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Seismicity Within and Beyond the Empire: Japanese Seismological Investigation in Taiwan and its Global Deployment, 1895–1909

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Abstract Taking the global deployment of scientific activities in the contexts of colonies and empires into consideration, this essay discusses seismological practices on and in Taiwan, circa 1900. During the early years of Taiwan's colonization, the Japanese empire had to cope with the natural and political hazards of earthquakes in the new colony. Japanese knowledge regarding Taiwanese earthquakes was, therefore, a tool-box with which the empire could tame the formidable physical and political environment. On the other hand, as seismicity is simultaneously local and global, seismological investigations also moved across borders, interacting with local and global contexts.

초록 과학 활동의 세계적인 전개 및 이와 관련된 제국주의라는 역사적 맥락을 고려하면서, 이 글에서는1900년을 전후하여 타이완에서 전개된 지진 연구를 살펴보고자 한다. 타이완을 식민지화한 일본 제국은 타이완의 지진활동이 지닌 자연재해로서의 리스크와 더불어 그 정치적인 위험성에도 대처해야만 했으며, 이러한 의미에서 일본이 타이완에서, 타이완에 대해 행한 지진 조사는 제국이 식민지의 물리적/정치적 환경을 길들이는 수단의 하나였다고 할 수 있다. 그러나 다른 한편으로, 지구 반대편에서 발생한 지진파가 관측 가능하게 된 이 시기, 지진에 대한 조사활동도 여러 경계선을 넘어서 전개되어 갔다. 지진 및 지진학은 지역성을 지니는 동시에 전지구적인 움직임도 내포하고 있었던 것이다.

Keywords Movement of knowledge · Geopolitics of science · Seismicity · Seismology · Taiwan

주요어 지식의 이동 · 과학과 국제정치 · 지진활동 · 지진학 · 타이완

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1 Introduction

The geographical deployment of science has been an important issue for historians of science. The movement of a knowledge system stemming from Europe has been the subject of geopolitical accounts, and the "centers" and "peripheries" of science have been reinterpreted in the context of imperialism.[1] The historiography of Japanese science, previously filled with essentialistic stereotypes (Low 1989), has also been reconsidered within a geopolitical framework, noting the interaction between the Japanese empire and its science sectors (Kato 1993, 1998, 2001; Tsukahara 1999, 2001).[2] On the other hand, empirical studies on scientific practices in non-Western areas have also problematized the denotations of the colonial historiography of science (Harrison 2005). Historical diversities of the scientific knowledge-making processes have blurred the geopolitical demarcations of "centers" and "peripheries" of scientific study, and more plastic and interactive terms, such as "polycentric communication networks," have been suggested (Chambers and Gillespie 2000).

Seismology, the science of earthquakes, is considered an example that sheds some light on the local and global settings in which scientific practices are conducted. This is related to the fact that seismicity, in terms of its geographical distribution, is a geophysical phenomenon that is simultaneously local and global. On the one hand, earthquakes can totally transform the material/political/psychological landscape in a limited area in the vicinity of an earthquake's epicenter. The intensity of any earthquake is a function of architectural styles and structures, the political system's response to disasters, the culture of the local people, as well as the physical energy radiated. On the other hand, seismic waves move quickly and globally, transcending the borders of empires and colonies, of centers and peripheries. The waves can be detected on the seismographs at the antipodes, and networked observatories throughout the earth can communicate their data with one another.

While earth sciences have been deployed globally, however, they have interacted with socio-political contexts (Miller and Edwards 2001; Jasanoff and Martello 2004). Historical studies on seismology, for instance, have shown the religious/economic/political dimensions (Geschwind 1998, 2001), cultural/political discourse (Clancey 2002a, b, 2006), and geophysical/geopolitical practices (Kim 2007), of the earthquake science and technology. The history of Japanese seismology illustrates the local and global arenas in which it has evolved during the age of empires and Japan's seismological investigations in Taiwan, a former colony of the Japanese empire, could offer more detailed terrains of the scientific activities. Gregory K. Clancey has already referred to the Japanese seismological investigation in colonized Taiwan, in the context of science and colonial discourse (Clancey 2006, 174–177). In this paper, with the addition of more empirical details, I will depict the Japanese investigation of seismicity in Formosa, during the early years of the colonization,

[1] As to the overviews on the topic of science and imperialism, for instance see MacLeod (2000), Anderson (2002), Schiebinger (2005).

