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A COMPARATIVE STUDY BETWEEN THE DOCUMENTATION STAGES OF THE FIRST KHUFU BOAT AT THE END OF THE FIFTIES AND THE INTERNATIONAL DOCUMENTATION RULES FOR ARTIFACTS

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Abstract:
The present study aims to explore the stages of documenting Khufu (Cheops) boat from the moment of discovery to reconstruction at the end of the fifties and the extent of its compatibility with the rules of international documentation approved by international organizations at the end of the nineties. Hag Ahmed Yousuf (Chief Restorer), documented the boat thoroughly through the engineering drawings of each of the thirteen layers of the boat, with undertaking documentation for each of the 1224 pieces disassembled, each piece on its own. He determined the position and orientation of each piece as well as its dimensions. He uplifted the archaeological drawings of the writings and signs on the wooden pieces and the sides of the pit to deduce the method of assembly and the position of each piece. He made a detailed drawing of the method of assembling the boat, bearing the dimensions and position of each piece. In addition, he designed of a detailed miniature model of the boat in a fixed scale with the design of detailed drawings of the belly of the boat, the planks and the oars and places of distribution and methods of compilation. However, these documents have not been published so far scientifically and the research is concerned with their publication. However, these documents have not yet been published scientifically, and it has not been studied and evaluated how the work team was able to benefit from the documentation process in reconstruction the Khufu ship and verifying its compatibility with the international documentation rules that have been established. It was later approved by international organizations.

1. Introduction

The documentation process has recently achieved significant progress using modern computer software. It is an essential tool in the documentation process for monuments [1]. Computer software is used to draw a complete and high-quality map of the artwork, record degradation manifestations, and draw a three-dimensional picture of the artifacts [2]. In addition, it illustrates the accurate dimensions of the artifacts on a fixed scale [3]. Since the moment of discovery, the artwork documentation process is deemed to be the established scientific document that helps researchers and restorers' complete works of study and restoration without falsity or fabrication [4]. Therefore, international organizations for archaeological restoration have set documentation standards that are reviewed, illustrated, and applied to the documentation of the first Khufu boat. These standards include: **a)** Description and indexing of the object. **b)** The object type should be registered. **c)** The technique of manufacturing the object. **d)** Dimensions: Object size and measurement units. **e)** The technical study of the object: Any significant mark, inscription, decoration, text, the signature of the manufacturer, etc. that can be clearly defined in the object. **f)** Distinguishing features: Distinguishing features of the object to be identified in the case of having similar artworks, such as deterioration, restorations, manufacturing defects, etc. **g)** Title: It often applies to the artworks in museums of modern art. It may help identify the object in the case of loss theft, such as Gogh's Poppy Flowers. **h)** Content or topic: In the case of having a portrait, what is its content? Does it represent a king or prince?. **i)** Date or period: It means the accurate dating of the object (era-dynasty). **j)** Maker: Who is the maker of the object? Sometimes, the name of the artwork contains the name of the

