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Grant Otsuki

University of Tokyo

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Cybernetics in Japan: Ikehara Shikao, Democracy, and Post-World War II Transformations in Japanese Universities

Grant Otsuki
University of Tokyo
E-mail: grant.otsuki@icloud.com

***Abstract*—Ikehara Shikao was a mathematician trained under Norbert Wiener at MIT in the 1920s. He became the main Japanese translator of Wiener's work on cybernetics, and played a crucial role in the popularization of cybernetics in Japan during the 1950s. During the war, he also became involved in reform movements in the Tokyo Institute of Technology, which aspired for a university based on the model of MIT. I discuss Ikehara as an out-of-place "bachigai" scientist, who strategically used his position in the borderlands between Japan and the US, and the war and postwar periods to effect change in Japanese universities. Ikehara discursively located cybernetics in Wiener, MIT, and the US such that American-style institutions became necessary conditions for a free society understood in cybernetic terms. This article contributes to the historiography of cybernetics in Japan, and shows the transformations that cybernetics underwent as it was taken up there.**

I. Introduction

In 1947, the Japanese mathematician Ikehara Shikao [1] (1904-1984) published a book entitled *Amerika Gakusei Seikatsu*-Student Life in America. Appearing soon after the end of World War II, the book describes the author's twelve years studying in the United States, which ended with a Ph.D. in mathematics from MIT. The book's preface announces Ikehara's vision of the path that Japan had to follow to avoid a resurgence of the military authoritarianism that had overcome the country and set it on the path to an unwinnable war. He wrote, "The life of the Japanese today is possible because of four human freedoms that America has given us." [2] Ikehara was referring here to the freedoms that Franklin D. Roosevelt had declared for the world in his 1941 State of the Union address: freedom of speech, freedom of worship, freedom from want, and freedom from fear. According to Ikehara, Japan needed a strong and democratic system of education to make these freedoms, "our flesh and our bone." In the following pages, Ikehara wrote at length on the structure, practices, and people of the place that he believed best embodied such an education: MIT.

In 1983, near the end of his life, Ikehara sent a similar message in another book, albeit in the terms of cybernetics and the new sciences of information. Cybernetics was a science of "control and communication" based on new theories of information and feedback that had emerged after World War II, sparking international excitement and vast research on the possibilities for smart machines, global electronic communication, and the automation of labor. Key to cybernetics was a new concept of information, which the "father" of cybernetics Norbert Wiener, defined as "a measure of a system's degree of organization" [3], the possibility of choosing the right message out of a sea of noise. Ikehara wrote that the Japanese bore a responsibility to understand the American education system, which had made it possible for such a discovery to be made. Echoing Wiener's definition, Ikehara continued, "Information is born where there are choices. Human beings receive education to develop the intelligence to choose, and accumulate the wisdom that allows them to work for the progress of society." [4]

How did Ikehara's 1947 dreams for a Japan that was democratic to its flesh and bones become articulated in terms of cybernetics? Part of the answer lies in Ikehara's personal and professional connection to Norbert Wiener. As Fred Turner writes, Wiener imagined society as an information system governed by feedback loops among its parts and with its surroundings, in which was embedded "a deep longing for and even a model of an egalitarian, democratic social order." [5] Cybernetics and information theory were nearly everywhere associated with the dreams of automation, freedom from tedious work, and deep and meaningful connection among authentic selves. As Wiener's closest colleague in Japan, Ikehara was strongly influenced by his mentor's views, but to stop here and conclude that Ikehara merely spread Wiener's ideas would collapse the history of cybernetics in Japan into one of mere dissemination of science from a Western origin to the global periphery. It does not give us a way to understand, for example, why Ikehara for his entire life held up MIT as the embodiment of democratic education, while Wiener would stake out a position and identity for himself as a public intellectual who was critical of MIT's tight embrace with the American government and military.

In this article, I examine Ikehara Shikao's work and relationship to Wiener, MIT, and cybernetics from 1922 to 1983. During the height of cybernetics's popularity in the 1950s, machines, organisms, humans and human society were all being rethought in terms of systems of information. In cybernetics, Ikehara saw a model for a liberal democratic social order, but unlike Wiener, he

idealized MIT as its embodiment. Thus, during a period when Japanese science and society were searching for a place in the postwar global order, Ikehara worked to establish cybernetics as the science for a new age, but also emplaced and located [6] it as a unique product of the social conditions of early and mid-twentieth century MIT, such that the cyberneticization of Japanese society necessitated the Americanization of its institutions. But this vision of Japan was not a product of cybernetics but an appropriation of it. I discuss how Ikehara was involved with dissident scholars who began working during World War II, prior to the arrival of cybernetics there, to reform Japanese universities based on models in US. With Ikehara, cybernetics became the idiom through which to articulate the necessity of transforming Japan in the image of MIT. In the process, I present Ikehara as a "bachigai" or out-of-place scientist, who occupying borderlands between the US and Japan, cybernetics and traditional sciences, and the Imperial and postwar periods, was able to tinker with "Japan, its governments, its universities," and with cybernetics itself. Here, I do not mean "bachigai" in its usual derogatory sense, but to highlight Ikehara's position between the US and Japan, able to draw on one to promote his views in the other. [7] I describe how he navigated and strategically used these borderlands to both promote cybernetics and advocate for reforms in postwar Japan.

This article has two aims. The first is to begin a discussion on the multifarious histories involving cybernetics in Japan. Cybernetics has drawn significant interest from historians of science over the past three decades as an area in which key aspects of the contemporary "information society" were developed. Within this literature, some scholars have begun to discuss how cybernetics was more than a science produced in a few places in the West: it was disunified [8], proliferating through multiple connections with knowledges, institutions, and people in other countries, as Yeang has discussed for China and Medina for Chile. [9] Challenging conventional historiographies that position cybernetics as a scientific knowledge that diffused to other places, recent work shows that cybernetics morphed as it moved, and came into contact with local concerns, reshaping both in the process. The same is true for Japan, yet very little has been written about cybernetics in that country in Japanese or in English. This article discusses a small part of that story by describing the reception and translation of cybernetics in Japan from 1949 as an initial contribution to the scholarship on the history of cybernetics in Japan.

Relatedly, this article's second aim is to discuss cybernetics in the context of post-war institutional and social reforms in Japan. Many scholars have investigated the diversely progressive, dystopian, and utopian imaginings and actualities of scientific and philosophical, as well as social and institutional change that accompanied the development of cybernetics and the information sciences. [10] This article contributes to this literature by examining how cybernetics was brought together with movements to reform Japanese universities that began immediately after the end of World War II. Under the initial direction of the American Occupation authorities, Japanese universities underwent extensive changes to dismantle wartime research infrastructures, foster research in new areas, and instill democratic ideals in students and institutions. I describe how some of these reforms were centered in efforts that began just before the end of the war at the Tokyo Institute of Technology (Tokyo Kougyou Daigaku, TIT) to reshape it in the image of MIT.

