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OF KOBANS IN THE YEDO PERIOD**

Michio Ueda* , Isamu Taguchi, and Tsutomu Saito*****

ABSTRACT

In the early modern times of Japan ruled by Tokugawa Shogunate, the oval-shaped gold coin named Koban was used as a means of payment. The Koban was an artificial alloy of gold and silver, and went through a series of recoinages changing drastically in fineness and weight, but no precise information on the fineness was released by the Tokugawa Shogunate. To shed light on this issue, the authors have conducted non-destructive analysis of the Kobans of the Yedo Period, which is a new analytical tool for examining the physical composition of the test material.

In this paper, four objectives are set to clarify the following questions: 1) to confirm the fineness of the Kobans in the Yedo Period, 2) to classify the Keicho Kobans which have 95 years' history by the fineness and the time of minting, 3) to distinguish between the Shotoku Koban and the Kyoho Koban that resemble each other extremely in appearance, and 4) to clarify the features of the surface treatment called "color dressing."

KEY WORDS: Gold Coin; Koban; Non-destructive Analysis

JEL CLASSIFICATION: N2

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1. Introduction

In the Tokugawa Shogunate rule of Japan from 1600 to 1868, gold and silver coins were used as general payment media. The Koban, the representative oval-shaped gold coin of the Yedo Period was not pure gold but an artificial alloy of gold and silver, and circulated as money by tale in the market. It gives the Tokugawa Shogunate government an authority to set the fineness of the Koban at discretion by changing the gold content. In fact, the Koban went through a series of recoinages from the first Koban, the Keicho Koban, to the Man'en Koban of the end of the Yedo Period, changing drastically in fineness and weight, but its face value remained unchanged at one ryo as the basic unit of money. But the general public had no means of knowing the fineness precisely at the time as the Yedo Shogunate government kept it strictly confidential.

In the Meiji Era, the new government published the fineness of gold and silver coins circulated in the Yedo Period and studies of the relevant historical records preserved by the Shogunate Gold Mint revealed the fineness of these Kobans fairly clearly. But much obscurity still surrounds those of the early Yedo Period, for which records at the time of minting are scarce. Some chemical analyses were conducted in the Meiji Era by melting Kobans, but the results of these analyses were not adequate and there is still room today for further research on the Koban's fineness in the Yedo Period.

To shed light on this issue, we have conducted non-destructive analysis of Kobans of the Yedo Period that have been preserved by the Institute for Monetary and Economic Studies of the Bank of Japan. Non-destructive analysis is a new analytical tool for examining the physical composition of the test material by irradiating it with electron or other beams from outside, thus avoiding melting or cutting it. It was conducted by the National Museum of Japanese History. Thus, this paper is a joint study by the Bank of Japan and the National Museum of Japanese History. Michio Ueda traces the development of the recoinages in the Yedo Period and summarizes the issues to be resolved. Isamu Taguchi who was then affiliated with the National Museum of Japanese History conducted non-destructive analysis in collaboration with Tsutomu Saito. And they finally interprets the results jointly. Application of non-destructive analysis to the Koban is unprecedented and this analysis may be regarded as a milestone on the road to the development of a new frontier in the field of numismatics in Japan.

The points that have been clarified by our analysis are summarized below in advance:

(a) For any particular type of Koban in the Yedo Period, the fineness shows a very small variation suggesting a high level of minting technology in that period, though there are considerable differences in fineness between different types of Koban. This analysis also confirmed the validity of the records kept in the Yedo Period and of the analytical results conducted in the Meiji Era.

(b) Although the literature indicates that the Keicho Koban's fineness was improved during the 95 years of mintings, we could not find a significant correlation between the features on the surface of the coins and their fineness. The classification of these Kobans by the criterion of the time of minting remains as a task for future research.

(c) The Shotoku Koban and the Kyoho Koban resemble each other extremely closely in appearance and no definite criterion had been found to distinguish between them, though it had been suggested that the spatial relationship of two Chinese Characters "Mitsu" and "Tsugu" on the obverse of the coin could be used for this purpose. Through our analysis we found convincing evidence supporting the validity of this criterion for the distinction of these two types of Kobans.

(d) A surface treatment called "color dressing" was given to the Kobans in the Yedo Period to raise the gold content in the surface layer. Our analysis revealed specific features of this color dressing treatment such as the thickness of the color dressed surface layer and the difference between the gold content of this layer and that of the remainder of the coin. It is likely that this color dressing was practiced at the time of the Keicho Koban before a series of recoinages that started with the Genroku Koban.

The structure of this paper is as follows: After a short summary of the history of issuance and repeated recoinages of the Koban in the Yedo Period in Section 2, Section 3 reviews the relevant literature on the fineness and identifies the issues to be resolved. Four objectives are set to clarify the remaining questions: 1) to confirm the fineness of the Kobans in the Yedo Period, 2) to classify the Keicho Kobans by the fineness and the time of minting, 3) to distinguish between the Shotoku Koban and the Kyoho Koban, and 4) to clarify the features of the color dressing. Then in Section 4, the results of non-destructive analysis are explained, followed by attempts at clarification of the above questions on the basis of these results.

2. History of Issuance and Recoinages of the Koban

(1) Issuance of the Keicho Koban

In the year Bunroku 5 (1596), Ieyasu Tokugawa minted and issued a Koban, later called the “Musashi Sumigaki Koban,” as money to be circulated in the 8 provinces in the Kanto Region which he held at that time. This was an oval-plate gold coin whose obverse bore hammer marks, the imprint of the heraldic emblem of a paulownia named “Go San no Kiri” at the upper end and the lower end, the Chinese characters “Ichi Ryo (the unit value of one ryo)” and “Mitsu Tsugu (a master name of Gold Mint)” and its signature stamp, and the brush written Chinese characters “Mu Sashi” in ink. This became the prototype of a series of Kobans issued in the Yedo Period.

The “Musashi Sumigaki Koban” stopped bearing the easily-erased brush written characters on the obverse and was replaced in Keicho 5 (1600) by the “Keicho Kochu Koban (old Keicho Koban)” which had an imprinted stamp instead of the brush written characters, followed in the subsequent year Keicho 6 (1601) by the minting of the Keicho Koban which circulated on a nationwide basis for the first time. Kobans were called “Keicho Koban” or “Genroku Koban,” the prefixed name being that of the “era” when that type of coin was first minted. These are not the original names at the time of minting, but ones given at a later time.

Between the beginning and the end of the Yedo Period, 10 types of Kobans were issued from the first Keicho Koban to the last Man'en Koban and the major features of these coins are described in **Table 1**. As for the morphology of the Kobans, in spite of a series of recoinages, the essential features such as the shape and the imprints that were determined for the Keicho Koban remained generally intact through to the Man'en Koban (see **Figure 1**).

(2) Recoinages in the Genroku Era and the Hoei Era

By monopolizing the authority to issue money, the Tokugawa Shogunate government could obtain the seignorage from the issuance of money (the difference between the face value and the minting cost of the money), a rich source of fiscal revenue. With the establishment of the monetary system in the Keicho era, a monetary economy started to expand rapidly and money supply increased accordingly.

As a result, an enormous amount of seignorage accrued to the Tokugawa Shogunate government. But, owing partly to squandering, the fiscal expenditure constantly expanded, and the fiscal conditions of the Shogunate government became extremely tight by the Genroku era. The Shogunate government decided to tide over the fiscal crisis by debasing the fineness of the gold and silver coins and carried out this recoinage in Genroku 8 (1695), the first since the establishment of the Tokugawa Shogunate government. The coins minted at this time were the Genroku gold and silver coins and in the case of the Koban, though the shape and the size remained the same as those of the Keicho Koban, the fineness was lowered from the range of fineness 52.2 -- 50.7 monme¹ (84.3% -- 86.8%) to about fineness 76.7 monme (57.4%).

