I. Relationship between Inoh Tadataka and Tokyo Geographical Society

Inoh Tadataka was born on 11th February, 1745 in Koseki village, Kazusa (Chiba prefecture) and died on 17th May, 1818 in Nihonbashi Kamejimacho, Edo (Tokyo). 2018 was the 200th anniversary of his death. The Tokyo Geographical Society is publishing a special commemorative issue of Journal of Geography (Chigaku Zasshi) on Inoh Tadataka, in order to examine earlier studies and obtain new directions for studies on Inoh’s survey.

The Tokyo Geographical Society has already honored him several times. He was awarded a court rank in 1883 at the recommendation of Sano Tsunetami (1823–1902)1 and Enomoto Takeaki (1836–1908)2 who were not only central figures within the Society but were also elder statesmen of the Meiji era. The Society erected a bronze obelisk titled Zo Sho Shii Inoh Tadataka Sensei Sokuchi Ikohyo (Fig. 1a) in his memory. The obelisk was requisitioned for its materials and melted down during World War II; however, the Society erected a replacement stone monument (Fig. 1b) in 1966. Furthermore, the Society published Recently Obtained Knowledge of Inoh Tadataka’s Map (Inoh-zu ni Manabu) in 1998 (Tokyo Geographical Society, 1998).

II. Outline of Inoh Tadataka’s achievements

Inoh Tadataka was a merchant before starting his nationwide survey. At the age of seventeen he married into his wife's family (Inoh), which operated a successful merchant enterprise, and he worked for the family business. He had a deep interest in astronomy, became a pupil of Takahashi Yoshitoki, who was the Tenmongata3, and studied to become a professional astronomer. His motive for undertaking a nationwide survey was his desire to obtain distances to one degree of the meridian4.

He left his residence in Fukagawa, Edo on 19th April, 1800 for Ezochi (Hokkaido) to start the nationwide survey. He undertook ten survey trips of Japan from north (Ezochi) to south (Yakushima and Tanegashima islands). However, he did not reach the northern part of Ezochi. It is accepted that Mamiya Rinzo5 completed the survey of Ezochi. It took Inoh seventeen years to complete the survey and he finally compiled the results in “Dainippon Enkai Yochi Zenzu” (A general coastal map of Japan). After his death, it was submitted to the Tokugawa shogunate government in 1821 by the Tenmongata, Takahashi Kageyasu, who was the elder son of Takahashi Yoshitoki.

“Dainippon Enkai Yochi Zenzu” is classified into three map scales: 214 large-scale maps (1:36000), eight medium-scale maps (1:216000) and three small-scale maps (1:432000). These maps were stored by the government as state secrets. Therefore, only high-ranking officials could view them. However, several copies were made for national defense purposes in the last days of the Tokugawa shogunate. The Inoh family also preserved an original copy of “Dainippon Enkai Yochi Zenzu,” and several original copies prepared by Inoh’s survey team for some feudal lords, which have been preserved at sev-

* ex Geospatial Information Authority
eral universities and museums, including Inoh Tadataka Memorial Museum and the Tokyo National Museum. The original map “Dainippon Enkai Yochi Zenzu” and the original copy preserved by the Inoh’s family were lost in fires at the Imperial Palace (1873) and following the Kanto Earthquake (1923). In the early days of the Meiji era, the Army, the Navy, and the Ministry of Interior made manuscripts from the original copy preserved by Inoh’s family.6 “Yochi Jissokuroku” (Survey data book), which was submitted to the government with “Dainippon Enkai Yochi Zenzu,” contains data on distances among survey points and latitudes of individual locations. That original book was recently discovered in the National Archives of Japan (Suzuki, 2011). A copy was published by “Daigaku Nanko” (South campus of University) in the early Meiji era. All volumes of “Santo Hoiki” (Data book of azimuths of mountains and islands obtained by an intersection survey) are preserved in the Inoh Tadataka Museum. In addition, “Sokuryo Nikki” (Survey diary), various survey instruments, maps, and documents etc. are kept in the museum and are designated as national treasures.

