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Nation

ASIA'S MICROBIAL GARDENS AND JAPANESE KNOWLEDGE

> Microorganisms are a part of culture, like language and religion. They are a part of history.
> —Komagata Kazuo, professor emeritus, Faculty of Agriculture, University of Tokyo, in discussion with the author

Tōa hakkō kagaku ronkō (A Study of East Asian Fermentation Chemistry), published in March 1945, is an anthropological work which presents the history of fermentation technologies as a reflection on the abilities and culture of civilizations.[1] Its author, Yamazaki Momoji (1890–1962), was a Japanese agricultural chemist who had worked in Shanghai from 1914 to 1927 and subsequently was based in Utsunomiya, a prefectural capital in eastern Japan, from 1930. He won the prestigious national Suzuki Prize in Agricultural Sciences, the highest honor of the Agricultural Chemistry Society of Japan, for his pioneering book in 1945. As early as 1906, the botanist Saitō Kendō had called Japanese brewing microbes part of the diversity of "useful fermentation microbes of East Asia," and had thought of collections of such microbes as "gardens" that could allow research on their theory and application, from the tropics to the poles.[2] The work of these prominent Japanese microbial strain collectors—who were at once fermentation scientists and, in the case of Yamazaki, writers of anthropological study—reveals how Asia's microbial gardens looked to Japanese eyes, and how they were used in, and contributed to, Japanese knowledge.

This chapter and the next examine the construction of a national "Japanese" fermentation tradition by considering Yamazaki Momoji's 1945 book against the background of industrial alcohol production in the formal and informal empire. This chapter analyzes the intellectual structure of the understanding of fermentation history, and the next chapter traces the material development of alcohol production technologies. For these scientists, fermentation techniques were traditional technologies, possessing qualities including uniqueness and regionality—which, in turn, were qualities used

by other Japanese writers and anthropologists in a multiplicity of ways in their depiction of cultural traditions at the time.[3] The frequent portrayal of Japan as modern *and* Asian at the height of 1940s Japanese pan-Asianism, for example, relied on particular ideological and rhetorical uses of sameness between Japan and Asia. That is, sameness was often constructed around the region's cultural uniqueness vis-à-vis the West, while it was deployed to highlight a *temporal* contrast between an advanced Japan and a more primitive Asia.[4] As the historian Robert Tierney explains, Japanese imperial culture is best understood as a "triangular structure," in which "the West was always the (implicit) third party."[5]

Science and technology have rarely been considered ancient cultural traditions in Japan, whether by intellectuals in imperial Japan or by historians today. Existing scholarship has assumed those things to be Western, universalist, and modern, something of the "now." Thus, a focus on intellectual discourses of science and technology has turned up only the latter assumption. To practitioners in fermentation science, on the other hand, microbial technologies in Japan were seen not as Western transplants but as Asian technologies. The historian Hiromi Mizuno has argued compellingly that the term "science-technology" (*kagaku gijutsu*, a now ubiquitous and seemingly innocuous phrase which can also be read as "scientific technology") was coined by wartime technocrats to mean a self-sufficient system of technological development led by Japanese research and based on raw materials from Asia, in order to support the imperialist vision of a Greater East Asia Co-Prosperity Sphere (*Dai Tōa kyōeiken*).[6] Practitioners in fermentation science, however—who had remarkably little to say on such abstract subjects as definitions of science or technology—would have struggled to reproduce even the technocratic imperial discourse that guided wartime policies in their own field: the rhetoric of Asia as representing merely resources, and Japan as offering science-technology. For Japanese scientists and technicians working in the empire, how could scientific and technical knowledge's traditional nature, as well as its debt to Asia, be reconciled with the imperialist ideology of scientific modernization?

It was a question at the heart of Japanese scientists' deepest ambivalence about national identity. *Kōji* today is the unique "national microbe" (*kokkin*) of Japan that makes the geographically distinctive products of sake, soy sauce, and miso; yet it is known to originate from China.[7] The phrase *Tōa* (East Asia) itself, which Yamazaki used in the title of his work, was so closely associated with the imperialist ambitions of the wartime state that after the country's defeat in 1945 it largely disappeared from common parlance. Yet until 1945 the identity of Japanese fermentation traditions and

ultimately their function within modern Japanese political economy could only be defined in relation to *Tōa*—a fact of which Japanese scientists themselves were overwhelmingly aware. Here I read the Japanese accumulation of microbial strains and technologies within time-specific layers of visions of *Tōa*. Maps of *Tōa* were simultaneously mirrors of Japanese identity, but they nonetheless show how Asia's microbial gardens contributed to Japanese knowledge.

The regional reality was starkly clear to fermentation scientists, for several different reasons. First, local technologies—beyond Japanese or European technologies—were needed to develop economic products from the specific raw materials available in the formal and informal colonies. To this end, Japanese scientists working in the empire needed knowledge of local products. Alcohol fermentation research took place primarily in the Japanese empire rather than on the main islands, and it vividly reflected the use of regional knowledge in practice. Taiwan, especially, was important because of its sugar industry, which generated large quantities of molasses as a by-product, which were then used as media to grow microbes. Second, it was debatable and not obvious that Japan had historically leapt ahead of China and Korea in fermentation technology. Therefore, those scientists promoting the Japanese state's goals in the empire needed to draw on regional knowledge to make an explicit case for Japanese superiority. Both regional achievements and the historical debt to Asia needed to be reconciled with empire's ideological justification in terms of a civilizing mission, amid aims for practical economic integration in the empire on the part of statist elites.[8]

The practical problem became more urgent after Japanese forces broke away from the international consensus on empire in China by invading Manchuria in 1931. Consequently, the Japanese state's rhetoric shifted from presenting Japan as a Westernizing influence in Asia to emphasizing Japan's exceptional suitability as a leader in Asia vis-à-vis the Western powers due to Asian regional uniqueness.[9] Fermentation, in particular, was a body of scientific and engineering knowledge that grew to massive proportions during wartime, under the Allied embargo on gasoline exports to Japan. Chemical sites across the ambit of the Japanese empire, with synthetic or fermentation capability, turned to the problem of alcohol production for fuel substitution.[10]

Examining the work of practicing fermentation scientists, then, highlights the debt to Asia owed by Japanese scientific knowledge and, even more significantly, Japanese scientists' clear awareness that Asian contributions were centrally important *even* in science and technology. Yamazaki

Momoji's scientific work on history constructs a particular conception of the Japanese nation that must be understood in terms of comparison—not between Japan and Europe, as conventional accounts of modern science and technology have assumed, but between Japan and other Asian countries including Korea and China, even in the context of modern imperialism. In this chapter as well as the next, I thus respond to Andre Schmid's call (here paraphrased by Taylor Atkins) to "assess the effects of empire building on Japan's successful modernization process, rather than viewing the empire as the *outcome* of that process."[11]

Between 1945 and the years that followed lies a chasm in the way scientists verbalized their memory of Asia's importance, and a discontinuity in scientists' deep awareness of Asia. Immediately after Japan's defeat in the war, government officials, textbooks, and public discourse as a whole enforced this break by practicing what Carol Gluck has described as "a kind of 'transliterated history'": "The words changed, as if they were writing the past in another script. The Great Empire of Japan vanished from utterance, even in negative mention."[12] For the new generation of scientists who came of age during Japan's economic miracle, and amid the silence regarding Asia's significance in Japanese modernity, *kōji* accordingly became Japanese alone, while Japan offered technical assistance to countries in Southeast Asia as a major foreign aid donor with a record of modernization that was perceived to be exceptional.[13]

When recovering the positions inherent in scientists' accounts of Asia during the imperial period, it must be remembered that we expect *no conceptual coherence*. Since other structures of power were at play, ideologies produced by middling statist elites such as scientists and technicians were not required to do all or even most of the work involved in stabilizing colonial institutions. "On the contrary, duality, not to say duplicity, characterizes Japanese writings about the colonized," to put it in the words of the historian Robert Tierney. "Depending upon time and place, Japanese played up affinities between themselves and other peoples of Asia or stressed differences, claimed to represent Western civilization or asserted their absolute uniqueness. Accordingly, the Japanese rhetoric of sameness was not invoked consistently."[14] This is true for writings about both the formal and informal empire. The most striking feature of Yamazaki Momoji's 1945 text is schizophrenia. With the enormous effort displayed in Yamazaki's attempt to survey regional knowledge on fermentation, the very assertion that regionality was not important, which he felt compelled to make repeatedly throughout the work, is a reflection of Asia's monumental importance for Japan in his eyes.

Yamazaki Momoji's *Tōa hakkō kagaku ronkō* (A Study of East Asian Fermentation Chemistry) and the circumstances of its production and publication offer a glimpse into a pre-1945 vision of Asia (*Tōa* in Yamazaki's title) within which Japanese fermentation scientists worked. It was a world that all but vanished from public discourse after Japan's surrender in August 1945. The book was published in March 1945, immediately before the watershed in public memory. In more recent times, the *Study* is cited as a key source in *longue durée* technical works on the history of Asian fermentation, but the book is also remembered by older scientists who lived through the war as not unlike a symbol of the world lost. Whatever these scientists' intentions or hopes were regarding other Asian countries at the time, it is clear that they were keenly aware of Asia's contribution to Japanese modernity.