[2] On the other hand, it has also been pointed out that Japan, in the "non-Western" hemisphere, has not been regarded as a full-fledged global "center" of science. For instance, see Bartholomew (2000).

against its global deployment, observing the travel of waves, knowledge and authority within and beyond the boundary of the empire.

2 The Imperial Gaze on the Seismic Landscape of Taiwan

Japanese scientific investigation of Taiwanese seismicity could be understood in the political context of the Japanese empire. Earthquakes and the measures to control them were tools used by the Japanese empire to domesticate its new colony. According to the 1895 Treaty of Shimonoseki, Taiwanese inhabitants had the right to choose whether to emigrate from the island within two years of its signing. During the first years of colonization, therefore, it was said to be a matter of vital importance for the colonizing governors to capture Taiwanese minds (Ino 1905, 63–71).[3] Showcasing the positive aspects of Japanese "civilization" could be a means to illustrate to the Taiwanese why the Japanese newcomers should rule the territory.[4]

Taiwanese earthquakes were, in reality, political problems. The earthquake of November 6, 1904, which originated in Chiayi prefecture, was a political hazard for the Japanese colonizers. The first conspicuous earthquake in colonized Taiwan, which killed 145 Taiwanese, occurred during the international crisis of the Russo–Japanese War. According to the official report of the colonial government, a rumor circulated after the first shocks of the earthquake to the effect that "without the cease-fire, the earthquakes will not stop" (Department of Civil Administration 1907, Appendix). Thus politicized, this natural disaster, blurring the dichotomy between the "natural" and the "human," could not be immediately resolved, even by the power of science which represented the pinnacle of civilization. A scientific report on the earthquake submitted by Omori Fusakichi, a Japanese seismologist, started with a section called "the superstition of the aborigines." In this section, the seismologist lamented "the superstition" of the natives, also called "the former Chinese," who had ascribed the natural disaster to the political calamities (Omori 1906b, 3–4).[5] However, for the Taiwanese inhabitants affected by the earthquake, the disaster pointed to the politics of morality: e.g., activities that had been conducted by the police to prevent epidemics, such as disinfection practices, were interpreted by the local people as treason against Heaven (Omori 1906b, 10–11). According to this interpretation, it was the police and their actions that had caused the earthquake. Furthermore, political boundaries limited the realm of knowledge. During his investigative trip in 1906, Omori could not get information from the territory of "the savages" (Omori 1907b, 60). The primitive landscape of Taiwanese seismicity seemed to be hostile to the Japanese administration to know and to control earthquakes.

Nevertheless, in spite of the politically dangerous "superstitions" of the colonized people, the colonizing process was conducted through natural disasters (Department

[3]Also, on the legal problems of citizenship that emerged just after the Japanese colonization of Taiwan, see Asano (2000).

[4]With regard to the Chiayi earthquake of 1906 and its subsequent city planning project, see Chen (1998, 9–38).

[5]Also, with regard to the creation of "superstitions" by Japanese colonizers, see Lee (1999).

of Civil Administration 1907, 218–222). The official report about the far more severe earthquake of 1906, which killed 1,249 people, argued that it was a "new" experience for the people in Taiwan to have the Japanese authorities, unlike the former Chinese government officials, industriously attempting to save them. The author of the report confidently added that using their "civilized" medicine had also been effective (Department of Civil Administration 1907, 414–416). The Japanese also contrasted images of the empire against the devastating power of nature. Responding to the report from Kodama Gentaro, the governor-general of Taiwan, the Japanese emperor and empress bestowed donations to relief efforts, and a military aide in the service of the Emperor was dispatched to the damaged regions of Taiwan. Official ceremonies for distributing the financial support glorified the blessings from the imperial family, and a Chinese-style poem expressing the Taiwanese people's great appreciation was dedicated to the "Son of Heaven," a traditional nickname for the Chinese emperor, though the poem was already using the Japanese name for the era, "Meiji" (Department of Civil Administration 1907, 315–320, 333–334).

