 3%; Sales of DCP Disappointing,” News of the Month, Business and Finance Journal of Agricultural and Food Chemistry 3(10) 1955, 822.
The *Ac’cent* brand was eventually acquired from Pillsbury in 1999 by B&G Foods Corporation, a leading processed foods conglomerate based out of Parsippany, New Jersey, whose products currently circulate in the United States, Canada, and Puerto Rico under nearly twenty different brand names. While *Ac’cent* serves as perhaps the most long-standing and visible example of MSG’s proliferation in postwar America, there are numerous other manufacturers of monosodium glutamate and glutamate-containing products in operation in the U.S. and internationally. Major producers in recent years have been cited as Ajinomoto, Fufeng, Vedan, and CJ CheilJedang; however, others include Archer Daniels Midland (ADM), DSM Food Specialties, Cargill, Tate & Lyle, Adumim Food Ingredients, A.E. Stanley, AisonsChem, Atlantic Sweetener Company, Basic Food Flavors, Inc., Burcon, DMV International, Halcyon Proteins, Jiali International, Kull Food Technologies, Veripan AG, and Vinayak Corporation.

Most of these companies have little name-recognition with the average citizen, as most manufacture highly technical products that are never marketed to the final consumer. What will be recognisable is the enormous range of food products in whose formulations MSG was enshrined. Campbell’s Soup remains an important example. In fact, in the present day I do not know of a single Campbell’s Soup product that does not contain some (usually multiple) form of additive glutamate or a complementary flavour enhancer, which I discuss more in the chapters to come. Other classic examples include but are not limited to: ‘fast’ foods, hotdogs, frozen dinners, prepared salad dressings, condiments, and spice rubs, and soup mixes, flavoured potato chips, ‘veggie’ burgers, and canned vegetables.

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Figure Above Left 2(c): “1953, International Minerals and Chemical Corp.'s Ac'cent division, San Jose: Rheua Nell Chase of Sunnyvale is announced as "Miss Ac'cent," official hostess for the opening of the expansion of the Ac'cent plant on Monterey Road. Ac'cent Flavor Enhancer -- monosodium glutamate -- is now made by New Jersey-based B&G Foods.”

Figure Above Right 2(d): “1953, International Minerals & Chemical Corp.'s Ac'cent division, San Jose: To celebrate the plant's expansion, "Miss Ac'cent" Rheua Nell Chase gives a tub of Ac'cent (monosodium glutamate) to Chef Louis Williams of the Hotel Sainte Claire. The first batch of Ac'cent from the new facility was delivered by stagecoach to San Jose restaurants and markets.”

Conclusion

In retrospect, the incredible proposition of MSG prompts the obvious question: what manufacturer would not want to make their food taste better, or for that matter, what cook? The


obvious commercial benefits of MSG’s capacity for flavour enhancement were too great to overlook for American military and nationalist commercial leaders—‘oriental’ origins or not. Monosodium glutamate was a crystalline powder, similar in appearance to table salt, and was therefore neither foreign nor intimidating in appearance. It was highly attractive to industrial adoption, as it was readily soluble in water, was inert—that is, not destabilizing other food ingredients—neither absorbing humidity nor solidifying, and produced no undesirable off-tastes or odours. The additive had demonstrated itself to be highly amenable to modern production processes; not only did it not detract from or counteract with existing ingredients, it vastly increased the flavour of many savoury, processed foods to which it was added.

Beyond being a general era of technoscientific optimism in the United States, in the 1950s and 1960s, wider research into the metabolism of glutamic acid perceived exogenous glutamic acid (not produced internally by the body) as beneficial in character. By the mid-twentieth century, American researchers had theorized that, since glutamate had been identified in large concentrations as a stimulant in the brain, dietary glutamate must be good for the body. In 1949, as MSG was first emerging in American food processing, neurochemist and psychiatrist Hans Weil-Malherbe conducted a test study of what he termed mentally retarded children to pursue this very theory. He forecasted that increased “brain fuel” in the form of MSG might improve the children’s cognitive capacity. The experiment was concluded a failure. However, it was not the last account to hypothesize—or popularize for an interested public—a connection between glutamate and benefits to human health. Time magazine reported in 1956 a new study by Boston and Chicago-based researchers into the possibility for elderly patients to have their

290 H. Weil-Malherbe, “Significance of Glutamic Acid for the Metabolism of Nervous Tissue,” Physical Review 30 1950: 549-568; Blaylock, Excitotoxins, 27, 35. Glutamate was thought to be a metabolite, and not also a neurotransmitter, as is currently understood.
diminished mental faculties restored by “swigging ‘geriatric cocktails’” of L-glutavite, a mixture of vitamins, minerals, and monosodium glutamate. The *New York Times* echoed this optimism for glutamate and American mental health in a 1958 report on scientists who had “spiked” the tomato juice of elderly schizophrenic hospital patients and thereby improved the disposition of a reported three-fourths of the test group. Physicians wrote in to the FDA inquiring as to whether reports of glutamate’s human health benefits could be substantiated. This was an era in which one of Europe’s most noted surgeons, Dr. Francois Ody of Geneva, could rhapsodize in earnest that

> All the victories which have been the pride of brilliant surgeons will be forgotten on the day when a medical genius, a laboratory man, chemist or physician discovers the substance which, in the form of a capsule, will capture the sources of energy that will bring recovery within minutes.

This is to say that the general tone of a wide range of scientific interest in glutamic acid in the United States at mid-century reflected an understanding of the amino acid as benign or beneficial to the human body. As such, monosodium glutamate’s use in food, from a scientific standpoint, posed little to no risk from a health standpoint, and it was of enormous interest to capital. Whatever might be glutamic acid’s definitive character in human sensation, metabolism, and health, it could be comfortably housed within the time-honoured—which is to say, modern ‘Western’—four-taste tetrahedron, and it could be proliferated as a biocapitalist technology for

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293 Correspondence of B. L. Gorrell, M.D., Editor of Clinical Medicine, to Dr. A. J. Lehman, Chief, Pharmacology Division. November 25, 1947. Monosodium glutamate flavour, including sodium glutamate and glutamic acid, 1938-1945: 462.92; Flavors and Extracts—General, 462. Records of the Food and Drug Administration (FDA), Record Group 88; National Archives and Records Administration (NARA)—College Park, MD.

improving the appeal of an array of processed foods consumers were eager to buy, and
manufacturers were happy to sell.

From the 1930s to 1960s, the food additive monosodium glutamate underwent a drastic
shift in the nature and scale of its industrial production. It went from being produced in facilities
in Japan, eastern China, select sites in Southeast Asia, and in a handful of fledgling enterprises in
the United States to a multibillion dollar industry with production facilities on several continents.
And it went from being consumed in East Asia as a table-top condiment to a mainstay of the U.S.
industrial food system with its canned, bottled, packaged/dehydrated, and frozen foods. In the
1950s and 1960s, MSG “went global,” thanks to the cost efficiencies of industrial fermentation
by bacterial strains. In this chapter, I have traced how this going global became possible in
microbial bodies and vast industrial plants, and was ontologized as the desirable international
uptake of a useful flavour enhancing technology. In chapter three, I delve into how and why that
ontology shifted in 1968, with the implication of MSG in a range of alleged toxic reactions that
came to be known as the “Chinese Restaurant Syndrome.”
Chapter 3
Contesting MSG: The Politics of the ‘Chinese Restaurant Syndrome’

*All substances are poisons . . . the right dose differentiates a poison from a remedy.*
~ Paracelsus (1493-1541)²⁹⁵

*Like eating, experimenting offers no control.*
~ Annemarie Mol²⁹⁶

Introduction

In 1968, the New England Journal of Medicine ran an editorial written by Robert Ho Man Kwok, M.D. A recent Chinese migrant to the U.S., Kwok expressed alarm at his experience of unpleasant sensations after eating at certain Chinese-American restaurants—namely, those whose dishes were inspired by northern Chinese cookery. He claimed to feel numbness, tingling, and tightness of the chest, and suggested there was something distinct—and problematic—about the food on offer at these migrant-owned eating establishments.²⁹⁷ While the NEJM received a flood of letters from readers claiming to experience similar reactions, impugning salt, tea, duck sauce, imported mushrooms and, above all, MSG—what the journal called the “Chinese-Restaurant Syndrome” was met by skepticism and derision from the scientific community. Dr.

²⁹⁵ Attributed to Paracelsus, sixteenth century.
Herbert Schaumberg at the Albert Einstein School of Medicine commenced a study of MSG’s effects in order, he noted with irony, to stem the “mounting hysteria and prevent the wholesale slaughter of Chinese restaurant owners.” Despite his initial doubts, Schaumberg’s 1969 report found overwhelmingly that MSG, when consumed at levels customary in many prepared foods, did produce such symptoms as headache, burning, and tightness around the face, neck, and chest in virtually all of the fifty-six test subjects.\(^\text{298}\) In the same year, neurophysiologist Dr. J.W. Olney, working out of the Department of Psychiatry at Washington University in St. Louis, found that MSG caused extensive damage in mice to neurons in the retina, and also to those in the hypothalamus and other areas of the brain.\(^\text{299}\) These alarming findings were sufficient fuel to ignite a firestorm of media discussion of this new evidence of the hazards of ‘Oriental’ dining establishments, the suspect nature of migrant populations, and the erosion of America’s social fabric.

Thus was born the Chinese Restaurant Syndrome, or the persistent association in American popular culture between MSG, Chinese food, and toxicity. In this chapter I trace monosodium glutamate’s materialization in American scientific and popular culture as not a flavour enhancer, nor as part of a universal human ontology of taste, but as an environmental toxin. I situate this historical ontology of MSG within the environmental critique and alternative food movements of the 1960s-70s and follow it through scientific debate waged in clinical trial


settings, as well as in the polemics and legal procedures of consumer advocacy groups and the American regulatory regime of the 1980s-90s. Covering the years between 1968 and 1999, I pinpoint key turning points in the focus and pace of corporate and corporate-partnered research investment into taste physiology as it related to food technology. Specifically, I argue that the materializing of MSG as a potential toxin, and the profound impact this negative publicity had on MSG producers, is directly linked to the historical resurgence of the ontology of glutamate as the molecular key to umami taste. The commercial stakes were too high for claims of MSG’s potential toxicity to go unaddressed. The flavour additive’s mechanism of action needed to be elucidated, and the glutamate producing industry needed a reinjection of scientific integrity behind its products. In the next two chapters I trace how the ontology of umami, the fifth taste sensation and feature of ancient and universal food traditions, emerged directly out of an historical moment of American xenophobia and consumer mistrust. Umami was revived within a decade of the birth of the Chinese Restaurant Syndrome, when the additive’s stubborn stigma failed to give way to on-going regulatory approval.

**Regulating Modern Eating**

The regulatory status of monosodium glutamate in the United States has been characterized by a dynamic in which regulators have played catch-up with industry. Back in the latter half of the nineteenth century, the industrialization of the American food system had made necessary new forms of state oversight of food production, distribution, and advertising. Specifically, in 1862, the American government created the precursor of the Food and Drug Administration (FDA), which they called the Division of Chemistry. This Division’s dual charge was to foster scientific advances in food production and to investigate food ‘adulteration’ or unsafe/fraudulent practices on the part of food producers. State-sponsored scientific research had
come to be seen as necessary to curb the abuses of new industrial food and drug manufacturers in an era of infamous snake-oil hucksterism and overblown health claims for a plethora of new patent medicines.  

Monosodium glutamate’s regulatory status in the U.S. is connected directly to a piece of legislation called the 1938 Federal Food, Drug, and Cosmetic (FDC) Act. In 1958, the Food Additives Amendment to this Act set forth new requirement for manufacturers to actively demonstrate the safety of new food additives—and prohibiting the approval of any new additive shown to induce cancer in humans or animals. As a corollary, the FDA published a list of nearly two hundred food substances already in widespread use that, by virtue of their history of evidently safe use, would thenceforth enjoy the regulatory status of Generally Recognized As Safe (GRAS). Monosodium glutamate was one of these. This ‘grandfathering in’ of MSG as a GRAS substance thus placed an enormous burden of proof on any subsequent toxicological research.

With this context in mind, in the 1950s, many researchers were investigating glutamic acid’s wider functions—beyond its industrial application as a flavour enhancer, that is—in the human body. By the end of the decade, reports of MSG’s potential for harm began to circulate amongst some English-language scientists. In 1957, researchers at the Wernher Group for Research in Ophthalmological Genetics in London found that subcutaneous administration (injection) of monosodium glutamate had caused rapid degeneration of neurons in the inner

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300 See, for example, Harvey Levenstein, Revolution at the Table: The Transformation of the American Diet (New York: Oxford University Press, 1988).

301 This act extended the landmark 1906 Pure Food and Drugs Act to the arena of cosmetics, therapeutics, and new pharmaceuticals. This act was modified with the publication of a set of FDA guidelines established in 1949 for industry called “the black book,” or "Procedures for the Appraisal of the Toxicity of Chemicals in Food.”

layers of the retina of infant mice.\textsuperscript{303} Several studies of similar administration of MSG to animals conducted through the 1940s-1960s corroborated the finding that glutamate could cause the destruction of particular nerve cells (e.g. retina, neurons of the developing brain).\textsuperscript{304} Other studies associated glutamate administration in rats, cats, monkeys, dogs, and humans with toxic manifestations like convulsions and vomiting.\textsuperscript{305} One 1954 study conducted by a Japanese neuroscientist named Hayashi found that injecting monosodium glutamate into the brains of dogs caused them to collapse and convulse wildly.\textsuperscript{306} While this last study provides less compelling evidence as to the effects of additive glutamate when ingested, it is interesting when read alongside the contemporaneous rural Filipino practice of feeding dogs one or two tablespoons of Vetsin (MSG) inside a \textit{pan de sal}, or roll of bread, in order to kill them before butchering.\textsuperscript{307} An unrelated 1959 study also found that MSG placed on the muscle tissue of invertebrate crustaceans prompted abnormally vigorous muscle contractions.\textsuperscript{308} These early critical studies

\textsuperscript{303} D.R. Lucas and J.P. Newhouse, “The toxic effect of sodium L-glutamate on the inner layers of the retina” \textit{AMA Archives of Ophthalmology} 58 1957: 193.


\textsuperscript{307} George Schwartz, \textit{In Bad Taste, the MSG Symptom Complex} (Santa Fe: Health Press, 1988), 61. Max Ricketts of the Naldo-Ricketts Foundation of the Philippines reported that after eating this preparation, dogs salivated and lost consciousness, then were wracked by involuntary spasms until they died.

passed beneath the radar of many medical and science professionals, not to mention the public. However, they anticipate the sea change that occurred in the late-1960s, when critical scrutiny of several food additives—and the wholesale practices of industrial food manufactures—would dominate governmental and popular discussions of food.

In the 1960s, a vocal minority in American society famously assembled a collective identity based, in part, on the rejection of consumer culture—including industrially produced foods. As discussed in the introduction, food studies and cultural studies scholars have identified food as a key part of the 1960s-70s counterculture movement, in which a disaffected contingent of middle-America invested themselves in environmental, ethical, and aesthetic critiques of corporate and consumer capitalism—such as the ideals of white-collar professionalism and consumer affluence, the privileging of a patriarchal nuclear family, and the cachet of supermarket shopping.\(^\text{309}\) In his brief piece on MSG in the U.S. and Japan, Jordan Sand points out that this critical shift in the 1960s was in many ways international. Other wealthy nations had similar shifts in thinking. For example, in 1968 Japanese consumers fought to ban Kanemi oil, a type of common cooking oil found to contain polychlorinated biphenyls (or PCBs), which thousands claimed had caused them harm. This agitation resulted in a basic Japanese consumer protection law the same year.\(^\text{310}\) He also notes an alarmist precedent in Japan; in the 1920s, a Tokyo magazine had started a rumour that Ajinomoto was made from snakes, and the company


rolled out a successful public relations campaign to denying the claim and restore consumer confidence. This scandal never went international; however, by 1960s, global media networks were established, and consumers had become much more distrustful of “vast food corporations whose business practices were invisible and production methods incomprehensibly complex...” So, what has retrospectively been termed ‘hippie’ or counter-culture in the United States in the 1960-70s had related but distinct manifestations in different parts of the world.

Based on the 1968 report released by Dr. John Olney, who found injecting mice with MSG had caused brain damage, President Nixon ordered an FDA review of all food additives on the GRAS list. Directly on the heels of the Congressional hearing in 1969, the FDA tasked the National Academy of Sciences (NAS) with investigating the safety of MSG, particularly for use in baby foods. The FDA’s choice of the NAS arose from their previous contractual relationship dating to 1966, in which the NAS was responsible for evaluating the effectiveness of 4,000 pharmaceuticals introduced between 1938 and 1962. The seven-person NAS panel concluded in the summer of 1970 that a review of animal and human studies “confirmed the high degree of safety” of MSG, obviating any need for the FDA to restrict the product’s use or sale to consumers. However, they did recommend that MSG be removed from baby food, an act that manufacturers had already volunteered, on the grounds that while the additive posed only an

311 Sand, “A Short History of MSG,” 44. Sand points out that this critique of modern culture and industry was fiercely gendered for some Japanese thinkers. Gunji Atsutaka, leading Japanese critic of Ajinomoto, demonized MSG (and processed foods more generally) as part of the era’s wider “spiritual ruin of Japanese women” within modern, feminized domesticity. Gunji equates Japanese and Americans, who unlike the rest of humanity and other animals, he averred, “happily ate food prepared by others, ‘as if they were prisoners.’” Gunji argued that Japanese women ought to master the culinary skills necessary to “make food delicious without the assistance of ready-made ingredients.”

“extremely small risk,” it offered no nutritional or health benefit.\textsuperscript{313} This observation is worth pausing on, as the question of nutritional health was deployed in MSG’s formative moments (with Ikeda in 1910s Japan) and will be conjured again, as I discuss in the next chapter. There has never been any scientific basis for claiming that MSG itself adds to the healthfulness of the food product it accompanies. The additive is valued by food producers for reasons that have nothing to do with enhancing consumer nutrition and have everything to do with enhancing the marketability of their product.

The NAS study swiftly became a target for critical observers. Industry nemesis Ralph Nader led an investigation of FDA processes made possible by the efforts (cheap expert labour) of a group of medical and law students. Presented in a Washington press conference in April 1970, the nearly 300-page report, written by Ohio State law graduate James Turner, condemned the NAS, certain prominent government officials, and the “small group of industry-dependent ‘food scientists’ who more often than not routinely produce scientific studies that support the most recent industry marketing decision.” The report cited the declining nutritional standards of the American diet, partially blaming the FDA’s inept attempts to curb the “corporate greed and irresponsibility” of the then $125-billion food industry, describing current regulation as a “catalogue of favors to special industrial interest.” The students’ review of more than 10,000 documents and 500 interviews with sources inside and outside the agency offered an abysmal portrait of misrepresented reports, bureaucratic inefficiencies, corporate endorsements, and suppressed critical research. Not the least of the uncovered offences was the fact that two of the studies Ley had cited in defence of MSG in 1969 had not been conducted at all, and the two

others were only in their preliminary stages at the time of the hearing.\textsuperscript{314} Ley later issued a public apology to the congressional committee. Despite the thoroughness of the review and its recommendations for improvement, FDA actions throughout the remainder of the decade were consistent with Turner’s 1970 assessment.

In September 1972, Olney led another critique of FDA investigation and regulation. At a three day Senate hearing on food additive legislation held by the Select Committee on Nutrition and Human Needs, Olney concurred with Nader and Turner’s conclusions. He claimed the 1970 NAS review was an “industry-arranged whitewash” conducted by scientists who had virtually no experience in neuropathology and whose work was dependent on industry subsidies.\textsuperscript{315} He revealed that the chair of the NAS committee, paediatrician Lloyd J. Filer, Jr. of the University of Iowa Medical School, had been conducting concurrent research on MSG supported by Gerber and by International Mineral and Chemicals Corporation (IMC), producer of Ac’cent seasoning. At the time of the study, a total of four (out of six) NAS panelists were employed by major chemical companies, such as DuPont, Dow Chemical Company, and IMC. Moreover, another of the panel members was slated to testify that very day for the Senate committee on behalf of the Grocery Manufacturers of America, a lobby group opposed to stricter regulations on food additives. Under the Senate committee’s scrutiny, one NAS co-author amended the review’s conclusions, stating that the 1970 panel might in fact have missed seeing some microscopic brain lesions in test monkeys. Another panel alumnus reportedly conceded in a telephone interview with Science magazine that the panel’s industry funding under the circumstances “looked like


hell.” Academy records revealed that, during 1970-71, the food, chemical, and packaging industries had covered $68,000 of the NAS committee’s general administrative expenses. These findings provoked sharp criticism of the NAS panel and the FDA from the Senate Committee for a “lack of sensitivity” to concerns of conflict of interest.

Meanwhile, several independent researchers throughout the 1970s corroborated Dr. Olney’s findings of a causal relationship between additive glutamate and nerve cell damage, brain lesions, and obesity in laboratory animals. 316 Researchers also expanded the scientific community’s awareness of the scope of MSG reactivity. One questionnaire study conducted in 1977 by Harvard researchers found that as many as 30 percent of the 1,529 adult respondents had some type of reaction to MSG, as well as 10-20 percent of children surveyed. Reactions ranged from dizziness, nausea, abdominal pain, and visual disturbances to fatigue, shortness of breath, and weakness. 317 Other researchers and clinicians began to correlate MSG-ingestion with asthma attacks and depression, as well as seizures and hyperactivity in children. 318 In response to this evidence of MSG’s potential for harm and concerns about conflicts of interest, the FDA commissioned the Federation of American Societies for Experimental Biology (FASEB). With no experience in reviewing the safety of food additives, FASEB undertook the latest FDA


research commission with a pledge to ensure that panellists would not be compromised by the pocketbook of industry.\footnote{Robert Gillette, “Academy Food Committees: New Criticism of Industry Ties” \textit{Science}, New Series 177(4055) September 29, 1972, 1172-5.}

I reproduce here in detail the arguments made within this exposé mode of debate because anti-establishment sentiment set the tone of MSG discussion in the United States in the 1970s. Scholars like Marion Nestle have thoroughly problematized the interconnectedness of American public health institutions and the food and pharmaceutical industries in the latter half of the twentieth century. What matters most for my discussion of MSG is that a material number of people from within the nutrition, medical, and regulatory communities spoke out to name the obvious: that industry players were frequently been better funded, more agile, and more urgently incented to adjudicate questions of product safety than their counterparts in government. Speaking to corporate influence on sensory research funding many years later, leading taste physiologist Linda Bartoshuk of the University of Florida acknowledges that she got herself “officially added to the no-fund list” for MSG research by speaking out against the claim that MSG was a unique taste enhancer. Bartoshuk was quick to point out that none of her colleagues would knowingly distort their research findings for monetary gain. However, her experience was that “companies will fund researchers already leaning toward results they want to see, leading to differentially funding research in certain areas.” Bartoshuk’s experience over decades of research corroborates critical insights into how biocapitalisms have worked—by making public health issues unthinkable and research practices impracticable outside of capitalist logics. There is not enough public research funding to go around; how else are scientists to do research, if not to pursue questions of interest to companies with capital to invest? And why would not

323 Nestle’s treatment of the interconnected histories of the food industry, the field of nutrition, and the FDA and United States Department of Agriculture (USDA) has been particularly influential in food studies. Marion Nestle, Food Politics: How the Food Industry Influences Nutrition and Health (Berkeley and Los Angeles, California: University of California Press, 2003).

324 At the time, Bartoshuk felt MSG was more accurately described as “an inefficient source of sodium.” “Inside the Psychologist’s Studio: Linda Bartoshuk,” Observer, Association for Psychological Science 23(6) July/August 2010; John Bohannon, “A Taste for Controversy, Profile: Linda Bartoshuk,” Science 328(5985) June 18, 2010: 1471-1473.
companies invest in research that enables them to expand a highly desirable and lucrative line of products?

How, then, did the glutamate industry respond to this worrying discussion of potential MSG toxicity? Before the close of 1969, Ajinomoto U.S.A. spearheaded the creation of an international industry lobby group called the International Glutamate Technical Committee (IGTC). According to the 1992 Encyclopedia of Associations, the IGTC’s then mandate was the sponsoring, gathering, and dissemination of research on the use and safety of monosodium glutamate; the design and implementation of research protocols and provision of financial assistance to researchers; promoting the acceptance of monosodium glutamate as a food ingredient; and representing its members’ collective interests. Members were described as individuals, companies, and staff composed of physicians and/or scientists researching glutamate or otherwise employed by its corporate producers or users.325

Bearing these developments in mind, the 1969 Congressional hearing on the safety of MSG may be viewed in a new light. The FDA was hamstrung by an unwieldy bureaucratic structure, lackluster political support, and insufficient funding. An outpouring of innovation and development in the fields of manufacturing, mechanical and electrical products, pharmaceuticals, textiles and plastics, and food technologies had confounded FDA regulators and prompted a rash of reform within the agency. Between 1955 and 1970, the FDA’s budget leaped from $5.1 million to $72 million, and its employees surged in number from 829 to 4250.326 In 1969, the

325 Samuels, Toxicity, 264.
326 Andrew Hamilton, “FDA: New Pressures, Old Habits Bring a Change at the Top” Science, New Series 167(3916) January 16, 1970, 269. One observer noted that the FDA devoted a disproportionate amount of time to the $5 billion/year pharmaceutical industry, to the detriment of consumers of the $100 billion/year food industry. In 1969, staffing to enforce the 1965 Fair Packaging and Labelling Act reportedly fell from a peak of eleven people to two men working part-time, as a result of a tight budget; FDA Docket #02P-0317 Recall Aspartame as a Neurotoxic
year of MSG’s Congressional hearing, researchers had just identified a new artificial sweetener called aspartame. Also, the FDA had been forced to remove another artificial sweetener called cyclamate from its GRAS list of substances, amid what *Time* magazine dubbed “the great cyclamate furor,” following reports that the sweetener caused liver tumours in laboratory animals. With considerable gnashing of teeth, companies heavily vested in the $1 billion-a-year diet market hurried to find an acceptable substitute for cyclamate in order to preserve demand for their heavily marketed ‘sugar-free’ brands. Viewed in light of its wider context, the 1969 Congressional hearing on MSG illustrates the scramble of regulatory bodies and independent researchers to keep pace with the explosive postwar proliferation of the applied food and pharmaceutical sciences.