On a day in 1985, as part of a featured series on Japan's former higher agricultural and forestry schools (after the war, the higher school system was dismantled and many of the specialist schools were incorporated into universities), editors from the *Nippon nōgei kagaku kaishi* (Journal of the Agricultural Chemical Society of Japan) interviewed faculty and faculty emeriti of the Utsunomiya University Faculty of Agriculture, which was until 1944 the Utsunomiya Higher Agricultural and Forestry School (from 1944 to 1949 the Utsunomiya Agricultural and Forestry College).[15] There Yamazaki Momoji had taught since returning from China in 1930 until his retirement in 1953, first as a lecturer in agricultural products and applied microbiology, and then as the first head of the new agricultural chemistry department from 1945, which opened in the chaotic period preceding Japan's surrender; his title was changed to professor in 1950 after the school became a university. The higher school in Utsunomiya had been especially well known for its strength in foreign studies, teaching languages including not only English and German but also Russian, Chinese, and Spanish.[16]

The main gate of the university campus opened onto an old French-style garden, which students curiously called the English garden, leading to the entrance to the Faculty of Agriculture, where the interview was conducted.[17] As the agricultural scientists reminisced about former teachers, Komagata Kazuo, an agricultural chemist serving as interviewer from the journal, raised the topic of Yamazaki Momoji's 1945 *Study*, of which he had come to possess a copy. Even to that day it was the only work that had investigated Asian matters, he observed (here, of course, Komagata used the contemporary term *Ajia* for Asia, rather than *Tōa*). One of the interviewees, an agricultural chemistry professor who had himself graduated from

the college in 1948, recalled Yamazaki Momoji cutting a figure as a distinguished scholar even though he was only in his early fifties: dressed in Chinese clothing, having just published the book, having won the Suzuki Prize. To defeated Japanese, the interviewee remembered, the book was a work of epic grandeur in its ambitions to unite Asian and Western culture.[18] Later, the *Study* was introduced by the leading Japanese agricultural chemist Sakaguchi Kin'ichirō in the PR magazine of the publishing house Maruzen, where the work was called "an illusory masterpiece among the war damage." It was illusory because most of the three thousand printed copies had been destroyed in the air raids and not sold in bookstores, making physical copies of the book relatively uncommon.[19]

A highly "individual" personality who was interested in many things, from the experimental brewing of Shaoxing wine to the locating of raw materials in Japan for making tsatsai (a pickled mustard featured in Sichuanese cuisine), Yamazaki was, as one interviewee put it, a "famous local product" (*meibutsu*) himself, giving loudly applauded public lectures in town dressed in Chinese clothing and bellowing at the top of his voice. After the war he styled himself "Dr. Nattō," after the strong-smelling fermented soybeans distinctive to Japanese cuisine, and wrote pamphlets lauding the nutrition value of *nattō* and other protein sources: "Eat *nattō*! My daughter raised on *nattō* is more gigantic than me." He could no longer walk by then, and would send his student (one of the interviewees) to kindergartens to do *nattō* taste research on his behalf.[20] Students and guests at his home were entertained with homemade vodka along with Chinese preserved duck egg and Chinese fermented bean curd.[21] When Utsunomiya University began selling some of their experimental agricultural products to the local residents of the city as an outreach initiative, a popular product was one of Yamazaki's creations: a lactic acid drink called "Milkis," which resembled the commercial drink Calpis.[22] His preserved duck eggs and Shaoxing wine were also said to be sold in the city.[23]

Considering Yamazaki's work in the empire as an agricultural chemist brings us further down the layers of memory into that pre-1945 world in which the modern construction of a national "Japanese" fermentation tradition took place. Yamazaki was a microbial strain collector, and his contributions are materially embedded in the Japanese culture collections. After graduating from the agricultural chemistry department of Tokyo Imperial University, he moved to Shanghai in 1914 and conducted research on Chinese agricultural products while based at the Tōa Dōbun Shoin (East Asia Common Culture Academy). He published a study titled "On Shaoxing Wine" in the *Nihon jōzō kyōkaishi* (Journal of the Brewing Society of Japan)

in 1917, and completed his doctoral thesis for the Tokyo Imperial University Faculty of Agriculture in 1925, titled "Research on Chinese-Produced Fermentation Molds and Fermented Goods."[24] In between, Yamazaki returned for a time from the Tōa Dōbun Shoin to work in his mentors' laboratories at the agricultural chemistry department of Tokyo Imperial University. He isolated and investigated mold strains from the Chinese *kōji* materials he had brought with him, and his systematization of strains in the *Rhizopus* genus became the basis of his doctoral thesis.[25]

Like Yamazaki's contributions, the history of Japanese microbial type culture collections as a whole is quietly entangled with the history of Japanese empire, and with it the *material* construction of a national fermentation tradition. Around the same time that the botanist Saitō Kendō was gathering strains at the Central Laboratory of the South Manchuria Railway Company, Nakazawa Ryōji (1878–1974), a graduate in agricultural chemistry of Tokyo Imperial University, built an extensive culture collection in Taiwan. From 1911, Nakazawa worked at the Taiwan Government-General Research Institute, at first as a technician, and then from 1916 as head of the Brewing Science Department, later reorganized as the Fermentation Industry Department, Division of Industry, Taiwan Government-General Central Research Institute.[26] Finally, Nakazawa became head of the entire Division of Industry in 1937. From 1930 he was appointed professor in the Faculty of Science and Agriculture, Taihoku Imperial University. When Saitō Kendō and Nakazawa Ryōji returned to the home islands in 1927 and 1939 respectively, copies of strains from the Taiwanese and Manchurian microbial type culture collections followed them.[27] Hanzawa Jun's (1879–1972) laboratory in the Department of Agricultural Chemistry, Faculty of Agriculture, Hokkaidō Imperial University was another prominent center of strain collection on the frontier.[28]

The imperial heritage of Japan's culture collections was a noted fact. Sakaguchi Kin'ichirō (1897–1994) remembered being a third-year undergraduate in the agricultural chemistry department of Tokyo Imperial University who was charmed by Takahashi Teizō's talk of microbes while dining at his house one evening, and how he thus decided to write his thesis with Takahashi, using as his starting point Felix Ehrlich's study of fumaric acid production by *Rhizopus*. Yamazaki Momoji's isolation of many *Rhizopus* species from China at the time offered Sakaguchi the possibility of using experimental materials different from the strains Ehrlich was using, and of thereby doing original work.[29]

As Komagata Kazuo remarked in the 1985 interview, *Rhizopus* strains that Yamazaki had collected were still preserved and used by other re-

searchers at the Institute of Applied Microbiology at the University of Tokyo.[30] To return to Saitō Kendō's metaphor, if Japan's national microbial culture collections were like gardens, then they were built from other gardens and were consciously celebrated for doing so. They did not encompass only newly discovered strains. They drew on Asia's microbial gardens, in turn built knowledgably by Asia's industries, which had curated strains of useful molds and yeasts for locally distinctive manufacturing.

In Shanghai, Yamazaki Momoji worked during a time of increasingly difficult relations between China and Japan from the late 1910s through the 1920s. He was in Shanghai in the first place due to scientific exchange being a part of cultural diplomacy with China. The Tōa Dōbun Shoin, where he worked as a professor, was a semiofficial institution, since it was sponsored by the Tōa Dōbunkai (East Asia Common Culture Association), which in turn received subsidies and grants from the Japanese Foreign Ministry. Taking its name from the slogan *Dōbun dōshu* (Common culture, common race), the Tōa Dōbun Shoin opened in the early 1900s and served several purposes including intelligence and empirical surveys for the Foreign Ministry, as well as the education of both Chinese and Japanese in the name of idealism and friendship.[31]

The term *dōbun dōshu* had been used by Japanese politicians and journalists since the late nineteenth century to describe the belief that China's relations with Japan should be different from relations with the Western powers because China and Japan supposedly shared a special cultural affinity. After Japan's victory in the Sino-Japanese War of 1894–95, Japan gained privileges equivalent to those of the other treaty powers in China, and around this time there also emerged the idea of the "Ōkuma doctrine," or the notion, as the historian Peter Duus explains, "that the Japanese, in repayment of their cultural debt to China, should take an active role in pulling China up the steep path toward 'civilization'" and against Western encroachment in Asia.[32] Along with the Western powers, however, Japan operated in the uneasy equilibrium of informal empire in China within the structure of the unequal treaty system. Following Japan's acquisition of rights in Manchuria after the Russo-Japanese War of 1904–5, Japanese thrived in this informal system, and on the eve of Japanese forces' invasion of Manchuria in 1931, not only did Japanese residents in China outnumber those of all the other treaty powers put together, but Japan had displaced Britain as the dominant foreign economic power in China.[33]

Tensions heightened with the growth of Chinese nationalism after the 1911 revolution and especially in the 1920s. Chinese movements called for the broader dismantling of the treaty structure. There were four different

major anti-Japanese boycotts in China, all of which included Shanghai, between 1919 and 1928.[34] While the British were willing to contemplate a gradual withdrawal from empire in China, Japanese leaders were concerned that the stakes they held in China were particularly wide-ranging and of acute economic and strategic importance, even though in the 1920s they were strongly divided on the question of foreign policy in China. The Japanese Kwantung Army's assassination of the Chinese warlord Zhang Zuolin in 1928, followed by its invasion of Manchuria in 1931, finally pushed domestic political forces toward a "strong" China policy that departed from the international consensus on informal empire in China.[35] In 1933, faced with international condemnation, Japan withdrew from the League of Nations.

When it came to cultural diplomacy, as the historian Sophia Lee puts it, all the treaty powers "followed the same prescription: relief work and medical services for the masses, and, more important, education, especially higher education, for China's future elites."[36] In the decade after Japan's victory in 1895, Chinese students flocked in the thousands to schools in Japan. But these numbers, as well as Chinese student numbers at the Tōa Dōbun Shoin, collapsed after the Japanese government's issuing of the Twenty-One Demands to the Chinese government in 1915, which was a naked display of Japanese leaders' imperialist intentions in China.[37] Moreover, by the mid-1910s Chinese students had increased opportunities to study in modern schools elsewhere, both abroad in Western countries and at home. Japanese educators in China in the 1920s, such as Yamazaki Momoji, felt themselves to be on the defensive regarding the value of education for Chinese at a Japanese school or university, compared to education at a school in the United States or Western Europe, or at a Western (mostly American)-run missionary school in China. As Lee describes: "In 1918, one Diet member declared that the difference between the [Japanese-funded] Dōjinkai hospital in Peking and its neighbor, the [American Rockefeller Foundation-funded] Peking Union Medical College, was akin to the difference between the houses of common Japanese and the mansions of the Mitsui and Mitsubishi dynasties. He fretted about what the Chinese thought of the obvious disparity."[38] More Chinese studied in Japan in the 1920s and 1930s than in any other foreign country, but it was widely perceived that a Japanese education did not confer prestige.[39]

By 1923 the Japanese government, following the other treaty powers, was providing backing for cultural initiatives in China using Boxer Indemnity remissions, creating a China Cultural Affairs Office (Tai-Shi Bunka Jimukyoku) in the Foreign Ministry to oversee programs, followed by a

binational advisory committee in Beijing in 1925. (The China Cultural Affairs Office was quickly renamed the Cultural Projects Division, or Bunka Jigyōbu. This was due to Chinese opposition to the unilateral nature of the words *tai-Shi* [toward China], as well as to the use of *Shi* representing the Japanese phonetic character compound *Shina* for China, instead of *Chūgoku*, or the character compound meaning Middle Kingdom, which was used by China itself. However, the term *tai-Shi bunka jigyō* [toward-Shina cultural projects] remained widely used by Japanese until 1945.) The Cultural Projects Division subsidized Chinese students in Japan and Japanese hospitals in China, as well as the founding of two new research institutes. These were the Pekin Jinbun Kagaku Kenkyūjo (Peking Humanities Institute), which opened in 1927 and became "principally a Chinese organization headed by a Japanese sinophile," and the Shanhai Shizen Kagaku Kenkyūjo (Shanghai Natural Sciences Institute), which opened in 1931 and in the end turned out to be "strictly speaking a Japanese organization."[40] After Japanese troops incited conflict in Jinan in 1928, all Chinese members withdrew from the advisory committee and the Nanjing government no longer recognized either institution, though both institutions continued informal engagement with Chinese scholarly and scientific associations.[41] Of course, the Manchurian Incident in 1931 ended all possibility of negotiating a new agreement with the Nanjing government on the matter.