This paper draws on Ikehara's published works, primary sources drawn from Norbert Wiener's papers held at MIT, the National Diet Library in Japan, and contemporary newspapers and journal articles. I also draw on secondary sources in English and Japanese, and interviews, including with Ikehara's student Hirota Osamu, who also provided me with access to Ikehara's letters and personal files related to cybernetics. [11]

In the first section, I introduce Ikehara, and describe his activities from 1922, when he first crossed the Pacific to the US, until 1934 when he returned to Japan. Ikehara was not the first Japanese student to study at MIT, let alone the US, but he was perhaps unique in the extent to which he idealized MIT and promoted it as a model research institution and liberal democratic education. I also discuss his relationship with Norbert Wiener, who would exercise the most profound influence on Ikehara's life. In the second section, I briefly overview cybernetics in Japan in the immediate post-war years to give context to Ikehara's contributions. In the third section, I discuss his relationship with MIT, especially in relation to his wartime activities. In the last few years of the war, Ikehara participated in a small gathering of scientists at the Tokyo Institute of Technology, which was an important starting point for university reforms that began immediately after the war ended. These reforms, which were patterned on the model of MIT, would attract the favor of the American occupation authorities, and turn TIT into an important new model for Japanese universities to follow from the middle of the 20th century.

II. Biographical Sketch of Ikehara Shikao

Ikehara Shikao was born in Osaka, Japan on April 11, 1904. [12] He was the oldest son of Ikehara Shikanosuke, a bureaucrat and businessman, who at the time was deputy mayor of Osaka. [13] After graduating from the prestigious *Hyogo kenritsu Daiichi Chugaku* (First Kobe Hyogo Prefectural Junior High School) in 1922, he travelled to the United States for further study. Nowhere does Ikehara write about his reasons for his decision to study in the US, but he appears to have set his sights early on MIT, even if the path he was to take there was initially unclear. What is evident is that his family was well connected. Ikehara was able to rely on the help of many

Japanese businessmen and scholars already in the US to help him find a path. After a couple of false starts in New York, he studied at Rutgers Preparatory School in New Jersey, graduating in 1923. [14] However, because his exam grades were insufficient to enter MIT, he studied for a few more months at Proviso Township High School in Mayfield near Chicago before he was finally able to enroll at MIT in 1924. There he received an undergraduate degree in electrical engineering in 1928 and a doctorate in mathematics in 1930, under the supervision of the young professor Norbert Wiener.

By 1927, Ikehara was also working as a researcher in MIT's physics and chemistry departments. [15] Despite Ikehara's research accomplishments and Wiener's apparent efforts, Ikehara was unable to secure ongoing employment in the US, and returned to Japan in 1934.

On his return to a country where he had not lived since he was a teenager, Ikehara had difficulties finding a place in Imperial Japan's notoriously insular universities. In the eyes of the Japanese establishment, he was only a junior high school graduate. But due to his published mathematical work, he came to the notice of Yagi Hidetsugu, an engineer famous for the invention of the Yagi-Uda antenna design. [16] Yagi had been pulled from a position at Tohoku Imperial University to staff and lead the physics department of Osaka Imperial University, which had just been established in 1931. In contrast to most university departments at the time, which were dominated by aristocratic members of "the quasi-kin gakubatsu" factions centered in older institutions like the Imperial University of Tokyo, Yagi wanted his program to be like "a zoo, full of interesting animals." [17] Today, the most well-known of these animals is the Nobel Laureate in Physics, Yukawa Hideki [18], but Ikehara also became a member of the zoo, the only one who had received most of their education abroad. Wiener's reputation as a mathematician seems to have helped Ikehara's case considerably, as many of his Osaka colleagues were familiar with Wiener's work in functional analysis. Ikehara remained as a lecturer at Osaka until 1944, when he was appointed an assistant professor at the new Tokyo Institute of Technology, where Yagi had become president two years earlier. Ikehara remained at TIT until 1965, when he retired and became a professor at Tokyo Denki University.

Ikehara was a gifted mathematician whose main contributions followed Wiener's prewar work on Tauberian theorems. His lasting mathematical contribution is the Wiener-Ikehara Theorem, a result in functional analysis that has been used to mathematically prove the intuition that large prime numbers are less common than small ones. Upon his return to Japan in 1934, he was touted by the Osaka Asahi Shimbun as a "young unknown Japanese man, who had solved one of the most important problems in mathematics." Ikehara continued to write on mathematics, including publishing several university textbooks, but his independent research appears to have nearly ceased after 1945. [19] His first major publications after the war were books on his American experience. In 1946, he published a book co-authored with Fujiyo Ineko entitled *Akarui kuni*: *Amerika Kateiseikatsu*,*Kyoiku*, *Bunka* ("The Shining Country: Domestic life, education, and culture of America"), which was followed in 1947 by his single-authored *Amerika gakusei seikatsu* ("Student life in America."). Both of these books present a picture of American life based on his time in the US with ethnographic attention to detail.

Ikehara's published writings are full of descriptions of his experiences, but he rarely personally reflects on them. He relates his immediate thoughts and emotional reactions to the events that he describes, but he does not explicitly contextualize them or discuss their significance to his life or ideas. Neither does he offer many personal details about his life or his family. As will be seen below, he does not shy away from polemics, but they are stated in the objective and universal terms of a mathematical theorem. As such, there is little published information about his relationship with Wiener during Ikehara's time at MIT, and it is unclear why or how Ikehara came to be Wiener's student after beginning his studies in electrical engineering. However, Wiener did have a reputation for caring for students from Asia. Wiener had struggled with his own Jewishness and experienced discrimination and disadvantage [20], and this led Wiener to take up an antiracist stance, one manifestation of which was his active support for students and colleagues from Asia. In his second autobiography, reflecting on his 1935 trip to Japan and year-long residence at Tsinghua University, Wiener wrote, "I have never felt the advantage of European culture over any of the great cultures of the Orient as anything more than a temporary episode in history". [21] Ikehara was in the first cohort of doctoral students that Wiener supervised at MIT, which also included Yuk Wing Lee a student from China, who would become Wiener's close collaborator and arranged for Wiener's invitation to Tsinghua. In addition, as an instructor at Harvard in 1915, Wiener became a close friend of Chao Yuen Ren, who would become a noted linguist and eventually draw cybernetic ideas into his own work. [22] During the same period, Wiener was also an assistant to Hattori Unokichi, then of the Imperial University of Tokyo, during the year that Hattori visited Harvard to lecture on Japanese and Chinese religion. [23] Wiener writes that this experience "stimulated my interest in the civilization of the Orient, to which I had already been led in dealing with the problem of my Jewish origin through my interest in the general problem of undervalued peoples." [24]

That Wiener became a defining presence in Ikehara's life is evident from published sources and from their correspondence. Ikehara's first public mention of Wiener in Japan appears in the 1934 Asahi newspaper article about the Wiener-Ikehara theorem, in which he credits

his achievements to Wiener. [25] The letters Ikehara exchanged with Wiener after that show their relationship to have been relatively close, if one-sided. Wiener's responses were comparatively terse and stuck to the business at hand. Ikehara's letters often referred to fond memories of his time at MIT or with Wiener's family, and a strong desire to be in Cambridge again. In one letter dated March 24, 1949, responding to a letter in which Wiener seems to have suggested the possibility of a position for Ikehara at MIT, Ikehara wrote "My joy will be boundless if you are generous enough to give me a chance to work at MIT again. I am very anxious to work in the invigorating atmosphere of your presence." [26]

Notably, after 1945 and even rarely before then, Ikehara does not appear to have sent Wiener any technical literature, including postprints of papers, nor did he address mathematical or scientific topics in his letters, except as they related to Ikehara's translations of Wiener's work.

