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Peaceful atoms in Japan: Radioisotopes as shared technical and sociopolitical resources for the Atomic Bomb Casualty Commission and the Japanese scientific community in the 1950s

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1. Introduction

This paper is a contribution to the historical understanding of the Atomic Bomb Casualty Commission (ABCC), the agency superseded by the Radiation Effects Research Foundation (RERF). In this paper, I discuss the development of the ABCC's Radioisotope Laboratory and examine how local Japanese scientists and American officials each used the project to advance their separate goals and how radioisotopes became a shared resource in the 1950s. I suggest that the needs and desires of the Japanese community, not just those of the ABCC, shaped the ABCC's work in Japan, and their interactions also affected Japanese science and medicine.

The ABCC was established in 1947 by the U.S. National Academy of Sciences-National Research Council (NAS-NRC), with funding from the U.S. Atomic Energy Commission (AEC). The ABCC conducted research studies with the atomic bomb survivors in Hiroshima and Nagasaki to elucidate the bombs' medical consequences. In 1955, the ABCC established a new isotope laboratory and, until 1958, conducted hematological studies using radioactive tracers. Concerned about negative publicity around the clinical use of radioisotopes, the organization strategically welcomed Japanese collaborators and tried to disseminate the message that peacetime applications of atomic energy could be a positive good for human society. For their part, Japanese scientists and researchers saw an opportunity to put American resources to use in rebuilding the state's (especially Hiroshima's) scientific and medical research programs and in advancing radiation medicine. ("Radiation medicine" in this paper is a translation of *hōshasen igaku* and includes, and is often equivalent to, nuclear medicine.) While the ABCC is generally viewed as a strictly American agency that operated in relative isolation in Hiroshima and Nagasaki, I see it as an integral part of the rapidly changing postwar landscape of Japanese medicine and science. I used the U.S. ABCC archive (preserved by NAS) and Japanese (mostly published) sources. Organized archives related to the ABCC are largely unavailable in Japan, though some materials are held at the RERF.[1]

There is limited knowledge about the complex and interrelated roles that the ABCC played in the development of postwar science and medicine in Japan and *vice versa*. Existing literatures on the history of the ABCC tell us more about the U.S. side of the story, partly because the ABCC was a predominantly American organization, especially in the earlier years, and because records produced by their Japanese collaborators are hard to obtain. John Beatty has examined the diplomatic role of the ABCC and social meanings of the early genetics project (Beatty, 1991, 1993). Susan Lindee has examined the first decade of the ABCC's work, including the genetics program (Lindee, 1994a,b). Lindee has documented the Japanese participation in ABCC activities to the extent that it could be reconstructed through records preserved by U.S. institutions. However, her work largely focused on American officials and scientists, with only a limited incorporation of Japanese experts' perspectives. In Japan, historical studies of the ABCC have often questioned whether the ABCC's activities (what and how they studied and for what purposes) were affected by political interests of the U.S. and Japanese governments (Nakagawa, 1986, 1987a,b, 2011; Sasamoto, 1995, 2001; Takahashi, 2008, 2009). In particular, Yukuo Sasamoto's 1995 book, which utilized American records of the Occupation period and available Japanese sources, examined the Japanese government's involvement in the U.S.-led medical research with survivors during the U.S. Occupation. However, missing from these studies were the many complicated roles and investments of Japanese scientists in the ABCC and its projects. Previous studies on the 1954 Bikini Incident have examined the roles and interests of the Japanese researchers involved in research conducted in the aftermaths of the Incident and showed that, while they dedicated themselves to their research of the contaminated bodies and environment, they simultaneously tried to take advantage of this opportunity to promote their fields and careers (Higuchi, 2015; Homei, 2007, 2013). This paper similarly focuses on scientific and sociopolitical interests of Japanese researchers who interacted closely with the ABCC.

More recent studies do attend to interactions between American and Japanese sides in the history of the ABCC. The historian and archivist Toshikuni Nakagawa examined the process of the establishment of the

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[1] My present analysis focuses on the Hiroshima ABCC, but it should be noted that history of the Hiroshima ABCC does not automatically represent that of the Nagasaki ABCC because of each city's unique local history. About the differences between the two cities, in English, see for example, Loh, 2012; Diehl, 2018.

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ABCC facilities in Hiroshima and the city of Hiroshima's interests involved in the process (Nakagawa, 2016). Others have focused on the experiences of *Nisei* (second generation Japanese-American) scientists working at the ABCC (Nagasawa, 2015; Smocovitis, 2011). Because *Nisei* scientists hired at the ABCC were expected to act as a bridge between the "Japanese" and "American" sides, their experiences offer new insight into the interactions between ABCC employees and Japanese scientists, both within the agency and in external collaborations. Journalist Katsuji Nagasawa's 2015 biography of *Nisei* pediatrician Wataru W. Sutow covers his years at the ABCC (1948–1954) and partly reconstructs Japanese physicians' interactions with ABCC investigators. This approach is significant in helping us to better understand the Japanese side of the story and to assess the place of the ABCC in the broader history of science and medicine in postwar Japan.

The ABCC offered significant resources to Japanese researchers and physicians, which contributed significantly to developments in Japanese medical research. The institution provided access to new information, techniques, materials, and scholarly networks. Local doctors used the ABCC's library, which had one of the best collections of up-to-date publications, invited ABCC doctors to their hospitals, asked them about new medicines, and formed a journal club with Sutow (and possibly other ABCC staff) (Nagasawa, 2015, pp. 141–146). In addition, ABCC scientists occasionally arranged for Japanese physicians and scientists to study in the U.S. The techniques and practices the local medical and scientific community adapted from ABCC studies were invaluable to Japanese scientists, though some of these were later criticized on ethical grounds. Japanese physician Tamotsu Sano collaborated with William W. Greulich on a study that involved x-raying the wrists of radiation-exposed children in order to assess bone age, a method widely known as the Greulich-Pyle method. Soon after his collaboration with Greulich, Sano applied this method to study bone growth of over 30,000 infants in the Tohoku area and identified malnutrition and rickets as a cause of high infant mortality (Nagasawa, 2015, pp. 123–134). Critics later charged that Greulich's ABCC study used Japanese survivors as little more than "guinea pigs," because scientists gave unnecessary extra doses of radiation to already-exposed children who needed different types of treatment or care at the time. Even more problematic was the fact that the investigators took nude photos of the children enrolled in the study to assess growth, including sexual maturation. While such ethical abuses in Greulich's study have made it hard to investigate further the broader implications of the study and of the ABCC, this episode does indicate that the ABCC played an important role in Japanese medicine.

The ABCC's Radioisotope Laboratory, established in Hiroshima in 1955, is a good site for analyzing dynamic relations between the ABCC and the Japanese scientific/medical community. The timing of the laboratory's founding is critical to understand its significance. Following President Eisenhower's "Atoms for Peace" United Nations address in December 1953, the U.S. started a campaign to convince the world that atomic energy could be a good in human society and that the U.S., unlike the Soviet Union, was a peace-seeking nation. Only three months after the speech, the 1954 Bikini Incident almost ruined the campaign. As the Incident stoked public anger about nuclear tests, U.S. and Japanese officials worried that this would aggravate the Japanese "nuclear allergy" and, further, that the growing Japanese anti-nuclear movement and anti-American sentiment would offer an opportunity for Communists to gain a stronger foothold in Japan. The two governments collaborated extensively to mitigate this risk in several ways, including an effort to build a nuclear power plant in Japan (and, in some proposals, to place it in Hiroshima); the United States Information Service (USIS)'s travelling Atoms for Peace exhibit; and other media campaigns.[2] Likewise, one of the ABCC's key aims in establishing the new lab was improving the organization's image by associating it with "peaceful" uses of atomic energy, rather than the atomic bombs. Local Japanese scientists welcomed the ABCC's move because they believed that the agency's focus on medical uses of atomic energy would help develop their scientific programs in the region.