Yamazaki Momoji's activities in Shanghai in the 1920s included advocating for the establishment of the Shanhai Shizen Kagaku Kenkyūjo. His publications from the time demonstrate the ways in which he articulated the significance of scientific (especially agricultural) research for Sino-Japanese relations, and vice versa. Much of the rhetoric produced for a *Japanese* audience, such as an essay on negotiations for the new institute that appeared in the *Dainihon nōkaihō* (Agricultural Society of Japan Report) in 1924, is predictable as well as predictably jarring to post-1945 ears. That is, he invoked the trope of cultural sameness between Japan and China vis-à-vis the West, as well as of temporal difference between Japan and China. The essay was an apologetic attempt to justify Japan's bid for a special leadership role vis-à-vis the West in Asia, in the name of both national and universal welfare.

For example, Yamazaki stated in the essay that he had long been in Shanghai for the sake of developing Asia (*kōa*) and for the sake of humankind, devotedly conducting investigations and research on China's (*Shina*'s) agricultural products, believing in the necessity of opening the way to utilization and welfare.[42] For Japan to explore each of the various locations of Asia that were scientifically unknown, and to achieve widely framed comparative research with them, was a pressing need for the advancement of academic

research and industrial development.[43] Yamazaki believed in making the world an ideal state of mutual love between humankind, but also believed that there was a proper order to things; first, that Sino-Japanese cooperation should be strengthened and used as the root axis to establish Asianism (*Ajiashugi*) among Asian people (*Ajiajin*), and that only then should there be movement to a world of mutual love among humankind. Cultural projects, he believed, should be managed along this principle. Thus Yamazaki welcomed the participation of certain Western scholars in the new natural sciences institute, but believed that it should be mainly Sino-Japanese scholars undertaking the research.[44]

Speaking of his own promotion of agricultural science within plans for the new institute, Yamazaki stated that the new institute should determine its priorities for topics with the following three questions in mind: On which topics could Japan offer to the world reference materials from scientific research on China that were qualitatively and quantitatively superior? Which topics were likely to produce the best research results if the research was assumed to depend only on cooperation between Chinese and Japanese people? Which topics were most essential to China then and in the future? In all these areas, agricultural science must obviously come first, Yamazaki argued. He turned again to the special role that he believed Japanese research played in Chinese science, asserting that results obtained in Japan served as important reference materials in the Chinese context, due to China and Japan most resembling each other in their crops, farming tools, climate, and agricultural economy.[45] Here he referred to the Japanese archipelago as extending "from Hokkaidō in the north to Taiwan in the south" (formal colonies such as Taiwan were usually spoken of as being part of "Japan"), implicitly emphasizing its climatic range despite its small size compared with China. Finally, Yamazaki made a moral appeal to agriculture using the rhetoric of Japanese affinity with China in the realm of ethics, drawing on sweeping generalizations that were clichés of the period. The West's way was the quest for hegemony; the core of Eastern civilization was the kingly way. Japan was once lost and pursued the quest for hegemony, but now it had awakened to the kingly way. In the Chinese context, agriculture and the kingly way were supposed to be consistent with one another.[46]

When his words were directed to a *Chinese* audience, Yamazaki Momoji's apologetic arguments for regionalism in science were different. They gestured toward a yearning for cosmopolitanism and were drawn from his own research specialty. In the spring of 1928, Yamazaki addressed an audience of about two hundred faculty and students at the College of Agriculture of the National Central University in Nanjing (the university was later

reorganized into a number of institutions including today's Nanjing University), with the aid of a Chinese simultaneous translator who was an engineering graduate from Kyoto Imperial University. A summary of the talk appeared in the Kyoto-based popular science magazine *Warera no kagaku* (Our Chemistry) the following year.[47] In his address, Yamazaki began with an appeal to scientific internationalism, and then focused on its tension with national culture. He opened with the question of how exactly to contribute to global culture (*sekai bunka*), a question which he said had arisen like a chant in nations across the world since the Great War.[48]

A nation-state, Yamazaki said, was where each individual within the nation exercised their abilities—or talents, even—to improve and develop that nation's indigenous culture; if each nation of the world was so, then overall improvements and developments in global culture would appear. The various countries of Europe and America, compared to "our Asia" (*waga Ajia*), were more advanced in the natural sciences and their application, as was well known. But if "we Asian people" (*wareware Ajiajin*) merely followed European and American people, then in a hundred years or a thousand years, the difference would only increase and would not likely contract. An imitation could not be said to be a contribution to global culture. Thus how could Asia contribute to global culture? How could Asia *not* be an imitation of the West?

Yamazaki's answer was to use Asian history as scientific data. Initially he phrased it in the lecture as using Western knowledge, methods, and techniques as tools to conduct scientific research on Asia; but when he moved to the example of fermentation chemistry, it became clear what he meant. In the far East, like the ancient and large enterprise of the brewing industry, the perfect mastery of special kinds of fermentation fungi deserved admiration, he said. China (*Chūgoku*) was by no exaggeration a cornucopia of fermentation fungi, and it was an honor as well as a responsibility to the world that the same country bore to research those fungi.

As Yamazaki told his audience at the College of Agriculture, from 1914 to March 1927 he had resided in Shanghai, researching many Chinese classics in relation to the sciences. In his address he offered his impressions from exploring those books. Here he praised the people of the Chinese nation for their gift for observation of natural phenomena as well as their matchless flair for applying the results to everyday life. The only regrettable thing, he said, was that it was not written, "Why is it so?" The *Honzō kōmoku* (the Japanese reading of the sixteenth-century Chinese classic in materia medica), for example, mentioned the substance *shingiku* (神麹), which

was still sold in drugstores and had been used as a digestive for about six hundred years.[49] When one conducted research on it, he continued, one found that it produced various kinds of enzymes and consisted of many fungi. Several decades ago, he explained, the digestive Takadiastase, a commercially popular enzyme preparation, had been invented and it, too, was made from fungi.[50] If six hundred years ago the question "Why is *shingiku* effective?" had been investigated, it would have represented advances in bacteriology and enzymology in China that would have been far ahead of Europe; for in the Yuan dynasty, China would already have had the discovery of diastase, he speculated. Similarly, the heat sterilization methods known as pasteurization had been carried out for wines in China six hundred years before—and in Japan two hundred years before—the time when they were discovered by the great French scientist Pasteur. If the question of why those methods were good had been researched, a Chinese bacteriologist would have preceded the pioneering Pasteur by more than five hundred years.[51]

Whether or not the reader agrees with Yamazaki Momoji's imagination of counterfactual timelines in the history of science is beside the point. The point is that Yamazaki's arguments extended from strategies of scientific inquiry that were already being used implicitly by Japanese chemists of the period in their work. For example, one of Yamazaki Momoji's mentors at Tokyo Imperial University, the agricultural chemist Suzuki Umetarō, claimed to have a research strategy that centered on a knowledge of local materials and that it eventually led to Suzuki's isolation and characterization of vitamin B from rice bran.[52] By Suzuki's account, his own mentor when he had studied in Germany—the chemist Emil Fischer—had advised him that upon his return to Japan he should focus his research not on proteins, as everyone in Europe was doing, but on problems distinctive to the East, such as rice. The reason, Fischer warned, was that if Suzuki followed the European fashion to investigate proteins, he would be unable to compete successfully for priority with chemists in Europe who were equipped with facilities far superior to those available in Japanese laboratories.[53]

The historian of chemistry Kaji Masanori makes a similar argument for organic chemist Majima Rikō, who discovered urushiol, the key ingredient in Japanese lacquer: "His research strategy involved *studying the structure of the components of Japan's local natural products using newly developed methods from Europe* to catch up to and compete with chemists in more advanced countries in the West. Majima's approach became the primary research method employed by organic chemists in Japan until the 1950s."[54]

The focus on local natural products and traditional industry within organic chemistry was part of a more general trend in Japanese chemistry as a whole, which extended across the first half of the twentieth century, as I have detailed for agricultural chemistry in chapter 1 of this book, and which began when modern science was institutionalized in Japan in the late nineteenth century.

