MORRIS F. LOW*

Accelerators and politics in postwar Japan

THE ESTABLISHMENT OF the Institute for Nuclear Study (INS) in Tokyo was a milestone in the history of experimental physics in Japan. Not only did it promote research in nuclear and particle physics, but it helped spawn what became the National Laboratory for High Energy Physics (KEK) at Tsukuba. Recently, INS and KEK have merged to become the High Energy Accelerator Research Organization.

Physicists also see the establishment of INS as representing a key moment in the relationship between science and citizenship in Japan. Whereas previously physicists asked themselves how they might best represent citizens in decision-making, the controversy surrounding INS prompted physicists to consider the role of citizens (rather than fellow scientists, bureaucrats, or politicians) in the policymaking process. Physicists had not seriously contemplated how citizens might supplement the role of experts such as themselves.[1]

This paper outlines the construction of accelerators in postwar Japan. It shows that physicists worked in a difficult environment, constrained by a lack of resources and Allied Occupation prohibitions. This helped shape the type of work that could be done. At first, the emphasis was on theoretical physics. Some theoriests went to the U.S. and on their return, like Sin-itirô Tomonaga, worked hard to establish facilities for experimental physics centering on accelerators.

*Department of the History of Science and Technology, Johns Hopkins University, 3505 N. Charles St., Baltimore, MD 21218; mlow@jhu.edu. I wish to acknowledge the constructive comments on an earlier version of this paper provided by Roderick W. Home and an anonymous reader.

The following abbreviations are used: EOL, Ernest O. Lawrence Papers, The Bancroft Library, University of California, Berkeley; G/S, GHQ/SCAP Records, National Diet Library, Tokyo; G/S/E, G/S Record Group ESS; SAL, Sakata Archival Library, Nagoya University.

1. Such issues are discussed in Sheila Jasanoff, "Science and citizenship: A new synergy," *Science and public policy*, *31:2* (2004), 90-94.

HSPS, Volume 36, Part 2, pages 275-296. ISSN 0890-9997.

To the initial dismay of physicists, the establishment of INS provided an opportunity for action by citizens who were concerned about possible military use of science and laboratories, and about the threat of radiation. Local residents felt excluded from decisions that affected their everyday lives. Physicists involved in advocating the establishment of INS awakened to the fact that postwar science was not only the realm of policy but also of politics.

Physicists went to considerable pains to establish the INS as a new, democratically-managed research organization run by themselves as a common-use facility.[2] They chose to construct accelerators that were flexible and appropriate to the state of physics in Japan at that time.

1. BEFORE INS

Destruction of the cyclotrons

In September 1945, the U.S. Scientific Intelligence Survey group went to Japan to investigate wartime activities.[3] The U.S. Initial Post-Surrender Policy prohibited research which might contribute to a revival of Japan's war-making potential; that included all activities relating to atomic energy. Research facilities were closed until the headquarters of the Supreme Commander for the Allied Powers (SCAP) could ascertain that their activities were of a "peaceful" nature. SCAP gave instructions to destroy or scrap "enemy equipment"—arms, war vessels, aircraft, and military installations. It exempted equipment considered "unique and new development" desirable for "examination, intelligence or research;" equipment deemed useful for U.S. army or naval operations; and equipment suitable for peacetime civilian use.[4]

In October 1945, the physicist Yoshio Nishina requested permission to operate a cyclotron for studies in biology, medicine, chemistry, and metallurgy. He received permission, but it was later withdrawn after Occupation authorities referred the matter to Washington. The request prompted the destruction that soon occurred. It was the only case in which a research program was discontinued because of SCAP objections. Other Japanese scientists avoided research that could be interpreted as violating Occupation guidelines.

On November 20, 1945, not long after Nishina's request was turned down, Thomas C. Smith, a U.S. Navy officer fluent in Japanese, visited Kyoto University with two officers from the Navy Department. Smith entered a high-ceilinged room where the cyclotron was housed in a recessed area. Several young men dressed in white, including the physicist Hideki Yukawa, were busy at work. Smith spoke with

2. R.W. Home and Masao Watanabe, "Forming new physics communities: Australia and Japan, 1914-1950," *Annals of science*, *47* (1990), 317-345, reprinted in Masao Watanabe, *Science and cultural exchange in modern history: Japan and the West* (Tokyo, 1997), 254-300, esp. 292-293.
3. R.W. Home and Morris F. Low, "Postwar scientific intelligence missions to Japan," *Isis*, *84* (Sep 1993), 527-537.
4. "Occupation instructions," APO 500, 25 Sep 1945 (G/S, Vol. 1, nos. 1-4).

the physicist-in-charge, Bunsaku Arakatsu, a short, friendly man with white hair. Arakatsu proudly showed off his cyclotron. Smith broke the news to Arakatsu that they had orders to destroy the cyclotron. Arakatsu remonstrated, to no avail, that the cyclotron had no military use.[5] A similar fate was in store for Seishi Kikuchi's cyclotron at Osaka University and Nishina's two cyclotrons at the Institute of Physical and Chemical Research (Riken). On the morning of November 24, army engineers set about dismantling the cyclotrons simultaneously in Kyoto, Osaka, and Tokyo. There were incorrect reports that five cyclotrons had been destroyed. U.S. Army personnel had mistaken a piece of equipment at Osaka University for a cyclotron.

After investigations had ascertained the Japanese had not made an atomic bomb, restrictions on nuclear physicists were relaxed, and orders to guard Japanese laboratories were lifted. But the prohibitions on research relating to atomic energy remained, and personnel with knowledge of the topic were registered and kept under surveillance. The Japanese were only left with Van de Graaff generators at Tohoku University, the University of Tokyo, and Osaka University, and a Cockcroft-Walton machine at Kyoto University.[6]

Who was to blame for the destruction of the cyclotrons? The order can be traced to the office of Leslie R. Groves, who headed the Manhattan Project that produced the atomic bombs which were dropped on Hiroshima and Nagasaki. Groves asked a member of his staff to "secure" the Japanese cyclotrons, which was apparently misconstrued as a request for their destruction. The request was made to the office of Secretary of War Robert P. Patterson and forwarded to General Douglas MacArthur, the Supreme Commander of the Allied Powers (SCAP).[7]

The destruction of the cyclotrons embarrassed SCAP. Evidently it needed personnel who could understand the science behind such equipment and carry out surveillance of scientists, especially those working in nuclear physics. The Americans chose Gerald Fox and Harry Kelly. Both physicists had worked on the development of radar at the Radiation Laboratory at MIT during the war and had not been involved in the Manhattan Project. There was no danger of their passing on nuclear secrets to the Japanese.