As cybernetics began to attract attention, Wiener anointed Ikehara the main Japanese translator of his works. Much of their correspondence during the 1950s was related to translation rights and royalty payments due to Wiener from his Japanese publishers. Their relationship was not one of research collaborators, as Wiener had with Yuk Wing Lee, but as an acolyte or avatar for Wiener. After 1950, Wiener began to receive correspondence from scientists across Japan, whom Wiener consistently referred to Ikehara. Furthermore, Ikehara was responsible for managing Wiener's affairs during trips to Japan in 1935 as well as in 1956, when Wiener had become a minor national celebrity. Ikehara became one of the main commentators on Wiener and cybernetics in the Japanese media during the 1950s and 1960s. The public reputation that Wiener enjoyed in Japan during that time was due in significant part to Ikehara.

III. Cybernetics in Japan in the late-1940s and 1950s

Ikehara was far from the only person in immediate post-war Japan to be interested in cybernetics. Ikehara received a copy of Wiener's field-defining *Cybernetics*: *Communication and Control in the Animal and the Machine* (1948) in 1949, and began its translation in 1950, but through other channels, Wiener's books and papers, as well as those of Claude Shannon and others associated with the new theories of information and communication, were circulating in Japan by 1950. It was that year that Wiener began receiving letters from across Japan about cybernetics. Several letters came from Kitagawa Toshio, a mathematician based at Kyushu University who had met Wiener during the 1935 visit. Mirroring the Macy Meetings on cybernetics, pivotal multidisciplinary gatherings [27] in the US between 1946 and 1953, Kitagawa organized two meetings bringing together specialists in physics, engineering, medicine to discuss cybernetics in 1952 and 1953. Participants included people who would later go on to play significant roles in the subsequent development of mathematics, physics, computer science, and operations research. The proceedings of these meetings were published soon after in two slim volumes, which like the Macy proceedings, came complete with transcripts of discussions. They were the first books to be published in Japanese on cybernetics. [28] One of the participants in these meetings, Takahashi Hidetoshi, a pioneering computer scientist, was also a member of a group of engineers and physicists that had named themselves "Logergist," based at the University of Tokyo, which began monthly meetings in 1951 as the "Cybernetics Study Group" (*Saibanettikusu Kenkyukai*) which continued in various forms for ten years. [29] By the mid-1950s, cybernetics had boomed, as a diversity of Japanese scholars began releasing books on cybernetics, and many others translated books by American, British, French, German, and Russian cyberneticists.

It was only Wiener who became a figure of interest to the general public. Wiener's growing celebrity in the US during the 1950s converted into significant press attention in Japan. On May 30, 1950, the Tokyo Asahi Shimbun published what appears to have been the first newspaper article on cybernetics in Japan, introducing it as "the science of artificial brains" that was attracting attention worldwide, accompanied by a brief profile of Wiener. Amidst growing interest in new technologies of automated factories and computers or "artificial brains," the article highlighted Wiener's warnings for the anti-human potential that automation might harbor, and his decision to distance himself from military research. Wiener's concerns for the future of human society and the ethical and political implications of cybernetics and technologies of control and automation were also at the forefront of *The Human Use of Human Beings*: *Cybernetics and Society* (originally published in 1950), which was the first book on cybernetics aimed at a mass audience. Owing to problems securing the Japanese translation rights to the earlier *Cybernetics*, Ikehara's translation of *Human Use of Human Beings* was the first work of Wiener's to be released in Japan. Going on sale at the beginning of 1956, it came just a few months before Wiener's second visit to Japan, which was sponsored by the national broadcaster NHK, and was accompanied by numerous features on cybernetics and Wiener in newspapers, to which Ikehara contributed.

IV. Ikehara as an Educational Reformer

As many historians of 20th century Japanese science and technology have shown, the end of World War II was a moment of both rupture and of continuity for research institutions and trajectories. The rupture is illustrated well by a famous radio address given by Prime Minister Suzuki Kantaro on August 15, 1945, not long after the Showa Emperor's announcement of surrender, in which

he asked the country to "strive for the progress of science and technology, which were our greatest deficiency in this war". [30] Whereas during the war, Japan's science and engineering research capacities had been centrally controlled for military purposes, immediately afterwards they were repositioned as the basis for a new Japan. The U.S. Occupation authorities had largely dismantled what of the country's research and development infrastructure had not been destroyed during the war. Yet, as Aaron Stephenson Moore and Janis Mimura point out, the technocratic ideas and technological imaginary that drove Japanese elite's efforts to achieve progress did not die with the war, but were part of longer trajectories that began before the war and carried on well into the late 20th century. [31]

In Wiener's case, the intellectual seeds of cybernetics were apparent long before World War II. Masani suggests that his cybernetical thought was in "embryonic form" in philosophical papers Wiener wrote as early as 1914. [32] But as an ensemble of technoscientific knowledges and practices, cybernetics was very much of the post-war age [33], an image strengthened by Wiener's constant references to the coming "third industrial revolution" of automation. In Japan, cybernetics arrived as part of the flood of new information that came streaming in from the United States after the war. It was a new science unencumbered, at least in popular discourse, from the horrors of World War II. Juxtaposed against fresh memories of constant air raids, atomic bombs, and human casualties on an industrial scale, not to mention the tight controls on information, cybernetics appeared as glimmer of hopeful progress. As Ikehara wrote in a 1954 letter to Wiener that "she [Japan] could ⋯be now more sensible and reasonable if she were in the midst of vigorous global cybernetics". [34] If science and technology had indeed been Japan's greatest deficiency during the war, then cybernetics appeared as a corrective.

The reasons for this "deficiency" have been explained in many ways, but one of special relevance to the present discussion is the rift between civilian and military researchers during the war. As Matsuo points out, there was significant distrust and lack of co-operation between military and civilian researchers in terms of personnel, resources, and operating practices, which hampered civilian work. An illustrative example is Yagi Hidetsugu. [35] Yagi resigned as president of TIT in 1944 to become director of the Technological Committee, a governmental body roughly corresponding with the Office of Scientific Research and Development in the US [36], which was tasked with coordinating scientific and technology research nationally with the primary aim of developing technologies for war. Though the Committee reported to the Prime Minister, the reality was that Navy and Army authorities exercised control over research, and therefore over his group's activities. On top of this struggle for resources, there was also xenophobia. After the war, Yagi, who himself had studied in Europe and the US, told a scientific mission from the US that civilian scientists, many of whom had experiences abroad, were treated with suspicion,"as if they were foreigners." [37]