maker (painter, sculptor, furniture maker, etc.). **k)** Photographic documentation of the object: Registration or documentation of the object and its details using photography; several photos from different angles should be taken to document the object and its writings and inscriptions comprehensively. This stage is very important because it helps identify the cases of loss or theft. The following items should be considered: ***)** Size and color: It is preferable to use a drawing scale to show the size and a color scale to determine the color of the object. In the case of black and white objects, a grey scale can be employed to determine color intensity appropriately. ***)** Identification numbers: In the case of photography, a clear identification number on a piece of paper should be placed in front of the piece. In the case of having more than a number of the piece, the general register number can be used because it is unique and cannot be duplicated in the museum. For example, in the Egyptian Museum, the pieces may have several numbers according to the numbering system of monuments (general register- special register- catalog- timer). To get a better result when taking photos of the multi-dimensional piece, the following should be considered: **-)** Two-dimensional (2D) objects, such as paintings, prints, drawings, and textiles, should be photographed from a direct facing location. If this is possible, these objects are dismounted from the walls, put on a flat (horizontal) level, and photographed overhead. **-)** The back side of the object can be photographed if it has distinguishing features or marks. **-)** In the case of the inscribed, molded, or high-relief surfaces, it is better to photograph them from a direct facing position, and several photos are taken from different angles to document the depth of the object. **-)** Three-dimensional (3D) objects are photographed overhead to show the top, front, and side of the object. **-)** Choosing the right background: For the best results, the objects can be photographed using a white, undecorated background to achieve the correct color balance. However, darker backgrounds can be used to show color contrast if needed. **-)** Photographing damage: Detailed photos of the deteriorated parts should be taken to be used in restoration. Photographic registration continues in every restoration stage: Before, during, and after restoration. **-)** Electronic documentation: **-)** It is important to register the data of museum collections using electronic databases that occupy a smaller area than the paper-based system. Moreover, backup copies are created. Databases facilitate the storage of information in a coherent and organized manner and allow quick search. **-)** Electronic documentation allows the exchange of information among museums or departments of the same museum. It allows sending the photos and data of the objects to researchers, police, or international organizations, e.g., UNESCO. **-)** Data stored in databases can be reused in different methods, such as preparing catalogs and exhibition texts. m) Scientific publication: It is one of the most important documentation stages because it is a scientific reference for future generations [5]. On May 26, 1954, Kamal El Malakh discovered Khufu Boat in a limestone pit arranged in 13 layers of 1224 planks. The process of documenting this boat, from the moment of discovery to the end of the reconstruction process, took place in a unique scientific method [6]. However, now modern means of technology were utilized in the process of documentation It is historically proven that all documentation processes until the end of the nineties were done manually in the form of research, reports and theses. [7]. In other words, the documentation relied on manual methods and was drawn as efficiently as modern computers. This led to the unparalleled success of rebuilding the first Khufu boat. The question is whether the documentation of the first Khufu boat was carried out in a scientific manner consistent with international standards in documentation work. This is what we will learn about by studying the approach that was followed during the documentation process, which has not been published since 1954 until now.

2. Materials and Methods

Archaeological documentation is highly significant Which is done using many fancies means regarding application and quality. However, international organizations, such as the International Council of Museums (ICOM) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), have set standards without which documentation is incomplete and does no fulfil the designated purpose, such as using technology [8].

3. Documenting Steps of the 1st Khufu Boat.

Khufu Boat was discovered inside a limestone pit, disjointed, into 1224 planks in 13 layers [9], with the Royal Cabin in the last upper deck. It was in good condition, where the ancient Egyptian covered it with a layer of mats and linen [10]. *Haj Ahmed Yousuf* (Chief Restorer) divided the pit, with its wooden planks, into thirteen layers to facilitate the registration process. The top layer contained mats, ropes, and fabric, labeled Layer A, followed by layers from (1 to 13) from top to bottom. This division did not depend on the ancient Egyptian division of the pit [11]. The process of documentation and visionary perception of Khufu Boat's rebuilding remained a mystery to the world because of its complete secrecy and the lack of scientific publication of any details. However, the sketches and photos left behind by the team supervised by Haj Ahmed Yousuf and stored in the store of Khufu Boat Museum clearly explained the process of documentation and the imaginary drawing of the method of assembling Khufu Boat before the reconstruction. In collaboration with the archaeologists at Khufu Boat Museum, a team of restorers recorded and classified the documents and sketches into three groups. The first group comprised 114 Cardboard plate of multi-dimensions and thickness showing the engineering drawings of the planks. This group was classified and recorded in the Museum's records to facilitate the study. The second group consisted of 421

kalk paper paintings, 129 of which were in 42 wooden drawers. The group also comprised a roll of sketches and hieroglyphic signs that the teamwork inspected from the stones covering the boat in the pit. The third group consisted of a large set of different-sized kalk paper of these sketches and signs kept in the closet of Haj Ahmed Yousuf at the Museum. The methods used to document the first Khufu boat can be as follows:

3.1. *Photography and sketch of the layers of the boat, in the moment of discovery, from the historical documents of Haj Ahmed Yousuf*