By the recoinage, the fiscal conditions of the Shogunate government gained a breathing space, but an expansion of expenditure to cope with big earthquakes and other expenditure demands aggravated them again. For this reason, a recoinage of the Koban was carried out in Hoei 7 (1710). Learning from the experience of the recoinage of the Genroku Koban, which had turned out to be very unpopular, the fineness itself was said to be restored to the level of the Keicho Koban (84.3%), but the size of the coin was reduced making the amount of pure gold per coin still lower than the Genroku Koban to the level of about a half of the pure gold contained in the Keicho Koban (the amount of pure gold per coin falling from a range of 15 -- 15.5 grams for the Keicho Koban to 10.2 grams for the Genroku Koban to 7.8 grams for the Hoei Koban).

(3) Recoinages in the Shotoku Era and the Kyoho Era

As the recoinage in the Genroku era and the Hoei era caused havoc, in the form of a sharp rise in prices, the Shogunate government decided to remint the gold and silver coins and to restore their fineness to the levels in the Keicho money system. A "return to the monetary standard set by the founder of the Shogunate government"

¹ In the Shogunate Gold Mint of the Yedo Period, the fineness of Koban was expressed by "monme" of gold-content. This is a unique way of expressing the fineness of Koban the "miscellaneous mixed metal adding method" or "supplementary silver adding method". In this method, 44 monme fineness is the fineness of pure gold, and the fineness of the coin is expressed by the total of the weight of the pure gold and the weight of the added miscellaneous metals. That is to say, "the fineness of 50 monme" means that the coin is composed of 44 monme of pure gold and 6 monme of miscellaneous metals. This measure is converted to the percentage by the following formula. $\text{Percentage} = (44/\text{xx monme fineness}) \times 100$. cf. *Za Kata San Po* (Mathematics for the Mint Officials) Hoei 9 (1759) and others.

was first proclaimed in Shotoku 2 (1712). That is to say, the gold content of the Koban should be restored to the level set by Ieyasu Tokugawa's Keicho Koban. In the subsequent year, Shotoku 4 (1714), the Koban was reminted (the recoinage of the Shotoku era) and issued as the Shotoku Koban, which was of the same size and fineness as the Keicho Koban. According to the historical records kept by the Shogunate Gold Mint, *Kin'i Narabini Kin Fukikata Tetsuzuki Sho* (Fineness of Gold Coins and a Manual for Minting Homogeneous Gold Coins), the fineness of the Shotoku Koban was to be 84.3%.

From Shotoku 4 to throughout the Kyoho era, there was no proclamation of any further recoinage. But according to the book cited above, the fineness was raised in the following year (Shotoku 5) from 84.3% to 86.8% as there was a widespread suspicion among the people that the fineness of the Shotoku Koban was slightly lower than that of the Keicho Koban, and the reminted coin was called the Kyoho Koban. Discrimination between the two, however, has so far been considered to be difficult even though they were distinct, since there was almost absolutely no difference in appearance.

(4) The Gembun Koban to the Man'en Koban

There was a series of recoinages after those of the Shotoku era and the Kyoho era until the end of the Tokugawa Shogunate government, in all of which Koban were degraded by reducing their gold content. In Gembun 1 (1736), the Shogunate government reduced the size and lowered the fineness from about 87% (gold content of 15.5 grams) to about 66% (gold content of 8.6 grams), proclaiming that "the government has decided to remint coins as it hears of inconveniences among the people caused by the shortage of coins in circulation." It was aimed at expanding money supply and as the money supply was more or less consistent with the economic conditions at that time, the Gembun Koban circulated stably for about 80 years. But in the 19th century, the Shogunate government finances became tight again owing to a series of natural disasters. Thus the Shogunate government sought a new source of revenue in a recoinage and carried it out in Bunsei 2 (1819), reducing the fineness of the Koban from about 66% to 56%. In the following Tempo era, the Shogunate government again fell into a fiscal crisis owing to the outbreak of great famines and carried out the Tempo recoinage in Tempo 8 (1837), lowering the gold content per coin from 7.3 grams to 6.4 grams by reducing the size of the coin.

The recoinage at the end of the Yedo Period was caused not only by the fiscal difficulties of the Shogunate government, but also by the resumption of trade with foreign countries. As the exchange rate between gold and silver in Japan then was 1 to 5.9 (between the Tempo Koban and the Tempo Ichibu silver coin) while it was 1 to 15 or 16 in foreign countries, a problem arose of a massive inflow of silver coins from abroad to Japan and a massive outflow of Kobans from Japan to other countries. Thus in order to narrow the gap between the exchange rate in Japan and that in foreign countries, the Ansei Koban was minted, which kept the same fineness as the Tempo Koban but was approximately 20% smaller, thereby reducing the gold content per coin, but the outflow of Kobans did not stop. In the end, another recoinage was carried out in Man'en 1 (1860) and the Man'en Koban was issued with a drastic reduction in the amount of gold per coin, to about one third the previous level, and with this recoinage the outflow of Kobans finally stopped. This Man'en Koban, the last Koban of the Yedo Period, though it kept the fineness at about 57%, equal to that of the Kobans of the Tempo and the Ansei, was a mere one third of the size of the Ansei Koban with a pure gold content of only 1.9 gram, or one eighth that of the first Koban, the Keicho Koban.

3. Unresolved Issues Concerning the Fineness of the Kobans of the Yedo Period

(1) Fineness of the Kobans of the Yedo Period

A. Fineness Recorded in the Old Literature

Though the Tokugawa Shogunate government carried out a series of recoinages of the Kobans, the fineness of the coin was never published, as was pointed out earlier. But literature such as the manuals for minting of Kobans used at the Shogunate Gold Mint, which was responsible for minting of Kobans at that time, left detailed records. The most valuable record among them is *Go Shoku Hi Kan* (A Collection of the Secrets of Our Trade, year of compilation unknown) that is the record left by the Sakakura family who held the position of minting master of Kobans at the Shogunate Gold Mint from the beginning of the Yedo Period and were officials, of the Shogunate Gold Mint after the middle of the Yedo Period, *Za Kata San Po* (Mathematics for the Mint Officials, 1759) by the Nagano family and others, *Kin'i Narabini Kin Fukikata Tetsuzuki Sho* (Fineness of Gold Coins and a Manual for Minting Homogeneous Gold Coins, 1790) which was submitted by the Shogunate Gold

Mint to the Shogunate government in the Kansei era and *Kin Kyoku Hiki* (Secret Records of the Gold Mint Bureau, year of compilation unknown) which is a record of the Kobans of the Bunsei era and the Tempo era. Though these records have some small differences in details, they are generally consistent with each other and seem to be reliable.

After the Meiji Era started, the Meiji government compiled *Naikoku Kin Kahei Hyo* (The Table of Domestic Gold Coins, 1868) on the basis of the past records when it liquidated the old money to carry out the monetary reform. Subsequently *Kyu Kahei Hyo* (The Old Money Table, 1873) was compiled by Chuzaburo Sato, a former official of the Shogunate Gold Mint and provided additional information such as the volumes minted of different types of coins. These tables seem to have been compiled on the basis of the historical documents preserved by the Shogunate government and the Shogunate Gold Mint, but such older documents as *Go Shoku Hi Kan* and others do not seem to have been fully taken into consideration.