These suspicions were not completely unfounded. [38] In 1944, a few months before Yagi left TIT, Ikehara joined him as an assistant professor in that university's tiny mathematics program. [39] There, Ikehara became a member of a secret group known as "Suiyōkai" (the Wednesday group), which consisted of a small number of staff from across the university. They listened to radio broadcasts from overseas on illegal shortwave radios and shared information gleaned from acquaintances in the press that could not be published in the newspapers. [40] Among their topics of discussion was the state of universities abroad, which centered on MIT. One of the members, Uchida Shunichi, a chemist, had spent significant time at MIT, and when he was placed in charge of the new chemistry department at TIT, gathered materials on chemistry programs from universities around the world to plan his own curriculum, eventually using MIT's program as his main model. Ikehara contributed his own experiences and materials gathered during his years working at MIT to the group. Suiyōkai became the center of a movement within TIT that would gather momentum immediately at the end of the war to restructure the university in the image of MIT. [41]

Soon after Japan surrendered in August 1945, General Douglas MacArthur, the Supreme Commander for the Allied Powers, arranged for a group of American educators to visit Japan for a month to advise GHQ and Japanese educators on the shape of postwar education in Japan. The first United States Education Mission to Japan arrived in March 1946 and met with a wide range of stakeholders representing ministry officials and staff in schools and universities, in coordination with GHQ's Civil Information and Education section (CIE.) Their report, issued in April 1946, constituted a representation of Japanese education and its issues in broad brush strokes, and gave a series of recommendations for developing a new education system that would be the basis for a liberal democratic society. Among them were proposals for a government agency that would establish standards for institutions of higher education to raise the overall quality of universities, and greater opportunities for "general education" for cultivating a "broader humanistic attitude" in its students to counter what the group saw as the overly insular and specialized approach that the universities had traditionally taken. [42]

By the time of the mission's arrival, TIT had already begun taking significant steps towards reforms of nearly precisely the kind that the mission sought. Following Yagi's departure in 1944 for the Technological Committee, Wada Koroku arrived at TIT from a senior post on the Technological Committee to assume the presidency of the university. He immediately began considering

fundamental changes to the institution. In memos dating from mid-1945, Wada writes that the goal of universities must be to pursue truth and nurture the brightest minds in the country, rather than simply teach skills, which should be left to technical schools. He cited models such as the Technische Hochsculen in Germany, and MIT and Caltech in the US. (Wada also attended meetings of Suiyōkai after his appointment as president.) [43] According to a letter from Ikehara to MIT President Karl Compton in 1948, Wada had approached Ikehara as early as January 1945 to formulate a plan for reforming the university, which Ikehara took as an opportunity to create a "modest MIT" in Tokyo. [44]

On September 28, 1945, mere weeks after the end of the war, a meeting of the institute's professors and lecturers resulted in the creation of a committee to reform the university, which was chaired by Uchida, beginning a multiyear process of transformation. Ikehara would join this process as a member of the "New Academic System Committee" ("Shingakusei iinkai") that began working in March 1947. Uchida and these committees continued to draw on models from MIT and Caltech to construct a new system for the university, as he had done for chemistry a few years earlier. The directness of this influence is evident in a table mentioned by Okada, which shows course listings drawn from the 1938 MIT Course catalogue and the 1939 CalTech catalogue and matches them to the new 1949 TIT course list, whose titles were all listed in English. [45] In addition to courses on math, science, and engineering topics, the new TIT curriculum included required courses in the humanities for the first time, as MIT had begun implementing in the early 1930s. [46] This is also the period when the English name "Tokyo Institute of Technology" began to be used, a name that may have been suggested by Ikehara. [47] In formulating these reforms, the committees used materials gathered by Uchida and Ikehara. They are also likely to have drawn on a three-page letter dated 2 September 1948 from MIT President Karl T. Compton. [48] Compton's letter was in response to one that Ikehara had written at the request of Wada, which explains Ikehara's desire to "transfer the MIT spirit" to Japan. Compton's reply outlined aspects of MIT's curricular philosophy, and staff appointment and promotion policies, and was accompanied by Compton's reports as president and MIT course catalogues. This contact with Compton and the use of materials from 1930s MIT is especially significant because of the reforms that Compton put in place during his time as president. Compton began enacting sweeping changes to MIT upon his appointment in 1930, which transformed the institute from a "mere engineering school servicing industry" into an elite research university. [49] Moreover, Compton was actively involved in developing standards and accreditation processes for engineering education in the US. [50]

TIT's activities first came to the attention of the Education Mission when in October 1946, Wada Koroku was called to be part of a group of ten university-president level officials by the Ministry of Education to participate in a meeting of the committee to establish new standards for universities in Japan, which was gathered at the direction of the CIE section of GHQ. Because of TIT's early efforts in this area, and the clear connections between their reforms and those instituted in the 1930s at MIT, of which the CIE would have been aware, Wada was then appointed to chair the subcommittee on education, and later he was named the first president of the Japan University Accreditation Association, likely with the support of the CIE. [51] The work of this committee made the reforms begun at TIT into a template for changes in science and engineering education at universities across the country, which were based in turn on Karl Compton's MIT. [52]

V. Americanizing Cybernetics

In this light, Ikehara's 1947 book *Amerika Gakusei Seikatsu* gains an interesting new dimension. Though it appears at first glance to be Ikehara's memoir of his American experience, it is also a public version of the materials on MIT that drove the reform movements at TIT. The book is roughly divided into two sections. The first half is focused on Ikehara's own observations and thoughts from his departure from Japan to his entry to MIT in 1924. The second section is about MIT, but rather than his student experiences, it places weight on the governance and organizational structure of MIT, the programs and staff, and includes tables showing every course in a typical four-year degree. It seems reasonable to speculate that much of this information was first compiled to plan TIT's reforms. In addition, the book had the effect of giving Ikehara a minor reputation as an education reformer. The book was reprinted in 1948, and Ikehara authored a number of pieces on education in America for education journals and newsletters at the end of the 1940s and beginning of the 1950s.

The book can also be read as a timely piece of pro-American propaganda. Published under the censorship regime imposed by the Occupation authorities [53], Ikehara's book held up America as a beacon of scientific and political freedom, and a democratic system of education its bedrock. In terms that closely echoed those of the American Mission's report, Ikehara presented an MIT-style education as the way of Japan's democratic future. He elaborated on these thoughts in a letter to Wiener, dated December 11, 1948. After describing the difficult conditions of postwar living in Tokyo, Ikehara wrote:

Hard living becomes a good prey [sic] for communism here. Since I have experienced the American way of life, I cannot understand those who favor communistic life. They are longing for the life behind the iron curtain, which moreover no one has actually seen in details [sic].