The Radioisotope Laboratory was not a creation of a higher-level office, but a product of collaboration between the ABCC staff and Japanese scientists. In recent years, several authors have revisited the historical relationship of Japan and atomic energy and argued that the origin of the Japanese utopian views about atomic energy cannot be explained only by the two governments' top-down projects installed after the Bikini Incident.[3] This paper argues that the roles local scientists played in promoting the peacetime use of atomic energy in Japan were a significant factor here.

As shown in previous studies, radioisotopes played a critical role in Cold War foreign policy and significantly advanced biomedical research in many countries (e.g., Creager, 2006, 2013, 2014; Krige, 2006; Santesmases, 2006). Previous studies on civilian uses of atomic energy in Japan have focused mostly on physicists' commentary (Hiroshige, 2012; Yamamoto, 2012; Yamazaki, 2009a; Yoshioka, 2011), but medical and biological experts also played an important role through their interest in and work with newly available radioisotopes.[4] Japan began importing isotopes in 1950 and rapidly increased the volume in the second half of the 1950s; accordingly, medical and biological researchers increasingly used isotopes to develop new research directions.[5] Radioisotopes were presented to the public as miraculous tools through exhibits, newspapers, books, and movies. In this paper, I look at Japanese medical scientists who were familiar with radiation risk and examine what roles they played in promoting the use of radioisotopes while also considering how their interests shaped the ABCC's work in Japan.

Finally, I trace increased isotope use in studies on human subjects, including atomic bomb survivors. As Angela Creager (2013) has shown, scientists had already recognized the value of radioisotopes for biomedical research and therapy before the Manhattan Project, but after the war, the AEC's large-scale production and distribution of isotopes supported the rapid growth of nuclear medicine. Tracer studies in human subjects became fairly common after the war in the U.S. and elsewhere. Such tracer studies were conducted openly by respected researchers and were published in respected biomedical journals. Some of these studies are no longer considered ethically acceptable, because subjects did not directly benefit from them.[6] In this paper, I illustrate how isotopes, particularly radioirons, entered the bodies of patients including the survivors in Japan in the 1950s. While it is beyond the scope of this current paper to examine the broader clinical use of radioisotopes in the Japanese medical community, I briefly discuss the growth of radioiron tracer studies after the ABCC terminated its own research due to concerns about the effects of low-dose radiation. This paper indicates that the collaboration

[2] See, for example, Ikawa, 2002; Yamazaki & Okuda, 2004; Yamazaki, 2009a, b, 2011; Tanaka & Kuznick, 2011; Tsuchiya, 2011; Yoshioka, 2011; Fukuma, 2012; Yamamoto, 2012; Yoshimi, 2012; Kato, 2013; Zwigenberg, 2012, 2014.

[3] Especially, Fukuma, 2012; Yamamoto, 2012; Kato, 2013; Zwigenberg, 2014.

[4] The important role of radioisotopes in the promotion of "peaceful" uses of atomic energy in Japan has been also pointed out by Shinsuke Tomotsugu, "Ajia genshiryoku sentā kōsō ni taisuru nihon no hannō: tai-ajia genshiryoku kyōdō no taidō [Japanese reactions to a proposal of the Asia atomic energy center: Beginnings of Japanese atomic-energy collaboration in Asia], 14 Oct 2018, *Japanese Political Science Association* annual meeting, Kansai University, Senriyama, Japan.

[5] Radioisotopes needed to be imported; all four cyclotrons that existed in Japan at the end of the war were destroyed by the U.S. military in 1945. See Nakayama, 2001.

[6] A list of human-radiation experiments, which was created by the Advisory Committee on Human Radiation Experiments (ACHRE) formed in 1994 under order of President Clinton, also includes many radioiron tracer studies. *ACHRE Report*, https://ehss.energy.gov/ohre/roadmap/achre/index.html (last accessed November 2019).

between the ABCC and local Japanese science community facilitated the growth of radioiron research, in Japanese human subjects, including vulnerable populations.

2. Radioisotopes as shared resources: the ABCC radioisotope laboratory

Robert H. Holmes became the ABCC director in July 1954, four months after the Bikini Incident. Even before the incident, the ABCC had already had serious public relations problems in Japan because of its no-treatment policy. While ABCC doctors were involved in some treatments on an *ad hoc* basis, the agency maintained the official policy because administrators worried that treating survivors could be mistaken as a gesture of U.S. atonement for the use of atomic bombs (Lindee, 1994a,b). After the Incident, the agency's standing further deteriorated in the face of renewed public suspicion that exposed Japanese fishermen were used as "guinea pigs" (Homei, 2007, 2013). Holmes, who directed the agency until May 1957, sought ways to improve the agency's image in Japan. American officials disagreed with his proposal to change the no-treatment policy.[7] Another approach he took was along the line of the U.S. Atoms for Peace initiative, using public information campaigns to divert the public's attention from the bombs and create a positive association with civilian uses of atomic energy. This was, in his view, a way to improve public relations in Hiroshima and Nagasaki. In a January 1955 speech to the Hiroshima medical community, Holmes described Hiroshima as a unique city where "the curtain first lifted upon this [atomic] era" and where scientists had generated critical knowledge since. Developing "the necessary protection, prevention, and treatment" protocols following peacetime radiation exposure was "the natural expectancy of an entire world living in an Atomic Age." Therefore, through its work in the bombed cities, the ABCC was a significant contributor to this important knowledge (Holmes, 1955).

From the start, U.S. officials expected the Radioisotope Laboratory to further strengthen the ABCC's association with the positive image of "peaceful" face of atomic energy. In his October 1954 lab proposal, Niel Wald, who became the facility's founding director, wrote that the lab would "provide a means for enhancing the appreciation of the beneficial aspects of atomic energy in Japan," which would in turn "aid indirectly in the optimal functioning of the ABCC."[8] Robert Holmes also believed that the laboratory could help the ABCC improve its standing with Japanese institutions with a more direct intervention that would benefit Japanese atomic research. He knew that local researchers regarded isotopes as essential for reconstructing and advancing their medical research, but the Japanese system of importing isotopes was inconvenient at that time (only semi-annual importations as of 1954).[9] In a letter to Keith Cannan at the NRC, Holmes wrote that using the lab as a "distribution center for radioisotopes to the various Japanese institutions interested in their use" could be "a significant role for us in providing better public relations."[10]

Japanese medical professionals consulted by the ABCC agreed that the new laboratory would be "very beneficial to the ABCC, and indirectly to science in Japan," if a "more direct channel for isotope procurement" between the Atomic Energy Commission and ABCC were to be established.[11] Moreover, Japanese researchers and physicians, especially those in Hiroshima, where extant facilities were inadequate for ongoing isotope research, saw an opportunity to use the lab and its resources to advance their own goals. In 1955, Hiroshima Medical Association (HMA) president and Hiroshima University Medical School dean Kunio Kawaishi (河石九二夫; 1895–1973) told the group's annual meeting that the University's isotope facility had made the community's first isotope studies possible, which he described as an achievement "worthy to be recorded." At the same time, he admitted that the facility was poorly equipped and that researchers handling isotopes were exposed to risk (Kawaishi, 1955). As we shall see, he subsequently requested the expansion of ABCC's isotope laboratory shortly after it opened later that year.

