Reprint Series
23 October 1992, Volume 258, pp. 578–580

SCIENCE

Early Cultivators of Science in Japan

Akihito

Early Cultivators of Science in Japan

Akihito

I have been told that this is a special issue devoted to "Science in Japan." Since science pursues truth and scientific technology puts truth to the use of mankind, it is desirable that such studies be pursued through cooperation that transcends national and other boundaries. I am pleased to note that, in recent years, when I visit research institutes in Japan, I often come across foreign researchers. Through my own study of ichthyology, I have come to feel strongly the importance of international cooperation in conducting scientific studies. I recall with a sense of gratitude that behind each one of the papers I have published there has been the unsparing cooperation of people abroad. I shall be delighted if this issue "Science in Japan" deepens the understanding of scientific activities here and contributes to the further promotion of international exchange.

When one thinks of the development of science in Japan, one recalls the untiring efforts of the people who nurtured its growth in ages past when communication with foreign countries was limited. I am not a student of the history of sciences, but as a person interested in this field, and on the occasion of this special issue, I would like to acknowledge some of these early cultivators of science in Japan.

Japan had been learning from Chinese civilization from olden times, but it was only in the latter half of the 16th century that the country came in contact with European science. It is said that in 1543 Tanegashima, an island in the south of Japan, was visited by Portuguese who introduced firearms to the inhabitants. Within only a few years, several dozen guns had been manufactured on the island, and the techniques for their manufacture had begun to spread throughout Japan. In the meantime, the Portuguese returned home with stories about Japan, and thereafter Portuguese ships loaded with merchandise for trade appeared frequently in Japanese ports.

After 1549, Francis Xavier and many other Jesuits came to Japan, serving both as missionaries and as conduits of European learning. It was during this period, for example, that the Japanese first learned that the earth was round and were first exposed to European medical practices, including surgery, which was not part of Chinese medicine. However, the Copernican theory, which had been formulated in the same year as the first Portugese landing in Japan, was not introduced to Japan at that time.

Divided for many years by local warlords, Japan came to be unified first by Oda Nobunaga (*1*), who had acquired many guns, and later by Toyotomi Hideyoshi, who succeeded Nobunaga, his lord. After the death of Hideyoshi, Tokugawa Ieyasu, one of the warlords, was

THE GRANGER COLLECTION

Tokugawa Ieyasu, appointed shogun in 1603. Under the Tokugawa shogunate, Japan entered a period of national seclusion that lasted over 200 years.

appointed shogun by the Emperor in 1603. His descendants, the Tokugawa family, continued to rule the country until 1867.

The interchange with Portugal and other European countries, which had such a great influence on Japanese learning and technology, lasted no more than 100 years. Under the Tokugawa shogunate, with the prohibition of Christianity, Japan entered a period of national seclusion. By 1639, edicts had been issued under which no Japanese was allowed to leave or return to Japan, and the Spanish and Portuguese were prohibited entry into Japan. Only the Chinese and Dutch, who had come to Japan solely for trading purposes, were allowed to stay. The Dutch were confined to a small man-made island off Nagasaki, called Dejima, where they maintained a trade office, and they were not allowed to visit the mainland except when they traveled to Edo (present-day Tokyo) to call on the shogun. This situation lasted for over 200 years, until the arrival of an American fleet in 1853 and the subsequent signing of the Treaty of Peace and Amity between the United States and Japan.

During the period of Japan's national seclusion, Europe produced many eminent scholars, such as Newton, Lavoisier, and Linnaeus, and saw great scientific progress; meanwhile, in Japan, due to the severe restriction of exchange with Europe, European learning waned year by year. Engelbert Kaempfer, who stayed in Japan from 1690 to 1692 as a physician of the Dutch trade office, gathered an astonishing amount of information about the country and later published a book entitled *History of Japan*. Notably, the book contains no accounts of exchanges with Japanese scholars, except for one reference to a physician of the shogun who sought medical advice during one of his two visits to Edo in the company of the chief of the Dutch trade office.

However, in 1716, when Tokugawa Yoshimune assumed power as the eighth shogun, the domestic situation began to change. Yoshimune tried to absorb knowledge of European civilization from the chief of the Dutch trade office when he traveled to Edo. He also placed orders for books and various goods from Europe and encouraged the study of the Dutch language. When he embarked on calendar reform, he received a suggestion that the new calendar should not be based on Chinese calendar theory, which had many errors, but should be based on European theory. Yoshimune subsequently authorized the importation of Chinese translations of European scientific books that were unrelated to Christianity. The government had long maintained a policy of minimizing contacts between Japanese and foreigners, but from this period onward, a willingness to learn from advanced European science began to appear.