Rebuilding Japanese physics

Kelly and Fox arrived in Japan in January 1946. They peered out of the plane window on arrival in Tokyo at a city largely reduced to rubble. It would be a big

5. Thomas C. Smith, "The Kyoto cyclotron," *Historia scientiarum*, *12:1* (2002), 74-82.
6. Tomoo Sugimoto, "Saikurotoron no saiken" ("Rebuilding the cyclotrons"), *Kagaku* (*Science*), *23* (June 1953), 323-327.
7. Bowen C. Dees, *The Allied Occupation and Japan's economic miracle: Building the foundations of Japanese science and technology 1945-52* (Richmond, Surrey, 1997), 34, 35, 40; Shigeru Nakayama, "Destruction of cyclotrons," in Shigeru Nakayama, Kunio Gotô,

job helping the Japanese rebuild their scientific infrastructure. The two physicists joined the Economic and Scientific Section (ESS) of General Headquarters (GHQ). ESS had been established by order of General MacArthur to advise on economic, industrial, financial, mining, and scientific policies to be followed in Japan. Although Fox returned to the U.S. after only eight months, Kelly would stay for four years, helping the Japanese to get back on their feet.[8]

During the war, Riken laboratories and related companies undertook contract research for the military. Established in 1917 on the model of Germany's Imperial Institute of Physics and Technology (est. 1887) and the Kaiser Wilhelm Society (est. 1911), its purpose, like that of Britain's Department of Scientific and Industrial Research (est. 1916), was to increase self-sufficiency in the production of strategic supplies and industrial materials.[9] The Japanese initially hoped to raise five million yen (£500,000 or $2.5 million) for Riken through contributions from the private sector. In addition, the government agreed to provide a subvention of two million yen (£200,000). The Imperial Family made a gift of one million yen (£100,000). Both grants were to be paid out over ten years. Of the expected eight million yen (£800,000 or $4 million), 2.5 million was earmarked for investment in land, buildings, and equipment.[10] Unfortunately, because of the grave economic situation Japan found itself in after World War I, less than half of the total pledged or expected was raised. As late as 1922, Riken had only received a little more than three million yen ($1.5 million).[11] To achieve its aim of becoming self-supporting, Riken formed a commercial arm in 1927, the Physical and Chemical Industrial Company, which, at its peak of prosperity in 1940, had links to some 63 different companies.[12] As a large industrial combine, Riken no doubt contributed to the war effort. In July 1946, it was therefore reorganized as part of the dissolution of the *zaibatsu* (large financial conglomerates). Kelly and Nishina went to great lengths to preserve Riken. In November, Nishina became its head and had less time for direct involvement in physics.[13]

---

and Hitoshi Yoshioka, eds., *A social history of science and technology in contemporary Japan*, Vol. 1 (Melbourne, 2001), 108-118, esp. 110.

8. Hideo Yoshikawa and Joanne Kauffman, *Science has no national borders: Harry C. Kelly and the reconstruction of science and technology in postwar Japan* (Cambridge, 1994).

9. Kiyonobu Itakura and Eri Yagi, "The Japanese research system and the establishment of the Institute of Physical and Chemical Research," in Shigeru Nakayama, David L. Swain, and Eri Yagi, eds., *Science and society in modern Japan: Selected historical sources* (Tokyo, 1974), 158-201.

10. "What Japan is doing: Her encouragement of science," *Science and industry*, *1: 3* (Jul 1919), 137-138; reprinted from *Nature*, 12 Dec 1918.

11. Itakura and Yagi (ref. 9), 193.

12. Dees (ref. 7), 122-123.

13. Samuel K. Coleman, "Riken from 1945 to 1948: The reorganization of Japan's Physical

Sin-itirô Tomonaga (born 1906) entered Kyoto Imperial University in 1926, majoring in physics. He graduated in 1929 and chose to remain at the university as an unpaid associate with Hideki Yukawa. Tomonaga travelled to Tokyo in September, 1929 to attend lectures given by Heisenberg and Dirac at Riken. These lectures, and an inspiring special lecture on quantum mechanics given at Kyoto by Nishina in 1931, prompted Tomonaga to join the Nishina lab at Riken in 1932. Tomonaga built up considerable research experience during World War II under Nishina as a Riken research fellow and also as professor at the Tokyo University of Science and Literature. In 1942 he first proposed his "super-many time theory," which turned out to be identical with the covariant field theory later developed by Julian Schwinger. Applied to quantum field theory it provided a powerful framework for renormalization.[14] Beginning in mid-1943, Tomonaga did research on magnetrons and ultra-shortwave circuits at the Naval Research Institute laboratory at Shimada.[15] This was on a part-time basis. From August 1944 to July 1945, his work included a temporary assignment to the Tama Army Technical Institute.[16] In 1946 he won the Asahi Cultural Prize for his work on meson theory and his super-many-time theory, for which he also received the Nobel Prize in 1965, along with Schwinger and Richard P. Feynman.

While Nishina was busy rebuilding Riken, Tomonaga encouraged younger Japanese physicists to continue thinking about research. In 1946, physicists and students from the Department of Theoretical Physics at Tokyo University of Science and Literature combined with some of the physics students that Tomonaga had taught at Tokyo Imperial University to hold a seminar once a week in what was left of Science and Literature's campus at Ôtsuka. Tomonaga's seminar attracted around thirty young researchers from all parts of Japan. It became a mecca for elementary particle theorists. It provided a space where bright young men could develop their social and intellectual power. It also served to shift the leadership of the Tokyo group of physicists from Nishina to Tomonaga.

In the years immediately after Japan's defeat, being in Tokyo was associated with deprivation rather than opportunity. In June 1947, Tokyo University of Science and Literature's Department of Theoretical Physics and part of the Experimental Physics Department moved to the burnt-out remains of the Army Technical Research Institute at Ôkubo. Finding appropriate accommodation was not the only problem.

---

and Chemical Research Institute under the American Occupation," *Technology and culture*, *31:2* (1990), 228-250.

14. Satio Hayakawa, "The development of meson physics in Japan," in Laurie M. Brown and Lillian Hoddeson, eds., *The birth of particle physics* (Cambridge, 1983), 82-107, esp. 102.

15. Minoru Oda, "Bannen no Tomonaga Sin-itirô sensei" ("Sin-itirô Tomonaga during his later years"), in Daisuke Itô, ed., *Tsuisô Tomonaga Sin-itirô* (*Reminiscences of Sin-itirô Tomonaga* (Tokyo, 1981), 99-115, esp. 109-110.

16. Sin-itirô Tomonaga, "Personal history statement" (G/S/E, B11467).

The Japanese remained cut off from the rest of the scientific world. Subscriptions to journals had been disrupted and were difficult to resume owing to the lack of foreign currency. Physicists had to rely on foreign colleagues to donate back-issues of journals. The situation was not helped by the fact that the Japanese could not send mail overseas until May 1948. GHQ relieved the lack of scientific communication by establishing a Civil Information and Education Section (CIE) Library in Hibiya, Tokyo in November 1945. The CIE opened twenty-one branches in regional Japan in August 1947 to help satisfy the demand outside Tokyo. Not until 1949 could Japanese citizens import Western books on science and technology. The Occupation years (1945-1952) continued the disruption to scientific information that had occurred during World War II. When communications resumed, Japanese scientists looked toward the U.S. rather than toward Germany as they had before the war. However, it was almost impossible for Japanese to go overseas during the early years of the Occupation. That handicap eased in 1949.[17]

For Japanese wanting to reach out to America, Kelly was a key figure. He liaised with Nishina and other Japanese physicists and was instrumental in the establishment of the Science Council of Japan to which Nishina and Tomonaga were elected in December 1948. In January 1949, Nishina became Vice-President of the Council and in March the acting director of its Scientific and Technical Administration Committee (STAC), created as a liaison between the government and the Science Council.

In 1949, some four years after the destruction of the cyclotrons, Thomas Smith returned to Kyoto and visited Arakatsu who seemed to have forgiven the Americans for what had happened. The fact that Arakatsu's student Yukawa had just won the Nobel prize in physics had helped soften the memory.[18] While Smith and others acknowledged the contribution that Japanese physicists such as Yukawa had made through the development of meson theory, they regarded Japan as behind in experimental research. One way of catching up was to send senior Japanese physicists to the U.S.

