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Radium traffic: radiation, science and spiritualism in early twentieth-century Japan

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Abstract

The emergence of modern health-related commodities and tourism in the late Meiji and Taishō eras (1900s–1920s) was accompanied by a revival of spiritualist religions, many of which had their origins in folk belief. What helped this was the people's interpretation of radiation. This article underscores the linkages between radiation, science and spiritualism in Japan at the time of modernisation and imperialism. In the early twentieth century, the general public came to know about radiation because it was deemed to have special efficacy in healing the human body. In Japan, the concept of radiation harmonised with both Western culture and Japanese traditional culture. One can see the fusion of Western and traditional culture both in people's lives and commercial culture through the popularity and availability of radium hot springs and radioactive commodities. Radium hot springs became fashionable in Japan in the 1910s. As scholars reported that radium provided the real potency of hot springs, local hot springs villages seized on the scientific explanation and connected their developments with national policies and industries. This paper illustrates how the discourse about radium, which came from the field of radiation medicine, connected science and spiritualism in modern Japan.

Keywords: Radiation; Radium; Radium Hot Springs; Science; Spiritualism; Japan

Introduction

In the early twentieth century, the general public came to know about radiation because it was deemed to have special efficacy in healing the human body. Shortly after the discovery of X-rays, doctors began to use radiation in medical practice and preach its benefits for the human body. By the end of the first decade of the twentieth century, scientific research had established the use of radiation in medical practice. Around the same time, radium industries emerged and started to sell radium commodities such as pills and drinks, which contributed to radiation's positive image. The enthusiastic embrace of radium was a trend not only in Europe and North America, but also in Japan. Kosakai Fuboku (小酒井不木) (1890–1929), a medical scientist who studied physiology and serology at the Imperial University of Tokyo, and later became a popular writer of detective fiction, depicted the radium craze in 1916 as follows:

Radium! [...] Its name reverberates throughout the world. [...]. This is the era of radium, or, the era of radiation [...]. The hot springs should contain radium and every kind of illness should be treated by radium [...] I would like to think about this appetite of the era, or the trend of the era.¹

Fuboku's essay reveals the popularity of radiation, at the same time it demonstrates how the concept of radiation harmonised with both Western modern and Japanese traditional cultures. The tourist industry that sprung up around radium hot springs is a particularly striking example of radiation's

¹Kosakai Kōji, 'Hōshasen chūshin jidai [The Era of Radiation]', *Kōzuiigo*, 12, 5 (1916), 19.

popularity, as is people's everyday use of radioactive commodities, such as pills, cosmetics and groceries. Why did radium become so popular and how did the Japanese people perceive the existence of invisible radiation? Through a careful reading of the discourses on radiation in early twentieth-century Japan, this paper will shine a light on the conjunction between Japanese spiritual beliefs and Western science.

Historians of science have shown how radium and radiation were interpreted and introduced in Western society.² It is well known that the use of radium was not limited to laboratories and hospitals, but was so widespread in society as to give rise to a radium craze. The radium craze of the United States has been examined in various ways. Observing American atomic culture before 1945, Matthew Lavine witnessed the vulgarization of radiation. He claims that it was not science-popularizers but commercial popularizers who were the impetus behind the radium craze. The key actor in the creation of a radium craze was the radium industry. Maria Rentetzi analyses the relationship between industry and academia that developed in the United States in the first two decades of the twentieth century, arguing that very little contact between industrial companies and academics, coupled with the failure of the state to monopolise radium production and control its use, gave a boost to the American radium industry.³ Radium was thus elevated to the level of a cure-all panacea. The Japanese radium industry was closely connected to academics and was often supported by academic doctors from the Imperial University. However, because of the close ties between the academy and industry, radium was elevated to the level of a panacea in Japan.

Through the history of the radium craze in Japan, I analyse the relationship between academics and industry, as well as the interplay between modern and traditional culture in the context of Japan, a country that eagerly desired to be a world power. Following the work of Maria Rentetzi, who develops the concept of *trafficking material* and shows that radium is the object of different but overlapping and intersecting worlds, I conceive of the Japanese radium craze through the lens of 'traffic': the intellectual traffic, or discourse, of radium in popular and academic worlds; the circulation of radium as raw material; and the literal traffic generated by tourism.⁴ According to Rentetzi, these are materials that travel from hand to hand, from discipline to discipline, from laboratory to laboratory, or from the scientific world to the world of commodification and consumption. In this sense, the 'traffic' of radium emerges as both a kind of materiality and overlapping networks of knowledge built by different actors. Becoming part of this network is not only a matter of gaining scientific expertise but also of using the right strategy and of possessing the power to impose oneself.⁵

Japanese culture imported and absorbed the knowledge and materials of radium from Western countries. Reconciling Western science and Japanese culture had been Japan's aspiration since the feudal government of the Tokugawa Shogunate was replaced with the Meiji government in 1868. The Meiji Restoration abruptly and drastically changed the political regime and the very structure of society and culture. After centuries of the Tokugawa Shogun's isolationist and anti-expansionist policy, the nation was now urged to emulate Western world powers. Having faced the threats from Western powers, the Meiji government adopted policies such as *Fukoku kyōhei*, 富国強兵 (Enrich the State, Strengthen the Military) and *Datsu-A Nyū-Ō*, 脱亜入欧 (Leaving Asia and Entering Europe). Along with shifts in public policy and military strategy, reconciling Japanese identity with Western science also became a critical issue for policymakers and intellectuals. Thus, the Japanese welcomed the slogan *Wakon Yōsai*,

²Spencer R. Weart, *Nuclear Fear: A History of Images* (Cambridge, MA: Harvard University Press, 1988). Matthew Lavine, *The First Atomic Age: Scientists, Radiations, and the American Public, 1895-1945* (New York: Palgrave Macmillan, 2013); Luis A. Campos, *Radium and the Secret of Life* (Chicago; London: The University of Chicago Press, 2015).

³Maria Rentetzi 'The U.S. Radium Industry: Industrial In-house Research and the Commercialization of Science', *Minerva*, 46 (2008), 437–92. Meanwhile, European countries such as France, Austria, Germany and England maintained their scientific authority and used the radium industry to their own scientific ends. For example, Armet de Lisle became one of the most important proponents of radium therapy in France by maintaining his close ties to the Curie laboratory. As for the role of the Curie laboratory, see: Soraya Boudia, The Curie laboratory: Radioactivity and metrology, *History and Technology*, 13 (1997), 249–65.