In addition, Holmes and the NRC's Keith Cannan joined the Hiroshima scientific establishment in campaigning for the establishment of a medical reactor in Hiroshima. The Atomic Energy Commission had circulated a proposal to establish a center "for the distribution of isotopes, for the operation of a small reactor, and for the training of the Japanese in the use of these facilities in biology and medicine." The Committee on Atomic Casualties (CAC) of the NAS-NRC endorsed the proposal and hoped that "the proposed center may be established in close relation with the Atomic Bomb Casualty Commission."[12] Keith Cannan cited both scientific and social benefits. An isotope center would "not only improve the scientific opportunity" but would also strengthen the positive identification between the ABCC and "the larger policy of 'Atoms for Peace' thereby dissociating it from its symbolic relation, in the eyes of the Japanese, with the dropping of the bombs."[13]

The establishment of a nearby research reactor that could reliably provide radioisotopes was very attractive to local scientists, who had already proposed the creation of an institute for radiation biomedicine (Watanabe, 1960). In January 1955, before they managed to fund their project, the Science Council of Japan (SCJ) independently proposed the establishment of a national institute for radiation medicine, which was soon endorsed by the Ministry of Education. When Kawaishi and others in Hiroshima learned about the American reactor proposal, they realized that the establishment of a new American reactor in Hiroshima might also bring the SCJ institute to the city. With a reactor, as Masanori Nakaidzumi (中泉正徳; 1895–1977) at Tokyo University's Faculty of Medicine later wrote to Cannan, Hiroshima could "possibly become the pinnacle of medical radiology in Japan."[14] This ambition was shared among key personnel in Hiroshima, including Kawaishi, Tatsuo Morito (Hiroshima University president and a former Minister of Education 森戸辰男; 1888–1984), Akira Masaoka (President of Hiroshima Prefectural Medical Association 正岡旭), and Hiroo Ohara (Prefecture Governor 大原博夫).[15]

By September 1955, bringing the American reactor to Hiroshima "become an active campaign among the local doctors and physicists."[16] In his correspondence with Charles Dunham at the AEC, Holmes

[7] Lindee, 1994a,b, p. 128. Also, Shuhei Yoshimura, "Hibakusha chiryō, reisen no dasan [Treatment of the survivors, a calculation in the Cold War]," *Mainichi Shimbun* 30 July 2015.

[8] Niel Wald to Robert Holmes, "Proposal for a radioactive isotope laboratory at the ABCC," 11 Oct 1954, ABCC Collection, Archives of the National Academy of Sciences, Washington, D.C., [hereafter NAS-ABCC], series1, box11, folder "ABCC NAS Office Correspondence, 1953–1954," p. 2–3.

[9] It was changed in 1955 to a quarterly system, which was improved but still inconvenient for researchers. Japan Radioisotope Association, 1963, p. 108.

[10] Holmes to Keith Cannan, 14 Oct 1954, NAS-ABCC, series1, box11, folder "ABCC: NAS Office Correspondence, 1953–1954."

[11] Wald to Holmes, "Proposal for a radioactive isotope laboratory at the ABCC," 11 Oct 1954, p. 12. Japanese researchers consulted included Masanori Nakaidzumi and Masao Tsuzuki. I follow the Romanization of "Nakaidzumi" in this paper as used by himself.

[12] Cannan to Detlev Bronk (NAS president), 10 Mar 1955, NAS-ABCC, series 1, box 11, folder "ABCC: NAS Office Correspondence, 1955."

[13] Cannan to Bronk, 3 Mar 1955, NAS-ABCC, series 1, box 11, folder "ABCC: NAS Office Correspondence, 1955," p. 1.

[14] Nakaidzumi to Cannan, "Present plans concerning construction of atomic reactors in Japan and related developments in Hiroshima," 29 Oct 1956, McGovern Historical Center reading room digital records of NAS-ABCC, Texas Medical Center Library, Houston, Texas [hereafter TMCL-NAS-ABCC], series 3, file ABCC-3-28-6, "Radioisotope laboratory at ABCC 1954–1957," p. 3.

[15] Holmes to Dunham, 21 Apr 1955, NAS-ABCC, series 2, box 12, folder "ABCC: Atomic Energy Commission Correspondence: 1951–1961."

[16] Holmes to Dunham, 21 Apr 1955.

conveyed the local administrators' message that they hoped to obtain the reactor "free of cost as a gift" from the U.S. and to use it "as a political wedge to force the new [SCJ-proposed] institute to come to Hiroshima." Holmes wrote, "I have assured the local delegates that I will do all I can to assist them in obtaining a reactor."[17] Holmes explicitly understood what the benefit to the ABCC would be: a tremendous improvement in public relations.

Ultimately, however, Hiroshima researchers had to pursue other strategies. The AEC did not build a medical reactor in Japan, and the new institute for radiation medicine (now known as the National Institute of Radiological Sciences; *hōshasen igaku sōgō kenkyūjo*) was established in Chiba, east of Tokyo, in 1957. Kawaishi and Morito then tried to encourage the ABCC to expand its scope in ways that might leverage greater resources for Japanese research in radiation medicine.

3. Interests converged: exhibits, the Japanese Advisory Council, and media

While the ABCC expected the new laboratory to improve the agency's standing with Japanese researchers, they were less sure that the establishment of the facility would not jeopardize relations with a general public through an association with the "emotional implications of the use of radioactive material."[18] The isotope laboratory proposal therefore outlined a public relations plan that included promoting the medical use of atomic energy; inviting Japanese physicians as collaborators "whenever isotopes are given clinically"; and publicizing the support and endorsements of national and local medical figures and organizations.[19] This section examines those public relations efforts, including recruiting Japanese experts, constructing of a permanent exhibit on the peacetime use of atomic energy, and carefully attempting to shape the local media portrayal of the new laboratory. Active Japanese involvement was essential for these efforts; again, converging American and Japanese interests resulted in collaborative promotion of medical uses of atomic energy.

Shortly after the bombings in 1945, geologist and university instructor Shogo Nagaoka (長岡省吾; 1901–1973) began walking through the streets of Hiroshima and collected various items that showed the horrifying consequences of the bombs' destructive power. In 1949, he placed these objects on display in a community center, and when he began planning the Hiroshima Peace Memorial Museum, he approached the ABCC for help in developing the new museum's permanent exhibits.[20] Nagaoka, the museum's founding director, planned to include material related to peacetime uses of atomic energy, and he offered the ABCC the opportunity to curate this content.[21] He asked the ABCC to "provide a permanent exhibit to occupy some 200 feet of wall space" in the museum, covering the following three topics: (1) the effects of radiation, (2) peaceful uses of atomic energy, and (3) nuclear physics.[22] The ABCC would be free to design it as they liked. Robert Holmes, writing to the AEC for assistance, emphasized the importance of this opportunity: the exhibit, unlike the United States Information Service's Atoms for Peace travelling installation, was to be a "permanent one to be viewed for the indefinite future" and "it would fit very, very well into the over-all Atoms for Peace Program."[23] Holmes also had in mind a specific focus for the exhibit, one that would advance the ABCC's interests: the radioisotope. In one exhibit plan of the museum, about half of the museum's floor space was labeled "Area for ABCC and 'Use of Radioisotopes' exhibit."[24]

The ABCC was unable to mount a complete exhibit before the Hiroshima Peace Memorial Museum inauguration in August 1955, but Holmes kept trying, stressing to the AEC leadership that an exhibit would be beneficial to both of them: "there is a great opportunity here to put the kind of exhibit the AEC might like in a place that might be of value to it, as well as to ABCC."[25] Holmes had first asked the AEC to donate materials for the project, but he also explored whether he could permanently acquire items from the USIS Atoms for Peace exhibit when it concluded its Japanese tour in 1957.[26] Holmes had observed that those in Hiroshima wanted the items from the USIS exhibit for education and for a potential "commercial tourist attraction."[27] This is likely because the USIS travelling exhibits were immensely popular throughout Japan (total number of visitors was over 2.6 million in 11 cities; nearly 110,000 people in Hiroshima alone; Ikawa, 2002, p. 253).

