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Recent Archaeological Excavations at the Tōdai-ji

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Built in the mid-eighth century AD, Tōdai-ji 東大寺 was the most important Buddhist temple of the Nara state (710–784). For this reason it has long attracted the interest of scholars of art, architecture, religion, and ancient history, both in Japan and in the West. Since few excavations have been conducted at the temple, however, archaeological studies of Tōdai-ji are rare. This imbalance has been partly redressed by two recent excavations by the Nara Prefectural Kashihara Institute of Archaeology; this paper will discuss the results of those investigations and their significance for the history of Tōdai-ji.

The first excavation was conducted in the spring of 1988 outside the west corridor of the Great Buddha Hall (Daibutsu-den 大仏殿). This was followed in 1991 by a second excavation of an area outside the East Gate of the Ordination Hall (Kaidan'in 戒壇院 ; fig. 1). For convenience these excavations will be referred to here as the Great Buddha Hall and the Ordination Hall sites. The first site yielded remains that appear to be connected with the casting of the Daibutsu or Great Buddha (completed 752). No remaining historical records deal directly with the fabrication method of this approximately 16 m-high bronze statue—the largest cast product of the ancient world. Archaeology—together with the limited documentary evidence—thus provides our primary means of understanding the casting process. As will be discussed later, the results of this excavation lend concrete support to the type of construction process suggested by KATORI (1981). The second site produced a Nara-period casting pit and smelting furnace. Although we are not sure exactly what was made in the pit, we can assume it employed the same level of technology used in the casting of the Daibutsu.

1. *Great Buddha Hall Site*: The excavation area was an irregular trapezoid of about 800 m^2 (ISHINO et al. 1988). Three main layers were recognized: layer 1 consisted of Kamakura and later deposits accumulated

after the late twelfth century; layer 2 was a Nara-period artificial fill containing casting debris; layer 3 represented the natural valley floor in the Nara period. Evidence for casting technology came from layer 2 and the bottom of layer 1, where a 10 cm lens of wooden chips was spread under a stratum of fine soil about 50 cm thick. Layer 2 was divided into two substrata, the upper of which was 10–15 cm thick and included two thin lenses of wooden chips, and the lower of which was up to 2.5 m thick and contained charcoal, clay bricks, and fragments of copper and bronze. Charcoal and fired clay lumps were attached to some of the metal fragments. In the upper part of layer 3, 226 inscribed wooden

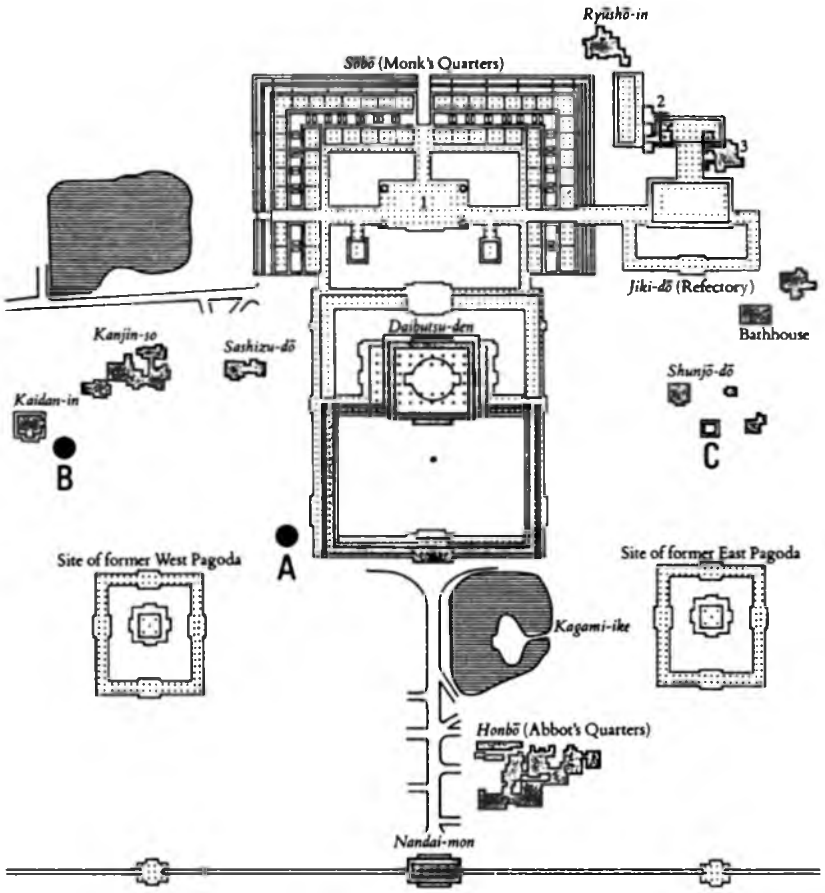

Fig.1: Plan of Tōdai-ji showing the two excavation areas. A = 1988 excavation; B = 1991 excavation; C = Nara Tarō Belfry. (Map prepared by Julie Abrams, originally published by The Art Institute of Chicago in association with Indiana University Press; COALDRAKE 1986, p. 34).