Tomonaga left Japan on August 9, 1949 to visit the Institute for Advanced Study in Princeton.[19] Without a senior figure to rally around, the Tomonaga Seminar came to an end. Tomonaga was impressed by the collegial way in which the Institute for Advanced Study brought scholars together from throughout the world, and entertained hopes of recreating that environment when he returned in 1950.

Another bright physicist who made his way to the U.S. after the war was Ryôkichi Sagane. Born in Tokyo in 1905, the fourth son of the eminent physicist Hantarô

17. Shigeru Nakyama, "The international exchange of scientific information," and "Sending scientists overseas," in Nakayama, Gotô and Yoshioka, eds. (ref. 7), 237-248, 249-260.
18. Smith (ref. 5).
19. "Japan's hidden physicists: Men who will follow in Yukawa"s footsteps," *Nippon times*, 22 Nov 1949 (G/S/E, E06365).

Nagaoka,[20] he was adopted in 1914 by Mrs. Chiyo Sagane.[21] His education followed the prestigious academic route, graduating from the First Middle School in 1923, the First Higher School in 1926, and the Department of Physics, Tokyo Imperial University, where he would later become professor, in 1929. Sagane entered graduate school in April 1929, completing his studies in 1931, whereupon he joined Nishina's laboratory at Riken.[22] Sagane became a central member of Nishina's group. In April 1933, he was appointed lecturer in the Faculty of Science at Tokyo Imperial University, but nevertheless remained busy in Nishina's lab.[23]

From August 1935 to November 1936, Sagane worked at Lawrence's Radiation Laboratory in Berkeley, after which he visited the Cavendish Laboratory, Cambridge and other research institutes in Europe. [24] He returned to Berkeley from Europe in June 1937, and remained until he returned to Japan in February 1938.[25] He worked part-time at Riken, while completing his D.Sc. degree, granted to him in December 1939 for a dissertation "On artificial radioactivity."[26] In May 1942, he became a full research member of Riken and in March 1943 a professor at Tokyo Imperial University. That August he joined the Naval Technical Research Institute to work on vacuum technology, to relieve the shortage of reliable vacuum tubes in Japan.[27] He was involved in policy-making from 1943, when he became a member of the National Research Council, and, beginning in 1944, as a special consultant to the Army at the Tama Research Institute. Sagane made contact with companies such as Japan Radio and helped complete magnetrons at the Shimada Naval Technical Research Institute, along with Tomonaga and other Japanese physicists.

After the war, Sagane wrote to Lawrence of his desire to visit the U.S. again. He envisaged a role for himself as a bridge between the U.S. and Japan for other Japanese.[28] Kelly helped by writing to Gerald Fox who had met Sagane while in Tokyo.

20. Akira Aizu, "Ichi gakusei no omoide" ("The recollections of one student"), in Publication Committee, ed., with a preface by Seiji Kaya et al., *Sagane Ryôkichi kinen bunshû* (*Collection of writings to commemorate Ryôkichi Sagane*) (Tokyo, 1981), 395-398.

21. Translation of extract of Census Register, Ômura city, Nagasaki prefecture, 17 Sep 1949; G/S/E, B11649, "Travel abroad of Dr. Sagane," p. 9.

22. Masa Takeuchi, "Nishina kenkyûshitsu shoki no Sagane san" ("Sagane during the early days of the Nishina Laboratory"), in Publication Committee, eds. (ref. 20), 290-294.

23. "Genshikaku kenkyû: Riken jidai o chûshin toshite" ("Nuclear research: Focussing on the Riken days"), transcript of discussion, in Publication Committee, eds. (ref. 20), 125-156, esp. 127, 132.

24. Nishina to Lawrence, 26 Jul 1935 (EOL, 39:9); J.L. Heilbron and Robert W. Seidel, *Lawrence and his laboratory: A history of the Lawrence Berkeley Laboratory,* Vol. 1 (Berkeley, 1989), 318.

25. Background resumé of Ryôkichi Sagane (G/S/E, B11649).

26. Kôji Fushimi, "Sagane Ryôkichi sensei no muttsu no katsudô sô" ("Six aspects of the activities of Prof. Ryôkichi Sagane"), in Publication Committee, eds. (ref. 20), 121-124.

27. Translation of Sagane to Lawrence, late 1945 (EOL, 7:8).

28. Sagane to Lawrence, 10 Mar 1947 (EOL, 39:9).

In December 1949, Sagane received permission to leave the country to accept a one-term Visiting Professorship in the Department of Physics at Iowa State College.[29] On his way, he stopped at Berkeley.

Since Sagane had last visited Berkeley, much had changed. In May 1947, C.F. Powell and his colleagues at Bristol University had confirmed the existence of two types of mesons in cosmic rays, the heavier pions and their decay products the muons. Lawrence invited Sagane to visit the Radiation Laboratory at Berkeley to work on pion physics. The new Berkeley 184-inch cyclotron was by then producing pions. Sagane invented a spiral orbit magnetic spectrometer that Lawrence had made up for muon experiments. The end-result became known as the "Sagane Magnet."[30]

Besides Sagane, Yukawa, Tomonaga, Seishi Kikuchi, Satio Hayakawa, Yôichirô Nambu and other outstanding Japanese physicists went to the U.S. for varying periods. Lawrence drew on a "small private fund" to support visits by Sagane and Kikuchi. He also approached the Ford Foundation in the hope that Japanese scientists might participate in its Exchange of Persons Program, describing such visits as "an extraordinary opportunity" to promote U.S.-Japan relations.[31]

Sagane certainly found the research environment to his liking for he extended his period overseas until April 30, 1955, over five years in all. This was an unusually long period away for an academic with a university position in Japan, but it did serve a useful purpose for colleagues visiting the U.S., and Sagane made a good ambassador for Japanese physics. He was probably instrumental in arranging a visit by Ernest Lawrence to Japan in 1951.

Back in Japan, Tomonaga took over from Nishina, who died of liver cancer in January 1951,[32] as Chairman of the Science Council's Liaison Committee for Nuclear Research (later known as the Special Committee for Nuclear Research). His priorities were to facilitate the re-emergence of experimental physics in Japan through the establishment of a Cosmic Ray Observatory at Mt Norikura and the revival of cyclotron research. And it was in regard to the latter that Lawrence's visit to Japan in 1951 greatly helped the latter cause. Lawrence asked that GHQ allow the Japanese to rebuild a cyclotron. The ESS was reluctant, especially given the poor economic situation in Japan at the time. However, Lawrence prevailed. He knew that Riken had obtained two magnets before the war, one of which had been used in the construction of a small cyclotron. One remained. He used this knowledge to

29. Kelly to Fox, 12 Jul and 27 Oct (G/S/E, B11649), "Travel abroad of Dr. Sagane," p. 1).

30. Luis W. Alvarez, "Professor Ryokichi Sagane: Personal recollections," in Publication Committee, eds. (ref. 20), 415-422, esp. 420.