As Clancey argues, on the other hand, investigating the seismicity in Taiwan could be said to be a process of "justifying the Japanese colonial project" based on "scientific grounds." The weakness of the Taiwanese houses implied their want of civilization (Clancey 2006, 176–177). After the 1904 earthquake, a Japanese architect, Sano Toshikata, was dispatched to Taiwan by the Imperial Earthquake Investigation Committee of Japan. In the devastated country, Sano ascribed the greater lethality of Taiwanese earthquakes, the numbers based on Omori's statistics, to "inferior" Taiwanese architecture. The architect argued that the "bad structure" and the "bad materials," sun-dried mud blocks in particular, were responsible for the weakness of Taiwanese houses and, therefore, explained the numerous casualties during the earthquake (Sano 1905a, b). Some years later, a semi-official history of Taiwanese architecture also criticized the structures of buildings for its fragility against the impact of earthquakes, while praising some aesthetic values (Yasue 1910).

A racial voice, representing "the Chinese-ness" of the inhabitants, also compared the strength of cultures in coping with natural hazards. On April 8, 1906, the headline article of *Taiwan Nichinichi Shinpo* [*The Taiwan Daily*], written in Japanese, attacked the tradition of foot-binding in the Chinese culture, relating it to the casualties of the earthquake. According to the article, foot-binding was responsible for Taiwanese women's high mortality rate, which compared unfavorably with the statistics on Japanese women. The article argued, based on the statistics of women's mortality rates during the disaster, that the tradition of foot-binding should be blamed for the misfortune of the Taiwanese women as well as for the psychological pain, economic inefficiency and immoral persecution it caused (Mizushina 1906). The official report of Japanese colonial government reprinted this claim, while modifying the reason to abolish foot-binding from "disillusion" to the "progress of Taiwan" (Department of Civil Administration 1907, 405–408).[6] The Taiwanese/Chinese attitudes toward the ferocity of nature were found

[6]At the time, a "natural feet" campaign was underway, supported by colonial officers. See Ide (1937, 355–357).

wanting with regard to progress, and thus the colonized were represented as needing enlightenment.

On the other hand, as Clancey mentions, the natural environment in Taiwan around the earthquake zones was also influenced by the existence of white ants. While Japanese experts preferred wooden buildings to the Taiwanese buildings made of sun-dried mud blocks, in terms of being earthquake-proof, the work of the insects, which might have eaten structures made of wood, had the potential to refute the argument for wooden construction (Clancey 2006, 175).[7] In this context, a zoologist, Oshima Masamitsu, started to research this exotic insect. In his report, Oshima compiled the measures needed to cope with the white insects, which were found in the Philippines, the British colony in the strait, India, Egypt, Natal and Transvaal in South Africa, and some states of Australia and the United States (Oshima 1911, 50–60). It might be said that the architectural circumstances in Formosa, which was also vulnerable to the white ants, was being grouped into a geographical/geopolitical category.

As such, perspectives and interpretation on Taiwanese seismicity were mingled with the gaze of the Japanese empire. However, even before the Taiwanese earthquakes conspicuously showed themselves in the official reports and in the newspapers, the Japanese had already been visualizing the seismicity of Taiwan using scientific tools. Seismological observers, far from the epicenters of Chiayi, were producing knowledge about the Taiwanese earthquakes.

3 Investigating Formosan Earthquakes: A Hierarchical Man–Machine Knowledge Network

For the empire to govern the colony efficiently, it needed an understanding of natural hazards, as well as of the inhabitants. In 1895, just after the island became part of Japan, a nationalistic article was printed in a scientific journal, *Chigaku Zassi* [*Journal of Earth Sciences*]. The article, mentioning Japan's human and monetary sacrifices during the Sino-Japanese War and the consequent interference of three European powers, went on to add that "the soil of Taiwan is fertile. However, the island is not less earthquake-prone than the Japanese Archipelago, which disturbs immigration from the mainland Japan [my own translation]" (Anonymous 1895). The author suggested that in order for the sacrifices to be considered worthwhile, Taiwan's seismicity should be controlled. Also, earthquakes were barriers to "modernizing" the island. In Fig. 1, seismicity is represented along with the infrastructure, such as railroads, harbors, lighthouses, submarine cables and so forth, which were vital manmade structures in the empire. As early as 1896, historical records on the seismic activities of the island had been surveyed by the meteorological observatory at Taipei (Anonymous 1896), and the next year a chronological table of natural disasters in Taiwan was published (Anonymous 1897).