As Kaji Masanori notes, and as I have argued in chapter 1, Japanese chemists were practical people engaged in experimentally oriented work, who were generally silent on the broader intellectual implications of their research for society. By explicitly encouraging scientists to use Western science as a tool to perform "Asian" (*Ajia no*) research on traditional industry and local products, and articulating its significance as a contribution to "global culture," Yamazaki Momoji took what Japanese scientists, particularly chemists, had consciously used as a national resource to achieve contributions within international science, and rhetorically turned it into one that was nationalistic. His narrative for the Chinese audience redrew the national unit of "Japan" to encompass instead the regional unit of "Asia," and appealed to a grander sense of history, referring to classical documents rather than industrial practices. At the same time, Yamazaki softened any emphasis on cultural sameness and temporal difference. Instead of sameness, he referred to China and Japan's responsibility to cooperate as "the two great independent countries in Asia." He took the trouble to defend himself against the accusation of promoting "cultural invasion," by arguing that his own name, which they could see written on his business card, was indebted to the Chinese cultural invasion of Japan, and that if not for China's and later the West's cultural invasions, Japan would be "as primitive as the South Seas" and not "one of the world's great powers."[55]

The formulation of an intellectual current in science that was self-consciously cosmopolitan-regional-nationalistic was Yamazaki's own expression of the motivation that eventually produced his *Study*. It was opposite to and in tension with the statist technocratic rhetoric of the Japanese role in "developing Asia" (*kōa*) that Yamazaki employed for a Japanese audience—a rhetoric that downplayed the historical existence of Asian scientific knowledge, prioritized provincialism over cosmopolitanism, and emphasized the appropriateness of Japanese leadership in the Western-style scientific modernization of Asia. The schizophrenia in Yamazaki's 1945 *Study*—driven by his interwar research in China using historical Chinese documents, but synthesized for a Japanese wartime readership—results from his hopeless attempt to reconcile the two contradictory ideological currents. The work remains today the most extensive definition of the iden-

tity of a "Japanese" fermentation tradition, and it is accomplished mainly through comparison with China and Korea, rather than with the West.

THE ORIGINS OF *KŌJI*

What exactly it is that makes *kōji* Japanese, rather than Chinese, Asian, or something else, is a question that has been answered directly by Yamazaki Momoji alone. H. T. Huang's volume *Fermentations and Food Science* in Joseph Needham's Science and Civilisation in China series, published in 2000 and comparable in length to (though differing in scope from) Yamazaki Momoji's *Study*, is the most extensive English-language account of Asian fermentation history to date and does not take up the issue.[56] The mold preparation *kōji*'s bearing on national identity has had a new resonance following the addition of "Japanese cuisine" (*washoku*) to the UNESCO Intangible Cultural Heritage list in 2013.[57] Although *kōji* is today the "national microbe" of Japan, the question does not necessarily arise; when it does, it is consistently Yamazaki's answer that is given, though direct reference to his work is left out as often as it is included. Yamazaki's answer, developed in the *Study*, is therefore definitive to the present day, and it is the following: Only Japanese culture uses *barakōji* (散麹) or *Aspergillus oryzae* to make wine (酒), whereas Chinese and other East and Southeast Asian cultures use *heikiku* (餅麹) or *Rhizopus* and *Mucor* to make wine from cereal grain (fig. 3.1).[58]

These are the two principal forms of mold preparation for brewing, also made from cereal grain. They share a common name in Chinese and Japanese, 麹 (Japanese: *kōji*; Chinese, Modified Wade-Giles as used by H. T. Huang: *chhü*), but *barakōji* is in loose granules, while *heikiku* is in cakes. Microbially, the fermentation ethnologist Ishige Naomichi puts the difference thus: "In China and Korea, *Rhizopus* and *Mucor* spores are placed on the outer surface of loaves of wheat flour that have been soaked in water before being kneaded. In Japan *Aspergillus* mold is cultivated on steamed rice, being placed on the surface of each individual grain."[59] H. T. Huang elaborates when describing mold cakes: "Conditions in the interior of the cake tend to favor the growth of *Rhizopus* species, while those on the surface, of *Aspergillus* species."[60] The difference has been explained in terms of color. In historical Chinese texts, for *barakōji* the appearance of mold on loose granules was described as a "yellow robe," whereas in *heikiku* making the appearance of a multicolor mold "coat" on the cakes was noted as a sign of the preparation's maturity.[61] The agricultural chemist Sakaguchi Kin'ichirō calls Japanese application of the yellow-green *barakōji* mold form in fer-

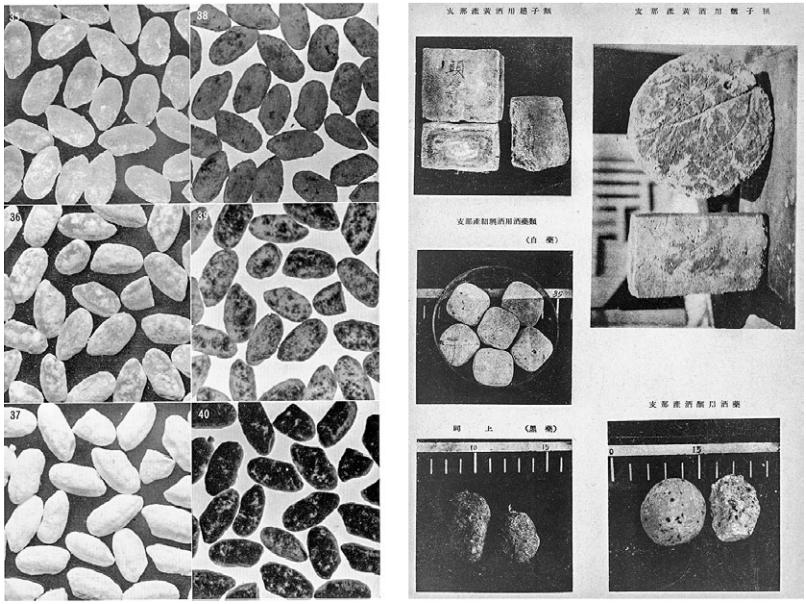

FIG. 3.1. The two main types of mold preparation used in brewing, both called 麹 (Japanese: *kōji*; Chinese, Modern Pinyin: *qū*, Modified Wade-Giles: *chhü*). Left: *barakōji* (散麹) or *Aspergillus oryzae* on individual grains, from Murakami Hideya, *Kōjigaku* (1986), front matter. Reproduced with permission of the Brewing Society of Japan. Right: *heikiku* (餅麹) or *Rhizopus* and *Mucor* in cakes or bricks, from Yamazaki Momoji, *Tōa hakkō kagaku ronkō* (1945). Reproduced with permission of Daiichi Shuppan.

mentation processes "monochromatic" across the entire product spectrum, from sake to soy sauce to miso, while Chinese and other Asian societies employ polychromatic *heikiku* preparations for wine, but yellow-green *barakōji* for condiments.[62]

Therefore, the so-called uniqueness of Japanese culture's use of *barakōji* applies to wine only. For the similar yellow-green *Aspergillus* mold preparations used in *other* fermentation processing, such as for shōyu, tofu, fermented fish products, and vegetable and meat pickling, the strength of historical regional commonalities and connections across Asia is evident and uncontested. The use of *Aspergillus* molds in miso and shōyu brewing in Japan, for example, is widely understood to have resulted directly from the transfer of Chinese fermentation processes.[63] The multiple meanings of the term *kōji* in Japanese also help to obscure the question: *kōji* is used by brewing specialists in a vernacular way to refer to brewing microbes of the *Aspergillus* genus, especially *Aspergillus oryzae*, as opposed to *kekabi* (*Mucor* genus) and *kumonosukabi* (*Rhizopus* genus) microbes, well as for the mold preparation as a whole. Unlike Huang's book, which spans a range of

fermentation products in China, Yamazaki's *Study* focuses on wines alone. Covering East Asia (*Tōa*), it is a compilation of four sections of surveys on China, Japan, Korea, and "areas surrounding China," in that order and at successively decreasing length, tracing the evolution of *kōji* making and winemaking as they relate to their surrounding agricultural and food systems, and beginning with prehistory but based mostly on the historical texts of the respective society.

As to *why* the difference arose, the enzymologist Kitahara Kakuo as late as 1974 cites the "mutation theory" in Yamazaki's *Study* as the only response in existence.[64] The mutation theory appears three times in the work, and only in the Japan sections, in connection with *kōji* making. It serves to punctuate remarks on the independent creativity of the Japanese race, whereby accomplishments "prove the excellence of the *Tenson minzoku* [race descended from the gods] who make up the mainstream of the Japanese race."[65] Each time, Yamazaki finishes: "The author is convinced that the *Tenson minzoku* actually appeared by a mutation."[66] The race's "sensitive skill" is apparently shown by the route of its discovery of *kōji*: "That when awareness of the efficiency of molds [*kabi*] has heightened, they would begin to make deliberate effort toward methods to propagate molds on steamed rice [*han*] and dried cooked rice [*hoshii*], and then advance to making '*kamutachi*' [*kōji* mold preparation]—this is only natural." For a race who had "already gone so far as to succeed in selecting excellent rice," such achievements as "the manufacture of '*kamutachi*' and the experiential selection of mold species" would not take special exertion to realize, Yamazaki writes.[67]

The mutation theory should thus be understood in the context of the question of the independence of Japanese culture from the Asian continent. The question opens and closes the Japan section within the *Study*, but is not mentioned in the other three parts of the work. In the opening words of the Japan section, Yamazaki sets out to place the common assumption that "the brewing methods of *Nihonshu* [sake] were transferred from Korea and China" under the "necessary" scrutiny of "scientific investigation."[68] The conclusion of the Japan section reiterates: "China's and Korea's influence is not apparent beyond trivial details of tools and operations."[69] In the *Study*'s conclusion, the wrap-up of the Japan section adds to the list of Japanese achievements "the excellent *Nihonshu*, which has no equal in East Asia nor the world."[70] The mutation theory, which Yamazaki self-consciously states as a sheer assertion, serves therefore to accentuate the *Study*'s commitment to the absolute independence and uniqueness of Japanese culture, which is repeated throughout the Japan sections.

Yet the mutation theory is clearly not the primary driving force in the work, as betrayed by the *Study*'s ultimate conclusions. The real contradiction at the heart of the *Study* lies in the measures of scientific worth, or modernity, by which the mutation theory is articulated, and the ways in which the mutation theory relates to the other sections of the work, especially the China sections. In the *Study*'s overall conclusions, Yamazaki writes of how the "*Tōa minzoku* [East Asian race] with their sensitive intuition" have "serendipitously produced" mold preparations and cereal wines.

