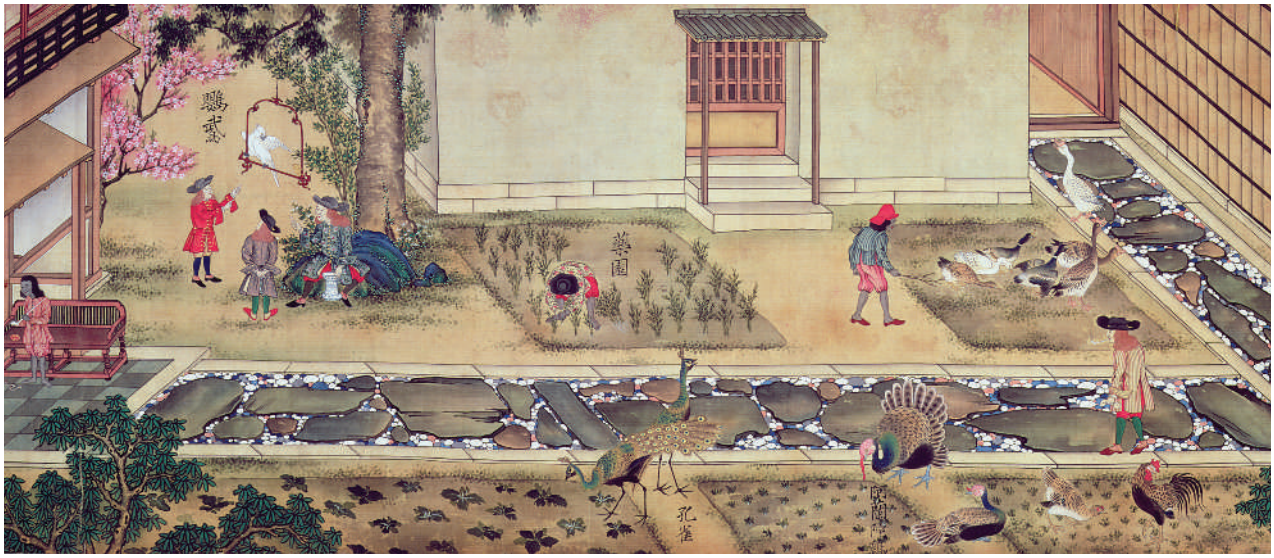

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Linnaeus and taxonomy in Japan

Doctors at the Dutch Trading House on Dejima were a conduit for science into and out of Europe.

His Majesty The Emperor of Japan

In memory of Carl Linnaeus I would like to address the question of how European scholarship has developed in Japan, touching upon the work of people such as Carl Peter Thunberg, Linnaeus's disciple who stayed in Japan for a year as a doctor for the Dutch Trading House (pictured above) and later published *Flora Japonica*.

In the first edition of *Species Plantarum* in 1753, and in his later books, Linnaeus described many Japanese plants and gave them scientific names. *Camellia japonica*, for example, was described in the first edition of *Species Plantarum*, and this scientific name is still used today.

These Japanese plants were illustrated by Engelbert Kaempfer in his book *Amoenitatum Exoticarum*, published in 1712. Kaempfer was a German doctor who served in the Dutch Trading House in Japan for two years from 1690.

At that time, Japan had isolated itself from the world. Japanese people were not allowed to go abroad, and visits by foreigners to Japan were severely restricted. As the policy of isolation was taken to suppress Christianity, the Dutch, who came for trading purposes only, were permitted to come to Japan.

Dutch people were made to live on an artificial island, Dejima, built in the sea off Nagasaki and connected to land by a bridge; they could not leave the island without permission. The head of the Trading House, however, was to visit the shogun at Edo — present-day Tokyo — once a year, accompanied by his delegation including the doctor. Kaempfer thus visited Edo twice, taking more than 80 days for the trip each time. The 256 sketches of Japanese plants he made during his stay are now kept in the Natural History Museum, London.

Rates of exchange

In 1775, 83 years after Kaempfer left Japan, a Swedish doctor, Carl Peter Thunberg, arrived at the Dutch Trading House. Thunberg was Linnaeus's pupil and later became a full professor at Uppsala University in both botany and medicine.

Whereas Kaempfer had just one visit from a Japanese doctor during his two trips to the city, Thunberg was visited by five doctors and two astronomers the moment he arrived in Edo. Japanese doctors had developed a deeper recognition of European medicine.