The U.S. donated the materials to the Hiroshima city, which staged the Atoms for Peace exhibit at the 1958 Hiroshima Restoration Exposition (*hiroshima fukkō daihakuran kai*). The exhibit took place at the museum and the donated items remained there after the Exposition. Some accounts say that Nagaoka was forced to accept these items, but this interpretation may be retrospective and incomplete.[28] When the new museum opened in 1955, Nagaoka told local press that he hoped to develop the museum, which displayed "just" the disastrous past, into a "world-class peaceful-atomic-energy museum."[29] Moreover, a recently

[17] Holmes to Dunham, 28 Sept 1955, NAS-ABCC, series 2, box 12, folder "ABCC: Atomic Energy Commission Correspondence: 1951–1961."

[18] Wald to Holmes, "Proposal for a radioactive isotope laboratory at the ABCC," 11 Oct 1954, NAS-ABCC, series1, box11, folder "ABCC NAS Office Correspondence, 1953–1954," p. 8.

[19] Wald to Holmes, "Proposal for a radioactive isotope laboratory at the ABCC," 11 Oct 1954, p. 14.

[20] Holmes to John C. Bugher, 2 June 1955, NAS-ABCC, series 1, box 8, folder "ABCC Director's Correspondence, June–Jul 1955." Holmes had earlier hoped to get involved in the museum's exhibition development but was unable to. Holmes wrote: Shinso Hamai ("left-wing Socialist") had been opposing the ABCC's involvement in the museum, but with Tadao Watanabe ("Conservative") taking the seat of the city mayor, "the ABCC received the green light and now have been officially invited to provide a permanent exhibit for that museum."

[21] And in the interview, he implied that the new museum was named considering the incorporation of items related to peaceful uses of atomic energy. Kenji Joji to Holmes, "Interview with Director Shogo Nagaoka," 7 Dec 1955, TMCL-NAS-ABCC, series 1, file ABCC-1-7-7, "ABCC Directors Correspondence, Dec 1955."

[22] "Draft," 14 June 1955, NAS-ABCC, series 1, box 8, folder "ABCC Director's Correspondence, June–Jul 1955."

[23] Holmes to Bugher, 2 June 1955.

[24] A floorplan of the museum is filed in NAS-ABCC, series 1, box 8, folder "ABCC Director's Correspondence, June–Jul 1955."

[25] Holmes to Dunham, 18 May 1956, NAS-ABCC, series 2, box 12, folder "ABCC Atomic Energy Commissions Correspondence, 1951–1961." For the opening day, the ABCC provided seven panels "depicting graphically the major findings of ABCC." *ABCC Semi-annual Report 1 July – 31 December 1955 Part1*, p. 64 (held at the Library of Radiation Effects Research Foundation, Hiroshima [hereafter RERF Library]).

[26] Kenji Joji to Holmes, "Interview with Director Shogo Nagaoka," 7 Dec 1955. Also see Tanaka & Kuznick, 2011, p. 35. As I described, Holmes was initially seeking a permanent exhibit *separate* from the travelling exhibit; "The exhibit material I asked the AEC for was specifically for ABCC and to be permanent in Hiroshima. I had no thought of procuring the travelling exhibit of USIA. I am still seeking a permanent exhibit separate from the USIA." In: Holmes to Cannan, 6 July 1955, NAS-ABCC, series 1, box 8, folder "ABCC Director's Correspondence, June–Jul 1955."

[27] Holmes to Dunham, 28 June 1955, NAS-ABCC, series 1, box 8, folder "ABCC Director's Correspondence, June–Jul 1955."

[28] Such an interpretation about this donation is in, for example, Zwigenberg, 2014, p. 122. An essay by a Chugoku Shimbun journalist (cited in Zwigenberg) describes, without references, that Nagaoka was taken aback by the amount of donated items (surpassing the Museum's A-bomb related materials) but does not say/imply that he was against the idea of exhibiting items related to civilian uses of atomic energy; see Chugoku shimbun sha, 1966, p. 263–266.

[29] Nagaoka's comment in: "Sanka wo koe heiwa genshiryoku hakubutsu kan e, umare kawaru genbaku siryōkan: Beikoku ya kokunai kara shryō atsumaru [A-Bomb Museum reborn as a peaceful-atomic-energy museum, overcoming the terrible disasters: Materials from the U.S. and within Japan are being gathered]," *Chugoku Shimbun*, 11 Dec 1955. Also see: "Sekaiichi no genshiryoku hakubutsukan e [Toward the world's number-one atomic-energy museum],"

discovered document shows that Nagaoka himself designed the Atoms for Peace exhibit: after walking through horrific consequences of military uses, visitors arrived at the human society's progress with glorious scientific achievements and be hopeful about the future development of "science culture" (*kagaku bunka*) (Echizen, 2017, pp. 48–50). Nagaoka thus almost certainly thought that the new museum would be able to contribute both intellectually and financially to the recovering and developing city by acquiring some of the popular items.[30]

Another ABCC public relations project involved recruiting Japanese experts as staff and advisers in order to make the organization and its projects look more like U.S.-Japan joint efforts. In November 1954, Merril Eisenbud, then the director of the AEC's New York operations office, responded to the initial lab proposal, writing that while there was "general agreement that this facility would assist the clinical investigations" at the ABCC, staffers were also concerned that "the use of radioisotopes might result in further allegations that we are using the Japanese as 'guinea pigs.'" Concerned that the clinical use of radioactive materials might exacerbate the already-existing allegations, Eisenbud suggested that a "satisfactory solution" to avoid such criticisms was to "appoint a Japanese scientist of appropriate stature as Chief." Eisenbud recommended Nakaidzumi, the founding chair of the Division of Radiology at Tokyo University's Faculty of Medicine (1934–1956).[31] Nakaidzumi had also been a central member of national-level organizations that dealt with the importation and distribution of radioisotopes, including the Japan Radioisotope Association (*nihon hōshasei dōigenso kyōkai*; later renamed as *nihon aisotōpu kyōkai*).[32] Shields Warren, the chairman of the Committee on Atomic Casualties, supported Nakaidzumi's appointment, writing that "the paternalistic attitude of the American staff toward Japanese personnel in the past has been a serious drawback."[33]

Indeed, placing a Japanese scholar in high-level positions was a controversial proposition at the ABCC in these years. Holmes was strongly against the idea, writing: "I don't, now, then, or ever, want to see the key positions in ABCC filled by anyone other than American personnel."[34] The AEC's Dunham was also against Japanese leadership, commenting that "Japanese research results could not be trusted if they were on their own."[35] Nakaidzumi did not become the Chief of the Laboratory, but he did join the ABCC's Radioisotope Committee and was named the organization's Associate Director in 1956.[36]

The agency clearly hoped that their concerns about negative press could be resolved by the nationality of the doctors in charge.[37] In addition to bringing Nakaidzumi on, the ABCC established the Japanese Advisory Council in 1955, inviting Japanese involvement in the management of the organization. The new council had eleven Japanese members, including Nakaidzumi; Hiroshima local delegates including Kawaishi, Morito, and Masaoka; Japan Red Cross Central Hospital director Masao Tsuzuki (都築正男; 1892–1961)[38]; and Kyoto University hematologist Takehiko Kikuchi (菊池武彦; 1893–1985), one of Nakaidzumi's colleagues on the board of the Japan Radioisotope Association.[39] A local newspaper described the newly formed Council's role as discussing ABCC's management matters, including those concerning the newly established isotope laboratory.[40] Furthermore, the new laboratory hired Japanese physicians, and Kikuchi's group also became involved in the ABCC's radioisotope studies in external collaboration (see below).