The upheaval of this moment in the history of the FDA and of food science reveals the contradictions between two pillars of American society: the ideal of public accountability and the prerogative of capitalist free enterprise. The Medical Director tasked with steering FDA policy through this period of critique was a Harvard-educated physician named Herbert Ley, the third Commissioner to serve the FDA in just a three-year period. It was Commissioner Ley who faced Dr. Olney and his colleagues in the Congressional hearing of 1969. While Olney testified about the development of brain damage and obesity in laboratory rats given MSG, Ley also testified,


reading a staff paper citing four alternate studies demonstrating the safety of MSG. The hearing concluded that the given evidence did not merit further regulation of MSG in foods. However, shortly thereafter, Dr. Jean Mayer, a noted Harvard food scientist, stated at a women’s meeting of the National Press Club that “with even the slightest presumption of guilt I would take the damn stuff [MSG] out of baby food.” In accordance with this sentiment, manufacturers such as Gerber, Heinz, and Beechnut voluntarily removed MSG from their baby food formulations by the end of 1969. This uncommon precautionary approach was echoed in statements like the New York City Department of Health’s adjuration to local cooks to “use MSG sparingly” in late 1969.

In December 1969, Secretary Robert Finch, of the Department of Health, Education, and Wellness (HEW), removed Ley from his position of Medical Director, frustrated with Ley’s seeming inability to navigate the politics of discontent plaguing the agency. Among the frustrated was Ley himself, as he declined a subsequent offer to serve as a Deputy Assistant Secretary in HEW, later declaring that the practice of the drug industry in particular of prioritizing sales over safety threatened to dig the industry’s own grave. Ley reportedly stated in 1969 that, "the thing that bugs me is that people think the Food and Drug Administration (FDA) is protecting them—it isn't. What the FDA is doing and what the public thinks it's doing

330 Schwartz, In Bad Taste, 3.
331 Food Additives: Blessing or Bane?” Time Magazine, December 19, 1969.
332 FDA Docket #02P-0317 Recall Aspartame as a Neurotoxic Drug: File #7: Aspartame History, <www.fda.gov/ohrms/dockets/dailys/03/Jan03/012203/02P-0317_emc-000202.txt>. Accessed 11/04/2016. In 1970, the FDA banned the sweetener cyclamate. Robert Scheuplein, then acting Director of FDA’s Toxicological Services Center for Food Safety and Applied Nutrition, reportedly remarked that "the decision was more a matter of politics than science."
are as different as night and day.” The comments of one investigator of the FDA on the House Government Operations Committee in 1970 may shed light on Ley’s professed cynicism: “The one pattern I could see emerge as I went over their [FDA’s] actions [on drug efficacy] was that they would twist and turn to find a way to leave the drug on the market… [they] displayed a lack of will to regulate when it comes to hitting the pocketbook.” An internal memo from the pharmaceutical and agricultural leader G.D. Searle Company of the same period, illustrating their strategy for pursuing FDA approval of aspartame, is an indication of the industry’s perception of regulation as an obstructive nuisance:

At this meeting [with FDA officials], the basic philosophy of our approach to food and drugs should be to try to get them to say "Yes," to rank the things that we are going to ask for so we are putting first those questions we would like to get a "yes" to, even if we have to throw some in that have no significance to us, other than putting them in a yes saying habit… [and] bring[ing] them into [a] subconscious spirit of participation.

The studies Commissioner Ley had cited as proof of MSG’s safety were later reported to have been, in two cases, incomplete, and in two others literally nonexistent—that is, fraudulent. While there was no credible scientific basis for causal harm from what were called ‘customary levels’ of dietary MSG, the evidence arrayed to support MSG’s non-toxicity was also profoundly insufficient.


In response to critics, the FASEB produced a report for the FDA in 1978 on the safety of MSG, other additive glutamates, and hydrolyzed proteins entitled “Evaluation of the Health Aspects of Certain Glutamates as Food Ingredients.” As the NAS review had eight years earlier, the FASEB report concluded that there was a lack of significant evidence of MSG’s toxicity. An examination of the sponsors of many of these studies is important: IGTC and Ajinomoto claim prominent positions, but so does Nestle, Gerber, COFAG (IGTC Europe), the National Institutes of Health (NIH), the International Food Information Council (IFIC), and International Minerals and Chemical Corporation (IMC). Lloyd J. Filer, Jr., who had chaired the 1970 NAS report, along with other industry-aligned scientists, edited a 1979 book entitled *Glutamic Acid: Advances in Biochemistry and Physiology*, which formed the basis of FASEB’s subsequent report on glutamate in 1980, a supplement to their conclusions in 1978. As before, the FASEB concluded that MSG was safe at current levels of use for the general population, but also recommended additional evaluation to determine MSG’s safety at higher levels.

The 1979 publication of *Glutamic Acid* is an example of a proliferation of research activity around the world on glutamate and other compounds as “food potentiators” as of the late-1970s. The first international conference on glutamic acid, held in May 1978 in Milan and the basis for *Glutamic Acid*, this International Symposium on the Biochemistry and Physiology of Glutamic


Acid brought together food scientists, physiologists, pediatricians, pharmacologists, anatomists, endocrinologists, and others to report on the topics of: glutamate’s sensory and dietary sources both natural and from commercial flavour enhancers; glutamate’s metabolism from both “endogenous and added sources;” glutamate’s role in the central nervous system, particularly its biosynthesis, uptake, and metabolism in the brain; and glutamate’s safety evaluation and experimental application. The editors of the resulting volume were the afore-mentioned L.J. Filer, Jr. (Pediatrics, University of Iowa College of Medicine, Iowa City, USA), Silvio Garattini (Director of the Instituto di Ricerche Farmacologiche “Mario Negri,” Milan, Italy), Morley R. Kare (Physiology, Director of the Monell Chemical Senses Center, University of Pennsylvania, Philadelphia, USA), W. Ann Reynolds (Anatomy, Associate Vice Chancellor for Research and Dean, The Graduate College, University of Illinois at the Medical Center, Chicago, USA), and Richard J. Wurtman (Endocrinology and Metabolism, Laboratory of Neuroendocrine Regulation, Department of Nutrition and Food Science, MIT, Cambridge, USA). While the conference was billed as international, all but one of the editorial staff worked out of the United States—a disproportionate representation of American research that is echoed, albeit to a lesser extreme, in the affiliations of all contributing authors.

At the outset, the editors define taste itself as “biochemical,” as a “system,” and as the “interaction” of a “stimulus” with “receptor sites.” They state their intent with the volume as bringing to the scientific community—from basic physiologists and neurochemists to those working in food safety and nutrition—a discussion of 1) the current state of knowledge about the sensory and dietary aspects of glutamate use in humans, and 2) more basic studies on glutamate

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metabolism in mammals. They also highlight the book’s inclusion of studies on glutamate’s mechanism of action as a “putative neurotransmitter” and on “the inaccessibility of exogenous glutamate to the brain.” These two areas of research focus pinpoint the specific means by which glutamate had by the late 1970s been flagged as a potential neurotoxin capable of causing brain damage by over-accumulation in the brain, an effect of the increasing dietary consumption of additive glutamates, e.g. MSG. The editors of *Glutamic Acid* thus established from the outset that they were not investigating glutamate from a risk-averse or activist standpoint, but rather *accumulating evidence that established* how additive glutamates do not enter the brain, and therefore do not pose significant neurotoxic risk. I provide a more detailed technical reading of the findings of this publication in chapter five, but I want to signal here the place of this set of studies in the evolving and contested ontologies of glutamate as either intrinsic to human metabolism and/or a dietary toxin. The editors of this volume assumed glutamate to be, at base, the former. In other words, this international group of studies discussed glutamate as an important actor in human (and other animal) metabolism and sensation. In other words, they ontologized glutamate as a natural component of the biochemistry of the human brain, sensorium, and digestive tract—and in rebuttal to critics’ ontologizing of additive glutamate as a neurotoxin. They did *not* ontologize glutamate as umami, or part of a universal, five-part basic taste system. The most influential scientists in 1979 were focused on establishing how glutamate worked in the body, and that it worked with impunity, i.e. was not demonstrably toxic. They were not yet gathering around glutamate’s conferral of umami, or extrapolating universal truths

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*Glutamic Acid* is separated into categories dedicated to the sensory and dietary aspects of glutamate, glutamate’s metabolism in mammals, the amino acid’s role in the central nervous system (CNS), some clinical aspects of the amino acid’s utilization, and its safety evaluation through experimental trials.
or healthful eating programmes on that basis, a shift in glutamate’s historical ontology dating from roughly 1985-onward that I track in chapter four.

The impact of the MSG toxicity debate on the food processing industries was profound. The Gerber Products Company, the iconic baby food giant, had been among the earliest food processors to adopt MSG, reportedly incorporating MSG into its bottled baby food formulations as early as 1951.\(^\text{341}\) To date, the baby food industry is the only one I am aware of having voluntarily withdrawn MSG from use, as an informal industry-wide practice. Jordan Sand has evocatively described the shift of public opinion in the 1970s as the transformation of science’s aura into a shroud. Sales fell for the first time in Ajinomoto’s history. From 1966 to 1974, seasonings dropped from 52 percent of Ajinomoto’s sales to 24 percent, and processed foods rose from 3 percent to 16 percent. Processed food production rose until it reached 35 percent of total sales in 1980, a strategy that resulted in steady growth of profits throughout the decade.\(^\text{342}\)

In other words, the company responded to the alarm about possible MSG toxicity by diversifying their product line in such a way as to shift their reliance on products in which the presence of MSG was *unintelligible* to the consumer.\(^\text{343}\) The company accelerated the sales strategy that had been so effective in entering the American market in the first place: they increased their marketing of additive flavourings for use by industrial consumers. To state this even more plainly, Ajinomoto did not decrease production of MSG; they just redistributed it in other things that people still wanted to buy. They also increased their commitment to a corporate marketing


\(^{343}\) This term, used in the context of chemical exposures, is also attributable to Michelle Murphy, *Sick Building Syndrome*. 
tack first initiated in the 1960s (when MSG sales suggested market saturation), which was to emphasize their “natural flavorings” line, e.g. fish-based instant broth *Dashi no moto*, and other processed foods.\textsuperscript{344}

Sand argues that this shift in corporate strategy was in step with an overall shift in corporate imagery that went from showcasing of state-of-the-art chemical technology to a disassociation with laboratories and smokestacks. The company shifted their nomenclature; a common term for MSG had been “chemical seasoning” (*kagaku chōmiryō*) in company documents, in law, and in journalistic coverage in Japan. Over the course of the 1970s, this gave way to the more colloquial word for “tasty.” The company began calling MSG “*umami* seasoning.” The industry research and advocacy arm was likewise rebranded. The Umami Seasoning Promotion Association formed in 1982, with the umami research center authoring the third Ajinomoto company history (1990), in which MSG is visualized and described in terms of nature and agriculture, rather than modernist science, e.g. “Cultivating Flavor” (*Aji o tagayasu*).\textsuperscript{345} For example, the visual imagery employed by corporate historians in 1971 transitioned from high-powered images of modernist office spaces, or of neon and steel corporate plants in the industrial city of Kawasaki, to images of underwater coral and seaweed in beams of sunlight captioned “The Origins of Life,” and to the snapshots of wheat ears, seaweed, and breastfeeding infants typical by 1990. Sand interprets this shift as an attempt to regain an earlier corporate image as a purveyor of beneficial science, a claim the company worked hard to establish scientifically in the 1980s by investing in the latest innovations in taste physiology, or a

\textsuperscript{344} *Nihon shokuryō shinbunsha*, ed., *Shokuryō nenkan* [Foodstuffs Annual] (1972), 60; *Shokuryō nenkan* (1971), 26. The *Foodstuffs Annual* reported in 1970 “natural seasonings” were booming, as there was “an extremely strong mood that ‘no matter what it has to be natural.’” *Shokuryō nenkan* (1970), 61, cited in Sand, “A Short History of MSG,” 45.

\textsuperscript{345} *Aji o tagayasu*, 497; *Ajinomoto shashi*, 275, cited in Sand, “A Short History of MSG,” 46.
strategic investment in what Sand caricatured as “the good science of flavour” versus “bad
science of chemical additives.” I find this shift to be consistent with the broader, post-modern
drift in consumer attachments—(selective) disaffection with industry and technology
accompanied by a longing for something called the natural.

Beyond Ajinomoto, large food processors in positions similar to that of Gerber were
instrumental to the 1977 creation of an American national counterpart to the IGTC called The
Glutamate Association (GA). While the membership of the GA has long remained secret, an
industry source has reportedly cited its membership as having at one point included Ajinomoto,
Archer Daniels Midland, Campbell, Corn Products Corporation, McCormick & Company, Pet
Foods, Pfizer Laboratories, and Takeda. The GA is one of several regional agencies affiliated
with an umbrella organization called the International Glutamate Information Service (IGIS).
The IGIS is an international agency whose stated goal is to provide “accurate and up-to-date
information about glutamate… the role it plays in our food and our bodies and its nutritional
benefits.” The IGIS premises its information service on the “extensive body of scientific
evidence which confirms the safety and the benefits of this widely used food ingredient.” The
GA’s national and regional counterparts include the Australian Glutamate Information Service,
the Australia Umami Information Center, European Committee for Umami, the Institute for
Glutamate Sciences in South America, the Southeast Asian Association of Glutamate Sciences,
the Taiwan Amino Acid Manufacturers Association, the Umami Manufacturers Association of

347 Samuels, Toxicity, 264. The IGTC and TGA reportedly retain close ties to the Robert H. Kellen Company, a
trade organization and association management firm, specializing in the food, pharmaceutical, and health care
industries.
Japan, and the Umami Information Center. Other officially non-profit agencies that are supported by industry and forward its interests include the International Food Information Council (IFIC) and the International Life Sciences Institute (ILSI). By the 1980s, then, a formidable network of national and international lobby institutions were actively engaged in funding and disseminating research that would thicken the scientific literature establishing how glutamate worked in the body, and contesting the ontology of additive glutamate as toxin.

If the decade of the 1970s was characterized by a heated scientific and political back and forth about MSG’s safety as a food additive, the 1980s was a period of unprecedented interest and investment in the ‘chemosenses’ or the ‘chemical senses’ of taste and smell. After the rapid-fire criticism of the early 1970s by activists such as Olney and Nader, neuroscientists elaborated Olney’s claim that glutamate worked as an excitatory neurotransmitter, or excitotoxin, a concept I return to later in this chapter. The FDA established the Adverse Reaction Monitoring System (ARMS) in early 1985 to monitor reports of adverse reactions to common food additives. According to a 1988 report in *FDA Consumer*, the agency’s informational journal, the ARMS had received approximately 6,000 complaints of adverse reactions to food additives in its three years of existence. While aspartame, a close excitotoxin relative of glutamate, received nearly 80 percent of the complaints, MSG topped the list of other culprits, followed by artificial colourings, nitrites, and vitamin supplements. In 1986, the FDA's Advisory Committee on Hypersensitivity to Food Constituents concluded once again that, while brief reactions in a small

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348 International Glutamate Information Service website, “About the IGIS.” [http://www.glutamate.org/about/about.html](http://www.glutamate.org/about/about.html) Accessed 14/04/2016.

349 The current (2016) IGIS website—which is available in seven languages—features articles titled “Video and Infographic Explain Why MSG is Perfectly Safe,” “Glutamate is Natural,” and “MSG Safe Use.”

minority of people might occur, MSG posed no threat to the general public, echoing the conclusion reached in 1987 by the joint Food and Agriculture Organization of the United Nations (FAO) - World Health Organization (WHO) Joint Expert Committee on Food Additives and placing MSG in “the safest category of food ingredient.”

Meanwhile, MSG had become an increasingly prevalent component of the American diet. A 1988 study conducted by the food giant Pillsbury traced the eating behaviours of Americans from 1971 to 1986. As reported in the Wall Street Journal on March 15, 1988, the largest and fastest-growing segment of American ‘eaters’ was what Pillsbury called the “Chase and Grabbits.” This segment represents those consumers whose diet was comprised mainly of ‘fast food,’ frozen dinners, and takeout pizza—some of the most frequent sources of additives like MSG. Pillsbury found that this segment had grown 136 percent in the fifteen years since 1971, representing 26 percent of the American population in 1986. In the words of Linda Smithson, then director of Pillsbury’s consumer center, the “Chase and Grabbit” eating habit had “become much more normal than random.” Manufacturers of MSG, therefore, had not redistributed the weight of their MSG from shaker bottles to processed foods formulations randomly. They had accurately ascertained the flavour enhancer’s usefulness to the proliferation of processed, pre-


352 Recall, Pillsbury had acquired International Minerals and Chemicals Co., the MSG producer.

353 Schwartz, In Bad Taste, 46.

**Unintelligible: Risky Eating**

Despite monosodium glutamate’s continued regulatory approval and the glutamate industry’s mustering of evidence in favour of MSG’s safety, critical voices persisted. In 1988, practicing physician and toxicologist George Schwartz wrote the first full-length critical book on the subject intended for a general audience. The book was (ponderously) titled \textit{In Bad Taste, The MSG Syndrome: How Monosodium Glutamate is a Major Cause of Treatable and Preventable Illnesses, such as Headaches, Asthma, Epilepsy, Heart Irregularities, Depression, Rage Reactions, and Attention Deficit Hyperactivity Disorder}. In it, Schwartz conducts a broad and accessible summary of the origin of MSG in foods and the evolution of scientific understanding of MSG as an excitotoxin—or an excitatory chemical that can overload neurons in the brain, causing them to die at an accelerated rate.\footnote{Schwartz provides his perspective on the additive’s potential for neurological damage and the food industry’s misrepresentation of that potential for harm. Schwartz argues that, in most cases, negative reactions to MSG do not represent an allergic reaction, but a toxic reaction; the distinction lies in the fact that while only select individuals experience allergic reactions to a given stimulus, any person will experience a reaction to a toxin, albeit with different manifestations. Schwartz, \textit{In Bad Taste}, 47-49, 57.} Schwartz’ most significant contribution is the introduction of the concept of an MSG syndrome characterized by a “symptom complex.” In this hypothesis, he connects a cascade of common ailments—as indicated by the book title—to the toxic neurological effects of consumers’ often inadvertent ingestion of MSG. He argues for additional study to explore the potential connection of MSG-induced neurological damage to
such pressing issues as the apparent rise in recent years of hyperactivity, depression, and obesity. While *In Bad Taste* does not appear to have been highly reported in major media channels or medical periodicals, Schwartz received a flood of letters from concerned consumers, many professedly relieved of misunderstood symptoms they anecdotally connected to MSG ingestion. This thickening of a critical vocabulary for self-identified MSG-sensitive individuals raised on processed foods set in motion another wave of American consumer activism in the 1990s.

In the last decade of the twentieth century, MSG was subject of a class-action suit against the FDA and a renewed wave of regulatory debate. Twenty years of lobbying by researchers and lobbyists convinced of MSG’s potential for harm has been insufficient to bring about a change in MSG’s regulatory status. At the close of 1989, the Social Issues Committee of the Society for Neuroscience convened to discuss a “hot area of neuroscience:” the toxic neurological effects of excitatory amino acids (such as glutamate and aspartate) in foods. Attendees included Dr. Olney and consumer advocate attorney James Turner, author of the Nader review in 1970. Other researchers present at the conference were divided on the issue of glutamate’s toxicity. While some felt Olney had made extrapolations not entirely justified by clinical findings, others echoed his concerns about the prevalence of additive glutamates. The conference featured breaking research studies connecting elevated glutamate levels in the brain with neurological damage resulting in stroke, hypoglycaemia, trauma, and seizure. Other researchers theorized that the nerve degeneration at work in Huntingdon’s, Parkinson’s, and Alzheimer’s could be due to

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356 Schwartz, *In Bad Taste*.

357 The significance of the book is evidenced by its impact on the formation of consumer campaigns against MSG in the 1990s, as well as by the many letters Schwartz received and appended to the second edition of the book published in 1999.
“glutamate metabolism gone awry.” Another school of thought held that neurodegenerative diseases were determined by genetic or acquired abnormality in glutamate metabolism, rather than by ingestion of additive glutamates. However, proponents of this theory acknowledged the potential for what they called ‘dietary excitotoxins to compound the vulnerability of such individuals genetically predisposed to neurological disease.\(^{358}\)

Considering this conference’s relevance to food regulation, organizers worked for months to secure representation from the FDA. After the fact, David Hattan, then Deputy Director of the FDA’s Division of Toxicological Review and Evaluation, claimed a desire to send someone experienced in both science and regulation. However, both he and Tom Sobotka, of the FDA’s neurobehavioral laboratory, the only two individuals who met these criteria, both claimed previous commitments.\(^{359}\) Nancy Wexler, chair of the society’s Social Issues committee told Science magazine in 1990: “Neuroscience is zipping ahead, and the translation of that into improved social policy and public health has to be through the regulatory agencies.” Wexler confessed that studies conducted through food industry funding were compromised by a fundamental conflict of interest. In her words, “the Society for Neuroscience has all these neuroscientists who are using tax dollars to do research. If the [regulatory] arm of the government doesn’t pay any attention to their research findings, that makes no sense.”\(^{360}\) James Turner (of the 1970 Nader report) also reflected that the absence of an FDA ban implied that MSG was safe for everyone, which he felt it may not be; in his mind, the issue for regulators was


\(^{359}\) Barinaga, “Amino Acids.”

heterogeneity within the population, as some people appeared to be harmed by MSG while others did not. Thus, the solution would be to provide complete informational labelling to indicate the possible health effects of additives like MSG. While the FDA has considered this labeling all forms of additive glutamate in foods, Hattan has stated that “the agency would need a solid case that there are people at risk from the additive to justify such regulation.”

In 1991, the European Communities’ (EC) Scientific Committee for Foods reaffirmed MSG’s safety and classified its “acceptable daily intake” as “not specified.” As stressed in an FDA Talk Paper, that is the most favourable designation for a food ingredient. A 1992 report from the Council on Scientific Affairs of the American Medical Association (AMA) also concluded that glutamate had not been shown to be a “significant health hazard.” The AMA declined in 1991 to implement a Resolution passed by its membership that called for the Association to encourage all regulatory bodies, including the FDA, to mandate labeling of additive glutamate so that “individuals wanting to avoid this substance may do so.” Indeed, despite documented existence of MSG sensitivity, influential medical bodies and industry lobby groups frequently stated the same thing: the ambiguously-reactive minority of the population was insufficient grounds to justify the regulatory expenditure—and, perhaps more importantly, the negative associations it would garner for a host of popular products—involved in increasingly the labeling of all forms of additive glutamate.

362 FDA Backgrounder August 31, 1995. “FDA and Monosodium Glutamate (MSG).”
Who were this reactive minority? Within a year of Schwartz’ publication of *In Bad Taste: The MSG Syndrome*, concerned readers formed a non-profit consumer advocacy group. The National Organization Mobilized to Stop Glutamate (NoMSG) was created with the mission to educate fellow consumers about the possible dangers of MSG ingestion, to promote MSG-free products, and to promote independent MSG research. The organization expresses the “outrage” of its hundreds of members at the prevalence of MSG and their “profound relief” in discovering they were not the only ones whose lives were adversely affected by the additives. Two of Schwartz’ concerned readers were Chicago-based Adrienne and Jack Samuels. At that point in time, investment banker/hospital administrator Jack Samuels was a middle-aged white man suffering from Alzheimer’s disease. After reading Schwartz’ exposé on MSG, Jack and Adrienne, an experimental psychologist, found to their amazement that removing MSG from his diet caused his symptoms of memory loss to go away. Inspired by this life-altering theory, the Samuels launched a non-profit consumer advocacy organisation called the Truth in Labelling Campaign (TLC) aimed at securing transparent and comprehensive labeling of all sources of what they called ‘processed free glutamate’ by food manufacturers. In 1995, the TLC launched a class-action suit against the FDA for its tolerance of incomplete labeling of additive glutamate.  

Consumer advocacy groups took up the mandate of MSG critique from political crusaders like Ralph Nader in the context of the conservative turn in American politics in the 1980s. Throughout the decade of the 1980s, the Reagan administration was explicitly eschewing interventionist regulation of industry. Thus, MSG’s popular contestation crystallised in the 1990s at a historical juncture in which a resurgence of classical liberalism was celebrating the ‘free

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364 Samuels, Toxicity, 273.
market’ as the victim of decades of monopoly growth, subsidies, and government regulations. Government intervention was linked to deficit spending, rising inflation, and personal disincentive to be productive. The neoliberal antidote to a bloated political class and rising costs of living promised that less government was better government, and the power of consumer choice would curb corporate abuse and direct corporate innovation.\textsuperscript{365} The resurgence of critical attention to MSG in the 1990s held the spirit of a politics of contract, in which the citizen-consumer was a customer of food products and health regulation, and ultimately, the “entrepreneur of him- or herself.”\textsuperscript{366} In such a neoliberal world, a social danger like a potentially toxic food additive was to be addressed through the calculative action of a consumer interest group. The critical moment represented by TLC’s class action suit against the FDA reflects a specifically neoliberal prerogative of medical self-diagnosis, out of which flowed a belief of entitlement to standards of service from the American public’s consumer protection representative, the FDA.