⁴Maria Rentetzi, *Trafficking Materials and Gendered Experimental Practices* (New York: Columbia University Press, 2007).

⁵*Ibid.*, 3.

和魂洋才 (Japanese Spirit and Western Techniques), which articulated a new belief that Western science and technology were useful tools that could be reconciled with Japanese identity.⁶ Largely due to this new national embrace of Western science and technology, Japan rapidly became a world power after its ‘victories’ in the Sino–Japanese and Russo–Japanese wars of 1895 and 1905. The First World War brought Japan dynamic advantages in industry and economy.⁷ Although the war saw Japan break ties with Germany, a main source for industrial chemicals, pharmaceuticals and precision instruments,⁸ the situation encouraged Japanese independent research and industry. Scholars such as Hiromi Mizuno argue that Japanese discourses on science began to support an imperial ideology in the 1910s.⁹ This crucial decade for the incorporation of discourses of ‘Western’ science into an imperial ideology coincided with the period of the radium craze. The analysis of the discourse on radiation helps to understand the acceptance of Western science in the context of Japan at the time of modernisation and imperialism.

In what follows, I examine the cultural reception and use of radiation throughout Japan, illustrating that discourses about radiation connected central and regional areas of the Japanese Empire. I begin with an overview of academic discourses of radiation both in the East and West, with particular emphasis on Japanese medical professionals’ importation of medicine, medical knowledge and medical practices during the crucial decade when discourses of ‘Western’ science were incorporated into the imperial ideology of the 1910s. In the second part of the article I focus on the cultural acceptance of radium in Japan. The concept of radium was harmonised with both modern and traditional cultures. In the last part, I analyse the way in which radium became embedded within the hot springs culture of Japan.¹⁰

Research on Radioactivity from Laboratory, Hospital and Hot Springs

Scientific research on X-rays and radioactivity was soon followed by medical implementation. Wilhelm Conrad Röntgen’s discovery in 1895 that X-rays could penetrate the human body created a sensation both in scientific circles and the public sphere. The first to use X-rays for skin diseases was physician Leopold Freund of Vienna, who treated a patient’s pigmented nevi.¹¹ Niels Ryberg Finsen’s light therapy for tuberculosis of the skin by that time also achieved a reputation. Radiation therapy spread quickly and X-ray technologies were introduced into many hospitals¹² for the diagnosis and treatment of diseases such as broken bones, eczema and skin cancer. A further development came with the discovery of the properties of radium in 1898. Radioactivity from radium seemed similar to X-rays, giving scientists and medical doctors high hopes for the medical use of radium. Before understanding the actual chemical and physical conditions in terms of modern science, doctors in different parts of the world (including

⁶About the roots of *Wakon Yosai*, see: Hirakawa Sukehiro, *Wakon yōsai no keifu [The Genealogy of Wakon Yōsai]*, (Tokyo: Kawade Shobō Shinsha, 1987).

⁷For the history of Japanese science and technology, see: James R. Bartholomew, *The Formation of Science in Japan: Building Research Tradition* (Hew Haven; London: Yale University Press, 1989); Tessa Morris-Suzuki, *The Technological Transformation of Japan: from the Seventeenth to the Twenty-first Century* (Cambridge: Cambridge University Press, 1994).

⁸James R. Bartholomew, *The Formation of Science in Japan*, 199.

⁹Hiromi Mizuno, *Science for the Empire: Scientific Nationalism in Modern Japan* (Stanford, CA: Stanford University Press, 2008).

¹⁰Elsewhere I have demonstrated how radiation medicine contributed to the popularization of hot springs in modern Japan. Nakao Maika ‘Kindai ka o hōyō suru onsen: Taishō ki no rajiumu onsen būmu ni okeru hōshasen igaku no yakuwari [Embracing Modernization: The Role of Radiation Medicine in the Radium Hot Springs Boom in the Taishō era]’ *Kagakushi Kenkyū*, 268 (2013), 187–99.

¹¹Freund L, ‘Ein mit Röntgenstrahlen behandelter Fall von Naevus pigmentosus piliferus’, *Wiener Medizinische Wochenschrift*, 47 (1897) 428–34.

¹²The X-ray technology has been recognized as one of hallmarks of scientific medicine in the twentieth century. Charles E. Rosenberg, *The Case of Strangers: The Rise of America’s Hospital System* (New York: Basic Books, Inc., 1987); John H. Howell, *Technology in the Hospital: Transforming Patient Care in the Early Twentieth Century* (Baltimore; London: Johns Hopkins University Press, 1996).

Germany and the United States) used radium in the treatment of diseases such as keloids, tuberculosis, syphilitic ulcers, hyperthyroidism, tumours and cancers.¹³

Like their Western counterparts, Japanese scientists marked radioactivity as an important new area of research, while Japanese medical doctors imported new Western medical technologies involving the use of radiation. Nagaoka Hantarō (長岡半太郎) (1865–1950), a physicist studying in Europe (he attended courses at several universities in Germany and Austria) when Röntgen discovered X-rays in Würzburg, reported the discovery in 1896 to Japanese scientists in an article published in *Tōyō Gakugei Zasshi* (東洋学芸雑誌), the oldest and most reputable general academic magazine in Japan.¹⁴ In the following years, we can see that Japan quickly absorbed the latest research and healing trends from countries such as Germany and the United States

Practicing physicists in Japan built their own machines and conducted replication research. Together with his laboratory members at the Tokyo Imperial University, Physicist Yamakawa Kenjirō (山川健次郎) (1854–1931), the first Japanese to be awarded a degree of doctor of science, constructed an X-ray machine in April 1896 that beamed crystals with X-rays. Other pioneers were physicist Mizuno Jōnosuke (水野敏之丞) (1862–1944) and the physician Marushige Bunryō (丸茂文良) (1862–1906), who also built X-ray machines for personal research. Japanese history ascribes the first successful example of radiography to the practicing physician Muraoka Han'ichi (村岡範為馳) (1853–1929), and the inventor Shimazu Genzō (島津源蔵) (1869–1951). Yet, none of these men trusted their machines enough for actual use on humans. Only after army surgeon Colonel Haga Eijirō (芳賀栄次郎) (1864–1953) imported an X-ray machine from Germany in November 1898 did the number of applications in health care increase.¹⁵ The Russo–Japanese War (1904–1905) was an important trigger for X-ray applications. One of the largest wars the Japanese Empire had fought, the Russo–Japanese War brought Japan and Russia into conflict over interests in Manchuria and on the Korean Peninsula. Through the Treaty of Portsmouth that ended the war, Japan gained a large territorial concession and became the first non-Western world power.

