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## I. Preface

In May 1822 the young physician Philipp Franz von SIEBOLD, who at that time practiced medicine in the small town of Heidingsfeld near Würzburg, was preparing for his journey to the East Indies and contacted scholars from various disciplines. With great enthusiasm Siebold wrote to the naturalist Carl Erembert Freiherr von MOLL, who was the secretary of the Bavarian Academy of Science, stating that “the earnest will to be of use to the [...] famous Academy is deeply engrained in me [...], and the opportunity will present itself to provide interesting contributions in the fields of zootomie [sic!], botany and mineralogy.”<sup>1</sup>

As it happens, SIEBOLD was sent from Batavia to Japan, and the knowledge gained during his stay there (1823-30) provided the basis for substantial contributions in the fields of zoology and botany published in *Fauna Japonica* and *Flora Japonica*, but the third part of the potential science trilogy, the “Mineralogia Japonica”, has never been published. This does not mean, however, that mineralogy was neglected in the realm of his wide-ranging studies, and there are clues that a publication was planned. Siebold had put his assistant, Heinrich BÜRGER, in charge of the fields of physics, chemistry and mineralogy. During their stay, and especially during their journey from Nagasaki to Edo to pay respect to the Shōgun, BÜRGER took detailed notes on various geological phenomena and collected minerals to be shipped back to Europe.

In the book at hand, mineralogists TAGAI Tokuhei (Prof. emer. of Tokyo University) and Dr. Lothar SCHRÖPFER (Universität Frankfurt) try to reconstruct the “Mineralogia” that SIEBOLD and BÜRGER could have written, based on the latter’s notes and collections. In a first step Prof. TAGAI attempted to reconstruct in painstaking detail SIEBOLD’s collection of minerals by visiting various museums and archives in Europe, bringing together specimens, their labels and descriptions kept in Leiden, with a list of minerals and various drafts on related topics by BÜRGER which are preserved in the Siebold Archive at Ruhr-Universität Bochum. Based on the results of this research he and Dr. SCHRÖPFER decided to compile the “Mineralogia” in order to complete what BÜRGER and SIEBOLD had begun, and to present their findings to the public.

This was not an easy undertaking. The language of BÜRGER’s handwritten drafts is rather convoluted and sometimes only in note form. In order to reach an international academic audience, Prof. TAGAI and Dr. SCHRÖPFER translated the text of the drafts into English, endeavouring to preserve the style of the German original by translating as literally as possible. They also placed the whole draft in the scientific framework of its time, when geological explanations of the formation of the earth, of mountains and oceans, were different from today.

Had the “Mineralogia Japonica” been published at the same time as *Flora* and *Fauna*, i.e. in the first half of the nineteenth century, it would probably have been the first attempt at a systematic description of the minerals of Japan based on Western scientific ideas. Now this credit is due to WADA Tsunashirō, who published several books on the subject, starting with the *Honpō kinseki ryakushi* (*Minerals from Japan*) in 1878, and who became one of

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<sup>1</sup> Des Frhrn. C. E. von Moll Mittheilungen aus seinem Briefwechsel, 3. Abt. (Augsburg 1834, p. 852 f.) (Heidingsfeld, 7.5.1822), in Körner, Hans: *Die Würzburger Siebold: Eine Gelehrtenfamilie des 18. und 19. Jahrhunderts*. Neustadt a. d. Aisch: Degener 1967, p. 808.

the leading experts on minerals and mining in Meiji-Japan. In the *Mineralogia* Prof. TAGAI and Dr. SCHRÖPFER use WADA'S early studies to put BÜRGER'S and SIEBOLD'S findings in a larger geological and geographical context in order to show the representativeness of the specimens collected and described by them.