III. History of studies on Inoh Tadataka’s nationwide survey

1) Ohtani Ryokichi’s voluminous work Inoh Tadataka

No documents explaining Inoh’s survey techniques remain except “Inoh Toga Senseiryu Ryochi Denshuroku,” which was written by Watanabe Shin, one of his pupils. Ohtani Ryokichi addressed the geodesy, survey technology, and cartography of Inoh’s nationwide survey for the first time (Ohtani, 1917). Ohtani wrote that it was unfortunate that no research had been carried out on Inoh’s results when the commemorative obelisk was erected. Afterwards, the Imperial Academy resolved to compile Inoh’s works and introduce them through an initiative by Nagaoka Hantaro. Ohtani researched Inoh’s achievements under Nagaoka, and Inoh Tadataka was published in 1917.

Ohtani (1917) discussed the survey and mapping technology of Inoh Tadataka based on the results of the nationwide survey. Besides “Inoh Toga Senseiryu Ryochi Denshuroku”, he reviewed maps, survey data, survey instruments, etc. preserved by Inoh’s family. Inoh Tadataka is evaluated as an excellent scientific biography and is a voluminous work of 766 pages. It is widely referenced and remains an essential work of literature for studies on Inoh. Inoh Tadataka discusses the scientific side of Inoh’s survey. However, as a geophysicist, he was interested more in survey technology, geodesy, and especially survey instruments than...
in maps themselves. He interpreted Inoh’s map projection as being a Sanson–Flamsteed projection and strongly criticized Inoh for failing to observe latitudes and for not having sufficient knowledge of map projections.

2) Hoyanagi Mutsumi: A New Appreciation of the Scientific Achievement of Ino-Tadataka Who Established a Landmark in the History of Land-survey and Cartography of Japan

After Ohtani (1917), ultra-nationalism swept Japan. Tadataka had come to be considered a great person based on imperialist ideas, and his history and achievements were distorted. There was no scientific discussion of his surveying and mapping work. After World War II, Hoyanagi Mutsumi reevaluated Inoh’s achievements from a scientific standpoint (Hoyanagi, 1974a).

The Tokyo Geographical Society organized a committee to publish Inoh’s achievements and to erect a replacement stone monument in his honor. The committee decided to publish a book of articles and materials on Inoh’s scientific achievements. As a result, A New Appreciation of the Scientific Achievement of Ino-Tadataka Who Established a Landmark in the History of Land-survey and Cartography of Japan was edited in 1974 (Hoyanagi, 1974a).

In this book, Hirose Shizuo discusses problems related to longitude on Inoh’s maps (Hirose, 1974) as well as Hoyanagi’s article (Hoyanagi, 1974b). Hoyanagi (1974b) recognized that the inadequacy of longitude on Inoh’s maps was unavoidable when comparing the level of science in those days, in spite of Ohtani’s criticism. He considered Inoh’s map projection to be a Sanson–Flamsteed projection and clarified that Inoh’s teacher Takahashi Yoshitoki contrived the new map projection method.

3) A Recent Knowledge of Ino-Tadataka’s Map published by the Tokyo Geographical Society

The Tokyo Geographical Society published A Recent Knowledge of Ino-Tadataka’s Map in 1998 to mark the 250th anniversary of his birth (Tokyo Geographical Society, 1998). The preface states “recently obtained knowledge about Inoh’s maps is compiled and Inoh’s maps should become familiar through analyses and explanations. Further studies can be expected by preparing catalogues of Inoh’s maps, literature, and survey diary.”

4) Trends of studies on Inoh Tadataka

As mentioned above, although there are very few studies on scientific issues associated with Inoh’s nationwide survey, those of Ohtani (1917) and Hoyanagi (1974a) are already classics. On the other hand, many enlightening biographies of Inoh Tadataka have been published. These introduce his life, character, and the journey of his nationwide survey. However, the theories of Ohtani (1917) and Hoyanagi (1974a) concerning the science and technology of his survey remained influential, and the geodesy and cartography of Inoh’s survey have only been covered in a few articles.