31. Lawrence to H. Rowan Gaither, Jr., Associate Director, Ford Foundation, 28 May 1951 (EOL, 16:7).

32. Fumio Yamazaki, "A short biography of Dr. Yoshio Nishina," in Sin-itirô Tomonaga and Hidehiko Tamaki, eds., *Nishina Yoshio: Denki to kaisô* (*Yoshio Nishina: Biography and reminiscences* (Tokyo, 1952), 3-15, esp. 14.

persuade ESS that the cost of building a cyclotron would be manageable. Sagane may well have provided this helpful advice to Lawrence prior to the trip.[33]

Japanese physicists at Osaka and Kyoto Universities were keen to build a cyclotron, as were physicists at the Kagaku Kenkyûjo (Scientific Research Institute), that, under Nishina's guidance, had succeeded Riken.[34] The Institute argued that it could build a small cyclotron relatively cheaply, with the help of funding from the Ministry of International Trade and Industry. Construction of the new, small 3.7 MeV cyclotron was begun in 1951 and completed in 1952. However, the Institute's priorities were no longer physics. In order to survive, the Institute effectively became an industrial research laboratory that relied on the production of penicillin for its income.[35] Economic activity rather than accelerator physics became its focus.

Meanwhile, the Ministry of Education agreed to fund the construction of a second cyclotron. After much debate, a Science Council committee headed by Tomonaga decided that Osaka University would build the second cyclotron (13 MeV). Kyoto University determined to proceed as well and to construct a 14 MeV machine using donated funds.[36] Tokyo-based physicists felt that they would be out-gunned by the Kansai-region physicists in Osaka and Kyoto. This sense of rivalry encouraged those in Tokyo to discuss the possibility of building a larger accelerator in Tokyo.

2. ESTABLISHMENT OF INS

A new approach

With the cyclotrons underway or completed in Tokyo, and at Osaka and Kyoto Universities, physicists considered an electron synchrotron or a proton synchrotron as the next step. The Osaka-based physicist Seishi Kikuchi insisted that the Japanese should prove themselves first with a 60-inch cyclotron, after which they could proceed to more ambitious high-energy physics. Some physicists wondered whether there was a need for another 60-inch cyclotron. The outcome of the debate was a machine that could operate as both a cyclotron and a synchrocyclotron. It was also decided to begin preparations immediately for a big machine for high-energy physics.[37] After much discussion, the physicists decided that the new ma-

33. Sin-itirô Tomonaga, "Genshikaku Kenkyûjo no setsuritsu to Kikuchi sensei" ("The establishment of the Institute for Nuclear Study and Professor Kikuchi"), in Tomonaga, *Tomonaga Sin-itirô chosakushû* (*Collected papers of Sin-itirô Tomonaga*), Vol. 6 (Tokyo, 1982), 305-327.

34. Dees (ref. 7), 129.

35. Coleman (ref. 13), 246.

36. Sin-itirô Tomonaga, "Genshikaku Kenkyûjo no sôsetsu nado" ("The establishment of the Institute for Nuclear Study, and other matters"), in Tomonaga, *Tomonaga Sin-itirô chosakushû* (*Collected papers of Sin-itirô Tomonaga*), Vol. 6 (Tokyo, 1982), 302-304.

37. Motoharu Kimura, "Kaku jikken gendai shi" ("A contemporary history of nuclear

chine should be in Tokyo and that the facility should be accessible to all nuclear physicists along the lines of the University of Tokyo's Cosmic Ray Observatory at Mt Norikura, and the Research Institute for Fundamental Physics (RIFP) at Kyoto University. These institutions, both established in 1953, were effectively inter-university research institutes despite being attached to specific universities owing to administrative requirements.

The RIFP was modeled after the Institute for Advanced Study at Princeton. Under the inaugural Director, Hideki Yukawa, it had four research sections: non-local field theory, nuclear theory, meson theory and the theory of properties of matter. Each section had a small permanent staff, and a number of visiting researchers. It was hoped that the new facility, with its construction budget of one billion yen (approx. $2.78 million), would also do what the RIFP was seeking to do in theoretical physics.[38] Both institutions sought to recapture the intellectual freedom and excitement that was a feature of the old Riken during Nishina's time.

Between 1950 and 1952, Kikuchi (inaugural INS director) visited Cornell University to help him decide on the sort of accelerator best suited to Japan. Japanese physicists experienced difficulty keeping abreast of overseas developments as journals were still difficult to obtain. At Cornell, Kikuchi had the advice of Robert R. Wilson, who had been chief of experimental physics at Los Alamos, and the theorists Hans Bethe and Richard Feynman. Kikuchi affiliated with Wilson, whose group had recently completed a 300 MeV synchrotron with funding from the Office of Naval Research.

Kikuchi reported back to Japan that nuclear physics in the U.S. had become an industry with various companies vying with each other to make the best counters and instrumentation. Japanese researchers often had to make such equipment themselves. He admired the American counters, the various circuits, and the excellence of the materials. He recognized that Japan had to achieve excellence in many related fields of science and industry to reach a level comparable to what he saw at Cornell.[39]

In 1953, Tomonaga, Kikuchi, Yoshio Fujioka, and others deliberated over whether an institute like INS was necessary.[40] Rapid advances in nuclear physics created a

---

physics experiments"), *Nihon Butsuri Gakkai shi* (*Journal of the Physical Society of Japan*), *13* (Nov 1958), 680-744, esp. 681.

38. Ibid.

39. Seishi Kikuchi, "Cornell Daigaku Genshi Kaku Kenkyûjo yori" ("From Cornell University"s Laboratory of Nuclear Studies"), *Kagaku* (*Science*), *20* (June 1950), 274-277.

40. Institute for Nuclear Study, Tokyo University, *Kakken nijû nen shi* (*The twenty year history of the Institute for Nuclear Study*), (Tanashi, Tokyo, 1978), and *Tôkyô Daigaku Genshikaku kenkyûjo sôritsu 40 shûnen kinen shiryôshû* (*Historical materials commemorating the fortieth anniversary of the establisment of the Institute for Nuclear Study at the University of Tokyo*) (Tanashi, Tokyo, 1996).

growing desire for larger apparatus. Furthermore, it was felt that the existing system of research in Japanese universities did not meet the new needs of experimental nuclear research. They concurred that creation of INS would help establish the concept of national joint-use research institutes in Japan. At a time of meager resources and institutional rivalries, the idea of a joint-use facility had a strong appeal.

At various meetings of the Physical Society of Japan, and at the Science Council's Special Committee for Nuclear Research (SCNR) under Tomonaga's chairmanship, plans were formulated that would allow physicists to give an example of an open and democratic discipline. This meant open access to information and to all levels of decision-making. The SCNR consisted of twenty members from theoretical nuclear physics, seventeen from experimental nuclear physics, and twelve from cosmic ray physics. In addition, between 1952-1954, three scientist groups were established to look after the interests of physicists. These were the Soryushi-ron Gurupu (Elementary Particle Theory Group); the Genshikaku Danwakai (Nuclear Physics Forum) and the Uchûsen Kenkyûsha Kaigi (Cosmic Ray Research Council). These groups brought a wider circle of physicists into the discussions and provided the Committee with a conduit for the demands and opinions of scientists at large.

In May 1953, the Science Council recommended the establishment of INS to the Japanese government. The Council hoped to open up the research facilities to all researchers throughout the country and to conduct programs administered by a "democratic" inter-university committee. Frequent exchanges of physicists between INS and other universities were foreseen. At the time, research facilities had to be attached to a specific university. Tokyo University would not agree to surrender to an inter-university steering committee,. They did agree with the common-use concept and, after considerable negotiation, the physicists became resigned to the fact that although informally inter-university, formally INS would have to operate as a research institute of Tokyo University.[41]

The time from recommendation to implementation of INS was astonishingly short. A special budget for reactors was proposed in March 1954. In the debate that followed, the Science Council argued for transparency in policymaking, autonomy for scientists, and the need for democratic principles.[42] The SCNR, via the Science Council, issued a declaration that all research on atomic energy be done in accordance with the three basic principles of non-secrecy (free access), democracy, and independence. This spirit of open inquiry that Japanese physicists sought to promote contrasted with the conduct of nuclear physics in the U.S. and elsewhere. In the nation that knew the horror of nuclear weapons, there was widespread agreement that Japanese research in nuclear physics should not be used for military purposes.