[7]Also, retrospectively in 1936, a Japanese architect Ite Kaoru mentioned that the first Japanese colonizers in Taiwan had discovered white ants in Formosa as being enemies against Japanese-style wooden houses. See Ite (1936).

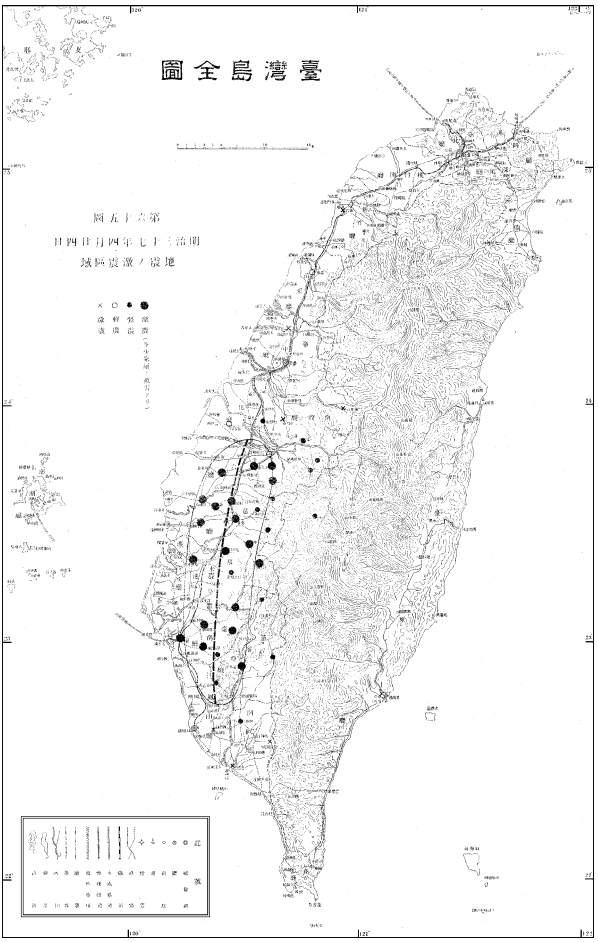

Fig. 1 A map showing the seismic zone of the earthquake of November 6, 1904. (Source: Omori 1906b, Fig. 65)

By the end of the nineteenth century, however, seismologists acquired scientific instruments that could record seismic activity across borders.[8] While investigations in the field provided detailed local information, they were bound to any socio-political conditions that could support the research trips. In the above mentioned Omori report on the 1906 earthquake, the author confessed that his isoseismic lines presented therein were incomplete and described only a part of the seismic zones, since he could not obtain information from the territory of "the savages" (Omori 1907b, 60). The seismograph, however, can detect distant epicenters, extending the range of observation across borders. Also, the device created a visualization of the seismicity by automatically recording the seismic waves. The seismograph enabled earthquake hunters anywhere to create rippled diagrams which visually represented the seismic waves.

[8]On the development and its historical meaning of seismographs, for instance see Dewey and Byerly (1969), Gooday and Low (1998), Clancey (2006, 71–80), Kim (2007, 26–35).