Radium research accompanied increasing interest in radiology as a diagnostic technique. In 1903, physicist Tanakadate Aikitsu (田中館愛橘) (1856–1952) introduced radium into the country from Europe and, in the following years, the number of researchers in Japan interested in radium continued to rise, including physicians, physicists and chemists.¹⁶ In contrast, the total amount of radium that Tanakadate brought to Japan was small: only 10 milligrams. This amount was divided between medical authorities at the Tokyo Imperial University and the Kyoto Imperial University, such as the internist Miura Kinnosuke (三浦謹之助) (1864–1950) and the dermatologist Dohi Keizō (土肥慶蔵) (1866–1931), both of whom performed radium therapy in their respective research fields.¹⁷

Radium research was not only conducted in laboratories and hospitals, but also in the field. From the beginning of physicists' research into the phenomenon of radioactivity, the nature of the gas, emitted by radioactive substances, was of major interest to physicists and chemists. In 1899, Ernest Rutherford discovered thorium and, in surveying its nature, named the emissions of radioactive substances 'emanation'.¹⁸ The following year, Ernst Dorn determined that what Marie and Pierre Curie had called induced radioactivity was the same phenomenon as Rutherford's emanation.¹⁹ In 1902, J.J. Thomson

¹³About the radium therapy in the U.S., see: Aimee Chantel Esther Slaughter 'Harnessing the Modern Miracle: Physicists, Physicians, and the Making of American Radium Therapy' (PhD dissertation, University of Minnesota, 2013).

¹⁴Nagaoka Hantarō, 'Rentogenshi ekisu(X) hōsansen [Dr. Roentgen's X-ray]', *Tōyō Gakugei Zasshi*, 174 (1896), 132–3.

¹⁵Kimura Masuo 'Dōnyū shoki no rinshō ni okeru X sen no unyō [Operation of X ray machines in the early time of introduction]', *Nihon Hōshasen Gishikai Zasshi*, 48, 8 (2001), 46–61.

¹⁶Nakamura Seiji, *Takanadate Aikitsu sensei [Professor Tanakadate Aikitsu]* (Tokyo: Hōbun Shoin, 1943).

¹⁷Gotō Gorō ed., *Nihon hōshasen igakushikō: Meiji Taishō hen [Japanese history of Radiation Medicine; Meiji and Taishō]*, (Tokyo: Nihon Hōshasen Gakkai, 1969).

¹⁸Ernest Rutherford 'A Radioactive Substance Emitted from Thorium Compounds', *Philosophical Magazine*, 49 (1900), 1–14; 'Radioactivity Produced in Substances by the Action of Thorium Compounds', *Philosophical Magazine*, 49 (1900), 161–92.

¹⁹Ernst Dorn 'Ueber die von radioaktiven Substanzen ausgesandte Emanation', *Abhandlung der Naturforschung Gesellschaft zur Halle*, 23 (1901), 1–15.

found radium emanation in tap water and deep-level springs.²⁰ In rapid succession in early 1900, researchers such as Elster, Geitel and H.S. Allen laid the basis for the analysis of springs and natural emanation.²¹

Since Western scientists such as Thomson and Allen had stated that radium emanation was found in natural springs, the Japanese scientists embarked on research to ascertain if radium emanation could be found in Japanese springs. In 1909, two graduate students at the Tokyo Imperial University, Manabe Kaichirō (眞鍋嘉一郎), a medical scientist born in 1878 in Aichi prefecture, and Ishitani Den'ichirō (石谷傳一郎), a scientist of physics and geology born in 1877 in Okayama prefecture, began investigating radium emanation in Japanese hot springs.²² Manabe and Ishitani started their collaborative research on radioactivity in hot springs, such as Yugawara, Izu, Atami, Arima and Ikaho, with the support of Aoyama Tanemichi (青山胤通) and Nagaoka Hantarō (長岡半太郎), both pioneers of Japanese medicine and physics. The next year, Manabe and Ishitani published a report stating that several famous hot springs contained high levels of radiation.²³

Within a few years of the appearance of Manabe and Ishitani's report, investigation of the radium content of mineral springs became a major concern of the national institutions – to the extent that ministries summarised the results independently. The Health Office of the Home Ministry (内務省) published a report in 1915, titled *The Mineral Springs of Japan*, exhibited at the Panama-Pacific International Exposition held in San Francisco. The Army Medical Team (陸軍軍医団) also summarised its findings in a report titled *The Table of the Radium Emanation Content in Japanese Mineral Springs*. The preciousness of radium and its high economic value might have spurred the rapid performance of the investigations.²⁴ Furthermore, the government had conducted its investigations because of 'radium fever' in society. In order to restrict the quack radium springs and products, the Health Office of the Home Ministry established state control over radium springs and products in 1915, and the Pharmaceutical Society of Japan established an official method of mineral spring analysis in 1916.

By the mid-1910s, radium fever had taken hold, spreading beyond research institutions on a scale that scientists and government could not control. 5 years after Ishitani and Manabe had concluded their research on radioactivity in hot springs, Ishitani remarked how the public opinion of radium had changed within a few years:

It seems that radium fever has reached a great peak. I feel the times have changed greatly [...] 6 or 7 years ago I felt quite embarrassed everywhere I went when I started the preliminary survey for radium emanation content in mineral springs [...] Because radium is said to be specially efficacious for several diseases, drug stores have skillfully advertised it, hot spring inns tactfully publicised it, and radium is even claimed to be effective against typhus and plague. Ultimately this tendency leads the lay person to think radium is a god or something similar.²⁵

²⁰J. Thomson 'Experiments on Induced-Radioactivity in Air, and on the Electrical Conductivity Produced in Gases When They Pass Through Water', *The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science*, 4 (1902), 352–67.