> In this way, only the Japanese and Chinese races have each independently accomplished these things, and it is not seen at all in other races and peoples. The Japanese race has in the aspect of "*getsu* 糵" (*barakōji* 撒麹) achieved unique discoveries and inventions, and responded to the efficiency of indigenous fungi and skillfully used and mastered them. The Chinese race has regarding "*kōji* 麹" (*heikiku* 餅麹 and *shuyaku* 酒薬) achieved unique discoveries and inventions, been engrossed in their devices and improvements, responded to the efficiency of multiple genera of fungi, and ingeniously used and mastered them.[71]

He ends the conclusion with a statement on the global stage of science, namely, his hopes for the place of East Asia in the world and the relevance of East Asian fermentation to the modern chemical industries. Specifically, he makes a plea for how the problems of high energy consumption and waste production—in the synthetic processes that are typical of modern industrial chemistry—might be surmounted by fermentation processes with their ambient pressure, low temperature, and biological catalysts.[72] (This very idea would be picked up globally in the late twentieth century, and has recently become a key focus of contemporary materials research.[73]) In an effusively subjective afterword, after again hammering down his belief in the "mutational superiority" of the Japanese race, he writes: "I eagerly await the day when East Asian fermentation chemistry reigns over the world."[74]

The irreconcilable paradox of Japanese uniqueness lies in this fact: that it can only be articulated in a work that focuses on China, written by a scientist who has devoted the greater part of his career to studying Chinese fermentation processes. In the *Study*, Chinese achievements are the benchmark by which Japan's own modernity is measured. Chinese independent creativity is taken for granted and does not need to be proved, unlike that of Japan. In order to fit the study's framework to the ideology promoted by the wartime state, the main challenge that Yamazaki faces is not the development of the mutation theory, but rather the establishment of the

steps necessary to essentialize Japanese *and Chinese* modernity as equal and opposite to each other. Just as the theory of Japanese uniqueness is inherently contradictory—after all, if there was no influence on Japanese identity from the Asian region, then why is it that Japanese identity can only be defined in intimate comparison against the region?—he is set to fail before he begins, if that is his primary goal. The argument for absolute Japanese cultural independence cannot be made any other way, but neither can it be made convincingly. Yamazaki's admiration for China is more apparent to the reader, as well as his unshakable awareness that Japan relies on the scientific knowledge of a vast region in Asia to find a leading place in a modern world dominated by a Western order—no matter how many times he repeats the mutation theory. However, the mutation theory is nonetheless the core of the *Japan* part of the *Study*, and it has been the work's main afterlife since the fundamental shift in the Japanese worldview later in 1945 made Yamazaki's East Asian frame unacceptable. As an explanation, it is tautological: Japan is unique because it is unique.

Such interpretations still have a place because the answers remain underdetermined by the evidence—whether textual, archaeological, or genomic—to the present day. Scientists who address these historical-mythological questions are wary of treading on the edge of a minefield.[75] A few things are agreed upon by scholars. First is the primacy of mold in East Asian grain fermentation, a technique unknown in premodern Europe, where an analogous function was performed by malt (cereal grain that has sprouted; in Europe, sprouted barley), since enzymes that break down proteins and turn starch into sugar are produced by brewing molds and malt alike. Second is that all the important developments in China date back to the Han dynasty (206 BCE–220 CE) or before, and in Japan they date at least back to the time of the tenth-century code the *Engishiki*.[76] Third is that the way Chinese, Korean, Japanese, and Southeast Asian developments relate to one another is not yet clear for *kōji*, whether it pertains to its application in winemaking or in fish fermentation.[77] If the world of origins far back in time is indeterminate, however, it is of interest because, in the words of one novelist describing those who construct their own life in the narration of it, "it tells you what they value, not what happened."[78] In debates on the origins of *kōji*, we see the changing weight given to awareness of intra-Asian historical connections in constructing Japanese modernity.

The historian Hiromi Mizuno has insightfully detailed intellectuals' moves to reconcile the wartime ideology of national uniqueness and superiority with scientific universalism, including attempts by "Japanist" scientists to claim that different races produced different sciences, as well

as key efforts to canonize the "scientific" in the Japanese classics.[79] But according to her analysis, these intellectuals' struggles pivoted entirely on a Japan-West axis. Practitioners of fermentation science, too, who were far less articulate than many of the philosophers and humanists whom Mizuno considers, faced the problem of recovering a "scientific" past for Japan as they worked toward goals set out by the state. Yet their conflict between modern national identity and scientific universalism turned above all on a Japan-Asia axis, even while a number of the leading scientists worked in colonial locations. This unintuitive dynamic of ambivalence toward Asia in conceptions of scientific modernity is understudied in the historiography of modern Japan.[80]

The reticence itself on the question of origins is a postwar phenomenon, a burying of the transwar consciousness. In conversation in 2012, one retired agricultural chemist in his eighties chose an off-tape moment to speak to me of the ways in which microbial classification can trace historical cultural flows across southeast and east Asia. At a Japanese symposium titled "The Culture of Food in East Asia" in 1981, Sakaguchi Kin'ichirō began a talk on fermentation by jokingly apologizing for telling a "boastful . . . old-fashioned history."[81] Today, the highlights of fermentation history as told by Japanese scientists have shifted to other, more domestically focused questions: the medieval roots of the practice of saving *kōji* spores from the last brew to make the next brew (*tanekōji* making); the evidence for the taming and speciation of the *kōji* microbe *Aspergillus oryzae* from the wild, closely related, aflatoxin-producing microbe *Aspergillus flavus*; or simply the ways in which yeast is a much better model organism for genetic studies than *kōji*, and why not many microbiologists work on *kōji* anymore.[82] Chinese American H. T. Huang's definitive English-language study of fermentation history is drawn on a different map than Yamazaki's, and it encloses present-day China as a national unit. Yamazaki's map, by contrast, is bounded by *Tōa* (East Asia) and drawn specifically to make his studies in China relevant to the Japanese question of national origins. That map is no longer acceptable, and so the category of *Tōa* is at the center of the question's—and the *Study*'s—problematic nature.

Both Huang (as part of the broader goals of the Needham series) and Yamazaki aimed to showcase coherent, culturally specific scientific traditions that were viable alternatives to Western civilization in China's and *Tōa*'s fermentation histories respectively (table 3.1, row 1). With the Science and Civilisation in China series, Joseph Needham's goal to render, in comparativist and civilizational terms, the extent of China's "precedence

TABLE 3.1. Summary of the comparison between Yamazaki Momoji's *Tōa hakkō kagaku ronkō* (A Study of East Asian Fermentation Chemistry, 1945) and H. T. Huang's *Fermentations and Food Science* (2000)

	Yamazaki, *Tōa hakkō kagaku ronkō*	**Huang, *Fermentations and Food Science***
1. Object of analysis	Essentialist modernity in *Tōa*	Essentialist modernity in China
2. Status of fermentation science	Globally weak (1945)	Globally strong (2000)
3. Primary measure of scientific progress	Saccharification method (depicts China and Japan as equal and opposite)	Use of step separation and pure culture (highlights obstacles to Western-style modernity in China)

and influence" in modern science also "functions as a critique of Western civilization," as Robert Finlay argues.[83] On the other hand, the categorization of *Tōa*, too, has a longer history, rooted in Japanese thinkers' desire to both present a civilization led by Japan that could compete with the West, and increase the weight of Japan vis-à-vis China within that region. As Jung Lee explains, the earliest use of the term was in the title of the Japanese translation of Ernest Fenollosa's *Epochs of Chinese and Japanese Art* in 1921—a work which, Benjamin Elman argues, drew its depiction of the aesthetic decline of Chinese art since the Song dynasty and the rise of Japanese artistic achievement in the modern period from Euro-American responses to Japanese victory in the Sino-Japanese War (1894–95). The term *Tōa* became widespread in parallel with the expansion of Japanese imperial aggression in China in the 1930s, and the vision of a Greater East Asia Co-Prosperity Sphere (*Dai Tōa kyōeiken*) in the 1940s during the Asia-Pacific War. Implicit in the term was "the claim that Japan had the unique ability to combine *Tōa* traditions with good things from the West."[84]

In fermentation histories of Asia today, we find a variety of maps that illustrate cultural zones (fig. 3.2). One can have a fish zone and a soy zone, in southeast and northeast Asia respectively; one can have a nation-microbe chart in which nations are colored according to their different predominant winemaking molds (*kumonosukabi* and *kekabi* for most of China, Korea, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia, and Vietnam, as well as Malaysia and Indonesia; yellow *kōji* microbes for most of Japan; black *kōji* microbes for southern Kyūshū, Okinawa, and Hachijō; and red *kōji* microbes for Taiwan and Fujian). One can have a polycultural history of Japan pursued through ethnochemistry, focusing on chewing-method wines, malt-method wines, or regional traditions.[85] But *one cannot have an East*

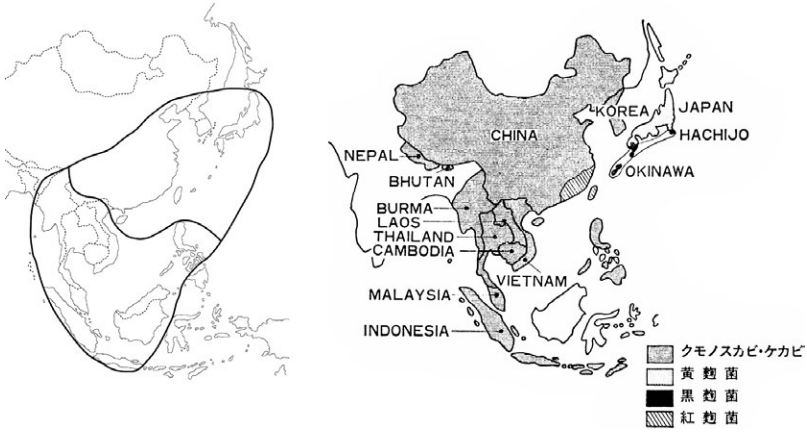

FIG. 3.2. Maps of traditions of fermentation in Asia. Left: fish fermentation zone in southeast Asia, and soy fermentation zone in northeast Asia. From H. T. Huang, *Fermentations and Food Science* (2000), fig. 88, after Ishige, "Fermented Fish Products" (1993), fig. 6. © Cambridge University Press 2000; reproduced with permission of Cambridge University Press through PLSclear. Right: nation-microbe chart. Microbially, the vernacular mold names translate as the following: *kumonosukabi* (*Rhizopus*) and *kekabi* (*Mucor*) for most of China, Korea, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, and Indonesia; yellow *kōji* microbes (*Aspergillus oryzae*) for most of Japan; black *kōji* microbes (*Aspergillus luchuensis*) for southern Kyūshū, Okinawa, and Hachijō; and red *kōji* microbes (*Monascus purpureus*) for Taiwan and Fujian. From Sakaguchi Kin'ichirō, "Hakkō" (1981), fig. 5.