As such, the TLC’s lawsuit followed immediately on the heels what MSG critics considered a distinctly unsatisfying verdict from the FDA. On August 31, 1995, the FASEB released a FDA-commissioned report entitled, “Analysis of Adverse Reactions to Monosodium Glutamate.” The 1995 report reaffirmed the agency’s position that all forms of additive glutamate were “safe food ingredients for most people when eaten at customary levels.” The FASEB report did acknowledge the existence of Schwartz’ “MSG symptom complex,” describing two small sub-groups of the population: one that might be intolerant to large doses of


MSG, and another that exhibited “poorly controlled asthma,” and whose members might experience worsening of their condition after ingestion of MSG. Of crucial significance were the parameters of the investigation set by the FDA. For example, one of the study’s questions was: What are the symptoms and signs of acute, temporary, and ‘self-limited’ adverse reactions? Accordingly, the FASEB report addressed this question but ignored the possibility of more severe, delayed, or prolonged reactions to MSG. In this way, the narrow temporal focus of the “MSG symptom complex,” as defined by the FASEB, minimized the possible range of MSG reactivity.367

Curiously, the same the FASEB review did conclude that the body of literature provided grounds for the FDA to require additive glutamate labeling.368 The FDA, however, did not implement this recommendation. The FDA had considered the requirement of full labeling of all sources of additive glutamate as far back as 1993, owing to the persistent expression of concern by critics in FASEB hearings. In 1996, the FDA issued an Advanced Notice of Proposed Rulemaking, which proposed increasing the labeling of some additive glutamate. The TLC alleges that the FDA took this step to provide the appearance of taking action during the course of the lawsuit against them. Their contention is intriguing, considering that the proposed legislation stipulated that only products containing in excess of three grams of MSG needed be labeled.369 A given food product rarely contains levels of added glutamate above one gram, because the food industry recognizes that amounts of this magnitude are not necessary to realize

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369 Truth in Labeling website, [http://www.truthinlabeling.org/FDA.html](http://www.truthinlabeling.org/FDA.html). Accessed 02/18/2016. FDA Backgrounder, “FDA and Monosodium Glutamate (MSG),” August 31, 1995. Adverse reactions to MSG have been reported at levels common in typical soups or processed foods, such as 0.6 grams.
optimal flavour-enhancing effect—that is, additive glutamates are self-limiting, and three grams would be a needlessly excessive. So, the FDA proposed labeling requirements that would apply to virtually no products in which additive glutamates were present. As it was, TLC’s suit was unsuccessful, and the FDA has yet to pursue any enforcement of labeling requirements for all forms of additive glutamate in foods.\(^{370}\)

In the course of their advocacy, the TLC uncovered a few revealing details about study glutamate methodology. In the early 1990s, TLC’s co-founder claims he found a letter from Andrew E. Ebert, PhD, Chairman of the IGTC, in FDA docket files. In the letter dated March 22, 1991, Ebert concedes that aspartame had been used in placebo material for nearly a thousand studies investigation the reaction of test subjects to MSG. Since additive aspartame has been alleged to produce toxic effects similar to additive glutamate, these studies, many of which found that test subjects reacted adversely to both placebo and test material (MSG), were methodologically flawed. The July 1995 FASEB report on MSG acknowledged that the use of aspartame in placebo materials was unsuitable under the circumstances.\(^{371}\) Researchers such as John Olney have also argued that FDA-commissioned studies have been compromised by other issues of study design. A few key examples include: the use of placebo material containing gelatin, a source additive or glutamate, or sucrose, which is known to delay glutamate metabolism; continuing subjects on medications, such the animal tranquilizer phencyclidine (PCP), which some contend complicates or blocks the effects of MSG; administering test material in capsule form, which delays MSG metabolism; measuring only those reactions occurring within one-two hours following ingestion, when numerous individuals have reported

\(^{370}\) In the intervening years, Jack Samuels has passed away. Adrienne, however, continues to publish her own polemical monographs, for example the part memoir, part exposé, *It Wasn’t Alzheimer’s. It Was MSG* (2013).

\(^{371}\) Samuels, *Toxicity*, 274.
MSG reactivity as much as twelve hours after ingestion; measuring only a limited range of potential symptoms, such as the typical ‘Chinese Restaurant Syndrome’ symptoms of numbness, tingling, etc., while ignoring other symptoms like migraine headache, which is the complaint in nearly fifty percent of the adverse reactions reported to the FDA; and using monkeys as test subjects, for whom the pharmacokinetics of glutamate metabolism is known to be distinct from that of humans.\footnote{In pharmacology, this is understood as what the body does to a drug, i.e. through absorption and distribution, in the chemical changes to the drug wrought by the body, and the effects and routes of the excretion of the drug’s metabolites.} Many researchers have acknowledged that plasma (blood) glutamate levels and other measures in rats and mice, at best, approximate the human experience.\footnote{Barinaga, “Amino Acids;” John W. Olney, ”Prepared Statement for the Public Meeting (April 1993) Pertaining to Adverse Reactions to Monosodium Glutamate (MSG),” Federation of American Societies for Experimental Biology (FASEB) review of MSG, 1993; Samuels, \textit{Toxicity}, 281.} While the species-specific metabolism of additive glutamates may appear relevant to expert observers, it is often meaningless to non-expert bureaucrats and consumers. For instance, it is counterintuitive that monkeys, as fellow primates, would not closely resemble humans in their metabolism of MSG. Whether or not these choices of study design were perpetrated strategically by industry-aligned researchers, as Olney has suggested, the FASEB review in 1995 was presented by the FDA as reflecting the most current and reputable scientific assessment of the safety of MSG.

Another thread of critical dialogue came toward the close of the twentieth century. In 1997, a neurosurgeon named Russell L. Blaylock wrote a book called \textit{Excitotoxins: The Taste that Kills}. In it he outlines in plain language an alternate theory of additive glutamate’s excitotoxicity. Blaylock describes amino acids as necessary and natural chemicals that are therefore able to cross the blood-brain barrier, the brain’s protective mechanism for regulating the passage in and out of substances. Blaylock argues that the brain is unequipped to filter out
excess amounts of these necessary chemicals, and theorizes that excitatory amino acids can overwhelm the neuron and thus destabilize its energy production, prompting it to “burn up” and die.\textsuperscript{374} Blaylock links a neurotoxic cascade of effects wrought by rising amounts of additive glutamate in foods to the high prevalence of cognitive disorders like hyperactivity, depression, and memory loss, as well as the neurological diseases like Alzheimer’s and Parkinson’s.\textsuperscript{375} In the intervening years, Blaylock has also been a vocal “anti-vacc’er,” as critics of vaccination are described in 2016, when such arguments have fallen decidedly out of favour. Speaking in 2004 on the interconnectedness of the endocrine and immune systems, and thus the potential neurological hazards of vaccination, Blaylock states that much of the critical discussion about innovation and risk “is buried in highly technical scientific journals beyond the reach and understanding of the average person. Too often, experts in the field are afraid to rock the boat by publicizing the known dangers.”\textsuperscript{376} Not everyone may agree with Blaylock’s content or his brand of careerist alarmism; however, as an historian of food and biotechnology, I cannot fault the observation that the average person is ill-equipped to mediate their own health in context of Big Food.

\textsuperscript{374} Blaylock, \textit{Excitotoxins}, 39.


I argue that monosodium glutamate’s unchanged regulatory status and prevalent use is an effect of what Michelle Murphy has theorized as the unintelligibility of the effects of MSG.\textsuperscript{377} Our knowledge of how processed food sources are metabolised by our bodies, as this bears on our experiences of health or ill-health, is determined by the ability of clinical trials to establish a direct causal link between cause and effect, observably consistent, reproducible, and linear.\textsuperscript{378}

Sarah Vogel’s excellent work on the controversy over common plastics component Bisphenol A (BPA) reveals the importance of how toxicological testing is conducted and how criteria for harm are established. Do high-dose trials conducted on adult animals yield a representative picture of the everyday effects of potential toxins, particularly of the effects of low-level exposure to immature organisms to novel chemicals of unknown carcinogenicity, toxicity, estrogenicity, etc.? As Vogel demonstrates, toxicology’s assumption of a consistently positively correlated, or monotonic, dose - response relationship (in which less toxin = less harm, a principle legally encoded as the \textit{de minimus} standard), has only begun to be shaken since the science on endocrine disruptors gained momentum in the 1990s.\textsuperscript{379} Increasingly, it appears that testing for toxicity per the \textit{de minimus} standard is not likely to reliably reveal the presence or absence of non-linear, variable carcinogenic or otherwise disruptive metabolic effects of a

\begin{itemize}
\item \textsuperscript{377} Michelle Murphy, \textit{Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers} (Durham, NC: Duke University Press, 2006).
\item \textsuperscript{379} Vogel describes ‘endocrine disruption’ as the “hypothesis that some chemicals could interfere with the production, processing, and transmission of hormones in the body and disrupt the normal functioning of the endocrine system.” As a biochemical phenomenon, the phrase was coined in 1991 as part of the Wingspread Consensus Statement, product of a meeting of wildlife biologists, environmentalists, endocrinologists, reproductive physiologists, and toxicologists in Racine, Wisconsin, which attested ‘with certainty’ that some chemicals could potentially disrupt the workings of human and non-human endocrine systems. Vogel, “Dose Makes the Poison,” S560-S561.
\end{itemize}
particular chemical. And, as Vogel observes, carcinogens can have very low official ‘toxicity’—but that does not mean they are not harmful. Defining the nature of harm is central to the calculation and pronouncement of safety versus danger; safety from one particular threat is not the same as *de facto* safety—no matter that the FDA and consumers alike often make precisely such conflations.

The safety debate around MSG thus presents a double-bind to individuals charged with making responsible eating choices within a technical food production paradigm that is incomprehensible to the inexpert—and that food producers are under little obligation to explain. Further, safety tests are designed to ensure the control of variables, consistency of method, and reproducibility of effects. These criteria—without even accounting for serious problems in study design (e.g. using aspartame in placebo)—effectively prevent the clarification of a possible symptom complex of toxic exposure that is inherently variable and resists a control. Finally, the established role of industry in funding research and their vested interest in the results predisposes published research outcomes that affirm a plausible deniability of MSG toxicity. On top of that, market competition incentives companies to over-state or outright misrepresent the potential value of a food offering, rather than outline its potential adverse effects.

Meanwhile, the engaged, rational citizen of the neoliberal era is socialized to have faith in the universal good of technoscientific progress and economic development. She is charged with proactively self-regulating and investigating the risk and benefit of each lifestyle choice, including diet.\(^{380}\) I argue that this oscillation between credulity and scepticism helps facilitate MSG’s regulatory stasis. A culture of technoscientific faith fosters dietary indulgence as an

obvious benefit of modernity. Discretionary and ‘risky’ dietary practices are justified by this responsibilising imperative for individual citizen-consumers to steward their own bodies, through which practice an extensive consumer protection apparatus is made redundant. That is to say, consumers—not the government—are ultimately on the hook for their own health, because it is among the distinct freedoms of American citizen-consumers to navigate the consequences of the myriad sensory delights that food engineering makes possible.

Monosodium glutamate’s variable effects meanwhile have a disaggregating effect. Those who believe they do suffer migraines, numbness, disorientation, fatigue, gastrointestinal distress, etc. are not encouraged to mobilise in this culture of independence. When a vocal minority has, in the case of the TLC, come together to demand regulatory action, it was as independent consumers united by shared interest—not as a social body in democratic protest, not as constitutionally protected citizens of the same country. Safety trials commissioned by a cash-strapped, industry-friendly regulatory apparatus have justified MSG’s continued use in large part through the variability—in terms of timing, longevity, severity, and type of effect—of alleged adverse reactions. The FASEB investigation set particular temporal parameters for legitimate MSG reactivity. It discounted the relevance of severe or delayed reactions—much less the possibility of cumulative or combinatory effects over time, instead focusing on immediate, acute symptoms. Therefore, research design has the power to dictate the time-space of scientifically legitimated MSG agency. Delimiting that window has discredited calls for stronger regulatory action by ensuring a disconnect between authoritative scientific knowledge and the lived experience of eating.

When this ontological disconnect is combined with the economies of MSG’s manufacture by cheap and available microbes and the additive’s vast commercial value, it becomes clearer
how MSG’s regulatory status has remained virtually unchanged despite more than forty years of controversy. In effect, the 1995 FDA ruling on MSG directly reinforces the two seemingly contradictory embodied responses implicated in MSG’s story: the credulous adherent of technoscientific innovation (who accepts that MSG has been objectively tested and found innocent) and the critical citizen-consumer (who accepts that his/her symptoms are exceptional, one of the FDA’s small minority of the ‘hypersensitive’ possessed of a unique risk profile which requires extra personal vigilance. The science has erased the metabolic plurality that is glutamate metabolism, and proven MSG to be safe. Therefore, it must be so.

**Conclusion**

In this chapter I have mapped dueling ontologies of monosodium glutamate—as a natural biochemical agent versus a potential dietary toxin (excitotoxin)—from 1968 through the close of the twentieth century. I have traced the ontology of MSG as toxin in terms of two scientific and popular phenomena: one, the ‘Chinese Restaurant Syndrome,’ in which increased cross-cultural and culinary exposure took the form of both a fetish of difference and racist fears of contamination in mainstream American culture; and two, the environmental and alternative food movements of the 1960s-70s, in which a rampant mistrust of the potential for corporate abuse extended into critiques of global, industrial food production or what food studies scholars have since termed ‘Big Food.’ I have traced MSG’s emergence as a neurotoxin within technical debates forged in clinical trial, crystallising in a legal standoff between the FDA and consumer advocates in the mid-1990s. This period of MSG’s history is a set-up for the second-to-last chapter of this project, in which I interpret the resurgence of umami as a reflection of escalated research investment and marketing renewal by the glutamate-producing and consuming industry
(i.e. food processors like Campbell’s Soup Company). In the chapter to follow, I trace how the molecular validation of glutamate as umami, the fifth taste sensation and purported evolutionary mechanism for identifying valuable protein sources, has made great strides toward making the Chinese Restaurant Syndrome go away.
Chapter 4
Legitimating MSG: Deliciousness Goes Global

Introduction

You have arrived in American food culture when New York Times food critic Mark Bittman declares you are “consciousness-expanding,” when celebrity chef Mario Batali dubs you the next genre in cooking, and when restaurants pop up with you as their central motif, e.g. sushi, tacos, ramen, farm-to-fork. Enter a foodscape in which umami, the fifth “basic taste” sensation, has become real. Today a Google search of “umami” yields 8 million+ results—this has doubled from 4 million+ when I first drafted this chapter in 2013. The term is enshrined in the annals of Wikipedia; parsed in editorials and blogs; elaborated by industry ‘educational’ arms like the Umami Information Centre; and marketed by specialized restaurants like Umami Burger (with fifteen locations across California), Umami Sushi (Toronto), and the Umami Café (New York). For perspective, a search for “sweet” generates upwards of a billion results. A current PubMed (MedLine) search for “umami” yields nearly 800 references—an exponential increase over the 86 PubMed references and the 4,000+ Google search results reported by one umami researcher in 2000 (and up significantly from 500+ in 2013).

382 The subject of much of chapter three.
384 In 2000, the lead researcher on the study that first definitively established the existence of distinct glutamate receptors enthused over umami’s popularity—miniscule compared to that of 2016. “Today a search in PubMed
Learner's Dictionary defines umami as: "a strong savoury taste that people recognize in foods such as cheese or mushrooms;" the Merriam-Webster Dictionary: "a taste sensation that is meaty or savory and is produced by several amino acids and nucleotides (as glutamate and aspartate);" the New Oxford Dictionary of English (Second Edition): "Umami/u:ma:mi/noun (mass noun) a category of taste in food (besides sweet, sour, salt, and bitter), corresponding to the flavour of glutamates, especially monosodium glutamate. ORIGIN Japanese, literally 'deliciousness;" and The American Heritage Dictionary of the English Language (Fourth Edition): "A taste that is characteristic of monosodium glutamate and associated with meats and other high-protein foods. It is sometimes considered to be a fifth basic taste along with sweet, sour, salty, and bitter."  

Over the last ten years, umami’s proponents have described it as the experience of rich, deep, savoury deliciousness. This taste can occur innately or, more often, be conferred by a food’s mode of preparation: ripening, sun-drying, pickling, aging, fermenting, toasting, or braising all break down proteins to release free glutamates or nucleotides, or what are currently known to food scientists and research chefs as umami tastants. Ripe tomatoes, Parmesan cheese, soy sauce, fish sauces, sauerkraut, olives, and ketchup are common examples of long-beloved foods.

(MedLine) for papers concerned with taste and containing the term 'umami' retrieved 86 references. (For comparison, 'sweet taste' retrieved 10 times more references published since 1980.) A search with the Google engine found >4000 web pages containing the phrase 'umami'. Some of these pages were from restaurants advertising umami food. Others dealt with the misconception that glutamate contained in food might be harmful. But foremost among them were pages reprinting newspaper articles about the discovery of umami receptors.” N. Chaudhari, A. Landin, and S.D. Roper, “A Metabolic Glutamate Receptor Variant Functions as a Taste Receptor,” Nature Neuroscience 3 2000: 113–9.

we can now employ knowingly as umami “flavour bombs.”\textsuperscript{386} Umami offers us an enticing universalizing narrative for why certain age-old foods have tasted so good across diverse culinary traditions. Could umami hold the secret to understanding why humans like to eat what they do? How did Americans go from dismissing umami taste altogether, and then abhoring MSG as a toxic additive associated with Chinese food, to opening restaurants specifically dedicated to plating umami “bombs?” How did English-language scientists and American food commentators come to embrace umami?

Addressing this question requires a situating of umami in the broader context of early twenty-first century American foodways. Over the last fifteen years, consumer activism against MSG has declined, the star of molecular food technique has risen and fallen into the obscurity of the norm, and the professional kitchen has become accessible to television and digital media armchair-chef-voyeurs around the U.S. A deluge of food writing, food television programming, food blogging, food tweeting, and all around celebrity chefery has ushered in a popularization of haute cuisine.\textsuperscript{387} And alongside this embrace of foodie-isms has been a growing exchange between scientific disciplines invested in knowing more about how bodies experience food: specifically, food technology, psychophysics, molecular biology, and neuroscience. A “molecular turn”\textsuperscript{388} in food thought has mainstreamed a deconstructionist approach to food first


popularized in the 1990s as *molecular gastronomy* \(^{389}\) and Harold McGee’s now classic tome first published in 1984, *On Food and Cooking: The Science and Lore of the Kitchen*. In other words, many commentators of the last decade have gathered at the neurological register—a shift that’s evidenced by recently trending neologisms like *neurogastronomy* and *gastrophysics*. \(^{390}\)

The rise of the molecular register in discussions of eating is particularly illuminating for the case of MSG. International scientific and culinary circles have finally embraced *umami* after leaving the idea languishing—on this side of the Pacific, that is—in obscurity for nearly a century. \(^{391}\) The 2000 and 2002 identification by researchers at the University of Miami of distinct umami receptors in the human mouth and digestive tract has prompted the culinary industry’s embrace of umami as a game-changing dimension of flavour. Meanwhile, industrial kitchens around the world have by no means lessened their long-standing reliance on the instant-umami effect of MSG. This rise of umami has the effect of naturalizing the techniques by which food science engineers not just our foods, but our bodies. As I have maintained throughout this project, MSG cannot properly be described as a food technology, but rather as a technology of


\(^{391}\) Japanese chemist Kikunae Ikeda isolated glutamic acid in its sodium salt form, or monosodium glutamate, from *kombu* (seaweed) in 1908. Immediately thereafter, he and former pharmacist Saburosuke Suzuki formed the Ajinomoto Company, still today the largest producer of MSG (and other fermentation products), and began marketing MSG both domestically and abroad.
The cutting edge of food science research in the twenty-first century lies in how to *make* happier eaters, the more literate of whom imbibe an expert vocabulary of gastronomic evaluation along with their entrées—e.g. retronasal smell, mouthfeel, acidity, viscosity, brightness, searing, caramelization, umami.

To put it another way, this chapter considers what it means—and how it matters—that the twenty-first century’s proliferation of foodies coincides with an era in which taste experience has been ontologized as a molecular phenomenon. What does it mean that haute cuisine and industrial food design (mass-produced, ‘low’ cuisine) seem to have eddied into one another, sharing not only a partly overlapping consumer base, but also foundational techniques? At the outset, and now at the close, of the century-long history covered in this project, MSG has been conjured as a means to open access to the good life—by way of better eating. However, I have insisted that, as a food technology, MSG does not precisely make possible better-tasting and more healthy food; it makes possible the proliferation of highly processed, low-input-cost, and nutritionally deficient foods by remaking the eater herself. It has historically been valuable precisely for its ability to make lesser quality foods seem delicious and satisfying. The rematerialization of umami provides a universalizing ontology within which all forms of glutamate—both additive and endogenous—are commensurate. Tomatoes, mushrooms, and Doritos—in my body, your body, and anyone’s body—the glutamate is said to be all the same. Molecular umami presents a new, universal ontology of savoury delicious taste made common to all humans throughout space and time. However, in this chapter and in the conclusion I trace

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392 This distinction follows the lead of literary critic and food scholar Kyla Wazana Tompkins in *Racial Indigestion* (2013).
how it is unevenly attached to branded national cuisines and leveraged by corporate stakeholders to imbue monosodium glutamate once again with the aura of health.

**Umami Science and Nation Branding**

In September 2008, the International Glutamate Technical Committee (IGTC) underwrote the first international symposium on glutamate in food science of the twenty-first century. A nongovernmental organization funded by industrial producers and users of glutamate in food, the IGTC was a self-described a patron of scientific research into dietary glutamate over the last four decades. This centennial convention, then, was a culmination of the decades of scientific investment and political lobbying of companies whose business relied centrally on technologies of umami taste. For this celebration, the lobby group gathered its best and brightest in Tokyo to celebrate the “100th Anniversary Symposium of Umami Discovery: The Roles of Glutamate in Taste, Gastrointestinal Function, Metabolism, and Physiology,” the proceedings of which were published in a special 2009 edition of the *American Journal of Clinical Nutrition*. In his introduction to the volume, John D. Fernstrom, a scientific advisor to the IGTC and the Ajinomoto Company, wrote that the organizing committee had crafted the 2008 symposium in the realization that the pace of an already “robust area of research [on glutamate] had budded and flowered,” mainly in the area of umami taste. His simple explanation for this was the last decade’s “remarkable” intersection of molecular biology with taste biology, uniting a long-founded food science interest in glutamate receptors with previously elusive data. Such exciting

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393 See the special issue of the *American Journal of Clinical Nutrition* 90(suppl) 2009.

advances, he declared, justified the IGTC sponsoring two major symposia on glutamate within a mere ten-year span.

The major research themes of the 2008 symposium were: 1) the variability of umami taste between animals and humans, e.g. a specific ageusia (loss of taste function) for umami identified in humans, linked to mutations in putative umami receptor genes; 2) a “new molecular toolbox,” enabling scientists to identify umami taste receptors outside the oral cavity and into the gut, a notion stimulated by work suggesting some type of transduction mechanism, with potential physiologic functions of glutamate being examined [also being studied for sweet receptors], and 3) functional MRI imaging studies, for exploring the role of cognitive bias in taste experience at the cellular level. In Fernstrom’s words, “[c]learly, the ultimate perception of the umami taste by the brain involves more than just the taste receptors themselves.” And just as clearly, umami taste has become the site of accelerated research excitement and investment. This culmination of research excitement can be traced back through two decades of concerted investment by scientists and food industry leaders—centred largely but not exclusively in Japan—into forging scientific consensus around the existence and importance of umami taste.

A 1979 paper written by Ajinomoto laboratory researcher Shizuko Yamaguchi and presented at a joint US-Japan scientific conference, entitled “The Umami Taste,” is retrospectively chronicled in industry publications as signalling a sea change in which umami began to generate serious interest in scientific circles outside Japan. However, collaborative, transnational

395 Fernstrom, “Introduction,” 705S.
396 Fernstrom, “Introduction,” 705S.
research into establishing umami as a causative force in taste biology was launched definitively in 1982, when a number of multilateral bodies were founded to advance knowledge and acceptance of this proposed fifth taste sensation. The Umami Research Association, an organisation comprised of physiologists, molecular biologists, nutritionists, and food chemists hailing from Japan, Europe, and the United States, was founded in this year, and would come to host a number of international symposia on umami in the intervening 25 years. The first international symposium in 1982 was launched with the explicit purpose of helping to establish umami as a “basic taste” by elucidating its underlying neurological mechanisms. Key questions up for discussion included: whether umami substances—namely, glutamic acid and certain ribonucleotides—just helped potentiate (enhance or activate) other sources of the four primary tastes, and whether taste fibres were responding specifically to the sodium ion in MSG or to the glutamate. In other words, what made this inaugural symposium distinct is that it was not about glutamic acid; it was about umami. It was about establishing umami taste’s basis in science, which is to say it was about making umami real. Its primary aim was to establish umami as a universal, biological fact of human taste capacity, and one associated with glutamate and other

398 See, for example, B. Lindemann, Y. Ogiwara, and Y. Ninomiya, “The Discovery of Umami,” Chemical Senses 27(9) 2002: 843-844. They state: “Umami research proceeded on a larger scale especially since about 1980. The umami substances L-glutamate, inosine 5’-monophosphate (IMP) and guanosine 5’-monophosphate (of which the latter two enhance the glutamate taste) were defined, and taste responses to them were investigated in humans and animals. Animal models, however, were of limited use as the responses of different species, even of different strains of mice, were at variance.”
tastants. This shift in focus is clear in the shift in symposia and publication titles between 1978 and 1985. What had been in the 1970s discussed in terms of ‘glutamic acid’ became increasingly styled simply as ‘umami.’

<table>
<thead>
<tr>
<th>Year</th>
<th>Occasion</th>
<th>Location</th>
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<tbody>
<tr>
<td>1978</td>
<td>International Symposium on the Biochemistry and Physiology of Glutamic Acid</td>
<td>Milan, Italy</td>
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<tr>
<td>1982</td>
<td>Umami Research Association founded</td>
<td>Japan</td>
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<tr>
<td>1985</td>
<td>First International Symposium on Umami</td>
<td>Hawaii</td>
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<td>1990</td>
<td>Second International Symposium on Glutamate</td>
<td>Sicily</td>
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<td>1993</td>
<td>Umami session, ninth International Symposium on Olfaction and Taste</td>
<td>Sapporo, Japan</td>
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<tr>
<td>1997</td>
<td>Umami session, 12th International Symposium on Olfaction and Taste</td>
<td>San Diego, CA</td>
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<tr>
<td>1998</td>
<td>International Symposium on Glutamate</td>
<td>Bergamo, Italy</td>
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<tr>
<td>2004</td>
<td>Umami session, 14th International Symposium on Olfaction and Taste</td>
<td>Kyoto, Japan</td>
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<tr>
<td>2008</td>
<td>100th Anniversary Symposium of Umami Discovery: The Roles of Glutamate in Taste, Gastrointestinal Function, Metabolism, and Physiology</td>
<td>Tokyo, Japan</td>
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Kumazawa and Kurihara showed a synergism between MSG and the nucleotides in the canine chorda tympani nerve, which could not be inhibited by known inhibitor of NaCl, amiloride. Therefore, this MSG-nucleotide synergism was not a function of salt’s metabolism by the animal, but rather was attributable to glutamate and nucleotides. See Kenzo Kurihara, “Glutamate: From Discovery as a Food Flavor to Role as a Basic Taste (Umami),” *American Journal of Clinical Nutrition* 90(3) September 2009: 719S-722S; T. Kumazawa and K. Kurihara, “Large synergism between monosodium glutamate and 5'-nucleotides in canine taste nerve responses,” *American Journal of Physiology* 1990 (259): R420–6.)