²¹Elster E, Geitel H 'Weitere Versuche über die Elektrizitätszerstreuung in abgeschlossenen Luftmengen', *Physikalische Zeitschrift*, 2 (1901), 560–3; Elster E. and Geitel H. 'Beschreibung des Verfahrens zur Gewinnung vorübergehend radioaktiver Stoffe aus der atmosphärischen Luft', *Physikalische Zeitschrift*, 3 (1902), 305–10; H.S. Allen, 'Radio-Active Gas Bath Mineral Waters', *Nature*, 68 (1903), 343.

²²Manabe Sensei Denki Hensankai, *Manabe Kaichiro denki [A Biography of Manabe Kaichirō]*, (Tokyo: Ōzora sha, 1998). Later Manabe became a lecturer at the Tokyo Imperial University and the Head of its Institute for Physiotherapy after he studied internal medicine and physiotherapy in Germany, Austria, and America from 1911 to 1914.

²³Manabe Kaichirō 'Onsen ni okeru rajiumu no kenkyū [Research on Radium in Hot Springs]', *Tōkyō Iji Shinshi*, 1656 (1910), 495–8; D. Ishitani K. Manabe, 'Radioactivity of Hot Springs in Yugawara, Izu and Atami', *Tokyo Sugaku-Butsurigakkai Kiji*, 2, 5 (1910), 226–51.

²⁴Radium was the most precious substance in the world at that time.

²⁵Ishitani Den'ichirō 'Rajiumu no kōnō to wagakuni no kōsen [Effectiveness of Radium and Japanese Mineral Springs]', *Chuō Koron*, 27, 7 (1914), 51–62, 51.

We hence see here an important shift: in the earliest days of Japanese radium research, the public still largely ignored scientists' investigations on radium. However, within a scant few years around 1910, large-scale investigations attracted nationwide attention, and hot springs claimed the presence of radium in their waters, just as manufacturers claimed the presence in their products.

Radium in modern and traditional culture

Radium industries emerged in the early 1910s and started selling radium commodities such as pills, cosmetics and drinks. How did these industries emerge, how did the Japanese people come to accept radium and how did radium insinuate itself into both the modern and traditional aspects of Japanese culture? This part investigates the emergence of radium industries and the cultural acceptance of radium in Japan, where radium was introduced into both modern and traditional cultures.

In a sense, the radium craze can be seen as a fashion boom connected to the Japanese longing for Western culture. This embrace of Western culture was on prominent display in the upscale Ginza district of Tokyo. Beginning in the Edo period (1603–1868), Ginza became a centre of Japanese economic growth and innovation. By the late nineteenth century, Ginza had become a symbol of modernisation and westernisation embodying the term *bunmei kaika*, 文明開化 (Civilisation and Enlightenment). New types of business were started in the city, for example, in 1911, Ginza was the location of the first café in Japan. At that time, cafés were places where Japanese people felt they were experiencing Western culture.²⁶ Several institutes and companies related to radium emerged in Ginza during this era (the 1910s). One such institute was the *Radium Kyōkai*, ラヂウム協会 (The Radium Institute), founded by Misawa Sotake (三澤素竹) in 1913 to research and actively propagate Western culture. It ran a spa, library, bar and its own café, the Madame Curie Café. In an advertisement placed in the 10 December 1913 issue of *Yomiuri Shimbun*, a daily newspaper based in Tokyo, the institute promises to provide clients 'health and pleasure'. An illustration shows a man wearing a Western tuxedo and holding a wine glass (Figure 1). Thus, the radium craze was part of a larger narrative of Japanese culture embracing a modern Western lifestyle.

The pharmaceutical companies such as *Radium Shōkai*, *Ōhira Shōkai* and *Tanaka Yakubō* also fed Japan's radium fever by marketing radium commodities to the public. *Radium Shōkai*, ラヂウム商会 (The Radium Trading Company), founded in 1910 by Morita Yasutarō in Ginza, became one of the biggest pharmaceutical companies in Japan during the 1910s.²⁷ *Radium Shōkai* began by importing radium commodities such as Radiogen Schlamm (Figure 2) and Radiogen Aqua, both bath agents, from Germany and in 1914 started manufacturing radium drugs as well. The company advertised its radium commodities heavily, with at least 301 advertisements in the *Tokyo Asahi Shimbun*, 東京朝日新聞 (Tokyo Asahi Newspaper), a Tokyo daily newspaper, between 1912 and 1919. The company's advertisements claim that radium was a universal remedy effective against a broad range of afflictions such as rheumatism, nerve pain, haemorrhoids and underarm odour. It was even promoted as a tooth whitener.

The advertisements emphasise 'proof' by medical doctors. For example, one 1912 advertisement in the *Tokyo Asahi Shimbun* claimed that 'radium soap is effective against general skin disease', explaining that 'Dr. Dohi and others also report that radium has an awesome healing effect on pigmentation and other kinds of skin disease because it emits strong electricity and light'.²⁸ The reference here is to an authoritative dermatologist, Dohi Keizō of the Tokyo Imperial University, who used radium to treat skin diseases. The Ministry of Home Affairs' patent-medicine regulation of 1914 made it compulsory for

²⁶Hatsuda Tōru, *kafē to kissaten: Modan toshi no tamariba* [Cafe and Coffee Shops: A Gathering Place in Modern City] (Tokyo: INAX Publishing, 1993).

²⁷Takeda Yakuhin Kōgyō Kabushiki Kaisha ed., *Takeda nihyakunen shi* [Two Hundred Years History of Takeda] (Osaka: Takeda Yakuhin Kōgyō Kabushiki Kaisha, 1983), 338.

²⁸Ippan hihubyō ni tokkō aru rajiumusekken [Radium soap effective to general skin disease], *Tokyo Asahi Shimbun*, 19 December 1912. We can assume that public images of radiation and electrocity, and ultraviolet ray were similar. Okumura Daisuke "Juntai, denki, hoshanō: Akashi Hirotaka to Matsumoto Chiwaki ni miru fuka hyōryōyūtai no gainen [Body, Electricity, and Radioactivity: Concept of Imponderable Fluid in Akashi Hirotaka and Matsumoto Chiwaki]" *Kindai Nihon Kenkyū*, 29 (2013), 309–45.



