

X-rays for Archaeology

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Cover shows an image of the tomb of Amenhotep III in Egypt.
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Foreword

The First International Symposium on X-ray Archaeometry took place in the conference hall of Waseda University, Tokyo, Japan, on 18–20 July 2002. The participants of the symposium were from Belgium, China, France, Greece, Hungary, Israel, Italy, Japan, Korea, Mexico, Romania, Slovenia, Sri Lanka, Taipei, UK, and USA.

One of the most important aims of the symposium was to combine two scientific fields, i.e. archaeology or art and X-ray science. Finding archaeological sites, dating, analyzing of archaeological objects, and so on needs the help of natural scientists and technicians. Natural scientists have a taste for solving mysteries hidden in archaeology. However, previously, using x-ray techniques was only a small part of the archaeological fieldwork and the x-ray field was largely disinterested in the analysis of archaeological objects. Until this symposium, no attempt has been made on having an international meeting on a worldwide scale to discuss archaeological subjects under equal partnership between the two fields mentioned above.

The symposium provided a broad forum for discussing experimental results of X-ray-based analysis. Of particular interest for the participants of the symposium was the non-destructive analysis of archaeological monuments using several kinds of X-ray techniques, especially under *in situ* and contact-free conditions, as well as the introduction of experimental results using advanced technologies such as ion beam and synchrotron radiation techniques.

This book, named “X-rays for Archaeology”, consists of papers selected from presentations in the First International Symposium on X-ray Archaeometry.

Finally, it is an especially great pleasure for me to warmly recommend this book to every reader interested in knowing more about X-ray archaeometry and understanding the importance of joining both scientists in the fields of archaeology or art and X-ray analysis.

Tokyo, Japan

Professor M. Uda
Chairman

Organizing Committee of the First International
Symposium on X-ray Archaeometry

Chapter IV-2

The Radiographic Examinations of the “Guardian Statues” from the Tomb of Tutankhamen

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Keywords: Tutankhamen, “Guardian Statues”, Wooden Statues, Valley of the Kings, the Egyptian Museum in Cairo

Introduction

An X-ray examination of the wooden statues, JdE 60708 (Figs. 3 and 4) and JdE 60707 (Figs. 5 and 6), was undertaken by a Waseda University Team consisting of Sakuji Yoshimura, Jiro Kondo, and Nicholas Reeves, on 28-29 April and 2-3 May 1993, with the generous cooperation of Dr Muhammad Ibrahim Bakr, the Chairman of the E. A. O., Dr Muhammad Salah, Director of the Egyptian Museum, Dr Nasry Iskander, General Director of Conservation of E. A. O., Dr Kamal Barakat, Director of Conservation of the Egyptian Museum, Mme Soheir el-Sawi, and other members of the Egyptian Museum.

The Guardian Statues from the Royal Tomb of Tutankhamen

The royal tomb of Tutankhamen was discovered in November 1922, by Howard Carter on behalf of the fifth Earl of Carnarvon. The tomb is now numbered 62 (KV 62), and is located in the central part of the main Valley of the Kings. There were two life-sized wooden statues in the northern part of the antechamber of the tomb. They were standing facing each other and guarding the entrance to the burial chamber. They were carved in wood and 1.9 meters in height. The face, body, arms and legs were painted with black resin. The gilded bronze uraeus was attached to each statue's forehead and the eyes were inlaid with limestone and obsidian in the frames of gilded bronze.

Their headcloths, collars, and kilts were overlaid with gold on the base of linen and gesso. The two statues were not exactly the same. The most notable difference was their headcloths. The one on the west of the doorway (Carter's no. 29; JdE 60708 - Fig. 1 and 2) was wearing the *khat* headcloth, while the one on the East

(Carter's no. 22: JDE 60707 - Fig. 3 and 4) was wearing the *nemes* headcloth. On the triangular kilt of each figure, the names and titles of Tutankhamen were inscribed. The figures wearing the *nemes* headcloth represented the royal *ka*, or spiritual double of the king.

The similar life-sized wooden statues were found from several royal tombs of the New Kingdom. In the British Museum, there are three such figures (EA 854, 882, and 883). The statues of EA 854 and EA 883 probably came from the tomb of Ramesses I (KV 16), and the statue of EA 882 seems to have come from the tomb of Ramesses II (KV 7). The kilt of EA 882 has a hollow which is 20 cm in depth. This hollow is considered to have been used for keeping a roll of papyrus. Similarly, hollows seemed to exist in the two guardian statues of Tutankhamen. They seemed to be sealed by pieces of stone plastered in position and gilded over. In a similar way four concealed niches were cut out into the decorated walls of the burial chamber of the tomb of Tutankhamen and sealed by the magic bricks. In order to clarify the role of the guardian statues as the hiding place of religious texts, we decided to perform an X-ray study of the two statues in the Egyptian Museum in Cairo.

The equipment used for the X-ray study

The equipment used for the X-ray study was called "High Technical System X-ray HK-100S", which was produced by Hitex co., Ltd. in Japan. Figure 1 shows the appearance and names of the system. The specifications are as follows:

- (1) X-ray
 - Input power: AC 240V 2A Single phase, Grounding 100Ω or less
 - Output power: 100KV 3mA Intermittent
 - X-ray indicator lamp: Provided (A signal-light flickers during X-ray radiation)
- (2) X-ray tube bulb and high voltage transformer
 - Type of X-ray tube: Fixed positive electrode type
 - X-ray tube voltage: 0-100KV Intermittent
 - X-ray tube current: 0- 3mA Intermittent
 - Focus dimensions: 0.4x0.4mm
 - Transformer circuit: All wave rectification type

System layout

We first installed the "cassette stage", "X-ray generator", "hand lift" and "control unit" as illustrated at Fig. 2. The cassette (stage) and the X-ray generator were placed parallel to each other. The control unit was placed at a location in the opposite direction from the direction of emission of X-rays. The cassette (film) and the irradiated object were placed as close to each other as possible. We adjusted the heights of cassette (film) and the X-ray radiation port to be horizontal with the handle of the handlift.