Photographic documentation of the disassembled panels of Khufu Boat was one of the most important and difficult stages. Haj Ahmed Yousuf was keen on taking an assembled photo of each layer in the pit to show all details and locations of the wooden pieces in the pit that was meters deep with cameras of poor quality at the time. However, he recruited a professional photographer called Hassan Zaki, who introduced a new method of photographic documenttation by integrating photography and sketching in one photo. In other words, Zaki created the sketch above each photo, illustrating the location of each piece in the assembled photo in the pit for each layer of the thirteen in an unprecedented scientific method. Photographer Hassan Zaki overcame the problem of taking an assembled photo of each layer in the pit with simple cameras at this time. He installed the cameras on a metallic beam across the pit, taking successive snapshots by moving the cameras in fixed distance along the beam, using a fixed vertical angle in each area in the layer showing the location of each plank at the time of discovery in a fixed sequence of photos. He then assembled the photos and occupied about 31 meters long, bearing the coordinates of each wooden plank of layer [12]. He also designed a network planning drawn over the photos after assembly, through which the disassembled planks can be allocated in their correct position [13]. In addition, photos were taken of each extracted plank from the nearest location as a guide to the location of each plank at the moment of discovery [10]. All photography work down to the eighth layer was performed on a simple adjustable platform hung above the pit [11]. These photos bore all the details of each layer and the orientation of each plank relative to the pit, using a unique method in the documentation process [12]. This method has achieved unprecedented success in the precise documentation of each layer of the boat as it supplies considerable details. Once these photos are examined, all their details. Haj Ahmed Yousuf also made notes on some planks after adding numbers to the margins of each image to disclose some details to serve as a direct reference. This was proved after the examination of the documents stored in Khufu Museum. In addition to documenting the orientation of each layer of the boat precisely to define the location and orientation of each plank in each layer. This technique is one of the unique methods that combine photography and network planning in one drawing to serve as guidelines for defining the location, orientation, and the number of each plank in each layer at the moment of discovery, fig. (1).

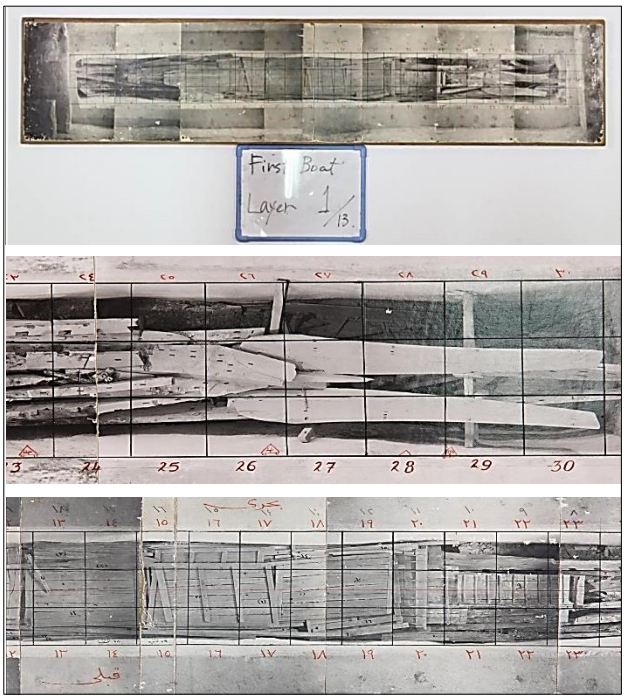

Figure (1) assembled photog of the first layer

3.2. *Documentation using the archaeological sketches of the guidelines in the pit sides and the detached planks of Khufu Boat*

The ancient Egyptians made some marks and symbols on the sides and bottom of the pit in which the boat was found, showing the four orientations, prow, aft, starboard side, and port side of the boat. They also executed some marks and guidelines in bas-relief and colored white on the surface of some boat blanks bearing certain connotations [14] to help rebuild the boat in the other world [10]. Haj Ahmed Yousuf and the team unlocked about 1131 marks and symbols from about 305 wooden planks using kalk paper and then painted them in black. Each paper contained one or more marks, the number of the wooden plank, and the location of the mark on the plank (i.e., at the tip or the middle), fig. (2). They also uplifted the hieroglyphic and hieratic symbols that the ancient Egyptian had painted on the sides of the pit using calque paper, fig. (3). Although the team drew these marks, their concept was not understood. Therefore, these archaeological sketches were neglected and stored without highlighting until 1964, when the fourth attempt to rebuild Khufu Boat began. At that time, an assistant to Haj Ahmed Yousuf realized the purpose of the engraved marks on the top of the wooden planks.