Figure 1. Advertisement of 'Radium Parlor', *Yomiuri Shimbun*, 10 December 1913.

every drug to have a scientific explanation of its properties. To comply with the government restrictions on patent-medicine, doctors endorsed these drugs. Since the effectiveness of radium seemed to have the imprimatur of the medical establishment, the co-dependent relationship between pharmaceutical companies and doctors may have encouraged an increasingly widespread belief in the beneficial qualities of radium among Japanese consumers.²⁹

The *Radium Shōkai* advertised not only radium medications, but also radium commodities, such as cosmetics and articles of daily use such as soap, facial cleanser and adhesive tape. The advertisements and

²⁹Medical doctors and scientists had a close connection with pharmaceutical companies. For example, a scientist Takamine Jōkichi was the largest shareholder of Naikoku and the president in absentia of Sankyō Shōkai. Julia Yongue 'Origins of Innovation in the Japanese Pharmaceutical Industry: The Case of Yamanouchi Pharmaceutical Company (1923–1976)', *Japanese Research in Business History*, 22 (2005), 109–35.



Figure 2. Radiogen-Schlamm, Kanoichiro Suizu, *Raiiumu Kōwa*, ラヂウム講話 (*The Story of Radium*), (Ryūbunkan, 1914), p. 193.

package of the products include both English and Japanese letters (Figure 3), thus appealing to those members of the Japanese public who admired Western culture. The products and advertisements mostly targeted female customers. As these advertisements show, the radium industry made radium a part of modern everyday life. Radium was thus perceived not merely as a medical drug but also as part of a modern and fashionable culture.

However, the cultural acceptance of radium was even more complex. The concept of radium was frequently combined with spirituality, and many spiritualists were inspired by radiation and radium.³⁰ For example, in 1910, Takahashi Gorō (高橋五郎) (1856–1935), one of the leaders of Japanese

³⁰Like its American and British counterparts, Japanese spiritualism adopted a general orientation of universalism, based on the idea that all humanity is united by possessing an eternal, undying soul, which it will rejoin upon the body's death. Helen



Figure 3. Advertisement of Radium Soap by the Radium Trading Company, *Tokyo Asahi Shimbun*, 26 November 1915.

spiritualism, wrote in *Shinrei bannō ron*, 心靈万能論 (Theory of Universal Spiritualism) that radium had changed the Japanese concept of religion.³¹ He tried to prove the existence of spirit by explaining the nature of radiation.³²

Radium was introduced into Japan during the Taishō era (1912–1926) at a time when methods of health management and healing practices were experiencing a boom, a boom that was itself heir to the spiritual boom of the late-Meiji era.³³ Oftentimes, it was a mixture of modern scientific knowledge and traditional practice. The practitioners (spiritualists and healers) used scientific terms such as radium, radiation and electron in the name of their therapy. For example, Matsumoto Chiwaki (松本道別) (1872–1942), a spiritualist (靈術家) who studied Eastern hygiene, proposed a ‘human body radium therapy’ in the early 1920s.³⁴ He hit upon the idea that the human body contains some scientifically unknown motive force and assumed it was caused by the action of radium (ラヂウム作用). He recognised human radium as having spiritual effects (精神作用). Another example of the mixture of the modern and the traditional in health management products was the ‘radium moxibustion instrument’ (ラヂウム温灸器), which was marketed by an entrepreneur, Kōno Yoshinori (河野義). The instrument had the same form as moxibustion (灸) that was used in the Eastern medicine and garnered a substantial market in the 1930s.

Embracing the radium in hot springs

Among several phenomena, the radium hot springs that emerged all over the country are particularly useful in helping us understand the radium craze. Radium hot springs embodied a fusion of radiation

Hardacre ‘Asano Wasaburō and Japanese Spiritualism’ in Sharon Minichiello ed., *Japan’s Competing Modernities* (University of Hawaii Press, 2017), 133–54. For spiritualism in Japan, see also Lisette Gebhardt, ‘The “Other World” in the Light of a New Science: Spiritualism in Modern Japan’ in Susanne Formanek and William R. LaFleur eds., *Practicing the Afterlife: Perspectives from Japan* (Vienna: Verlag der Österreichischen Akademie der Wissenschaften, 2004), 383–96.

³¹Takahashi Gorō, *Shinrei bannō ron [Theory of Universal Spiritualism]* (Tokyo: Maekawa Bunneikaku, 1910), 47.

³²The spiritual discourses on radiation were connected with that of vitalism. Vitalism (生命主義) was closely related to spiritualism, mesmerism, and animism and was one of the mainstream currents of thought during the Taishō era (1912–1926). About Vitalism in Japan, see: Suzuki Sadami ed., *Taishō seimei syugi to gendai [Taishō Vitalism and the Present]* (Tokyo: Kawade shobō shinsha, 1995).

³³Kurita Hidehiko, Yoshinaga Shin’ichi, and Tsukada Hodaka eds. *Kingendai nihon no minkan seishin ryōhō [Folk Psychotherapy in Modern Japan]* (Tokyo: Kokusho Kankōkai, 2019); Tanaka Satoshi, *Kenkō-hō to iyashino shakaishi [Social History of Health Management Method and Healing Practice]* (Tokyo: Seikyū sha, 1996).

³⁴Matsumoto Chiwaki, *Jintai rajiumu ryōhō kōza [Lecture on Human Body Radium Therapy]* (Tokyo: Jintai Rajiumu Gakkai Honbu, 1921).

and traditional culture, and we can see that many actors aimed at harmonising modern Western culture with local Japanese traditions. Moreover, healing was transformed from a religious act into a practice associated with the new trend of wellness tourism. Scientific and religious validity became mutually reinforcing sources of legitimisation.

In Japan, people had been visiting hot springs since, at least, medieval times. People had long thought the potency of hot springs came from spiritual power. In fact, the 'hot-springs cure culture' was sustained by the unification of the potency of hot springs and peoples' religious beliefs.³⁵ These springs were thus religious and spiritual places, often housed in a Shinto Shrine. However, during the early modern period, hot springs gradually transformed from a place for a religious cure into a destination for a leisure trip. The rapid industrialisation of the late nineteenth century, particularly the development of railway infrastructure, accelerated this change. The railway connected urban and rural areas and made it easier for city workers to visit rural hot springs.