Ultimately, Eisenbud's concern that radioisotope research would invite new criticism of the ABCC did not materialize. Instead, the Japanese media emphasized the ABCC's goodwill and reported that the new lab would allow for advanced medical treatments: Holmes had announced that the facility would be generously shared with local physicians for the purpose of treating the survivors. For example, a July 1955 article about the upcoming opening of the new lab reported that "radioisotope treatment is the best in modern medicine," that it was "very effective in the treatment of cancer or leukemia," and that it would be "made available free of charge to physicians in the city treating A-bomb patients."[41] *Asahi Shimbun* published a similar report on the same date, associating the laboratory with treatment of the survivors.[42]

In fact, Holmes told Keith Cannan that he made no such promise. The ABCC had not changed its official no-treatment policy, and when he received the translated press, Cannan thought that the new laboratory's association with treatment was a problem.[43] Cannan also believed that "the laboratory is neither equipped nor staffed for advice on or conduct of radiation treatments" and such an "injudicious pursuit of publicity" was an embarrassment to the ABCC.[44] Holmes explained to Cannan that he did not envision the ABCC "as a center for radiation therapy," only that he had discussed it as "a possibility worth considering.[45] Regardless, the Japanese public's expectations for medical

(*footnote continued*)
Mainichi Shimbun *(Hiroshima), 24 August 1955. The Museum asked universities and institutions throughout Japan to provide for display materials related to civilian uses of atomic energy.*

[30] About ten years later in 1967, the museum removed these items from their exhibits. *Chugoku Shimbun*, 7 May 1967.

[31] Merril Eisenbud to John Bugher, 21 Dec 1954, "Visit to ABCC," NAS-ABCC, series 2, box 12, folder "ABCC: Atomic Energy Commission Correspondence: 1951–1961," p. 4.

[32] He was a member of the Scientific and Technical Administration Committee's radioisotope committee, which was established in 1949 to prepare for the import of isotopes, and subsequently became a central member of the Japan Radioisotope Association since its establishment in 1951 (trustee and vice president). Japan Radioisotope Association, 1963, p. 102, 298–302.

[33] Shields Warren to Bronk and Cannan, 18 Apr 1956, NAS-ABCC, series 4, box 36, folder "Dr Warren report on visit to ABCC, Feb 1956," p. 3.

[34] Holmes to Cannan, 31 Jan 1955, TMCL-NAS-ABCC, series 1, file ABCC-1-8-3, "ABCC Directors Correspondence, Jan–Mar 1955."

[35] Connel to Cannan, 20 Apr 1955, "Talk with Mr. Donnelly—AEC plan for isotope center," NAS-ABCC, series1, box8, folder "ABCC Director's Correspondence, Apr–May 1955," p. 1. Also see Lindee, 1994a,b, p. 44–45, for the same American skepticism toward Japanese scientists in the initial period of the ABCC.

[36] "Minutes of the Research Committee, May 20, 1955", TMCL-NAS-ABCC, series 14, file ABCC-14-99-6, "Research Committee Meetings 1955," p. 9.

[37] About the nationality issue at the ABCC/RERF, see Lindee, 2016.

[38] Tsuzuki was the leading authority on medical effects of radiation. About Tsuzuki in English, see Lindee, 1994b, p. 24–26; Homei, 2013.

[39] Japan Radioisotope Association, 1963, p. 298. A list of participants at the first JAC-ABCC meeting on 9 Nov 1955: in TMCL-NAS-ABCC, series 14, file ABCC14-92-10, "Japan Advisory Council to ABCC Meetings, 1st-3rd 1955–1956." Three of the members, Nakaidzumi, Tsuzuki, and Kikuchi, had long been involved in studying medical conditions of the survivors through their service on Japan's Special Research Committee on the Atomic Bomb Disasters (gen*shi bakudan saigai chōsa kenkyū tokubetsu iinkai*), which was established by the Japanese Ministry of Education in 1945 (about this Japanese committee, see Lindee, 1994b, p. 22; Sasamoto, 1995, p. 56–61).

[40] "ABCC ni nihongawa no shimon-kikan wo secchi [The Japanese side's council was established at the ABCC]," *Asahi Shimbun* 18 Oct 1955.

[41] "Translation, The Mainichi Press, 29 July 1955, ABCC Isotope Laboratory available to Japanese physicians," TMCL-NAS-ABCC, series 3, file ABCC-3-28-6, "Radioisotope laboratory at ABCC 1954–1957." Original: "Aisotōpu kenkyūshitsu wo teikyō, ABCC ga nihon no ishi e," *Mainichi Shimbun* (Hiroshima), 29 July 1955.

[42] "Translation, The Asahi Press, 29 July 1955, ABCC Isotope Laboratory available to physicians," TMCL-NAS-ABCC, series 3, file ABCC-3-28-6, "Radioisotope laboratory at ABCC 1954–1957." Original: "Ishi ni kaihō, ABCC no aisotōpu-shitu," *Asahi Shimbun* (Hiroshima) 29 July 1955.

[43] He circled the word "treatment" appearing in the translated press he received.

[44] Cannan to Shields Warren, 22 December 1955, TMCL-NAS-ABCC, series 3, file ABCC-3-28-6, "Radioisotope laboratory at ABCC 1954–1957."

[45] Holmes to Cannan, 12 Jan 1956, TMCL-NAS-ABCC, series 3, file ABCC-3-28-6 Radioisotope laboratory at ABCC 1954–1957.

treatment were salutary for the ABCC. Citing Nakaidzumi's "praise" about the facility being the most up-to-date, the journalists did not question the risks that isotope intake might have on human subjects, and instead showed high trust toward the cutting-edge medicine.[46] The news about the ABCC's new laboratory escaped public scrutiny.

4. The ABCC's clinical studies of anemia with radioisotopes and the growth of Japanese radiation medicine

The ABCC Radioisotope Laboratory opened in Hiroshima in 1955, launching a project that used tracers to examine anemia, one of the major symptoms among the survivors. In August, the U.S. AEC and Japan's Scientific and Technical Administration Committee approved radioisotope procurement for clinical use with human subjects. The first shipment of isotopes arrived in September, and by October the first patient was studied, utilizing iron-59 (^{59}Fe) and chromium-51 (^{51}Cr) for the measurement of blood volume, red blood cell survival, plasma iron uptake and iron utilization in hematopoiesis. Staff at the Nagasaki ABCC performed the same clinical procedure on one individual "to confirm the feasibility of performing parallel studies" (and the samples were sent to Hiroshima for radio-counting because there was no dedicated lab facility in Nagasaki).[47]

There were two types of studies conducted at the lab.[48] The first type involved studying iron metabolism and the life span of red cells. In this procedure, a patient's blood (about 50 cc) was withdrawn, labeled with radioisotopes of ^{59}Fe and ^{51}Cr, and injected back into the patient. Blood samples were withdrawn for radiation counts at 5, 30, 60, 120, 180, and 240 min and, thereafter, twice a week for four weeks (Wald, Hoshino, & Driscoll, 1956). Sometimes the level of radioactivity in different organs (e.g., spleen, liver, bone marrow) was measured via the skin surface with a scintillation counter (Hoshino & Wald, 1956). The second type of study involved administering vitamin B12 labeled with radioactive cobalt-60 (^{60}Co) and examining its metabolism (in the production of red blood cells). None of the ABCC's semi-annual reports or published reports specify the protocol, but the general procedure for tracing vitamin B12 involved oral intake of ^{60}Co-labeled vitamin B12, followed by radio-counting of a patient's urine or stool. The first ^{60}Co-vitamin B12 tests were also performed in the fall of 1955.[49]