Adapted from Kurihara, “Glutamate,” 721S.
Leading Japanese researchers also founded an educational organization in 1982. The Umami Information Center was established with the goal of conveying “beneficial information” about umami as a basic taste “in an accurate manner based on facts,” both within Japan and throughout the rest of the world. While operating under the umbrella of the international industry lobby group, the International Glutamate Technical Committee (IGTC), the UIC would later be officially accredited as a Non-Profit Organization (NPO) by the Tokyo Metropolitan Governor’s Office in 2007. The UIC’s representation of the commercial interests of MSG producers and users was thus transmuted into a representation of the public interest and cultural heritage of Japanese, or specifically Tokyo, citizens.

The dogged materializing, or bringing into being, of umami as a fixture of Japanese foodways was conducted not only domestically, but internationally. “Umami” is delicious,” then Ajinomoto president Katsuhiro Utada told The New York Times in 1983, at which point, according to the Times, “a food-lovers’ swoon” was begun. It must have been a highly select group of American food-lovers in 1983, because thirty-years later, the Umami Information Center Chairman, Dr. Kenzo Kurihara, was just celebrating the recent embrace of umami as part of the “international language of food”—and as part of the inevitable recognition of the taste sensation’s long-existence in “not only Eastern, but also Western culture.” He and his successor Chairman, Takashi Yamamoto, have both echoed in their communications the

402 This usage is attributed to Michelle Murphy in Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers (Durham, NC: Duke University Press, 2006).
significance of the “unprecedented boom” (Kurihara) and “burgeoning international profile” (Yamamoto) of Japanese cuisine, which they both attribute to the growing interest in “healthy eating choices,” which practices the Japanese exemplify, to borrow Yamamoto’s words, in their “skillful use of umami to create tasty, healthy dishes without animal fats.” In 2012, Kurihara described the organization’s mission as “doing whatever we can… to ensure that a greater number of people around the world will have a proper understanding of umami.”

The UIC literature rhapsodizes the recent surge in American interest for Japanese food in tandem with growing interest in a diet of lowered fat, sugar, and starch (thought consistent with traditional Japanese dishes), and a growing acceptance of umami as a fifth universal taste dimension. These public statements are representative of early-twenty-first century messaging from key producers and users of MSG, in which an appreciation of umami is the late recognition of the universally obvious—rather than the effect of years of research investment and public education campaigns.

Considering another example from the history the institutionalization of chemosensation (the “chemical senses” of taste and smell) research and its role in health and nutrition helps illustrate the indivisibility of the infrastructure and goals of scientists, government

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representatives, and industry leaders. In 1987, physiologists Yōjirō Kawamura and Morley Richard Kare edited the influential compendium of research findings from the first international symposium on umami in 1985 in Hawaii. The title, *Umami: A Basic Taste*, or Volume 20 in Dekker’s series on Food Science and Technology, was reviewed in *Appetite* and is to this day considered an authoritative tome, codifying the bewildering breadth and state of knowledge on umami of its day. Kawamura held an appointment in the Faculty of Nutrition and Koshien University in Takarazuko, Japan. A Winnipeg, Manitoba native, Kare enjoyed a prominent career as a professor of physiology at the University of Pennsylvania, was a member of the Corporation of the Culinary Institute of America and a World War II veteran. Alongside other members of the academe, government, and industry, Kare founded in 1968 what is now a leading center for taste and smell research, serving as its director until his death in 1990: the Monell Chemical Senses Institute in Philadelphia, PA. Just under ten percent of the contributors to this volume were employed at the Ajinomoto Company, Inc.—the largest representation from any single institution, public or private. Participants came from applied and basic research centres of nutrition, dentistry, food chemistry and technology, pharmaceutical sciences, marine biochemistry, psychology and neuroscience to medicine, and almost exclusively from the United States and Japan.

So, while Kikunae Ikeda coined the term “umami” in 1908, it took at least another seventy-five years of before the concept gained international scientific traction. By international,
the implication is English-language acceptance, or acceptance among American, British, and Continental scientists. Instead, mid-to-late twentieth century science in English on MSG’s flavour enhancing effect was commonly described as “amplitude” and “mouthfulness” and “bloom” and “potentiation.”

Scientists writing in 2000 in the *Journal of Nutrition* speculated that a major impediment to the international recognition of umami as a “basic taste” was the lack of “traditional words to describe it in Western languages.” The lack of umami enthusiasm among ‘Western’ scientists has also been explained within the research community by the lack of detailed translations of Ikeda’s work into English. These challenges of translation that textured MSG’s export to the United States are valid and important to the history of umami taste. Also relevant was the implicit attachment of many Euro-American scientists to the four-taste system theorized by Aristotle, a commitment bolstered by the influential, mid-century counter-theory of E.C. Crocker (of the pre-eminent A.D. Little Inc. laboratory in Cambridge, Mass.) that MSG just amplified and blended all of the four basic tastes: sweet, sour, salty, and bitter. However, the research archive suggests a less circumstantial and more interested

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412 Interestingly, in one influential study, Japanese research subjects familiar with umami taste were prompted to describe MSG’s impact on food flavour without using the word umami; they responded with descriptors like: overall taste intensity, continuity, mouth fullness, impact, mildness and thickness. Shizuko Yamaguchi and A. Kimizuka, “Psychometric studies on the taste of monosodium glutamate,” in eds. L.J. Filer, Jr., S. Garattini, M.R. Kare, W.A. Reynolds, and R.J. Wurtman, *Glutamic Acid: Advances in Biochemistry and Physiology* (Raven Press New York, NY, 1979): 35-54. Discussed also in Shizuko Yamaguchi and Kumiko Ninomiya, “Umami and Food Palatability” *Journal of Nutrition* 130(4) 2000: 921S-926S.

413 Lindemann, et al., “Discovery of Umami.”

414 This is the subject of chapter two.

Japanese scientists have over decades established their prominence in amino acid research, and the genealogy of research establishing umami in science is a relatively transparent network of industry-sponsored or affiliated applied research into amino acid-based technologies, of which MSG is one. Over the 1980s and 1990s, various methodological approaches were used, such as multidimensional scaling methods, and behavioural and electrophysiological paradigms in animals to investigate the independent existence of an umami taste.  

Significant resources and time were thus exerted by food scientists working with or in collaboration with industry partners to overturn the four-basic-taste paradigm. One effect of this shift in the ontology of taste which was to exonerate MSG and its industrial producers and users from the stigma of the additive’s potential toxicity. Examining the research genealogy behind umami’s validation in the early twenty-first century suggests that umami’s acceptance within the last two decades is the result of: 1) years of research investment and lobbying by industrial producers and users of MSG, the most visible of which is the Ajinomoto Co., Inc.; and 2) the development of molecular techniques applied to the taste physiology and neuroscience. I do not try to make the case that the integrity of taste research in the 1980s and 1990s was singularly compromised by commercial interests, or that the scientists in question were nefarious characters who pursued private gain under the guise of basic research. Instead, I have throughout this project built on the foundational insight of those such as Kaushik Sunder Rajan that the leading edge of biomedical and biotechnological research in the late-twentieth and early-twentieth

Recent food scholarship has similarly documented the centrality of branding consultancy and techniques to the circulation—and it is worth clarifying, the *valuation*—of national identities within global exchanges of people, ideas, and goods. Umami has been made valuable to the export of Japanese foodways abroad, particularly in a United States stricken with chronic diseases of affluence like hypertension, obesity, and diabetes, and as Japanese food scholar, Katarzyna Cwiertka has observed, a mythology of an ancestral food tradition marrying flavour with healthfulness to cultivate the integrity of the national body have had particular resonance in a contemporary Japan characterized by internally diverse food customs and rising health concerns associated with the growth in popularity of imported fried foods (e.g. Chinese, American) and rich curries (e.g. Indian). Umami as the essence of Japanese cuisine, and as a healthful essence, matters enough to both ideas of Japanese identity and futurity within Japan, as well as internationally enough for Japanist Jordan Sand, writing in 2005, to conclude that efforts to proliferate an English-language science of umami were “yielding results”—with umami taste receptors acting as “tiny physiological legitimizers for MSG.”

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The Molecular Turn

The umami taste sensation has come into its own under within the context of wider research into the molecular mechanisms behind our experience of taste.\(^{421}\) As I discussed above, while Ajinomoto Co, Inc. and many Japanese food scientists had declared throughout the twentieth century that umami was the fifth universal taste sensation, the theory’s uptake in the English-language scientific community was limited.\(^{422}\) Over the course of the last twenty years, the identification of new umami receptors and tastants has become a hot area of sensory research, in which much enthusiasm and capital has been invested. In the 1990s, additional umami-conferring substances were identified, e.g. the monophosphate esters of guanosine (GMP), adenosine (AMP), and xanthosine (XMP).\(^{423}\) Most importantly, in 2000, molecular biologists at the University of Miami identified a unique taste receptor for glutamic acid on the tongue of a mouse, a metabotropic glutamate receptor they called taste-mGluR4.\(^{424}\) They determined that this taste receptor was chemically aroused by the presence of glutamate outside the cells of the taste bud, which then sent an electric signal to the brain, causing the consumer to experience the savoury, rich, mouth-filling umami taste. Only two years later, another group located two more of what are called G protein-coupled (metabotropic, or ‘lock-and-key’) receptors, named T1R1 and T1R3, which are at work in both the umami and sweet tastes and respond varyingly to

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\(^{422}\) Lindemann, et al., “Discovery of Umami.”


\(^{424}\) Chaudhari, et al., “Metabolic Glutamate Receptor.”
several amino acids, including glutamate. The ‘Columbus’ of umami receptors, Nirupa Chaudhari of the University of Miami, described umami in 2012 as the taste of many amino acids, or, as the effect of a changeable combination of “multiple receptors expressed in different subsets of taste cells,” through which “differing mixtures of amino acids, peptides, and nucleotides prompt the brain to register subtly different taste qualities.” In brief: umami is complicated. It is perhaps even more complicated than the other accepted taste mechanisms (sweet, salty, sour, and bitter)—and scientists still do not understand the precise mechanism by which we experience saltiness and salt’s enhancement of accompanying flavours. Nonetheless, these breakthroughs made possible by molecular techniques previously unavailable to taste researchers validated for the English-speaking scientific community Ikeda’s century-old argument: that umami is a distinct basic taste which companies and policymakers can and should be using to understand and to influence what people eat. Chaudhari’s own research illustrates the continuity between this chapter and the last chapter’s discussion of MSG as a biocapitalist technology, in which the value to commercial application was a pre-condition of much glutamate-related chemosensory research. In retrospect, a 1996 publication anticipated Chaudhari’s official identification of a fifth taste mechanism; in it, he and colleagues based in Colorado use reverse transcriptase (RT)-PCR and RNase protection assays to identify a metabotropic glutamate receptor, mGluR4 localized specifically to gustatory cells, and they do


so using research grants from Kraft General Foods and the Umami Manufacturers’ Association of Japan.427

The validation of umami—and the seeming exoneration of MSG—is located in a wider ‘move to the brain’ and to the molecular register of applied research over the last two decades. With the triumphant completion of the Human Genome Project in 2003 and widespread advances in molecular biology techniques (generally described as analyses and manipulations of DNA, RNA, proteins, and lipids), the molecular register has become the de rigueur site for inquiring into previously unknown workings of the body. Consider the example of the emerging field of neuroprosthetics, a field in which neuroscientists have in recent years been developing technologies for enhancing bodies from the brain out. At the Boston, Mass at the annual meeting of the American Association for the Advancement of Science in 2013, researchers reported their success in creating infrared-sensing rats, whose implanted brain electrodes enabled the animals to respond to infrared signaling in order to gain a reward. This first attempt “not to restore a function but to augment the range of sensory experience [emphasis added],” said Duke University neurobiologist Miguel Nicolelis, the research team's leader, demonstrated how the brain is "much more plastic than we thought" when it comes to adapting to new stimuli. Another reported new application was presented by Todd Coleman, a bioengineering professor at the University of California at San Diego, in a less-obtrusive brain-control device: a stamp-sized wireless sensor to be worn like a “temporary tattoo” to monitor a person’s medical signs or, if worn on the head, to pick up brain waves. Such “sensory cortical prostheses” are distinct from classic sensory substitution experiments dating from the late 1960s that focused on ‘restoring’

sight to congenitally blind individuals—in itself a contested intervention. These technologies instrumentalize the cross-modal plasticity of the somatosensory cortex, the goal being a “cortical sensory prosthesis capable of augmenting the subject’s perceptual capability.”

What does wider research into extending the sensorium mean for eating? The unprecedented capacity for developing neuroprosthetic technologies signals a shift in attitude in which it becomes increasingly normal for products to bypass outlying sensory or motor functions to intervene directly in the cortex of the brain. In this respect, they are not unlike chemosensory technologies such as MSG. Both are intended to expand a perceptual frontier. Both are capitalized by institutions in government and industry, as part of a politically and economically loaded calculus of cost and gain. Food commentators have in recent years been remarking on the implications of the genetic revolution alone for the production of gastronomic experiences. In 2008, *Gourmet* magazine ran a piece on the “tantalizing” possibility that, as understanding grows of the biological foundations of our food preferences, biotech companies may be able to customize a dish to our individual genetic coding. In so many words, “We might even have a food type, just as we have a blood type.” This was not to contradict the clear evidence that food preferences can be acquired, but to suggest a clear direction in dining innovation, that “[s]oon

each of us will carry around our own periodic table of what food chemicals we respond to. While this may sound like a hackneyed futurist’s fantasy, this kind of molecular deconstruction of eating is precisely the language of performative cooking, food shopping, and eating that has been popularized amongst early twentieth-century foodies.

In the early 1990s, late Oxford physicist Nicholas Kurti and French chemist Hervé This founded a school of culinary innovation they dubbed molecular gastronomy. Anticipating the cross-pollination of molecular biology and taste biology, Kurti and This declared that it was not enough for chefs to simply become adept at established techniques, like mastering a veal stock or the perfect emulsion. Neither was it enough for the chef to understand; he or she must manipulate—with appreciation for the underlying biochemistry of their trade. Years before food scientists decided it themselves, Kurti and This declared a new mandate for molecular gastronomy and thus for anyone truly interested in occupying the front lines of food innovation: the cultivation of conscious, applied knowledge not just about food components, but about what happens at the molecular register when those components are consumed by the body.

The vogue of molecular deconstruction has had a palpable impact on our understanding of taste. “Flavor chemistry is finished,” said Cornell University’s Terry Acree, a forty-year flavour chemistry veteran in 2008. “Flavor chemistry is finding the chemical molecules that are

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430 In the introduction, I defined “foodie” as a slippery category of identity which names as an individualistic—yet shared, and often performative—preoccupation with the hedonics and politics of food. Its popular usage appears to date to the cheeky cult classic by Lisa Birnback, *The Official Preppy Handbook* (New York: Workman Publishing, 1980).

important to aroma and taste. We spent decades doing this. But the other side of the equation is what’s been missing: how these chemicals interact with our bodies. That’s the part we’re getting to now [emphasis added].”

According to this narrative, what chefs are said to have understood instinctually for generations, molecular biology has begun to reveal. Understanding enables manipulation of a chemical conversation between taste receptors and the brain. Knowing how to moderate that dialogue promises that the food industry can commercialize more products with their undesirable taste qualities blocked or their desirable taste qualities enhanced. In other words, it presents a potentially unlimited market for additives like MSG and ‘non-nutritive’ (artificial) sweetener analogues. One hundred years later, we have arrived back at the stated aim of MSG inventor Kikunae Ikeda: to improve public health by making people think healthy foods taste better than they might otherwise. In Acree’s words, “Taste is like a chair with four legs”… “Before, we only had one leg—flavor chemistry. Now we’re building the other three: how a chemical reacts with the receptor; how that receptor communicates with the brain; and how the brain processes that information into behavior.” It is in the potential for changing human behaviour that makes all this research into the brain, or into the molecular mechanisms of chemosensation, valuable. And that value is frequently not problematized—in fact, it is communicated in matter-of-fact or celebrationist terms in publications for food enthusiasts and culinary professionals like Gourmet magazine, from which the above statements from Acree were taken.


Many culinary professionals behind the scenes in institutional kitchens and exclusive, high-end restaurants have embraced techniques honed in food science and molecular gastronomy in their quest to produce that ‘best bite.’ A few examples will help give form to how molecular technique has infused foodie culture in the United States and parts of Europe. In The Fifth Taste: Cooking with Umami (2005), food writers David Kasabian and Anna Kasabian claim to bring umami lore to America, building on its slowly growing acceptance in English-language food circles at the turn of the new millennium. When David Kasabian learned about umami at a gastronomy lecture at the Culinary Institute of America in New York, NY, he made it his mission to explore the fifth taste as comprehensively as possible and, in conjunction with his wife Anna, an established author and writer, to increase awareness and acceptance of the fifth taste and "take it out of the laboratory and onto the dinner table." Umami was a lot less well known in 2002 than it is now, but its halting translations into American food culture have included a sense of the caricatured ‘Eastern’ mystery or spirituality. "I've heard people say, 'I've reached a state of umami,'" recalls Kasabian with a chuckle." The Umami Information Centre, for one, has celebrated the Kasabians’ contribution to their battle to establish umami across the Pacific, crediting the “phenomenal” increase in awareness and understanding of umami between 2007 (when the Kasabians’ book was released) and 2012 to their work. None the worse for conviction, David Kasabian declared in an interview by the Centre that now, chefs unaware of

435 The Umami Information Center, “The Umami Man.”
and uninterested in cooking with umami may soon be in the minority—a development he feels is enabling people to “eat better as a result.”

Food development executive turned author Barb Stuckey wrote a book of similar tone that appeared on bookshelves in 2012. Titled *Taste What You’re Missing: The Passionate Eater’s Guide to Why Good Food Tastes Good*, Stuckey’s offering to lay foodies is an industry insider’s vocabulary for knowing the dynamics responsible for one’s personal enjoyment of foods, or lack thereof. Stuckey opens the book with an account of her evolving love affair with the tortilla chip—a professional journey to realize the ideal balance of caramelization, acidity, mouthfeel, lubricity, seasoning, finish, etc. Stuckey offers readers the promise of her own hard-won professional wisdom: the ability to “see flavors more clearly,” to “suck more juice out of food, wring more pleasure out of meals.” The concept of umami makes an early appearance on page three, where Stuckey recounts confronting a room of blank stares when discussing the use of tomato solids and enzyme-modified cheeses for extra umami kick with a group of food marketers. She deplores the lack of popular discussion of the tastes and aromas at work in food; people passionately deconstruct and contest the flavour dimensions of wine, she declares, so why not food?

*Taste What You’re Missing* progresses into a systematic outline of the senses (taste, smell, touch, sight, sound), the basic tastes (of which Stuckey counts five: salt, bitter, sweet, sour, umami—plus fat as a possible sixth, in addition to many potential others), the commercial

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436 The Umami Information Center, “Umami Man.”


chemistry of flavour, and a concluding programme for “get[ting] more from every bite.” Why? Because “eating better food means living a more satisfying—and arguably healthier—life.”

Escorting the reader through an introduction into their own unique “sensory world,” Stuckey visits food industry laboratory technicians, sensory experts, and long-tenured chefs throughout the U.S. The message she drives home is that individual variations in food experience—cravings, aversions, preferences—all have a chemical and neurological basis, and if one understands that basis, one can gain a sensory literacy that translates into a new level of sophisticated, discriminating eating—a taste cultivation of tasting. Each person’s tasting apparatus is different, the combined product of one’s tongue anatomy, genetics, and personal/medical history. Some people simply have a higher concentration of taste buds and are predisposed to be more sensitive to certain flavours or textures; these preferences are also influenced by experience, such as injury resulting from nerve damage (surgery), localized trauma (a cut tongue), the legacies of childhood infections (ear), or habitual consumption of very spicy foods (tolerance is the result of nerve damage). She explains how the relative dominance or inhibition of certain nerve paths over others can result from many intrinsic or emergent factors, i.e. the trigeminal nerve (which mediates tactile sensations and is thus responsible for conveying food texture information to the brain) may be relatively dominant or passive as compared to the chorda tympana nerve (which mediates the basic taste sensations proper: sweet, sour, bitter, salty, umami… fat? etc.?). Plain old genetics also play a role; some people taste chemicals that others just cannot, some have more of certain enzymes than others, and still others are born without the sense of smell—which, as Stuckey emphasizes, is a major component of the sensory experience colloquially described as “taste.” Sensory science distinguishes tastes from aromas, both of which are understood to confer

“flavour,” known to the inexpert as “taste,” e.g. “This tastes good.” Emphasized throughout is the conundrum that “taste,” as it is commonly understood, is a highly subjective phenomenon; we simply cannot know whether one person’s experience of “buttery” or “savoury” or “citrus” is the same as another’s. 440

Not only does Stuckey endorse umami’s existence as a basic taste sensation, she discusses it holistically as the taste quality imparted by compounds inherent to many delicious foods, as well as by commercial monosodium glutamate and disodium guanylate and inosinate. She declares that public alarm in the U.S. about MSG is a product of a “lack of understanding of umami.” Like salt, she writes, and at “reasonable levels,” MSG is “not to be feared.” 441 However, Stuckey also likens added umami tastants to a “beer goggles of taste,” causing everything they accompany to taste better, fuller, richer, and more delicious than they would have otherwise. She also concludes that “the more natural way to work MSG into your food” would be to use inherently glutamate-rich ingredients like chicken or beef broth, soy or fish sauce, cooked mushrooms or tomatoes, and aged cheese, because “no one feels good about sprinkling a white powder into his food.” 442 Her logic betrays an odd contradiction, since that is precisely what we do with salt (also white powder or crystals). This inconsistency, however, is not enough to prevent Stuckey from exonerating MSG, as part of a wider conflation of MSG with the intrinsic free glutamates found in so many foods. At base, her book is a work of molecular translation, interpreting the micro for those who live in the macro—explaining lived experiences of food in

441 Stuckey, Taste What You're Missing, 245.
442 Stuckey, Taste What You're Missing, 245.
terms of their neurological and sensory underpinnings, establishing the learned eater as one who is learned in the molecular.

Yale neurobiologist Gordon M. Shepherd offers a similar read to foodies interested in expanding their gastronomic vocabulary. In 2012’s *Neurogastronomy: How the Brain Creates Flavor and Why It Matters*, Shepherd coins a neologism that renders explicit one of the central themes of this chapter: eating recast as molecular mechanisms in the sensory organs and the brain. He defines neurogastronomy as the scientific endeavour of addressing diet-related chronic disease through a new understanding of how the brain creates the flavours we experience when we eat. Shepherd is quick to correct the abuses of everyday language; food does not contain flavours, he explains. Rather, foods contain molecules, whose flavours are “actually created in our brains.” Drawing on his research into the patterns of smell created by microcircuits in the brain, *Neurogastronomy* describes a “human brain flavor system” involving perception, emotion, memory, consciousness, language, and decision-making—an expanded understanding that he claims will provide a “new scientific basis” for healthy eating. While Shepherd’s deployment of the term ‘gastronomy’ has been criticized as cynical and/or ineffectual, the significance of Shepherd’s work is in its thickening of a popular conversation that locates eating at the site of the brain; he likewise includes umami in his enumeration of the basic tastes for which there are identifiable nerve receptors and thus a molecular basis, or distinct molecular ontology on which we ought to base personal decision-making and public policy.


444 Shepherd, Neurogastronomy, ix.
A deconstructionist, molecular approach is precisely that employed by avant garde restaurants like El Bulli, in Spain, The Fat Duck, near London, at Noma in Denmark, and at momofuku in New York, to explode the limits of food experience. The ontology of food-as-molecular inspiring both the high and the low of contemporary food development is, I believe, being popularized by today’s foodie culture as the new natural. While New York restaurant demigod Jean Georges Vongerichten reportedly opts for “MSG substitutes” in deference to the additive’s negative connotation in the US, his restaurant chain nonetheless has trotted out its own offering to the new umami literati: intense dishes called umami "bombs," ranging from a $185 Parmesan custard with white truffles to a $12 lunch dish of black bread with sea urchin.  

Meanwhile, Chris Young, a chemist and former food-research manager at The Fat Duck, declared to Gourmet magazine in 2008: “Lots of chefs have said they don’t care about [relying on novel molecular techniques and synthetic additives]... They just care how the food tastes on the plate. That’s fine. But this research will eventually trickle down to every level of cooking.”

A review last month of NYT reporter Michael Moss’ much-discussed book Salt Sugar Fat points out that Moss ignores the fact that “many of the techniques developed by food scientists —fat-globule dispersion, sugar-crystal manipulation — were cherished by Escoffier, the early twentieth century giant of French cuisine. Chefs have long played with the chemistry of food, intuitively hunting down the “bliss point” with as much gusto as any chip scientist at Frito-Lay.”


David Chang, founder of the three-Michelin starred momofuku group of restaurants (with locations in New York, Toronto, and Sydney), has made umami the cornerstone of his culinary research lab based in New York. Speaking with his head of research and development, Dan Felder, provides a fascinating glimpse into a small circle of young, innovative chefs striving for a fresh and authentic frontier, a new edge to work against in culinary invention: by harnessing the microbial fermentation behind that lies behind so much of the umami taste. Chang goes so far as to say that, as the route to umami, “microbes are the future of food.” In his vision for the future of the research lab—and momofuku’s commercial empire—Felder’s words display post-modern generations’ subconscious lament for a site of origination, an authenticity that signifies true novelty. As self-styled “stewards” of the microbial cultures they harvest in the lab, Felder, Chang, and their tribe of momofukians are seeking flavour novelty and delight in the most homely and raw site they can imagine: native Manhattan yeast and bacteria. Yet, without irony, Chang and Felder describe these explorations as being informed—authorized, in a sense—by multi-generational artisanal miso producers in Japan and by microbiology collaborators at Harvard University. Science and the Ancient East are married in the Momofuku lab, their progeny an unknown horizon of future fermented deliciousness.