The *Mineralogia Japonica* provides us with first-hand knowledge about the geological and mineralogical situation in Japan at a time when the country was still closed to most foreigners. Even though not all the facts related by Bürger can be taken at face value, as e. g. his too negative judgement on mining technology shows, the book bridges the gap between the mainly empirical knowledge applied in early modern Japan and the later studies by WADA and others, using Western methods and categories. Being in charge of the SIEBOLD Archive at Ruhr-Universität Bochum, I am delighted that this important publication will appear in our series *Acta Sieboldiana*. I want to thank all those who have been involved in this project, especially Prof. TAGAI and Dr. SCHRÖPFER, and the generous sponsors, the Humboldt Foundation, the Japanese Ministry of Education, Science, Sports and Culture and the Toshiba International Foundation. Those interested in mineralogy and geology and in the history of science in general will find the book a fascinating source of information on natural resources and the development of natural history in Japan and in Europe.

Bochum, March 2016

Regine Mathias

## II. Introduction

Philipp Franz von SIEBOLD (1796 -1866) was born in Würzburg, Germany. In 1815 SIEBOLD began to study medical science at Würzburg University. His intention was to become a natural scientist and to perform research on natural history in East Asia. In 1822 SIEBOLD obtained the position of *Chirurgus Major* in the Dutch East Indies. Departing from Rotterdam in September 1822, he arrived in Batavia in February, 1823.

Just after SIEBOLD arrived at Batavia, Baron VAN DER CAPELLEN, Governor-General of the Dutch East Indies, proposed to him to visit Japan to make comprehensive studies of the country's history, social system, geography, natural products etc., from the viewpoint of natural history.

We see clear evidence of his determination to carry out this research from the following letter written to his uncle:

*“Unter sechs Jahren verlasse ich Japan (nicht) und auf keinem Fall eher, als ich eine ausführliche Beschreibung von Japan, ein Museum japonicum und eine Flora geliefert habe, und dann glaube ich, in Europa unserem Namen Ehre zu machen.”*<sup>2</sup>

(Not before six years will I leave Japan and by no means until I have rendered a comprehensive description of Japan, a *Museum japonicum* and flora, and then, I believe, I will have done credit to our name in Europe.)

The captain of the Dutch settlement had a habit of making regular courtesy visits to Edo (Tokyo). When a Dutch delegation went to Edo in 1826, SIEBOLD took the opportunity to accompany the captain. This was also an excellent chance to collect natural history specimens himself. AS SIEBOLD showed much more interest in the botanical and zoological specimens than the mineralogical ones, he employed a young German pharmacist, Heinrich BÜRGER, from Batavia, who had superior knowledge of physics, chemistry and mineralogy. SIEBOLD instructed BÜRGER to describe the geology and to collect minerals.

SIEBOLD wrote in his book *Nippon, Archiv zur Beschreibung von Japan und dessen Neben- und Schutzländern Jezo mit den südlichen Kurilen, Sachalin, Korea und Liukiu-Inseln* (abbreviated to *Nippon*) as follows:

*“Einer ähnlichen großmütigen Entscheidung der Niederländisch-Indischen Regierung hatte ich die Bewilligung meines Gesuches um einen Gehülfen und einen Zeichner zu verdanken. Die Herren Heinrich BÜRGER und Karl Hubert DE VILLENEUVE wurden nach Japan gesendet. Herrn BÜRGER, früher Apotheker bei unseren Hospitälern auf Java, übertrug ich nun die Fächer der Physik, Chemie und Mineralogie, die er mit besonderer Vorliebe betrieb [...]”*<sup>3</sup>

2 Philipp Franz von SIEBOLD: Letter to Adam Elias von SIEBOLD, 18.11.1823. Cited in: von SIEBOLD, Philipp Franz: *Nippon, Archiv für Beschreibung von Japan und dessen Neben- und Schutzländern Jezo mit südlichen Kurilen, Sachalin, Korea und Liukiu-Inseln*. 2. Auflage. Würzburg und Leipzig: Woerl, 1897, p. XVI, and in KURE: *Philipp Franz von Siebold. Leben und Werk. Deutsche, wesentlich vermehrte und ergänzte Ausgabe*, bearbeitet von Friedrich M. Trautz, hg. von Hartmut Walravens, Bd. 1. München: iudicium 1996, p. 63.