By March 1956, radioisotope studies were performed "at the rate of once a week in each city."[50] As stated in their lab proposal, ABCC clinical practices involved Japanese collaborators whenever isotopes were administered to patients. In 1956, the lab employed four clinical assistants, two of whom were described as Japanese technicians in a semi-annual report that year.[51] Physician Takashi Hoshino (星野孝; ?-2012) had been hired as "ABCC professional staff," but was regarded internally as a technician. In addition, the ABCC also started an external collaboration in 1956 with Masaichi Fukase (深瀬政市; 1914–1989) from Takehiko Kikuchi's group at the Kyoto University Medical School, studying at least two cases with ^{59}Fe and ^{51}Cr that year.[52]

The studies detected no differences between the anemia patients who had been exposed to radiation from the bombings and those who had not. In a 1956 paper, lab chief Niel Wald and coauthors reported, "it has not been possible, by the methods used, to demonstrate any significant deviation from the characteristic pathophysiology of the disease as it occurs in the non-exposed" (Wald, Truax, Sears, Suzuki, & Yamamoto, 1959 [1956], p. 8–9).[53]

In the first half of 1957, a total of 57 anemia cases and 10 controls were studied in Hiroshima with the same tracer techniques.[54] Some of these results were presented in April 1957 to the audience of the Japanese Society of Hematology (JSH). Wald's full paper, which was published later that year in the Society's journal *Acta Haematologica Japonica* (now *International Journal of Hematology*), reported data of 44 cases for ^{59}Fe iron metabolism tests, 45 cases for ^{51}Cr red cell survival tests, and 12 cases for ^{60}Co-vitamin B12 tests. Again, as in the 1956 paper, he concluded that there was no difference in the characteristics of anemia between the exposed and non-exposed patients (Wald, 1957, pp. 157-8). Isotope studies were also used to examine effects of a particular treatment of a blood disease. A 1958 paper published in *Blood* examined the effects of a drug, MYLERAN (busulfan), on blood cancer polychthemia vera (Wald, Hoshino, & Sears, 1959 [1958]).[55] For this paper, the ^{59}Fe/^{51}Cr tracer study was conducted before and after MYLERAN treatment in order to measure blood volume, red-cell production and survival, and iron turnover.[56]

By 1959, a considerable number of the survivors and control subjects had been exposed to radioisotopes, but the ABCC had also ended its radioiron studies. Niel Wald returned to the U.S. at the end of June 1957 and Hoshino led the tracer studies for about a year before the project was terminated. At the 1958 Japanese Society of Hematology annual meeting, Hoshino presented three studies, all of which involved ^{59}Fe and ^{51}Cr radioisotopes (Hoshino, 1958; Hoshino & Sugishima, 1958; Tajima, Fukase, & Hoshino, 1958). One study examined iron metabolism and erythrocyte lifespan in 11 healthy individuals and "about 50" patients of various anemic conditions (Hoshino, 1958). Another study on erythrocyte lifespan involved 11 anemic patients and was a collaboration with Fukase, a member of Kikuchi's group (Tajima et al., 1958). These studies were not concerned with the differences between exposed and non-exposed individuals, as the earlier anemia studies had been, and it is unclear whether the subjects were drawn from the ABCC's study populations.[57] Unfortunately, there are no

[46] Ishi nimo kaihō, rajio aisotōpu tōchaku, ABCC genbakushō no hinketsu tuikyū e [Making the lab available to physicians; Radioisotopes arrived; ABCC researching further the survivors' anemia], *Asahi Shimbun* (Hiroshima) 8 Nov. 1955.

[47] *ABCC Semi*-annual *Report 1 July – 31 December 1955 Part1*, p. 5–6. In Nagasaki, a radioisotope laboratory was not established though they were planning to have one; see p. 35, Minutes of the third JAC-ABCC meeting on 14 November 1956, TMCL-NAS-ABCC, series 14, file ABCC14-92-10, "Japan Advisory Council to ABCC Meetings, 1st-3rd 1955–1956."

[48] I-131 was also imported at the beginning for the purpose of "blood volume, cardiac output, and diagnostic thyroid metabolism tests" (see the first page of "Application for radioisotope procurement," TMCL-NAS-ABCC, series 14, file ABCC-14-89-9, "Atomic Energy Commission, New York Operations Office, 1955–1961"), but the use of I-131 for hematological studies was not reported in semi-annual reports. In the semi-annual report from the second half of 1956, there is a record that I-131 had been used for testing thyroid function (p. 32).

[49] *ABCC Semi*-annual *Report 1 July – 31 December 1955 Part1*, p. 5–6.

[50] Committee on Atomic Casualties, Minutes of 22nd Meeting, 13 Mar 1956, TMCL-NAS-ABCC, series 12, file ABCC12-78-14, "CAC Meetings 22nd 13 Mar 1956," p. 414 (Bulletin, Atomic Casualties).

[51] The lab was staffed by "two foreign national technical assistants and two Japanese technicians," *ABCC Semi-annual Report 1 July – 31 December 1956* Part1*, p. 32 (RERF Library). About Hoshino, see the Atomic Bomb Casualty Commission 1947–1975: A general report on the ABCC-JNIH Joint Research Program, p. 89.*

[52] *ABCC* Semi-*annual Report 1 July – 31 December 1956 Part1*, p. 32.

[53] It reported on Fe-59/Cr-51 tests for 24 and 12 cases of severe anemia among the survivors in Hiroshima and Nagasaki, respectively, and on six Co60-vitamin B12 cases. Originally published in *Proceedings of the Sixth International Congress of the International Society of Hematology, August 27 – September 1, 1956*. The same text is reproduced in ABCC Technical Report.

[54] *ABCC Semi-annual Report 1 January – 30 June 1957 Part1*, p. 29.

[55] The paper reported data of three survivors and nine controls for the Fe-59/Cr-51 tracer study. Originally published in *Blood* 13 (1958): 757–762. The same text is reproduced in the ABCC Technical Report.

[56] The authors note that the use of MYLERAN was to avoid extra radiation as it "obviates the need for radiation, either by ^{32}P or by x-ray, and thus avoids the use of an agent which, under some circumstances, is known to be leukemogenic, in treating a disease in which there already is an increased incidence of leukemia" (p. 12).

[57] One more study (which is not described in the main text) was based on one family with hereditary elliptocytosis and was authored by two ABCC

further details about the above studies after mid-1957, when the ABCC's semi-annual reports were replaced by annual reports. The reports no longer contained descriptions of the radioisotope laboratory. In the 1957-58 annual report, "Anemia Studies with Radioisotopes" and "Vitamin B-12 Metabolism in Blood Dyscrasias" were simply listed in a table of "program components of the ABCC research design."[58] The following year, the ABCC discontinued the vitamin B12 studies, describing them as unsuitable for routine procedural use.[59] The radioiron studies were also most likely discontinued, as the 1958-59 annual report no longer contained any description of this project and Hoshino was sent to the U.S. for training.[60]

Archival documents suggest that one reason for the termination was uncertainty surrounding the effects of low-dose radiation, which was a major subject of discussion among researchers. A 1956 NAS study, the Summary Reports of the Biological Effects of Atomic Radiation (BEAR), stated that natural background radiation would cause an "unavoidable quantity of so-called spontaneous mutations," and that "[a]nything that adds radiation to this naturally occurring background rate causes further mutations, and is genetically harmful." Furthermore, the "harm is cumulative" (NAS, 1956, p. 3). The study recommended reducing the medical use of x-rays "as much as possible as is consistent with medical necessity"; to keep the reproductive cell exposure at the lowest practical level; and to keep records for every individual of the "total accumulated lifetime exposure to radiation" (NAS, 1956, pp. 7–8).