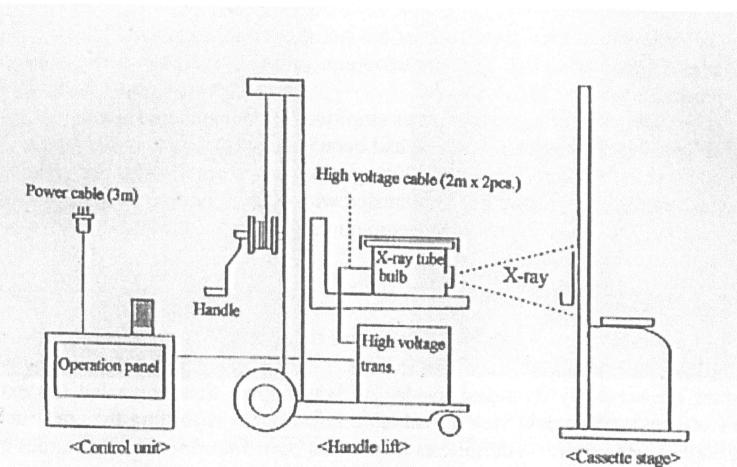


Figure IV-2-1. Appearance and names.

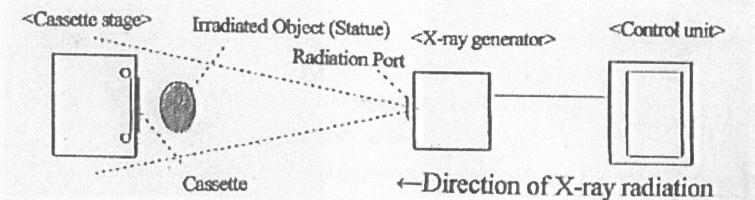


Figure IV-2-2. System Layout.

Background

This work was undertaken for the following three main objectives:

- 1) To check the present condition of the statues and to learn what kind of preservation work had been done to them, and to prepare for future conservation needs;
- 2) To reveal construction techniques employed by the ancient Egyptians;
- 3) To pursue the suggestion which had been put forward by C.N. Reeves in 1985 (*Tutankhamen and his papyri, Göttinger Miszellen* 88, 39-45), that religious text on papyrus might have been concealed within royal funerary on the basis of a similar statue in the British Museum and other smaller statuettes from other tombs in the Valley of the Kings.

A series of non-destructive x-rays was taken of the Tutankhamen statues with the glass cases removed, as shown in Figs. 3-6. It has been cleared that the wooden statues are seriously damaged inside. As was hoped, these revealed the extent of previous restoration, and yielded valuable information regarding the construction of the statues. However, no definite evidence has been found so far that statues contain papyrus, as the statue in the British Museum evidently once had.

Results

The results of this examination have satisfied two of the principal aims of the project. However, the problem of Tutankhamen's papyri had not been solved, and it is proposed that the research be continued along similar lines with the whole series of smaller gilded and resin-coated statuettes from the king's tomb. Such an investigation would provide additional information on the Tutankhamen treasures and on the skills and techniques of the ancient Egyptian craftsman.

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 Reeves, C. N.: *The Complete Tutankhamun*, London, 1991, 128-9.
 Porter, B. and Moss, R. L. B.: *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings: I. The Theban Necropolis, Part 2. Royal Tombs and smaller Cemeteries*, Oxford, 1964, 507, 535.



Figure IV-2-3.
Profile of the "Guardian Statue (JdE 60708)".

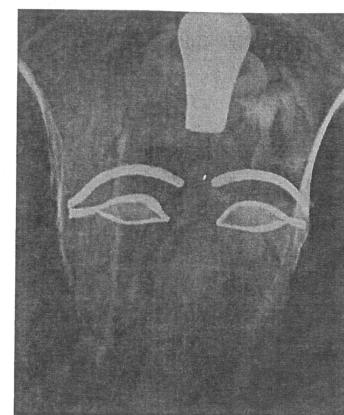


Figure IV-2-4.
Face (front view) of the Statue (JdE 60708).

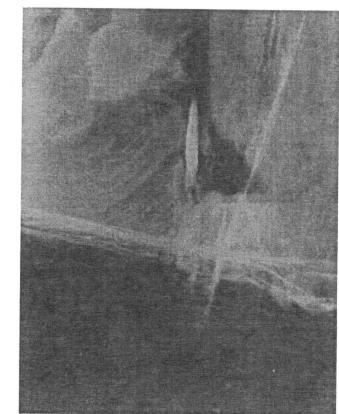


Figure IV-2-5.
Side-view of under-kilt of the Statue (JdE 60708).
*No space for the papyri.

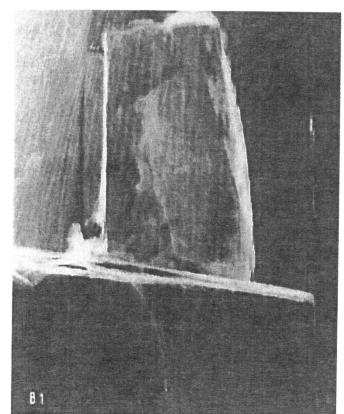


Figure IV-2-6.
Side-view of under-kilt of the Statue (JdE 60708).
No space for the papyri.