B. Fineness of the Kobans as Determined by Analytical Experiments

The Meiji government conducted fairly large scale elementary analysis (melting analysis) of the coins of the Yedo Period at the Mint House (later the Mint Bureau) in the first years of the Meiji Era and in the period of Meiji 20s and 30s (1888 ~1908). The aim was to determine at what price the government should purchase the money circulated during the Yedo Period before melting the old coins and issuing new money under either the silver standard or the gold standard system. The results of the analyses conducted in the beginning of Meiji Era were summarized in *Dajokan Fukoku Dai 93 Gou* (The Cabinet Declaration No. 93 of Meiji 7, 1875) and a report of the data obtained through an independent analysis conducted by Dillon, a foreign specialist employed by the Mint House was published in *Nihon Osaka Kokoku Zoheiryō Syucho Dai San Syunen Hokoku Syo* (The Third Year Report by the Director of the Mint House of Imperial Japan, 1874). Further analyses were conducted in the periods of Meiji 20s and 30s by Nobumasa Koga (called the Koga analysis below), manager of the Division of Gold Coin at the Mint House and the detailed records of the analyses are preserved in *Kokingin Chosa Meisai Roku* (The Detailed Report of the Investigation of Old Gold and Silver Coins, 1930). As Kobans are valuable as historical materials, the melting of Kobans is undesirable and there has been no large scale analysis since.

Table 2 summarizes the records in a variety of old literature as well as the

results of different chemical analyses. As is clear from this table, a rough consistency is observed in the data provided by the historical documents compiled by the Shogunate Gold Mint. The results of the chemical analyses after the Meiji Era generally endorse the data given by the Shogunate Gold Mint, but the coverage of these analyses was limited. Particularly, the Koga analysis tested only six out of ten types of Kobans. This is why it is necessary to conduct analyses of all types of Kobans using modern analytical techniques to answer the remaining issues.

(2) Fineness of the Keicho Kobans and their Classification by the Time of Minting

As to the Keicho Kobans, the issues to be resolved are first what was the official fineness (standard fineness for minting) and secondly whether or not there was a difference between the fineness of the coins minted at an earlier time and those minted later. There was no definite standard for the Keicho Koban in the earlier years of minting, but it was in general roughly 84.3%. After Mitsutsugu III, succession as the Master of the Shogunate Gold Mint in Kan'ei 18 (1641), it may be deduced to have become 86.8%.² To confirm this point, an analysis should be conducted to compare the early minted Kobans and the later minted Kobans. Unfortunately, it is not easy to determine the time of minting of a Keicho Koban, for reason, which will now be discussed.

The period of minting of the Keicho Kobans lasted for a long time span of 95 years and there is considerable variety in the external features of the coin. So the question is whether or not the time of their minting can be identified and classified by their external features. Along this line of reasoning, the external features of the Keicho Koban and the Kobans minted in and after the Genroku era are compared and the following changes over time in the external features can be detected to some extent: (a) There is variation in the number of the horizontal cut marks engraved on the surface of the Keicho Kobans; those with dense horizontal cut marks have more than 20 lines per centimeter, and those with less dense horizontal cut marks only 5 to 6 lines per centimeter. But generally the Kobans minted in and after the Genroku era have less dense horizontal cut marks, with 4 to 6 per centimeter. (b) The location and the

² A detailed research has been done on the official fineness of the Keicho Kobans by exploring the records of the Shogunate Gold Mint and it concludes that the official fineness was 86.8%. For your reference, see Taya (1973).

number of the seals of approval by the Shogunate Gold Mint are irregular for the Keicho Kobans, but those minted in and after the Genroku era always have two seals at the same location on the left side. (c) The Keicho Kobans with less dense horizontal cut marks have two seals of approval at the left side. (d) The Keicho Kobans with the highest density of horizontal cut marks resemble the older Keicho Kobans. On the basis of these four kinds of evidence, one might be able to conclude that the horizontal cut marks on the Keicho Kobans gradually changed over time from the more dense to the less dense and from variable location and number to a fixed location and number of seals of approval.

The speculation above is not endorsed by any direct evidence and remains a mere hypothesis. But in the current situation where no criterion has been established to distinguish the earlier Keicho Kobans from the later Kobans, the criteria of the number of the horizontal cut marks and the location of the seals of approval may constitute significant criteria to some extent. By our non-destructive analysis, we will try to test the validity of the hypothesis above for the identification of the time of minting as well as to clarify the fineness of those coins of the Keicho era.

(3) Distinction between the Shotoku Koban and the Kyoho Koban

The distinction between the Shotoku Koban and the Kyoho Koban has been considered difficult in the past. Only after the Second World War was an effective method of distinction proposed in numismatics circles.³ The method proposes to name as “Shotoku Koban” coins having the seal of approval imprint on the surface of two overlapping Chinese characters “Mitsu” and “Tsugu”⁴ (overlapping Mitsu Tsugu) and as “Kyoho Koban” those with the two Chinese characters separated (separated Mitsu Tsugu) (see **Figure 2**). This characteristic is consistent with the illustrations in *Dai Nippon Kahei Shi* (History of Money in Japan, 1876) and this method has received general support. To be fair, this method does not provide direct proof and is of the nature of circumstantial evidence. On the other hand, there is no reason to reject this

³ The numismatist Hiroshi Ogawa found this criterion of “overlapping Mitsu Tsugu” while judging the values and features of the requisitioned the precious metals together with Isao Gunji after the Second World War and advocated this method of distinction. cf. Ogawa (1964).

⁴ There is an imprinted seal with the characters “Mitsu Tsugu” on the obverse of the Koban. This is the name of the first generation mint master of the Goto family, “Shozaburo Mitsutsugu.” The same name continued to be used by the second generation and thereafter as a seal of the Goto family of the Shogunate Gold Mint.

method either. If the difference in fineness between these two types of Kobans is proven by the analytical experiment to be consistent with the descriptions in the old literature, it will provide strong support for the validity of the criteria for distinction described above.

(4) Color Dressing of the Koban

In spite of enormous differences in the fineness of the Kobans created by a series of recoinages, the color of the surface did not deteriorate much and the surface generally shines with a golden color. The Kobans of low fineness, namely the Genroku Koban and the Gembun Koban do look slightly inferior in the surface color to other types of Kobans, but other Kobans minted in and after the Bunsei era show just as beautiful a golden color as the high fineness Keicho and Kyoho Kobans even though their fineness is even more inferior.

This phenomenon is produced by the last process in the minting of the Koban called "color dressing" (color improvement or coloring). This process dissipates the silver element on the surface of Koban by heating it after coating the surface with chemical substances. This process seems to be unique to Japan in the history of minting and we have not heard of any similar instances in other countries. Dillon, a foreign technical adviser employed by the Japanese government in the early Meiji Era, refers to the process of color dressing in the report cited above as hearsay from others.

In *Go Shoku Hi Kan* (A Collection of the Secrets of Our Trade), there is a record of loss of weight of the Kobans due to the color dressing treatment (refer to **Table 3**) as part of the description about the loss of weight during the minting process; for example the Genroku Koban lost 0.21 % of its weight and this loss is considered to be caused by the silver dissipated in the process of color dressing. The comparison on the basis of this record shows little loss of weight for the high fineness Kobans of the Hoei era and the Kyoho era and more loss of weight for the low fineness Kobans of the Genroku era and the Gembun era. In other words, the lower the fineness of the Koban, the more weight was lost, which suggests that more thorough color dressing was applied to the lower fineness Kobans.

