



Abstract

Egyptian incense burner for burning incense in front of a divine shrine. Bronze. Twenty-fifth Dynasty. The third intermediate period, 700 BC. The first recorded use of incense was by the Egyptians during the Fifth Dynasty, 2345-2494 BC. The use of incense in religious ceremonies developed further. The incense burner is in the shape of an arm. This type of incense burner appeared in the era of the Middle Kingdom. It was topped with a box for storing incense grains, and a dish for burning incense. The arm-shaped incense burner in the Middle Kingdom was called *n-snt* and in one case the material used in its manufacture was identified as *m-HtmaS*. This name also appeared in the Greek and Roman eras in the form of the letter n Hr. It was the popular name for the arm-shaped incense burner throughout the Middle and New Kingdoms, and in the Late Period in ancient Egypt. The ancient Egyptians also used incense in many aspects of their daily lives, in medical prescriptions, personal care, perfuming homes, clothes, and magic, in order to protect them from evil spirits. They also considered incense one of the most important disinfectants in the rituals of the Egyptian religion. Egyptian texts indicate that the ancient Egyptians gave incense burners many names since the era of the Old Egyptian Kingdom. Then the names of the censers varied according to their shapes. *KAp* was the name of the cup-shaped incense burner with a lid. *StAt* was a rare name for cup-shaped incense burners as well. The case of the incense burner was broken into several parts, and was covered with a lot of rust and many layers of mud. A plan was drawn up to work on it and conduct some analyzes to determine the thickness of the rust. Some analyzes were also conducted to determine rust compounds. The restoration process began with mechanical cleaning using many different brushes and brushes. It was ensured that all layers of rust were removed and the insulation material was prepared. The separate parts were also assembled using non-reactive or materials (bronze) and were prepared for display in one of the halls of the Grand Egyptian Museum.

Key words: Incense burner, bronze, corrosion, investigation, conservation.

1. Introduction

Incense was a common tool used by the ancient Egyptians in medicine, personal hygiene, home and clothing fragrances, and sorcery to ward off evil spirits. They also believed that one of the most significant disinfectants used in Egyptian religious rites was incense.

During the Fifth Dynasty, which lasted from 2345 to 2494 BC, incense was first used by the Egyptians. Incense's use in religious rites progressed. The incense burner is designed to resemble an arm. During the Middle Kingdom era, this kind of incense burner first arose. On top of it was a dish for incense burning and a box for storing incense grains. The incense burner with an arm shape was known by the common name *n-Hr* in ancient Egypt's Middle and New Kingdoms as well as the Late Period.

The incense burner was disassembled and covered in corrosion and soil deposits, necessitating cleaning and restoration. The incense burner was analyzed using a variety of techniques. The primary goals of this research are to examine the preservation condition, detect the damage to the incense burner, and choose the best strategy for conservation.

2. Object Description

The investigated object is a metal incense burner with accession no. 31816. It was discovered at Saqqara, moved to the Egyptian Museum in Cairo, and recently to the Grand Egyptian Museum-Conservation Center. It dates back to the Middle Kingdom. The object disassembled into three pieces and reassembled with a wood core indicated that the object was previously restored. It is in bad condition, with corrosion products of various colors and soil deposits, see (fig. 1).



Fig. 1. (a)The studied incense burner before treatment at the GEM, (b) it's parts.

3. Materials and Methods

Several investigative and analytical approaches were performed on the incense burner to assess and evaluate the preservation conditions, including:

- **Stereo Microscope:** to determine if there has been any previous treatment, cracks, examine the details on the incense burner's surface, and to obtain information on the manufacturer.
- **Scanning Electron Microscope (SEM):** to determine the extension of the corrosion products.
- **Potable X-ray Fluorescence (p-XRF):** to determine the elemental composition of the incense burner's alloy.
- **X-ray Diffraction (XRD):** is used to identify and characterize corrosion layers.

4. Conservation and Preservation Processes

To remove any soil deposits and corrosion products, the cleaning technique was carried out mechanically.

5. Results and Discussion

5.1 Characterization and incense burner's Condition

Microscopic investigation indicated that several locations of the incense burner are covered in layers of corrosion products and soil deposits, obscuring any ornamentation that may be on the incense burner's surface. The surface morphology of the corroded layer of encrustations is diverse. There are also some regions with active corrosion, indicating that the corrosion process is still progressing, see (fig. 2).

