Postwar Reconstruction of Japanese Genetics: Kihara Hitoshi and the Rockefeller Foundation Rice Project in Cold War Asia

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Abstract

This paper examines the post-Occupation reconstruction of Japanese genetics by considering its relations with both US postwar interests and Japanese wartime activities in Asia. In the 1950s, the Rockefeller Foundation approached Kihara Hitoshi,[1] a prominent Japanese plant geneticist, as part of their interests in a large agricultural project in Cold War Asia, which eventually developed into what is now known as the Green Revolution. Kihara used this opportunity to bring in necessary resources for Japanese geneticists, obtaining a grant from the foundation to research the origin of cultivated rice at the National Institute of Genetics (NIG). When the foundation established the International Rice Research Institute (IRRI) in the Philippines in 1960, Kihara was named one of the trustees. Using the IRRI network, Kihara integrated the NIG into the international network and reestablished Japanese rice geneticists' authority internationally through the standardization of rice gene symbols. With the foundation's support, Japanese geneticists reentered fields in Asia soon after Japan began restoring its diplomatic relations. In this article, I show that Kihara's postwar reconstruction effort was a continuation of Japanese geneticists' longstanding development of resources, networks, and authority in Asia since wartime. I also suggest that examining interactions between the foundation/IRRI and the Japanese rice research community broadens our understanding of the history of rice science in Asia, including that of the Green Revolution, whose narrative is often centered on postwar US interests.

Keywords: Kihara Hitoshi, Rockefeller Foundation, rice, genetics, International Rice Research Institute, Japan

1. Introduction

This paper examines the post-Occupation reconstruction of Japanese science, using the case of the prominent plant geneticist Kihara Hitoshi and his research on rice that was supported by the Rockefeller Foundation in the late 1950s to the 1960s. I situate the postwar history of genetics in the broader context of Cold War Asia and show how Kihara seized opportunities that emerged in that context to advance his own goals. Following the recent scholarship viewing Japan's postwar development as continuations of its wartime

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[1] The Japanese convention of placing surname first, followed by the given name, has been adopted for all Japanese names. References use English-language order for all Japanese names.

activities in Asia, I show that Kihara effectively revitalized and further developed the resources, networks, and authority in Asia that he and the Japanese genetics research community had previously developed during wartime.[2] Finally, I suggest that this case study contributes to our understanding of the history of rice science in Asia and that examining interactions between the foundation and the Japanese rice research community through key mediators such as Kihara could broaden our understanding of the history of the foundation's rice project in Asia, whose narrative is often centered on postwar US interests and activities.

Kihara had been well known internationally since the late 1920s for his cytogenetic studies in wheat and remained one of the best-known Japanese geneticists in the international community in the postwar years, at least until the 1960s.[3] After graduating from Tohoku Imperial University in Hokkaido (later Hokkaido Imperial University), he joined Carl Correns's laboratory in Germany. Upon returning to Japan in 1927, he became professor in the Faculty of Agriculture of Kyoto Imperial University and started running the Laboratory of Experimental Genetics. In 1942 he expanded his research group and established the Kihara Institute for Biological Research in Kyoto with industry financial support, by appealing to practical ends. The institute had five research teams—one each for sugar beet, sugarcane, barley, lumber, and cotton—and the members were stationed throughout the Japanese colonial empire to conduct field experiments in the appropriate climate for each crop. After the war, Kihara played a critical role in the establishment of the National Institute of Genetics (NIG) under the US Occupation. He became the second director at the NIG in 1955 and remained in the position for fourteen years.[4]

Kihara was the first Japanese scientist to go abroad after the war, in 1948. After coming back from his tour in Europe and the United States, he wrote that Japanese scientists had been only "imagining developments in foreign countries based on

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[2] Hiromi Mizuno, Aaron S. Moore, and John DiMoia, eds., *Engineering Asia: Technology*, *Colonial Development*, *and the Cold War Order* (London: Bloomsbury Academic, 2018); see, for example, Masato Karashima, "Itagaki Yoichi and the Formation of the Postwar Knowledge Infrastructure for Japan's Overseas Development Aid in Asia," 59–82. Also see Wataru Iijima, "Miyairigai no monogatari: Nihon jūketsu kyūchūbyō to kindai nihon no shokuminchi igaku [A story of Miyairi snails: *Schistosomiasis japonica* and colonial medicine of modern Japan], in '*Teikoku*' *nihon no gakuchi* [Knowledge of 'Imperial' Japan], vol. 7, ed. Tetsuya Sakai et al., (Tokyo: Iwanami shoten, 2006), 139–175; Aya Homei and John P. DiMoia, "Integrating Parasite Eradication with Family Planning: The Colonial Legacy in Post-war Medical Cooperation in East Asia," *Social History of Medicine* (2020): hkaa005.

[3] Kaori Iida, "Practice and Politics in Japanese Science: Hitoshi Kihara and the Formation of a Genetics Discipline," *Journal of the History of Biology* 43 (2010): 529–570; Iida, "Genetics and 'Breeding as a Science': Kihara Hitoshi and the Development of Genetics in Japan in the First Half of the Twentieth Century," in *New Perspectives on the History of Life Sciences and Agriculture*, ed. D. Phillips and S. Kingsland (Cham, Switzerland: Springer International, 2015), 439–458.

[4] On the establishment of the NIG, see Iida, "Practice and Politics in Japanese Science." Kihara took the NIG position in October 1955, concurrently with his professor position at Kyoto University, and retired from the latter in March 1956.

fragments of texts" during almost ten years of isolation—isolation that had started largely in 1937 with the Second Sino-Japanese War and continued after the Second World War under the US Occupation.[5] During and after the Occupation, recovering from this long isolation was the top priority for Japanese scientists, and it involved catching up with tremendous developments made in other countries, disseminating their own work, and rebuilding the networks that had been lost during their isolation. Kihara was instrumental in this postwar reconstruction of science in Japan.

For Japanese researchers, private funding from foreign countries was crucial for the reconstruction before Japan recovered enough economically to be able to fund research on its own. As part of a larger agenda to keep Japan as its political ally after the end of the Occupation, the United States provided such funding.[6] Kihara received Rockefeller Foundation funding both at the Kihara Institute and at the NIG in the 1950s–60s. The grant with the most funding that he received from the foundation was for a project to research the origin of cultivated rice that started in 1957 at the NIG. With this support, which came at a timely moment following a series of restorations of Japan's diplomatic relations, Kihara was able to reenter southern Asia and resurrect the comprehensive research style that he developed during wartime. Kihara continued receiving funding for his rice project at the NIG until 1967.