The documents, data, and maps of Inoh’s survey were donated to the Inoh Tadataka Museum in Katori city, Chiba prefecture and are designated as national treasures. Among the documents and data “Sokuryo Nikki” (Survey diary) has been made available to the public. The life of Inoh Tadataka and his nationwide survey are clarified by “Sokuryo Nikki”, letters handed down to Inoh’s family from Tadataka, and local documents. Inoh’s maps including both originals and copies held by some universities and museums have been made available in museum exhibitions and pictorial records. Some items of information can be retrieved from the homepages of organizations possessing them. The history and presentation of these maps have been widely studied and many facts have been clarified.

On the other hand, almost no scientific technological documents and data besides “Sokuryo Nikki” have been analyzed by scholars besides Ohtani (1917), Hoyanagi (1974a) and few other researches.
IV. The significance of Inoh’s nationwide survey

1) Understanding the national land

Inoh Tadataka represented the national land in the latter period of Edo era, namely at the beginning of the nineteenth century, on his maps. In our time, survey and image technologies have become highly developed and scientific research and statistics on the national land are also well prepared. As a result, we can understand much about the condition of the national land. However, survey technologies were formerly rather elementary and the only images available were illustrations. Photography started to be utilized in the last years of the Edo era. Consequently, old maps, historical documents, and pictures are essential for studies of the national land at the beginning of the nineteenth century. The results of Inoh’s nationwide survey are elementary, but they are scientific and unified, so it is no exaggeration to say that Inoh’s maps are excellent records for understanding the national land at the beginning of the nineteenth century.

2) Inoh Tadataka’s place in the modern history of science and technology

Many scholars in both the merchant and samurai classes were active in various fields at the time of Inoh Tadataka. Inoh’s nationwide survey reflects the progress of science and technology and he was able to obtain results with the help of Tenmongata Takahashi Yoshitoki and Hazama Shigetomi, who were pupils of Asada Goryu. Asada Goryu was the leading authority at that time in the field of astronomical studies derived from Europe.

Inoh’s nationwide survey should be understood as part of the flourishing of science and culture in the latter part of the Edo era, and his work was influenced greatly by exchanges with many scientists in those days. Clarifying those exchanges is also important for understanding the circumstances surrounding Inoh’s survey.

3) Clarifying the science and technology of Inoh’s survey

The levels and the processes of survey and mapping technologies used in Inoh’s nationwide survey have been outlined. However, many problems remain to be clarified. Concerning Inoh’s maps and survey data, although the original formal maps in “Dainippon Enkai Yochi Zenzu” were destroyed by fire, original draft maps and survey data table, “Santo Hoiki” for example, have been preserved.

Although survey data were discussed by Ohtani (1917) and Hoyanagi (1974a), there have been no detailed studies on these survey data until now. It is commonly accepted traditionally that Inoh Tadataka computed the distance of one degree of latitude based in his survey data using the traverse and intersection method, and that he successfully determined latitude astronomically but failed to determine longitude. As a result of these efforts, he finally succeeded in making accurate and precise maps. These commonly-held views still rely on the work of Ohtani (1917) and Hoyanagi (1974a).

Digital images of several Inoh’s maps and “Sokuryo Nikki” have been made available on the Internet by some organizations. The Tokyo Geographical Society is making available digital images of “Santo Hoiki” held by the Inoh Tadataka Memorial Museum. Digital images of some of Inoh’s maps can be accessed at the US Library of Congress, Inoh Tadataka Memorial Museum, Tokyo National Museum, National Diet Library, National Archives of Japan, Tokushima University, and Waseda University and so on.

4) How Inoh’s maps are utilized

“Dainippon Enkai Yochi Zenzu” was designated a state secret after submission to the government and there was no opportunity to utilize it. Besides, draft original maps presented to some of feudal lords were not utilized widely. Inoh’s maps started to be utilized from the last days of the Tokugawa Shogunate and through the Meiji era.

The Meiji government set up modern survey and mapping organizations within the Army, the Navy, and the Ministry of Interior. These organizations started to prepare national maps.
and geographical data including topographic maps and charts. Inoh’s maps were utilized to prepare these maps and charts because it was hugely costly and labor intensive to prepare them with modern survey technology. At first, coastlines were copied directly from Inoh’s maps. Inoh’s maps contributed much to the preparation of national maps and charts of Japan. Maps utilizing Inoh’s maps were not only the basis of published national maps but also of nongovernmental maps in various fields.