In May 1957, Edward Lewis, a prominent geneticist at California Institute of Technology, published an important article based on leukemia data, including those from Hiroshima and Nagasaki, in *Science*. He suggested that there might be a linear relationship between radiation effects and the dose, even at a low dose with no threshold (Lewis, 1957). In the same year, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) issued a statement on the medical use of radiation, writing that "radiation due to diagnostic radiology and to radiotherapy constitutes a substantial proportion of the total radiation received by the human race" and "medical irradiations of any form should be restricted to those which are of value and importance" (UNSCEAR, 1957, pp. 517–518).

The ABCC's 1957-58 report reflected these concerns, discussing other sources of radiation to which study subjects might be exposed—residual radiation, induced radiation, natural background radiation, fallout, and x-ray—and questioning whether these might contaminate their results.[61] In the report, the ABCC concluded that the effects of diagnostic and therapeutic x-rays in particular could not be ignored: "It is clear that for the people under study in Hiroshima and Nagasaki the question must be resolved as to whether or not the dosages received by them in the course of examinations and treatment over the years will have to be taken into account lest the findings be compromised." Extra x-ray exposure might affect health and thus might skew their analysis.

External evaluators also raised concern about the lab's use of medically unnecessary irradiation. In 1958, Lewis Dahl at Brookhaven National Laboratory visited the ABCC as a consultant. In a section of his report entitled "Isotope and x-ray studies," he wrote that "careful thought should be given before undertaking research studies (as contrasted with necessary diagnostic studies) involving further irradiation of a population unusually sensitive—in the psychological sense—to the possible harmful effects of radiation" (underlined in original). While he did not name any one project directly, Dahl saw that some studies at the ABCC were categorized as "research studies" and were probably less necessary compared to the other kinds of studies. Moreover, he reiterated the BEAR recommendations: "In any event, careful records on each subject should be set up and maintained of the calculated radiation dosage obtained by these routes."[62]

While CalTech geneticist Edward Lewis's work was challenged by several experts, including Niel Wald (Wald, 1958), the linear no-threshold hypothesis took hold as the international consensus. It was, in the population geneticist James Crow's expression, "if not correct, […] at least a prudent assumption for setting radiation standards" (Crow & Bender, 2004, p. 1779). In 1959, the International Commission on Radiation Protection (ICRP) lowered its suggested maximum permissible doses, based on the idea that there was no safe level of exposure (Walker, 2000, pp. 18–28; also see; Boudia, 2016).

But just as American researchers discontinued radioiron research, Japanese scientists wanted to *expand* radioisotope studies. The Japanese researchers named here appear to have been unconcerned about the question of possible risk of extra radiation exposure. No such questions appear in the records of the ABCC's Japanese Advisory Committee meetings. Tracers in general were used in small amounts because they were meant to trace metabolism without disturbing physiological functioning. The actual dosage employed at the ABCC laboratory was reported during a JAC meeting to be within the maximum permissible doses of the time.[63] Leaders in the field had long expressed concern that Japan would quickly fall behind other nations in radiation research; in a 1956 speech, Nakaidzumi argued that it was necessary to use more isotopes by more people for more applications as soon as possible; otherwise Japan would quickly fall behind (Nakaidzumi, 1956, p. 7). The scientific community's eagerness to use more isotopes and to reconstruct and advance science further overrode concerns about exposure.

To the Japanese medical establishment's great frustration, the ABCC did little to expand their access to radioisotopes. Kawaishi asked the ABCC to expand the laboratory to allow for more access for Japanese researchers, but when the ABCC received an authorization from the Atomic Energy Bureau in Japan to import isotopes directly from the U.S., the agency apparently did not open these supply channels to local researchers.[64] Frustrated, Kawaishi pressured the ABCC by targeting their sore point: the existing negative publicity. He said that because "[c]itizens in Hiroshima have a feeling that ABCC uses patients as guinea pigs," the ABCC needed to offer more radiation medicine so that the public would "feel that ABCC is providing something beneficial" to them. He suggested the expansion of the isotope laboratory to take more patients and use more isotopes. If they offered radiation medicine, Kawaishi said, the ABCC should find "willing cooperation" from people in Hiroshima—and this did not exclusively mean patients. Importantly, Kawaishi noted that access to local patients was mediated by local doctors: "To get patients, ABCC will have to maintain close relations with various Japanese institutions."[65]

(*footnote continued*)
researchers, Hoshino and another physician Kiyoaki Sugishima (Hoshino & Sugishima, 1958). They found one patient with this hereditary condition among the non-exposed control group, then examined his/her family members, and tested at least one of them with Cr-51 and Fe-59.

[58] *ABCC Annual* Report *1 July 1957 - 30 June 1958*, p. 49.

[59] *ABCC Annual* Report *1 July 1958 - 30 June 1959*, p. 32.

[60] *ABCC Annual* Report *1 July 1957 - 30 June 1958*, p. 61, 68.

[61] "Induced radiation" is radiation "induced in elements of the soil, building materials, etc., by the neutrons emitted from the bomb." *ABCC Annual Report 1 July 1957 - 30 June 1958*, p. 19.

[62] Lewis K. Dahl to Cannan, "Observations on ABCC Medical Service at Hiroshima," 28 May 1958, TMCL-NAS-ABCC, series 4, file ABCC-4-36-17, "Dr Dahl Report on ABCC Visit 1958," p.12.

[63] Minutes of the third JAC-ABCC meeting on 14 November 1956, TMCL-NAS-ABCC, series 14, file ABCC14-92-10, "Japan Advisory Council to ABCC Meetings, 1st-3rd 1955–1956," p. 33.

[64] Kaichi Suzuki to Holmes, 31 Jan 1956; Holmes to Cannan, 10 Apr 1956, TMCL-NAS-ABCC, series 3, file ABCC-3-28-6, "Radioisotope laboratory at ABCC 1954–1957."

[65] Minutes of the second JAC-ABCC meeting on 20 February 1956, TMCL-NAS-ABCC, series 14, file ABCC14-92-10, "Japan Advisory Council to ABCC Meetings: 1st-3rd 1955–1956," p. 16; Minutes of the third JAC-ABCC meeting on 14 November 1956, p. 35–36.

Morito and Kawaishi hoped that they could steer the ABCC toward radiation medicine and utilize the ABCC as a resource for developing the new discipline in Japan. It was in this context that a discussion of changing the name of the ABCC came up at JAC meetings. Both Morito and Kawaishi hoped for the biomedical use of atomic energy to be reflected in the organization's name; in a meeting held on February 1956, they proposed a new name, "Japanese-American Medical Institute for Radiobiology."[66] Despite such discussions, the name remained unchanged (Lindee, 1994b). According to his "Proposal for the ABCC Program" circulated in the same meeting, Morito also asked the ABCC to establish a "closer cooperative relationship" with local universities and physicians in Hiroshima and Nagasaki. This would have involved training young Japanese researchers in radiation medicine; exchanging staff between the ABCC and the local institutions; and making the isotope laboratory available as a shared facility.[67]

But any resistance from the ABCC ultimately mattered little in terms of the development of Japanese radiation medicine. The availability of isotopes to Japanese researchers was significantly greater than it had been when the ABCC lab opened in 1954, when the value of isotope imports was 19 million yen. By the time the agency's tracer studies were terminated, local researchers and physicians were far less reliant on the American isotope laboratory. The total amount of isotope imports was on a sharp rise: 168 million yen in the 1960 fiscal year, which was nearly nine-fold of the amount in 1954 (Japan Radioisotope Association, 1963, p. 184).