slips (*mokkan* 木簡) were found, most of which were records of the construction of the Great Buddha.

In the preliminary report, the excavators argue that all the excavated materials from this site were closely connected with the production process of the Great Buddha: the brick was used to make the furnaces, the charcoal was used as fuel, the bronze fragments were scraped off the statue's body during the finishing process, and so on (ISHINO et al. 1988). Metallurgical analysis has shown that the bronze fragments from layer 2 are identical to the material used in the Great Buddha itself (KUNO 1990).

In order to understand why these artifacts were in this artificial fill, we need to consider the casting process of the Daibutsu (fig. 2). KATORI's (1981) theory on how this process worked has been well summarized by PIGGOTT (1990, p. 464):

> Katori Tadahiko has suggested that after clearing and leveling the site, workers excavated a deep hole and packed it with rocks, sand, clay, metal piles, and molten lead to make a fortified foundation. Then the image-making team constructed a frame for the statue out of wood, cloth, and lacquer, and laid clay over it to serve as a modeling surface. On the clay the features of the Great Buddha took form, although the head was sculptured separately. Once the clay modeling had dried, another team mixed clay with sand and rice husks, laid it over the model, baked, cooled, and removed it in sections. Then they pared away part of the clay image so that there

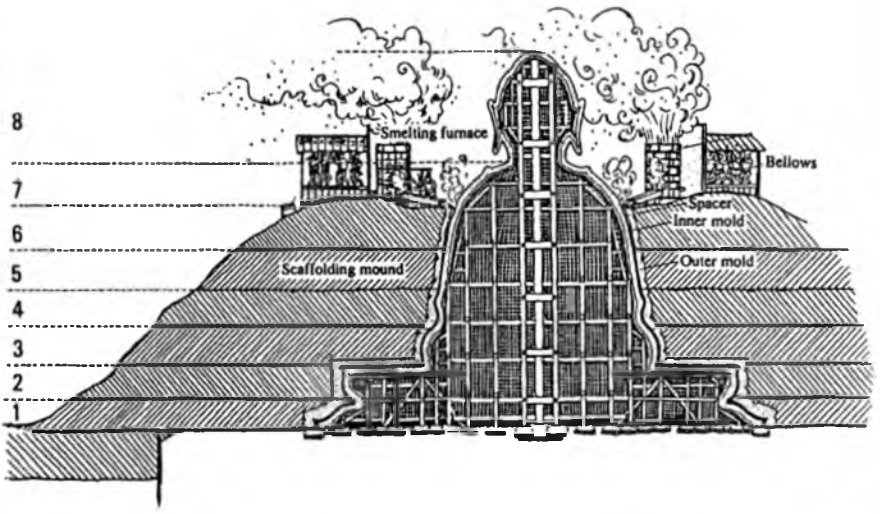

Fig. 2: Schematic drawing of the construction process of the Great Buddha. From KATORI 1981, pp. 28–29.

> would be a cavity between the outer mold and the clay image, and into this cavity molten metal was poured. In the next step, the casting mold was reassembled over the Daibutsu in eight stages and the image packed tightly with a rising mountain of earth. Molten bronze was poured into the mold from wood- and charcoal-burning furnaces, whose heat was intensified by human-powered bellows. Several of these furnaces, perhaps as many as twenty or thirty, stood on the mountain of earth that gradually buried the statue.

After casting was complete, the huge artificial scaffolding mound was gradually leveled while finishing touches were made to the statue. Copper and bronze waste fragments, charcoal, and brick were mixed in with the soil from this mound, which was then used to make the foundation for the Daibutsu Hall. It is this soil which comprised layer 2 of the trench.