Molecular Ethical Eating

Science and technology studies scholars writing in the last two decades have tracked the phenomenon put succinctly by Sara Shosak: that “the molecular is political.” The inaugural

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2006 edition of *BioSocieties* featured articles examining a development in the neurosciences, in which research interest had been seen to shift from curing ills to enhancing capacities, and all this via the brain. In their opening salvo, editors Ilina Singh and Nikolas Rose call on neuro-ethicists to abandon the reliance on the futurism, speculation, and hype that characterizes the field they presume to interrogate. They contend that

normality, in human attributes, is socially, historically and geographically variable... It is hard, today, to find a ‘normal’ person in an advanced industrial society who has not taken at least one mood or mind altering concoction, legal or illegal, whether it is coffee, alcohol, marijuana, nicotine, a sleeping pill, a herbal remedy or a prescription psychiatric drug. Indeed, one might say that those who have not ingested such substances are the abnormal ones.”

I appreciate their prompt that, as critical scholars of technoscience, “we need to ask some searching questions of those who interpret the outcome of investigations in these domains as demonstrating that ‘mind’ is ‘what brain does,’” a concern being pursued under the new disciplinary banner of ‘neuro-ethics,’ or what Rose in his wider work has described as new kinds of ‘ethopolitics’ (politics of ethics) across micro and macro scales.

The cachet of conversations situated at the brain, Singh and Rose point out, is extremely high. However, popular accounts in particular of the neurological mechanisms behind mental illness and behaviour more broadly vastly simplify and thus misrepresent much of even our preliminary understanding of these complex phenomena. For example, the contemporary advertising for SSRIs has capitalized on a highly reductive account of the relationship between

serotonin and mood. However, they suggest the neat account of ‘too little serotonin in the brain’ being rectified by a pharmaceutical has become a powerfully iconic narrative and an example of the ways in which “a scientific ‘lock and key’ narrative can spread even when—or perhaps precisely because—it grossly oversimplifies the state of current scientific knowledge.” To mitigate this distorting capacity of simplification, they place the onus on social scientists to insist, rather, that things like mood variation and neurotransmitter action are “distributed through the brain and the body, and are further embedded in the environment of interactions, expectations and meanings. When considered on this distributed plane, it is clear that we know rather little about what psychotropic drugs actually do.” They suggest instead that mind-bodies are complex and multiple.

Such a concern rendered for a popular readership looks something like this. Neuroethicist S. Matthew Liao, director of the bioethics program at New York University, has explained for the non-neuroscientists among us that, “until very recently, the human mind was a black box. But here we are in the twenty-first century, and now we have all these new technologies with opportunities to look inside that black box — a little.” The advent of functional magnetic imaging (fMRI) has enabled scientists to capture images of what the brain does during cognition, and to match those areas of activity with specific behaviours. On the heels of these insights are a plethora of new drugs being developed and tested to modify behavior. Neuroethics as a field

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addresses the questions of, “Are these new technologies ethical?” and, “[What are] the downstream implications of these new possibilities?” Liao for one hopes to realize more informed decision-making by enabling citizens and policy makers to be “thinking in advance about how new technologies will affect them. As a society, we don’t do enough of that.” For the middle and upper classes in the U.S. who make a habit of reading this kind of conversation in the New York Times, Liao provides examples whose downstream implications resonate with the capacity of MSG and other flavour enhancing additives to engineer happiness: there is significant government interest in propranolol, a drug the U.S. government has tested on soldiers affected with post-traumatic stress disorder (PTSD) in an attempt to “remove” their bad memories.

However, Liao cautions, “[y]ou need memory for a conscience. Doing this routinely might create super-immoral soldiers…When you start to tinker with those neurosystems, we’re not going to react to our fellow humans in the right way anymore.” Liao’s reservations echo in the ethics of directly engineering our sensory response to consumer food products, which is to say engineering future consumer behaviour. In this and another stated example, Liao touches directly on a treasured American value: an individual’s freedom of choice. He conjures the Fifth Amendment protection of defendants who cannot be forced to testify against themselves. Liao asks: “If the police put you into a machine that’s reading your mind, are you being forced to testify against yourself? At present, a person can be forced to surrender DNA. Is an fMRI scan

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456 Dreifus, “Ethical Questions.”
457 Dreifus, “Ethical Questions.”
458 Dreifus, “Ethical Questions.”
the same thing? Is it a different proposition for a food product to be strategically designed so as to alter an individual’s mood state and chemically foster allegiances to brands or convenience format foods, e.g. prepared condiments, frozen dinners, fast foods? Is this just a different tactic in the same game as marketers have been pursuing for decades in inculcating habitual or emotional brand allegiances through visual imagery, convenience packaging, jingles, and celebrity endorsement? How is MSG different from other, much-discussed ‘addicting’ food ingredients— for example, the sodium, refined sugar, or fat that have been so thoroughly critiqued by food writers in recent years? My sticking point, after years of thinking about MSG, is that the popularization of molecular-eating-for-pleasure that I traced above, has not been paralleled by popularization of ethical molecular eating. Yes, there is a mind-numbing density of prescriptive and alarmist discussion about corporate adulteration of foods and avoidance philosophies (gluten, nitrates, artificial colours/flavours, hydrogenated oils, etc.), of which MSG is still a part in the U.S. However, what I have found is that the MSG enthusiasts are speaking louder than the detractors, and the detractors’ reservations have come to sound increasingly tired, anti-science, or rancid with submerged racism.

To illustrate, one of the most compelling endorsements of MSG to date has come from culinary golden boy David Chang. Founder of the three-Michelin starred momofuku group of

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460 Only the most recent work in this vein is journalist Michael Moss’s Salt Sugar Fat: How the Food Giants Hooked Us (WH Allen, 2013).

461 For example, in his 2012 address at the avant-garde culinary symposium, MAD, in Copenhagen, Denmark. Per founder René Redzepi (co-owner and head chef of the two Michelin star restaurant Noma, whosename is a portmanteau of the Danish words nordisk (Nordic) and mad (food)), the MAD symposium was instituted in 2011 in recognition that, “Chefs have a new opportunity – and perhaps even an obligation – to inform the public about what is good to eat, and why. But we ourselves need to learn much more about issues that are critical to our world:
restaurants (with locations in New York, Toronto, and Sydney), Chang has made umami the
cornerstone of his culinary research lab based in New York. In many ways, Chang personifies
the confluence of historical geopolitics, corporate interests, culinary innovation, and populism at
play in this turn-around in umami thought. A Gen-X American of Korean heritage, Chang is now
celebrated as one of the most innovative, charismatic, and successful chef-restaurateurs in the
business. He is vocal in his appreciation of MSG as a viable and delicious addition to his—and
any other—kitchen or dining table. He provides bottles of Maggi sauce (which offers an instant
umami hit courtesy of hydrolyzed vegetable protein) at his noodle bars, an unaffected move
earning him praise for some corners for déclassé authenticity; he has repudiated the xenophobic
roots of the “Chinese Restaurant Syndrome” and “unscientific” demonization of MSG in the
United States; and as I mentioned in the introduction, he has been the professedly stunned and
gratified recipient of glowing official thanks for his advocacy from Ajinomoto’s public relations
arm. What Chang’s public endorsement of MSG overlooks is that, even though the additive’s
history was forged in Japanese nationalistic ambition and tempered by mid-century fears of

culinary history, native flora, the relationship between food and food supply systems, sustainability and the social
significance of how we eat… We wanted to organise the culinary analogy: an outdoor festival fuelled by a devotion

Speaking with Chang’s then head of research and development, Dan Felder, provided a fascinating glimpse into
a small circle of young, innovative chefs striving for a fresh and authentic frontier, a new edge to work against in
culinary invention. In his vision for the future of the research lab—and momofuku’s commercial empire—Felder
revealed a subconscious lament for a site of origination, the authenticity that enables true novelty: in cultivating
native Manhattan yeast and bacteria to make delicious condiments. Without irony, Chang and Felder have described
these explorations as being informed by the 2,000-year old tradition of artisanal miso producers in Japan and by
microbiologists at Harvard University. Leading science and the ‘Ancient East’ are thus married in the Momofuku
lab, their progeny an unknown horizon of future fermented deliciousness. Chang and Tejedor, “Microbes, Misos,

‘foreign’ incursions into the integrity of the American body, MSG is about so much more than the alternate threat or fetish of Asian foods in America—it is about people lacking the vocabulary to question whether they are eating for a ‘fix’ or to be fed. Molecular theories of umami for pleasure, or as I develop in my Conclusion, umami for health (in lieu of salt, sugar, or fat), go down easier than molecular theories of harm, for example metabolic syndrome, or endocrine disruption, or microbiota-depletion. This is particularly the case when such ideas are propelled by the public relations engines of billion dollar companies whose profit margins swell and shrink in the mythical space of nation, place, and wellness.

To that point, the originator and largest world producer of MSG, Ajinomoto Inc. recently expanded its biomedical products share. The Japanese company’s April 2013 $175 million purchase of privately held San Diego biotechnology company, Althea Technologies Inc., has created Ajinomoto Althea Inc., cited as an early strategic step in Ajinomoto’s plans to expand its biopharmaceutical presence in the North American and Asian markets, reaching an annual biomedical revenue of $320 million by 2020. Ajinomoto’s acquisition of Althea’s contractual relationships with over one hundred pharmaceutical companies in San Diego and around the world, working in protein and drug development clinical trial design, was the source of “significant value,” according to Hiroshi Shiragami, co-chairman and managing director of Ajinomoto. At the gala reception celebrating the merger in La Jolla, U.S. Rep. Scott Peters praised Ajinomoto’s contribution of “more high-wage, high-skill jobs for San Diego.” Ajinomoto’s roots were avowedly in the business of engineering food taste for increased health; it is clear that the company sees its future in the value of food ingredients as a

\[464\] These are prominent sites of research - conducted within the molecular turn and in the early twenty-first century – into potential detrimental health effects of consumer capitalist society, from industrial pollution to plastics to food preservatives.
pharmacologically- or bio-active. None deterred by challenges to understanding the brain’s complexity, the company clearly sees its growth potential not in producing new or better foodstuffs, but in acquiring better understanding of how bodies can be made to eat.

**Conclusion**

In this chapter I have framed umami’s scientific and lay validation in the twenty-first century within a wider molecularization of eating, and I have sketched the ethical frontier that additive umami compounds present. Consciously scrambling sensory response at the neurological level presents health stakes not usually associated by the everyday consumer with questions about food—that is, about how their foods are produced and regulated. Flavour enhancing technologies like MSG engineer neurological responsivity with the explicit aim of influencing future consumer behaviour. This capacity brings them into comparison—by logic, if not by degree—with behaviour-modifying drugs commonly known and regulated as pharmacological agents (like SSRIs). If additive umami tastants—termed elsewhere in this project as additive glutamates—act more like ‘drugs’ in this sense, they point to the political and capital value of the ambiguity between our categories of ‘food’ and ‘drug’ and ‘toxin.’ Monosodium glutamate illustrates the profound inadequacy of these ontological categories for questions of public health. What does the rematerialization of umami foreclose? It frustrates the ideal of informed consent or, more broadly, critical discussion of the ethical question of reverse-engineering the embodied experience of delicious flavour. In an undoubted majority of instances, eaters are not aware of the flavour enhancers they are consuming. And for the variably food-literate communities within that eating population, the validation of umami occludes critical

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discussion by way of the seduction that is *participation in flavour as technique*. Learning how to seek out and foster umami or deliciousness is a self-actualizing, aspirational project through which the chef and the foodie are brought on board, into compliance, with the corporate imperative of engineering our taste responsivity, because it is intellectually and physically gratifying. Additive glutamate-enhanced foods are delicious. A reverse-engineering of eating translates into molecular precision in food development and marketing, or a new instrument in the toolbox of companies whose work is to create demand for their products: a tactic companies seem confident will pay off.

Over a century ago, Ikeda’s avowed mission with MSG was to make foods taste better so that more people would enjoy eating what was healthy. This remains one stated endeavour of companies (glutamate producers and users) sponsoring research in the quest for new food technologies. However, such technologies are specific in their operation, which is not make consumers healthier, but to make them happier about what they are eating. The engineering at work in additive MSG, insinuate, and guanylate is not just reductive food functionalism (eat protein for sustained energy, avoid ‘empty’ calories). Its effect is to increase the palatability of foods whether or not those foods are otherwise assessed to be healthful. MSG does not pause to ask after other ingredients’ nutritional value or provenance (no matter how these factors interface with MSG’s metabolism). It is for this reason that the expert and popular embrace of umami as a fifth taste sensation is so fascinating and so relevant; the rise of umami signals how naturalized sensory technologies (since all food is molecular, anyway) are put to work to *increase value to consumer products tout court*. As I traced in chapter three, not all sources of umami taste are metabolically equivalent. And additive umami tastants and the products whose flavour they amplify are mass-produced in accordance with the whims of raw ingredient supply, competitive
pressures, and corporate marketing criteria even as they are consumed as part of a seeming exercise of free choice and personal taste. In sum, the molecularization of food development and eating not only promises increased accessibility to delicious flavours; it increases the accessibility of the diner to processed foods manufacturers. This goes beyond socioeconomic profiling, tracking one’s internet history or deploying focus group input, beyond channelling affect in marketing to incite a purchase decision. It is an intensification of applied sensory research, a direct neurological intervention pursued because it has immeasurably vast economic value. And since the pursuit of gustatory pleasure is largely experienced by consumers not as a bodily violation, but as a function of choice and affluence, too few people are worried about a downside to making more foods more delicious.
Men who will come after us will know much more than we of this subject, and it cannot be disputed that it is chemistry which will reveal the causes or the basic elements of taste.

(Meditation ii): "But for the odour which is felt in the back of the mouth, the sensation of taste would be but obtuse and imperfect."

~ Jean Anthelme Brillat-Savarin (1825)

"Trust me: we know so little about flavor."

~ Dan Barber

Introduction

In 1825 French aristocrat, food philosopher, and founder of gastronomic writing, Jean Anthelme Brillat-Savarin published his magnum opus, The Physiology of Taste: Or Meditations on Transcendental Gastronomy, without reference to which any present-day rumination on food, gastronomy, or cuisine is incomplete. In this famous text, Brillat-Savarin does making things, among which is a curious and as-yet unsung contribution to historical ontology of deliciousness I trace in this project. He invents the term “osmazome” to describe that quality “which gives all the value to good soups ... makes the savory red tinge in sauces and the crisp coating on meat.” In other words, Brillat-Savarin provides an alternate ontology of savoury delicious taste, or

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468 Stephen Mennell, All Manners of Food: Eating and Manners in France and England from the Middle Ages to the Present (Champaign, IL: University of Illinois Press, 1996), 267.
umami. This neologism was necessary because there was no French word to describe the taste he was thinking of, nor was there an established epistemological mode for investigating the parameters of this quality of prepared foods—or the hedonic experience of eating them. Brillat-Savarin is a telling point of entry for this chapter’s treatment of the chemosenses within modern science, American culture, and global biocapitalisms. By the chemosenses of eating, I mean the science of taste and smell as they have been elaborated over the twentieth century and in close collaboration with the food and flavour manufacturers to whom such research is so valuable. Brillat-Savarin’s work helped to inaugurate the modern problem of the chemosenses of eating not only by drawing on physiological science, but also through his focus on food as a key site of pleasure.

Brillat-Savarin’s work has had such currency since its translation into English by culinary legend M. F. K. Fisher in 1949—and particularly in recent years—because his simultaneously celebratory and prescriptive philosophy of eating anticipated those metamodern foodie subjectivities (discussed in the Introduction) proliferating in the U.S. since roughly the end of the twenty-first century. Brillat-Savarin did not write about the art of taste. He wrote as a cosmopolitan polygot and epicure in the language of the leading science of his day; he wrote about the physiology of taste as his referencing authority for a universal programme for living well. His hedonistic read on the world hinged upon knowledgably cultivating, and then savouring, the pleasure latent within the necessary process of eating. One of the most fascinating things he did was to materialize some of the key areas of focus of sensory researchers and food technologies today. Specifically, dimensions of eating like ‘finish’ and ‘mouthfulness’ have been discussed as key benefits conferred by additive glutamates like MSG. He writes:

Taste is simple in its action, which is to say that it cannot receive impressions from two flavors at once…But taste can be double, and even multiple, in succession, so that in a single mouthful a second and sometimes a third sensation can be realized; they fade
gradually, and are called aftertaste, perfume, or aroma...Men who eat quickly and without thought do not perceive the taste impressions on this second level.\textsuperscript{470}

As I discussed in chapter two, MSG was so valuable to food producers because it was found to be an instant means of extending the spatial (mouth-feel) and temporal (finish) impacts of the food it accompanied. Additive glutamates were a magic bullet route to the modern, affluent eating anticipated by Brillat-Savarin: the expansive, deliberative privilege of eating for pleasure. By the twenty-first century, this privilege exceeds selective choice to increasingly include a participatory engagement with, or an emotional investment in, the molecular science behind those delicious choices.

The history of monosodium glutamate, the flavour enhancer, necessarily evokes the long-standing scholarly dyad of taste as either sensibility or physiology. This dichotomy is often traced back to Pierre Bourdieu’s \textit{Distinction} (1984) and Roland Barthes’ \textit{Mythologies} (1957) and can be followed through the precursor disciplines of food studies—agricultural history and culinary history. In such fields, scholars have, for reasons of clarity or convention, separated food production and food consumption, gustatory taste and aesthetic taste, the material and the cultural.\textsuperscript{471} The idea was that we were either talking about taste as a dimension of class or cultural capital, or we were talking about taste as a visceral, embodied experience. Pioneering work in sensory studies by scholars like philosopher Carolyn Korsmeyer and historian Priscilla Parkhurst Ferguson has established how Greco-Roman philosophers and classics scholars in Europe (and later, the United States) assembled taste, smell and touch as the vulgar ‘lower


senses,’ and privileged vision and audition as the superior senses associated with rational inquiry and reflection. Ferguson argues that the rise of aesthetics in the eighteenth century had the effect of “dissociating taste from bodily functions and associating it instead with reason and refinement”—relocating “the site of taste from the body to the mind.” The seed was thus planted for taste to become a newly powerful arbiter of social hierarchy. This elevation of taste is key to my discussion here and in chapter four. Within bourgeois society, taste “whether innate or acquired” came to be synonymous with “good taste,” and it coded for the superiority of an individual or a “taste public,” also known to Ferguson as cultural consumers: a group united by their shared preference for a cultural product. Scholars like Korsmeyer, David Howes, and Constance Classen have contributed to a growing humanities and social sciences conversation around what they have called a ‘sensory revolution’ in the human sciences (supplanting the linguistic and pictorial turns) to complicate the hegemony of vision and privileging of discourse in cultural theory. Monosodium glutamate is particularly significant to historians of taste because it has been used ubiquitously in taste research as a stand-in for umami or savoury sensation overall: it is inexpensive, chemically stable, and the most efficient route of eliciting a savoury taste response. So, MSG has been instrumental to establishing both the scientific basis of

In this chapter I expand our knowledge of the ‘sensual revolution’ (dating roughly from the 1970s onward) through a reading of select technical literature in the chemical senses or chemosenses: smell and taste. I engage this body of research to theorize the hedonic experience of deliciousness as an affective product of molecular breakdown—or the phenomenon of delicious (molecular) destruction I put forward in the introduction of this dissertation. Delicious destruction can be understood as a part of what is elaborated by scientists as metabolism: the chemical reactions that keep organisms and the cells comprising those organisms alive. This chapter is thus a critical historical account of how chemosensory scientists have researched, and enabled the commercialization of, intensified deliciousness through removing foods from the raw state—by assembling food products in a molecular jigsaw puzzle for maximal portability, non-perishability, and (hedonic) desirability. I call this practice the creative destruction of chemosensory eating with global biocapital. Food technologies like additive glutamates and the 5’-ribonucleotides provide a fast track to this increased flavour through breakdown, offering the rationality and reliability so necessary to industrial processes. Importantly, creative destruction, then, also names the production of value by flavour enhancing additives like MSG. Industrial fermentation, for example, captures the biovalue of microbial fermentation; adding MSG and other flavour enhancers to foods generates value through its stimulation of human sensory and

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476 In chemosensory research, salty taste is tested with sodium chloride and sweetness with sucrose.

affective response. Creative destruction generates value through a proliferation of food products and the pleasure conferred by eating that product. Pleasure is an associative value researchers (from chefs to taste psychophysicists) and marketers are employed to seek out. This capacity to create experiences of deliciousness, then, becomes an attribute of commodities, a purposeful choreography of chemosenses in bodies and molecular effects within manufactured food so as to produce value for capital.

Delicious destruction may be a property of edible matter stemming back millennia—as some of the scientists soon to be discussed believe. However, what this chapter traces is how delicious destruction has been made possible, practicable, and valuated as a biocapitalist formation. From a technical standpoint, over the last twenty-odd years molecular techniques of mapping chemosensation (the chemical senses of taste and smell) have been woven into a universalizing, evolutionary biology explanation for human eating behaviour. Umami taste has come to be understood by current experts as that elicited by many amino acids, but particularly by the most common one, L-glutamate, a cleavage product of all proteins. L-glutamate circulates when proteins are broken down by the action of enzymes (for instance, by the enzymes produced by microbes we ferment in culture). This technical research literature typically explores subjective yet standardized metrics like food ‘acceptability’ and ‘palatability’ to gauge the desirability of a foodstuff. In effect, these measures represent an effort by sensory researchers, whose studies presuppose and are supported by the industrial food system, to measure the capacity for a food product to produce pleasure in the consumer. Feelings of pleasure bleed into happiness, which is invaluable within global capitalisms because it is a predictor of patterned (repeat) and thus predictable future consumer behaviour. The most recent multisensory research ontologizes eating as an effect of both ‘higher’ cognition and sensory mechanisms. That means memory, cultural mores, socialized associations of desirability or undesirability, pleasure and disgust are being
interrogated on a molecular level. What we think impacts what we ‘taste.’ I do not suggest anything as blunt as conscious control of flavour perception. Instead I submit, in an evocation of recent work by Sara Shostak and Hannah Landecker, that the sensory is affective is molecular is political. In the simplest of terms, this means a significant thrust of cutting-edge chemosensory research (the molecular) has been conducted in train with corporate food and beverage research and development. Our most authoritative knowledge of how taste and smell work (the sensory) has been oriented toward figuring out what chemical compounds humans register as pleasurable (the affective), and thus what food products humans will be willing to buy (the political).

**Delicious and Creative Destruction**

The guiding logic of early twentieth-century state nutritional campaigns may be characterized as the belief that full stomachs made productive citizens. The twenty-first century has made us wiser. Discussions of food ‘acceptability’ and ‘palatability’ have populated trade journals of food science and technology for years; however, since the turn of the twentieth century, molecular technique has evolved to make the science of taste engineering more available and sophisticated than ever before. I would venture that if there is anything universal to humanity, it is the power of formative flavours to forge individual and group identity, to confer


pleasure, and to provide consolation for life’s many injustices and indignities. In these late days of modernity, we seem to have realized that happy palates help make happy citizens.⁴⁸⁰

What does pleasure and happiness have to do with cellular breakdown? Considering the Maillard effect and caramelization alongside the history of industrial, my guiding questions about delicious destruction for this chapter are: why do things that are broken down chemically taste better to us? The second: what is at stake in the biocapitalist enrolment of delicious destruction? The concept of creative destruction has a specific history of use in economics and political economy, on both the political left and right. Marx wrote about annihilation or destruction (in the German, vernichtung), or the phenomenon by which he saw capitalism dismantle previous economic orders and assemble itself in their wake. He wrote that capitalism operates by necessarily devaluing existing resources (anything deemed by a society to be of value) in order to make possible the creation of new wealth, for example though war, dereliction, and regular or episodic economic crises.⁴⁸¹ German Marxist sociologist Werner Sombart has been credited with first use of the term “creative destruction” in 1913’s (Krieg und Kapitalismus (“War and Capitalism”), and Joseph Schumpeter, an early twentieth-century Austrian-American economist, saw “creative destruction” as integral to capitalism: a process in which new technologies and products incessantly destroyed and refreshed economic structures. In other words, new economic structures relentlessly dismantled the ones that came before in a dynamic


that Schumpeter saw as both the heart of capitalism’s success and the source of its demise. Creative destruction is useful for illuminating food development within biocapitalism because, in very basic terms, food development and production on an industrial scale is premised entirely upon breaking edible matter down into an array of more or less simple molecular components (think of all the mono- and di-‘s, poly-‘s and malto-‘s and oligo-‘s on food labels), and recombining them for greater utility in the goal of manufacturing more shelf-stable and delicious-tasting food products more people will want to buy. As other historians have suggested, the modern food industry could not exist without the flavour industry—and, as I suggest, without flavour enhancing technologies that expedite and amplify the deliciousness edible matter delivered in novel, simplified, and expertly calibrated forms.

The connection between molecular breakdown and deliciousness stretches back from Aristotle (c. 384-322 BCE) to early empiricist Roger Bacon (1214-1284), through the post-Aristotelian cosmology of itinerant, German physician/rebel Paracelsus (1493-1541), through late-nineteenth century Parisian chef Auguste Escoffier (1846-1935) and his cookbook dedicated to veal stock—and all the way to umami’s creator, Kikunae Ikeda, whose attachment to

482 Joseph Schumpeter, *Capitalism, Socialism and Democracy* (New York: Harper & Bros, 1942). In Milton Friedman, 1976 Nobel prize-wining conservative economist and leader of the Chicago school of monetary economics, naturalized this destructive character of capitalism, theorizing that economic change never occurs without a crisis to shock the system into said change, whether natural, induced, or perceived (war, terror threat). Finally, Naomi Klein’s *The Shock Doctrine: The Rise of Disaster Capitalism* (New York: Metropolitan Books, 2007) popularizes this insight in the context of the neo-imperialism of the twenty-first century. “Global instability,” she writes, “does not just benefit a small group of arms dealers; it generates huge profits for the high-tech-homeland security sector, for heavy construction, for private health-care companies, for the oil and gas sectors – and, of course, for defense contractors.”