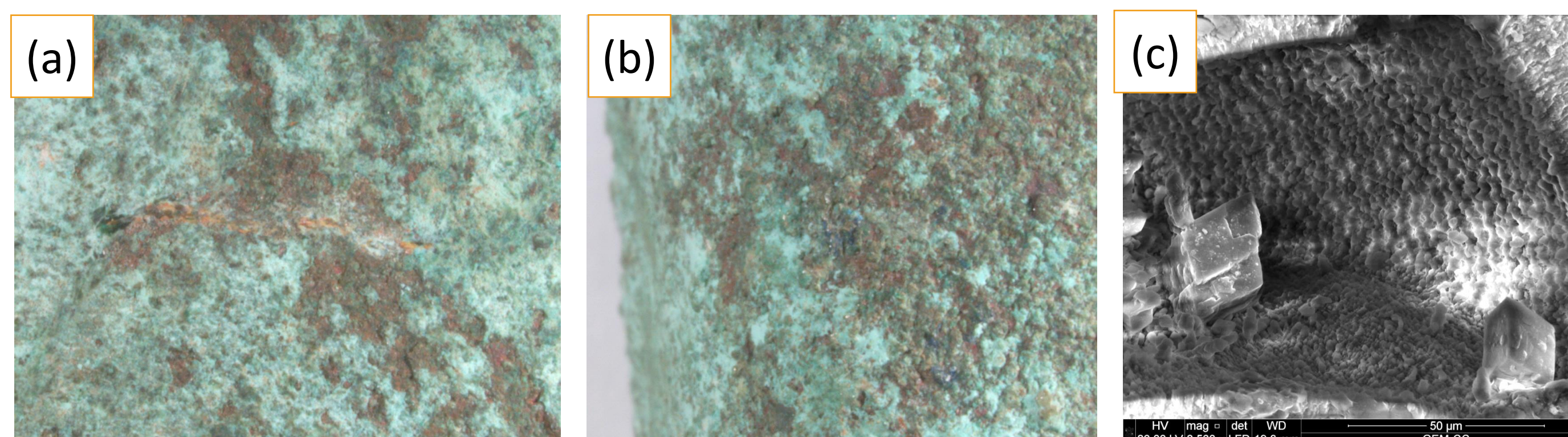


Fig. 2. Stereo microscope pictures (a, b) the incense burner's surfaces covered with corrosion layers, and SEM (c) showed corrosion products and salt crystals

5.2 Investigation and Analyses

Microscopic examination revealed no prior treatment, but it did reveal the stratigraphy, distribution, and spread of corrosion products on the surface of the incense burner alloy. p-XRF indicated that the incense burner is made of a bronze alloy (table 1). XRD gave valuable insight into the corrosion layers (table 2).

Table 1. Elemental composition of the incense burner using p-XRF

Elemental	Cu	Sn	Pb	Sb	Fe
Percentage (Wt.%)	86.9	6.8	3.6	0.9	0.7

Table 2. Corrosion products analyzed using XRD

Sample	Corrosion product	Chemical name	Chemical formula	Percent %
copper corrosion products	Cuprite	copper (I) oxide	Cu ₂ O	16
	Malachite	copper carbonate hydroxide	Cu ₂ (CO ₃)(OH) ₂	32.4
	Quartz	silicon dioxide	SiO ₂	17
	Atacamite	copper (II) chloride hydroxide	Cu ₂ Cl(OH) ₃	32.6

5.3. Cleaning Process

Mechanical cleaning was done to remove dust, active corrosion, and wax residue with scalpels, soft brushes, and a fiberglass pen. Dust and dirt also were removed using organic solvent (alcohol). After mechanical cleaning and optical examination, the surface morphology of the incense burner began to emerge, see (fig. 3).