Hot springs have been important in various societies as places for spiritual and bodily rejuvenation. Indeed, in examples from across cultures, hot springs served as places where different cultures and values are negotiated, and were thus connected with various cultures, religions and ideologies. Scholars have studied European hot springs in their usage for both religious-spiritual practice and health rejuvenation. For example, Jens Chr. V. Johansen has shown that the Protestants created holy springs in Denmark as a medical rationale for a religious practice.³⁶ He suggests that the use of holy springs became important after the Reformation as a compensation for the loss of other, formerly acceptable, sources of miraculous healing. Inspired by Alain Corbin's work, which showed the birth of the beach as a consequence of bourgeois leisure practices,³⁷ Douglas Mackaman has depicted how spa culture in France was created along with the emergence of bourgeois vacation leisure in the nineteenth century.³⁸

Historians who have discussed the modernisation of Japanese hot springs stress the importance of a traffic network represented by railway system.³⁹ However, such literature mainly addresses leisure culture. An open question remains though: how did peoples' perceptions of the benefits of hot springs change, and how did modern science contribute to this transformation? Answers to these questions can be found in guidebooks to hot springs, which explained the beneficial effects of particular hot springs and educated readers on how to use hot springs to improve health. From medieval times onwards, these guidebooks provided crucial instruction to hot springs visitors. It was around the late seventeenth century when some guidebooks started to offer not just attributions of a hot spring's miraculous efficacy to the divine workings of gods or Buddha, but also medical and scientific explanations for the potency of the hot springs.⁴⁰ The trend of herbalism (*Honzōgaku*, 本草学) came from China, and people's interest in healing heightened the medical explanation in the guidebooks. *Arimayama onsenki* 有馬山温泉記 (Account of Mt. Arima Hot Springs) is a pioneering guidebook published in 1711. The author, doctor and Neo-Confucian scholar Kaibara Ekken (貝原益軒) (1630–1714) wrote 'the most common spirit (ki 氣) of Arima's hot water is sulphur' and prohibited the drinking of the water while praising the hot springs.⁴¹ Kaibara was influenced by herbalism, especially the popular herbalist book *Honzō kōmoku* (本草綱目) written by Li Shizhen (李時珍) (1518–1593) in the late sixteenth century, who taught that hot springs must contain sulphur.

³⁵Suzuki Noriko, 'Touji no jittai o saguru: onsen-gaku no igakushi [Exploring a Hot Spring Cure: Medical History of Balneology]' in Nihon Onsen Bunka Kenkyukai ed., *Onsen o yomu [Read Hot Springs]* (Tokyo: Kōdansha, 2011), 89–121, 94.

³⁶Jens Chr. V. Johansen, 'Holy Springs and Protestantism in Early Modern Denmark: A Medical Rationale for a Religious Practice' *Medical History*, 41, 1 (1997), 59–69.

³⁷Alain Corbin, *Le Territoire Du Vide: L'Occident et le désir du rivage (1750–1840)* (Paris: Aubier, 1988).

³⁸Douglas P. Mackaman, *Leisure Settings: Bourgeois Culture, Medicine, and the Spa in Modern France* (Chicago; London: University of Chicago Press, 1998).

³⁹Seto Akiko, *Kindai tūrism to onsen [Modern Tourism and Hot Springs]* (Kyoto: Nakanishiya Shuppan, 2007); Nunoyama Yūichi, *Onsen kankō no jishōteki kenkyū [Demonstrative Research on Hot Springs Tourism]* (Tokyo: Ochanomizu Shobo, 2009).

⁴⁰Suzuki Noriko 'Touji no jittai o saguru', 94.

⁴¹Kaibara Ekken, *Arimayama onsen-ki [Account of Mt. Arima Hot Springs]* (Kyoto: Rrūshi-ken, 1711).

The Meiji government began investigating and publishing on the chemical composition of the mineral springs in 1868. Although the chemical analysis of hot springs began in the Edo period with Rangakusha (蘭学者, or scholars who had studied Western sciences in Dutch) and Udagawa Yōan (宇田川榕菴) (1798–1848), their efforts were not cited after the Meiji era. The Meiji government invited foreign scientists to Japan as government advisors (*oyatoi gaikokujin*, お雇い外国人) and asked them to conduct scientific investigations. For example, a pharmacologist from the Netherlands, Anton Johannes Cornelis Geerts, dedicated his efforts to hot springs analysis and published *Nihon onsen doku annai*, 日本温泉独案内 (Japanese Hot Springs Solo Guide) in 1879. Geerts wrote this book for both medical experts and the bathing public and explained that the aerobic alkaline springs were the most effective for several illnesses. Erwin von Bälz, a German physician who came to Japan in 1876, tried to assess the therapeutic efficacy of Japanese hot springs by conducting significant research on it. His results were published in 1880 in *Nihon kōsen ron*, 日本鉱泉論 (Study of Japanese Mineral Springs). The Health Office of the Home Ministry embarked on a full-scale investigation in 1875 and summarised data on the 920 mineral springs in the three volume *Nihon kōsen shi*, 日本鉱泉誌 (Bulletin of Japanese Minerals) in 1886. This investigation was influenced by Western countries, such as Germany and Austria, and the summary was exhibited in the International Balneology Exhibition in Frankfurt am Main in 1881. The Japanese government, at that time, was eager to boost its national cultural capital to be on par with the Western powers and this investigation might have been conducted because of that motivation. Summaries of these investigations were also incorporated into hot springs' local guidebooks. For example, *Iizaka onsen annai*, 飯坂温泉案内 (The Iizaka Hot Springs Guidebook), published in 1895, contained numerical data of chemical substances, such as sodium, calcium, sulphuric acid and carbonic acid. It also gave an explanation for the effectiveness of hot springs in treating ailments like gout, beriberi and neurosis. However, though scientists provided analyses of the chemical substances in the hot springs, there was no explanation of a causal relation between any of these chemical substances and the claimed efficacy of hot springs.