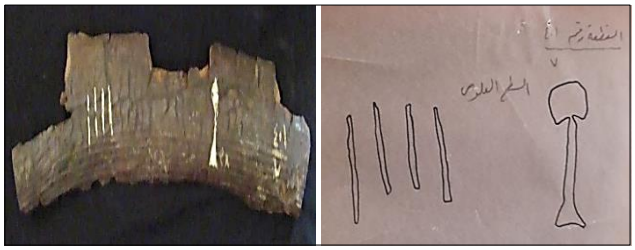

Figure (2) marks and symbols from wooden planks

Figure (3) Hieroglyphic and hieratic symbols painted by the ancient Egyptian on the sides of the pit

3.3. *Documentation and engineering drawings for each plank of the boat*

A detailed work plan was prepared to document the wooden parts of the boat in an accurate scientific manner. It comprised two stages. The first stage covers the scientific documentation of the wooden planks with all their details. About 12 draftsmen were recruited to carry out this work [6]. The work covered: **a)** Design of an index card for each plank containing its number in the grid system of the assembled photograph. **b)** An accurate sketch with dimensions, time of extraction, and entry to restoration lab. This was conducted especially for the restoration and rebuilding of the boat. Such sketches reflected the extreme precision of the documentation process and sketch for the wooden planks with all their details, fig. (4-a & b). This plan resulted in 300 engineering drawings. **c)** Processing of photographs of the planks when entering the laboratory. **d)** A card containing a photograph of the plank with a precise description of its type (door- oar- plank of the cabin), date of extraction, No. of the layer it was extracted from, and restoration material, fig. (4-c). A record was made containing a photograph of each plank. It was configured, where a detailed photograph was placed therein, date of extraction from the pit, and location in the pit (in the Southern end or Northern end). Additionally, the dimensions at the time of discovery (length, width, and height) were taken, and the type of plank (part of the boat's floor or the planks of the cabin or oar) was determined. He developed an accurate description of the conditions of the plank and was found weak, medium or otherwise. He precisely described the manifestations of damage including cracks, loss, and warping). A card of acquaintance of one of the boat planks in Khufu Boat Museum record by Haj Ahmed Yousuf included the data as follows (a plank of the floor of the boat was uplifted on 25/10/1956 from the Southern side of the pit to the south of the Great Pyramid. It consisted of four longitudinal planks connected with the side tabs and nine straps and each of them had three double tenons. Each strap had some grooves for decoration. On each side, there were lines and black ink, indicating the order of these straps from the west to the east in the fourth blank 22-24b no. 59.

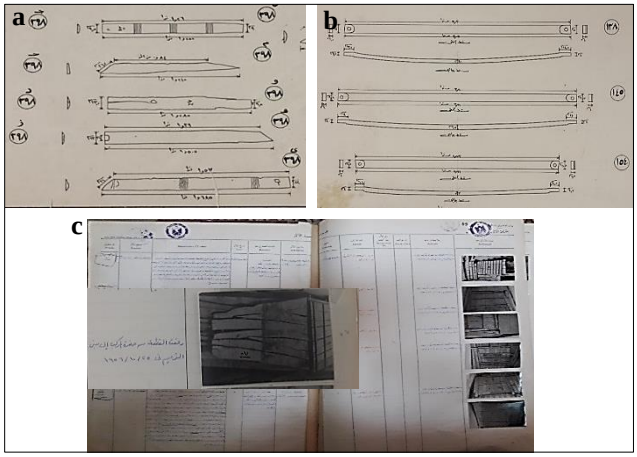

Figure (4) **a.** detailed stage of documentation and precise scientific sketch of the wooden planks, **b.** processing of photographs of the planks when entering the store

In the second stage, the first plan was modified after one year of work due to increased pressure to finish the restoration work, in order to display this great discovery to the public, which is the second largest discovery in the world after the discovery of the tomb of Tutankhamun. It is also the largest discovery of a wooden structure in the world and was discovered as a complete object [15]. Hence, the main goal was to complete the work of restoration and reconstruction of the boat for display. This, in turn, resulted in reducing the number of draftsmans to one draftsman and two assistants to continue the work, even if not at the same precision as it started (from the correspondence between Haj Ahmed Yousuf and the Director of the Antiquities Authority at the time to expedite the work). Consequently, the sketches were less accurate, reflecting only dimensions with a general shape and recording a reference number for each plank. This was clearly shown in some sketches that showed the inconsistency of the edges of the wooden planks, fig. (5).