As noted above, Kihara was internationally well known, and rice was an important crop to be studied, but the social context in which Kihara's rice project materialized was also crucial. It has been well documented how the foundation's project in rice improvement was closely related to American geopolitical and economic interests in Cold War Asia.[7] During the war, Japanese scientists had done much research on rice not only in the mainland but also in colonies[8]; after the war, American officials needed to access relevant people, information, and materials in Japan in order to advance their own interests. The Rockefeller Foundation, together with the Ford Foundation, established in

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[5] Hitoshi Kihara, *Kagakusha no mita sengo no ōbei* [Postwar Europe and US, as seen through the eyes of a scientist] (Osaka: Mainichi shimbun sha, 1949), 1. See Iida, "Practice and Politics in Japanese Science." For more about Japanese scientists' isolation under the Occupation, see Walter E. Grunden, "Physicists and 'Fellow Travelers': Nuclear Fear, the Red Scare, and Science Policy in Occupied Japan," *Journal of American-East Asian Relations* 25 (2018): 343–383.

[6] See Takeshi Matsuda, *Sengo nihon ni okeru amerika no sofuto pawā: Han-eikyūteki izon no kigen* [American soft power in postwar Japan: The origin of semi-permanent dependency] (Tokyo: Iwanami shoten, 2008), also published in English as *Soft Power and Its Perils: US Cultural Policy in Early Postwar Japan and Permanent Dependency* (Stanford, CA: Stanford University Press, 2007).

[7] For example, see Robert S. Anderson, Edwin Levy, and Barrie M. Morrison, *Rice Science and Development Politics: Research Strategies and IRRI's Technologies Confront Asian Diversity (1950–1980)* (Oxford: Clarendon, 1991); John H. Perkins, *Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War* (Oxford: Oxford University Press, 1997); Nick Cullathar, "Miracles of Modernization: The Green Revolution and the Apotheosis of Technology," *Diplomatic History* 28, no. 2 (2004): 227–254; Cullathar, *The Hungry World: America's Cold War Battle against Poverty in Asia* (Cambridge, MA: Harvard University Press, 2010).

[8] The "mainland" here means the geographical range without newly acquired colonies.

1960 the International Rice Research Institute (IRRI) as the central institution for their rice program in Asia that came to be known as the Green Revolution, but the idea to establish such an international institute originated by 1954, before Kihara received funding for his project at the NIG.[9] When the IRRI was established, Kihara was named one of the trustees. As we shall see, Kihara's research at the NIG continued in the 1960s and developed further as it was positioned to be coordinated with the IRRI projects.

Some recent studies on the American agricultural project in Asia have shifted their central focus away from the United States and shown that scientists in Asia used opportunities that emerged through the project to further their own goals in their local context.[10] In this article, I demonstrate how Kihara utilized the opportunity on his end; namely, he resurrected his own comprehensive research style, which he had developed during wartime, to influence the field of genetics after the war, helped Japanese rice geneticists to regain leadership internationally through the standardization of gene symbols, and further facilitated the reconnection of the Japanese community with the international community. I argue that these postwar reconstruction efforts did not emerge fresh after the war and depended on experiences and networks that the Japanese community had developed during wartime. Histories of rice studies viewed from local perspectives in Asia like this current article would help us further broaden our understanding of the history of rice science in Asia including that of the Green Revolution, beyond the bilateral and often asymmetrical relationship with the United States. Kihara, a mediator between the Japanese rice research community and the Rockefeller Foundation/IRRI, offers a good window through which to examine further how and why the extensive rice knowledge produced in Asia since the 1920s was (or was not) transferred to the foundation and how such movement and distribution of knowledge affected Cold War Asia.[11]

2. Resurrecting Kihara's Wartime Research Style in the 1950s

Kihara was quite skillful in maneuvering his way to getting funding in different political contexts, and used the same strategy in obtaining research funding during and after the war. It was his strategy to take up a new research material as a funding opportunity opened up, and to channel the scarce funding to basic research. During

[9] See Robert F. Chandler, Jr., *An Adventure in Applied Science: A History of the International Rice Research Institute* (Manila: IRRI, 1992), 2.

[10] For example, see James Lin, "Sowing Seeds and Knowledge: Agricultural Development in Taiwan and the World, 1925–1975," *East Asian Science*, *Technology and Society* (2015) 9: 127–149; Tae-Ho Kim, "Making Miracle Rice: Tongil and Mobilizing a Domestic 'Green Revolution' in South Korea," in Mizuno, Moore, and DiMoia, *Engineering Asia*, 189–208.

[11] On the transnational history of science and technology, for example, see John Krige, ed., *How Knowledge Moves: Writing the Transnational History of Science and Technology* (Chicago: University of Chicago Press, 2019).

wartime, he obtained at the Kihara Institute of Biological Research financial support from the industries of sugar, beer, and fiber, which could benefit from breeding studies of sugarcane, sugar beets, barley, and cotton, respectively. In these research programs, Kihara maintained flexibility, and his group conducted studies that could cover both basic and applied goals in order to satisfy both the funder and his own research needs.

Kihara was less interested in the production of improved varieties of industrial crops than in the development of the related basic science to support such practices. When the Kihara Institute of Biological Research was inaugurated in 1942, Kihara told the audience at the opening ceremony that their research at the institute would be about the "growth, flowering, and fruition" of plants, which was "the foundation of agriculture and forestry."[12] His interests were in this broad foundation. Although genetics was at the core of their studies, beyond the narrower focus on genes in the nucleus, Kihara's group asked broader questions, including effects of environment, and often included a physiological component in their research program. As I have discussed elsewhere, this "comprehensive," often multidisciplinary, approach to biological problems was characteristic of research activities at the Kihara Institute during wartime.[13] That research style accompanied field studies and plant collections in various climates abroad. With the 1957 grant from the Rockefeller Foundation, Kihara reentered southern Asia for the first time after the war and resurrected his research style. The important plant that guided Kihara's postwar effort was rice.

Kihara had had interests in rice since wartime. In 1943 he gave a talk titled "Genetics and the Establishment of Greater East Asia," and emphasized the need to support geneticists' research of important crops. According to the lecture draft, he spoke about three crops—rice, barley, and sugarcane—and first talked about rice, the "staple for the people of Greater East Asia."[14] Although his group had not previously worked on rice, he knew it was an effective instrument to attract funding in the expanding nation. Covering both basic and applied goals, three topics he mentioned were the study of the origin of cultivated rice varieties, identification of genetic linkage groups, and creation of disease-resistant varieties. It is reasonable to speculate that he was hoping to add a rice research team at Kihara Institute if he could obtain funding.

He might also have had a bigger plan of establishing a new research institute studying staples such as rice in southern Asia and sending his people there to conduct this

[12] H. Kihara, "Rakuseishiki" [Inauguration ceremony], *Seiken zihō* 1 (1942): 103–104.