484 Escoffier was the owner of the city’s most glamorous, expensive, and innovative bourgeois restaurant—no private aristocratic patron for Escoffier. In his 1907 cookbook, *A Guide to Modern Cookery*, Escoffier codifies recipes that elevate the value of a newly perfected flavour base: veal stock. August Escoffier, *A Guide to Modern...*
glutamate-rich *dashi* stock opened this dissertation.\textsuperscript{485} Michael Pollan even made it the focus of his most recent book, *Cooked: A Natural History of Transformation* (2013).\textsuperscript{486}

Many forms of managed chemical breakdown—whether fermentation, preservation, or cooking—have been associated with greater flavour perception for the eater. For example, few people would choose a raw side of beef over a seared steak, raw potatoes over French fries, a stalk of wheat over fresh bread, cabbage over sauerkraut or kimchi, raw soybean over tofu or miso, raw hops over beer. Since the late-nineteenth century, chefs have identified the production of flavour via the *Maillard effect*, named after Louis-Camille Maillard (1878–1936), French physician and chemist, or the phenomenon in which foods realize a more complex, rich flavour when amino acids and sugars are heated (250 degrees Fahrenheit if searing meat or toasting bread; cooler when brewing beer, aging balsamic vinegar, braising a roast, reducing stock, etc.). This was related to a similar process called caramelization, which occurs at 240 degrees F for fructose, 338 degrees F for sucrose/table sugar; today this process is known as the oxidative breakdown (non-enzymatic browning reaction) of carbohydrates such as sugar, and is a process used extensively for the nutty flavour and brown colour it generates. I cannot possibly treat the entirety of this fascinating topic. Excellent histories bridging science and technology studies and

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food studies have been written in recent years for some of the recent examples of refurbished artisanal fermentation techniques, such as New England’s raw cheese activists.\textsuperscript{487} I offer delicious destruction as a provocation for all of us interested in the biocapitalist formations within contemporary American foodways—for thinking about the stakes of the applied knowledge generated by chemosensory researchers into how to rationalize a historical, craft practices of breaking down macronutrients through cooking or fermentation to make them longer-lasting, more healthy, and more delicious.

One early contributor to this lore was the sixteenth century alchemist-with-a-medical bent, Jean Beguin (ca. 1550-1620). Beguin investigated digestion as an “operation in which things are \textit{cooked} by means of a digestive fire.” He defined fermentation as “an exaltation of a thing in its substance; by \textit{means of digestion} the active heat surpasses and changes the nature of what is passive” [emphasis added]. Beguin’s work is widely considered to have been foundational to the later establishment of the modern field of chemistry. For our purposes, he forms part of a long genealogy of scientific thought in which digestion, fermentation, and cooking were viewed as analogous processes. Historian of science and food Rachel Laudan argues that in the seventeenth century a critical mass of physicians—and then chefs—began to embrace a modern, Protestant cosmology of diet and wellness in favour of the humoural theory of Antiquity.\textsuperscript{488} The shift in cosmology might be distilled down to a revision in the concept of

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\item A schematized version of the genealogy she traces looks like: Hippocrates – Aristotle – Dioscorides – Galen - Arab translators like Avicenna – thirteenth-century School of Salerno in southern Italy - fifteenth century Humanists resurrecting the Greek and Latin classics = the basis of the medical theory – including dietary philosophies – taught in the major medical schools of early modern Bologna, Montpellier, and Paris. I am indebted to Rachel Laudan for her interpretation of the legacies of classical, medieval, and Renaissance medicine and dietetics for modern (read: \end{enumerate}
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the animating force sustaining all matter (minerals, plants, animals, and humans): from cooking (coction) to fermentation. Prominent scholars across Europe, such as Johannes Baptista van Helmont, Sylvius de la Boë, Thomas Willis, and John Arbuthnot (Royal Society members and often physicians to sitting monarchs)—figures who often described themselves as iatrochemists, but whom Laudan simply calls chemical physicians—saw baking, brewing, and putrefaction as one and the same process. Cooking was fermentation, and as a chef, you had to be seen by your wealthy patron to get it right. Cooking foods well was a “kind of chemistry”—an act that had the power to ease a person’s digestion, or not, because cooking was in effect a process of pre-digestion.

In chapter four I describe the popularization of a molecular ontology of eating in the United States between the 1990s-2010s, a shift that redefined cuisine as a multisensory phenomenon upon which the chef can improve and the gastronome can meditate in precise, shared terms. The animating force was emotional (passion for eating delicious foods), the politics were progressive (liberal, eco-criticism directed at big industry), and the language was scientific (aromatics, mouthfeel, caramelization, umami, high notes, and finishes). The question of delicious destruction is situated within this wider trend of recasting food in terms of its

French) cuisine—and by extension, the chimera we call American cuisine. Laudan argues (1999, 2013) that the emergence of French cuisine in the seventeenth century is connected to a paradigm shift in medical opinion. For example, the fact that green vegetables, mushrooms, and fruits putrefied (spoiled) quickly had condemned them as unwholesome in the humoural cosmology; in the new cuisine, this observation elevated them, as it meant they were readily digestible and did not require much pre-digestion or cooking. Hence culinary historians’ observation of the rise of fresh salads and fruits within the new, modern cuisine, perhaps best exemplified in Pierre La Varenne’s Le Cuisinier François (1651). Laudan, “A Kind of Chemistry, 16. For other accounts of the emergence of modern cuisine, see Priscilla Parkhurst Ferguson, Accounting for Taste: The Triumph of French Cuisine (Chicago: University of Chicago Press, 2004) and Vanina Leschziner, “Epistemic Foundations of Cuisine: A Socio-Cognitive Study of the Configuration of Cuisine in Historical Perspective” Theory and Society 35 (4) August 2006: 421-443.
molecular components, and it is in this context that I characterize flavour enhancers like MSG on a continuum with other fermentation products as biocapitalist technologies for expanding the boundaries of what people will enjoy eating. The expansion of chemosensory research since the 1970s, and particularly since the 1990s, strove to elucidate the precise mechanisms by which people taste delicious what they eat—and always with an eye to applying that knowledge to commercial produces. The research question driving chemosensory research was how taste and smell worked; however, frequently the goal was how to optimize the pleasure and satisfaction a consumer could be made to experience through eating. It is this dynamic I seek to name with the equation: the sensory is affective is molecular is political.

The Sensory is Molecular

Taste has long been discussed by scholars of the senses as not only a multi-faceted experience of aroma, flavour, texture, and temperature, but also as a complex process that is experienced differently in different places and times by different people. Greek scholar of antiquity Democritus (ca. 460-370 BC) wrote that the human sensory apparatus consisted of four taste dimensions: sweet, sour, salty, and bitter. He theorized that each taste sensation was a reflection of sweet, sour, salty, or bitter-tasting matter, each consisting of distinct atomic shapes. Sweet tasting substances were made up of round and large particles; salty of isosceles triangles; bitter of spherical, smooth, scalene and small bits; and sour of large, rough, and angular

atoms. While other quantifications of taste have been documented, such as Aristotle’s two-part sweet versus savoury dichotomy or Qing commentators’ six-nine taste pantheon, the four-taste system was endorsed by European scholars up through to the microscope’s revelation of human taste buds, which to nineteenth century researchers seemed to resemble little keyholes—adapted to accept differently shaped food particles.

As some of umami’s advocates would declare around the turn of the twentieth century, for centuries philosophers and, later, scientists retained the time-honoured hypothesis of four taste sensations: sweet, salty, bitter, and sour. In 1916, a German psychologist named Hans Henning famously devised a "taste tetrahedron" with those four Classical tastes he believed ‘primary’ at the four vertices. Laboratory experiments involving tongue swabs of blindfolded, nose-plugged subjects confirmed that the only things most tasters could consistently identify were sour, salty, sweet, and bitter. Another influential ontology of taste is the infamously reductive “tongue map.” This was a spatial rendering of the taste functionality of the tongue, in which those four basic tastes were localized to different areas of the tongue—sweet at the tip, sour at the edges, etc. This schema was popularized by Harvard experimental psychologist Edwin G. Boring in the 1940s and has been thoroughly debunked since at least the early 1990s—with early evidence for a more complicated tongue emerging in the 1970s, in which the

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493 Published first in the *Zeitschrift für Psychologie*, and later as Hans Henning, *Der Geruch* (Leipzig: Barth, 1916).

494 Henning, *Der Geruch*. 
chemosenses experienced a revival of research interest and investment. “[The tongue map is] just hokum,” said Jeannine Delwiche, senior sensory and psychophysics scientist at Firmenich, the world’s largest private fragrance and flavour company, in a 2008 interview with Gourmet magazine. “You can taste everything everywhere.”

Some contemporary sensory researchers go so far as to question the very premise of a “basic taste.” Michael O’Mahony, a sensory scientist at the University of California, Davis, states: “There are no basic tastes… The notion was arbitrary.” He elaborates in answer to his own rhetorical question of, what is a basic taste?

Well, there are more than four types of taste receptors, so it can’t be that. There are more than four ways a chemical can react with a receptor. There are more than four types of neural codes those receptors can send to the brain. Lots of scientists felt they had to describe tastes using one of the four categories. It’s silly.

Another researcher confidently asserts that the number of tastes, as measured by their chemically-specific taste receptor mechanisms, is much larger than commonly thought—possibly around forty, according to Terry Acree of Cornell, while the number of olfaction receptors is much higher, at around three hundred. At least half of those theorized taste mechanisms are specific to the detection of bitter tastes. The wisdom supported by a growing toolkit of molecular techniques, including fMRI tests and the sequencing of the human genome, is that humans likely


497 Feiler, “The Corrections.”

498 Feiler, “The Corrections.”
have distinct mechanisms for perceiving metallic, alkaline, fatty acid, and carbohydrate-specific
tastes. A distinct fatty taste is now understood to operate at the intersection of somatosensory and
gustatory perception. Previously, dietary fats were thought to be recognised by diners simply by
their texture (somatosensory); recently, however, researchers, have moved toward recognizing
fatty taste as another basic taste quality, since it is conferred by the detection of fatty acids by
specific membrane receptors on taste bud cells.\textsuperscript{499} A preference for high-fat food is argued by
some to be a universal human trait, due to its contribution of aroma, mouthfeel, and texture).\textsuperscript{500}

Similarly, in 2014, New Zealand-based researchers published findings of a double-blind
study establishing a carbohydrate-specific nutrient signalling mechanism in humans (afferent
nerve transduction)—that is, we may have a taste just for carbs. Using fMRI tests and mean
blood-oxygen-levels, they witnessed increased activity in the primary taste cortex, regions
involved in visual perception, and limbic reward systems as indication of the sensation of
carbohydrate sources positive effect on corticomotor output or performance. In other words, this
study supports not only this author’s anecdotal observation, but also behavioural studies (e.g.
Jeukendrup & Chambers, 2010) that suggest something profound: not just ingesting—but
tasting—carbs makes you do stuff better.\textsuperscript{501}

\textsuperscript{499} Nirupa Chaudhari and Stephen D. Roper, “The Cell Biology of Taste,” Journal of Cell Biology 190(3) 2010:
286 (285-296); T.A. Gilbertson, L. Liu, I. Kim, C.A. Burks, D.R. Hansen, “Fatty Acid Responses in Taste Cells
from Obesity-Prone and –Resistant Rats,” \textit{Physiology and Behaviour} 86 2005: 681-690; T. Kawai and T. Fushiki,
“Importance of Lipolysis in Oral Cavity for Orosensory Detection of Fat,” \textit{American Journal of Physiology –

\textsuperscript{500} A. Drewnowski, “Why Do We Like Fat?” \textit{Journal of the American Dietetic Association} 97(Supplement 7) 1997:
389-414.

\textsuperscript{501} Clare E. Turner, Winston D. Byblow, Cathy M. Stinear, Nicholas Gant, “Carbohydrate in the Mouth Enhances
Activation of Brain Circuitry Involved in Motor Performance and Sensory Perception,” \textit{Appetite} 80 (2014): 212-
219.
Chemosensory researchers have yet to authoritatively acknowledge these other potential tastes and enshrine them in scientific convention. Some scientists attribute a lag in taste and smell research uptake to a historically disproportionate emphasis on vision and audition in sensory research. Cornell psychologist Jeannine Delwiche has publically estimated that, for every one hundred people studying vision, there are ten studying audition and one studying taste or smell.\(^{502}\) Once again I will draw on the incisive reading of science studies scholar Hannah Landecker, who wrote in 2013 of model or experimental organisms: “We know next-to-nothing – because we have thought next-to-nothing – about how they have been fed and housed [my emphasis].”\(^{503}\) Our scientific facts follow directly in the wake of not only long-standing social biases and values, but also the funding trails of research investment. Scientists only “know” the basic tastes whose molecular mechanisms state or private bodies have invested significant time and money into establishing within clinical trial. This renders the ‘five basic taste’ paradigm within which umami is marketed and categorized a working fiction if not an outright myth.

So, how are the chemical senses of smell and taste thought to work? Chemosensory researchers identify many distinct mechanisms at work in the sensory experience we refer to in colloquial English as “tasting.” The “taste,” then, of our morning cereal is considered scientifically to be an effect of three interconnecting sensory phenomena: taste, smell, and touch. Tastes are understood as sensations caused by chemical compounds (whether sugars, salts, acids, or alkaloids), which sensory scientists call tastants. These compounds dissolve in our saliva and encounter chemical-sensing sites on the taste buds on our tongues and elsewhere in our mouths and, as is increasingly being discovered, throughout the digestive tract. This sensory mechanism

\(^{502}\) Feiler, “The Corrections.”

is called *gustation*. Smell or *olfaction* is understood as a distinct chemical sense whereby volatilised or vapourised chemicals in our foods called *odorants* waft through our nostrils to the soft palate on the roof of our mouths to activate olfactory receptors at the top of the nasal cavity. Gustation and olfaction are understood to together confer *flavour*. Most experts also agree that flavour is also complemented by a third sensory dimension: the stimulation of the trigeminal nerve endings in our oral and nasal cavities by, for example, the pungency of garlic, the heat of chillies, the cool of alcohol or menthol, and even food textures, for instance the crunch of a cracker or the tingle of sparkling wines. In the last fifteen or so years, such *somatosensory* modalities as texture and visual cues like colour have been increasingly studied as important modulators of what we describe as the “taste” of the foods we eat. These are understood to combine with texture and visual cues like colour to greatly influence our perception of how tasty—or not tasty—a given food may be to us.

**The Sensory is Affective**

University of Pennsylvania psychologist and sensory science giant Paul Rozin is attributed with first asserting that the perceived taste of foods—tasty, neutral, disgusting—cannot

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be separated from questions of emotion and culture. More recently, neurobiologist Gordon Shepherd has popularized the theory that metaphorical ‘flavour images’ are created in the brain through chemosensory systems that are fundamentally mediated by affective memories of past sensory experiences.

Fascinating research over the last ten years and relying on cognitive fMRI tests has explored the effects of cognitive bias on perceived tastes in clinical study. For example, prominent glutamate researcher and industry collaborator J.D. Fernstrom stated in 2012 that “cortical responses are further enhanced when umami and nucleotides are paired with consonant smells (for example, vegetable) and diminished when subjects are told they are tasting MSG (thus showing cognitive bias at the cellular level) [my emphasis].” In other words, feelings, values and perceptions based on past experience moderate chemosensory perception in ways and to degrees researchers are still exploring.

There are typically tens to hundreds of different aromatic or volatile (airborne) compounds that contribute to the flavour of even a single food ingredient, let alone a whole dish. There are a variety of external sensory stimuli (registered as taste, smell, temperature, texture, astringency, creaminess, colour and other visual cues, and sound) that combine with


internal states, namely the emotion, motivation, and craving circuits in the brain that impact flavour perception, which are in turn related to language, consciousness, and memory circuits. Numerous studies explore the impact on culturally specific ontologies of sensation and nature upon taste perceptions. Anthropologist Diana Young of the University of Queensland in Australia, for example, studied the culture of Western Australia’s Pitjantjatjara people and has observed that they associate the smell of rain with the color green, hinting at the deep-seated link between a season’s first rain and the expectation of growth and associated game animals, both crucial for their diet. She calls this “cultural synesthesia”—the blending of different sensory experiences on a society-wide scale due to evolutionary history. Culturally specific values and ideas are registered on a neurological level in the orbitofrontal cortex (reward centre) of the brain, which some studies document are activated by not only pleasant tastes and odours but also abstract rewards like money. Researchers localize aversive verses pleasant (subjective designations, obviously) smells and tastes in distinct parts of the cortex, along with what they


term “motivationally relevant affective stimuli including pleasant touch.” This is combined in discussions with evidence from animal studies that taste is involved in a range of motivationally oriented unconditioned behaviors and emotional learning. The anterior (pleasant tastes) and ventral cingulate cortex in humans seems to be involved in the pathology of depression in humans, the regulation of normal mood, and emotional response. Other affective stimuli have been shown to activate nearby parts of the anterior cingulate cortex of the brain, with evidence tracking chemical tastants in foods to the phenomenon of sensory-specific satiety (I’m tired of lasagna; I want pie), as enacted in orbitofrontal cortex taste neurons. So, chemosensation is also extensive and variable into space and time.

A few examples will help clarify how MSG, a biocapitalist technology of flavour enhancement, has been roped to ancient evolutionary pressures and classical flavouring techniques since the chemosensory renaissance or ‘sensory revolution’ of the 1970s. First, taste has come to be currently understood as exhibiting a spatiotemporality, in which there are observable individual and circumstantial variations whose range is said to be universally consistent. So, there is a measurable range of normal in taste. First, foods have to be masticated (chewed) in order for their tastants to be dissolved (solutes, per the chemists) in your saliva (the


solvent, which contains water). These dissolved chemicals stimulate thousands of taste buds distributed throughout the tongue, mouth, and throat. Different areas of the mouth possess different gradations of taste-specific sensitivity. The sensitivities to umami in the form of MSG, IMP and their mixture have been noted to be high on the root area of the tongue; however, subjects reportedly can sense umami over a much wider area of the tongue than just the root, and also reported perceiving it in the middle of the tongue, where there are not known to be any taste receptors, a disparity explained in part by illusion or touch. This broad distribution of umami receptors might conceivably explain some reports of the spatial effects of the umami taste such as “broad development,” “mouth fullness” and “mildness.” Umami tastants are particular in their observed longer finish than salty or sour tastants—this is one reason for MSG’s tremendous value to food developers. It extends the hedonic impact of a food product, conferring a lingering delicious taste.

In 1982, Paul Rozin famously distinguished experimentally between retronasal (breathing in through your nose) and orthonasal (breathing out through your nose) smell. In these subjects trained to recognize smells through sniffing struggled to recognize them when introduced in the back of the mouth. The importance of this was realizing that what we smell while simultaneously breathing and chewing our food has a significant impact on the perceived flavour of that food.

Another sensory science leader, psychophysicist Linda Bartoshuk’s (now University of Florida) assembled a vocabulary for innate as well as acquired physiological taste capacities. Through the 1990s, she schematized individual variations in taste acuity in accordance with tastebud density, correlating with people she termed ‘supertasters,’ tasters,’ and ‘nontasters.’ While these hard

categories have since given way to yet still greater nuance, her intervention was important to
debunking the subjective 10-point scale index used in sensory and consumer research to
quantifiably index pain and pleasure. Bartoshuk argues the scale is easy to use but impossible to
make commensurate; how to know whether one person’s “3” is the same as another’s? The
lasting impact of the differential taster theory was to elaborate an ontology of variable taste
acuity and intensity across populations, which translates into commercially significant
differences in consumer food preferences—for example, how high to pitch the taste amplitude of
the new chip flavour so as to appeal to the greatest number of people within the product’s target
demographic (18-24 year old males).

Other researchers have studied tastants through what they call “time-intensity tracking.” Time-intensity tracking experiments of MSG, IMP, NaCl and tartaric acid in the 1990s looked at
the effects of expectorating after exposure to a taste solution. The sour taste of tartaric acid
decreased rapidly after expectoration, as did its residual aftertaste. The saltiness of NaCl left a
somewhat stronger aftertaste than the sourness of tartaric acid. In contrast, the taste intensities of
the umami substances MSG and IMP increased after expectoration. Moreover, the aftertaste of
umami was stronger than that of the other tastes. The same result was obtained when subjects

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518 Bartoshuk is something of a chemosensory bad girl, with her penchant for openly acknowledging not only the
force of corporate influence but also gender politics in scientific research. Interviewed in Science magazine, she says
she abandoned her early interest in astronomy when she learned that “women weren't allowed to use the big
telescopes.” As some consolation, she states: “Psychophysics has a lot in common with astronomy. Like the stars in
a distant galaxy, the minds of other people are ultimately “untouchable.” John Bohannon, “A Taste for Controversy,
Profile: Linda Bartoshuk” Science 328(5985) June 18, 2010: 1471-1473.

519 M. O’Mahony and S. Y. Wong, “Time-intensity Scaling with Judges Trained to Use a Calibrated Scale:

520 Shizuko Yamaguchi and I. Kobori, “Humans and Appreciation of the Umami Taste,” in eds. K. Kurihara, H.
swallowed the solutions.\footnote{Considerable qualitative differences have been reported for the immediate taste and aftertaste after expectoration (at threshold levels) of MSG, IMP and GMP (Horio and Kawamura 1990). The descriptions of the immediate taste quality of the umami substances varied significantly across subjects, but were consistent with regard to aftertaste. Y. Kawamura, “Significance and History of Research on Umami (in Japanese),” in eds. Y. Kawamura, Y. Omura, S. Kimura, and S. Konosu, Umami (Tokyo: Kyoritsu Shuppan, 1993): 1-16.} The duration of pleasurable sensations following a meal or a snack is understood by these researchers to be as an important component of that meal’s “overall enjoyment.”\footnote{Shizuko Yamaguchi and Kumiko Ninomiya, “Umami and Food Palatability,” Journal of Nutrition 130(4) 2000: 921S-926S.} New sensory evaluation studies, published as recently as January 2016, have tracked something they call the temporal dominance of sensations (TDS) or the extension in time of sensory perception. One group of study authors remark: “The sensory properties of food or drink products have been described by TDS; however, basic sensory data on TDS are still lacking [my emphasis].”\footnote{Hiroya Kawasaki, Yuka Sekizaki, Mariko Hirota, Yuki Sekine-Hayakawa, Masahiko Nonaka, “Analysis of binary taste-test interactions of MSG, lactic acid, and NaCl by temporal dominance of sensations,” (Institute for Innovation, Ajinomoto Co., Inc., Japan) Food Quality and Preference 52 (2016): 1.} The technical literature is replete with background context that reveal how powerful product research is driving chemosensory research, and at the expense of advances in basic science—that is, science conducted without an urgent commercial application in view. They analyzed the duration of TDS for umami (monosodium glutamate [MSG]), salty (sodium chloride [NaCl]), and sour (lactic acid) tastes. The duration of the umami taste of MSG was longer than that of MSG/inosine 5-monophosphate solution of equivalent umami taste intensity. The duration of NaCl saltiness was increased with MSG and decreased by coexistence with lactic acid; the duration of the umami taste of MSG was suppressed by NaCl but not by lactic acid; and the duration of the sour taste of lactic acid was suppressed by MSG but not NaCl.\footnote{Kawasaki, et al. “Analysis of Binary Taste-test Interactions,” 1-10.} The pleasure conferred by consuming one molecular compound is moderated—contracted, extended, reduced, amplified—by the other compounds it accompanies, as well as by...
a mood and previous cognitive associations with those ingredients: desirable, undesirable, healthy, or unhealthy. In particular, these streams of research indicate that umami tastants have the effect of overriding tastes that may have negative associations, and extending the experience of pleasure conferred by those tastes coded as pleasant and satisfying.

**The Sensory is Political**

The molecular, or specifically chemosensory, ontology of deliciousness is not still. On the contrary, researchers pursue its elaborations in order to clarify the role of chemosensation in wider metabolic processes. Overwhelmingly, they do this by materializing a particular spatiotemporality of chemosensation—in which umami is especially potent. In the wake of the discredited tongue map, chemosensory researchers describe taste and smell sensation as a shifting, composite phenomenon, in which there are many tastes and smells—some up front, some at the end, several co-mingling, and all of these combining to produce a holistic sensory effect greater than the sum of its parts. Second, they study the wider physiological implications of chemosensory mechanisms throughout the gastrointestinal tract—for example, the connection between sensation and satiety, food intake, digestion, and energy homeostasis. And third, some pull together these two sets of observations to extrapolate a universal, evolutionary biological rationale for human chemosensory capacity. This move illustrates the tendency anthropologist Stefan Helmreich has observed of those active in biocommerce—to “(mis)take” biological potency, broadly conceived, as a “primordial ontology upon which biocapitalism merely elaborates.” In other words, technologies for amplifying and optimally harmonizing those five ‘basic tastes’ are interpreted as benign extensions of an innate or evolutionary human drive to 1)

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register necessary nutrients (or filter out toxins through taste), and 2) cultivate food preparation or preservation techniques—both of which processes are conducted on a hedonic level. Umami in particular has been written into a universalizing evolutionary narrative in which *flavour and nutrition are positively correlated* and situated in a mythology of ancient and universal techniques of food breakdown. Researchers and industry representatives have inserted additive glutamates and ribonucleotides into deep evolutionary time, with the effect of naturalizing biocapitalism’s co-optation of the phenomenon I have been tracing in this chapter as delicious destruction.