Though it is confirmed by the old literature that the Kobans of the Genroku era and thereafter were color-dressed, it is not clear whether this treatment was applied also to the Keicho Koban. If the purpose of the color dressing was to give a false

impression by coating the surface of debased Koban which naturally looked inferior, then it has generally been considered that the high fineness Keicho Koban did not require such a treatment. *Kin'i Narabini Kin Fukikata Tetsuzuki Sho* (Fineness of Gold Coins and a Manual for Minting Homogeneous Gold Coins) also referred to the color dressing. It has also been argued whether or not there is a basic technological difference in the color dressing of Koban of the Bunsei era and thereafter from that of earlier eras. But though this color dressing is an interesting subject from the view points of both the history of technology and the history of monetary policy, there was almost no positive analysis conducted on the color dressing. Even the reports of analyses in the Meiji Era do not mention the color dressing at all. This is owing to the fact that it was technically difficult to analyze the fineness of the surface and that of the inner part of the Koban separately. In our non-destructive analysis, we tried to clarify the features of the color dressing of the Kobans by measuring the change in the fineness of the Kobans from the surface layer to the inner part.

4. Results of the Non-destructive Analyses

(1) Objects of the Analyses

The Kobans used for the analyses are a total of 39 coins of 10 types ranging from the Keicho Kobans to the Man'en Kobans preserved by the Bank of Japan. For each type of Koban, the representative external features were chosen. For the Keicho Kobans, gold coins estimated to have been minted at an earlier time and at a later time were both chosen to test the difference in fineness for different times of minting. As to the Kyoho Kobans, those minted in Sado Island were also included in the analyses for the sake of additional information. The size, weight and external features of the Kobans used for the analyses are shown in **Table 4**.

(2) Analytical Methods

The analyses and measurements were conducted primarily by electron beam excitation X-ray analysis. X-ray fluorescence analysis and Auger electron analysis were used jointly with it. A simple explanation follows below for each of these methods.

(a) Electron Beam Excitation X-Ray Analysis

Electron beam excitation X-ray analysis measures the characteristic X-rays emitted from the specimen by an energy dispersive X-ray spectroscope with a scanning electron microprobe when the specimen is placed in a vacuum and irradiated with beam of electrons. As the characteristic X-rays have the energy unique to the elements contained in the specimen, it becomes possible to quantify the chemical composition of the specimen by measuring the intensity of the characteristic X-ray of each element. The measured part of the Koban is about 0.6 micrometers deep and a very tiny area of the surface of 0.3 millimeters \times 0.2 millimeters. This method was primarily used for our measurement of the fineness of Kobans.

Though this analysis measures only a tiny part of the Koban, it is not a serious problem if a number of parts are measured and the results are averaged, as the Kobans are presumed to have a roughly homogeneous composition of gold and silver from the time of melting. The inner part of Koban that reveals in the edge through a scratch or a cut was thus polished to exclude the effect of the color dressing process.

(b) X-Ray Fluorescence Analysis

In method (a), the electron beam is irradiated against the specimen, but X-Ray fluorescence analysis irradiates it with X-ray instead of an electron beam and measures the characteristic X-ray (X-ray fluorescence) emitted from the specimen. In our analysis, the measured part was a circle with a diameter of 20 millimeter on the reverse of Kobans. This method requires only a short time for measurement, but it cannot exclude the effect of the color dressing process as it measures the specimen to the depth of about 10 micrometer from the surface. Because of this shortcoming, this analysis was supplementarily used for the measurement of fineness.

(c) Auger Electron Analysis

This method analyzes the depth profile of the chemical composition by irradiating the surface of the specimen with an electron beam and measuring the electrons (the Auger electrons) emitted from the atoms composing the specimen. A much thinner surface layer can be analyzed than with electron beam excitation X-ray analysis. This was used to illuminate the treatment of color dressing as it can investigate the changes of composition from the surface to the inner part if it is employed jointly with ion sputtering (which peels off the surface layer atoms bit by bit

by irradiating it with such elements as argon). But this analysis has the shortcoming of taking a long time for measurement and it was used only for a small number of specimens.

(3) The Results of the Analyses and their Interpretation

The results of the analyses are shown in **Table 5** and all specimens are almost exclusively composed of gold and silver. Other than gold and silver, a trace of copper was detected from every specimen, but the amount is so infinitesimal that it can be ignored. Thus only the gold and silver composition is shown. The data on the fineness are all obtained by electron beam excitation X-ray analysis. The data obtained by other analyses are cited supplementarily in the consideration of each separate theme.

A. Fineness of Different Types of Koban

(a) Distribution of Fineness

The fineness of Kobans in terms of the gold content is plotted in **Figure 3** while **Table 5** summarizes the ratios of gold and silver determined by the analyses. From the total picture of this figure, the following confirmations can be made. First, it shows the changes in fineness of Kobans throughout the Yedo Period. Though the fineness of Kobans in the Yedo Period started with a high level of around 85% as in the Keicho Koban, it fell to the low level of 50 odd percent in the Genroku Koban. It was restored to 80 odd percent again in the Hoei Koban and thereafter fell again from the Gembun Koban to the Bunsei Koban and remained at the level of 50 odd percent thereafter to the Man'en Koban, the final Koban of the Tokugawa Shogunate government.

Secondly, the variation in the fineness (official latitude) for each type of Kobans is small and a rough standard value can be specified for each type. To give an example of the Keicho Koban, which provided the greatest number of specimens, the 9 specimens plotted on the figure are concentrated within a narrow range of 83.6% to 86.5% with the largest deviation from the average value being about 2 percentage points (standard deviation 0.9). Incidentally, in England from the 16th to 17th centuries (corresponding to the time under consideration), the official latitude for coins is estimated to be 10 percentage points (Max Weber, *Abriss der universalen Sozial-*

und Wirtschaftsgeschichte) and we can see that the variation in the fineness of the Japanese Kobans was much smaller.

Thirdly, though the fineness was lowered by recoinage, it still remained at between 55% to 60%. As was pointed out above, the surface of the Koban could be finished to exactly the same golden color as the surface of the high fineness Koban thanks to the color dressing treatment. But problems such as breaking and cracking of the Koban could have been reported if the fineness had been lowered excessively. From the practical viewpoint, debasement may have been limited to around 55% gold content.

(b) Comparison with the Data of the Meiji Era

The comparison of the results of our analyses with the data of the Meiji Era is made in Table 6. As the table shows, for those higher fineness Kobans such as the Keicho Kobans, the results of our analyses show slightly lower fineness values and for those lower fineness Kobans such as the Ansei Kobans, they show somewhat higher values. The differences are mostly limited to within the range of ± 1 percentage point except for the Shotoku Kobans. Though the Shotoku Kobans turned out to have a rather large difference of -2.3 percentage points, it may be fair to conclude that this difference of value is of no significance because the data in the Meiji Era on the Shotoku coins was simply borrowed from the analysis of the Keicho Kobans, as was pointed out earlier. Compared with the officially prescribed fineness recorded in the old literature, 3 types of Kobans in and after the Tempo era showed slightly higher values and other types slightly lower values in our analyses. But the differences are small and can be ignored.

Though our analyses are of a limited nature as they are partial analyses by employing non-destructive techniques and used only a limited number of specimens, in general the results of our analyses have mostly confirmed the validity of the data of the analyses conducted in the Meiji Era and the officially prescribed finenesses reported in the old literature.

B. Variation in Fineness of the Keicho Kobans

The average fineness of 9 Keicho Kobans analyzed this time was 85.4% and roughly consistent with the results of the analyses in the Meiji Era. Though this value is higher than the average fineness of 84.3% for the Keicho Kobans reported in the *Kyu*

Kahei Hyo (The Old Money Table) and others, it is lower than the 86.8% reported in the old literature as the so-called “higher fineness.”