3 VON SIEBOLD: *Nippon*, p. 49.

(A similar generous decision of the Dutch-Indian Government I should acknowledge is the acceptance of my request for an assistant and an illustrator. Messrs. Heinrich BÜRGER and Karl Hubert DE VILLENEUVE were sent to Japan. To Mr BÜRGER, formerly pharmacist in our hospitals on Java, I assigned the subjects of physics, chemistry and mineralogy, which he pursued with particular predilection [...].)

During the courtesy visit to Edo, BÜRGER made geological observations, collected mineral specimens, analysed hot springs waters, measured longitudes and latitudes, and recorded meteorological data. Based on his investigations of Japan, SIEBOLD later published the books *Nippon*<sup>4</sup>, *Flora Japonica*<sup>5</sup>, *Fauna Japonica*<sup>6</sup>, but not a “De Mineralogia Japonica” (abbreviated to “Mineralogia”). Fortunately, we found a draft of “Mineralogia” written by Bürger and its “Contents” page by SIEBOLD in the Sieboldiana Collection of Ruhr University Bochum.<sup>7</sup> Therefore, we can understand that “Mineralogia” was in preparation but not published, for reasons unknown. In order to publish “Mineralogia” we tried to translate BÜRGER’s German text literally into English.

The contribution of BÜRGER to the investigation of mineralogy and geology of Japan is described below.

A biography of BÜRGER was published by M. J. VAN STEENIS-KRUSEMAN.<sup>8</sup> According to VAN STEENIS-KRUSEMAN, Heinrich BÜRGER was born in Hameln, Germany, in 1806 (or possibly 1804). He entered the University of Göttingen, where he studied mathematics in 1821 and then turned to astronomy in 1822. In 1823 he suddenly left Germany and went to Holland. He signed up for service in the East Indies and left Amsterdam in September 1823. In Java he was appointed apprentice pharmacist in the hospital at Weltevreden near Batavia, and in 1825 he obtained the degree of pharmacist third class. In 1825, BÜRGER was sent to Japan to become SIEBOLD’s assistant. He arrived in Dejima in the summer or autumn of 1825. BÜRGER accompanied SIEBOLD on the journey to Edo. While travelling the country Bürger observed and described the geology of the localities, collected rocks and minerals, and made chemical analyses of hot springs waters. Furthermore, he assisted SIEBOLD in measuring the latitude and longitude of many places in order to determine their exact geographic position. Additionally he collected meteorological data during the journey.

It is important to consider BÜRGER’s background in geology, mineralogy and analytical chemistry in order to understand his activities in Japan. It is not certain that BÜRGER

4 S. footnote 2.

5 SIEBOLD, Philipp Franz von, and Joseph Gerhard ZUCCARINI: *Flora Japonica sive Plantae quas in imperio Japonico coll., descripsit, ex parte in ipsis locis pingendas cur.* : [Lugduni Batavorum apud auctorem 1835-1870] / Ph. Fr. de Siebold. *Sectio prima, continens plantas ornatui vel usui inservientes Digessit J. G. Zuccarini. Monumentum in memoriam Engelberti Kaempferi ; Caroli Petri Thunbergii in horto botanico insulae Dezima cura et sumptibus Ph. Fr. de Siebold positum* 1826.

6 *Fauna Japonica sive Descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava imperium tenent, suscepto, annis 1825 - 1830 collegit, notis, observationibus et adumbrationibus illustravit Ph. Fr. de Siebold. Conjunctis studiis C. J. Temminck e H. Schlegel pro vertebratis atque W. de Haan pro invertebratis elaborata.*

7 Sieboldiana Collection, Ruhr Universität Bochum, no. 1.141.001, p. 3.

8 VAN STEENIS-KRUSEMAN, Maria Johanna: “Contributions to the History of Botany and Exploration in Malaysia, 8-9”, in: *Blumea*, vol.XI, no.2, 1962, pp. 495-508.