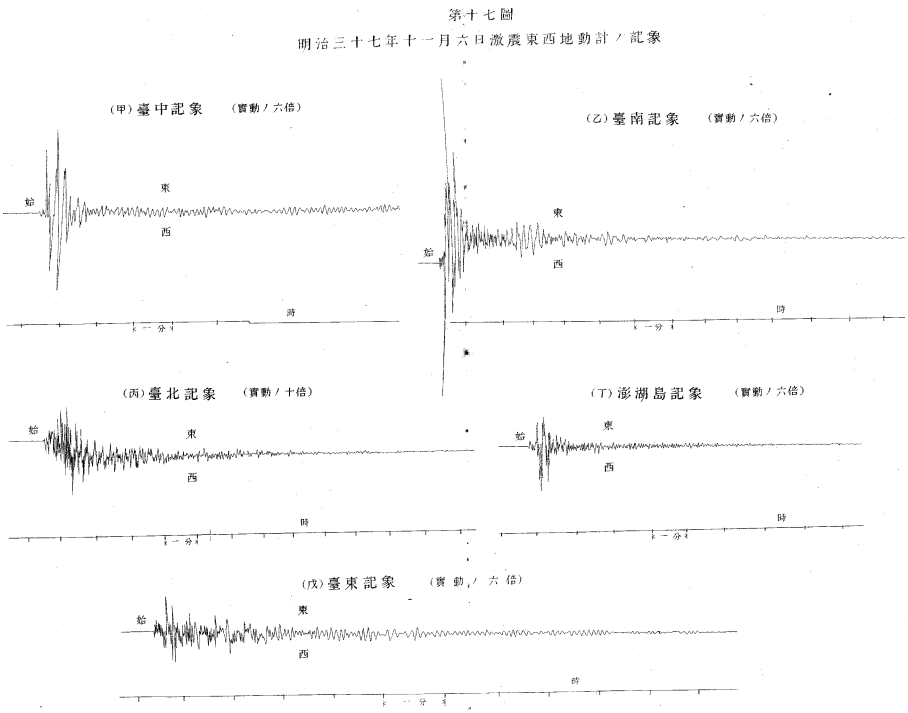

Fig. 2 Inscriptions of Taiwanese seismicity: seismograms of the November 6, 1904 earthquake, which were inscribed in five observatories in Taiwan. (Source: Omori 1906b, Fig. 17)

The instrumentation of the scientific devices by the Japanese followed what had been done on mainland Japan, and seismographs in Taiwan were housed in the meteorological observatories. Even though the Ching Dynasty and the Westerners at the Anping customs house had recorded Taiwanese earthquakes, the observations were conducted without the help of seismographic instruments (Anonymous 1896, 91). In March 1896, as soon as the Japanese started colonizing Taiwan, an imperial edict of Japan provided the Taiwanese Colonial Observatory and the meteorological facilities were built throughout Taiwan (Japan Meteorological Agency 1975, 126–127; Kondo 1899). A seismograph was first set up at the Taipei observatory and, consequently, similar devices were placed in other observatories. By November 6, 1904, when a severe earthquake originated in Chiayi prefecture, the observatories at Taipei, Taichung, Tainan, Taidong, Penghu, Keelung and Hengchun had already installed seismographs (Omori 1906b, 13). Figure 2 shows the seismograms of the November 6, 1904 earthquake, which were inscribed at the observatories of Taichung, Tainan, Taipei, Penghu and Taidong.[9] The raw data to understand the earthquake had also been produced at observatories far away from the epicenter.

The organization of the network of earthquake observatories, established as they were in a bureaucratic system, was hierarchical. The capacities for observation among the

[9]Clancey has already pointed out that seismograph could be understood as a kind of inscription device. See Clancey (2006, 71). As to the concept of inscription device, see Latour and Woolgar (1986, 45–53).

observatories were not uniform, and with the exception of the seismograph set up at Taipei, the observatories in Taiwan had initially installed simpler devices (Omori 1906b, 48). For instance, from January 1903 to September 1903, the seismicity of the Taichung area was investigated using a portable seismograph, which could not detect long-period seismic waves transmitted from distant epicenters (Omori 1906a). Along with the meteorological observatories, rain-gauge stations were established. Since January 1904, 76 stations had been established on the initiative of Kondo Kujiro, the director-general of the meteorological observatories in Taiwan. The stations were obliged to provide information about seismic activities in monthly weather reports for the main meteorological observatory (Omori 1908). Kondo in Taipei headed up the observations and, during disasters, he proceeded to the epicenters.