What does this look like in the technical literature? The most frequent and far-reaching interpretive framing is to depict taste and smell as sensory modalities that direct organisms to eat nutritious things and avoid poisons, indigestible foods, or spoiled foods. For instance, two of the most influential researchers of umami, including the University of Florida lead author of the studies that officially brought umami into the basic taste canon, stated in 2010:

For humans, this means recognizing and distinguishing sweet, umami, sour, salty, and bitter—the so-called “basic” tastes… There are likely additional qualities such as fatty, metallic, and others that might also be considered basic tastes. Each of these is believed to represent different nutritional or physiological requirements or pose potential dietary hazards. 526

Sweet tastes are our evolutionary signal to consume the carbohydrates that provide us with energy. Salty tastes enable us to regulate our intake of sodium ions and other salts, which have a vital role in regulating our hydration and blood circulation. Umami is theorized to signal a food’s protein content—desirable for muscle building and sustained exertion. Sour taste signals the

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presence of acids, which are often generated in food spoilage; since sourness is generally aversive, this displeasure is thought to prevent us from becoming ill, or otherwise destabilizing our internal acid-base balance. Bitter is considered “innately aversive” and supposedly helps us avoid eating poisons, many of which are known to taste bitter to us. The University of California at Davis sensory researcher Hildegarde Heymann states that the human body can taste faster than it can touch, see, or hear-tasting in as little as 1.5 thousandths of a second, as compared to 2.4 thousandths of a second for touch, and 1.3 hundredths of a second for hearing and vision.

According to the standing director of the Monell Chemical Senses Center in Philadelphia, PA, Gary Beauchamp, “scientists now widely believe that the body was designed to recognize glutamate” … “Just as we crave sweets as a spur to seek out carbohydrates, we are also geared to enjoy glutamate so that we will eat proteins”—even babies will eat more of a soup that contains small amounts of additive glutamate. This neat evolutionary biology paradigm—while pervasive—is nonetheless acknowledged to contain wrinkles. For one, some bitter and sour tastes are acquired as the source of great and documented pleasure: for example, the caffeine in coffee and the citric acid of citrus fruits. Variations in taste preferences are also interpreted to arise from genetic variation in taste receptors, and to be greatly visible across different cultures.

528 Feiler, “The Corrections.”
The most far-reaching infusion of evolutionary biology interpretation to taste research occurs with the taste sensation umami. One of the most active umami advocates in the research community in recent years has been a Danish biophysicist named Ole Mouritsen. An ardent lover of all things seaweed (rich in glutamate), Mouritsen is part of a recent flowering of taste research collaboration between Scandanavia and Japan, one I could caricature as the 2010s’ New Nordic Cuisine meets the Cradle of Umami. Mouritsen has co-authored a book with chef Klavs Styrbaek dedicated to elaborating umami as an evolutionary mechanism through which humans instinctively seek out food that tastes good. For Mouritsen, umami is just the East Asian concept for “an ancient taste impression” that guides us to preparing more delicious food without the customary recourse to fat, salt, and sugar. Since glutamate has many functions in biological systems, playing physiological roles throughout the gastrointestinal system and as a neurotransmitter, he states that glutamate not only impacts food palatability and acceptability, but also “influences the digestion of food by a specific activation of the brain-gut axis, and hence… is of significance for energy homeostasis.” From this observation Mouritsen enthuses that increasing our scientific understanding of umami “may actually help to regulate food intake, in relation to both overeating and nutritional management for elderly and sick individuals, as

well as lower the need for additional salt, sugar and fat.”

Mouritsen’s theory is buttressed by brain-imaging studies (which show that umami is represented in the anterior part of the orbitofrontal cortex, a cortical region that represents information about the reward value of other primary and secondary reinforcers) with canonized studies on newborn gustatory response that underpin the theory of innate human preference for sweetness and umami. Chemical analyses of human breastmilk and amniotic fluid support the idea of the human fetus and newborn as creatures “primed to savour umami.” Amniotic fluid (2.2 mg/100 g) and human breast milk (19 mg/100 g) both contain free glutamate, so mother’s milk is not only distinctly sweet, it is distinctly umami or savoury delicious.

Studies establishing a universal registry of umami taste combine with well-documented and diverse global culinary traditions of cultivating umami through techniques of macronutrient breakdown: drying, cooking, stewing, braising, and fermenting/pickling. These dovetail into recent anthropological theories of cooking as a pivotal evolutionary trigger. Michael Pollan’s recent book (2013) and television special (Netflix’s Mind of a Chef) called Cooked has popularized anthropologist Richard Wrangham’s theory that our ancestors, the early hominines, used fire and heat to prepare food almost two million years ago. The social and physiological effects of cooking foods—more so than agriculture—are theorized to have prompted the evolutionary development that made us Homo sapiens. Humans are said to be unique in eating a

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534 Mouritsen, “Umami Flavour,” 58.

diet that is rich in cooked and non-thermally processed food. In other words, “Homo sapiens is a cook!”

As early as 1990, chemosensory scientists were putting these pieces together. Cooking and fermenting meat and vegetables release large amounts of free glutamate and nucleotides, and hence lead to food and meals enriched in umami flavour. In the words of two researchers, “It is likely that our preference for delicious food with umami taste has been encoded in our sensory system over millions of years.” Since sensory scientist and food technologies have been aware for decades that ionized amino acids like glutamate and nucleotide monophosphates are produced by hydrolysis—breakdown of macronutrients—during aging or curing, the industrial production by biotechnological fermentation of MSG is integrated into a seductive, global history of how humans prepare foods—a set of practices through which the increase in nutrition and flavour co-exist and are a positively correlated. In 2002, after the identification of umami’s molecular mechanisms, one research team brought molecular insights full circle with Ikeda’s nearly century-old theory of umami.

Humans consume high-calory food as fat, polysaccharides and proteins. All of these are tasteless but elicit taste sensations through cleavage products. Sweet taste is the taste of mono- and disaccharides, and guides us to the consumption of starch. Umami taste is elicited by the most common amino acid, L-glutamate, a cleavage product of all proteins.


538 Chaudhari and Roper, “Cell Biology of Taste.”
Such argues Ikeda in his [1909] article.\footnote{Bernd Lindemann, Yoko Ogiwara, and Yuzo Ninomiya, “The Discovery of Umami,” \textit{Chemical Senses} 27(9) 2002: 843-844.}

To state this in my own terms, this postulated link between umami and human evolution offers a universalizing theory of the delicious destruction of macronutrients by food preparation (cooking, fermenting, pickling)—which simultaneously makes nutrients more bioavailable and makes foods more delicious. This theory is fascinating. However, the theory has been strategically deployed by the glutamate producing and consuming industries to naturalize additive glutamates and ribonucleotides. These I distinguish as objects of the \textit{creative destruction} through which biocapitalisms operate—umami tastants not necessarily metabolically equivalent to their endogenous counterparts.

At stake in this seductive ‘primordial ontology’ of delicious destruction, then, is its resonance with other sensory research linking sensation to the maintenance of adequate nutrition. According to Alan R. Hirsch, a neurologist at the Smell & Taste Treatment and Research Foundation in Chicago, IL specializing in smell and taste loss, the posterior insular cortex (taste) and the orbitofrontal cortex (smell) talk to the anterior cingulate cortex (behaviour). This conversation ultimately regulates our nutritional intake.\footnote{Alan Hirsch, “Preface,” in ed. Alan Hirsch, \textit{Nutrition and Sensation} (CRC Press: Taylor and Francis Group, 2015): vii.} Hirsch posits a fundamental relationship between nutrition (on which there are millions of publications “mostly about weight reduction diets”) and sensation, or the hedonics of eating. “Ultimately, behaviour results from integration and higher cognitive interpretation of the sensory experience of eating,” he writes.\footnote{Hirsch is something of a medical entrepreneur, with many advice manuals under his belt, all with zingy titles like \textit{Scentsational Sex} (1998) and \textit{What’s Your Food Sign}? (2006). See Alan R. Hirsch, “Preface,” xii.}
Hirsch exemplifies the politically fraught dimension of chemosensory research: its urgent implications in the ethical question of devising nutritional guidelines for public consumption—discursively and materially, as they are rolled out in cafeterias in schools, hospitals, and prisons.

Smell and taste become even more significant to health policy in light of other recent research identifying chemosensory cells lining the stomach and intestine. Chemosensory cells in the gut respond to detected amino acids, peptides, sugars, and bitter compounds by locally releasing peptides (e.g., GLP-1).\textsuperscript{542} These cells are thought to play a role in the signalling between the gut and the brain that governs digestion and satiety.\textsuperscript{543} In taste physiology, taste buds are understood to initiate physiological reflexes that prepare the gut for absorbing nutrients: by releasing digestive enzymes (necessary for us to break down our food), initiating peristalsis (the wave-like contractions that move food along our GI tract), increasing mesenteric blood flow (i.e. to the stomach, liver, intestine, and colon), and to prepare other organs for other metabolic adjustments like insulin release, sympathetic activation of brown adipose tissue (which is understood to burn calories), or increased heart rate.\textsuperscript{544} Together, these reflexes triggered by the sensory (sight, smell, taste) perception of food are called \textit{cephalic phase responses}.\textsuperscript{545}

\begin{itemize}
\item \textsuperscript{542} Chaudhari and Roper, “Cell Biology of Taste,” 286.
\end{itemize}
The chemosenses are thus emerging as deeply interconnected with wider metabolic processes that we are only beginning to decipher. Changes in chemosensory range and acuity during the life course and owing to hormonal changes are well known. Menstruation, pregnancy (significant hormonal fluctuations) and natural aging have been associated with changes or loss of smell and, somewhat less frequently, taste.\textsuperscript{546} But the chemosenses are connected to more than aging and hormonal fluctuation, digestive regulation, and cognition and mood-states. As if those were not significant enough, there are demonstration connections between chemosensory degeneration and broader neurodegeneration. Richard Doty, director of the Smell and Taste Center at U of Pennsylvania Medical Center has observed that people genetically prone to Alzheimer’s have a ninefold higher risk of developing the condition when they also report problems with their sense of smell. Neurodegenerative diseases like Alzheimer’s and Parkinson’s are thought to be complicated by toxic nasal exposure to herbicides, pesticides and heavy metals, as well as by the damaging effects of infections. Some researchers, like Linda Bartoshuk’s mentee Jennifer Stamps, hypothesize an inverse relationship between neurodegenerative conditions like dementia and chemosensory “exercise.”\textsuperscript{547} The idea is that by eating more and ever-varying foods, a person can challenge or keep their brain in shape by having to build new olfactory cells to interpret novel flavours.\textsuperscript{548} Bartoshuk and other researchers have associated obesity with different “orosensory and orohedonic” experiences as compared to average-weight

\textsuperscript{546} Mouritsen, “Umami Flavour,” 67.

\textsuperscript{547} See, for example, Jennifer J. Stamps, Linda M. Bartoshuk, and Kenneth M. Heilman, “A Brief Olfactory Test for Alzheimer’s Disease,” \textit{Journal of the Neurological Sciences} 333 2013: 1-14.

\textsuperscript{548} This is also discussed for interested foodies in Stuckey, \textit{Taste What You’re Missing}, 167.
individuals.\footnote{Linda M. Bartoshuk, V.B. Duffy, J.E. Hayes, H.R. Moskowitz, and D.J. Snyder, “Psychophysics of Sweet and Fat Perception in Obesity: Problems, Solutions and New Perspectives,” Philosophical Transactions of the Royal Society B: Biological Sciences 361(1471) 2006: 1137–1148.} That is to say, obese people have been argued to experience reduced sweetness, which likely intensifies their perception of fatty tastants—potentially compelling those individuals to seek out ever-greater sweetness or to find particular pleasure in high-fat foods.\footnote{Bartoshuk, et al., “Psychophysics of Sweet and Fat Perception.”}

Delicious destruction matters thus because our knowledge (molecular) of what we taste and smell (sensory) seems greatly to impact what and how we feel (affective), as well as what companies know how to induce us to buy—to our health benefit or detriment (political). The chemosenses figure here as distributed, multiple, and inconstant mechanisms that vary within individual bodies (parts of tongues, mouths versus stomachs, small intestines, or livers); across the time of individual life courses and in conjunction with other health states; and within the deep time-space of the evolution of sometimes homogenized (we all share a common ancestor in\textit{Homo erectus}) and sometimes differentiated (cultural distinctions, healthy versus variously unhealthy) populations. Chemosensation is also being assembled as inseparable from cumulative and associative processes of learning. Chemosensation and cognition are both considered exercises in the rapid-fire production of composites based on patterns and learned associations, e.g. sensory fusion, intra- and cross-modal enhancement within/between sensory systems.\footnote{Shepherd, Neurogastronomy, 122-3, 119, 208.} So, chemosensation is emerging as an extensive phenomenon that encompasses the entire body-mind and is deeply implicated in our ability to optimally extract nutrients from our food, digest that food efficiently, moderate the adipose tissue we carry, and just all around feel good. If the sensory is affective is molecular is political—as I claim it to be—delicious destruction is not
only bound up in our evolutionary past; it is central to our capacity to persist and thrive within biocapital regimes of eating. This chapter is thus my emerging meditation on the evidence that Big Food may sustain us from a caloric and nutritive standpoint, i.e. sufficient daily intake of vitamin D (the creative), even as its multibillion-dollar industries, built on proprietary, molecularly deconstructed recipes, ravage us from a metabolic standpoint (the destruction).

**Rolling out Creative Destruction**

So, how do we put into context these examples of recent research tracing an affective ontology of chemosensation? How does it matter? Proponents of umami say the taste sensation, as an ancient and time-tested link between healthfulness and deliciousness, may just provide the means for collapsing the division between foods people want to eat (tasty)—and foods people think they should eat (healthy). This, of course, was the stated mission of Ikeda at the turn of the twentieth century—to fortify the Japanese nation by making them want to eat the foods that would make and keep them well. Monosodium glutamate is promoted by some as an innovation that brings greater food pleasure to a greater number of people through its increased prevalence, lower-cost, speed of deliver—as a cornerstone of an imagined hedo-consumerist food democracy. This delicious future is underpinned by an imagined delicious past. Just as people around the world have “intuitively paired” steak and mushrooms, mozzarella and tomatoes, anchovies and Caesar salad, Chris Koetke, Dean of Kendall College's School of Culinary Arts in Chicago, “ancient Romans used fermented fish juice as a seasoning,” and “traditional Southeast
Asian cuisine[s]” employ fish sauce to build umami flavour. "Glutamate-rich foods were used in every civilization," says Debbie Carpenter, foodservice manager for the national sales and marketing departments of Kikkoman International Inc., in San Francisco." The French used it in stocks and Italians paired cheese and tomatoes." This powerful way to add delicious taste to meals is said to be “mostly overlooked in the Western world” although “we have plenty of sources of it in Western cuisine.” Mouritsen himself is exuberant in his championing of umami “control and optimization” as the secret to “providing healthier, less caloric and more satisfying meals to the population” that are tailored to human physiological needs. In this phrase, Mouritsen evokes the writing of Ikeda from a century prior. How better to optimize the umami factor in a meal than through the cheap, ubiquitous, and chemically purified (read: rationalized) MSG?

A lionising of umami, within the context of exonerating MSG, in some hands is built upon the celebration of Japanese cuisine. “Lessons from the classic, strictly vegan, Japanese temple cuisine, shōjin ryōri (‘The enlightened kitchen’), demonstrate that it is possible to produce healthy and delicious food virtually without using fats and oils.” A set of techniques developed by the Buddhist monks and echoed in “the entire traditional Japanese cuisine,” build umami through deliberate selection and combination of ingredients. The base of this culinary tradition is dashi soup broth dashi, an aqueous extract of konbu and katsuobushi, complemented

553 Kevin, “I Want my Umami,” 110.
556 Ole G. Mouritsen, Sushi. Food for the Eye, the Body & the Soul (New York: Springer, 2010).
by soy sauce, miso, mirin or sake, which all contribute umami. Until recently, obesity was not a health problem in Japan, and some researchers speculate that a Japanese style of expertise in umami could help “caloric uptake” and reduce sodium intake while retaining good taste.557

The replacement of sodium with MSG and other flavour enhancers has been a particular refrain. Salt has been under high scrutiny due to its correlation with hypertension, a major risk factor in cardiovascular disease. One teaspoon of common table salt contains about 2,400 mg of sodium. The American Heart Association recommends that sodium intake be reduced to 1,500 mg daily for salt-sensitive populations. There are three main issues when sodium is reduced in processed foods: taste, processing, and preservation. Reduced-sodium products tend to be bland, with less initial impact and expansion. Less protein is extracted in meat processing when sodium is reduced, and there are changes in food chemistry. Since salt helps preserve food, reduced salt may shorten a product’s lifespan. Potassium chloride, monosodium glutamate, sodium-free glutamates, nucleotides, and yeast extract/HVP are all offered up as reduced-sodium options for flavour enhancement—even MSG itself, with less than a third of the sodium of table salt. Proper use of the umami taste could greatly reduce salt intake without compromising consumer acceptance.558 This is precisely the benefit advertised by B&G Foods after their acquisition of the Ac’cent brand in 1999. Their marketing states: “Ac’cent wakes up the natural flavors in your food…. [it has] 60 percent less sodium than salt and is a terrific alternative to salt for people


watching their sodium intake.”

One study concluded that dietary glutamic acid may have independent blood pressure–lowering effect. “When food manufacturers look to reduce sodium content, umami can help them retain the savory taste, while they still retain ‘craveability.’”

Autolyzed and hydrolyzed yeast and yeast extracts, hydrolyzed and texturized proteins, monosodium glutamate—are sources of umami that “overcome control issues without bulk, color, and other potentially undesirable flavor notes.”

Glutamate industry representatives promote umami tastants—regardless of their derivation—as secret ingredients for cultivating satiety and happiness in the consumer. Umami’s qualities of fullness, mouthfeel (texture), and roundedness can solve the great divide between healthful and taste: “Lean proteins usually have reduced flavor (from less fat), so the addition of umami-rich ingredients, such as soy sauce, provides the synergies needed to compensate for what may be lacking.” Glutamate is said to aid in satiety because of its stimulation of saliva and immunoglobulin A secretion (smoothening mastication and swallowing) promote the immune system and oral health by protecting teeth and mucosa from infections.

More saliva is associated with better nutritional status, since it promotes digestion and nutrient availability in

Free glutamate in the diet can provoke a visceral response from the stomach, intestines and portal vein, stimulating the appetite in elderly individuals, and hence increasing food acceptance and intake. Glutamate can reduce total sodium in a meal by 30–40% without reducing palatability. It also works well to enhance the palatability of fat-reduced meals, thereby suggesting a viable route to lower caloric intake of fats and oils. Chemosensory research into umami, in particular, has an immediate deployment in biocapitalist imaginaries in which both the commercial products and the consumers of Big Food may yet be improved. Old product lines (e.g. with ‘too much’ sodium) may be cannibalized so that new ones more reliant on additive glutamates may take their place. Obese or hypertensive sensing bodies may continue to be gratified—the evolutionary drive to consume salt may have led them astray, but the pull of umami will serve them well. The creative destruction of deliciousness volunteers to solve its own problem. We do not need less processed foods; we just need better processed foods.

The creative destruction of biocapitalist technologies of eating is most worrisome in its proximity to some of society’s most vulnerable members. For example, the recommendation of additive umami tastants in the diets of elderly individuals with decreased taste sensation or loneliness due to routinely solitary meals; patients undergoing intensive hospitalization or

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565 Mouritsen, “Umami Flavour,” 70.

chemo- and radio-therapeutic treatments (and who may suffer from permanent or temporary impairment of taste and smell, and thus loss of appetite, malnutrition, even anorexia); and those at especial risk of cardiovascular disease.\footnote{Jacqueline B. Marcus, “Unleashing the Power of Umami,” \textit{Food Technology} 63(1) November 2009: 24-30; Kondon and Torii, 2008; Yamaguchi and Takahashi, “Interactions;” Shizuko Yamaguchi, “Fundamental Properties of Umami in Human Taste Sensation,” in eds. Y. Kawamura and M.R. Kare, \textit{Umami: A Basic Taste} (New York, NY: Marcel Dekker, 1987): 41–73; Yamaguchi and Ninomiya, “Umami and Food Palatability.”} Particularly relevant is the consistency of industry funding for such research. For instance, Mouritsen’s 2012 papers in \textit{Nutrition and Health} and \textit{Flavour} declared grant funding support from the Danish Food Industry Agency.\footnote{Mouritsen, “Umami Flavour,” 71; Mouritsen, “The Emerging Science of Gastrophysics,” 8.} Umami promises increased satiety and short-term happiness, perhaps, but those vulnerable individuals are also more likely to be institutionalized, where bureaucratic economies make the use of MSG and other flavour enhancers, as found in processed and pre-prepared ingredients—not the slow cultivation and selection of vegetable-based and fermented produce of Japanese temple kitchens of yore—to be nearly guaranteed.

\textbf{Conclusion}

I have offered up a history of taste as an embodied experience that is both molecular and affective, and whose authoritative disciplinary language—chemosensory science—is bound up in biocapitalist regimes of eating. I suggest that contemporary chemosensory research posits taste and smell as intrinsically affective, a development that compels us to collapse the long-standing dyad of taste as either distinction \textit{or} sensation, to view sensibility and embodied experience as...
indivisible. I have situated this intervention within the wider reflections of sensory studies scholars of a ‘sensory revolution’ in the human sciences and cultural studies over recent decades and attempted to capture it in the shorthand of: taste is molecular is affective is political. I situate the trajectory of chemosensory research, particularly since the turn of the twenty-first century, in the context of delicious destruction, which names the phenomenon whereby edible matter is seen to broken down by practices of cooking, pickling, fermentation, curing, etc. with the effect of improving our ability to metabolize its nutrients; stave off competitive digestion by spoilage microbes; and derive more pleasure from its ‘tastants’ than we would in raw, bound form.

In this chapter, I have focused on the hedonic value generated by splitting molecules into their composite parts—for example, by liberating glutamates from the proteins in which they occur, and what this appears to confer for taste perception and wider human metabolism. Flavour enhancing technologies like additive glutamates and the 5’-ribonucleotides provide a fast track to felt deliciousness through breakdown, despite the amount of conjecture punctuating current understandings of how this works. Chemosensory knowledge underpinning technologies of sensory enhancement like MSG have increased in step with the proportion of processed foods comprising national diets not only in the U.S. but around the world. This chapter thus problematizes the imbrication of chemosensory researchers in the commodification of human sensory capacity. Creative destruction, then, names the distinction between craft fermentation or cheese-making, for example, and their scaled-up counterparts enrolled in circuits of global capitalism—specifically the food, beverage, flavour, and biotech industries. The molecular breakdown of the food particles entering our body is necessary for us to derive nourishment; curiously, this destruction is also an enigmatic act of creation. It creates feelings of pleasure, and pleasure is inseparable from myriad value-systems and ideologies, a centrality that has given rise to universalizing theories that naturalize the inducement of sensory response through food
processing techniques as just another stone in the path of human evolution. It is then so easy for public relations and marketing experts within industry to insert their offerings into this globalized history of unfurling deliciousness. Delicious destruction is coopted by industry within a promissory future of affluent eating, symbolized by a profusion of uniform, shelf-stable, attractively packaged, nutritionally adequate, and tasty consumer food products. And it concerns me that so much of our most authoritative knowledge of how these important senses animate our bodies and our sociality has emerged out of testing the ‘craveability’ of that supermarket cornucopia. In the conclusion to follow, I turn to some of the gaps in our knowledge of glutamate metabolism, in particular and as expressed by sensory researchers themselves; and two, to the fault lines in the methodologies, like brain imaging or comparator animal models, within which even this much knowledge is generated. In particular, I attend to the unnumbered millions of non-human bodies cluttering the factories and laboratories of better eating through science.
Conclusion
A Trans-species Rumination on Eating

Tiny, multitudinous, with little recognizable emotion or individual consciousness, they do not easily register as objects of moral obligation or as agents of ethical change. [They] seem doubly other – other than humans and other than the animals that we eat as well. 569

It is not by chance that the Russian verb ‘to be’ is identical, in the variant yest, to the verb ‘to eat’. 570

Introduction

This dissertation has been largely about eating as a site for many distinct processes of transmutation: of form, biochemistry, language, meaning, practice, capital value, moral value. It has shown how eating is not only figuratively transformative (symbolically, culturally), but also chemically, physiologically, and emotionally. I began this dissertation with the aim of tracing a materialist sensory history and an historical ontology of human chemosensation. In its conclusion I offer some preliminary thoughts for a non-human materialist sensory history and a historical ontology of non-human chemosensation. The production of both the substance MSG and its chemosensory science is built upon investigations and interventions into the metabolic and sensory capacities of animals and microbes. Attending to MSG’s non-human dimensions is inspired by recent work offering sentience (rather than rationality or verbal language) as the basis


570 Michael Marder, “Is it Ethical to Eat Plants?” parallax 19(1) 2013: 29.
for membership in a moral community. This community, then, would include humans, other animals, and plants (long identified as social and environmentally-responsive)—and what, I wonder, about microbes? Picking up the case for plants, the philosopher Michael Marder has lamented the lack of human concern for the violence inherent in contemporary horticulture, framing it within a species-wide struggle for emancipation from the valuations of capital, in which no creature is valued as greatly as “the commodity prices they are converted into.”

In order to commoditize deliciousness, I have traced how edible matter—whether plant, animal, or microbial in origin—has been deconstructed on a molecular basis so it can then be rationally reallocated and deployed. I have focused on how delicious destruction has been commoditized through a process of creative destruction, a process through which human chemosensory responsiveness is induced by additive flavour enhancers that help to make processed foods palatable. So, my concluding thoughts for this project are dual and linked. I provide a brief analysis of the non-human bodies through which our chemosensory knowledge is produced: in other words, I consider how MSG is also a trans-species choreography of responsivities both sensory and metabolic. In what follows, I pause a moment with the model organisms or laboratory animals of umami research, and consider their creative destruction—their ‘sacrifice’ for the production of commercially valuable scientific knowledge—as a point of

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572 I have previously discussed Stefan Helmreich’s valuable work on human alienation from microbes in Alien Ocean: Anthropological Voyages in Microbial Seas (Berkeley and Los Angeles: University of California Press, 2009).