Only sound education will help Japan from the claw of the Polar Bear. Your country is helping us in many ways, but greater emphasis on education will pave a long way towards a happier nation in the world. [⋯] As you believe in M.I.T., I am convinced that our Institute must bear great responsibility in establishing marching front of democracy in Japan. T.I.T is the only one of its kind here at present. Therefore I am doing my best to make ours a little M.I.T. in the orient. [54]

Whether Wiener believed in MIT in the way that Ikehara thought is debatable. Following the war, Wiener refused to participate in research for military purposes, in which MIT was actively involved. Wiener was especially horrified by the use of the atomic bomb on Japan in 1945. Hiroshima signified for him a new era in which "it has become possible for a limited group of a few thousand people to threaten the absolute destruction of millions⋯without any⋯immediate risk to themselves." [55] From 1951, his separation from MIT deepened, when he become alienated from those who had been his closest collaborators in cybernetics there. [56] Furthermore, while Ikehara continued to venerate his former professor in electrical engineering, Vannevar Bush, Wiener's decisive stance against participating in military research had put him at odds with Bush, who was working at the national level to foster the close integration of research, the state, and the military. [57] No doubt, Ikehara's long devotion to Wiener, the friendly relationship their families shared, and the great distance between Tokyo and Cambridge prevented any disagreements from scuttling their relationship. In any case, Wiener did not comment on Ikehara's efforts at TIT in his replies. Compton, in contrast, had parts of a letter from Ikehara expressing similar sentiments published in the Institute's magazine.

In the context of Ikehara's activities, the publication of the book marks a turning point for Ikehara's position in Japan. When Ikehara returned in 1934, he was seen by the academic establishment as a junior high school student, who found a place due to Yagi's desire to create a scientific "zoo" of interesting animals. By 1948, the landscape had changed to take what had been marginal closer to the mainstream. Ikehara was at the forefront of a movement that sought to reshape the establishment into something resembling his beloved alma mater. This project found eager and powerful supporters in GHQ. But this did not mean that he also became part of the mainstream of Japanese science. The publication of the book coincides with the period in his life when he ceased actively publishing new research in mathematics. According to interviews with Hirota [58], Ikehara continued to encounter many professional and academic obstacles to pursuing his own research within the insular Japanese mathematics community. Faced with the fact of his continued exclusion from mathematics, he turned towards promoting cybernetics in Japan.

From this position, Ikehara drew cybernetics into his vision of reform. Scientifically, Ikehara's translations of Wiener's books and the concurrent rise of broad interest in Wiener himself contributed to the spread and diversification of cybernetics and information theory into many areas of Japanese research. After beginning his translations of Wiener's work, Ikehara continued to proselytize for transforming Japanese education in MIT's image, but he began framing the necessity of the transformation as one entailed by the science of cybernetics. As mentioned above, Wiener imagined society as an information system that embodied a deep longing for a democratic social order. But where Wiener saw the America of the time as veering dangerously away from that ideal, Ikehara presented America and the cybernetic democratic ideal as isomorphic. To do so, Ikehara used the universal science of cybernetics, which took animals, machines, human beings, and human societies all as information systems, and emplaced it firmly in MIT and in the United States. In short, Ikehara Americanized cybernetics so that cybernetics could Americanize postwar Japan.

Beginning with the publication of the Japanese translation of the first edition of *The Human Use of Human Beings* in 1956, Ikehara translated three of Wiener's earliest books. The others were Wiener's autobiography *Ex-Prodigy*, published in translation in 1956, and *Cybernetics* in 1957. A translation of the second edition of *Cybernetics* followed in 1962. [59] Ikehara also wrote extensively on cybernetics himself. In addition to newspaper articles, the most notable are a series of nine articles introducing cybernetics for the journal *Denshi Kōgyō*, which were published between 1961 and 1962, and *Jyōhō Riron Nyūmon*: *Jyōhō kagaku no tanjyō to MIT*, co-authored with his student Hirota Osamu, which appeared in 1983.

Ikehara's translations of Wiener's work display an approach to translation that mirrors the ideas of cybernetics itself. For Wiener, cybernetics implied that the primary problem was of understanding the conditions in which information could be communicated in the presence of noise. The ideal end point was to create a society in which noise was combatted so that communication would have the "scope that it properly deserves as a central phenomenon of society" and people can "grow to be a human being in the fullest and richest sense of the word". [60] This was based, as Peter Galison has argued, on a vision of the human as an opaque, black-box monad that interacts with other monads through the exchange of information [61], or as Katherine Hayles has written, a cybernetic version of the rational and autonomous liberal humanist subject. [62] In translating Wiener, Ikehara was focused on providing sentence-by-sentence reconstructions of the original texts in Japanese that took the originals as unambiguous messages that had to be recoded. Ikehara's personal copy of *Ex-Prodigy* is marked up with only occasional Japanese definitions

of unfamiliar English words, and check marks after each paragraph, apparently to mark the completion of its translation. To translate *Cybernetics* and other of Wiener's books, Ikehara relied extensively on Japanese colleagues for support on technical details, but never bothered Wiener for clarification of his ideas, except for a small handful of occasions to check the odd formula or turn of phrase. [63] Ikehara's translator's notes were sparse and gave minimal clarifications, such as to explain literary references. It appears that to Ikehara, Wiener's works could stand for themselves. [64]

In his own writing about cybernetics, Ikehara articulated a vision of liberal democratic society that evokes the idea of feedback, which would later be reframed in terms of cybernetics. In his 1947 book, prior to his direct engagement with cybernetics, Ikehara wrote of a liberal democratic society as organized through a relation between rulers and the ruled, in which the rulers had constantly to work with the consent of and in concert with the rules to achieve a strong and vibrant democracy. [65] Moreover, old rulers had to be continuously replaced by younger rulers as their abilities to innovate ossified. In 1961, Ikehara repeated this dynamic but hierarchical image in the journal *Denshi Kōgyō*, but the problem of the relationship of rulers with the ruled reframed in terms of the cybernetic problem of noise and uncertainty in communication. It was only when the conditions of communication permit the clearest signals to circulate that the rulers can obtain the consent and co-operation of the masses, and the society as a whole could work smoothly for the common homeostatic good. [66] These statements echoed Wiener's own arguments that free communication had to flourish for people "grow to be a human being in the fullest and richest sense of the word." [67]

Where Ikehara diverged from Wiener was in explaining what he saw as the deep connections between cybernetics and the American environment for research and education. At the end of the 1956 translation of *The Human Use of Human Beings*, Ikehara allows himself a few pages to explain America as "the society of which [cybernetics] was a product." [68] He justifies this characterization by drawing an analogy between cybernetics and Wiener himself. On numerous occasions, the first of which was his translator's afterword to *The Human Use of Human Beings*, Ikehara introduces Wiener's background as a child prodigy, the education and experiences he had from his youth until becoming a professor at MIT, and his personal and professional struggles during early adulthood and his difficult relationship with his father, Leo Wiener. Ikehara presents Wiener as a genius, but one whose genius could only be realized because of the social conditions in which it appeared. At the very end of the afterward, Ikehara writes that "the greater the philosophy, the deeper it embodies the spirit of an age." [69] In relation to Ikehara's activities up to that point, it is clear that the afterword implicitly compares the US to Japan, and finds Japan wanting. In Ikehara's eyes, even if a genius of Wiener's caliber had been born in Japan, it could not have achieved as much as Wiener had, because of deficiencies in the society. By extension, a science as radical as cybernetics could not have been born, but in the US.