This change occurred because in 1720, Shogun Tokugawa Yoshimune relaxed the prohibition on importing books, which had been put in place to prevent Christian ideas from coming into Japan. This development stimulated research on European science, and people came to focus their attention on medical books written in Dutch. In 1774, for example, *A New Book of Anatomy* was published. This Japanese translation of a Dutch book was made by doctors of Edo, including Sugita Genpaku, Katsuragawa Hoshu, a physician for the Shogun, and his friend Nakagawa Jun-an, after they saw a dissection of a human body and were convinced of the accuracy of the Dutch book.

Katsuragawa Hoshu and Nakagawa Jun-an visited Thunberg almost every day and sometimes stayed until very late into the night to learn from him about various scientific matters. Both of them, Nakagawa Jun-an in particular, could speak Dutch quite well. In his book *Travels in Europe, Asia and Africa Made During the Years 1770–1779*, Thunberg writes that he asked Katsuragawa Hoshu and Nakagawa Jun-an the Japanese names of the fresh plants that they brought, and taught them the Latin names and the Dutch names of the plants.

Exchanges between Thunberg and the two Japanese doctors continued even after Thunberg's return to Sweden. The letters are kept in Uppsala University. I saw them with Their Majesties the King and Queen of Sweden during our visit in 1985, as Crown Prince and Crown Princess, and it left a deep impression on both of us.

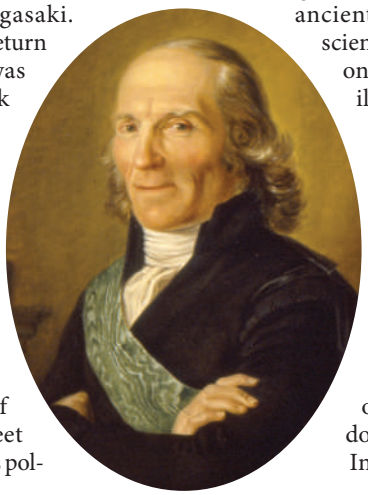
End of an era

We do not know exactly when the scientific names under the binomial nomenclature, originated by Linnaeus, were introduced to Japan. Despite what Thunberg writes in his book, some doubts remain that they were first introduced to Japan at his time. They started to be used here after a German doctor, Philipp Franz von Siebold, arrived at the Dutch Trading House in 1823. By this time, there were many Japanese who could speak Dutch. Siebold established a school of medicine and a clinic for treating patients in the suburbs of Nagasaki. He could also leave the island of Dejima to visit patients at their homes or to collect medicinal herbs.

In 1829, Ito Keisuke wrote a book in

which Linnaeus's nomenclature was used for the first time in Japan. Keisuke took the scientific names of plants in Thunberg's *Flora Japonica*, which Siebold had brought to Japan, put them in alphabetical order, and added their Japanese names. In his book, Keisuke introduced Linnaeus's classification system as the "Explanation of the 24 Classes".

Keisuke studied under Siebold for six months in Nagasaki. When he was about to return home to Nagoya, he was given Thunberg's book as a gift. Keisuke sent the manuscript of his book, *A Translation of Thunberg's Flora Japonica*, to Siebold in Nagasaki, and Siebold checked it.



Carl Peter Thunberg, pupil of Linnaeus.

In 1854, Japan and the United States signed the Treaty of Peace and Amity as the arrival of the American naval fleet brought to an end Japan's policy of isolation, which had lasted for more than 200 years. After that, Japan began establishing diplomatic relations with many countries. The last shogun, Tokugawa Yoshinobu, resigned from his post in 1867, and a new government was formed under Emperor Meiji.

The Meiji government sent students overseas and invited foreign teachers to Japan, and the Japanese people made a great effort to acquire Western knowledge. The foreign teachers who were invited to Japan at this time made a great contribution to Japan, and the students who went to study overseas also contributed in various ways to the subsequent development of Japan.

New shoots

One of the academic achievements made by Japanese scientists in the nineteenth century was the discovery of gymnosperm sperm. In 1896 Hirase Sakugoro, an illustrator in the botanical laboratory of the University of Tokyo who later became a research associate, observed the swimming of ginkgo sperm, and published his paper on this discovery in the *Botanical Magazine* (Tokyo).