41. Japanese Physics Committee for 1964 Peking Symposium, Working Group of Experimental Nuclear Physics, presented by Susumu Morita, "The establishment of the Institute for Nuclear Study at Tokyo University and its results," *Papers presented at the 1964 Peking Symposium,* Vol. 1*: Natural science* (Peking, 1965), 311-337, esp. 311-312.
42. Tomonaga (ref. 36).

Science for the people?

In 1952, the Democratic Scientists' Association (abbreviated in Japanese as "Minka") began to promote the slogan "Kokuminteki kagaku no sôzô" ("Creating science for the people").[43] The Association paralleled the Association of Scientific Workers in England and the Federation of Atomic Scientists in the U.S.[44] Despite such slogans, however, Japanese physicists felt that they knew how to represent the interests of citizens without consulting them. *The lucky dragon* incident of 1954 prompted Japanese citizens to seek a more direct say in the politics of siting research facilities and the direction of science policy.

On March 16, 1954, *Yomiuri shinbun* reported that twenty-three Japanese on a tuna fishing boat called *The lucky dragon* had been contaminated by radioactive fallout near the Bikini Atoll during tests of hydrogen bombs about two weeks earlier.[45] Against this background the Japanese public learned, in July 1954, that a site in Tanashi, Tokyo had been selected for the Institute. The site was a farm belonging to the Faculty of Agriculture at the University of Tokyo.

The neighbors took fright and protested against the construction of the Institute. They linked the new facility with the sudden Japanese government's promotion of nuclear power and the U.S. hydrogen bomb tests in the Pacific.[46] The Tanashi Town Council was an unusually activist local authority, having passed a resolution on March 30, in the wake of *The lucky dragon* incident, supporting a ban against testing atomic and hydrogen bombs. The Council also called for the promotion of the peaceful uses of atomic energy and strict international control. It was the first town or village council in Japan to pass such resolutions.[47]

A Tanashi town councilman reminded his fellow councilors that even the Citizen Watch Company was forced to become a weapons manufacturing plant during the Pacific War. Citizen had a factory in Tanashi. Now, when there were fears of

43. Tetsu Hiroshige, "Sengo Nihon no kagaku undô (2): Tsuzuki, kyûbô to sakoku no jidai" ("The science movement in postwar Japan (2): Poverty and national isolation"), *Shizen* (*Nature*), 14 (June 1959), 74-82.

44. See Alice Kimball Smith, *A peril and a hope: The scientists' movement in America, 1945-47* (Chicago, 1965); William McGucken, *Scientists, society and state: The social relations of science movement in Great Britain, 1931-1947* (Colombus, 1984).

45. Japan Atomic Industrial Forum, *Nihon no genshiryoku: 15 nen no ayumi, ue* (*Atomic energy in Japan: A 15 year history, Part 1*) (Tokyo, 1971), p. 16. For an account of the incident see Ralph Lapp, *The voyage of the lucky dragon* (New York, 1958); Michael Schaller, *Altered states: The United States and Japan since the Occupation* (New York, 1997), 71-75.

46. Sin-itirô Tomonaga, "Genshikaku Kenkyûjo no mezasu mono" ("Towards an Institute for Nuclear Study") in Tomonaga (ref. 42), Vol. 6, 283-288; first published in *Asahi shinbun*, 28 and 29 Sep 1954.

47. Kiyonobu Itakura, *Kagaku to shakai: Sôzô o umu shakai, shisô, soshiki* (*Science and society: Society, ideas and organizations that give birth to creativity*) (Tokyo, 1971), 177.

yet another war, the councilman argued that they would be safer without INS in their neighborhood. A shopkeeper countered that INS would help bring prosperity to Tanashi. The councilors voted 11 to 10 in favor of a resolution opposing the establishment of INS. In the papers supporting the resolution, it was noted that the national parliament had declared that it would not remilitarize and yet the government had nevertheless strengthened the Self Defense Forces. The councilors looked for assurances from the government that it would only pursue peaceful uses of the atom. None were forthcoming. Hence the townsfolk's feeling of distrust toward the government.[48]

The Tanashi people were right to entertain concerns as governments, rightly or wrongly, saw accelerators as part of the armory to harness atomic energy for both civilian and military purposes.[49] Sin-itirô Tomonaga, Seishi Kikuchi, and Hiroo Kumagai met with the mayor, various local officials, and residents to assure them that the mission of the Institute was pure research, not industrial or military application. The controversy regarding the siting of the Institute reveals that physicists had neglected to include local residents in the decision-making process. Belated attempts to assuage their protests had to rely on the credibility of experts such as Tomonaga.

Many of the physicists advocating the establishment of INS were deeply opposed to the development of hydrogen bombs. In order to defend their position, they argued that basic science needed to be protected lest it be perverted for the purposes of military science. Defending and promoting basic science were represented as forms of resistance to militarization. The argument did not persuade the people of Tanashi.[50]

On the evening of October 25, 1954, Tomonaga attended a long meeting with over a hundred local residents at the Tanashi Public Hall. Residents complained that at a time when many Japanese had difficulty making ends meet, building such an Institute was an extravagance. One young, male worker complained that workers were slow to be paid. One man he knew was so desperate that he sold his blood to buy rice. He asked Tomonaga, "what is the connection between this research and our lives? Is it true that the Institute will ultimately become a source of happiness to the people?" These were difficult questions at the best of times for physicists to answer. Tomonaga responded by saying that while he could not promise happiness, he did think that the research would eventually be of some use.[51]

48. Ibid., 178.
49. John Krige, "The installation of high-energy accelerators in Britain after the war: Big equipment but not 'big science'," in Michelangelo De Maria, Mario Grilli, and Fabio Sebastiani, eds., *The restructuring of physical sciences in Europe and the United States, 1945-1960* (Singapore, 1989), 488-501.
50. Hiroshige (ref. 43), 81.
51. Makinosuke Matsui, "From research scholar to scientific administrator," in Makinosuke Matsui and Hiroshi Ezawa, eds., *Sin-itirô Tomonaga: Life of a Japanese physicist* (Tokyo, 1995), 203-213, esp. 207-208.

Tomonaga came across as an approachable, ordinary person in appearance who nevertheless left a deep impression. He was worldly, yet had the common touch.[52] Despite Tomonaga's reassuring personal qualities, however, the townspeople did not think that the government could be trusted or that politicians would provide hundreds of millions of yen for peaceful research.[53] There were fears that INS was connected with the U.S. military installations located nearby at Tachikawa, Yokota, Narimasu, Asaka, and Chôfu.

The Allied Occupation had come to an end with the signing of the San Francisco Peace Treaty in 1951, and ratification of the U.S.-Japan Security Treaty by the U.S. Senate in 1952. But even after the official end in 1952, Japan still lived "in the shadow of the Occupation."[54] Some 200,000 American troops remained. In Tokyo alone, there were over 200 U.S. military bases. Through the efforts of residents, local authorities, and the Tokyo Metropolitan Government, the bases were consolidated, but fifty years later, eight of them remain.[55] The protests against the establishment of INS must be viewed against opposition to U.S. bases in Japan.