As was pointed out above, on the basis of the historical documents compiled by the Shogunate Gold Mint, the fineness of the Kobans minted in the later Keicho era is considered higher than those in the earlier era. To test the differences in the fineness, the relationship between the fineness and the density of the horizontal cut marks and that between the fineness and the location of the seal of approval are plotted in **Figure 4**. These are considered to be the external features that represent the time of minting. If the Keicho Kobans minted earlier have dense horizontal cut marks and low fineness, and those minted later show the opposite features, the figure should show a distribution of dots from the upper left to the lower right. But the results of our analyses did not show such a trend. In the figure, ● represents the Koban with two seals of approval on the left side of its reverse, which are speculated to be those minted in a later part of the period. If the hypothesis that the Kobans minted at a later part of this period should have higher fineness were correct, then the ● marks should concentrate on the right side of the ○ marks, but this is not the case.

The analyses were also conducted to identify the relationship between the fineness and such external features as the height, the shape of the imprint of “one ryo,” the shape of the imprint of the 2 Chinese characters “Mitsu Tsugu,” the size of the signature stamp on the reverse and so on. But we could not get significant data showing a correlation between these features and the fineness of the Kobans. For these reasons, we could not succeed on the basis of the data obtained from our analyses in proving that the fineness improved after his succession of Mitsutsugu in Kan’ei 18 (1641). This implies that we could not confirm our working hypothesis that the time of minting could be identified by the external features of the coins. Thus further analysis will be required to deepen our knowledge of the relationship between the time of minting and the fineness of Kobans.

C. Distinction between the Shotoku Koban and the Kyoho Koban

Comparing the Shotoku Koban with the Kyoho Koban on the basis of the results of our analyses, the fineness of the Kyoho Koban is higher than the Shotoku Koban by about 3 percentage points. This result seems to be consistent with the record in the old literature and suggest that the fineness was further raised when the Shotoku Koban was reminted as the Kyoho Koban. As the Shotoku Koban was

minted as the restored version of the Keicho Koban, it was supposed to have the same fineness as the latter. In the money evaluation made in the Meiji Era, these two types of Kobans were always treated as having the same fineness. But as our analyses show, the fineness of the Shotoku Koban is lower not only than that of the Kyoho Koban but also that of the Keicho Koban. As **Figure 3** shows, it is the Kyoho Koban that has a closer distribution pattern of fineness to that of the Keicho Koban. Thus one may conclude that the restoration of the fineness of the Keicho Koban was finally achieved with the Kyoho Koban.

Before embarking upon our analyses, we classified the specimens as Shotoku Kobans and Kyoho Kobans by the criterion of whether the two Chinese characters, “Mitsu” and “Tsugu” used for the imprint of seals of approval are overlapping or separated. The fact that the two groups showed a clear difference in fineness in our analyses provides strong, though perhaps not conclusive, evidence for the validity of this criterion.

The fineness of the Sado Koban was also analyzed. This Koban is exactly the same in external appearance as the Kyoho Koban apart from the imprint of “Sado” and for this reason it has been categorized in the past as belonging to the Kyoho Koban group. But on the basis of the measurement of the specimen used in our analyses, its fineness seems to be inferior to that of the Kyoho Koban. Further investigation will be necessary in the future to clarify the issue.

D. On the Color Dressing

To investigate the features of the color dressing process, a Kyoho Koban (identification number E2) was chosen. The result of the electron beam excitation X-ray analysis is that the fineness of the polished part of the coin, or the internal part of the coin, is 86.6% but that of the unpolished surface is 98.7%. In other words, this demonstrates that the gold content of the surface of the coin is higher than that of the inner part and that the surface consists of almost pure gold. For further information, this Koban shows 89.8% gold content in X-ray fluorescence analysis. This is owing to the fact that this analysis measures both the surface with high gold content and a considerable depth of an internal part with low gold content together.

To find out the thickness of the surface layer with high density of gold or the color-dressed part, Auger electron analysis (together with the ion sputtering method) was used and **Figure 5** shows the change of the concentration of gold for different

depths vertically from the surface. The figure shows that the concentration of gold gradually declines from the near pure gold of the surface toward the inner part and deeper than about 3 μm the gold content stabilizes. It can be considered that for the approximately 3 μm thick surface layer, silver that was contained in this layer dissipated as part of some chemical compound in the process of color dressing.

Similarly, an Auger electron spectrum analysis was conducted on the Keicho Koban (identification number A8). As was pointed out earlier, if the purpose of the color dressing was to hide the degradation of the surface color at the time of recoinage of the Kobans in the Genroku era, it follows that there was no need to do this for the Keicho Kobans. The fact that the specimen we analyzed this time (identification number A8) is speculated to have been minted early in the Keicho era (though we could not confirm this), however, may suggest that the color dressing was practiced from the beginning of the minting of Kobans. Presumably the purpose was to make the color of the coin as close as to the color of pure gold by this treatment as the coin was a paler golden color being an alloy of gold and silver.

5. Concluding Remarks

The analyses conducted this time were full-scale non-destructive analyses of all 10 types of Kobans in the Yedo Period for the first time by spectrum analysis. The results of the analyses generally proved the validity of the descriptions in the documents compiled by the Shogunate Gold Mint and others. In particular, the following points should be stressed.

First, the difference in fineness between the Shotoku Koban and the Kyoho Koban became clear to some extent. Of course, further investigation as to the validity of classifying them by external features is still needed, but is an important achievement to have classified them into these two distinct groups of Kobans and to have confirmed the difference in fineness between them. Secondly, though limited to only some Kobans, the color dressing treatment was clarified. Though it had been pointed out for a long time that the color dressing was used for Kobans, almost no analysis had been conducted on it.

We have succeeded in answering some of the questions relating to the fineness of the Kobans of the Yedo Period through the analyses. But, we could not clarify the differences in fineness between the different types of Keicho Kobans belonging to the different times of minting. There is still room for further

investigation as to the color dressing of all 10 types of Kobans and the state of technology at the time which could produce the gold and silver alloy coin with very high precision. It will be a future task to expand the range of objects of analyses and carry out more research on these issues on the basis of these results obtained.

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Table 1 Outline Features of the Kobans of the Edo Period

Name	Approximate Weight (g)	Approximate Fineness (%)	Approximate Gold Content (g)	First Year of Minting	Last Year of Circulation
Keicho Koban	17.9	84~87	15.0~15.5	1601 Keicho 6	1738 Gembun 3
Genroku	17.9	57	10.2	1695 Genroku 8	1717 Kyoho 2
Hoei	9.4	84	7.8	1710 Hoei 7	1719 Kyoho 4
Shotoku	17.9	84	15.0	1714 Shotoku 4	1738 Gembun 3
Kyoho	17.9	87	15.5	1715 Shotoku 5	1738 Gembun 3
Gembun	13.1	66	8.6	1736 Gembun 1	1827 Bunsei 10
Bunsei	13.1	56	7.3	1819 Bunsei 2	1842 Tempo 13
Tempo	11.3	57	6.4	1837 Tempo 8	1866 Keio 2
Ansei	9.0	57	5.1	1859 Ansei 6	1866 Keio 2
Man'en	3.3	57	1.9	1860 Man'en 1	1874 Meiji 7

(Note) "Approximate fineness" is an official fineness recorded in the Edo period literature.

Table 2 Comparison of the Fineness of the Kobans of the Edo Period

The simple figures without the unit name are expressed in % or ‰.
Figures in () are percentage figures converted from the fineness expressed in monme.