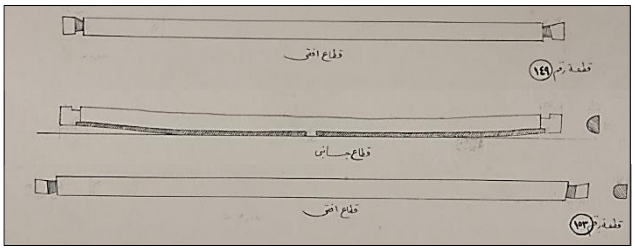

Figure (5) the second stage of documentation, the graphics are less accurate

3.4. *Graphic design and actual embodiment of the boat before reconstruction*

Haj Ahmed Yousuf drew up a general layout of the boat, proving the success of documenting the rebuilding Khufu boat. As a result, the boat was brought out for the first time through the diagram in an assembled picture with all the details on a fixed scale, specifying the position of each plank in dimensions and sizes, fig. (6). Haj Ahmed Yousuf was

creative enough to develop a visual perception of the boat with all its details and dimensions in a sketch before commencing the assembly and reconstruction [8]. With these sketches, Haj Ahmed Yousuf could reconstruct the boat in a scientific manner, based on an integrated schematic study in order to avoid any error during the assembly process. These documents are a witness of the proficiency of the documentation process. Without these steps, the process of rebuilding Khufu Boat, which stunned the world, would not have become a reality. These documents are an integral part of the monument, as well as its survival and preservation that are not less important than the documents and papyri left by the ancient Egyptian because they are the key to the mystery of the disassembled Khufu Boat.