The first Japanese attempt to prove a causal correlation between a hot spring's health benefits and its chemical content came in the form of 'radium emanation', an idea put forth by the medical scientist Manabe Kaichirō in a 1909 lecture about his joint research with his colleague, Ishitani Den'ichirō, at the Atami hot springs.⁴² Atami is one of the most famous hot springs in Japan and was well-known for its high medical efficacy. Manabe asserted that radium was the cause of Atami's medical benefits, specifically that emanation – gas emitted by radium – had proven medical efficacy. Manabe relied on several studies in Europe to support his claim: first, the absence of cases of neuralgia or rheumatism among mine workers in the Joachimsthal uranium mines; and second, Neusser's observation of the same effect as hot springs when he had his patients sit in a hot bath, which contains radium emanation. Manabe considered several explanations about the way emanation worked on the body. He reasoned that a certain quantum of emanation, which he understood as a gas given off by radium, was available at a given hot spring, that this emanation permeated the air we inhale or the hot spring water we drink, and that once we inhale or imbibe this emanation, it circulated through the body to cause a kind of 'electric' action. Thus, the amount of emanation available for breath determined the hot spring's potency. He described this through the metaphor of life and death, stating that 'new hot springs rich in emanation are what is called the living hot springs. Old hot springs running out of emanation are dead hot springs. However, these dead hot springs can be regenerated by adding additional emanation'. Manabe's claim of the correlation between a hot spring's potency and radium emanation was persuasive because the hot springs where Manabe and Ishitani initially observed radium emanation (Yugawara, Izu, Atami, Ikaho) were all known for their medical efficacy.

Soon after Manabe's lecture, discussions of radium started to appear in hot springs guidebooks. For example, Saitō Yoichi includes a reference to Manabe's lecture in his 1914 *Shinsen Atami annai*, 新撰熱海案内 (New Atami Guidebook) to bolster his claim that Atami is the most excellent hot spring in the

⁴²The lecture was transcribed and published as an article in a Japanese medical journal. Manabe Kaichirō, 'Onsen ni okeru rajiumu no kenkyū' [Research on Radium in Hot Springs], *Tōkyō Iji Shinshi*, 1656 (1910), 495–8.

world.⁴³ Manabe's lecture on the Atami hot springs was used to prove the excellence of the springs. The 1913 *Kinosaki onsen shi*, 城崎温泉誌 (Kinosaki Hot Springs Guidebook) written by the Kinosaki Hot Springs Office similarly considered the value of radium with reference to Manabe and Ishitani, noting the following: 'Since recent theory has proven that the gas of radium endows great benefit to bodily health, and that hot springs are more effective than medical drugs because of its radium content, the Kinosaki hot spring's relatively high radium content was proven by the analysis of Manabe (B.Med.) and Ishitani (B.Sc.).'⁴⁴

The impact of Manabe and Ishitani's report on radium emanation in Japanese hot springs can also be seen in the way many hot springs started to advertise their radium content. Hot springs villages, such as the Iizaka hot springs in Fukushima prefecture, started to exploit the springs' radium content to drum up business. A different understanding of radium emerged in Iizaka, where the substance was seen as a spirit ingrained in the land.

The village of Iizaka has a long history dating back to its mention in the tenth century *Kokin Wakashū*, 古今和歌集 (Collection of Japanese Poems of Ancient and Modern Times), one of the oldest anthologies of Japanese poems. Due to its location near the newly built railway system, Iizaka became well-known to urban dwellers by the beginning of the twentieth century. Radium was found in Iizaka precisely at the moment that its reputation as a hot spring was growing. Iizaka then started to advertise the hot spring's radium content, and merchants began selling radium rice cakes, radium crackers and the like.

In fact, the actor responsible for connecting Iizaka and radium was the National Institute of Railways (鉄道院 *Tetsudōin*, hereafter NIR).⁴⁵ The NIR was trying to popularise leisure trips and took advantage of the popularity of 'radium' as a good marketing word to capture the attention of city dwellers. The business section of NIR asked Manabe to confirm the radiation content of the Iizaka hot springs, and after they were confirmed, a special train between Tokyo and Iizaka was established. To increase ridership on the special train, NIR also published its own guidebook of the Iizaka hot springs.⁴⁶ This guidebook emphasised the potency of radium and the confirmed presence of radium in the Iizaka hot springs. The NIR's guidebook starts with the explanation of radium potency as well as the presence of radium in Iizaka as follows:

There are many hot springs in our country but few have the proven existence of 'radium' like the Iizaka hot springs. Needless to say 'radium' is one of the hot spring's active components. It's a regrettable matter that research on hot springs have not been fully conducted since it requires special knowledge to prove the presence of it (radium). Therefore, it is great news of biblical portions that Tokyo Imperial University's Bachelor of Medicine Manabe and others recently proved that the Iizaka hot springs and spring water of the whole area obviously contains 'radium emanation'. Believing we have to introduce this heaven's blessing to society and share the benefits to the public, the office decided to edit this guidebook for our visitors' convenience.

This guidebook included ten pages of discussion about medical knowledge of radium, plus a reprinting of an academic paper by Manabe and Ishitani describing experiments at the Tokyo Imperial University, in which patients drank radium bromide and radium water.⁴⁷ Manabe and Ishitani used commercially produced radium preparations called Radiogen Schlamm and they reported that about

⁴³Saitō Yoichi, *Shinsen Atami annai [New Atami Guidebook]* (Atami: Atami Hot Springs Association, 1914).

⁴⁴Kinosaki Onsen Jimusho, *Kinosaki onsen shi [Kinosaki Hot Springs Guidebook]* (Kinosaki: Kinosaki Onsen Jimusho, 1913), 98–9.

⁴⁵The Japanese railways were operated by several governmental agencies such as Ministry of Industry, Home Ministry and Ministry of Telecommunications from 1870. Along with the Railway Nationalization Act in 1906, 17 private railways were nationalized and the NIR, founded in 1908, operated all the railways in Japan until the Ministry of Railways was created in 1920.

⁴⁶Tōbu Tetsudō Kanrikyoku Eigyōka ed., *Iizaka onsen annai [Iizaka Hot Springs' Guide]* (Tokyo: Tōbu Tetsudō Kanrikyoku Eigyōka, 1911).

⁴⁷Manabe Kaichirō, Ichitani Den'ichiro 'Rajioakutibitōto to sono iryoujou uuyō oyobi nisan no "Pureparato" ni tsukite' [Radioactivity and its Medical Application, and few "Preparation"], *Tōkyō Igakkai Zasshi*, 24. 6 (1910), 1–71, 64–7.

seven out of ten patients fully or partly recovered from several symptoms such as rheumatism and nerve pain. The quotation of the medical paper in the hot springs guidebook demonstrates how medical discourse was important to the hot springs. By selling the image of radium, the NIR's advertisements succeeded in rapidly increasing the number of visitors to Iizaka. The scientific explanation of radium in the Ministry's guidebook became almost religious scripture in Iizaka village. The guidebooks of the Iizaka hot springs in the following decades inserted medical explanations about radium from *Iizaka onsen annai* into their pages.