Above Kondo were his superior agents, housed in mainland Japan.[10] After the great earthquake of 1906, the Central Meteorological Observatory in Tokyo dispatched Ikegami Keikichi to the devastated area, where he surveyed the fault lines (Ikegami 1906). At the top of the seismological section of the Japanese empire, furthermore, was Omori, the professor of seismology at Tokyo Imperial University. He obtained seismic data from various sources: the data of the Taipei observatory, reports of local authorities, documents sent from the directors of the Taiwanese railway, and what Omori directly saw and heard in the Formosan field (Omori 1906b, 64). Omori himself, who provided his theories for the inhabitants in Taiwan, was the representative of the seismological knowledge of Japan. The authority from Tokyo, in a local newspaper, *Tainan Shinpo* [*The Tainan Times*] of April 13, 1906, predicted the spatial origin of the next earthquake, and, according to the scientist, the estimation of the subsequent epicenter was proven to be correct on the very next day, April 14.[11] Here the Japanese seismologist was displaying his scientific ability in front of the lay audience in the earthquake-prone colony, and further, for the readers of his paper, which was written in English.

While people were traveling across borders, so too were geophysical waves. Even though the impact of the April 25, 1900 earthquake in Taiwan was moderate, the waves of the earthquake were visible on distant seismographs which had been set up at Aomori and Akita, in the northern part of the mainland Japan, as well as on those in Tokyo (Omori 1906b, 20). The range of Japanese detection, however, was not limited to Japan's imperial sphere of influence. By the first decade of the twentieth century, Tokyo had established its own seismological knowledge-producing system,[12] and it monitored seismic activity throughout the archipelago and beyond.

[10]However, it should also be noted that the Japanese meteorological observatory system in Taiwan was, beyond the hierarchy within an empire, networked to the imperial matrices of knowledge-producing activities. The Taipei observatory telegraphed meteorological data inter-imperially with observatories at Shanghai, Hong Kong and Manila. See Japan Meteorological Agency (1975, 127).

[11]However, Omori confessed that the intensity of the earthquake had been more extensive than his prediction. See Omori (1907b, 66).

[12]Since the 1880s, British scientists hired by the Japanese government invented seismographs and constructed a seismological network in Japan and, after the foreigners left Japan, the Japanese appropriated the knowledge-producing system. See Clancey (2006, 63–90, 151–179), Kim (2007, 19–107). Also, with regard to the overall history of Japanese seismology, see Fujii (1967), Hagiwara (1982). Furthermore, since 1992, the Editorial Committee of History of Geosciences in Japan and the Tokyo Geographical Society has annually published historical reports in *Chigaku Zassi* [*Journal of Earth Sciences*].

4 Taiwanese Seismicity beyond the Empire

It was between the eruption of Mt. Vesuvius from April 7 to April 13 and the San Francisco earthquake of April 18 that an earthquake on April 14, 1906, revisited Chiayi (Omori 1906c, 428). Like the seismic events, seismological investigations were deployed globally, interacting with the geopolitics of the time.

In a lecture in Taiwan in 1904, Omori emphasized that delicate seismographs could detect earthquakes originating all over the globe. While in Tokyo, he explained, he could observe Russian and American earthquakes. Furthermore, according to him, seismographs set up in Taiwan could similarly record earthquakes around the world. In this lecture, Omori was boasting in a nationalistic way of Japanese scientific abilities, in the context of a geopolitical regime which relegated Asia to a periphery. Japanese seismology had progressed remarkably, he emphasized, and thus Japanese science in general deserved to be called "admirable" (Department of Civil Administration 1907, 70–71). Simultaneously, his rhetoric in this lecture mentioned an anomaly, in terms of relationships between the detectors and the detected, to transgress the geopolitical hierarchy of the time. According to him, even Taiwan, as long as the peripheral island had the sophisticated scientific instruments, could spy upon the seismicity in the Western hemisphere. In reality, the Taipei observatory did inscribe the San Francisco earthquake of 1906, even though, within the imperial order, it participated in the scientific activity as a representative from Japan (Omori 1907a).

On the other hand, some inhabitants in Europe, like those in Taiwan, became the witnesses of the seismological expert who came from Japan. The waves of the great Italian earthquake of December 28, 1908 were delivered to the seismological observatory at Tokyo, and with his scientific analysis in hand Omori traveled to the epicenters. During a 3-month stay in Italy, Omori, by giving his seismological theory via newspaper articles, allayed fears that a second large earthquake might occur in the same place. In the damaged country, furthermore, Omori was honored with an audience with the Italian monarch (Omori 1909a, c).[13] His role in Italy, as a representative for the seismological power of Japan, was hardly incongruent with what he had already done in the Formosan island.