In subsequent writings, Ikehara expanded on this basic point a number of times. In 1961 and 1962, Ikehara wrote a series of nine articles on cybernetics for the electronics engineering journal *Denshi Kogyo* the first of which gives a biography of Wiener spanning his life as a child prodigy in Cambridge with his father to his postwar research at MIT, interspersed with brief technical discussions of the topics that Wiener was engaged at each stage of his life. [70] The preface to the article ends with Ikehara writing again that Wiener was able to build cybernetics as a result of the era, his life, and his surroundings. Ikehara's last and most direct statement on the importance of MIT to cybernetics appeared in his 1983 book, which drew heavily from what had already been written in 1961 and 1962. There, Ikehara affirms that America and MIT provided the *necessary* conditions for the emergence of cybernetics and information theory.

Part of his argument is geographical; the sheer size of the country made the long distance communication of information a scientific and technological issue that the US had unique need to address. Another condition Ikehara identifies was Wiener's genius. As in earlier iterations, Ikehara retells the story of Wiener's life as a child prodigy, but adds details about the numerous opportunities he had to encounter many ideas during his early life, from the access to libraries and museums that his father's position at Harvard afforded him, to the work he found writing for encyclopedias and newspapers and the studies he was able to undertake in the US and abroad with notable mathematicians and philosophers.

In this book, Ikehara also briefly addresses the contributions of Vannevar Bush to the postwar American research environment, but the most notable addition is an expanded section on what Ikehara identifies as the key institutions of American science: Harvard University (along with Radcliffe College), the Smithsonian Institute, and MIT. Ikehara continued here to argue that educational institutions were key to fostering the discernment and wisdom necessary to make progressive choices that could lead to significant scientific discoveries. Ikehara asserts that, whatever one thinks of America, the social environment plays an important role in major sci-entific discovery, and that the Japanese bear a responsibility to understand American education.

In his writings on Wiener and cybernetics, Ikehara appears keenly aware of the effects of social and political conditions on the production of scientific knowledge. Cybernetics appeared in the US because the social context of scientific research, which was also the context of

Wiener's upbringing, afforded it. Continuously bringing this context into the foreground, Ikehara presented Wiener's liberal democratic ideals and the institutional forms of American science as inevitable for any society that sought to achieve similar triumphs, and it was on this basis that Ikehara made his case for change in Japan. But this was not a stance that Ikehara came to because of cybernetics. As shown above, it was one already in progress from before the war, and which was shared by other civilian scientists who hid in the margins of the academy in Imperial Japan, until they could emerge to claim a central place within the post-war regime. Ikehara moved between Japan's pre-World War II universities and the reformed postwar institutions, made cybernetics both a universal science and an achievement specific to early 20th century America and MIT, and acted as an interface between Wiener in the US and Japan, using his status as an out-of-place "bachigai" scientist to effect change in his home country.

VI. Conclusion

Ikehara did not have the final word on cybernetics in Japan. The meanings and influences of cybernetics multiplied and expanded in ways that cannot be addressed in this article. Indeed, the greatest scientific impacts of cybernetics were due to contemporaries, such as Logergist, who went on to build Japan's capacities in information technology, operations research, and robotics. What Ikehara's example makes clear, however, is that beyond its influence on the content of science, cybernetics was emplaced in the US and then mustered as a strategic discursive resource for justifying changes in the institutional conditions in which those sciences could be pursued. Following these changes back in time shows the significant but hidden influence of foreign-trained civilian scientists on postwar Japanese universities, for whom MIT especially represented an ideal to aspire to. For Ikehara, cybernetics was not the beginning of his story but its final chapter, a way of thinking that he used to bring together his main activities as an activist scholar in Japan into a trajectory that could take on the appear-ance of scientific necessity.

References

[1] All Japanese names are presented with family name first.

[2] Shikao Ikehara, *Amerika Gakusei Seikatsu* アメリカ学生生活 [Student Life in America], Tokyo Komine Shoten, 1947, p2.

[3] Norbert Wiener, *Cybernetics, or Command and Control in the Animal and the Machine*, 1st ed. New York: John Wiley and Sons, Inc., 1948, p18.

[4] Shikao Ikehara and Osamu Hirota, *Jyoho Riron Nyumon: Jyoho Kagaku no Tanjyo to MIT* 情報理論入門—情報科学の誕生と MIT [Introduction to Information Theory: The Birth of Information Science and MIT], Tokyo Keigaku Shuppan, 1983, p124.

[5] Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*, Chicago and London: University Of Chicago Press, 2006, p24.

[6] On the location of technoscience, see Warwick Anderson and Vincanne Adams, "Pramoedya's Chickens: Postcolonial Studies of Technoscience," in *The Handbook of Science and Technology Studies*, ed. Edward J. Hackett et al., Cambridge, Massachusetts and London, England: The MIT Press, 2008; John Law and Annemarie Mol, "Situating Technoscience: An Inquiry into Spatialities," *Environment and Planning D: Society and Space* 19, no.5 , 2001: 609?21, https://doi.org/10.1068/d243t.

[7] Sharon Traweek, "Kokusaika, Gaiatsu, and Bachigai: Japanese Physicists ' Strategies for Moving into the International Political Economy of Science," in *Naked Science: Anthropological Inquiry into Boundaries, Power, and Knowledge*, ed. Laura Nader, New York: Routledge, 1996, 174-200.

[8] Ronald R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age* (Baltimore, JHU Press, 2015).

[9] Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (MIT Press, 2011); Chen-Pang Yeang, "From Modernizing the Chinese Language to Information Science: Chao Yuen Ren's Route to Cybernetics," *Isis* 108, no.3 , 2017.

[10] See for instance Atsushi Akera, *Calculating a Natural World: Scientists, Engineers and Computers During the Rise of U.S. Cold War Research*, Cambridge, MA and London: The MIT Press, 2007.
Paul N. Edwards, *The Closed World*, Cambridge, Mass.: The MIT Press, 1997.
Bernard Dionysus Geoghgan, "From Information Theory to French Theory: Jakobson, Levi-Strauss, and the Cybernetic Apparatus," *Critical Inquiry* 38, no. 1 (2011): 96-126; N. K. Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, University Of Chicago Press, 1999.
Ronald R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*.
Lydia He Liu, *The Freudian Robot: Digital Media and the Future of the Unconscious*, Chicago: University of Chicago Press, 2010.
Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*.

[11] These materials are held by Hirota Osamu at the Quantum Information Science Research Center at Tamagawa University in Machida, Tokyo. See Heather Love, "The Ikehara Collection: Norbert Wiener's Japan Connections," *IEEE Technology and Society Magazine*, 2017, 44-49. These materials will be cited as "Ikehara Collection."

[12] Ikehara's biography in Ikehara and Hirota (1983) gives his birthplace as Osaka. However, his entry in the 1928 *Technique MIT Yearbook* gives his birthplace as Kobe. Shikao Ikehara and Osamu Hirota, Joho Riron Nyumon: Jyoho Kagaku No Tanjyo to MIT.

[13] "Sekai sekigaku wo shinogu mumei seinen no kyuri; 世界碩学を凌ぐ無名青年の究理" ("The brilliant theorem of the unknown man who stands alongside the scholars of the world") *Osaka Asahi Shimbun*, October 30, 1934.