Residents sought assurances from the incoming Director, Seishi Kikuchi, that INS would not pursue military research.[56] While Kikuchi was able to placate them, some physicists entertained doubts themselves about their ability to resist pressure to undertake military-related research.[57] Their concerns were well-founded. Despite the government position that Japan would not produce, possess, or introduce nuclear weapons, *The bulletin of the atomic scientists* has revealed that American nuclear weapons or components were kept at several locations in Japan.[58]

The physicist Shôhei Miyahara saw the conflict with the Tanashi residents as an opportunity to become aware of the sensitivities associated with nuclear research, and of the need for scientists and science to engage with citizens. *Asahi shinbun* reported on November 7, 1954 that a committee for the establishment of

---

52. Nobuyuki Fukuda, "Yoki contorasuto: Yukawa hakase to Tomonaga hakase," ("The good contrast: Drs Yukawa and Tomonaga"), *Kagaku zuihitsu zenshû geppô* (*The scientific essay collection monthly*), *2* (May 1961), 1-2.
53. Y., "'Kakken' setchi to heiwa no kagaku: Rekishi kenkyûsha ni oshieru mono" ("The Establishment of INS and science for peace: Lessons learnt by an historian"), *Rekishi hyôron* (*Historical review*), *61* (Dec 1964), 88-90.
54. Michael Schaller, *Altered states: The United States and Japan since the occupation* (New York, 1997), 62.
55. Headquarters of the Governor of Tokyo, Planning and Coordination Division, "U.S. military bases in Tokyo," *Measures for U.S. military base in Tokyo*, online at http://www.chijihon.metro.tokyo.jp/kiti/english/etonokiti.htm/.
56. Shôhei Miyahara, "Genshikaku Kenkyûjo kensetsu no koro: Kagakusha to jumin" ("Scientists and local residents: The construction of the Institute for Nuclear Study"), *Nihon no kagakusha* (*The Japanese scientist*), *14*:*6* (June 1979), 334-336.
57. Ref. 53.
58. Robert S. Norris, William M. Arkin, and William Burr, "How much did Japan know?," *Bulletin of the atomic scientists*, *56:1* (2000), 11-13, 78-79.

INS had met the day before and it had been decided that while the physicists would certainly consider the concerns of the Tanashi people, the basic direction of the Institute would remain the same. A liaison committee with representatives from INS and the local community would be formed to ensure close communication about staffing and management.[59]

Despite the opposition of the townsfolk, construction went ahead and INS was formally opened in July 1955 with Kikuchi as first director. Staff included Hiroo Kumagai (from the University of Tokyo) and Itaru Nonaka (Kyushu University). The centerpiece of the Institute was a 63-inch cyclotron that would be completed in October 1957 at an approximate cost of 200 million yen (over $500,000).[60] Meanwhile, the cyclotron at Osaka University was coming into operation and Kikuchi, who worked there as well as at INS, was busy flying between both places.

Problems

The agenda of INS was to promote research in nuclear and particle physics, both experimental and theoretical. Although the theorists preferred high- to low-energy physics, INS decided to pursue the latter along with the study of cosmic rays. A high energy accelerator appeared to be too costly and difficult. A cyclotron would have the widest applications and allow the quickest approach to world standards in experimental nuclear physics. Planning involved all the relevant stakeholders. In order to meet the research agendas of its prospective users, the cyclotron was designed to run as a fixed frequency (FF) type of variable energy (7.5-15 MeV) and also as a frequency modulated (FM) machine, a synchrocyclotron.[61] If money had been no problem, two separate machines would have been preferable, but this was not an option. It was the first synchrocyclotron to be built in Japan and, with a proton energy of 65 MeV, it was by far the highest energy accelerator designed by Japanese physicists.

As Sharon Traweek has noted, experimental equipment used in Japanese university laboratories and in national research institutes tends to be built by commercial firms rather than by technicians in on-site workshops. This contrasts with laboratories in the U.S. where graduate students are often involved in constructing equipment.[62] Despite the added cost that buying out creates in Japan, it serves to build links with the private sector, helps firms to innovate, and ultimately may prove useful when students seek employment.

59. "'Kakken' kensetsu kôji hajimaru" ("INS construction commences"), *Asahi shinbun*, 7 Nov 1954, 7.

60. Ichirô Katayama and Tokushi Shibata, "Kakken R=160 cm FM/FF saikurotoron no rekishi" ("The history of the 160 cm radius FM/FF cyclotron at INS"), *Nihon Butsuri Gakkai shi* (*Journal of the Physical Society of Japan*), 49:3 (Mar 1994), 200-207.

61. Itaru Nonaka, "Kaku Ken no saikurotoron ga kansei shite" ("Completing the INS cyclotron"), *Kagaku* (*Science*), *27* (Dec 1957), 624-628.

62. Sharon Traweek, "Kokusaika, Gaiatsu, and Bachigai: Japanese physicists" strategies

Although Toshiba built the 160 cm cyclotron for the Institute, INS staff and Toshiba technical personnel collaborated in its design. It was a source of pride that a first-class machine could be made in Japan. When asked by foreign visitors whether the cyclotron was made in Japan, staff member Itaru Nonaka could proudly say "all of it."[63]

The FF portion was completed in September 1957 and experiments began the following June. It differed from other ordinary cyclotrons in that it could produce an external beam of energies from 7.5 to 15 MeV (protons), 15 to 20 MeV (deuterons), and 30-40 MeV (alpha particles). The FM portion, the synchrocyclotron, was completed in May 1958 by adding a radio frequency (RF) cavity that accelerated protons to an energy of 60 MeV. The RF cavity served to feed energy into the beam and synchronize the particles travelling through it. INS staff reported what they had accomplished in a paper in the journal *Nuclear instruments and methods*.[64] In-house reports suggest that the machine worked well as both an ordinary cyclotron and as a synchrocyclotron.[65]

The next machine to be built at INS was an electron synchrotron (ES). The project was begun by Kumagai and overseen by Yoshio Yamaguchi. In contrast to the cyclotron, the electron synchrotron had sufficient energy to produce mesons, which allowed the Japanese to enter the realm of high energy physics without relying on cosmic rays.[66] Work began on a 750 MeV electron synchrotron in 1956. A 6 MeV linear electron accelerator (linac) acted as the injector of the strong focussing ES.[67] In December 1961, the ES had come into operation with an electron beam of up to 750 MeV. In March 1966, the energy had reached 1.3 GeV.[68] It was effectively the first accelerator for elementary particle physics in Japan.[69]

As we know, Tokyo University refused to hand control of INS administration to an inter-university committee of researchers, but rather left decision-making with

---

for moving into the international political economy of science," in Laura Nader, ed., *Naked science: Anthropological inquiry into boundaries, power, and knowledge* (New York, 1996), 174-197, esp. 190-191.

63. Nonaka (ref. 61), 628.

64. S. Suwa et al., "Efficient beam extraction from a synchro-cyclotron at n = 1," *Nuclear instruments and methods*, *5* (1959), 189-193.

65. A. Suzuki, S. Suwa, Y. Sazi, T. Karasawa, T. Miyazawa, and J. Sanada, "On the external proton beam of about 55 MeV of the INSJ 160 cm synchro-cyclotron," *INSJ report no. 23*, 17 Dec 1959.