Name of the document or historical material	Author	Year of Compilation	Keicho	Genroku	Hoei	Shotoku	Kyoho	Gembun	Bunsei	Tempo	Ansei	Man'en
Za Kata San Po	Tsunetoku Nagano and others	1759 (Horeki 9)	fineness of 52.2 (84.29)	fineness of 76.7 (57.37)	fineness of 52.2 (84.29)	fineness of 52.2 (84.29)	fineness of 50.7 (86.79)	fineness of 66.9565 (65.71)	—	—	—	—
Kin'i Narabini Kin Fukukata Tetsuzuki Sho	Anonymous	1790 (Kansei 2)	fineness of 52.2 monme (84.29)	fineness of 76.7 monme (57.37)	fineness of 52.2 monme (84.29)	fineness of 52.2 monme (84.29)	fineness of 50.7 (86.79)	fineness of 66.9565 monme (65.71)	—	—	—	—
Go Shoku Hi Kan	Sakakura family	Unknown	fineness of 50.7 monme 2) (86.79)	fineness of 76.7 (57.37)	fineness of 52.2 monme (84.29)	fineness of 50.7 monme (86.79)	fineness of 50.7 monme (86.79)	fineness of 66.9565 monme (65.71)	—	—	—	—
Kin Kyoku Hiki	Anonymous	Unknown	—	—	—	—	—	—	fineness of 78 monme (56.41)	fineness of 77.5 monme (56.77)	—	—
The Cabinet Declaration No. 93 of Meiji 7	Government	1874(Meiji 7)	856.9	564.1 ³⁾	834.0	856.9	867.0	653.2	559.4	567.5	569.7	573.6
Nihon Osaka Kokoku Zoheiryō Syucho Dai San Syunen Hokoku Syo	E. Dillon	1874(Meiji 7)	862.0	564.0	—	—	—	654.9	—	—	555.0	574.7
Kokugin Chosa Meisai Roku	Nobunasa Koga	1930(Showa 5)	862.8	—	—	—	861.4	653.1	560.5	567.7	—	572.8

(Notes)

1. But it is stated that the unexpectedly high fineness of 50.7 monme was realized only after the third generation Shozaburo (1641-77).
2. It is stated that though the fineness of 50.7 monme was determined at the time of the third generation Shozaburo, there had been no "clear official fineness" before that time.
3. Only the fineness of the Genroku coin was revised by the Proclamation No. 103 of Meiji 18 and this revised fineness is used here.

Table 3 Loss of Weight of Kobans through the Process of Color Dressing

	Genroku	Hoei	Kyoho	Gembun
Weight of 1,000 ryos (monme)	4,760	2,500	4,760	3,500
Loss of weight for 1,000 ryos (monme)	10	4	3	9
Percentage loss of weight (%)	0.21	0.16	0.063	0.257
Loss of weight per coin (g)	0.038	0.015	0.011	0.034

(Source) *Go Shoku Hi Kan* (A Collection of the Secrets of Our Trade)

Table 4 List of the Specimen Kobans Analyzed

Types	Identification Number	Height (mm)	Width	Weight (g)	Horizontal cut marks		Imprint of "Mitsu Tsugu" ²⁾	Diameter (mm) of the imprint of signature on the reverse	Seals of Approval (Location) (Number)
					Lines	Density ¹⁾			
Keicho	A 1	73.1	39.2	17.70	5	22	Touching	12.0	Right 1
Keicho	A 2	73.5	39.1	17.70	5	5	Separated	11.0	Left 2
Keicho	A 3	71.7	38.7	17.70	5	5	Separated	---	Left 2
Keicho	A 4	71.3	38.1	17.70	5	16	Touching	13.0	Right 1
Keicho	A 5	72.3	38.2	17.75	5	14	Touching	11.0	Left 2
Keicho	A 6	71.1	39.0	17.75	5	10	Touching	11.0	Left 2
Keicho	A 7	71.9	38.4	17.70	5	16	Separated	11.5	Left 1
Keicho	A 8	70.0	38.3	17.75	5	20	Touching	13.0	Left 1
Keicho	A 9	69.8	38.9	17.75	5	7	Separated	12.0	Left 2
Genroku	B 1	72.2	38.6	17.80	5	6	Overlapping	10.5	Left 2
Genroku	B 2	72.6	38.6	17.85	5	6	Overlapping	10.0	Left 2
Genroku	B 3	72.1	39.2	17.75	5	8	Overlapping	10.5	Left 2
Hoei	C 1	60.6	32.9	9.30	4	3	Overlapping	7.5	Left 2
Hoei	C 2	60.4	32.9	9.30	4	4	Overlapping	8.0	Left 2
Hoei	C 3	60.3	32.0	9.35	4	4	Overlapping	8.0	Left 2
Shotoku	D 1	69.4	38.5	17.80	4	7	Overlapping	9.5	Left 2
Shotoku	D 2	69.3	38.2	17.75	4	6	Overlapping	9.5	Left 2
Shotoku	D 3	70.0	38.8	17.65	4	5	Overlapping	9.5	Left 2
Kyoho	E 1	69.9	38.0	17.75	4	8	Separated	9.5	Left 2
Kyoho	E 2	69.7	39.0	17.75	4	8	Separated	9.5	Left 2
Kyoho	E 3	69.6	38.5	17.70	4	7	Separated	9.5	Left 2
Kyoho(Sado) ³⁾	F 1	69.0	38.8	17.80	4	7	Separated	10.0	Left 2
Kyoho(Sado)	F 2	68.7	38.8	17.85	4	7	Separated	9.0	Left 2
Kyoho(Sado)	F 3	69.6	39.0	17.80	4	6	Separated	9.5	Left 2
Gembun	G 1	64.9	35.6	13.05	4	4	Overlapping	9.0	Left 2
Gembun	G 2	66.3	38.9	13.10	4	5	Overlapping	8.5	Left 2
Gembun	G 3	64.8	34.1	13.05	4	5	Overlapping	8.5	Left 2
Bunsei	H 1	61.9	33.6	13.15	4	14	Overlapping	9.0	Left 2
Bunsei	H 2	59.3	31.7	13.15	4	4	Overlapping	8.5	Left 2
Bunsei	H 3	63.3	34.7	13.10	4	5	Overlapping	8.5	Left 2
Tempo	I 1	59.4	31.4	11.20	4	10	Separated	8.0	Left 2

Tempo	I 2	59.3	30.1	11.20	4	8	Separated	8.0	Left 2
Tempo	I 3	59.1	30.7	11.25	4	9	Separated	8.0	Left 2
Ansei	J 1	58.7	31.7	9.00	4	11	Separated	8.0	Left 2
Ansei	J 2	58.5	31.3	9.05	4	8	Separated	8.0	Left 2
Ansei	J 3	58.9	31.0	8.95	4	9	Separated	8.0	Left 2
Man'en	K 1	35.8	20.4	3.30	4	11	Overlapping	4.5	Left 2
Man'en	K 2	36.2	22.8	3.35	4	10	Overlapping	4.5	Left 2
Man'en	K 3	36.1	22.7	3.30	4	9	Overlapping	4.5	Left 2

(Notes)

1. The density of horizontal cut marks is the number of wave lines per 1 cm.
2. With regard to the imprint of "Mitsu Tsugu", the coins were classified into three groups according to whether the two Chinese characters "Mitsu" and "Tsugu" were separate, touching or overlapping.
3. The Kyoho (Sado) Koban is the one minted on the Sado Island and is classified as the Kyoho Koban.