[14] Ikehara was likely led to Rutgers because of the history that the school had for accepting Japanese students. During the 19th century Bakumatsu Period, the school was the sole destination for Japanese men studying in the United States, who did so in defiance of laws that harshly restricted travel abroad. The school would remain a preferred first destination for Japanese students in the US after borders were loosened during the Meiji Restoration, though its importance diminished greatly over time. (See Perrone 2017). Ikehara was among the small number of students who followed this welltrodden path into the US in the early decades of the 20th century. Fernanda Perrone, "Invisible Network: Japanese Students at Rutgers during the Early Meiji Period," *Bulletin of Modern Japanese Studies* 34 (2017): 448-68.

[15] In the biography for Ikehara attached to Ikehara (1969), his date of appointment to researcher at MIT is given as April 1927. Ikehara (1947) shows dates his appointment to November 1926. Shikao Ikehara, *Amerika Gakusei Seikatsu* (Tokyo: Komine Shoten, 1947); Shikao Ikehara, "Kyoiku Ishin 教育維新" ("The reform of education") *Journal of JSEE* 16, no. 2 (1969): 5-12.

[16] The Yagi-Uda antenna is a design Yagi developed with Uda Shuntaroō during the 1920s at Tohoku University, which was used for radar and radio during World War II. The design later became ubiquitous in antennas for televisions worldwide. See James E. Brittain, "The Evolution of Electrical and Electronics Engineering

and the Proceedings of the IRE: 1913-1937," *Proceedings of the IEEE* 77, no. 6 (1989): 837-56; Hiroshi Matsuo, *Denshi Rikkoku Nihon wo Sodateta Otoko: Yagi Hidetsugu to Dokusosha tachi* 電子立国日本を育てた男; 八木秀次と独創者たち (Tokyo: Bungei Shunju, 1992); Shozo Usami and Gentei Sato, "The Authenticity of the 'Newman' Notebook and Its Reference to the 'Yagi Antenna,'" vol. 1 (IEEE Antennas and Propogation Society International Symposium 2001., Boston, MA: IEEE, 2001), 26?29, https://doi.org/10.1109/APS.2001.958785.

[17] Hiroshi Matsuo, *Denshi Rikkoku Nihon wo Sodateta Otoko: Yagi Hidetsugu to Dokusosha tachi*; 電子立国日本を育てた男一八木秀次と独創者たち (The men who built the electronic nation of Japan: Yagi Hidetsugu and the Innovators) (Tokyo: Bungei Shunju, 1992).

[18] Kenji Ito, "The Geist in the Institute: The Production of Quantum Physicists in 1930s Japan," in *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, ed. David Kaiser (Cambridge: MIT Press, 2005), 151-84.

[19] Notably, only 5 English-language articles by Ikehara appear in the ZBmath bibliographic database, all dated 1931. The Osaka University Knowledge Repository, which contains internal research publications for the period of Ikehara's tenure there, only lists one publication, a profile of Wiener that also announces his impending visit. Some of his letters to Wiener between 1931 and 1945 refer to new mathematical work, but no publications appear to have resulted.

[20] Norbert Wiener, *Ex-Prodigy: My Childhood and Youth* (Cambridge, MA: The MIT Press, 1953), 143-148.

[21] N.Wiener, *Ex-Prodigy: My Childhood and Youth*, 181-182.

[22] On Chao's relationship to cybernetics, see Yeang, "From Modernizing the Chinese Language to Information Science: Chao Yuen Ren's Route to Cybernetics."

[23] On Hattori, see Paula S. Harrell, *Asia for the Asians: China in the Lives of Five Meiji Japanese* (Portland, Maine: MerwinAsia, 2012).

[24] Wiener, *Ex-Prodigy: My Childhood and Youth*, 228-229.

[25] "Sekai sekigaku wo shinogu mumei seinen no kyuri," *Osaka Asahi Shimbun*.

[26] Letter from Ikehara to Wiener, 24 March 1949, Norbert Wiener papers MC-0022, Massachusetts Institute of Technology, Department of Distinctive Collections, Box 6, Folder 94.

[27] On the Macy Meetings, see Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*.

[28] Toshio Kitagawa, ed., *Cybernetics: Kyokai Ryoiki Toshite No Kousatsu* サイバネティックスー境界領域としての考察 (Cybernetics: Inquiries into a Cutting Edge Field) (Tokyo: Misuzu Shobo, 1953); Toshio Kitagawa, ed., Zoku Cybernetics: Jidoseigyo to Tsushin Riron 続サイバネティックスー自動制御と通信理論 (Cybernetics Continued: Automatic Control and Communication Theory) (Tokyo: Misuzu Shobo, 1954.).

[29] The word "Logergist" was formulated in direct response to Wiener's neologism "cybernetics." It is a combination of the Greek "logos" ("word," or as the members of Logergist interpreted it, "information") and "ergon" ("work"). The word captured their sense that cybernetics placed too much weight on the importance of information explaining various phenomena, and not enough on energy. See Logergist, *Buturi no sanpomich* 物理の散歩道 (The walking path of physics,) (Tokyo: Iwanami Shoten, 1963).

[30] Tessa Morris-Suzuki, *The Technological Transformation of Japan: From the Seventeenth to the Twenty-First Century* (Cambridge: Cambridge University Press, 1994), 161.

[31] Janis Mimura, *Planning for Empire: Reform Bureaucrats and the Japanese Wartime State* (Ithaca: Cornell University Press, 2011); Aaron Stephen Moore, *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era, 1931-1945* (Stanford: Stanford University Press, 2013).

[32] P. Masani, "Comments on [14c], [14d], and on T.S. Eliot's Communication on [14d]," in *Norbert Wiener: Collected Works. Cybernetics, Science, and Society; Ethics, Aesthetics, and Literary Criticism; Book Reviews and Obituaries*, by Norbert Wiener, ed. P. Masani, vol. IV (Cambridge, MA and London: MIT Press, 1985), 68. Moreover, Wiener's work for Hattori and an interest in Asia he shared with T.S. Eliot during the same period, mentioned above, may have influenced these cybernetic "embryos" as well.

[33] Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21, no. 1 (1994): 228-66.

[34] Letter from Ikehara to Wiener, September 7, 1954. Norbert Wiener Papers MC-0022, Massachusetts Institute of Technology, Department of Distinctive Collections, Box 15, Folder 200.

[35] Hiroshi Matsuo, *Denshi Rikkoku Nihon wo Sodateta Otoko, Yagi Hidetsugu to Dokusosha tachi* 電子立国日本を育てた男; 八木秀次と独創者たち (The men who built the Electronic Nation of Japan: Yagi Hidetsugu and the Innovators); Minoru Sawai, Yagi Hidetsugu 八木秀次 (Tokyo: Yoshikawa Kobun kan, 2013).

[36] The Office of Scientific Research and Development was established under President Franklin Delano Roosevelt in 1941. Roosevelt appointed Vannevar Bush, an electrical engineer and former MIT vice president, as director. See Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Vintage Books, 1979). Compton refers to Yagi as the "Van Bush" of Japan. Letter from Karl T. Compton to Norbert Wiener, 15 October 1945, Norbert Wiener Papers MC-0022, Massachusetts Institute of Technology, Department of Distinctive Collections, Box 4, Folder 69.

[37] R.W. Home and Morris F. Low, "Postwar Scientific Intelligence Missions to Japan," *Isis* 84, no. 3 (1993): 527-737.