The guidebooks of Iizaka in the 1910s and 1920s continued to espouse the benefits of radium. However, the explanation for the presence of radium soon underwent a transformation: radium became a spirit that had been in the land for generations. An early example of this transformation is the *Osen annai: Iizaka to Yuno*, 温泉案内 飯坂と湯野 (Hot Springs Guidebook: Iizaka and Yuno), published in 1913 by Tochinai Bunhichi.⁴⁸ In this book, radium is introduced as a 'spirit' in the land of Iizaka. This guidebook contained a poem on the theme of radium in which radium, as a spirit, can replace a good doctor. 'Riches radium, who has taken to be the inventor, spirit cures all ill, one does not need a good doctor'. This relationship between radium and spirit also appears in other guidebooks such as *Iizaka onsen*, 飯坂温泉 (Iizaka Hot Springs) published in 1915,

Radium reisen no shiori, ラヂウム霊泉の禁 (The Leaflet of Radium Holy Springs) published in 1920, and *Iizaka Yuno onsen yūran annai*, 飯坂湯野温泉遊覧案内 (Guidebook of Iizaka and Yuno hot springs) published in 1927. The guidebook *Iizaka onsen* was written by a military man, Tezuka Kaizō, who loved the hot springs.⁴⁹ Tezuka wrote the history of Iizaka and stated that there are no local people who suffered rheumatism and nerve pain. He then went on to claim that the effectiveness of the hot spring was due to none other than radium emanation, which to Tezuka was the spirit of the hot springs. Tezuka described radium emanation as a spirit.

In the *Iizaka yuno onsen yūran annai*, radium was embedded in nature.⁵⁰ This particular guidebook attributes the beauty of the landscape to the richness of the hot spring's radium emanation, claiming that 'the Iizaka hot springs' uniqueness and beauty is due to the effect of radium emanation which has no parallel at home or overseas'. In the part which describes the efficacy of the hot springs, the guidebook omits the usual table of chemical substances present in the hot springs, a table, it says, that would be 'unnecessary'. Instead, it states simply that 'the uniqueness of our Yuno Iizaka hot springs is attributed solely to the richness of its radium emanation content and the spaciousness of its diffused area'. Thus, the guidebooks used radium as a means of arguing for the superiority of the Iizaka hot springs over all other springs. Scientific explanations were no longer necessary. Radium was accepted as a spiritual presence embedded in the land.

Iizaka leveraged radium as a marketing tool, and by doing so attracted many visitors, becoming the most popular hot spring in the Tohoku area. Iizaka's prosperity resulted not only from the NIR's strategy of connecting the hot springs to radium; it was also due to the local villagers' willingness to embrace radium as a business opportunity. For example, they produced souvenirs, such as radium rice cakes, soon after radium emanation was detected by Manabe. Furthermore, most of the guidebooks (such as *Osen annai Iizaka to Yuno*, *Iizaka onsen and Rajiumu reisen no shiori*) were written and published by local people. Overall, radium became an essential factor in attracting visitors from the city. In this process of differentiation from competitors, medical discourses were embedded into local legend. Although radium received less attention as the Iizaka hot springs became a popular leisure area, radium remained a part of the hot springs' original legend, or folktale. Only scientists could determine the existence of this benign and invisible 'radium emanation' acting like a 'spirit' that blessed this village. The discourse on radium in the guidebooks of the Iizaka hot springs exemplifies the 'new tradition' created by combining traditional

⁴⁸Tochinai Bunhichi, *Osen annai Iizaka to Yuno* [Fukushima: Hot Springs Guidebook: Iizaka and Yuno] (Osaka: Kawamura Ichirō, 1914).

⁴⁹Tezuka Kaizō, *Iizaka onsen* [Iizaka Hot Springs] (Tokyo: Tokyo Haikai Shobō, 1915).

⁵⁰Ishizuka Naotarō, *Iizaka Yuno onsen yūran annai* [Guidebook of Iizaka and Yuno Hot Springs] (Iizaka: Iizaka Yuno Onsen Annaijo, 1927).

spirituality with modernity. What helped the creation of this new tradition was the interpretation of radiation⁵¹.

Conclusion

The history of Japanese conceptions of radiation reveals a dynamic relationship between modern and traditional cultures. By examining radium through the lens of ‘traffic’, this article explores how the Japanese created and articulated their culture. The emergence of radium commodities and radium hot springs shows how radium from Western science became absorbed into the Japanese culture under the Empire.

The radium craze was generated through interactions between Japanese scholars, national policy, industry and the public. All of these actors tried to keep pace with modernisation. This fusion of modern and traditional, of Japanese spirit and Western techniques, occurred in people’s daily lives, often driven by the logic of commerce and consumerism. Discourses about radium helped to enable this fusion, by moving radium out of the field of science into the larger culture, connecting traditional and modern values.

Radium culture still survives in Japan. Iizaka village has advertised the radium in its springs from 1911 on, and the radium egg, which is boiled in the hot springs, has to this day been one of the souvenirs of the village. When the TEPCO Fukushima Daiichi nuclear accident happened in 2011, the sociologist Kainuma Hiroshi pointed out that the citizens of Fukushima had been embracing nuclear energy; the local people include the word ‘atom’ in the name of some souvenirs and local facilities.⁵² In a similar way, the Japanese people have incorporated radiation into their culture. The cultural history of radiation shows us the deep history of this embrace.

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⁵¹Not only spiritualists and practitioners but also scientists used spiritual terms when discussing radium. For example, Suizu Kanoichirō (水津嘉之一郎), a chemist and professor at Tokyo Advanced Engineering School (東京高等工業学校), explained the potency of radium by using terms such as Holy Springs Spiritual Water (神泉靈水) and Spiritual Power Mysterious Ability (靈効奇能).⁵¹ While scientists argued that radium was the real identity of what was regarded as a spirit, the spiritualists proposed that radium was the name of a spirit. Suizu Kanoichirō, *Raiumu kōwa [The Story of Radium]* (Tokyo: Ryūbunkan, 1914).

⁵²Kainuma Hiroshi, ‘Fukushima’ ron: *Genshiryoku-mura wa naze umareta no ka [On ‘Fukushima’: What Brought Forth the Nuclear Village?]* (Tokyo: Seidosha, 2011).

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