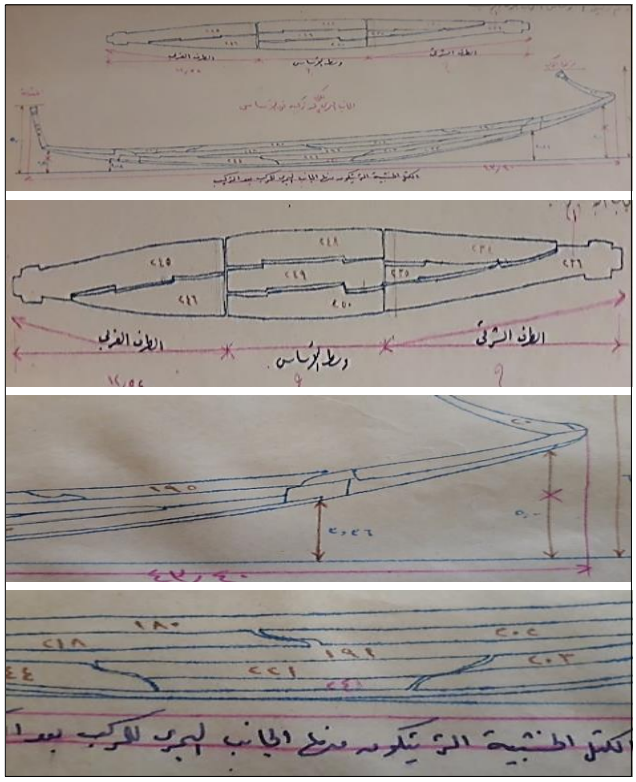

Figure (6) diagram of the method of assembly and interlocking planks

3.5. *Documentation and engineering drawings of special-purpose wooden planks*

3.5.1. Engineering design of the oars and their positions on board the boat

The boat of Khufu had twelve oars. There were no indications for the adjustment of the oars on the deck of the boat [10]. After assembly, they were readjusted; two in front and the other ten were distributed, five on each side of the main chamber, fig. (7-a & b). Haj Ahmed Yousuf's sketches preserved in Khufu's boat store showed that he was keen on the study of the oars. He designed an assembled diagram for the oars and their positions and the method of pres-entation, with a detailed sketch of each oar and its parts in dimensions. Each oar was recorded meticulously with all the details when putting with other planks, as shown in the handwritten register of the museum by Haj Ahmed Yousuf (for example, the oar's length 581 cm, oar pan length 191 cm, oar pan edge thickness 1.3 cm, stem diameter 5.4 cm, with maximum diameter 11.2 cm. When the stem joins the pan, it is 10.4 cm, and the stem extends in the pan up to about 20 cm from its end). The method of oars' assembly differed from the assembly of other planks. Some oars were found in one plank and others were disassembled in more than one plank. Haj Ahmed Yousuf paid attention to registering and drawing the different assembly and Joinery techniques used to connect the disjointed parts together to facilitate the assembly process, fig. (7-c & d).

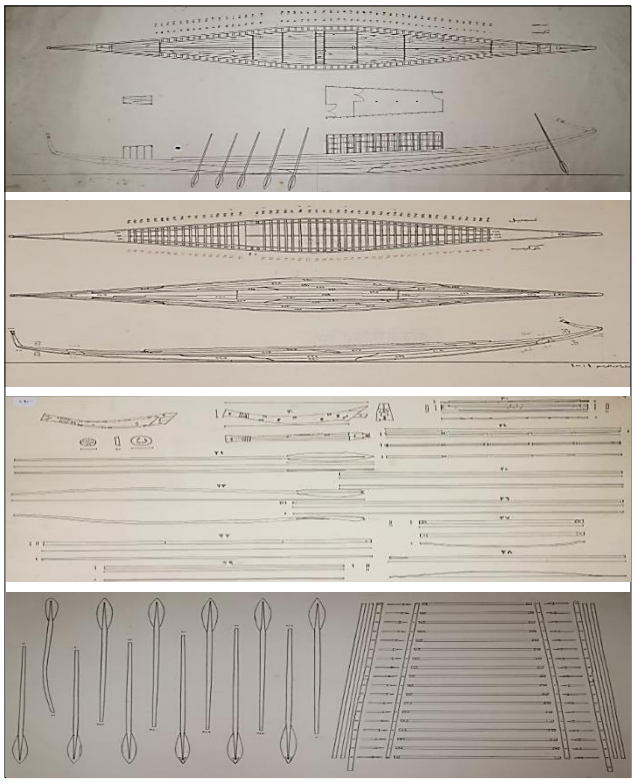

Figure (7) **a.** & **b.** graphic design and actual embodiment of Khufu's vessel before reconstruction and distribution of oars, **c.** & **d.** engineering design of the oars

3.5.2. Sketch of the columns of the boat

The team found 48 columns in the form of papyrus plant bud in the pit [5]. The team led by Haj Ahmed Yousuf documented this collection with all decorative details, fig. (8).

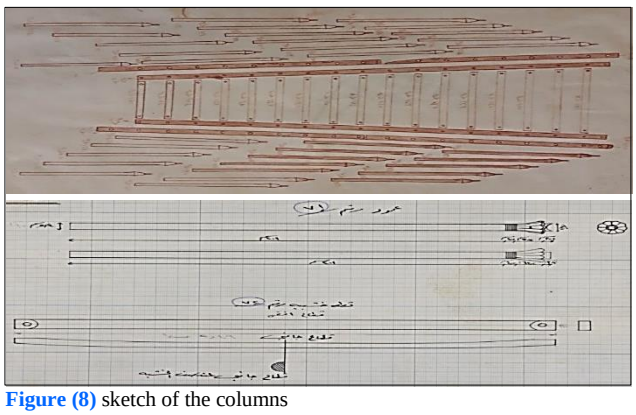

Figure (8) sketch of the columns

3.5.3. Designing a 3D wooden model for the abdomen of the boat and another for the boat as a whole

Through the diagram, prior to starting the reconstruction of Khufu's boat and avoiding any doubt, Haj Ahmed Yousuf designed a three-dimensional detailed wooden model of the boat to contemplate the use of modern computer programs to draw a three-dimensional (3D), fig. (9). Thus, he succeeded in the reconstruction of the imaginary Khufu's boat before embarking on the process of actual reconstruction. This is one of the greatest achievements of Haj Ahmed Yousuf, where he explained a practical planned method to reconstruct the deck of the boat with all the details in the main hall of Khufu Boat Museum, demonstrating his accuracy and genius. This model has become the accurate documentary record of the deck of the boat and the basic guide for the reconstruction of Khufu boat in a studied and documented process. Figure. (10) shows the Khufu Boat after the successful reconstruction