learned geology or mineralogy at the University of Göttingen. However, even if he did not study these subjects, we think that he had the chance to learn about geology, mineralogy and chemistry by reading textbooks later on. This can be inferred from special textbooks received in Dejima, transferred from Java in 1826 and documented in the following list<sup>9</sup>:

- “1. Hoffmann : Handbuch der Mineralogie
2. Breithaupt : Über die Aechtheit der Kristalle
3. Werner : Letztes Mineralsystem
4. Ballenstedt : Die Urwelt
5. Hermbstaedt : Experimentale Chemie
6. John’s Chemisches Laboratorium, oder Anweisung zur Analyse der Naturalien”

With these books in his possession, Bürger could study geology, mineralogy and chemistry in Java and Dejima by himself.

Here we should note two remarkable textbooks on mineralogy and geology, namely HOFFMANN’S *Handbuch der Mineralogie* and WERNER’S *Letztes Mineralsystem*. The most interesting fact is that WERNER and HOFFMANN were well known as proponents of neptunism.

There was considerable geological debate on the formation of the earth’s rocks at that time in Europe, the dominant theory in the late eighteenth century being the theory of neptunism. Neptunism was proposed by Abraham Gottlob WERNER, who was a professor of mining and mineralogy at the Mining Academy in Freiberg (Saxony). According to neptunism, all matter was dissolved in a primeval ocean that completely covered the earth. On evaporation, crystallization started from this solution depositing granite, thus creating a crystalline bed rock.

WERNER proposed five stages of development of mountain rocks:<sup>10</sup>

- |                          |                                |
|--------------------------|--------------------------------|
| I. Urgebirge             | → Primitive Mountain Ranges    |
| II. Übergangsgebirge     | → Transitional Mountain Ranges |
| III. Flötzgebirge [sic!] | → Floetz Mountain Ranges       |
| IV. Aufgeschwemmtes Land | → Alluvial Formation           |
| V. Vulkanische Gebirge   | → Volcanic Mountain Ranges     |

Formation of the crystalline bedrock (granite) was stage I. In the course of time the composition of the solution changed and different rocks were deposited in layers. Then

9 Priv. com. of Prof. Dr. H. BEUKERS (Leiden), and Nr. 401 Sieboldiana Japaninstitut.

As the list only contains the family names of the authors and short titles, it is not possible to know the exact edition of these books, but general bibliographical data are as follows: HOFFMANN, Christian August Siegfried: *Handbuch der Mineralogie*. Freiberg: Craz and Gerlach, 1811-13. BREITHAUPT, August: *Uiber die Aechtheit der Kristalle*. Freiberg: Craz and Gerlach, 1815. *Abraham Gottlob Werner’s letztes Mineral-System. Aus dessen Nachlasse auf oberbergamtliche Anordnung herausgegeben und mit Erläuterungen versehen*. Freyberg and Wien: Craz and Gerlach and C. Gerold, 1817. BALLENSTEDT, Johann Georg Justus: *Die Urwelt oder Beweis von dem Daseyn und Untergange von mehr als einer Vorwelt*. Quedlinburg and Leipzig: Gottfried Basse, 1818. HERMBSTÄDT, Sigismund Friedrich: *Systematischer Grundriss der allgemeinen Experimentalchemie*. Berlin: Heinrich August Rottmann, 1800. JOHN, Johann Friedrich: *Chemisches Laboratorium oder Anweisung zur chemischen Analyse der Naturalien*. Berlin: Friedrich Maurer, 1808.