Asia. This is why, fifty-five years later, H. T. Huang cites Yamazaki's *Study* cursorily and with puzzlement, misreading the author's name as "Yamasaki Hiyachi," and only because the *Study* continues to be cited by Fang Hsin-Fang, one of the preeminent Chinese scholars on whom Huang's synthesis relies.[86]

Huang narrates from a much stronger position than Yamazaki since, between 1945 and 2000, fermentation methods did become staple parts of global industrial chemistry (table 3.1, row 2). Where Yamazaki ends his book on his hopes for fermentation in the modern world, Huang finishes on the real accomplishments of mold fermentation in contemporary enzyme production, and places Japan's scientific role in its development alongside the West's.

> [A person who has] never heard of the word *chhiū* or *koji* [still experiences its enzymes or others inspired by it] each time he/she consumes a piece of cake, drinks a glass of clarified fruit juice, gulps down a tankard of beer, gobbles a slice of bread, eats a bowl of fast-cooked oatmeal, inserts a piece of processed cheese in a sandwich, sprinkles grated Romano cheese on spaghetti, or pours corn syrup on a pancake or waffle.[87]

In Huang's account, modern Japan is a key node for the assimilation in Asia of Western scientific methods, such as the use of pure culture for mold preparations, *and* for facilitating the flow of fermentation methods in the opposite direction *from* Asia to the United States and Europe, "because [Japan] was the first country in East Asia to become industrialized."[88]

Yet both Huang's *Fermentations* and Yamazaki's *Study* share a primary concern to look back upon the past and find a modernity in Asia that measures favorably with that of the West. Huang's strategies, then, tell us something about the strategies at Yamazaki's disposal as well as his constraints, by way of contrast. Huang's and Yamazaki's measures of scientific progress (table 3.1, row 3) converge substantially, as both are trained chemists. Where their focus of comparison differs, it is due to a difference in audience: a wartime Japanese audience for Yamazaki, and an English-speaking audience at the turn of the twenty-first century for Huang. Whereas Huang puzzles over obstacles to Chinese modernity, Yamazaki aims to show that East Asia is a region superior to the West.

H. T. Huang's line of progress is similar to that of Needham's Science and Civilisation in China series as a whole.[89] It is the trajectory of European science, and he compares China directly to Europe. He demonstrates that Chinese civilization was precocious by tracing the origin of cereal wines in China to around the period when beer appeared in Mesopotamia.[90] Addressing why the two civilizations diverged in the saccharification method (the process for breaking down starch into sugar), he attributes the lack of mold fermentation in the West to a combination of nature—that is, microbial ecology—and the historical path of cooking technologies, whereby grains were ground into flour to make bread, instead of being dehusked and steamed as in China.[91] Huang asks why China nevertheless did not achieve the results of Western science. His measures of worth center on the separation of the saccharification and alcohol fermentation steps, and on the use of an inoculum from the last brew as a precursor to pure culture—both of which were implemented in premodern Europe, but not in China.[92]

Huang sees these operational changes as a reflection of a capacity for scientific analysis, and thus his categories have a tautology too. As the analytical components, he takes for granted the concepts that already existed in modern science when it was imported to East Asia from the West—saccharification and alcohol fermentation as individual chemical processes, and microbes as isolated pure-cultured strains. He does not consider them as simply magnifications of existent process divisions in premodern Europe. In European beer brewing, for example, malting occurs separately *before* alcohol fermentation, but in Chinese mold brewing the saccharifica-

tion and alcohol fermentation steps are performed by the mold preparation simultaneously. So in the latter process only, there is no *operational* basis for a conceptual division between the two.[93]

Yamazaki's line of progress differs from Huang's. It runs from single-fermentation wines (such as grape wine and other fruit wines), in which only alcohol fermentation of the raw material is needed, to compound-fermentation wines, in which *both* saccharification and alcohol fermentation of the raw material are required (steps for the breakdown of starch into sugar *and* of sugar into alcohol, as are demanded by cereal wines).[94] Alcohol fermentation occurs spontaneously where sugar is present, as wild yeasts from the air settle on the raw material and carry out the conversion. This means that single-fermentation wines exist in nature without human intervention. In compound fermentation, on the other hand, yeasts likewise perform the alcohol fermentation step, but the saccharification step does take human invention, or what Yamazaki calls "intellect and sensitive intuition."[95] Yamazaki's main object of comparison is the saccharification method in compound-fermentation wines.[96]

In this way, in the first few lines of the *Study*, Yamazaki divides the world's civilizations into two, between the "Western (*Seihō*) cultural sphere," where malt (sprouted barley) is employed to perform saccharification and the exemplary product is barley wine (beer), and the "East Asian (*Tōa*) cultural sphere," where mold is employed for saccharification and the representative product is *chō* (醴; an ancient Chinese ritual wine, and to Yamazaki the prototype of all rice wines).[97] He emphasizes that while East Asia had known of malt methods since ancient times, the premodern West did not know of mold methods. His measures of scientific worth thus place East Asia at the pinnacle of progress in compound fermentation methods, superseding the West. They give him a rationale to consider East Asia only, and in the rest of the book he focuses on identifying the fundamental principles of winemaking methods in China, Japan, and Korea, and on describing how they developed in each nation.[98]

Nonetheless, Yamazaki and Huang's measures of worth converge in their commitment to finding a modernity in Asia. For them as chemists, it means uncovering a moment of innovation—that is, a route of serendipitous discovery—of the mold preparation, and then investigating the magnitude of its influence upon surrounding civilizations and the world. Both use elaborate flowcharts to think through the moments in the past at which the opportunities for serendipity would likely have arisen. Both argue that the technology of cooking pots for processing grain led to the invention

of mold preparations in China, and that there was a significant change in the nature of the mold preparations with the shift from stone tools to clay pottery, which allowed grain to be steamed.[99] For both authors, Shaoxing wine exemplifies a tradition of core principles of Chinese winemaking that is continuous to the present.

Yamazaki describes Chinese mold preparation for wines as beginning with *getsu* 蘗 (meaning loose granular *barakōji* in his interpretation), which was displaced by *kōji* (meaning *heikiku* wheat-flour bricks in his interpretation) in the Han dynasty. In central China during the Song dynasty (960–1279 CE), these northern Chinese *heikiku* traditions were then synthesized with independent southern Chinese traditions of *sōkiku* 草麹 (mold preparations involving medicinal herb leaves) to create *shuyaku* 酒薬—an intermediate between *sōkiku* and *heikiku* that was closer to the latter, and which represented a compilation of methods from across northern and southern China.[100] Early wines in the Neolithic period, such as *chō*, were made by applying mold to what were probably congee preparations (*birei* 糜醴), but in the Northern Wei dynasty (386–535 CE), many wines were made by applying *heikiku* to steamed rice preparations. In Yamazaki's account, there were three major milestones in Chinese winemaking: the rise of the *shuyaku* form of mold preparation, the replacement of congee by steamed rice (*funrei* 饙醴) as the primary raw material for fermentation, and the implementation of heat sterilization in wine storage. These three developments culminated in the Song dynasty in the creation of Shaoxing wine, which for Yamazaki is the emperor of all Chinese wines.[101] Huang's milestones for Chinese wines generally match Yamazaki's, with the establishment of mold preparation making by the Zhou dynasty (1046–256 BCE), the emergence of the wheat-flour cake as its dominant form during the Han dynasty to be later modified by southern-inflected *shuyaku* technology, and the continuity represented by Shaoxing wine.

There are three key differences between Huang's narrative and Yamazaki's, besides the millennial endpoint. The first concerns the interpretation of the word *getsu*, which I discuss further below. Second, Huang places greater emphasis on the emergence of the highly distinctive "red *ferment*" (*benikōji* 紅麹, microbially dominated by *Monascus purpureus*), which is specific to Fujian province, in the Song-Yuan period (960–1368 CE). This is partly because his ancestral village is near Fuzhou and he first learned of the variety of Chinese fermentation processing techniques there, as he movingly describes in his author's note.[102] Third, Huang mentions the *transmission* of Chinese wine methods to Japan.[103] The application of sprouted rice

(malt) to steamed rice to make wine, he suggests, was transmitted to Japan as *rei* 醴 and became today's *amazake* 甘酒 (a sweet wine with a low alcohol content, which is often drunk at festivals).

By contrast, for the *Japanese* origins of the mold preparation, in place of a route-of-discovery flowchart, Yamazaki Momoji has a personal anecdote from his youth. He recounts memories of himself and his siblings leaving *sekihan* rice as an offering at the Shintō altar at home and often forgetting to clear it. When under scolding from his family he would finally remember to clear it, he would see that mold had grown. He imagines Japan's Neolithic people cooking, storing, and carrying rice in pots, and forgetting to clear their offerings to the gods in the same way.[104] This is how Yamazaki argues that Japan discovered the mold preparation independently, unlike in Huang's narrative of transmission; and he makes the moment of discovery both a nationalistic and an emotive one by connecting it to Shintō rituals in his family home during his childhood.

Yamazaki traces Japanese winemaking from the spontaneous emergence of *amazake* in the sweetness of moldy congee, to the deliberate cultivation of mold on freshly steamed or dried cooked rice (*han* 飯 or *hoshii* 糒) to make *kamutachi* 加無太知—the mold preparation. The latter marks the actual moment of discovery, and it is the first place in the book where Yamazaki states the mutation theory. Applying *kamutachi* in turn to *amazake*, Japanese could also seek a product with a strong flavor or sweetness, leading to *ame* 飴 (a sugar product) and, along a different line of development, *seishu* 清酒 (sake) eventually. The improvement of *kamutachi* converged with the rise of rice cultivation in the Jōmon and Yayoi periods to result in the employing of *kōji*—that is, the indigenous *kamutachi*—to make a rice-based wine by the time of the Age of the Gods (the era preceding the reign of the legendary first emperor of Japan Jimmu [660–585 BCE] as chronicled in the *Nihon shoki* and the *Kojiki*), a wine which was used in Shintō ritual offerings.[105] For Yamazaki, this wine represents the fundamental principles of Japanese winemaking.