Table 5 Electron Beam Excitation X-ray Analysis

		Composition (%)				Composition (%)	
Types	Identification number	Gold	Silver	Types	Identification number	Gold	Silver
Keicho	A 1	86.1	13.9	Kyoho (Sado)	F 1	85.4	14.6
Keicho	A 2	84.5	15.5	Kyoho (Sado)	F 2	83.5	16.5
Keicho	A 3	85.0	15.0	Kyoho (Sado)	F 3	83.7	16.3
Keicho	A 4	85.8	14.2	Gembun	G 1	66.0	34.0
Keicho	A 5	86.2	13.8	Gembun	G 2	65.2	34.8
Keicho	A 6	86.5	13.5	Gembun	G 3	65.7	34.3
Keicho	A 7	85.5	14.5	Bunsei	H 1	56.2	43.8
Keicho	A 8	85.0	15.0	Bunsei	H 2	56.7	43.3
Keicho	A 9	83.6	16.4	Bunsei	H 3	55.4	44.6
Genroku	B 1	57.1	42.9	Tempo	I 1	56.4	43.6
Genroku	B 2	55.5	44.5	Tempo	I 2	58.6	41.4
Genroku	B 3	57.2	42.8	Tempo	I 3	57.4	42.6
Hoei	C 1	82.1	17.9	Ansei	J 1	58.1	41.9
Hoei	C 2	82.8	17.2	Ansei	J 2	57.1	42.9
Hoei	C 3	84.1	15.9	Ansei	J 3	59.3	40.7
Shotoku	D 1	82.5	17.5	Man'en	K 1	57.4	42.6
Shotoku	D 2	83.7	16.3	Man'en	K 2	59.4	40.6
Shotoku	D 3	83.9	16.1	Man'en	K 3	58.6	41.4
Kyoho	E 1	85.7	14.3				
Kyoho	E 2	86.6	13.4				
Kyoho	E 3	86.5	13.5				

Table 6 Comparison of the Results of the Analyses

(Unit: %)										
Analysis \ Types	Keicho	Genroku	Hoei	Shotoku	Kyoho	Gembun	Bunsei	Tempo	Ansei	Man'en
Our analysis ¹⁾ (A)	85.4	56.6	83.0	83.4	86.3	65.6	56.1	57.5	58.2	58.5
Proclamation No. 93 ²⁾ (Meiji 7) (B)	85.7	56.4	83.4	85.7	86.7	65.3	55.9	56.8	57.0	57.4
(A) - (B)	- 0.3	+ 0.2	- 0.4	- 2.3	- 0.4	+ 0.3	+ 0.2	+ 0.7	+ 1.2	+ 1.1
Official fineness recorded in documents	84.29 ~86.79	57.37	84.29	84.29	86.79	65.71	56.41	56.77	56.77	56.77

(Notes)

- 1) An average of the results is given as the fineness for each type of Koban.
- 2) Rounding figure of Table 2.

Figure 1 Essential Features of the Kobans (Keicho Kobans)

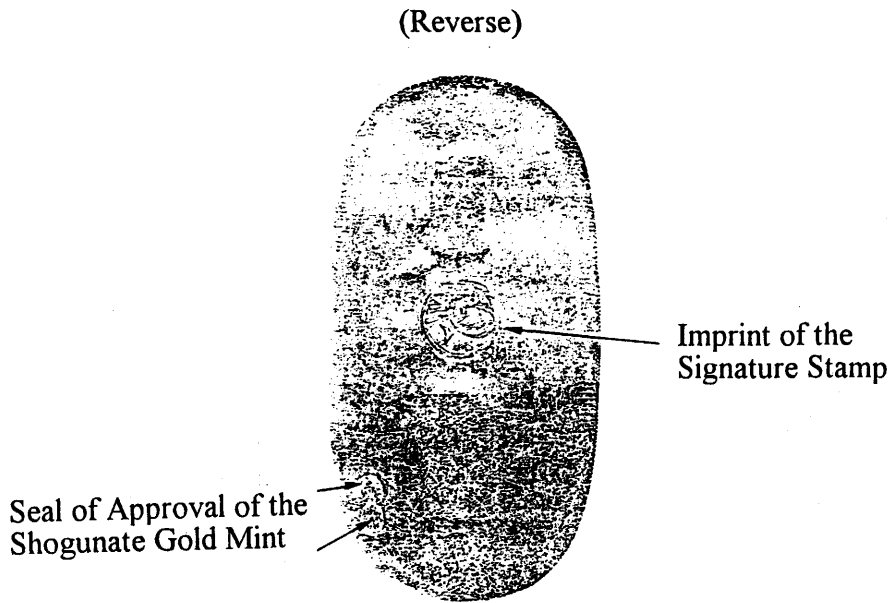
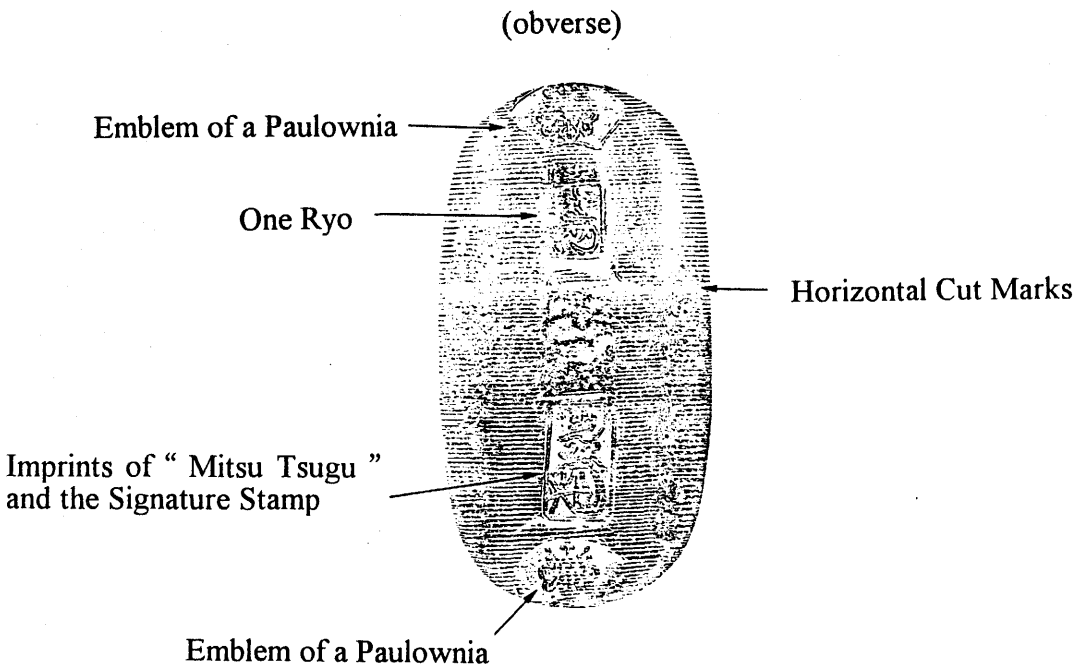
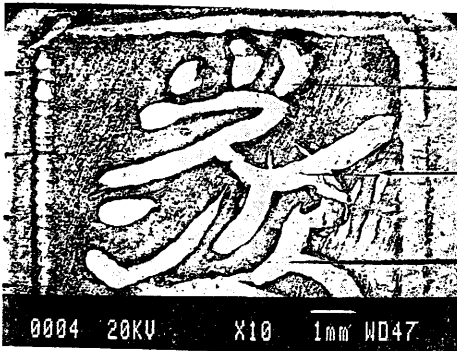
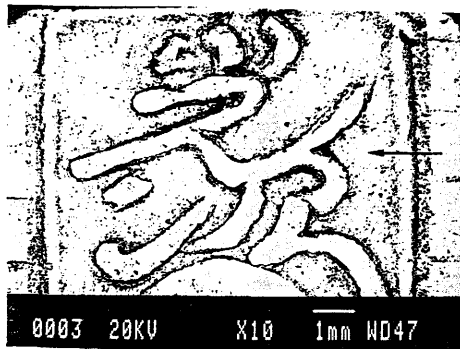
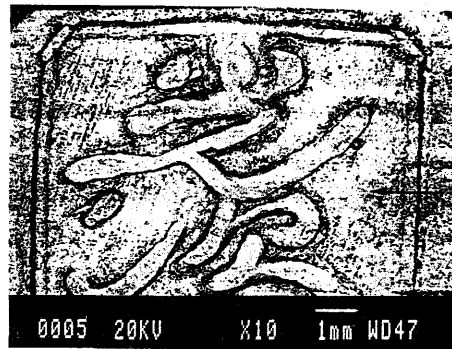