10 WERNER, Abraham Gottlob: *Kurze Klassifikation und Beschreibung der verschiedenen Gebirgsarten*. Dresden: Waltherische Hofbuchhandlung, 1787, p. 5 and passim.

because of massive deluges these layers were disturbed and foliated, yielding gneiss and schist in a second formation stage. This brought forth the transitional ranges with additional wacke and shales and the floetz mountains with additional coal, gypsum, limestone and basalt (the former second stage later became stage II and III). The third formation stage (later stage IV) was mainly characterized by mechanical sedimentation that resulted in beds of gravel, sand and clay, which Werner named alluvial rocks. Volcanic rocks were thought to have been formed by the burning of underground coal deposits, which melted parts of the floetz. Details of this theory can be found in the book *Elements of Geognosy* by Robert JAMESON.<sup>11</sup>

A rival theory was plutonism, which held that rocks were formed in the course of volcanic processes. The controversy lasted until the early nineteenth century, with plutonism gradually winning out over neptunism.

In Chapter 1 of “Mineralogia”, BÜRGER described his geological observations in Japan, applying the same terms of “Urgebirge”, “Übergangsgebirge”, “Flözgebirge” and “Aufgeschwemmtes Land” as used by WERNER, and it is quite probable that BÜRGER had learned geology and the theory of neptunism through studying HOFFMANN’s and WERNER’s textbooks.

In Chapter 2, BÜRGER described minerals from Japan, using the same classification system as Werner. This fact indicates that BÜRGER also adopted the system of mineralogy from the same two books by HOFFMANN and WERNER.

BÜRGER set up his system of mineralogy according to the mineral specimens collected not only by himself but also by Japanese collaborators. However, the quality of the mineral specimens collected by the collaborators was often unsatisfactory due to their insufficient knowledge of geology and mineralogy. They often collected specimens only because of their curious external forms, surface patterns, colours etc. and not for true scientific reasons. The collections of BÜRGER and the Japanese collaborators are thus insufficient to permit a profound writing of “Mineralogia”. Therefore, in order to publish “Mineralogia”, it is necessary to introduce other scientifically collected mineral specimens.

The first scientific collection of minerals from Japan was assembled by WADA Tsunashirō. He was born in 1856 and studied mineralogy at Kaisei-Gakkō (the precursor of the University of Tokyo). In 1876 and 1877 he published two reports on mineral production in Japan, listing the minerals according to place where they were found, but without scientific classification. In 1878 he summarized these two reports in his publication *Honpō kinseki ryakushi* (Minerals from Japan)<sup>12</sup>, in which the mineralogy of Japan was systematically described for the first time. Later WADA became the first professor of mineralogy in Japan. He wrote *Nihon kōbutsu shi* (Minerals from Japan)<sup>13</sup> in 1904 and revised it further in 1907. WADA’s mineral collection is one of the best known in the world. The mineral description of WADA in 1878 is much more recent than that of BÜRGER, however, we assume that if BÜRGER could have collected mineral specimens from all over Japan himself, he could have made the collection equivalent to that of WADA in the 1870s.

11 JAMESON, Robert: *System of Mineralogy, Elements of Geognosy*. Vol. III, part II, Edinburgh, 1808.

12 WADA Tsunashirō: *Honpō kinseki ryakushi* (Minerals from Japan). Tōkyō: Tōkyō daigaku rigakubu, 1878.

13 WADA Tsunashirō: *Nihon kōbutsu shi* (Minerals from Japan). (Private print) 1904; a reprint was published by Tōkyō daigaku shuppan in 2001.

We then tried to find out whether it was possible to recreate the “Mineralogia” of SIEBOLD by combining the collection of BÜRGER with that assembled by WADA in 1878. SIEBOLD sometimes added his comments on BÜRGER’s description, which are shown in *small italic letters* in this chapter.

SIEBOLD’s mineral collection is kept in the National Museum of Natural History, Leiden.<sup>14</sup> The photographs of the minerals in this chapter were taken by one of the authors (T. T.).

In Chapter 3 BÜRGER described copper production in Japan, referring to the book *Kodō zuroku*<sup>15</sup> (Illustrated Book on the Smelting of Copper) which had been presented as a gift by the SUMITOMO family<sup>16</sup> in Osaka during the journey from Edo to Nagasaki.