[13] Following Jonathan Harwood's terminology, I call Kihara's broad interests and the accompanying approach "comprehensive." Harwood, "National Styles in Science: Genetics in Germany and the United States between the World Wars," *Isis* 78 (1987): 390–414; Harwood, *Styles of Scientific Thought: The German Genetics Community, 1900–1933* (Chicago: University of Chicago Press, 1993); Iida, "Practice and Politics in Japanese Science"; Iida, "Genetics and 'Breeding as a Science.'"

[14] H. Kihara, "Genkō 4, kōen sonota 1943- [Drafts 4, lectures and others 1943–]," a notebook preserved by Kihara Yuriko.

research. After coming back from a trip to inspect agricultural research institutes in Java, Malaya, Singapore, and Sumatra, Kihara wrote in 1944 that a large-scale basic research institute and agricultural experiment station must be established in a location in the southern region such as Sumatra, and that the Japanese should initiate research on staples such as rice and corn because the Dutch had concentrated exclusively on cash crops during their colonial rule. He emphasized the importance of basic research to create high-quality products and to contribute to the development of science.[15] He did not have an opportunity to work on rice in wartime, but after the imperial expansion was over a funding opportunity emerged. He picked up rice as a research subject in the 1950s through the US Cold War interests in agricultural reforms in Asia.

In 1953, one year after the end of the US Occupation, Kihara was invited to Columbia University through the university's Intercultural Exchange Program, which was partially justified by the American desire to influence Japanese intellectuals and to keep Japan as their political ally.[16] During Kihara's stay in the United States, Paul C. Mangelsdorf, a professor of economic botany at Harvard University's Botanical Museum and an agricultural consultant for the Rockefeller Foundation, arranged to have Kihara meet J. George Harrar, then the deputy director of agriculture of the foundation (and who became the president of the foundation in 1961), to discuss rice improvement work.[17] Kihara was probably seen as the best source for the Americans to consult about genetic and breeding studies of plants in Japan, and Mangelsdorf, who worked on research into the origin of corn, personally knew Kihara as well as his work on the origin of wheat. With the invitation, Kihara immediately realized the prospect of bringing in US funding. During the meeting with Harrar, Kihara told him that he was in the United States to study *both* wheat and rice, even though Kihara's itinerary did not include rice institutions (and Harrar noticed it).[18]

Kihara told Harrar the significance of Japanese achievements in research areas related to rice cultivation, including yields, quality, and resistance to disease, and added that among Asian nations, "only Japan had an adequate rice technology." Furthermore, Kihara declared that Japan was "essentially saturated with rice specialists" in many areas of study, including plant breeding, soil chemistry, entomology, and plant pathology, because many Japanese rice specialists previously located in Taiwan and other former colonies had returned to their home country. Kihara told Harrar that many of those

[15] H. Kihara, "Nanpō ni okeru nōgyō kenkyū kikan no genkyō (3)" [The current situation of agricultural institutes in the South (3)], *Nōgyō oyobi engei* [Agriculture and horticulture] 20, no. 6 (1945): 251–252.

[16] "Japanese-American cultural relations," undated document, folder "American-Japanese Project," box 23 "Japanese Committee on Intellectual Exchange Committee," Harry J. Carman Papers, Rare Book & Manuscript Library Collections, Columbia University, New York.

[17] 23 January 1953, folder 235, box 21, series 609, RG 1.2, Rockefeller Foundation Archives, Rockefeller Archive Center, Sleepy Hollow, New York (hereafter cited as RF).

[18] "Interviews: JGH [Harrar]," 2 February 1953, folder 235, box 21, series 609, RG 1.2, RF.

specialists were "available for assignment to other countries should they be needed elsewhere."[19]

At the time, the foundation had been supporting rice research in Asia.[20] In 1957, Robert F. Chandler, assistant director of the agriculture division of the foundation, visited Kihara at the NIG to discuss a new project proposal to study the origin of cultivated rice. Shortly after the meeting, Kihara sent a research plan to Harrar and eventually obtained $125,000 for five years (1957–1962).[21] His lack of experience in rice was not a problem. Because of his accomplishments in the origin of cultivated wheat and of the fact that he was based in Asia, "the home of the genus *Oryza*," the foundation staff saw Kihara as "especially well qualified to direct research on rice."[22] This grant was larger than another foundation's grant that the NIG received in the same year for a project on genetic effects of radiation in animals, a significant topic of the time.[23] All of the plant geneticists at the NIG at the time worked on the rice project that Kihara had brought to the institute.

The proposal was essentially a replicate of a research structure at the Kihara Institute in wartime. During wartime, the institute had project teams for each major research material and each team had research bases in appropriate climate areas (e.g., sugar beet studies in Hokkaido and Manchuria; sugarcane studies in Saipan and Ponape). Kihara hoped to conduct field trips but did not have a chance to send an exploratory party due to the war. In 1957 he expanded his 1943 idea and proposed to analyze the origin of cultivated rice with what he himself described as a "comprehensive approach," through morphological studies, physiology, population genetics, genetic analysis such as linkage analysis, and cytogenetic analysis.[24] Several plant collection trips were planned and soon laboratories (*kenkyūshitsu*) abroad in warmer climates were set up.

The physiological component was important for Kihara's research style, and in fact, the first modern environmentally controlled greenhouse in Japan was established in 1953 at the NIG by Matsumura Seiji, Kihara's former student and a central member of the Kihara Institute.[25] Matsumura moved to the NIG in 1949 and became the head of the newly established Mutation Department in 1955 (while continuing to be involved in the sugar beet project at the Kihara Institute).[26] The NIG facility was modeled after an American greenhouse created by Frits W. Went in 1939 at Caltech, and could control

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[19] "Interviews: JGH [Harrar]."

[20] Anderson, Levy, and Morrison, *Rice Science and Development Politics*, 47.

[21] Kihara to Harrar, 26 February 1957, folder 297, box 26, series 609, RG 1.2, RF.

[22] "Resolved RF 57080," 3 April 1957, folder 297, box 26, series 609, RG 1.2, RF.

[23] The radiation project received $52,000 for three years. "Resolved RF 57178," 24 October 1957, folder 291, box 25, series 609, RG 1.2, RF.

[24] Kihara to Harrar, 26 February 1957. Quoted from p. 1 of the proposal attached to this letter.

[25] Michio Konishi, "Phytotrons in Japan and the Japanese Society of Environmental Control in Biology and Its Activities, Including the Plan of the 'National Biotron Center,'" *Environmental Control in Biology* 10, no. 3 (1972): 91–100.