Of the 226 Nara-period *mokkan* found between layers 2 and 3, 37 are shipping tags recording weights of raw materials, types and quality of copper, and details of the smelting furnaces (WADA 1988). *Mokkan* Nos. 1 to 8 record raw material weights: No. 1, for example, mentions 300 *kin* 斤 (202.5 kg) of copper; No. 11 reads "Received from the palace [*miya* 宮] 11,222 *kin* [7.6 tons] of fine quality copper." The only project likely to have used such a huge amount of copper is the Great Buddha itself. *Mokkan* Nos. 12 to 18 use the character *kamado* 竈 , which WADA (1988, p. 9) believes refers to a 2 m-high cylindrical smelting furnace of 50 cm internal diameter and a capacity of 1 ton at a time. Several of the *mokkan* mention from two to seven *kamado*, showing that quite a few furnaces were in use simultaneously. Other wooden documents record the names of the workers and the food with which they were provided.[1]

Although no actual remains of furnaces or workshops were recognized in the excavated area, the metal waste fragments, brick, charcoal, and *mokkan* are eloquent testimony to the processes involved in the construction of the Great Buddha.

2. *Ordination Hall Site*: This site, uncovered during excavations that preceded construction of a cistern for fire-fighting use, consists of a smelting and casting plant for large objects related to the temple. The excavated remains have proved to be of considerable importance in understanding Nara-period casting technology. Two large casting pits (one of which was almost completely destroyed in antiquity) were excavated, together with two copper smelting furnaces and a pebble stone foundation, possibly for a bellows structure (NAKAI 1991). The excavator also mentions the discovery of traces of simple roofs that covered the casting

[1] Further details of the Tōdai-ji *mokkan* can be found in PIGGOTT 1990, pp. 463–66.

facilities, storage pits for charcoal fuel, and rows of post holes for buildings, but no details of these have yet been published.

The preserved casting pit was 7 x 7 m square with rounded corners and 4 m deep (fig. 3 and plate 1). Close to its base, seven 4 m-long parallel timbers were placed about 40 cm apart, aligned in a north-south direction (fig. 3, no. 1). Above these another seven were aligned east-west (no. 2). A layer of gray soil had been spread over this timber framework, and in the center of this soil bed stood a wooden post (no. 3).

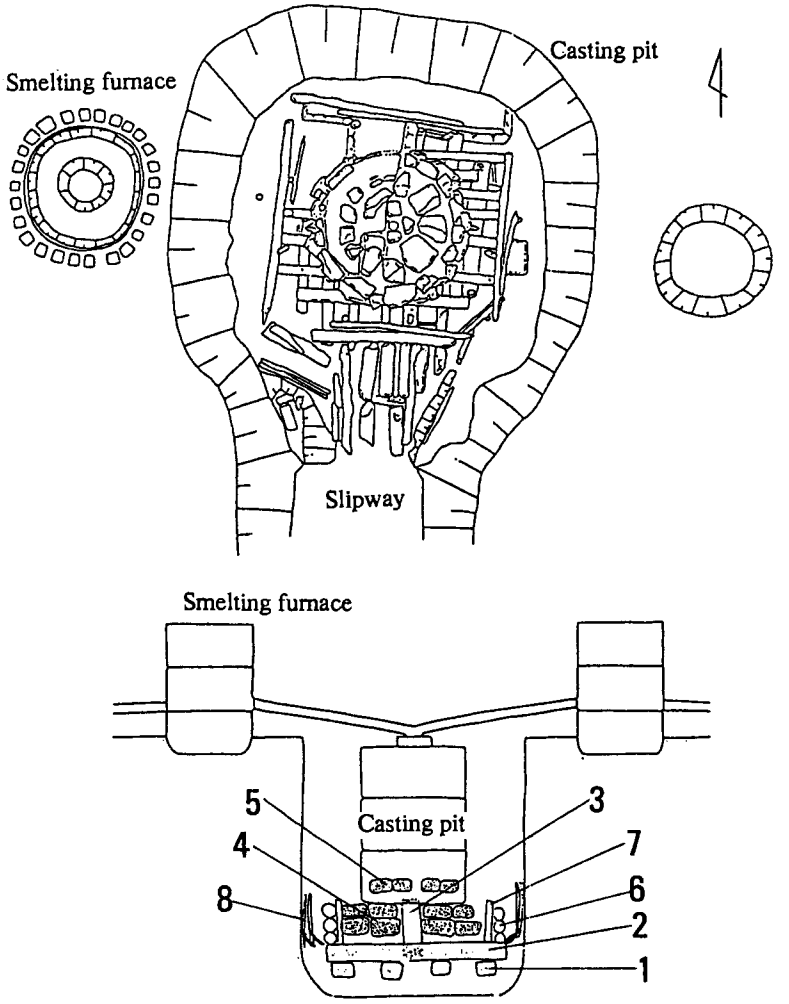

Fig. 3: Ordination Hall site casting pit.
Top: plan. Bottom: schematic section. From NAKAI 1991, p. 4.
No scale provided in original.