In Chapter 6 the principal mountains of Japan are listed. The list was not written by BÜRGER but by one of SIEBOLD’s Japanese collaborators, maybe ISHII Sōken. SIEBOLD added comments on volcanic activities, classifying the volcanic mountains as either “active volcano”, “extinct volcano”, or “trachyte cone”. His “extinct volcano” may be “dormant volcano”, and “trachyte cone” may be “extinct volcano” in modern geological terms. The list of mountains is a faithful copy of that presented in the book *Meizan zufu* (Paintings of famous mountains)<sup>17</sup> by the Japanese artist TANI Bunchō. The library of Leiden University owns the *Meizan zufu*, which was given to SIEBOLD in 1826 during his stay in Edo by a Japanese medical doctor, KATSURAGAWA Hoken, dubbed Wilhelmus Botanicus by the Dutch.

In Chapter 7 the results of the chemical analysis on the hot springs waters from several volcanic areas in Kyūshū are shown. BÜRGER performed the chemical analysis by the process described in the books *Experimental Chemie* by HERMBSTAEDT and *Chemisches Laboratorium, oder Anweisung zur Analyse der Naturalien* by JOHN, which were available in Java and Dejima.<sup>18</sup>

Appendix 1 is the list of SIEBOLD’s mineral collection prepared by Johann Joseph HOFFMANN. HOFFMANN was an assistant of SIEBOLD in Leiden who later became the first professor of Japanese at Leiden University. It is probable that the list was written according to the inventory by BÜRGER, which has not yet been discovered. The details of the mineral list have been discussed by MIKOUCHI and TAGAI.<sup>19</sup>

Appendix 2 is a document written by BÜRGER on his geological observations in 1826 while travelling from Nagasaki to Edo. The document includes the geological descriptions

14 TAGAI Tokuhei and MIKOUCHI Akiko: *Mineral collection and ‘Lapidographia Japonica’ by Philip [sic] Franz von Siebold*, [The University Museum, The University of Tokyo, Bulletin 44], Tōkyō 2008.

TAGAI Tokuhei and MIKOUCHI Akiko: “Mineral collection of Philipp Franz von Siebold (II)”. In: TAGAI Tokuhei and SASAKI Takenori (eds.): *Mineral and fossil collections of Philipp Franz von Siebold*. [The University Museum, The University of Tokyo, Bulletin 45], Tōkyō 2010, pp. 1–212.

15 MASUDA Kō (text), TANBA Tōkei (illustr.): *Kodō zuroku* (Illustrated Book on the Smelting of Copper). Naniwa: Sumitomo Family, published between 1811 and 1816. (There are an English and a German translation of the *Kodō zuroku*, published in 1983 and 1984 respectively.)

16 The SUMITOMO family owned the large copper mine of Besshi and was in charge of copper processing and smelting in Ōsaka.

17 TANI Bunchō (illustr.) and KAWAMURA Juan: *Meizan zufu* (Collection of paintings of famous mountains), Nanbu 1804.

18 Priv. com., Prof. Dr. H. BEUKERS (Leiden).

19 MIKOUCHI Akiko and TAGAI Tokuhei: “Characteristic features of Hoffmann’s list of Siebold’s mineral collection”, in: *Bochumer Jahrbuch zur Ostasienforschung*, vol. 37, 2013/14, pp. 271–280.



of Japan by the neptunist BÜRGER, which is most significant because BÜRGER wrote Chapter 1 of “*De Mineralogia Japonica*” according to this document.

Finally, some technical remarks: In the literal translation of the original texts of BÜRGER the names of persons and places are given in the original spelling. The same applies to the labels of the specimen. In the parts added by TAGAI and SCHRÖPFER in chapter III.2 modern Japanese spelling is used. Throughout the book Japanese names are written in the Japanese order, with the family name preceding the first name. Book titles are given in italics, but as the “*Mineralogia*” has not yet been published, the title is given in inverted commas. Underlinings are retained as in the original text. Footnotes and glosses in the original are set within the text. For facilitating comparison, the original text of the “*Mineralogia*” and Hoffmann’s list are appended in facsimile.