[38] The following section draws heavily from work by Okada Daishi. Daishi Okada, "Tokyo Kougyo Daigaku kara mita kagakugijyutsu jinzai yosei no rekishi to sono hikaku, Tokyo Kougyo Daigaku no sengokaikaku to 1930 nendai no Massachusetts Koka Daigaku ni okeru kaikaku wo toshite 東京工業大学からみた科学技術人材養成の歴史とその比較ー東京工業大学の戦後改革と１９３０年代のマサチューセッツ工科大学における改革を通して," ("The history and comparison of education in science and technology from the perspective of Tokyo Kougyo Daigaku: Through the postwar reforms of Tokyo Kougyo Daigaku and the 1930s reforms of the Massachusetts Institute of Technology") Tokyo Daigaku Shi Kiyo; 東京大学史紀要 23 (2005): 85-98; Daishi Okada, "Tokyo Kougyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu 東京工業大学における戦後大学改革に関する歴史的研究" ("A historical study of postwar university reforms at Tokyo Kougyo Daigaku") (Tokyo, Tokyo Institute of Technology, 2005).

[39] According to Hirota, it seems likely that Yagi asked Ikehara to join him in Tokyo once he became involved in the Technological Committees activities. Ikehara was likely the only person in Japan who had direct and exten-sive personal knowledge of Vannevar Bush, having studied under him, when they were both at the Department of Electrical Engineering at MIT. Hirota Osamu, interview with the author, June 2019.

[40] Okada, "Tokyo kogyo daigaku kara mita kagakugijyutsu yosei no rekishi to sono hikaku- Tokyo Kogyo Daigaku no sengokaikaku to 1930 nendai no Massachusetts Koka Daigaku ni okeru kaikaku wo toshite," 4 (93);
Okada, "Tokyo Kogyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu," 34.

[41] Later in his life, Ikehara established a mathematics study group, whose members came from various companies and universities, which he called the "Suiyozemi" (the Wednesday Seminar.) Hirota Osamu, interview with the author, June 2019.

[42] The United States Education Mission to Japan, The Report of the United States Education Mission to Japan, 1946, 79; Okada, "Tokyo Kougyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu," 73-74, 78.

[43] Okada, "Tokyo Kougyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu," 44-45.

[44] The letter appears as Ikehara Shikao, "M.I.T. in Tokyo." *Technology Review*, November 1947, 10, 78.

[45] Okada surmises that these were shown in English because of Ikehara and Uchida. Okada, "Tokyo Kogyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu,"118-119.

[46] Christophe Lecuyer, "The Making of a Science Based Technology University: Karl Compton, James Killian, and the Reform of MIT, 1930-1957," *Historical Studies in the Physical and Biological Sciences* 23, no. 1 (1992): 153?80.; Christophe Lecuyer, "Patrons and a Plan," in Becoming MIT: Moments of Decision, ed. David Kaiser (Cambridge: MIT Press, 2010), 59?80.

[47] Hirota Osamu, interview with the author, June 2019.

[48] Letter from Karl T. Compton to Ikehara, 2 September 1948, Ikehara Collection.

[49] Lecuyer, "The Making of a Science Based Technology University: Karl Compton, James Killian, and the Reform of MIT, 1930-1957."

[50] K.D. Stephan, "All This and Engineering Too: A History of Accreditation Requirements," *IEEE Technology and Society Magazine* 21, no. 3 (2002): 8-15, https://doi.org/10.1109/MTAS.2002.1035224.

[51] Okada, "Tokyo Kogyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu, 114.

[52] Okada, "Tokyo Kogyo Daigaku ni okeru sengo daigaku kaiku ni kansuru rekishiteki kenkyu, 124. Uchida himself would become president of TIT in 1952.

[53] On postwar censorship, see, for instance, John Dower, *Embracing Defeat: Japan in the Wake of World War II* (New York: W.W. Norton and Company, 2000); Shunya Yoshimi and David Buist, "'America' as Desire and Violence: Americanization in Postwar Japan and Asia during the Cold War," *Inter-Asia Cultural Studies* 4, no. 3 (December 2003): 433?50, https://doi.org/10.1080/1464937032000143797.

[54] Letter from Ikehara Shikao to Norbert Wiener, 11 December 1948, Norbert Wiener Papers MC-0022, Massachusetts Institute of Technology, Department of Distinctive Collections, Box 6, Folder 87.

[55] Quoted in Flo Conway and Jim Siegelman, *Dark Hero of the Information Age: In Search of Norbert Wiener the Father of Cybernetics* (New York: Basic Books, 2006), 337.

[56] Conway and Siegelman, *Dark Hero of the Information Age: In Search of Norbert Wiener the Father of Cybernetics*, 221-229.

[57] See Kevles, *The Physicists: The History of a Scientific Community in Modern America*.

[58] Hirota Osamu, interview with the author, June 2019.

[59] Translations of Wiener's other books, including second edition of *The Human Use of Human Beings*, a revised translation of Ex-Prodigy, and a new translation of Wiener's second autobiography *I am a Mathematician* were done by Shizume Yasuo. Shizume was a physicist who worked as a researcher under Ikehara at TIT, and aided Ikehara in the preparation of his manuscripts. Shizume went on to translate and write many other books on science. To translate *Cybernetics*, Ikehara drew on the expertise of mathematician Yoshida Kosaku, electrical and com-puter engineer Kiyasu Zenichi, physicist Tomiyama Kotaro, physiologist Okamoto Akihiro, mathematician Iyenaga Shokichi and pioneering computer scientist Muroga Saburo, the last two of whom were credited as co-translators of the first edition. Computer scientist Toda Iwao was added as a co-translator on the second edition.

[60] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (London: Free Association Books, 1989), xxx.

[61] Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision."

[62] Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*.

[63] Ikehara did offer corrections to the English manuscript, which were reflected in the second English edition.

[64] This is in stark contrast to the later translations by Shizume Yasuo, in which he delves extensively into social and political context of Wiener's work to aid interpretation, speculates about Wiener's intentions, and at times even critiques Wiener's statements. According to interviews with Hirota, this difference likely contributed to a falling out between Ikehara and Shizume. Hirota Osamu, interview with the author, June 2019.

[65] Shikao Ikehara, Amerika Gakusei Seikatsu (Tokyo: Komine Shoten, 1947)

[66] Shikao Ikehara, "Cybernetics Nyumon サイバネティックス入門" ("Introduction to Cybernetics"), *Denshi Kougyo* 4 (1961): 68-74.

[67] Wiener, *The Human Use of Human Beings: Cybernetics and Society*, xxx.

[68] Norbert Wiener, *Ningen kikai ron-Cybernetics to shakai*; 人間機械論—サイバネティックスと社会, trans. Shikao Ikehara, 1st ed. (Tokyo: Misuzu Shobo, 1956), 222.

[69] Ikehara in Wiener, *Ningen kikai ron-Cybernetics to shakai*, 228.

[70] Shikao Ikehara, "Cybernetics Nyumon."

[71] Shikao Ikehara and Osamu Hirota, *Joho Riron Nyumon: Jyoho Kagaku no Tanjyo to MIT*, 123.