V. The aim of this special issue on Inoh Tadataka

This special issue marks 200 years since the death of Inoh Tadataka. Original articles, review articles, and short articles related to Inoh’s nationwide survey have been compiled based on the descriptions above and to encourage the scientific and technological progress of studies on the achievements of Inoh Tadataka.

The contents of this special issue are roughly divided into three parts: process of Inoh’s nationwide survey, utilization and analysis of survey results, and geodesy and cartography of Inoh’s survey. Ten articles are carried in this issue: (1) scientific exchanges among scholars and experts on the process of Inoh’s nationwide survey (Suzuki, 2020), (2) scientific facts of Inoh’s survey from analyses of “Santo Hoiki” (Konno, 2020), (3) utilization of Inoh’s maps in the preparation of national maps and charts inside and outside Japan from the last days of the Edo era through the Meiji era (Yashima, 2020), (4) regional changes in GIS analyses over 200 years (Iwai et al., 2020), (5) questions and problems raised by Inoh’s survey (Hoshino, 2020), (6) astronomical observations which formed the basis of Inoh’s survey (Nakamura, 2020), (7) observations of lunar eclipses and the problem of longitude (Nogami, 2020a), (8) accuracy of the distance of one degree on the meridian (Kaidzu, 2020), (9) the distance of one degree on the meridian as a definition for mapping (Nogami, 2020b), and (10) the problem of the map projection on Inoh’s maps (Hishiyama, 2020). Fundamental problems that had not yet been discussed or that had been misunderstood are addressed in this special issue.

New problems in studies of Inoh’s nationwide survey are clarified by reexamining commonly accepted theories on Inoh’s nationwide survey held until now.

Notes
1) Sano Tsunetami (1823–1902) was a samurai in the Saga region of Kyushu who had experience of using Inoh’s maps when he was a student at the Naval school in Nagasaki.
2) Enomoto Takeaki’s father, Hakoda Ryosuke (1790–1860) participated in Inoh’s survey team.
3) Tenmongata was one of the posts of the Tokugawa shogunate government. It corresponded to the director of an astronomical observatory. Takahashi Yoshitoki (1764–1804) was the leading astronomer at the time.
4) Inoh surveyed the distance from his residence to the Tenmongata office using the traverse survey and astronomical observation data at his residence and the Tenmongata office, and calculated the distance of one degree of meridian. However, Takahashi Yoshitoki did not accept his results because of the insufficient distance surveyed. Takahashi recommended a survey extending as far as Ezochi (Hokkaido).
5) Mamiya Rinzo was a pupil of Inoh Tadataka in the field of surveying and mapping. He is famous for discovering the Mamiya strait between Kafuto (Sakhalin) and the Maritime Province of Siberia.
6) Watanabe (2003) classified Inoh’s maps as original, duplicate, manuscript, copy, and reproduction. Original maps were submitted to the Tokugawa shogunate government. Duplicate maps were prepared by Inoh’s survey group. Manuscripts were uncompleted duplicate maps. Copies were maps copied by hand in the Edo era. And, reproductions were maps copied after the Meiji era.
7) Nagaoka Hantaro (1865–1950) was a famous physicist. He held the posts of professor at Tokyo Imperial University, President of Osaka Imperial University, and President of Imperial Academy. Ohtani Ryokichi was a pupil of him.
8) Hoya Kikumori (1905–1987) was a geographer and a professor at Tokyo Metropolitan University.
9) Asada Goryu (1734–1799) was an astronomer in the mid-Edo era. He was an authority in the field of astronomical studies derived from Europe in those days. He was the principal of a private school of astronomy in Osaka. Takahashi Yoshitoki and Hazama Shigetomi were the most outstanding pu-
pils of his school. Takahashi was of the lowest class of samurai and Hazama was a pawnbroker.

10) Tokyo Geographical Society web library: http://www.geog.or.jp/library [Cited 2020/1/29].

11) US Library of Congress possesses large-scale maps copied from original maps preserved by Inoh's family by the Army in the early days of the Meiji era.

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* Title etc. translated by Y.H.