Yamazaki thus places all the important developments in the mythological or prehistoric age. He then follows the diversification of wines in the historical era. Considering heat sterilization for wine storage, he makes a point of the fact that the Japanese technique uses a lower temperature than the Chinese operation, and declares that Japan developed the technique independently.[106] He has a chapter directly addressing the influence of Korea and China on Japanese winemaking, including details in the *Kojiki* of a Korean man named Susukori who presented the court of the semi-

legendary emperor Ōjin (third to fourth century CE) with wine, which the emperor was said to have enjoyed. Yamazaki concludes that, beyond such trifles of tools and operations as the form of the barrels, there was no continental influence upon the fundamental principles of Japanese winemaking.[107] These arguments of independence and lack of outside influence are all to be expected of a book that aims to conform to wartime clichés of absolute Japanese uniqueness and civilizational superiority based on race, and they are one of the most significant areas of deviation from Huang's presentation.

Far more telling, however, is a different major point of divergence: how Yamazaki interprets the term *getsu* within the history of Chinese mold preparation. Most specialists, including Huang, have read *getsu* clearly to mean malt (sprouted grain) in Chinese sources. According to this interpretation, malt-method wines—a kind of beer made with sprouted rice—were made in early China, and then disappeared in the Han dynasty when they were displaced by mold-method wines.[108] Yamazaki's interpretation of *getsu* in the early Chinese context to refer to mold instead of malt is idiosyncratic; for him, the meaning of *getsu* dissociates from mold and becomes malt only later, in the Northern Wei dynasty.[109] He specifically interprets *getsu* to mean the *barakōji* form of mold preparation that is now associated with Japanese winemaking and the yellow-green *Aspergillus* mold. He believes, then, that *barakōji* mold was displaced by *heikiku* wheat-flour mold cakes for winemaking during the Han dynasty.

In the Japanese context, the consensus among experts is that *getsu* is more likely to refer to mold there than in China, and that it can plausibly be interpreted in Japanese sources to mean either mold or malt.[110] In the Japan part of his *Study*, Yamazaki presents the "*Tenson minzoku*" strand of the "Japanese race" as having had a continuous *barakōji* tradition since Neolithic times. Later, he argues, Japanese used imported Chinese characters to describe the indigenous *kamutachi* mold preparation, and so designated to it both the characters *getsu* (to be used for the colored spores, or the equivalent of today's *tanekōji* 種麹) and *kōji* (to be used for the white growth without spores, the same as today's *kōji*). Yamazaki explains that the *getsu* character in the tenth-century *Engishiki* should be read *yonenomoyashi*, a term which is synonymous with the *tanekōji* of contemporary brewers.[111]

Reflecting later on the state of the field, the agricultural chemist Sakaguchi Kin'ichirō declares that the connection between *getsu* and *kōji* is certainly ambiguous in Japan; but he asks why Yamazaki would go so far as

to assume that *getsu* has the same meaning in Chinese sources. Sakaguchi attributes it to Yamazaki's (over-) "confidence" from his long studies in the subject.[112] My own explanation is this: The reason for Yamazaki's eccentric interpretation of *getsu* in the Chinese context lies in the requirement to essentialize Chinese civilization as equal and opposite to Japan's, in order to make the *Tōa* concept work. If in China *getsu* means mold, then China and Japan are equal (East Asian, in using only mold for winemaking) and opposite (*heikiku* versus *barakōji*) in their respective continuous tradition, which is in line with the notion of *Tōa*, though it does imply that China possessed a precursor to Japanese sake. If in China *getsu* means malt, on the other hand, then China had beer (malt winemaking), and so China is superior to Japan because China also has elements of the West, thus overturning the *Tōa* premise. Yamazaki's elaborate attempt to make his depiction of China and Japan conform to the map of *Tōa* is unmistakable. As he states in the conclusion of his section on Japanese *kōji* making, "In the East Asian cultural sphere . . . only Japan" uses "*getsu* (*barakōji*)" to make wine, while in China, by contrast, "*kōji* (*heikiku*)" was developed and *barakōji* discarded since ancient times.[113]

Nobody else but Yamazaki, publishing in 1945 before the surrender, has the need to make China and Japan equal and opposite, and the mold interpretation would be unlikely by other scholarly standards. As I have mentioned above, H. T. Huang writes that a beerlike product in the form of *rei* was in fact transmitted from China to Japan, "probably through Korea," in the late Han period. In contrast to Yamazaki's earlier narrative of cultural independence, Huang's statements are based on the work of the agricultural chemist Ueda Seinosuke, who believes not only that chewing-method wines (see below) predominated in Japan prior to *rei* and were then eclipsed by the transmission from China of *rei*, but also that Japanese may have subsequently derived the *kōji* mold preparation from *rei*.[114] The fermentation scientist Katō Hyakuichi, who has written prolifically on sake history, does trace the mold preparation *kamutachi* in Japan back to the Yayoi period or earlier, on the basis of archaeological evidence. But his tentative explanations for Japan's distinctive use of *barakōji*—citing the historian of Chinese food Shinoda Osamu—are similarly premised on transmission from the continent. Perhaps Japan was more humid than the continent, altering the molds that settled; or Korea's role was significant and remains little understood; or the Japanese mold technology of rice *barakōji* was transmitted from paddy-farming regions around the Lower Yangtze, rather than being influenced by the wheat-flour *heikiku* traditions of northern China or Korea.[115]

The Japan section of Yamazaki's *Study* includes its prewar formal empire—with the exception of Korea, which is given its own section (discussed further below)—as well as areas on the geographical and cultural periphery of the Japanese main islands. The Japanese perception of ethnic difference from both the Ainu and the people of Okinawa had already developed in the nineteenth century, and had coevolved with the marginalization and exploitation of those peoples in the Japanese economy.[116] In Japanese anthropologists' writings, as the historians Robert Tierney and Taylor Atkins have argued, the colonized were a foil to highlight temporal contrast with the metropole.[117]

Japanese anthropological research in the early twentieth century, as Tierney and Atkins emphasize, was motivated not only nor even primarily by the practical aims of managing colonial populations but by the search for the origins of Japan itself.[118] Japan incorporated both the Ainu of the northern island of Ezo and the people of the southwestern Ryūkyū island chain directly into the borders of the nation-state, as Hokkaidō prefecture in 1869 and Okinawa prefecture in 1879, respectively. In the wake of the colonization of Taiwan following victory in the Sino-Japanese War in 1895, the seizing of German-controlled Micronesia at the beginning of World War I (after which the islands were administered by Japan as a League of Nations mandate), and the invasion of European and US colonies in Southeast Asia in the name of a Greater East Asia Co-Prosperity Sphere in the 1940s, two key assumptions justified Japanese expansion and the rhetoric of a civilizing mission. One was the notion of prehistoric blood ties between Japan and its empire in the Asia-Pacific. Another relied on the cultural evolutionist premises of the era—the idea that colonized peoples, with their racial affinity to Japan, represented earlier stages in Japan's own development.

Unlike his presentation of China, Yamazaki's account of the areas under colonial control function conversely to depict the supposed characteristics of Japanese that were frequently featured in wartime propaganda—"belonging to a pure race and possessing a unique culture to distinguish them from their rivals and enemies in the West," as Tierney explains.[119] Yamazaki devotes two chapters to the Hayato and the Ainu respectively. In his description, the ancient Hayato 隼人 race (he uses the label to refer to various groups of peoples who would probably be called Austronesian today) encompassed tribes in the Ōsumi region of southern Kyūshū, the Ryūkyūs (present-day Okinawa), and Taiwan, and their contemporary de-

scendants live in the "South Seas." He introduces the Hayato and Ainu as indigenous races of the Japanese archipelago, which fused with the *Tenson minzoku* eventually to form the Japanese race, and thus the Ainu had had contact with the Hayato before the *Tenson minzoku* pushed the Ainu north.

In the imperial hierarchy of culture, the indigenous peoples of Taiwan and Micronesia occupied what Tierney, quoting Michel-Rolph Trouillot, identifies as the "savage slot," and the Ainu were perceived to be "atavisms."[120] In Yamazaki Momoji's descriptions, indeed, their primitive quality is symbolized especially by chewing methods of saccharification to create *kuchikamizake* 口噛酒. It is a technique of chewing plant material in the mouth and then using the chewed plant preparation to ferment cereals in pots as compound-fermentation wines. According to the *Study*, the saliva method still exists in Okinawa and Taiwan.[121]

For Yamazaki, *kuchikamizake* is representative of a primordial cultural sphere he calls the "Greater South Seas." Both the Hayato and the Ainu in the past apparently made *kuchikamizake* cereal wines, along with single-fermentation wines from plant juices. Indigenous mold-method wines among the Hayato and Ainu had also existed but were then, he argues, displaced by Japanese mold preparation methods. Yamazaki says it is uncertain whether *kuchikamizake* methods were invented by the Ainu or Hayato, or came from the continent. In Chinese historical documents, *kuchikamizake* has been recorded among the wines made by Tatars and Jurchens of Manchuria, and he argues for a connection with the Ainu. Yamazaki is adamant that unlike these minority groups, the *Tenson minzoku* themselves did not have chewing brewing methods.[122] However, as I have mentioned above, later experts do not agree with this strict separation.[123]

Other than saliva-method wines, Yamazaki notes two other kinds of compound-fermentation wines made by the Hayato. The Paaran tribe in Ōsumi made a *barakōji*-like mold preparation by wrapping millet in plant leaves, but Yamazaki writes that, after the tribe came into contact with the *Tenson minzoku*, these indigenous methods were probably lost via assimilation into *kamutachi*. Another is the distilled wine known as *awamori*, which is a famed tradition of the Ryūkyū islands. The corresponding *barakōji*-like mold preparation uses black *Aspergillus* microbes, which are strongly distinct from the yellow *Aspergillus* microbes used in other parts of Japan. Yamazaki speculates that it is likely that Hayato people assimilated the *Tenson minzoku*'s mold preparation methods, but the climate of the Ōsumi region led to the emergence of distinctive microbial species as well as cereals and plant materials used in brewing. He underlines similarities between the dumpling-like mold preparations made by some Taiwanese

and Pacific island tribes—such as the Toroko and Taudaa—with southern Chinese herbal mold preparations—or *sōkiku*—and explains them in terms of a biological connection between these groups. Despite his acknowledgment of some of the cultural diversity of the region, then, Yamazaki merely uses that variety to present a pure, unique, *barakōji* mold tradition carried by the *Tenson minzoku*.