A month later, Ikeno Sei-ichiro, an associate professor in the agricultural department of the University of Tokyo who collaborated with Hirase Sakugoro, found cycad sperm, also reported in the *Botanical Magazine* (Tokyo).

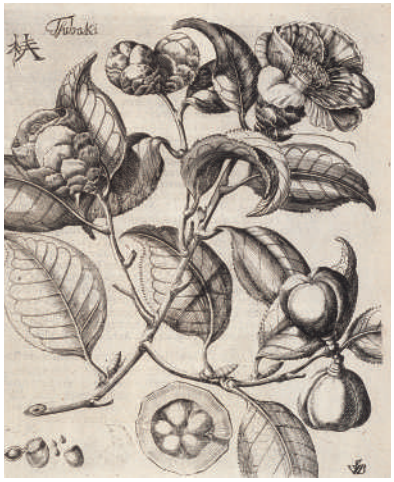
This discovery was not believed at first, but it became accepted after *Zamia* sperm, from the same cycad family, was discovered in the United States the following year in 1897. For this achievement these two researchers were awarded the Imperial Award of the Japan Academy in 1912.

The ginkgo is unique in its phylogeny because it is a single-order, single-family, single-genus, single-species plant. It flourished in the Mesozoic Jurassic age but survived only in China, and was brought from China to Japan in ancient times. It was given a scientific name by Linnaeus, on the basis of Kaempfer's illustration.

The ginkgo tree that Hirase Sakugoro used for his research is still standing in the Koishikawa Botanical Gardens of the University of Tokyo. I visited with the Empress last year and looked at the ginkgo tree, thinking of the research that was done a long time ago.

In the twentieth century, as Japanese taxonomy made progress, more and more new species began to be reported. Before that, Japanese animals and plants were given scientific names by European scientists, and as a matter of course, the type specimens used for naming them were kept in European museums. Therefore, when Japanese researchers wanted to describe a Japanese animal or plant as a new species, they had to check the type specimens in foreign countries one by one, and the difficulties they encountered were far from trifling.

Thanks to the efforts made by many people, all Japanese spermatophytes, pteridophytes and vertebrates excluding fishes now have scientific names. However, there are still many unnamed fishes; in particular, there are many gobioids that must be given scientific names.



Linnaeus referred to Kaempfer's drawings.

When I started my research, I frequently referred to a book titled *Fish Morphology and Hierarchy* by Kiyomatsu Matsubara, published in 1955. The book covered all Japanese fishes with keys to the species, and it listed 134 gobioids, including subspecies. In the more recent *Fishes of Japan with Pictorial Keys to the Species*, published in 2002, the number of gobioids, including subspecies, increased to 412, but 45 of them have only Japanese names and have no scientific names yet.

KVA

Class act

In 1967, I published a paper in the *Japanese Journal of Ichthyology* on the classification of the four gobioid species of the genus *Eleotris* found in Japan based on the arrangement of their sensory papillae. In those days, no one in Japan was yet classifying gobioids thus, and some people had considerable doubts about my classification. The arrangement of the sensory papillae has now become an important factor in classifying gobioids, and I am glad that I have been able to make some contribution in this field.

The binomial nomenclature established by Linnaeus has been immensely beneficial, providing a universal basis for taxonomy and enabling taxonomists around the world to communicate with each other through a common language about things existing in nature.

Today, an even newer field of research, molecular biology based on evolution, is seeing remarkable development. As a result, systems based on phylogeny are considered to be more accurate and are now the mainstream of taxonomy.

As I have been familiar with classifications based on morphology since I was young, the appearance of the electron microscope, which enabled me to observe minute morphological characteristics, and my encounter with an even smaller world, where classification is based on DNA analysis at a molecular level, have been great experiences for me as a researcher.

On the 300th anniversary of Linnaeus's birth, I feel that taxonomy is entering a new era. The analysis of mitochondrial DNA will open up great possibilities of discovering new species that cannot be distinguished morphologically. I hope to understand and take into consideration this newly developing field of research, but at the same time, I intend to continue to give my attention to and keep up my interest in morphology, which is a field of study carried on from Linnaeus's days. ■

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This is an edited extract of a speech given by His Majesty The Emperor of Japan to the Linnaean Society of London on 29 May 2007. The full text of this speech (http://tinyurl.com/29djvx) will be published later this year by *The Linnaean*.

ESSAY