66. Hiroo Kumagai, "Kaku Ken no denshi shinkurotoron" ("The INS Electron Synchrotron"), *Nihon Butsuri Gakkai shi* (*Journal of the Physical Society of Japan*), *13* (Nov 1958), 745-746.

67. Tetsuji Nishikawa, Jiro Tanaka, Akira Miyahara, and Hiroo Kumagai, "The design study and the general picture of linear electron accelerator for the injector of 1 BeV synchrotron," *INS report no. 27*, Dec 1959.

68. KEK High Energy Accelerator Research Organization, "History," c. 2000, online at ccwww.kek.jp/main2000/japanese/syomu/enkaku-e.html.

69. Ref. 50, 313-314.

the INS faculty board. In response, the SCNR set up an Inter-University General Committee with membership equally divided between INS members and people outside Tokyo University. While formally the faculty board did not have to heed the recommendations of the SCNR General Committee, they felt a moral obligation to do so. In another fit of democratization the faculty board (consisting of professors and associate professors) agreed to receive input through an INS staff steering committee of advice from a congress made up of all INS staff. Furthermore, each section (low energy physics, high energy physics, cosmic ray physics, and theoretical physics) held weekly staff meetings to discuss issues of concern. To encourage the idea of common-use by other researchers, special committees consisting of researchers from each field (chosen from throughout Japan) and representatives from the Inter-University General Committee were formed.[70]

Unlike the Research Institute for Fundamental Physics at Kyoto University where most of the staff apart from the director, Hideki Yukawa, were on fixed-term appointments, INS staff had standard academic appointments. Permanent INS positions were a mixed blessing as this deprived other physicists from enjoying the opportunity of working long-term in a research-only environment.[71] In September 1959, one staff member did leave when Kikuchi resigned from INS to become the Executive Director of the Japan Atomic Energy Research Institute.

In 1964, Susumu Morita outlined some residual problems at INS at a symposium in Peking. Morita was one of a delegation of left-wing Japanese physicists who attended the Peking Symposium in the hope of improving Sino-Japanese relations. Shôichi Sakata was the Japanese delegation leader. Morita complained that only students from the University of Tokyo had a good chance for an education at INS. A second problem was that the emergence of big science and the desire for bigger and more powerful machines aggravated the disparity in social position and remuneration between INS scientists and the technical staff. The People's Republic of China (PRC) was an appropriate place to voice such concerns.[72] A final problem was the lack of machine time on an accelerator shared by all the nuclear physicists in Japan. Notions of fairness suggested that as many users as possible should be given the opportunity to use the ES. No one group could use the machine long enough to conduct a complicated experiment. In an attempt to remedy the situation, INS encouraged project-based research over an extended period.

Some Japanese physicists thought that Western physicists unfairly denied them recognition for their work. Contributing causes were delays in the distribution of journals overseas, difficulties in attending international conferences, and cold war politics. Japanese who were able to present papers at international conferences,

70. Ibid., 314-316.
71. "Zadankai: Kyôdô riyô kenkyûjo no kadai" ("Roundtable discussion: On the topic of common-use research institutes"), *Kagaku* (*Science*), 29 (July 1959), 272-278.
72. Ref. 50, 311-337, esp. 337.

often did so in poor English. Mituo Taketani aired these concerns at an International Conference on Elementary Particles held in Kyoto in September 1965 to celebrate the thirtieth anniversary of the meson theory.[73]

In September 1967, INS hosted the International Conference on Nuclear Structure, an opportunity to showcase Japanese achievements to foreign scientists. Kikuchi welcomed conference participants, noting how recent improvements to the linear accelerator that served as an injector for the electron synchrotron, especially the introduction of the tandem machine, made for an initial beam of much better quality. In a tandem machine, both ends of the accelerator are at ground potential and the accelerating effect of the high voltage is effectively doubled. Kikuchi remarked that the tandem machine made operation of accelerators more stable and allowed easy variation of energy over a wider range. The Japanese produced pulsed beams of very short duration and also polarized beams. They had made big improvements in detectors and other instrumentation. Developments in computers made data processing much easier. Kikuchi referred contentedly to "a vast flow of new and more reliable data."[74]

3. ESTABLISHMENT OF KEK

After the successful establishment of INS in 1955, physicists lobbied for several years for a second accelerator facility.[75] In 1957, Sakata succeeded Tomonaga, who had been elected President of the Tokyo University of Education, as chairman of the SCNR. In 1958, INS director Kikuchi proposed the construction of a high energy accelerator as the next logical step after completion of the INS electron synchrotron.[76] After much debate, the SCNR submitted a long range plan for nuclear research to the Science Council in April 1962. The plan called for the establishment of a Research Institute for Elementary Particle Physics separate from INS.[77] INS had gone to great lengths to ensure balance in its promotion of nuclear and particle physics. It deliberately did not favor high-energy physics.

73. Mituo Taketani, "On the meson theory of nuclear forces," *Proceedings of the International Conference on Elementary Particles in commemoration of the thirtieth anniversary of meson theory, Kyoto, 24-30 September 1965* (Kyoto, 1966), 170-181.
74. S. Kikuchi, "Opening address," in J. Sanada, ed., *Proceedings of the International Conference on Nuclear Structure, Tokyo, September 7-13, 1967*, *Supplement to the Journal of the Physical Society of Japan*, *24* (1968), 3-4, esp. 3.
75. Lillian Hoddeson, "Establishing KEK in Japan and Fermilab in the U.S.: Internationalism, nationalism and high energy accelerators," *Social studies of science*, *13*, (1983), 1-48; Satio Hayakawa and Morris F. Low, "Science policy and politics in post-war Japan: The establishment of the KEK High Energy Physics Laboratory," *Annals of science*, *48* (1991), 207-29.
76. SCNR minutes, 3 May 1958 (SAL, SCNR file).
77. Vice-president of the Science Council Masao Yamagata to Prime Minister Ikeda, 24 May 1962, (SAL, SKS file).

On June 11 the Ministry of Education's Council for Research Institutes, headed by Tomonaga, conducted a special hearing of the proposed plans. It decided to appoint a sub-committee to study the proposal in greater detail.[78] The Nuclear Physics Sub-Committee presented its first interim report on August 16. The report included a request for funding for preparation for a 12 GeV proton synchrotron, which would build on experience gained from construction of the INS electron synchrotron and combine the best of the technology of the large proton synchrotrons at CERN and Brookhaven. The Japanese hoped to achieve a beam intensity several hundred times that obtained at those places.[79]

At the seventh meeting of the Nuclear Physics Sub-Committee on April 12, 1963, Yoshio Yamaguchi proposed convening a new preparatory committee for the Research Institute for Elementary Particle Physics.[80] Funding for 1963 would be channelled through INS and the INS director would have responsibility for the committee.[81] By October 10 the SCNR agreed to have Tomonaga as chairman of the preparatory committee.[82] The overlap of membership between the Science Council and the Ministry's committees appeared to some to threaten the autonomy of the Council. Some thought Tomonaga's presidency of both the Science Council and the Council for Research Institutes was a conspicuous case in point.[83]

The splitting of Japanese physicists into three separate groups, the Elementary Particle Theory Group, the Nuclear Physics Forum, and the Cosmic Ray Research Council, had led to sectionalism regarding future plans for the construction of a major accelerator facility and was the main source of the conflict that was being experienced by the physical community.[84] Furthermore, there was little interaction between various divisions of the Institute despite close physical proximity.[85] By 1965, the Japanese theoretical physics community had split into two groups, which were described as those east and those west of Hakone. This division was a result of both political and academic differences, and it manifested itself in the timing of two major international symposia. From May 6 to 17 the inaugural Tokyo Summer