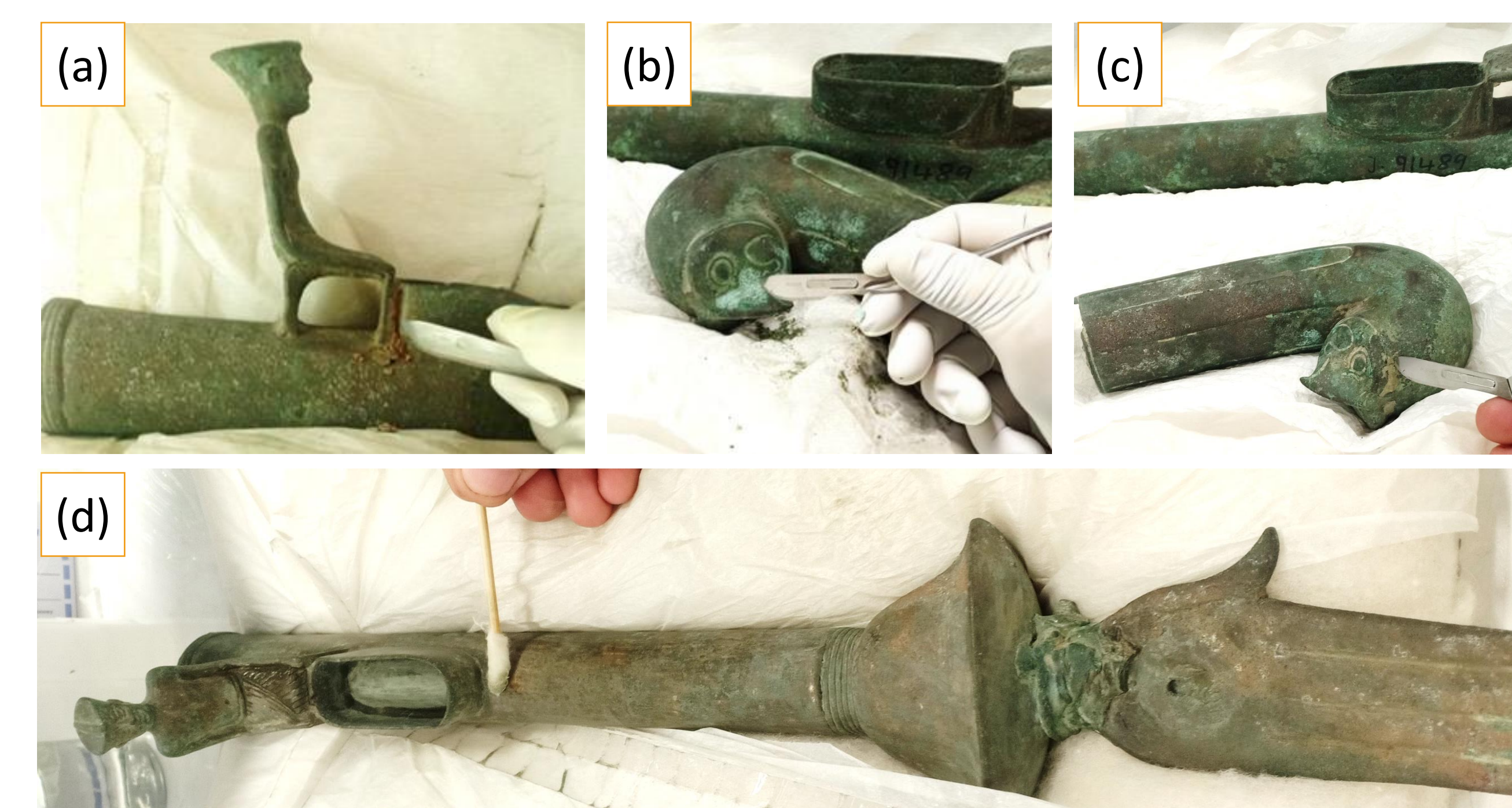


Fig. 3. Mechanical cleaning of the incense using different tools (a,b,c) and alcohol (d)

5.4. Joining Process

Then, separate handle was assembled using a bar of Plexiglas with a proper diameter to the inner diameter of the incense burner and fixed with 40% Paraloid B-44 dissolved in acetone, followed by filling the gaps with a paste of 20% Paraloid B-44 with a filler consisting of Microballoon and suitable pigments.



Fig. 4. During (a, b) and after (c) assembling of incense burner handle

5.5. Stabilization Process

After removing active corrosion layers, 3% BTA in alcohol was used as corrosion inhibition. Finally, a coating of 3% of Paraloid B-72 was applied to the surface of the incense burner to make an extra protection.



Fig. 5. The incense burner during after treatment

6. Conclusions

Mechanical cleaning was used to successfully remove corrosion layers from the incense burner, revealing the original surface and border decorations. According to XRF data, the incense burner is made of a bronze alloy. A corrosion inhibitor containing 3% BTA was brushed over the surface of the incense burner. Finally, 3% of B-72 coating was applied to make an extra protection.