There were changes in the field of medicine, too. Some physicians who had been trained in Chinese medicine began to question its validity, turning instead to the concept of trial and experimentation and showing great interest in the accurate anatomical drawings in Dutch medical books. Among such physicians was Yamawaki Toyo, a court physician in Kyoto. He observed the first officially approved dissection of the human body and, for the first time in Japan, published in 1759 the record of the dissection in several anatomical illustrations under the title of *Zoshi* (*Record of Internal Organs*). However, because virtually no physicians in those days could read Dutch books (with the exception of some interpreters in Nagasaki who studied medicine under Dutch physicians), they had to satisfy themselves with looking at the illustrations.

It was during this period that *Ontleedkundige Tafelen* (*Anatomical Tables*), written originally in German by Johan Adam Kulmus in 1734, was translated from Dutch into Japa-

Akihito, His Majesty the Emperor of Japan, is an ichthyologist who has published 26 papers in the *Journal of the Ichthyological Society of Japan*. He resides at the Akasaka Imperial Palace in Tokyo.

nese and published under the title of *Kaitai Shinsho* (*A New Book of Anatomy*) by a group of physicians that included Sugita Genpaku, a physician of the lord of Obama. The impetus behind this translation was an invitation extended to Genpaku and two fellow physicians, Maeno Ryotaku and Nakagawa Jun'an, to witness the dissection of the body of an executed criminal. They took with them Kulmus's *Anatomical Tables* and noted, first, that the drawings in the book were extremely accurate and, second, that what they witnessed was inconsistent with the old Chinese theory.

The next day, Genpaku and his colleagues resolved to translate *Anatomical Tables* and gathered in the house of Ryotaku to begin. Because there was no Dutch-Japanese dictionary in those days, the task turned out to be a succession of tremendous difficulties. Ryotaku had some knowledge of the Dutch language from his studies in Nagasaki, but Genpaku, who was almost 40 years old then, had not learned even the alphabet. Later, reminiscing about the experience, Genpaku wrote in his book *Rangaku Koto Hajime* (*The Beginning of Dutch Learning*) that he and his colleagues had struggled with a sentence as short as "The eyebrows are the hair growing above the eyes" throughout a long spring day and at nightfall were still unsure of its meaning. *A New Book of Anatomy* was finally published in 1774, 3 years after the translation was begun.

THE GRANGER COLLECTION

Dutch and Chinese ships in Nagasaki Harbor, 17th century. During the period of national seclusion, only the Dutch and Chinese, who had come to Japan solely for trading purposes, were allowed to stay. The Dutch were confined to a small man-made island off Nagasaki, called Dejima, where they maintained a trade office.

The publication of *A New Book of Anatomy* held great significance for the subsequent development of science in Japan. First, it revealed errors in Chinese medical books that had previously been the sole source of information for Japanese physicians and illustrated the importance of learning by direct observation and of having an open mind. For example, *A New Book of Anatomy* points out that even upon witnessing a human dissection, one cannot accept what was actually seen if the mind is framed with the traditional ideas. Thus one cannot step into the world of new medical science unless the old notions are given up and the mind undergoes a complete transformation.

Second, it served as a focal point for gathering physicians in Edo who shared a common interest in European science. Many of these later made significant contributions to the development of Dutch studies as well as of European medicine in Japan.

Third, Genpaku was mindful of contributing to society through the translation. He hoped to make the book available to the public as soon as the translation process would allow. He differed on this point not only from Ryotaku, who attached greater importance to the accuracy of the translation, but also from the general practice in those days, where a physician used to refer to his skill as belonging to a certain school and to confide his knowledge as secrets to only his disciples.

Furthermore, Genpaku wished his work to be useful not only for the Japanese but also for the people in China. *A New Book of Anatomy* was written in classical Chinese, which well-educated people in Japan used to read, and though it is not clear whether this book was actually read in China, some Chinese terms that Genpaku created in the process of translating Dutch words, such as the word for "nerve," shinkei, are commonly used today both in Japan and in China. One can feel here his aspiration for the progress of universally applicable medical science.

In the final section of *The Beginning of Dutch Learning*, Genpaku looks back with satisfaction over his long life of over 80 years. He likens the translation of *A New Book of Anatomy* to a drop of oil spreading across the face of water and expresses his joy at seeing Dutch learning spread through Japan, with new translations being published year by year, thanks largely to peace in the nation.