[26] The Kihara Institute for Biological Research moved from Kyoto to Yokohama in 1956.

temperature, humidity, and light.[27] In the application requesting government funding to build the greenhouse, Matsumura wrote that both genetic and environmental factors must be controlled to conduct "heredity-related research with precision" and that unlike genetic background, which could be standardized through inbreeding, controlling multiple environmental factors required a specialized facility.[28]

The Rockefeller funding offered an opportunity to further develop this physiological component at the NIG. In the Rockefeller rice project, Matsumura headed the physiological section of the research, which included topics such as "response to day-length," "response to temperature, soil conditions, drought and other unfavorable environmental conditions," and "resistance to fungus diseases and insect pests."[29] With the Rockefeller funding, by 1958 the NIG established another greenhouse designed specifically for wet rice that could control temperature, humidity, and day length (the first wet-rice environmentally controlled greenhouse in Japan) and another facility that could control only day length for wet rice.[30]

One big difference between Kihara's wartime and postwar research was that Kihara no longer had experimental fields in the former colonies. For example, his wartime projects on sugarcane conducted in Saipan and Ponape had to be terminated because there were no alternative zones with a similar climate within postwar Japanese territory. The rice project faced the same climatic issue: temperature and day length in Japan were not right for rice varieties collected from tropical areas. The problem was partially solved by building an environmentally controlled greenhouse, but its space was limited.[31] Thus Kihara installed temporary laboratories abroad to regain access to the warmer climates.

Kihara expanded his laboratory bases through the former colonial network as well as a postwar international aid program, the Colombo Plan, in which Japan participated as a donor country.[32] One laboratory was placed in the Paradeniya Botanical Garden in Ceylon until 1959, through a member of the NIG rice project, Sakai Kan-ichi. Sakai, an expert on rice and plant biometry, was the head of the Applied Genetics Department at the NIG and was sent to Ceylon as an expert for the Colombo Plan for 1957–59. In Ceylon, agricultural experience had been dominated by cash crops such as tea and rubber under British colonial rule. Japanese rice experts such as Sakai went there via the

[27] This greenhouse of 1939 was a smaller and cheaper option to model after than the larger Earhart Plant Research Laboratory, the first phytotron, established in 1949. See also *Kokuritsu idengaku kenkyūjo nenpō* [NIG annual report], vol. 3, 1953.

[28] Sadao Sakamoto, "Matsumura sensei to seibutsu kankyō chōsetsu [Dr. Matsumura and environmental control in biology]," in "Hōshasen idengaku to Matsumura Seiji hakushi [Radiation biology and Dr. Matsumura Seiji]," supplement to *Radiation Biology Research Communication* vol. 2 (1967): 28–31.

[29] Kihara to Harrar, 26 February 1957. Quoted from p. 3 of the proposal attached to this letter.

[30] NIG annual report vol. 8, 1958, p. 132.

[31] See also H. Kihara, *Komugi no gōsei* [Synthesis of wheat] (Tokyo: Kōdansha, 1973), 50.

[32] Japan joined the Colombo Plan with economic interests in South Asia. See, for example, Hideo Kobayashi, *Sengo ajia to nihon kigyō* [Postwar Asia and Japanese enterprises] (Tokyo: Iwanami shoten, 2001).

Colombo Plan to help rice-breeding efforts at recently established rice research stations. During his stay in Ceylon, Sakai went on collection trips in the surrounding areas and conducted field experiments for the NIG project.

Another laboratory was placed in the Taiwan Provincial College of Agriculture (台湾省立農学院) in Taichung, a college originally established in 1919 by the Japanese Imperial government.[33] This Taiwanese connection was gained by hiring Oka Hiko-Ichi, who had been a professor at the college from 1942 to 1954. He returned to Japan when he obtained a position at the NIG's Applied Genetics Department. Retaining his affiliation in the Taiwanese college, Oka also carried out field experiments in Taiwan and went on collection trips in collaboration with members at the college, including Hu Chao-Hwa 胡兆華 and Chang Wen-Tsai 張文財. Five students of the college also worked on topics related to the NIG project for their graduation thesis projects. Chang was one of Oka's former students, and such connections that Oka had built since wartime helped him and Kihara run this laboratory. [34]

Using the advantage of the fields in a warmer climate, both Sakai and Oka conducted experiments on physiological aspects. For example, Oka, Hu, and Chang investigated variations in photoperiod sensitivity and critical day length for different strains of rice (collected in Taiwan, India, and Thailand) using the experimental field in Taiwan.[35] Building upon these studies and using the environmentally controlled greenhouses at the NIG, one Japanese student wrote a doctoral dissertation on photoperiodism in rice, which was published in English in 1964.[36]

Sakai and Oka also studied genetic topics such as problems of hybridization. Rice breeders hoped to improve the *indica* type in the tropics by crossing it with *japonica* varieties. The *japonica* type was well studied and already had characteristics that were useful for intensive agriculture (e.g., high fertilizer response), but *indica-japonica* hybridization was difficult. At that time, evolutionary relationships among rice varieties were mostly unknown and thus there was a demand for fundamental research on genetic variabilities and hybrid fertility. Oka and Chang, for example, worked on inter- and intrapopulational genetic variabilities in wild rice (i.e., more primitive ones undifferentiated into *japonica* and *indica* types). Sakai in Ceylon also worked on genetic variabilities in wild strains of rice and in local varieties that had been cultivated

[33] It is now National Chung Hsing University.

[34] NIG annual report vol. 8, 1958, p. 14–16; Hiko-ichi Oka, "Report on research activities in Taiwan," 13 November 1958, folder 298, box 26, series 609, RG 1.2, RF. For recollections about Chang and Oka, see Hsieh Ching-Shun謝景順, "在西非採集野生稻倒下的張文財教授 [Prof. Chang Wen-Tsai's journey in West Africa to collect wild rice]," 興大校友 [National Chung Hsing University alumni newsletter] 26 (2016): 24–27, http://ir.lib.nchu.edu.tw/bitstream/11455/94491/1/08.pdf.

[35] NIG annual report vol. 9, 1959, pp. 105–106.

[36] It was for Kyoto University and was published in Tadao C. Katayama, "Photoperiodism in the Genus *Oryza*," I and II, *Japanese Journal of Botany* 18, no. 3 (1964): 309–348 and 349–383.

traditionally.[37] They also conducted numerous crossing experiments to measure hybrid fertility at different stages of plant development.