To the Japanese seismologist, furthermore, the seismic and seismological regime of the European peninsula was as weak as that of the colonized Taiwan. The earthquake-prone European country, according to Omori, had not yet prepared the necessary knowledge, knowledge-producing system, and resistance against the natural hazards. In a paper explaining the 1908 Italian earthquake, which was written in Japanese, Omori listed three methods to identify the epicenter: (1) analyzing seismograms sent from plural observatories, (2) surveying the damaged area, and (3) investigating the fallen objects. To his disappointment, however, the Italian observatories could not satisfy the first condition on the list (Omori 1909b, 435). For the Japanese scientist, therefore, the seismological investigation system of Italy could not be relied upon. Also, he criticized the Italians for lacking "a sound theory"

[13] Also, with regard to the relationship between Japanese seismology and Italy, see Clancey (2006, 63–66, 172–174).

about the outbreak of great earthquakes (Omori 1909a, 385). It was Japanese science, he implied, that instead had the theory to predict where future earthquakes would occur.

Interestingly, the devastated countryside of Italy reminded Omori of the Taiwanese architectural landscape. Similar to what he had seen in the epicenters in Taiwan after the great earthquake of 1906, many collapsed houses in Italy in 1908–9 were built of the sun-dried mud blocks, which Sano and Omori in Taiwanese field had found helplessly fragile against the impact of earthquakes. According to Omori, the structures of collapsed Italian buildings were also "so coarse that they seemed as if [the builders] had increased only the heights of Taiwanese natives' houses [my own translation]" (Omori 1909a, 386–387). Thus, in the discourse of Omori, the epicenter in European civilization was flattened to the almost same extent as a peripheral tropical island in Asia.

As Gregory Clancey has already related, Omori's geophysical research project was influenced in myriad ways by the geopolitics of the time. In reality, Omori's seismological research was a fulcrum of inter-imperial politics. A scientific report about the Great Indian earthquake of 1905, written by the seismologist, starts with a lengthy diplomatic preamble of the sorrow and sympathy from the Japanese people, the emperor, various politicians and a newspaper, which had been delivered to their counterparts in the British empire when the Japanese had been informed of the sad news of the calamity in British India (Omori 1907c, 1–2).[14]

Such a diplomatic role that a field of Japanese sciences played was hardly common in the first decade of the twentieth century. However, the global movement of seismic waves helped seismologists travel across borders, with the knowledge and authority they owned.

5 Conclusion

Since seismicity can be local and/or global, the socio-political backgrounds in which seismological investigations were deployed could also be local and/or global. During the earliest decades of Taiwan's colonization, the Japanese empire's scientific regime and its corollary discourses pertained to domesticating the human and natural hazards in Taiwan. Seismicity of a colony and science of an empire mutually defined and modified each other's meanings. Simultaneously, however, seismicity and its research were traveling beyond the realm of the empire. Knowledge and the scientific activities were propagating globally.

The global movement of knowledge does not mean that the media of transmission were neutral to politics. On the contrary, the arenas of seismological activities were arranged hierarchically between the detectors and the detected, and within the bilateral relationship between an empire and a colony the spheres of knowledge and

[14]Simultaneously, however, the Japanese seismologist was able to mobilize a global information network that could transmit raw data to the observatory-office at Tokyo. To research the Indian earthquake of 1905, Omori asked observatories around the world to send him their data and he eventually obtained data from nearly 70 stations. It was the geophysical practices that allowed the geopolitical performances to grow and expand. See Omori (1907c, 7–9).

power were concentrically structured. However, this hierarchy was not transcendentally fixed. Seismological waves and practices could move across geographical borders, and it could be said that historically the co-evolution of geophysics and geopolitics was able to influence the order itself.

The seemingly elusive niche of seismology within the ecology of sciences seems to be a subject for understanding further the terrains of scientific knowledge production. The evolution of sciences in East Asia, on the other hand, could provide historians with cultural and political topography in which scientific knowledge and practices formed, moved, and transformed, locally and globally.

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