Figure 2 Distinction between the Shotoku Koban and the Kyoho Koban

The Shotoku Koban:
two overlapping Chinese characters



The Kyoho Koban:
two separated Chinese characters



Type of Koban	First Year of Minting	Fineness							
		60%		70%		80%		90%	
Keicho	1601								
Genroku	1695								
Hoei	1710								
Shotoku	1714								
Kyoho	1715								
Kyoho (Sado)	1715								
Gembun	1736								
Bunsei	1819								
Tempo	1837								
Ansei	1859								
Man'en	1860								

(Unit: %)

Figure 4 Distribution of the Fineness of Keicho Kobans

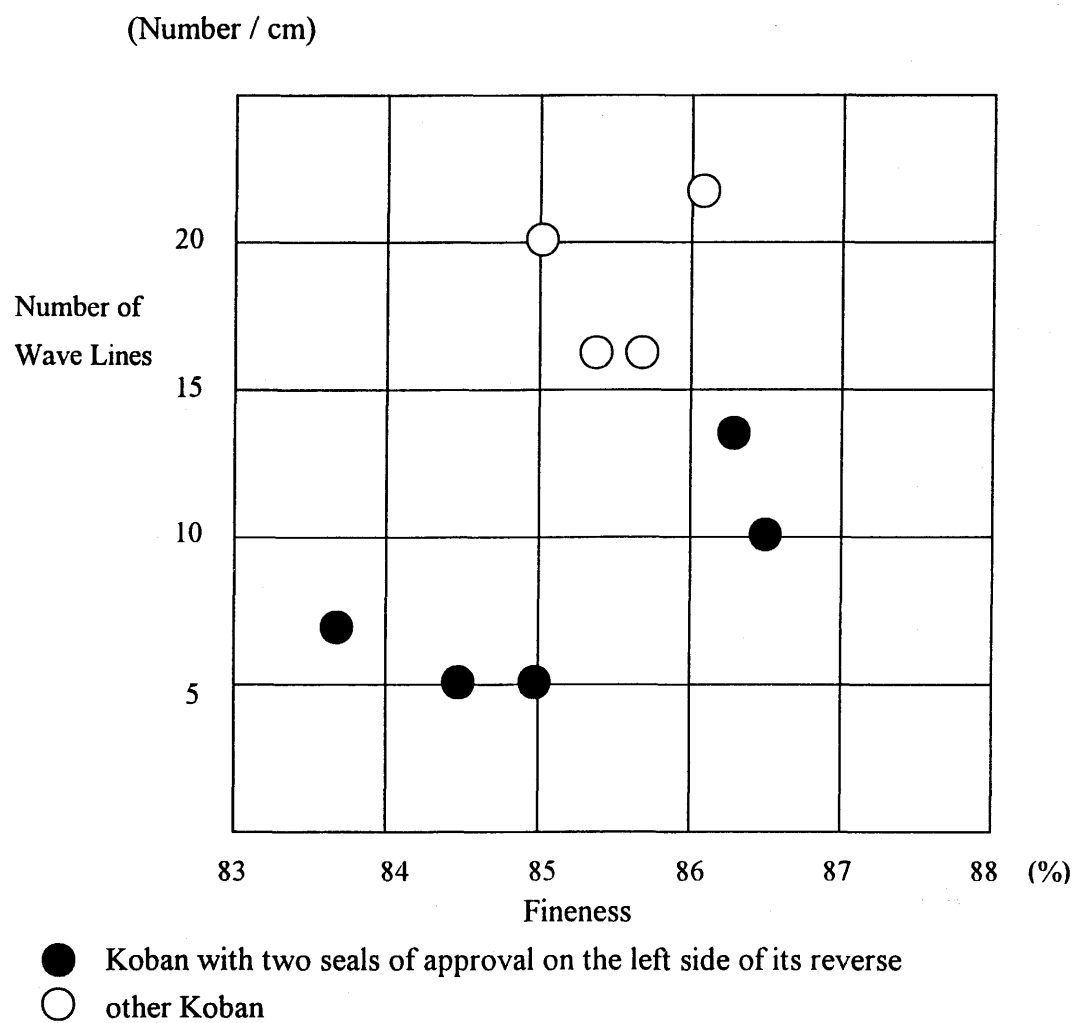
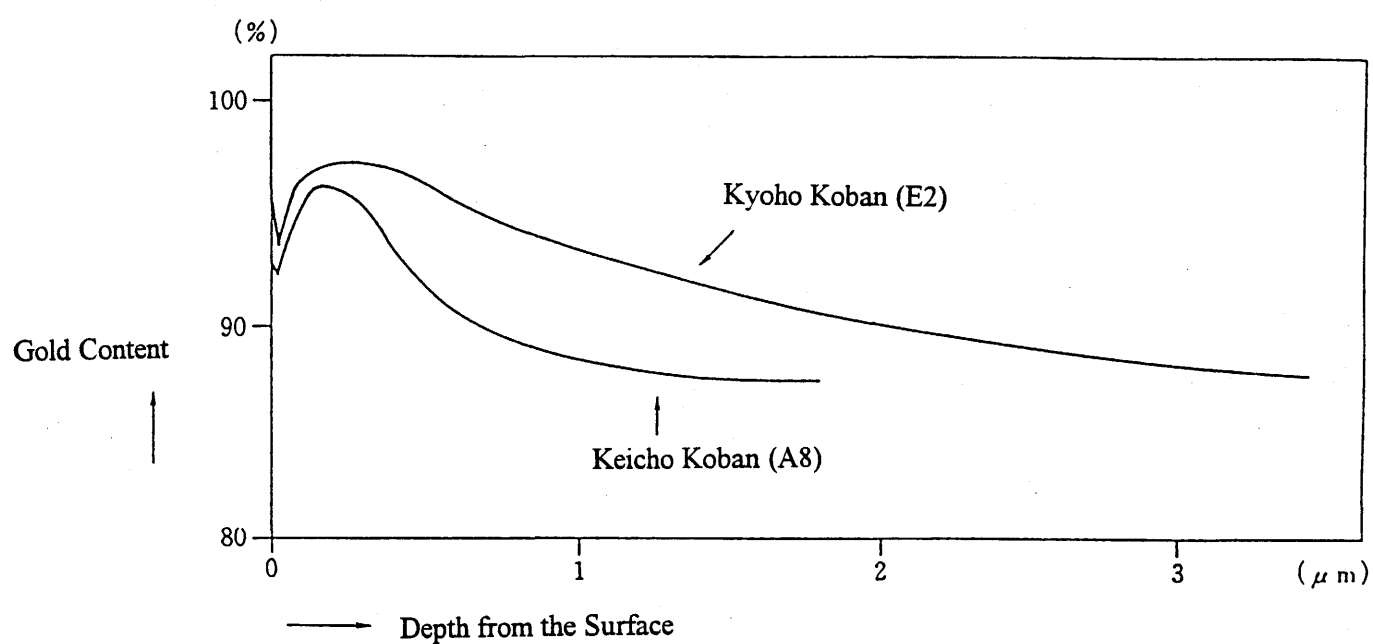


Figure 5 Change in the Gold Content in the Surface Layer



(Note) This figure was drawn for the sake of illustration on the basis of the results of the Auger spectrum analysis.