78. "Report of the Research Institute Council hearing into the future plans for nuclear physics," 13 June 1962 (SAL, SKS file).
79. "Supplement to the minutes of the Ninth KKJ Meeting," 27 Feb 1963 (SAL, SKS file).
80. "Memorandum for the minutes of the Nuclear Physics Sub-committee, Research Institute Council," 12 Apr 1963 (SAL).
81. Minutes of the SKS meeting," 27 May 1963 (SAL, SKS file).
82. Minutes of the SKS meeting," 10 Oct 1963 (SAL, SCNR file).
83. "Reference material attached to minutes of 1964 Budget Policy Sub-committee Meeting," Feb-Mar 1964 (SAL).
84. *High Energy Physics Accelerator Laboratory bulletin*, no. 2 (16 May 1961) (SAL, SJC file).
85. Mimeographed circular originating from the Research Institute for Fundamental Physics, Kyoto University, ca. 2 Nov 1961, and Outline of replies to questionnaire on the future plans for theoretical physics (SAL).

Institute of Theoretical physics was held at Oiso in Kanagawa prefecture. Ryôgo Kubo and Nobuyuki Fukuda were the organizers. The second group, composed of senior physicists centered on Yukawa at Kyoto University, organized the International Conference on Elementary Particles from May 23 to 30 in Kyoto to celebrate the thirtieth anniversary of the meson theory.

The differences among the theoretical physicists dated back to the late 1940s when Tomonaga (Tokyo), Sakata (Nagoya), and Yukawa (Kyoto) were still active in research. Susumu Kamefuchi, who studied under Sakata at Nagoya University in central Japan, has described the rivalry between Sakata and Tomonaga and their respective students. Sakata was the more radical in particle physics and politics.[86] In contrast to Tomonaga and Sakata, who were both approachable and had many students, Yukawa was aloof, aristocratic, and not attractive to students. His attempts to develop field theory with nonlocalizable or nonlocal field theory can be described as radical. These differing approaches and personalities made for tensions in the community of theorists. When one of them, Tomonaga, seemed to monopolize key positions, protests followed.

In 1965, Tomonaga's three positions as president of the Science Council, chairman of the KEK preparatory committee, and deputy head of the Japan Antarctic Research Expedition project were diagnosed as a conflict of interest.[87] He tendered his resignation to the preparatory committee and Satio Hayakawa took over as chairman.[88] Despite some misgivings about Tomonaga's involvement in so many activities, the announcement of his Nobel prize (together with Julian Schwinger and Richard Feynman) in 1965 reinforced the belief that his involvement was important to getting the proposed Research Institute for Elementary Particle Physics. On July 27, 1966, Tomonaga, Kumagai, Suwa, and Isao Miura went before the National Diet Special Committee for Policy for the Promotion of Science and Technology to explain the plans for the accelerator. The session began auspiciously with a congratulatory remark on the Nobel prize.[89] By early 1967, attitudes had changed and the Ministry of Finance suggested abandoning the Research Institute project in favor of participation as a member nation in research at CERN. Seiji Kaya, Kikuchi and Tomonaga met with the Prime Minister on February 22 to discuss the matter. They argued that distance would prevent a large number of Japanese from participating in research at CERN and that a Japanese facility was needed.[90]

86. Susumu Kamefuchi, "Study of the divergence problem at Nagoya around 1950," *Progress of theoretical physics,* suppl. no. 105 (1991), 197-203.
87. "Opinion of the Sub-committee for Research Organization, on the subject of future plans for nuclear physics," 7 May 1965, attached to SNCR minutes, 11 May 1965 (SAL, SCNR file).
88. "Minutes of the SCNR meeting" 10 June 1965 (SAL, SCNR file).
89. Special Committee for Policy for the Promotion of Science and Technology, 52nd National Diet Assembly, "Minutes," 27 Jul 1966 (SAL, SJC file).
90. "Minutes," 27 Mar 1967 (SAL, SJC file).

On May 27, 1967, INS director Gyô Takeda suggested that the new Institute (KEK) and its planning apparatus be separated from the INS. Administering the increasing budget of the Institute posed a strain on INS resources. On November 4, 1968, INS director Takeda submitted his resignation owing to problems associated with the student revolt at the University of Tokyo.[91] This was a major setback as Takeda had taken on the INS directorship to help prepare for the construction of the accelerator. Blows kept coming. In December, the government offered the physicists 8 billion yen to cover the construction of an accelerator one quarter the size of the one they had proposed. That was the largest amount possible under the grants-in-aid scheme for science at that time. Despite the desire by many physicists to accept the 1/4 plan, the cosmic ray group voted in the negative and neither proposal materialized.

During the student unrest of the late 1960s, there was a sense of closure and new beginnings. In 1969, Tomonaga retired from the Tokyo University of Education and resigned as president of the Science Council. The National Laboratory for High Energy Physics (KEK) was finally approved and established in 1970. Under the directorship of Shigeki Suwa, it took as its primaray task the construction of a 10 GeV proton synchrotron at Tsukuba Science City. This time, the proposal diplomatically included the establishment of a cosmic-ray institute in Tokyo and a low energy institute in Osaka, ensuring that physicists working in other areas would also benefit. Tomonaga as elder statesman, served as a councilor of the new laboratory. In 1976, there was much cause for celebration. The proton synchrotron produced an 8 GeV beam in March and reached 12 GeV in December, and Tomonaga received the Grand Cordon of the Order of the Rising Sun. He died a few years later, in 1979.[92]

In this paper, we have seen how the history of the construction of accelerators cannot be divorced from the context within which physicists were immersed after the Pacific War, whether it be the concerns of local residents, the state of physics at the time, or competing claims for funding from other physicists. It was at this difficult time that scientist-statesmen such as Tomonaga could provide a steadying influence that served to calm worried residents, and encourage bureaucrats and fellow scientists with competing interests to come to some compromise.

91. INS, "Progress report on the matter of the resignation of the Director," 26 Nov 1968 (SAL).
92. Matsui and Ezawa, eds. (ref. 51), 315-316.

MORRIS LOW

Accelerators and politics in postwar Japan

ABSTRACT

The destruction of Japan's cyclotrons by Occupation Forces after the Pacific War resulted in a major setback for experimental physics in that country. Key figures such as Yoshio Nishina, Sin-itirô Tomonaga, and Ryôkichi Sagane strived to help Japan rebuild its scientific infrastructure and regain some of its former eminence in the field, but in the wake of the dropping of the atomic bombs on Hiroshima and Nagasaki, the atom had new meaning. Local residents objected to the establishment of the Institute for Nuclear Study in Tanashi, Tokyo. Despite their protests, construction went ahead and the Institute of Nuclear Study (INS) opened in 1955. Within a few years, physicists sought to establish a second major accelerator facility. Sectionalism among physicists and shortage of funds plagued attempts to establish the National Laboratory for High Energy Physics (KEK) which eventually came into being in 1970. This paper reveals some of the problems that physicists faced and how they sought to overcome them within the context of a defeated Japan, wary of military research, and desperately seeking to rebuild its economy. Physicists sought to influence the direction of science policy and to deal with the concerns of citizens in a newly democratic Japan.

KEYWORDS

Japan, physics, history, accelerators, politics