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Review Article

A COMPARATIVE CONSTRUCTIONAL ANALYSIS OF TWO ROYAL ARMCHAIRS FROM THE OLD AND NEW KINGDOMS

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Abstract:
During the third decade of the 20th century two remarkable archaeological discoveries in Egypt provided the first tangible evidence of the form of wooden furniture used by the rulers of this ancient civilization. Although, these armchairs display similar physical characteristics, in that they raise the seat to a comfortable height, provide a back panel and arm panels, the manner of their design and construction differ considerably. It is these differences that will be examined in this paper to show how advances in design thinking and methods of construction could potentially improve the quality of armchairs, the principles of which are still seen in modern forms of seating.

1. Introduction

The first discovery, made in 1922 by Howard Carter (1874-1939), was the intact New Kingdom tomb of Tutankhamun (KV 62) (c. 1341 BC – c. 1323 BC) in the valley of the kings at Thebes. While three years later George Andrew Reisner (1867-1942) opened another royal chamber at Giza that contained the funerary furniture of Queen Hetepheres I (2600 BC), the royal wife of the Old Kingdom king Snefru and the mother of Khufu whose great pyramid dominates the Giza plateau. Although both deposits contained objects of a royal context, their manufacture was separated by twelve centuries and their depositions by 500 kilometers. Both deposits contained a range of royal wooden furniture that illustrates the quality of products made by ancient Egyptian craftsman over a long time period. The most impressive pieces were the royal armchairs that had been made in wood and covered with thin gold sheet.

2. The Armchair of Queen Hetepheres I

The earliest of the two armchairs being discussed in this paper was found in a fragmentary condition in a small chamber at the bottom of a deep shaft on the eastern side of Khufu's pyramid at Giza. The chamber contained Hetepheres funerary furniture, but the Queen's body had not been interred with the deposit. The chamber was numbered G7000X by George Andrew Reisner and it took seventeen months to recover the deposit and meticulously record the chamber's contents [1]. Hetepheres' armchair had been made from carved wooden elements that were covered with gold sheets that had been worked over the wooden substructure, fig. (1).

Figure (1) Armchair of queen Hetepheres I., GEM 6365, Cairo (*Photographic credit: Lorraine March-Killen*).

Unlike the furniture deposited in the tomb of Tutankhamun (KV 62), moisture had entered G7000X over an extended period of time, causing the wooden substructures to swell and rot and a general collapse occurred leaving the gold sheets and inlays that had been attached to the furniture lying in layers amongst the decayed wood fibres which resembled cigar ash. William Arnold Stewart (1882-1953) was tasked by Reisner to reconstruct the Queen's furniture from the thousands of fragments of gold sheet and inlays that had been recovered from the chamber. Stewart had travelled from England at an early age to work in Egypt. He was appointed as Director of the School of Arts and Decorations in Cairo and moved in the same social circles as Reisner. Stewart was a talented artist, draughtsman and craftsman and was approached by Reisner to paint a watercolour of the chamber's interior before the removal of the deposit. This watercolour painting has been lost but was copied in oil by Mr. J. Lindon Smith, the American artist and is presently on loan from the Museum of Fine Arts, Boston (27.388) and has been on display at Fitchburg Art Museum, Massachusetts, since June 8, 1939. Once the deposit had been removed, Reisner asked Stewart to join the Harvard University/Museum of Fine Arts, Boston, team to reconstruct the furniture by making new wooden substructures and placing on them the surviving gold sheets and inlays. During his work in reconstructing the furniture he was assisted by a local carpenter and the excavations chauffeur who doubled up as the projects smith and metalworker. Using the detailed excavation notes, photographs and drawings, Stewart worked meticulously to re-establish the form and construction of each of the pieces of furniture that had been placed in the chamber. During his work he wrote a detailed diary with associated thumbnail sketches and produced a series of technical drawings which explain his reasoning behind the reconstruction of each piece of furniture. His diary and working drawings are preserved in the Griffith Institute, University of Oxford. Alfred Lucas (1867-1945) the eminent Egyptian based analytical chemist, acted as a consultant for the conservation of finds discovered in the tombs of Hetepheres and Tutankhamun, he urged Stewart to record and publish his conservation and reconstruction work on the Queen's furniture [2]. Sadly, Stewart died before being able to publish his work. The fragmentary remains of two armchairs were discovered in the chamber. A replica of the second armchair, that was not reconstructed by Stewart, has been recently reconstructed using modern materials and technologies by the Giza Project/Harvard University team led by Professor Peter Der Manuelian [3]. The armchair which Stewart reconstructed, fig. (1), had collapsed and partly fallen into the chamber's entrance shaft and onto the chamber's floor where it had decayed. Photographs taken at the time of the discovery showed the arm panels were made up of a group of three papyrus flowers held together with a centre piece. The flowers were arranged to fill the space between the side seat rail, back panel, arm and the front arm support and were attached to these elements by large mortise and tenon joints. The gold shells of the papyrus flowers were reformed, by manual manipulation, to their original shape. New wood cores, fig. (2), were carved to fit inside the gold shell and a small gap was left between the gold shell and wood core which was filled with thin plaster.