Around this were three concentric circles of flat stones, the outermost of which was 3 m in diameter (no. 4). On top of the stone circles was another layer of soil, over which lay a 1.8 m-diameter stone pavement (no. 5). Sun-dried bricks—possible remains of the outer and/or inner casting molds—were found around this pavement. The whole structure was surrounded by a wooden fence (no. 6), supported by two vertical posts to prevent it from collapsing inwards (no. 7). These posts were strengthened by penetrating tie beams. Finally, more soil was packed between the fence and wooden boards attached to the inside of the pit (no. 8). The whole casting pit was an extremely solid and well-constructed facility.

In a ditch adjoining the main pit was a 2 m^2 timber pavement with a stone foundation beneath it; both were at a level lower than the central stone pavement. Though only part of the ditch was excavated, it clearly extended down the natural slope of the hill from the casting pit. At the bottom of the ditch were long timbers arranged as slip rails along which the cast object was moved. Many small wooden chips were piled upon the timber pavement and the bottom of the ditch, and these probably provided a cushion for the cast product when it was lifted out of its mold. This ditch must have been dug as a slipway for moving the product following completion of the casting and cooling process.

Bronze for use in this casting pit appears to have been smelted in surrounding furnaces. Two such smelting furnaces were found on the east

Plate 1: Ordination Hall site casting pit from the north.
Photo: Nara Prefectural Kashihara Archaeological Research Institute.

and west sides of the pit. Of these, only the west furnace remained in good condition (plate 2). It was encircled by a ring of 25 cm-long sun-dried bricks with clay mortar; surrounding this was a further 50 cm layer of clay. Inside this, a large quantity of burnt soil and burnt brick fragments were accumulated in a ring 30 cm in depth. At the bottom of this was a central 50 cm-deep round hole of 1m diameter. These remains are interpreted by NAKAI (1991) as a cylindrical smelting furnace with an internal diameter of 2.7 m and 50-cm thick walls. The original height of the furnace could not be determined from the excavation, as the above-ground remains had all been destroyed. The casting capacity of the pit is also unclear at present; elucidation of this point would be an important contribution to the history of ancient technology.

Although the eastern furnace had been badly damaged, a 1 x 3 m stone pavement was discovered two meters further east. The stones were on average 10–20 cm long and firmly packed. The excavators suggest that this pavement was part of some kind of structure for the furnace bellows system.

There are no documents giving the exact date and function of this large casting pit, but KATORI (1991) suggests three products it may have been used to cast. The first is a 4.5 m-high bronze model pagoda that no longer exists but is known from records to have been housed inside the Ordination Hall. A second possibility is the hemispherical bases of the

Plate 2: Close-up of the preserved smelting furnace from the west. Photo: Nara Prefectural Kashihara Archaeological Research Institute.

finials of the East and West Pagodas. These are also no longer in existence, since the two pagodas were destroyed in 1180. The last candidate is Nara Tarō 奈良太郎 ("the first son of Nara"), Tōdai-ji's huge bronze temple bell which stands 3.85 m high, has a diameter of 2.7 m, and weighs 26.3 tons. Cast in 752, this bell can still be seen in the Shō-rō 鐘楼 (Belfry).

As mentioned above, the second of the large casting pits discovered at the Ordination Hall site was badly damaged, and no details pertaining to it are known. From the fact that the two casting pits were in close proximity, it is conceivable that they were used to cast a pair of objects. As nothing is known about the damaged pit, however, we can only base our arguments on the well-preserved example. The pit described here bears a striking resemblance to that used to cast the Hōkō-ji 方広寺 temple bell in Kyoto in 1614. Detailed records of the fabrication of this bell are included in the *Sunpuki* 駿府記; and from similarities in casting technique, NAKAI (1991) and KATORI (1991) suggest that the Ordination Hall pit may also have been used to make a bell. For example, the *Sunpuki* records that four sets of smelting furnaces were arranged around the pit in which the Hōkō-ji bell was cast. Since the top of Nara Tarō has four depressions from the pouring of molten bronze, a similar technique may have been used at Tōdai-ji. The size and solid nature of the casting pit structure and the systematic layout of the furnaces, bellows, and slipway support this hypothesis. It is probable that many furnaces were used for smelting copper for the bell, but most of them appear to have been destroyed, leaving only two on either side of the massive casting pit.