Sakai, Oka, and Kihara had all graduated from the Faculty of Agriculture of Hokkaido Imperial University and were connected by the influential alumni network.[38] During wartime, Kihara expanded his activities through this network. It is notable that the first two projects of his group (sugar beets and barley) were conducted in Hokkaido. In particular, his sugar beet project (the creation of triploid beets by the application of colchicine) emerged in the late 1930s in a conversation with a college friend who was working as a sugar beet specialist for the sugar industry in Hokkaido, and soon the Hokkaido government and two private companies took interest in the project.[39] After the war, Kihara restarted the sugar beet project in collaboration with the plant breeding laboratory (*ikushugaku kōza*) at Hokkaido University beginning in 1951.[40]

This laboratory also worked as an important node for his rice project. Hokkaido had been one of the centers of rice research in Japan since the Meiji era, when agronomists tried expanding rice cultivation to Hokkaido, which was beyond what was then the northern limit of the cultivation. Responding to the demand, the lab produced many rice experts, including Sakai and Oka. Furthermore, in wartime, Hokkaido Imperial University supported agricultural programs in colonies and sent many graduates especially to Taiwan, including rice experts such as Oka and also Iso Eikichi, who played a central role in developing the Ponlai (*hōrai*) rice in Taiwan (Oka had worked as an assistant to Iso).[41] Kihara was part of the network as a Hokkaido alumnus and had also been officially sent to Taiwan as an agricultural consultant.[42] This Hokkaido network helped Kihara develop his rice project and place two laboratories abroad for the first time

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37 NIG annual report vol. 8, 1958, pp. 14–16.

38 Japanese researchers' networks not only helped Japanese colonial management but also affected the postwar development of a certain field in the former colonies, as a recent study shows. In case of genetics in Korea, see Jaehwan Hyun, "Making Postcolonial Connections: The Role of a Japanese Research Network in the Emergence of Human Genetics in South Korea, 1941–1968," *Korean Journal for the History of Science* 39, no. 2 (2017): 293–324.

39 Hitoshi Kihara, "Tensai kenkyū uchiawasekai sekijō no aisatsu" [Speech at the meeting for sugar beet research], *Zihō* 2 (1941): 66–68.

40 Man-emon Takahashi, *Midori no chiheisen: Takahashi Man-emon no ayunda michi* [The green horizon: Traces of Takahashi Man-emon's steps] (Sapporo: Takahashi Man-emon sensei bunka kōrōsha shukuga kinen jigyōkai, 1996), 47.

41 The Hokkaido network was strong particularly in Taiwan and Manchuria. Koji Tanaka and Ryoichi Imai, "Shokuminchi keiei to nōgyō gijutsu: Taiwan, Nanpō, Manshū" [Colonial management and agriculture: Taiwan, the South, and Manchuria], in '*Teikoku*' *nihon no gakuchi* [Knowledge of 'Imperial' Japan], vol. 7, 108–111; Mihoko Yamamoto, "Taiwan ni watatta hokudai nōgakubu sotsugyōsei tachi [Graduates of the Faculty of Agriculture of Hokkaido University who went to Taiwan]," *Annual Report of Hokkaido University Archives* 6 (2011): 15–41. On the relationship between Oka and Iso, see Takahashi, *Midori no chiheisen*, 20–21. On Iso and Ponlai rice, see Tatsushi Fujihara, "Colonial Seeds, Imperialist Genes: Hōrai Rice and Agricultural Development," in Mizuno, Moore, and DiMoia, eds., *Engineering Asia*, 137–161.

42 Documents in folder "Taiwan kankei shorui [Taiwan-related papers]," preserved by Yuriko Kihara.

after the war.

Using the Rockefeller Foundation's funding and the renewed connections in Asia, Kihara's team began building a significant collection of wild rice varieties. Members of the project conducted collection trips in Thailand, Indonesia, Burma, India, and Ceylon.[43] Kihara himself went to Sikkim and Assam in 1959 with one of his former students and collected about three hundred varieties of rice.[44] Japan's diplomatic relations to most countries were restored in 1952 with the Treaty of Peace with Japan and in the following years (1955 for Burma, 1956 for the Philippines, 1958 for Indonesia). The foundation's financial support, as well as a Japanese wartime network and a postwar aid program, made it possible for the geneticists to visit these countries soon after the political restrictions were lifted.

When the Rockefeller and Ford Foundations established the International Rice Research Institute in the Philippines in 1960, Chandler, who had helped organize the rice project at the NIG, became the first director-general and Harrar assumed the chair of the Board of Trustees. In his memoir, Chandler states that he and Harrar had little difficulty in deciding on candidates for the board members. Kihara was a top candidate for them, as he was one of the four members they listed initially.[45] The Board of Trustees was divided into Executive, Program, and Finance Committees, and Kihara, as the sole geneticist on the board, was made chair of the Program Committee. The committee's responsibilities included considering "the nature and scope of the scientific program of the Institute" and "types of staff members and positions required."[46] It thus seems that the committee was influential to the IRRI's scientific management.

At the second meeting of the Program Committee in 1960, according to his diary, Kihara suggested creating a permanent position devoted to collecting and preserving cultivated and wild rice species.[47] Kihara's suggestion indicates that the IRRI at the time was not committed to the preservation of rice specimens.[48] Kihara had had strong interests since wartime in collecting and preserving plants as genetic resources for plant research as well as for national efforts in agricultural improvement. In 1941, he wrote that "if we compare genes to inorganic materials," genes would be "equivalent to gold and

[43] NIG annual reports vols. 9–10, 1959–1960.

[44] Kihara, *Komugi no gōsei*, 47.

[45] The other three were Paul C. Ma, dean of the College of Agriculture of National Taiwan University; K. R. Damle, secretary of agriculture of the government of India; and M. C. (Prince) Chakrabandhu, director-general of the Department of Agriculture within the Ministry of Agriculture of Thailand. See Chandler, *Adventure in Applied Science*, 20.

[46] Quoted from p. 4 of "Minutes of meeting of members and meeting of the board of trustees, April 13–14, 1960," folder "I.R.R.I. shokan tsuzuri [a collection of letters] 1960–," preserved by Y. Kihara.

[47] Notes on 6 October 1960, notebook "Nisshi [a journal] Manila (1960)," preserved by Y. Kihara.

[48] Also see Helen Anne Curry, "From Working Collections to the World Germplasm Project: Agricultural Modernization and Genetic Conservation at the Rockefeller Foundation," *History and Philosophy of the Life Sciences* 39 (2017), article no. 5.

silver," and urged that an institute to store "living gold," living seeds and seedlings, was necessary.[49] In wartime, Kihara had hoped to fulfill the desires of both scholars and bureaucrats through plant collection and preservation, but in the postwar context his aim shifted to forming a strong relation between the IRRI and NIG.