573 Michael Marder, “Is it Ethical to Eat Plants?” parallax 19(1) 2013: 29.
entry for a brief discussion of the gaps in the contemporary science of glutamate metabolism and chemosensation.\textsuperscript{574} Umami is a sensory phenomenon that varies not only by individual but also by species, in accordance with divergent metabolic modalities and species-specific chemosensory mechanisms. I ponder for a moment the ease with which biocapital exploits microbial metabolic processes, as discussed in chapter two, in the manufacture of everything from insulin to MSG. As scholars like Stefan Helmreich and Michael Marder have suggested, the tiny and creepy-crawly are low on the ethical radar of rights activists, for instance.\textsuperscript{575}

In order to carry out the first task, I take up Hannah Landecker’s provocation to consider how food has, in recent decades, been assembled as a signal, rather than straightforward energetics of calories in, labour out. For Landecker, \textit{metabolism} (chemical transformations essential to living organisms) is key to clarifying how “the alimentary and the therapeutic are being pressed into new relations of meaning and value in ways that reconfigure both food and medicine.”\textsuperscript{576} The molecular compounds of a food, for example sugar, are as much signal as fuel, and as such “both \textit{amount and kind matter} [my emphasis].” This observation that has profound implications for public policy and regulation of, for instance, products high in added sugar.\textsuperscript{577} Landecker argues that inattentiveness to metabolic activities’ complex roles in gene regulation reflect the historical gendering of metabolic functions as (feminine) ‘housekeeping’ (as opposed to the (male) ‘executive’ functions of the cell)—“essential but boring.” She cautions that the signal, like the


\textsuperscript{575} Marder, “Ethical to Eat Plants?;” Helmreich, \textit{Alien Oceans}.

\textsuperscript{576} Hannah Landecker, “Food as Exposure,” \textit{Public Culture} 2013: 499.

\textsuperscript{577} Landecker, “Food as Exposure,” 501.
gene, is a “floating reference” or unit of communication with “indeterminate edges,” and as such, “it may be blocked, augmented, diminished, competed with, interrupted, or mimicked… [And for this reason] it is amenable to capitalization — pharmaceutical development and intellectual property protection.”578 I have dedicated many previous pages to establishing how flavour enhancing technologies have been amenable to capitalization. However, it is not glutamate’s gene-regulating or signalling capacity (with wider and variable implications in metabolic processes) that is explicitly valued within biocapital. It is additive glutamate’s hedonic capacity, its ability to incite the sensuous register of the eater that is the site of the flavour enhancer’s capital value. Additive glutamate’s open-ended capacity for wider metabolic effects (intervening in satiety, cognition, mood, energy homeostasis, neurodegeneration even?) is an excess, an unintended consequence of targeted technoscientific investment in the knowledge of how to make human bodies feel pleasure through eating. In chemosensory research, the metabolic capacities of laboratory animals are made commensurate with those of humans, even as researchers acknowledge species-specific variation. How else to produce that most valuable biocapitalist product: the science of chemosensation for use in industry? Microbial metabolism, while no more fully understood, is deployed in the manufacture of the secondary product: the additive itself.

**But What About the Non-humans?**

Literary critic Jessica Berman has described *trans-* as one of the American Comparative Literature Association’s “ideas of the decade,” drawing from ‘transnational,’ ‘trans-medial,’ and ‘trans-gender’ critical practices. She defines *trans-* as “not a substantive but rather an

578 Landecker, “Food as Exposure,” 513-514.
‘orientation’ of critical approaches, attitudes, and habits of reading or experiencing.” In other words, doing a trans-history does not mean studying an isolated ‘trans-y’ thing; it means attending to how any object, across time, demonstrates trans-dimensionality: for instance, moves against and across borders, is positioned along many axes, and is territorialized “within agonistic horizons.” To illustrate, in the history I have just reviewed, glutamate has been isolated and crystallized as a domestic commercial product and an export whose packaging and end consumer were largely transformed at the American border; it has been materialized and rematerialized as an amino acid, a fifth basic taste, a toxic feature of Asian food, an excitotoxin, and as an umami tastant that has driven humans since time immemorial to consume sufficient protein; and it has been claimed, rejected, naturalized onto Japanese bodies, and branded for the global promotion of Japanese national cuisine. It has transmutated in step with dominant epistemological paradigms and scientific disciplinary boundaries, geopolitical tensions, and cultural values. Its material and ontological production have also hinged on the generation of biocapital across species—the commoditization of bacterial metabolism is necessary for the elucidation of animal glutamate metabolism is necessary for the inducement of human chemosensory response. I have focused my analysis up to this point on the human dimensions of this story. I turn now to the roles of mice, rats, dogs, monkeys, and bacteria.

Gastronomic science guru Harold McGee has, in the wake of the molecular authorization of umami taste in 2000, weighed in in favour of MSG’s exoneration. Discussing the established


experimental technique of using MSG as an obesogenic agent in mice studies on cancer and
diabetes, for example, he stated in 2004

A decade before Kwok's letters on "Chinese Restaurant Syndrome" were published, some
scientists began doing research on the effects of MSG on mouse brains… where mice
were fed massive amounts of MSG via feeding tube. The most dramatic result wasn't in
the brain, where he was looking, but their bodies: the mice fed MSG became "obese”…
Given that glutamate registers as "deliciousness," one might assume that the difference
was that the MSG-fed rats just liked their food a lot more and ate past satiety, but the
MSG was administered by feeding tube, so taste shouldn't have had anything to do with
it.581

The sentience of laboratory mice—that they eat for pleasure—is apparent from their use in
sensory studies; however, that capacity of feeling is typically overlooked due to the usefulness of
mice as model organisms in wider research on the links between diet and overweight-obesity and
diabetes. Numerous studies conducted since the 1970s, when researchers published an influential
report in the British Journal of Nutrition on the obesogenic property of large amounts of MSG
delivered parenterally (intravenously) or orally to infant mice, have relied on the fact that rodents
given large and rats fed large amounts of MSG will gain weight.582

The structural abuse of laboratory animals has been foundational to modern science, and
food science is no exception.583 In the isolated literature on glutamate covered in this project,

581 McGee is referring here to the work of John W. Olney, e.g. “Brain lesions, obesity and other disturbances in
mice treated with monosodium glutamate,” Science 164 1969: 719-721; Harold McGee, On Food and Cooking: The

Glutamate,” British Journal of Nutrition 35 1976: 25-39. For more recent literature relying on MSG as an
obesogenic agent, a useful review is available in, for instance, Kate S. Collison, Nadine J. Makhoul, Marya Z. Zaidi,
et al. “Prediabetic Changes in Gene Expression Induced by Aspartame and Monosodium Glutamate in Trans fat-fed
C57Bl/6 J Mice,” Nutrition & Metabolism 10 (2013): 44.

583 See, for example, Donna Haraway, The Companion Species Manifesto: Dogs, People, and Significant Otherness.
Chicago, Illinois: Prickly Paradigm Press, 2003); Sarah Franklin, Dolly Mixtures: The Remaking of Genealogy
(Durham, NC: Duke University Press, 2007); Rader, Making Mice; Angela N. H. Creager, The Life of a Virus:
Tobacco Mosaic Virus as an Experimental Model, 1930-1965 (Princeton, NJ: Princeton University Press, 2002);
toxicological protocols were particularly gruesome. In order to test toxicological thresholds, generations of rats, mice, rabbits, dogs, monkeys, guinea pigs, and hamsters endured repeat pregnancies and pre-term caesarean deliveries so that pre-term neonates could be injected with MSG and then killed hours or days later for pathology analysis. Such practices are routinized and hegemonic—and conducted for the purpose of generating useful knowledge—but are ethically dubious when considered alongside the professed comparability of mammalian sensory response with that of humans. If such animals are valuable to research for the similarity of their sensory responses to those of ours, then it follows that such scientific studies involve immeasurable pain and ill health visited on sentient creatures accessible to scientific research by virtue of their being non-human and, thus, expendable.

Chemosensory researchers studied laboratory animals in their quest to establish umami as a basic taste in the 1980s and 1990s. Manipulations of the chorda tympani nerves of dogs, the glossopharyngeal nerves of mice, and the taste cortex of macaques gave weight to the existence of a unique umami taste before molecular techniques revealed unique receptor sites. The pivotal 1979 publication *Glutamic Acid* contained an entire section on “Glutamate Metabolism in Mammals” and included comparative metabolic studies in different animals—for instance,


comparing glutamate metabolism in adult humans, mice, monkeys, and newborn pigs.\textsuperscript{586} These studies found that the method of MSG administration greatly affects its metabolism; for instance, MSG administered with water resulted in much higher plasma glutamate levels than the same dose administered with a meal.\textsuperscript{587} So there have been demonstrated ranges of similarity in glutamate metabolism across mammals. However, researchers have also established umami taste sensation as being mediated by distinct mechanisms in different species. The taste synergism between glutamate and nucleotides (where nucleotides enhance glutamates’ flavour enhancing effect), discussed in chapter two, varies in degree across species; for example, the effect is observed to be less strong in rats and mice than in humans. And rats and mice demonstrate sensory synergism (at the receptor level) with nucleotides across a range of amino acids—not only with glutamate, as is the case for humans and dogs.\textsuperscript{588} Beyond the ethical questions attendant on our reliance on what are these ‘model organisms,’ our knowledge of what umami is in great part brought to us by research conducted on animals whose metabolic pathways and taste mechanisms are different from those of humans. Science studies scholars have ably problematized the distorting effects the reliance on model organisms can have on the results of scientific study—in which outcomes specific to one species or experimental design are inaccurately interpreted as representative of a phenomenon more broadly.\textsuperscript{589} One umami research team wrote in 2002 that the expansion of umami research around 1980 was characterized by reliance on both human and animal studies; “[a]nimal models, however, were of

\textsuperscript{587} L.D. Stegink, et al., “Comparative Metabolism of Glutamate,” 91.
\textsuperscript{588} K. Kurihara, “Glutamate: From Discovery as a Food Flavor to Role as a Basic Taste (Umami),” \textit{American Journal of Clinical Nutrition} 90(3) 2009: 721S.
\textsuperscript{589} Rader, \textit{Making Mice}; Hayden, “Brine Shrimp.”
limited use as the responses of different species, even of different strains of mice, were at variance. How reliable and transferable are studies based on routinized, violent interventions in the bodies of sensate animals whose physiologies and metabolisms are similar enough to ours to promise insight into human chemosensation and metabolism, but dissimilar enough to frustrate it?

The research of Gary Beauchamp, director of the Monell Chemical Senses Institute in Philadelphia, has also explored variation across species in sensory response—as measured by intake—to monosodium glutamate.

One curious finding is that the taste of pure MSG is generally not judged to be pleasant, unlike the taste of sugar and, in some cases, salt. This finding in humans contrasts with work in rodents: these animals show a clear preference for MSG and nucleotide monophosphates at appropriate concentrations… This species dichotomy is another way in which umami seems to differ from the other basic tastes; we do not understand why this is the case.

Canonized studies by Beauchamp and others on glutamate’s role in evolutionary determinants of diet echo animal studies in their cavalier use of the most vulnerable—very young, very old, or ill humans. The most compelling scientific evidence accumulated to support glutamate’s signaling of dietary protein is provided by studies conducted from the late-1970s on malnourished infants from Guadalajara, Mexico. Researchers observed the facial reactions of infants fed broths

590 Lindemann, Ogiwara, and Ninomiya, “Discovery of Umami.”
591 Beauchamp, “Sensory and Receptor Responses,” 724S.
592 M. Vazquez, P.B. Pearson, and G.K. Beauchamp, unpublished results, 1979, cited in Beauchamp, “Sensory and Receptor Responses,” 724S-725S. Authors of one of these infant studies also pointed out that some of the malnourished infants were undergoing treatment for a range of medical conditions during the period of the trial (e.g. intestinal parasites), which may have had a complicating effect on study outcomes. While not stated in the study notes, it would be interesting to know how disadvantaged parents were convinced to subject their newborns to scientific experimentation; the previous commentary suggests food and/or medical care may have been offered. Such study recruitment techniques would be grossly exploitative to say the least.
with or without added MSG, with or without added hydrolyzed casein (a lesser source of additive glutamate), and those fed plain water or water plus the above additives. They hypothesized that “nutritional state would feed back on taste preferences.” Beauchamp, however, reported that

We found that whereas nutritional state did affect casein hydrolysate intake (malnourished infants preferred soup plus casein hydrolysate, whereas well-nourished infants responded in the opposite manner), it had no effect on MSG preference. Both malnourished and well-nourished infants preferred (ie, consumed more in brief intake tests) MSG-containing soup to soup containing no MSG. This finding thus fails to support the proposition that MSG signals the presence of protein. Beauchamp ventures from these and other results that glutamate’s hedonic, flavour-enhancing property does not necessarily correlate with the presence of protein—as Ikeda and many industry narratives propose.

Indeed, many of the natural foods high in free glutamate (eg, seaweed, tomatoes) are not rich sources of protein. Moreover, there is very little human evidence that protein deficiency enhances the intake of umami-tasting foods... [B]oth elderly individuals and individuals of lower nutritional status had a preference for higher concentrations of MSG in soup than did individuals of higher nutritional status... However, this effect could be the result of sensory loss rather than hedonic judgment. Moreover, a large series of studies with protein-restricted rats found the reverse: protein-deficient rats avoid umami substances. The idea that umami taste in foods signals the presence of protein thus requires much more supporting evidence before it can be accepted.

Such brief examples cast doubt on the neat evolutionary rationale behind umami, the celebrated fifth taste sensation, such that assembled links between tastants and ‘evolutionary imperatives’

593 Beauchamp, Sensory and Receptor Responses,” 724S.
594 M. Vazquez, P.B. Pearson, and G.K. Beauchamp, unpublished results, 1979, cited in Beauchamp, “Sensory and Receptor Responses,” 724S. Authors of one of these infant studies also pointed out that some of the malnourished infants were undergoing treatment for a range of medical conditions during the period of the trial (e.g. intestinal parasites), which may have had a complicating effect on study outcomes. While not stated in the study notes, it would be interesting to know how disadvantaged parents were convinced to subject their newborns to scientific experimentation; the previous commentary suggests food and/or medical care may have been offered. Such study recruitment techniques would be grossly exploitative to say the least.
(dictating what we want to eat), as discussed in chapter four, become as dubious as that old, discredited tongue map.

**Just Bacteria**

The question of our scientific knowledge of MSG’s metabolism and safety is therefore epistemological, ethical, and political. I have focused above on the production of glutamate science, but what about MSG’s industrial production itself? What about the factories full of fermenting microbes? I outlined in chapter two how the majority of MSG has been manufactured since the 1960s by exploiting the genetic mutability of bacteria. While animals—including human animals—have only a single set of metabolic pathways, some bacteria have more than twenty fundamentally different ones. Science and technology scholars have described the rise of a ‘bioeconomy’ in the latter twentieth century defined by private-sector engineering of the untold potential of the biosphere’s micro register (the genetic, microbial, cellular).

Commoditizing the biological is made possible by harnessing the *autopoiesis* (‘self-making’) or ability of living cells to perpetuate themselves and their boundaries through the metabolism of material and energy. As Hannah Landecker has demonstrated in her work on cell cultures, ‘cultured life’ (*in vitro* versus *in vivo*) is premised on the manipulation not only of the life form


but also of the conditions of life and the timing of biological processes—and I would add, also the scale at which life processes are carried out. In the manufacture of MSG, bacterial strains like *M. glutamicus* and *C. glutamicum* were found to excrete the highest amount of glutamic acid in the least nutrient- and energy-rich medium. The bacterial bodies of MSG manufacture are recast, rationalised “as routine tools, alienable commodities, and sites of production.” In a recent piece on Food Infrastructures, Christopher Otter writes, “when a system increases in scale, it frequently displays emergent properties. Emergence refers to the capacity of systems to generate genuinely novel phenomena: they are surprising.” Monosodium glutamate came to be produced by industrial fermentation in order to facilitate a massive scaling-up of the prospective MSG-market: in growing processed and frozen foods market segments, and in ‘emerging markets’ in the Global South.

It is the second musing of this conclusion to consider how an attendant scaling-up of additive glutamates’ circulation in the body (or, the scaling up of flavour enhancer consumption) might affect human metabolism. A central assumption of modern biologies (classificatory, evolutionary, systems) has been the discrete and sovereign nature of the organism. Bruno Latour, Donna Haraway, and others have famously rejected this sovereign organism and the nature-culture division by conceptualising living creatures as networked agents, both non-human and human, in which ‘companion species’ or ‘associate species’ (*symbionts*) are integral to human

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Evolutionist Ernst Mayr has claimed that “every individual of most species is actually a consortium of several species.” Evolutionary biologist Lynn Margulis and science scholar Dorion Sagan have asserted that symbionts—two or more organisms of different kinds existing in protracted physical contact, e.g., the intestinal bacterial in the human gut that make the vitamins K and B that we absorb through our intestinal walls, comprise an estimated ten percent dry weight of the average human body. For Margulis and Sagan, the human body is more accurately understood as a “walking assemblage” or “loose committee” of associated organisms. An uptick in research enthusiasm into the wider metabolic and health significance of the human microbiome—in which our bodies are seen to be shaped by not only our own 23,000 genes but also by the more than 8,000,000 genes of the microbes who live within us. What we eat and how we eat it is increasingly understood to be linked to the health of our microbial communities, which has a direct bearing on things like our 1) ease of digestion, 2) defense against cold and influenza, 3) incidence of obesity, and 4) onset of type 2 diabetes.

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603 Mayr, “Foreword,” xiv.


605 For an excellent treatment of this question, see Scott F. Gilbert, Jan Sapp, and Alfred I. Tauber, “A Symbiotic View of Life: We Have Never Been Individuals,” *The Quarterly Review of Biology* 87(4) December 2012: 325-341.

The link being made by researchers in microbiology, gastroenterology, and immunology and is that consuming high proportions of processed (read: refined, and/or molecularly deconstructed and reassembled) foods may have impoverished the ability of our trans-species gut communities to digest what we eat, and to obtain from that food the nourishment we need to be healthy. Whether or not additive glutamates are metabolised differently from endogenous ones, MSG and other flavour enhancers are used extensively in precisely those food products understood to be so detrimental to our health. And for that reason alone, MSG’s ‘exoneration’ is premature and fraught by the vested interest of industry.

Moreover, as a trans-species composite, a variable and ecological ‘assemblage’, the human consumer of MSG is very difficult to map from within the clinical trial. MSG’s effects are as variable as those of other foods and drugs—coffee, vitamins, dairy, wheaten bread, soy, etc.—dependent on one’s metabolic rate, genetics, sex, age, geographical location/ecology, relative nutrition, stress, fatigue, hunger, ad infinitum. Simply put, metabolism in all its dimensions—taste, excretion, satiation, health, and ill health—surfaces as a relational and contextual phenomenon scientists struggle to apprehend within clinical trial. Capital is generated

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607 There is a relatively long history of scientific investigation into glutamate’s role in neurodegenerative diseases like Alzheimer’s disease, Parkinson’s disease, epilepsy, and Fragile X Syndrome. Japan’s Daiichi Pharmaceutical Company has made inquiries into pharmacological treatments for Alzheimer’s disease designed to “[protect] neurons from over-stimulation by glutamate.” Brain Canada president Inez Jabalpurwala makes the case for increased investment in basic neuroscience research by pointing to a sobering reality: “The collective impact of brain disease is greater than cancer and cardiovascular disease combined. It’s the single biggest health burden for this century.” Daiichi Pharmaceutical Co., “Conclusion of an Agreement for Co-Development and Sales in Japan of the New Alzheimer’s Agent Memantine Hydrochloride,” March 19, 2002.

by increasing the rate and scale of glutamic acid excretion, on the microbial side, and of hedonic response, on the human and other animal side. The claim of the glutamate-producing and consuming industry is that as a naturally occurring amino acid, glutamate of any derivation may be consumed by humans with impunity. Underpinning both the bacterial and human dimensions of the MSG phenomenon is the assumption that biochemical context is irrelevant to questions of wellness or lack thereof—that bacterial and human bodies are knowable by their isolable chemical constituents and processes which, once mapped, can and should be optimised. Anecdotal MSG-reactivity in the form of headache, fatigue, depression, weight gain, or anxiety may easily be attributed to another event (stress, fatigue, other food source, etc.). The food industry’s disassociation of MSG with consumer red flags like ‘toxin’ and ‘drug’ is made possible by disaggregating a wide range of possible MSG reactivity and by endorsing an understanding of MSG as one source of a universal taste sensation that reflects an evolutionary imperative to consume necessary protein.

How does it matter that MSG has been seemingly legitimated, as an example of a twenty-first century metafood? At this historical juncture of unprecedented scales of technological change and unseen biological hazard, MSG’s history tells us something important about the stakes of relying on reductive, mechanistic assumptions about how bodies can be made to operate. Naturalising biocapitalism’s prerogative to redefine the possible—and assuming we have the ability to define the boundary between what is ‘natural’ (enough), what is a drug, what is a toxin, and what is a food—deceptively flattens questions of health policy. It appears greatly to matter, in the biochemical, ethical, and political senses, in the context a source of glutamate is metabolised. MSG’s conflation in industry discourse with endogenous glutamate reflects biomedicine’s occlusion of the ecological critique, of the evidence of life as relation, flux, or
becoming. Mechanistic scientific paradigms like that underpinning the de minimus standard neglect the observation that the relative health and development of living beings is determined at the “nexus of a very large number of weakly determining causal pathways.” In evolutionary biologist Richard Lewontin’s words, this “deep structural limitation of the experimental investigation in biology” ignores the observation that organisms are “internally functionally heterogeneous.” That is to say, we all work differently, at different times, in different places, and in different ways—or that the embodied time-space of glutamate metabolism matters.

The additive’s alternate constructions as food, drug, and toxin prompt us to reconsider how our taxonomies of the chemically novel can converge with a seemingly progressive project—namely, making more foods taste delicious for more people—to foreclose questions of corporate interest and evidence of non-human and human suffering. I do not have any simple answers. But I feel confident stating that the recent exoneration of MSG serves industry first and foremost—not any progressive goal of facilitating more ethical, more sustainable futures through scientific eating. A useful insight may be Jane Bennett’s thinking on the evidence of structuration or regularities within what she calls “agentic assemblages.” These she describes as webs of entities, forces, or phenomena that effect agency in the world while also evidencing

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609 Lewintor, Triple Helix, x.

open-endedness and unpredictability. MSG and other additive flavour enhancers have an observable or patterned quality to their effects (most people report increased savoury flavour, richness, more pleasing and longer ‘finish’ to a food, and some people report subsequent headache, dizziness, numbness, digestive distress, etc.). However, their material ‘agency’—their pharmacodynamics (what a drug does to a body)—intermingles with so many other pharmacokinetic (what a body does to a drug) factors that assumptions of linear causation and reproducibility make it difficult for any link between ingestion and harm to stick. Additive glutamates exemplify how capital circuits reward ontological simplifications by grafting onto bodily capacities tremendous economic stakes—stakes that require conceptual certainty to be made actionable within bureaucratic structures. Those dollar values translate into career trajectories, corporate annual earnings, Gross Domestic Product (GDP), and so forth—economic metrics that likewise translate into lived experiences and possibilities on the ground.

**Conclusion**

So, what can I say with any confidence when it comes to the genuine question people continue to ask: is MSG safe? More than a century ago, Ajinomoto scientists declared umami as a universal taste sensation, a level of savouriness uniquely conferred by glutamic acid’s metabolism in the human body. What makes any foodstuff good? Assignations of food quality may refer implicitly to such things as: superior provenance, technical preparation, aesthetic presentation, nutritional value, or freshness. Monosodium glutamate (MSG) and similar flavour-enhancing technologies choreograph sensory experience on the molecular level, in the brain and

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611 Bennett, *Vibrant Matter*. 
throughout the digestive tract—and from thence, throughout the body and mind. They are invisible yet palpable, standardized and yet deeply subjective. They redistribute the field of flavour experience in a rationalized sensory economy, one that has become integral to the global processed foods industry. As such, flavour-enhancing additives have for decades recalibrated the potential for product shelf-life and consumer appeal. They help make people desire products out of proportion to (relative to an individual’s previous sensory threshold) those products’ degree of freshness or nutritional value—that is, out of proportion with the ineffable descriptor that is food quality.

In chapter three I relayed the history of MSG’s implication in a “Chinese Restaurant Syndrome from 1968 onward—and in a syndrome or “symptom complex” from the late-1980s. These shifting ontologies of potential MSG toxicity describe a set of adverse health effects ranging from numbness and tingling to aggravated asthma, affective disorders, and gastrointestinal distress—even neurodegenerative conditions like Alzheimer’s and Parkinson’s diseases. I end with the working hypothesis that glutamate may act as a regulating signal, one that potentiates not only flavour—but also other actions like digestion, cognition, satiety, and energy homeostasis. It appears to me that not all glutamates (or umami tastants more broadly) are metabolically equivalent, owing to the widely varying metabolic contexts within which and scales at which they are consumed. The healthfulness of glutamates, then, is likely linked to the particularities of kind, rate, and quantity of absorption in a sensing body.

I argue that these nuances are lost against the commercial value of monosodium glutamate, as my flagship example of flavour enhancing technologies as a whole, to makes palatable all those food products comprised of less varied, less fresh, and less nutrient-rich ingredients. This rematerializing capacity of MSG, as a biocapitalist technology, facilitates the defining purpose
industrial food producers: to pursue corporate profitability secured by expanding their ‘stomach share’ of a given consumer base. Corporations’ primary purpose is to generate a return on investment for their shareholders. Their corporate social responsibility initiatives are peripheral to this goal—and I would say, are pursued only in so far as they facilitate that primary purpose. The creative destruction of reverse engineering deliciousness on an industrial scale matters because deliciousness maps onto pleasure. Learned pleasurable associations—as I elaborated in chapter five—write happiness onto the pleasure of consuming processed foods that are frequently unhealthful and unsustainably produced. Creative destruction in eating causes people enjoy the conditions of their own subjection. Eating is a sensory experience that is molecular that is affective that is political. Monosodium glutamate’s history illustrates the ways and stakes with which not only biotechnology and pharmaceutical firms, but also food producers, harness bodily capacities for the proliferation of capital—through capitalising metabolic capacities in the production of manufacturing efficiencies, brand advantage, and popular foodways (e.g. the anticipated pleasure of the routine McDonald’s lunch run). The politics of MSG’s proliferation and contestation in the U.S. prompts us to cultivate humility in the face of metabolic agencies that exceed the limits of our skin and of our credulity.
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