Just as the ABCC terminated theirs, then, Japanese radioiron studies increased. At the 1958 Japanese Society of Hematology annual meeting, where Hoshino presented the ABCC's last report in the series of their radioiron studies, a non-ABCC Japanese research group reported the results of a radioiron study in humans. Outside the ABCC studies, this was the first presentation of radioiron clinical studies at JSH meetings.[68] Kiku Nakao (中尾喜久; 1912–2001), a prominent Tokyo University hematologist, presented a full paper on his radioiron studies in 4 healthy control individuals and 12 individuals with anemia or other hematological diseases (Nakao & Nagai, 1958).[69] The authors tracked radioactivity in the bone marrow, spleen, and liver via a scintillation detector on the skin surface over 10 days. Two years later, the JSH held a special session on iron metabolism for the first time. Gyoichi Wakisaka (脇坂行一; 1914–2007), Professor at Kyoto University's Medical School and a former member of Kikuchi's group, gave a talk on radioiron studies, involving at least 5 healthy individuals and 30 patients with hematological disorders (Wakisaka, 1960). In 1961, Nakao, now at Gunma University, reported at the JSH that his group examined cancer patients hospitalized at their institution using ^{59}Fe and ^{51}Cr (Nakao et al., 1961). In the same year, Wakisaka's group presented feeding studies of radioiron (e.g., administering isotopes through ^{59}Fe-blended cooked eggs) to observe its absorption in both healthy control subjects and anemic patients (Yamaba, Wakisaka, & Kariyone, 1961). Blood was not the only target of tracer studies. In 1960, one medical journal published a series of two special issues on the use of radioisotopes, which included tracer studies in various parts of the human body such as the lungs, liver, heart, kidney, and thyroid.[70] It is beyond the scope of this current paper to examine the extent of Japanese tracer studies in humans, but it seems that this rapid development of radiation medicine was largely unaffected by geneticists' concerns and discussions about the effects of radiation exposure at the time (e.g., Hamblin & Richards, 2015; Higuchi, 2011, Chap.1; Onaga, 2018).

5. Conclusion

At the ABCC, U.S.-Japan collaboration of various degrees was almost always necessary for reasons both diplomatic (e.g., distributing interests and responsibilities between the two countries) and practical (e.g., enrolling the survivors in studies) (Beatty, 1993; Lindee, 1994b, 2016). The ABCC officially collaborated with the Japanese National Institute of Health (*kokuritsu yobō eisei kenkyūjo*), but this was not the only such partnership (nor has it been examined sufficiently). Many things, including information, materials, techniques, and practices, as well as people, flowed in and out of the ABCC. Therefore, it was inevitable that the controversial agency would affect the trajectory of Japanese science and medicine and *vice versa* over the decades.

In this paper, I have shown that the establishment of the ABCC Radioisotope Laboratory and the development of their projects were in fact products of the interactions between the ABCC and local Japanese scientists who had shared positive visions of medical uses of atomic energy. The ABCC needed Japanese researchers for its public legitimacy, and the Japanese side needed the ABCC for its abundant U.S. resources in efforts to rebuild their facilities and scientific programs. Their stakes coalesced around radioisotopes. Their collaboration stimulated the growth of tracer studies in Japanese human subjects, especially in hematology.

It should be noted, however, that this current study is limited by the lack of archival records of correspondence between Japanese researchers. They may express conflicting ideas about radioisotopes (e.g., the "dual use" aspect and the balance of risk/benefit) and about the U.S. or ABCC. Nonetheless, I do not think that these Hiroshima scientists whom I examined here were unique. In 1950, the year the first batch of isotopes arrived in Japan, a Nagasaki University Medical School professor wrote that the horrific atomic bombs brought Japan defeat, but their atoms shocked the Japanese with scientific wonder at the level "beyond the black ships," which had forced open the Japanese ports at the end of the Edo era (Usuku, 1950, p. 1). Just as Nakaidzumi had, he concluded that radioisotopes should be distributed to Nagasaki and used for the development of medicine as soon as possible.

According to Lindee (2016), since its 1975 reformation, the RERF has evolved "from a weapons orientation to an economic orientation," with an active involvement in radiation accidents in the world, and it has become a critical node in a global network of institutions that seek to manage radiation risk. This paper suggests that this evolution probably started much earlier and that it occurred because both local Japanese and ABCC administrators were invested in associating the organization with broader positive discourse about civilian uses of atomic energy, though their motivations varied.

The evolution was also made possible by the broader context in Japan. At least in the period examined here, people in Hiroshima, on their part, generally embraced "peaceful" uses of atomic energy because many were convinced that its promotion was a way to move forward and reconstruct the city and nation (e.g., Fukuma, 2012; Yamamoto, 2012; Zwigenberg, 2014; Hiroshima City, 2018). In his 1955 request that the AEC make a medical reactor a gift to the city, Hiroshima University president Tatsuo Morito wrote to AEC medical director Charles Dunham that the U.S. should offer Hiroshima an "up-to-date facility to promote the utilization of atomic energy … for peace

[66] Tsuzuki suggested an even broader name, American-Japanese Medical Institute, Hiroshima-Nagasaki Center. See Minutes of the second JAC-ABCC meeting on 20 February 1956, p. 23–24. For the ABCC and AEC, too, a new name without the word "A-bomb" seemed to be attractive as it might shift people's attention away from the military significance (Lindee, 1994b, p. 160–162).

[67] Minutes of the second JAC-ABCC meeting on 20 February 1956, p. 26–27.

[68] It is likely that the ABCC studies were the first published cases of radioiron clinical studies in the nation. A clinical study using Fe-59 (published in 1959) also listed the ABCC study as the earliest citation of the clinical application in Japan (Nakajima, 1959).

[69] Although their first presentation at JSH meetings was in 1958, their first publication on human studies appeared in 1957 (Nakao et al., 1957). But this was still later than the ABCC's 1956 presentations.

[70] The special issues I and II of "rajio-aisotōpu no kenkyū to ōyō [research and applications of radioisotopes]" are in: *Saishin igaku* (1960) v.15 no.4 and 5.

and welfare of mankind." In this way, he continued, the bombed city could overcome the disastrous past by embracing the peaceful aspect of atomic energy.[71] After the defeat, Japanese officials and intellectuals saw the revitalization of science and technology as essential to building a new nation of peace and democracy (e.g., Dower, 1999; Morris-Suzuki, 1994). Atomic energy quickly became a symbol for progress and modernization in the postwar years (Kato, 2012; Miyokawa, 2006), and in Hiroshima too, promoting its peacetime uses was placed at the center of the city's reconstruction project (Zwigenberg, 2014, Ch.3).

However, the successful cultivation of enthusiasm for atomic research may have relied upon the incomplete representation of radiation's risks and benefits to the public. Radiation is imperceptible, and the public's knowledge about its risks has to rely on official representations and experts' descriptions (Kuchinskaya, 2012). I was unable to find whether and how the subjects were informed about the tracer studies at the ABCC, and if the subjects relied largely on the Japanese media's reporting, they may not have had full and accurate knowledge of those risks and benefits. The RERF, now a critical institution in guiding the international regulation of radiation risk, has long been a site connecting the sufferings of the survivors with the social, political, scientific, and economic goals of atomic energy in Japan and the world. Further research into relationships between the ABCC and the Japanese scientific community and their collaborative shaping of the public knowledge landscape of radiation's risks and benefits is needed to untangle the complicated history of both local and global managing of radiation risk.

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