In 1963, for example, Kihara proposed multinational collaboration on collection trips in African countries, among the Academia Sinica of Taiwan, the Central Rice Research Institute of India, the IRRI, and the NIG of Japan. Researchers could ask each other for a specific variety to be collected. The collected samples of plants and seeds were to be preserved as a duplicate set at the IRRI.[50] Kihara also tried to create a "small center" of the IRRI within the NIG to preserve materials as a shared resource and to make them available for visiting scientists to use. In 1963, he requested extra funding to construct such a facility at the NIG. "I visualize," Kihara wrote, that "such a place would serve as a tiny extension" of the IRRI.[51] By 1963, according to Kihara's report to the foundation, the NIG members had built a collection of 4,300 strains of seeds and 900 herbarium specimens covering 28 species of the genus *Oryza*. The collection and preservation efforts by the Japanese project must also have been beneficial for the IRRI especially because the IRRI was rather reluctant to be fully committed to the preservation yet. Kihara received $42,000 in 1964–67 for "constructing and equipping a seed and plant specimen storage facility."[52]

In addition, the IRRI viewed it as advantageous to keep the NIG in the circle as a supplementary program focusing on basic research and as a model for collaboration. In January 1962, when the five-year grant beginning in 1957 was near the end of its term, Kihara submitted to the Rockefeller Foundation a new grant proposal on "genetics and cytological studies of wild and cultivated rice species." In this proposal, he wrote that the research focus should shift from the origin of cultivated rice to even "more fundamental problems," including interrelationships among different strains of cultivated and wild rice. Kihara added that these fundamental studies would contribute to the development of the IRRI.[53] The foundation staff judged that Kihara's team had already made significant contributions in understanding the complex phylogenetic relationships of wild and cultivated varieties of rice and that this was valuable to the practical breeding programs. When this grant was approved, they commented that the NIG's research "would be coordinated closely" with the IRRI's research programs, and this cooperative relation

[49] Hitoshi Kihara, "Shokubutsu no shūshū to hozon" [Collection and preservation of plants], *Shokubutsu oyobi dōbutsu* [Botany and zoology] 3, no. 5 (1941): 142.

[50] Herbert H. Kramer, "Resolutions," in *Rice Genetics and Cytogenetics: Proceedings*, ed. International Rice Research Institute (Amsterdam: Elsevier, 1964), 249–250.

[51] Kihara to Moseman, 21 December 1963, folder 300, box 26, series 609, RG 1.2, RF.

[52] Kihara to Robert Osler, 8 August 1963, folder 300, box 26, series 609, RG 1.2, RF.

[53] Kihara to A. H. Moseman, 19 January 1962, folder 300, box 26, series 609, RG 1.2, RF.

should “serve as a model for similar collaboration” between other institutions in Southeast Asia and the IRRI.[54] Kihara received $60,000 for three years starting in May 1962. For the entire rice project at the NIG, Kihara received three grants totaling $227,000 from 1957 to 1967.

For Kihara, keeping a solid relation with the IRRI was beneficial to maintaining his comprehensive research style at the NIG. His new grant proposal submitted in 1962 again proposed research in a combination of genetic and physiological components and included items such as “chromosome and genome analysis” and “physiologic-genetic studies of quantitative and ecological characters.”[55] Kihara was in fact disappointed by the predominance of biochemical genetics that was breaking life apart into enzymes and molecules. He later complained that there were many people who could write a process of gene expression from DNA to protein but did not know even the names of roadside flowers. Rather than privileging molecular biology, he saw the old “natural history” as more necessary because it saw that all living organisms and the environment are interconnected.[56] He hoped to push molecular perspectives aside in favor of a more holistic vision and to integrate the study of various aspects of life (heredity, physiology, evolution, and development) by promoting a comprehensive approach to genetics (and biology) at his institute.[57] Maintaining programs using higher plants (rather than virus, microbes, and flies) was a way to resist the loss of that integrity. Developing a semi-permanent plant resource center that could attract researchers of higher plants was an effective strategy to keep such research activities going for the long term.

3. Reestablishing Authority through the IRRI Network: Standardization of Gene Symbols

At the Program Committee meeting in 1960, Kihara also suggested that the IRRI host a symposium on “standardization of gene symbols.”[58] This symposium came into fruition as the Symposium on Rice Genetics and Cytogenetics in 1963, and it was the first international conference sponsored by the IRRI. Through this case, I examine how Kihara used the IRRI to end conflicts originating in the long isolation since the late 1930s and to regain Japanese leadership in the international community of rice studies.

The standardization of gene symbols was important not only for practical purposes but for recognition and sometimes for national pride as well. Japan had been outside the international discussion of standardization of genetic symbols since the beginning of the

[54] “Resolved RF 62027,” 1 March 1962, folder 297, box 26, series 609, RG 1.2, RF.

[55] Kihara to Moseman, 19 January 1962.

[56] Hitoshi Kihara, *Ichiryūshashujin shashinfu* [Photo collection of ichiryūshashujin] (Yokohama: Kihara Institute for Biological Research, 1985), 241–247.

[57] Also see Iida, “Genetics and ‘Breeding as a Science.’”

[58] Notes on 6 October 1960, notebook “Nisshi [a journal] Manila (1960),” preserved by Yuriko Kihara.

Second World War. When the first international meeting on the nomenclature was held (in conjunction with the Seventh Congress of Genetics) in Edinburgh in 1939, delegates from Japan (as well as Belgium, Italy, and Finland) were not allowed to participate. In 1938, preparing for the 1939 meeting, B. S. Kadam and Krishnaswami Ramiah, two Indian scientists who were members of a special committee under the Indian Council of Agricultural Research, sent a proposal on rice gene symbols to rice experts in the international community, including those in Japan. According to the rice geneticist Yamaguchi Yasuke, this caught Japan "off guard."[59] In his account, the Indian scientists had thrown a "bomb" at the Japanese rice community, and thus he decided to "destroy [the Indian proposal] with a more powerful bomb."[60] At least two Japanese proposals had been previously published (in 1927 and 1935 in German and Japanese journals, respectively) but had no international influence.[61] Responding to the new Indian proposal (based in English), Yamaguchi, who had proposed the symbols of 1927, quickly created a new set of symbols in Latin ("the most fair and rational" language[62]) and published it in a newsletter of the Genetics Society of Japan. Yamaguchi sent back to the Indian scientists this temporary proposal with a note stating that they must first consult the "authority" of East Asia. However, the Japan-made "bomb" that Yamaguchi sent over to India had no impact.[63]

At the 1939 meeting, delegates from 12 countries reached a consensus on a general rule of gene symbols (common for all representative organisms) and published it in *Genetica* in 1940, though it did not obtain the Congress's approval due to the disruption of war.[64] Ramiah, who attended the 1939 meeting, also discussed their proposal for rice symbols, received suggestions, and published the revised version in 1943. According to Ramiah, "rice geneticists the world over, except Japan" adopted this proposal.[65] After the war, the Japanese community of geneticists soon resumed their discussions of symbols in order to gain control and authority internationally. In 1949, they formed committees under the Science Council of Japan, and Kihara took a leadership role in putting together

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[59] Yasuke Yamaguchi, "Wagakuni ni okeru ine no idenkenkyū no genjō" [The current state of genetic study in rice in our country], in *Idengaku no shinkō o mezashite* [Aiming for the promotion of genetics], ed. Genetics Society of Japan (Tokyo: Genetics Society of Japan, 1941), 24.