The location of the casting plant, only a few meters from the Ordination Hall, may provide important clues as to its function. It seems unlikely that it was used after the completion of the Hall in 755, thus probably ruling out the hypothesis that the pagoda finial bases were produced there, since the East and West pagodas were not built until the late eighth century. The casting pit may also have been too close to the Ordination Hall to have been in use during its construction, making the model pagoda suggestion even less likely. We can therefore argue that the pit was used to cast Nara Tarō in 752 and then filled in before work began on the Ordination Hall. While this line of reasoning appears logical and is not contradicted by the excavated potsherds from the pit which suggest a mid-eighth-century date, a major unresolved problem is the distance between the Ordination Hall and the Belfry. If the bell was really cast in this pit, it would then have had to have been carried at least 500 m uphill to the Belfry. While we know the technology to move large objects such as stone coffins had existed for some centuries, there still remains a possibility that the casting pit was used to produce something other than Nara Tarō.

In conclusion, if Katori's hypothesis of the method of casting the

Great Buddha is correct, then we will never be able to find *in situ* remains of the actual process, since the furnaces would have been dismantled one after another as the scaffolding mound was lowered. Despite the absence of such direct evidence, however, the two excavations discussed here have provided us with invaluable information on the casting process of the Daibutsu in particular and Nara-period metal technology in general. The bronze and copper waste, charcoal, brick fragments, and inscribed wooden documents from the excavation near the Great Buddha Hall can be taken as support for Katori's theory of the construction method of the Daibutsu. The level of casting technology and type of smelting which would have been used for the statue is clearly shown in the remains from the Ordination Hall excavation site.

REFERENCES

COALDRAKE, William H.

1986 The architecture of Tōdai-ji. In *The Great Eastern Temple: Treasures of Japanese Buddhist Art from Tōdai-ji*. Organized by Mino Yutaka, 33–47. Chicago and Bloomington, Indiana: The Art Institute of Chicago and Indiana University Press.

ISHINO Tōru 石野 亨

1984 *Nara no daibutsu wo tsukuru* 奈良の大仏をつくる [Making the Great Buddha of Nara]. Tokyo: Komine.

ISHINO Hironobu 石野博信 et al., eds.

1988 *Tōdai-ji daibutsuden nishi kairo rinsetsuchi no hakkutsu chōsa* 東大寺大仏殿西廻廊隣接地の発掘調査 [Excavations near the west corridor of the Tōdai-ji Great Buddha Hall]. Nara: Tōdai-ji and Kashihara Institute of Archaeology.

KATORI Tadahiko 香取忠彦

1981 *Nara no daibutsu* 奈良の大仏 [The Great Buddha of Nara]. Tokyo: Soshisha.

1991 Tōdai-ji idokoro no ikō 東大寺鋳所の遺構 [Remains of a casting plant at Tōdai-ji]. *Gekkan bunkazai shutsudo jōhō* 月刊文化財出土情報 July, p. 115.

KUNO Yūichirō 久野雄一郎

1990 Tōdai-ji daibutsu no dōgenryō ni tsuite no kōsatsu 東大寺大仏の銅原料についての考察 [Observations on the bronze raw material of the Tōdai-ji Great Buddha]. *Kōkogaku ronkō* 考古学論攷 14: 111–31.

NAKAI Kazuo 中井一夫

1991 Tōdai-ji Kaidan'in higashi chiku no ōgata chūzō ikō 東大寺戒壇院東地区の大型鋳造遺構 [The large casting facility from the

eastern locality of the Tōdai-ji Ordination Hall]. Abstract of Kashihara Institute of Archaeology Public Lecture Series, November and December. Kashihara: Kashihara Institute of Archaeology.

PIGGOTT, Joan R.
1990 Mokkan: Wooden documents from the Nara period. *Monumenta Nipponica* 45/4: 449–70.

WADA Atsumu 和田 萃
1988 Shutsudo mokkan no gaiyō 出土木簡の概要 [Outline report of the excavated wooden documents]. In *Tōdai-ji daibutsuden nishi kairō rinsetsuchi no hakkutsu chōsa*, Ishino et al., eds., 9–13.