Genpaku thus made a great contribution to Japanese medical science and to the development of Dutch learning. His contribution, however, was through educating and not through his own medical achievements.

Kagawa Gen'etsu is an example of a man who contributed to the advancement of Japanese medicine through his own research and medical practice as an obstetrician. Gen'etsu was born in 1700, 33 years before Genpaku. It is said that Gen'etsu studied medicine in Kyoto, while supporting himself as a second-hand copper-ironmonger and as a masseur-acupuncturist, and that he had no particular teacher. Although he could not read Dutch, he referred to Dutch medical books and also read Chinese medical books. However, Gen'etsu attached utmost importance to what he observed with his own eyes and touched with his own hands. One of his major contributions was the development of a new method for delivering a deceased fetus with an iron hook when the mother's life was in danger. With Gen'etsu's method it became possible for the first time to save the mother's life.

Gen'etsu published his work, *Sanron* (*Theory of Obstetrics*), in 1765. In this book he described his own finding that a child in the mother's womb is normally positioned head downward. In *A New Book of Anatomy*, which was published nearly 10 years after the publication of *Theory of Obstetrics*, Genpaku commented that he had doubted Gen'etsu's theory because it was different from the traditional view and because he could not find corroboration in various Dutch books of anatomy. Genpaku later had occasion to look at an English book on obstetrics whose drawings confirmed Gen'etsu's theory. Realizing his mistake, Genpaku praised Gen'etsu's achievement, admitting that he had been wrong to doubt the theory and expressing regret that he had doubted so easily something that he had never seen and had been unable to verify.

What Genpaku and Gen'etsu shared in common was a love for people. We can see Gen'etsu's attitude in his last instructions, expressed in a poem that can be translated, "Pursue my way which fulfills the blessings of the heaven and earth, and save the people." At about 70 years of age, Genpaku wrote in his book, *Keiei Yawa* (*Night Dialogues with My Own Shadow*), "If you are entrusted with a patient, you must look on him exactly as you would your sick wife or child, and must treat him with deep thought and utmost kindness. Whether your patients are very poor and mean, or very rich and of high rank, you should give them exactly the same medical treatment and should never distinguish between them."

After the mid-18th century, the European influence on science in Japan became much more pronounced. It was during this period that Carl Peter Thunberg, who studied under Linnaeus and who later became a professor at the University of Uppsala in Sweden, came to Japan as a physician of the Dutch trade office in Nagasaki. The purpose of Thunberg's visit, 1 year after the publication of Genpaku's *A New Book of Anatomy*, was botanic research, and, even under the severe restriction of national seclusion, he managed to collect large numbers of plant and animal specimens. His books *Flora Japonica* and *Fauna Japonica*, published upon his return home, featured 812 and 334 specimens, respectively. Although he stayed in Japan for only 1 year (1775 to 1776), he published a detailed account of his travels here. In this book he commented that "the sciences in general fall infinitely short in Japan of that exalted preeminence, to which they have attained in Europe" but that "arts and manufactures are carried on in every part of the country, and some of them are brought to such a degree of perfection, as even to surpass those of Europe" and that "they work extremely well in iron and copper."

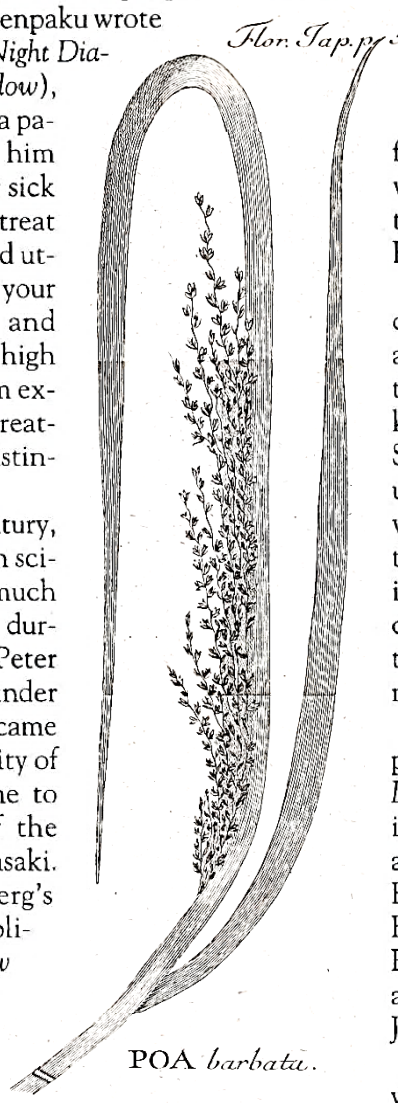

Illustration from Carl Peter Thunberg's *Flora Japonica*.