[60] Y. Yamaguchi, "Ine no gen kigō tōitsu shian" [My idea on standardization of gene symbols in rice], *N.I.G. danwashitsu* 4 (1939): 1.

[61] Described in Kihara, "Need for Standardization of Genetic Symbols and Nomenclature in Rice," in *Rice Genetics and Cytogenetics: Proceedings*, 3. Yamaguchi's list was published in *Zeitschrift für induktive Abstammungs-und Vererbungslehre* 45 (1927): 105–122. Seijin Nagao, "*Ineno iden inshi kigō ni tsuite* [About genetic symbols in rice]," *Nōgyō oyobi engei* [Agriculture and horticulture] 10 (1935): 1391–1394.

[62] Yamaguchi, "Wagakuni ni okeru ine no idenkenkyū no genjō," 25–26.

[63] Yamaguchi, "Ine no gen kigō tōitsu shian."

[64] "The Symbolizing of Genes and of Chromosome Aberrations," *Genetica* 22, no. 1–3 (1940): 264–268.

[65] K. Ramiah, "Early History of Genic Analysis and Symbolization in Rice," in *Rice Genetics and Cytogenetics: Proceedings*, 33–34. The symbols were published in B. S. Kadam and K. Ramiah, "Symbolization of Genes in Rice," *Indian Journal of Genetics and Plant Breeding* 3, no. 1 (1943): 7–27.

Japanese proposals for both general rules and specific ones for wheat, silkworm, and rice, the organisms that Japanese geneticists had analyzed extensively.[66]

The Japanese committees sent their general-rule proposal ("Rules for nomenclature and symbolization of genes") to the Permanent International Committee for Genetics Congresses in 1952 through the Science Council of Japan. Meanwhile, they tried to reconcile on rice gene symbols. Ramiah was invited to Japan in July 1952 and had a meeting with a group of Japanese geneticists, including Kihara, to discuss each other's proposals, but they only confirmed that they needed a third party to reconcile their discrepancies.[67] With no compromise, rice geneticists in Japan kept using their own set of symbols. This created a severe problem, as one scientist recalled that international collaborations had to be delayed until the standardized symbols were commonly accepted.[68]

The Japanese general-rule proposal was, according to the Canadian wheat geneticist Áskell Löve, "the strongest propaganda for alterations of the [1940] Rules."[69] This led to the establishment of a new international committee in 1954, with a Japanese geneticist as chair.[70] Eventually, the summary report submitted by this committee was adopted by the Tenth Congress in Canada in 1958, and the final report came out in 1959.[71] It presented much simpler rules than the Japanese proposal, and it made clear that standardization should not be compulsory. Importantly, however, the Japanese geneticists finally took part in the process, which meant that this could be used as the basis for further discussions of the standardization in each organism.

With the authoritative report, soon a new committee for rice gene symbolization was appointed, with three rice experts, one each from India, Japan, and United States.[72] A

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[66] Two committees (the National Committee of Genetics and the National Committee of Plant and Animal Breeding) were formed under the Science Council of Japan in 1949. Kihara was the chair of the National Committee of Genetics but represented Japanese interests in the symbolization matter. The chair of the other committee was Morinaga Toshitaro.

[67] H. Kihara and T. Morinaga, official summary report of the National Committee of Genetics and the National Committee of Plant and Animal Breeding, 31 July 1952, file "D-56, 3−1," SCJ collections, Science Council of Japan, Tokyo.

[68] N. Parthasarathy, "FAO's Interest and Role in Gene Symbolization and Nomenclature," in *Rice Genetics and Cytogenetics: Proceedings*, 37.

[69] Áskell Löve, untitled, undated [February–August 1956], folder "Nomenclature history (Folder 2)," box 18, M. Demerec Papers, American Philosophical Society Library, Philadelphia, Pennsylvania (hereafter cited as APS). See p. 2.

[70] It was the International Committee on Genetic Symbols and Nomenclature, with Tanaka Yoshimaro, a Japanese silkworm geneticist, as its chair. Lerner to Barigozzi, 21 April 1954, folder "Permanent International Committee on Genetics Congresses, Correspondence (1953–1954)," I. Michael Lerner Papers, APS.

[71] Y. Tanaka, "Report of the International Committee on Genetic Symbols and Nomenclature," *Wheat Information Service* no. 8 (1959), http://shigen.nig.ac.jp/wheat/wis/No8/p24/1.html.

[72] A renewed committee appointed under the International Rice Commission consisted of R. Seetharaman (representing Ramiah), Takahashi Man-emon (representing Nagao Seijin, who proposed a set of symbols in 1935 and again in 1951), and Nelson Edgar Jodon, an American researcher at the US Department of Agriculture Rice Experiment Station in Louisiana, as a mediator between the Japanese and Indian communities. See Jodon, "Toward Uniformity of Gene Symbolization," in *Rice Genetics and Cytogenetics: Proceedings*, 42. Nagao's

briefer report came out in 1959 and a full report with a complete list of symbols came out in 1963.[73] The latter had lists of symbols and references sorted by the nationality of authors. The list of symbols reported by Japanese authors since the 1940s was the longest among all three countries' contributions, and the references used for those symbols amounted to 92 articles, the majority of which were published in Japanese. For the Japanese, the symbolization effort was a process to make these studies visible and obtain the associated recognition.

Kihara played an important role in disseminating a package of symbols and the relevant Japanese studies, using the IRRI network. In 1960, at the second meeting, the IRRI's Program Committee recommended that the IRRI be the "authority of the standardization of rice gene symbols and gene linkages" and that they "organize a Committee and/or Symposium for panel discussion on such subjects."[74] Finally, the reconciliation of the long conflict of symbolization was showcased at the Symposium on Rice Genetics and Cytogenetics in 1963. The symposium began with Kihara's opening address, titled "Need for Standardization of Genetic Symbols and Nomenclature in Rice," and one whole session, among six sessions with specific topics in rice genetics, was dedicated to gene symbolization and nomenclature. Interestingly, the presentations here were not about actual issues of nomenclature but about history. One American scientist and two Indian scientists, including Ramiah, all of whom were involved in the standardization, talked about the history of the process and their experiences with it. Overall, the session celebrated the accomplishment of the standardization, encouraged others to comply with it and be practical about further adjustments as science would progress, and recognized the IRRI as the authority to maintain the uniformity of the symbols.

One of the major goals of the symposium was to unify rice geneticists' basic language: names for genes and genomes and for species and subspecies. In addition to gene symbols, Kihara also sorted out conflicts (again between Japanese and Indian researchers) related to rice genome symbols, by establishing the Committee on Genome Symbols for *Oryza* Species, with himself as chair.[75] There was also a committee "appointed to attempt a standard classification and nomenclature of the genus *Oryza*."[76]

postwar proposal of the symbols is in Nagao, "Genic Analysis and Linkage Relationship of Characters in Rice," *Advances in Genetics* 4 (1951): 181–212.