More than any other part of the work, it is in the Korea section where Yamazaki draws the temporal contrast between Japan and its "primitive selves"—to borrow Taylor Atkins's phrase—most directly.[124] Korea, which Japan annexed in 1910, was in a more ambiguous position culturally than other Japanese colonies, in that there was an especially strong scientific consensus among Japanese and Western ethnologists regarding Korea and Japan's common racial origins. Therefore, the Japanese portrayal of Koreans as being "mired in self-destructive stagnation, while their Japanese cousins progressed triumphantly into the modern age" was particularly acute.[125] Korea's supposed regression as a civilization is expressed explicitly in the *Study* in several ways. One is the emphasis on a lack of documentation. Yamazaki declares that he cannot find any evidence in the written record that Korea independently invented mold preparations (*kōji-getsu*), and that this fact makes Korea extremely different from the Chinese, the *Tenson minzoku*, and the Japanese race.[126]

Another is the characterization of Korea as a scientifically inferior copy of China. The *Study* details the process of Korean *kōji* making: wheat flour is wrapped in cloth, straw, and leaves and stamped upon to make a small, shallow, circular disk. The method is intermediate between China's *heikiku* and *shuyaku*, and somewhat closer to *shuyaku*.[127] When Yamazaki analyzes winemaking methods, he restricts himself to purely fermented wine, leaving out distilled wine. Overprocessed rice in congee form comprises a large proportion of the raw material for fermentation in the Korean winemaking method, he argues, in contrast to the use of steamed rice as the raw material base in the mainstream yellow-wine methods of China. Adding the observation that Koreans also make an indigenous distilled wine (soju) based on cooking sorghum into congee, he draws a connection with those congee methods that he says now predominate in northern China and Manchuria. Implied is these northern regions' cultural inferiority vis-à-vis southern China, which is resonant with the imperial hierarchy of his wartime present—with Manchuria having been under Japanese occupation, mostly as a puppet state, for almost fifteen years.

The underpar quality of Korean winemaking lies in its distinctive use of congee instead of steamed rice as the raw material for the wine, according

to Yamazaki's analysis. To prove it, he replicates the winemaking method from Korean sources in his laboratory, and conducts quantitative chemical analysis on the product at different stages of the operation. He argues that a finely processed congee basis makes for an inferior tasting wine, since the bits and pieces do not gelatinize, and the microbes cannot stick directly to them but merely float viscously in between, leading to poor "amylo effect" (see chapter 4) in terms of mold propagation on and decomposition of the material.[128] The smell, too, is bad due to the fermentation of raw and unripe starch; here Yamazaki's description echoes other descriptions of wartime manufacturing, such as experiences of the smell of amino acid fluid.[129] He notes that Korean winemaking also lacks heat sterilization. Concluding, he writes that not only are Korea's mold preparation and winemaking methods mostly an imitation of Chinese *shuyaku* mold methods and *shuyaku* wines, but where indigenous Korean elements have intervened, they have only led to regress.

To show that Japanese history alone can stand as equal to China's, Yamazaki must demonstrate that it is so by setting it alongside the supposedly converse example of the history of Korea. Thus he is compelled, by the constraints of the framework of *Tōa*, to devote a section to a society about which he has spent little to none of his career acquiring in-depth knowledge. His final point—that his conclusions could be due to the shallow learning of the author, and that he is prepared to correct himself immediately upon the supply of evidence—could hardly make the Korea section more disheartening as a representation of his views. For our own historical purposes, there remains little scholarship today on Korean alcohol history available to an English-language readership; one important exception is Hyunhee Park's recent work on the transfer of distillation technology from the Mongols.[130]

The final and shortest section considers "areas surrounding China," using Chinese historical documents. Yamazaki's analysis ends by confirming that wines and their origins here, too, match his three cultural zones: the "Western cultural sphere" that has malt-method wines, the "East Asian cultural sphere" that has indigenous mold-method wines, and the saliva-method wines that constitute "Greater South Sea wines." Notably, there are historical records of saliva-method wines being made in Manchuria, Mongolia, and Primorsky Krai (the Siberian area on the Pacific coast that is nearest to Korea and Japan), and according to Yamazaki, the methods were transmitted from the Pacific rather than being indigenous in origin.[131] The claim of cultural and perhaps racial affinity between these regions resonates broadly with Japanese imperial ambitions of that era, and there is still

an ongoing territorial dispute between Russia and Japan over the nearby southern Kuril Islands today. In this way, Yamazaki's book—which more than any other work defines the identity of a national "Japanese" fermentation science—begins and ends with Asia, not with the West.

CONCLUSION

The origins of a national "Japanese" fermentation tradition lie beneath the layers of silence that have fallen on the question of Japan's relationship to Asia since August 1945. The national microbial culture collections form a material record of that history and its deep entanglement with empire. For an explicitly articulated answer, however, the microbial strain collector Yamazaki Momoji in *Tōa hakkō kagaku ronkō* (A Study of East Asian Fermentation Chemistry) gives the first and only extensive response to the question of a national fermentation science, creating a key heuristic source for all subsequent scholarly histories of Japanese fermentation. To return to the problem of how the traditional nature of scientific knowledge and its debt to Asia could be reconciled with the imperial rhetoric of scientific modernization: it could not. The current of hope for a cosmopolitan-regional-nationalistic science that motivated Yamazaki's work on the *Study* was impossible to align in any coherent fashion with the clichés of wartime provincialism advocating Japanese uniqueness and superiority. Thus, the mutation theory that he repeats through the work is contradicted by the work's very structure, which takes China to be the benchmark against which Japanese scientific modernity is measured. Not only that; he is unable to complete the task without addressing the achievements of other Asian nations, particularly Korea, in a comparative light—whatever the quality of the analysis or the nature of the conclusions that he draws.

Yamazaki decided in the *Study* to present Asian history as an immense resource of Western-style scientific data, building on trends already existent in prewar Japanese chemical research to focus on local materials and traditional industry. In so doing, he turned strategies that had been national into rhetoric that was both nationalistic and, in principle at least, applicable across Asia. The emphasis on finding innovation in human cultures' "response to the efficiency of indigenous molds, and the skillful use and mastery of them" was an answer to the question of Japan's historical relations to Asia that would set the contours for all histories of Japanese fermentation to follow. But the question itself would fall into obscurity and remain unanswered as the problematic nature of the *Tōa* category became recognized after August 1945.

What defined the nature of the ideological tension between state ideals and Yamazaki's work was the map of *Tōa*—the wartime Japanese conceptualization of Japan's relations to Asia. The vision of *Tōa* captured in the *Study* in March 1945, as well as physically and somewhat silently in the national microbial culture collections as a whole, reveals how Japanese scientists tackled the question of modern national identity using intra-Asian comparisons rather than comparisons to Europe. Essentialism is inherent in the question, but what quickly drops out of the frame as secondary issues are the dichotomies of technology/science, traditional/modern, and even East/West that tend to dominate our historical perspective on science in East Asia and which, for example, emerge so strongly from Joseph Needham's seminal project.[132] In their place, what emerges above all is the *awareness* of the debt that Japanese modernity owed to Asia, which we can recognize most clearly as ambivalence. Japanese scientists and technicians, including Yamazaki as well as all those prominent strain collectors who, like him, had carried out much of their work in Japan's informal or formal empire, perceptibly struggled to see themselves as harbingers of modernity in Asia, counter to wartime and colonial apology.

Contrary to the misconception that the construction of modern Japanese nationalism has been simply an exercise of "leaving Asia" to join the ranks of civilized nations of the West—a misconception that is especially strong for science—the assertion of Japanese identity in the modern period necessarily involved resolving Asia conceptually.[133] The question of the modern Japanese nation's and nationalism's relationship to Asia goes far beyond science. For example, the twenty-first-century reign name Reiwa—a character compound derived from the native poetry compilation the *Man'yōshū*—was officially chosen to break with precedent by being the first reign name to be drawn from a Japanese rather than a Chinese classic. Yet, as was also televised at the time of the name's announcement, the relevant lines were recorded in an era that was one of Japan's most cosmopolitan, the Nara period (710–94 CE), and were themselves inspired by Chinese literature. To return to the work of the microbial strain collector Saitō Kendō, who had worked for sixteen years in Manchuria, in a memoir in 1949 he described *kōji* as an important and special microbe, *which had been discovered* not only in Japan but across Asia, from Korea, Manchuria, and China to India and the Pacific (emphasis mine, in contrast to Yamazaki's conclusions).[134] Similarly, I argue that if we misinterpret the self-conscious ambivalence of scientists to be mere incoherence while they worked to construct modern Japanese nationalism, we consequently miss the central place of Asian contributions to Japanese scientific modernity itself.

This fact becomes more obvious when we trace the history of the microbial culture collections further down the time-specific layers of visions of Asia to the work of fermentation scientists in the formal colonies, who never wrote or philosophized on such abstract issues as definitions of science or of national tradition. Thus Yamazaki Momoji's singular articulation of the importance of Asian regionality at the historical-mythological level of modern national identity, only months before the surrender, must be considered as only part of the background for understanding the practical uses of regional knowledge across the Japanese empire since the turn of the twentieth century. As the next chapter will show, it was scientists and technicians at the colonial frontier who led the work of industrial alcohol production, a sector which was absolutely vital to the military expansion of the Japanese empire. They not only acknowledged the existence of fermentation traditions in other parts of Asia outside Japan and beyond those of the West; they found themselves compelled to use knowledge of regional scientific traditions in practice, especially in wartime.