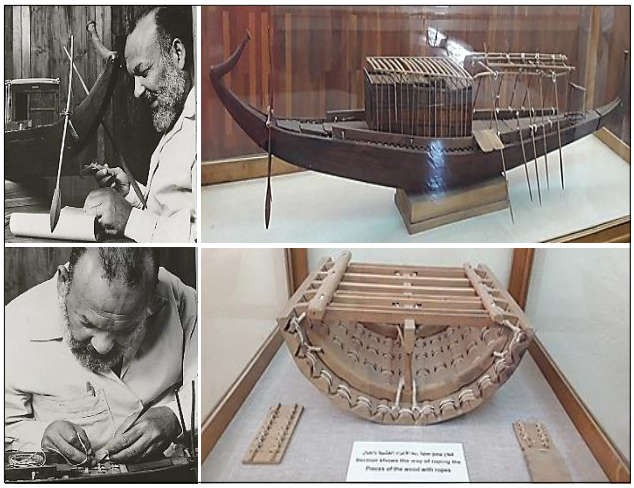

Figure (9) wooden models of the boat and boat deck

Figure (10) Khufu Boat after the successful reconstruction (https://gate.ahram.org.eg/News/2887109.aspx)

4. Results

Based on the above-mentioned data many results could be concluded as follow:

***)** The study proved that the documentation work that took place on the Khufu boat It is a scientific achievement ahead of an era.

***)** The documentation and engineering drawing works succeeded in determining the location of each piece and assembling the Khufu boat with engineering drawing before starting to assemble the boat's boards.

***)** The archaeological identification of signs and symbols on the surface of the boat helped in understanding the places where the planks were assembled.

***)** The design of a wooden model for the boat that includes the method of assembling and connecting the wooden panels with each other was the biggest factor in the success of assembling the disassembled Khufu boat without falling.

***)** The documents left by the work team are an important part of the history of the object and also help in understanding the methods of dealing with the Khufu boat during the restoration and preservation works. The boat has now been dismantled and transported for reassembly and display in the Grand Egyptian Museum.

5. Discussion

The research paper revealed important facts about the stages of documenting the Khufu ship, which had been kept secret for many years. The stages of documenting the Khufu boat in 1954 preceded the restoration rules approved by international organizations at the end of the nineteenth century. According to the internationally recognized documentation rules, the methods of documenting the Khufu boat are considered a scientific reference, as shown in the highly accurate and detailed photography from the moment of discovery, pieces' dimensions, drawing scale, illustrating the status and deterioration of each piece with accurate documentation of each piece, archaeological lifting of symbols and marks using a fixed scale, preparing illustrating cards of each piece with a detailed explanation of the status and documentation at discovery, and accurate numbered records with the details of each piece. The accurate 3D wooden model of the boat corresponded to and surpassed modern computer software. Despite the high documentation accuracy, documentation lacks an important stage, which is electronic and recording part data via electronic databases. However, the documentation work has not yet been published scientifically. They have been kept in the archives of Haj Ahmed Yousuf. Unfortunately, Haj Ahmed Yousuf deprived humanity of utilizing such great knowledge achieved in the documentation works.

6. Conclusion

Despite the success of Ahmed Youssef in laying the scientific foundations for the documentation process very early, which was a major reason for the success of the process of rebuilding the Khufu boat. However, these foundations were

not used except for the boat itself, and no one benefited from it, due to his lack of scientific experience in publishing, so we say that he lost his right to intellectual property to lay the scientific foundations for the process of archaeological and engineering documentation of monuments. In the current era of digitization, recommendations and necessary measures must be taken, through the work of Database for the Ahmed Youssef Archive and the work documenting Khufu's boat, as is the case with the tomb of Tutankhamun, Griffith Museum.

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