Thunberg accompanied the chief of the Dutch trade office on his trip to Edo, which gave Japanese scientists an opportunity to meet with him. Among those who visited him in Edo were two physicians who worked on the translation of *A New Book of Anatomy*, Katsuragawa Hoshu, the shogun's physician, and Nakagawa Jun'an, who served the same lord as Genpaku. Of these physicians Thunberg wrote, "the two physicians at court, my much beloved pupils, who visited me almost every day, had, through my assiduous pains, and their own unwearied endeavors, made considerable advances in the science." Hoshu, on his part, commented about Thunberg that he had never met a man with so much deep knowledge of such a wide range of academic subjects. There was a remarkable difference in the Japanese attitude toward European scientists at that time compared with the time of Kaempfer's stay in Japan.

Hoshu and Jun'an maintained communication with Thunberg even after his return home, and some of the letters they wrote to him are kept in the University of Uppsala. Several years ago, when I visited the university, I saw these letters and was deeply moved by the thought that so many years before, even during the time of national seclusion, communication had been maintained in this way between the Japanese and Swedish scientists.

As Genpaku wrote with great pleasure in *The Beginning of Dutch Learning*, major advances were made in the early 19th century as more and more books in various fields of European science were published. However, it was difficult to learn European science solely from books, and there were few Europeans in Japan to teach it.

This situation changed greatly when Philipp Franz von Siebold arrived in Japan in 1823 as a physician of the Dutch trade office. His mission, defined by the chief of the trade office, was to teach the Japanese who were willing to study medicine and other sciences and to render services to those who sought medical care. As the restrictions of national seclusion were somewhat relaxed in those days, Siebold was able to go out of Dejima to teach. During his 5-year stay, Siebold's disciples numbered over 50, and many others maintained communication with him.

Twenty years later, Japan signed a treaty, first with the United States and then with European countries, that brought an end to the national seclusion policy that had lasted over 200 years. Then, in 1867, political rule was transferred from the fifteenth and last shogun, Tokugawa Yoshinobu, to the new government, which was established under Emperor Meiji, who had just acceded to the throne at the age of 15. The new government instituted a centralized school system that included universities and that incorporated small-scale private schools and schools run by local lords which until then had operated independently. Under this new system, the study of Western science was strongly encouraged. In 1871, Yamao Yozo, later Minister of Public Works and the president of the Japan Federation of Engineering Societies for 36 years, who had studied at the University of London and had learned shipbuilding as an apprentice in Glasgow, made a strong recommendation for the establishment of an engineering school, saying, "Even if there is no industry at present in Japan, if we train a man, he will find an industry." These words convey the vigorous spirit and energy of those days. With many surrounding countries being colonized, the Japanese yearned for peace and development of their nation. Those who studied Dutch learning and European science not only worked for the advancement of science in Japan but also, with their knowledge of world affairs, had a profound influence on the opening of the nation to the world and its future course.

Fukuzawa Yukichi, the founder of Keio University and an individual who had a great impact upon Japan as she was establishing her new national order, was among those who spent their youth at a school for Dutch learning. In 1890, the year when the Imperial Diet was first convened in Japan, Yukichi recollected in his preface to the second edition of *The Beginning of Dutch Learning* (2) that "each time we read the book we thought of the great difficulty these pioneers had gone through, were surprised by their intrepidity, and were deeply moved by their fervent passion, and everyone would weep with emotion." He continued, "This book will not only spread all over Japan the story of the great efforts our forerunners made, but also it will show to the people of the whole world the fact that in Japan, a country of the Far East, Western civilization germinated and took root in the academic community as early as more than a century ago, and that the rapid progress she is making today is not by accident."

Another 100 years have passed since then, and it is a matter for rejoicing that, thanks to the efforts of many scientists, science in Japan has continued to make steady progress and has become able to contribute to the world's scientific community. At the same time, I cannot help recalling, with a sense of gratitude and respect, those people who exerted their untiring efforts for the development of science in Japan at its infant stage, under the severe conditions of national seclusion, without a teacher, and relying solely on books that were brought from Europe.

NOTES

1. All Japanese names are given family name first, in Japanese style.
2. *The Beginning of Dutch Learning* existed only in handwritten form until 1870.
3. I thank Y. Kimura, S. Ito, T. Haga, and Y. Murakami for critical comments on the content of this essay and Y. Karita and J. J. Boccellari for help with the English manuscript.