[73] "Genetic Symbols for Rice Recommended by the International Rice Commission," *International Rice Commission Newsletter* 8, no. 4 (1959): 1–7; "Rice Gene Symbolization and Linkage Groups," USDA Agricultural Research Service *ARS* 34, no. 28 (1963): 1–56, https://archive.org/details/ricegenesymboliz3428unit/page/n1/mode/2up.

[74] "DRAFT, Minutes of the second meeting of the program committee, IRRI," 6 Oct 1960, folder "I.R.R.I. shokan tsuzuri [a collection of letters] 1960–," preserved by Yuriko Kihara.

[75] "Appendix 2, Recommendation of the Committee on Genome Symbols for *Oryza* Species," in *Rice Genetics and Cytogenetics: Proceedings*, 253–254.

[76] "Appendix 1, Report of Committee Appointed to Attempt a Standard Classification and Nomenclature of

For each committee, a Japanese member who was also a member of the NIG project had a seat. Importantly, the institute's library had been working to collect a large volume of publications from different countries, and at the symposium it was specifically announced: an "up-to-date bibliography of Japanese rice literature was maintained, and some of them were being translated into English."[77] By making the past Japanese work visible and overseeing the standardization of nomenclatures, the IRRI—and Kihara—helped the Japanese cement their leadership in the international network on research in rice genetics.

4. Conclusions

Seizing the opportunity that emerged through the American interests in improving rice cultivation in Asia, Kihara brought in resources that were used to support basic research, to reestablish Japanese authority through the standardization of nomenclatures, and to integrate the NIG in the IRRI's international network especially by developing a shared plant resource. While his project did not become a force influencing the field of genetics, which was in the midst of the molecular trend, the NIG today still maintains laboratories focusing on rice and offers an invaluable resource of wild rice for researchers worldwide.[78]

These activities did not emerge fresh after the war; they were, rather, continuations of Japanese geneticists' activities since wartime. The Japanese efforts in trying to gain leadership in international symbolization and Kihara's research style involving collecting plants and setting up labs abroad were not new; these postwar efforts depended on experiences and networks that they had built over a long time. In particular, Kihara's NIG project was supported by the Hokkaido (Imperial) University's network, which contained both a colonial management network and a new network of postwar international aids. Having American dollars helped the Japanese to continue developing resources, networks, and authority in Asia.

Kihara's collaboration also benefited the Rockefeller Foundation and the IRRI. As we have seen, the NIG project supplemented the IRRI with basic research and plant collection and preservation and also offered a model example for US–Asia collaboration. In addition, Kihara recommended Japanese researchers for IRRI staff; such a contribution was probably one of the highest expectations the IRRI had of him. Using his Hokkaido network, Kihara, for example, recommended Tanaka Akira, who graduated from Hokkaido University. Tanaka headed the physiology program at the IRRI and made

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the Genus *Oryza*," in *Rice Genetics and Cytogenetics: Proceedings*, 251–252.

[77] R. F. Chandler, foreword, in *Rice Genetics and Cytogenetics: Proceedings*, vi.

[78] K. Nonomura et al., "The Wild *Oryza* Collection in National BioResource Project (NBRP) of Japan: History, Biodiversity and Utility," *Breeding Science* 60 (2010): 502–508.

significant accomplishments in studies of high-yielding rice varieties in the tropics.[79]

The Japanese side of the story involving the IRRI—especially what the Japanese did and did not offer to the American rice project and how and why it happened—should be examined further because it is an important piece of the history of rice science in Asia, including that of the Green Revolution in the region. As Harwood has pointed out, the Green Revolution in the 1960s–70s in Asia made mistakes that retrospectively seem as though they could have been avoided if those people involved in the program had learned from past experiences accumulated since the 1920s in Japan in particular.[80] Previous literature has pointed out, for example, that Japan had mostly small-scale farms (and thus had extensive knowledge highly relevant to the other regions in Asia), and had a better institutional model than the IRRI's centralized system in facilitating fine-tuned adaptation of crops at each local experimental station, but also had a history of making mistakes by ignoring local people's social and cultural needs.[81] With Kihara's NIG project alone, the IRRI had enough of a network to access Japanese rice experts with rich experience, but it is unknown how much of that knowledge was pursued by the project staff. As discussed in this paper, Kihara had been consistently interested in developing Japanese basic research environment during and after the war. I speculate that these interests of a key mediator between Japanese and American communities did not encourage the active transfer of the diverse knowledge produced in the long history of rice cultivation practices in Japan and its former colonies to the Rockefeller Foundation/IRRI. How and why some knowledge that already existed in Asia was selected and some was ignored is an important part of the history of the Green Revolution in Asia, and this pattern should not be explained only through US interests. By focusing more on rice research and its accompanying interests within Asia, we would understand better how rice-related knowledge was distributed through complicated interactions of Japanese, American, and various other Asian forces and how this affected rice cultivation in Cold War Asia.

The current paper is limited by the lack of perspectives of local experts in other Asian countries. If relevant archives can be identified, future studies could explore how those local experts viewed and used their collaboration with the Japanese in their own context, how the United States played a role in the dynamics, and how these local

[79] Also, Ishizuka Yoshiaki, who replaced Kihara as a board trustee at the end of Kihara's term, was a professor of soil science at Hokkaido University. Tanaka was one of Ishizuka's former students. See Man-emon Takahashi, "Hokkaidō no inasaku to hokudai [Rice cultivation in Hokkaido and Hokkaido University]," *Hokudai hyaku-nenshi, Tsūsetsu* [The centennial history of Hokkaido University, general category] (1982), 777–788, http://hdl.handle.net/2115/30037. Chandler, *Adventure in Applied Science*, 62.

[80] Jonathan Harwood, *Europe's Green Revolution and Others Since: The Rise and Fall of Peasant-Friendly Plant Breeding* (New York: Routledge, 2012), 123–131.

[81] Harwood, *Europe's Green Revolution*, 130–131; Tatsushi Fujihara, *Ine no daitōa kyōeiken: Teikoku nihon no 'midori no kakumei'* [The Greater East Asia Co-Prosperity Sphere of rice: Imperial Japan's 'green revolution'] (Tokyo: Yoshikawa kōbunkan, 2012); Fujihara, "Colonial Seeds, Imperialist Genes."

activities shaped the American project in Asia. More research at multinational archives in Asia would help shift our gaze away from a narrower focus on the bilateral relationship with the United States and deepen our understanding of the complex transnational process of development of science and technology in Cold War Asia.

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