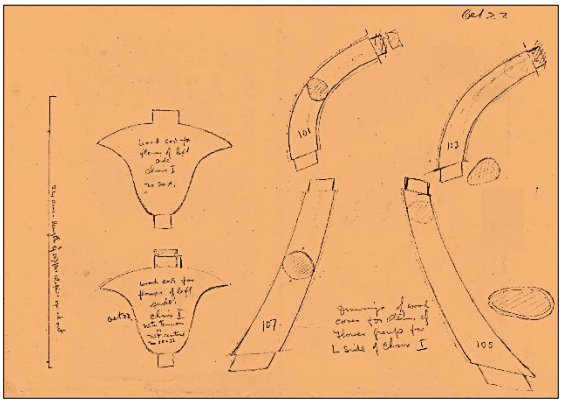


Figure (2) Stewart MSS 104, drawing: Wood cores of stem of flower groups. Nos. 20A, 28, 32, 38, 101, 103, 105, 107. Dated. Oct 22. (*Reproduced with permission of the Griffith Institute-University of Oxford*)

When the plaster had set, Stewart removed the gold and scraped away any remaining wax, that had been used as a temporary method of fixing the gold pieces together, and hand modelled the plaster. He cleaned all wax from the gold with hot water and then applied the gold piece by piece to the plaster coated wood core with hot glue. The semi-circular section of both of the armchairs arms was covered with thin gold foil which had broken into many pieces but these fragments showed that the arms had been formed with a ribbed pattern in high relief. Stewart found a pair of gold end caps that fitted onto the ends of the arms which gave him the cross-section of the arm on which the foil would have been originally fixed. He used gummed paper to repair the gold foil and then laid the gold on to a hard wood arm that had been made by the carpenter. He used carbon paper to mark the ribbed pattern of the gold sheath onto the prepared hard wood arm and then carved the arm to accommodate the gold foil and then fixed them together with a coat of glue and gesso. The arm and the back panel of the armchair had been covered with gold foil before the armchair had been finally assembled. Mortise and tenon joints were used to connect both elements with rawhide ties drawn through holes in the joints to fasten them together. The armchair legs had been carved to a lion form,

the front pair of legs were taller than the back legs which resulted in the armchairs seat slightly sloping towards the back of the armchair. Stewart found that he could not carve new wooden lion shaped legs onto which he could reapply the gold. He developed a unique plaster casting process around a wood core for manufacturing the legs before reapplying the gold. The wood core that protruded from the top of the plaster leg, acted as the tenon which located in a mortise chopped into the underside of the seat frame, fig. (3).

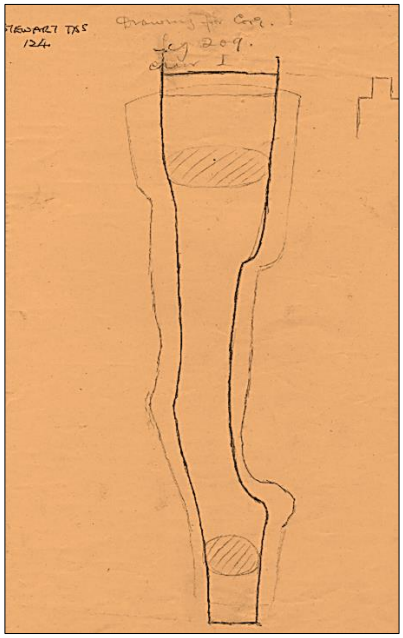


Figure (3) Stewart MSS 124. Drawing: Provides the shape of the wood core used to make a chair leg (No.) 209, chair No. I. A lighter pencil line indicates the shape of the metal case in which the wood core fits. Also shown is a cross hatched section through the core and a side elevation of the tenon that would project from the top of the finished leg (*Reproduced with permission of the Griffith Institute-University of Oxford*).

Stewart discusses the process of casting the armchair's legs in detail in his daily diary, and in a forthcoming publication a practical experiment to replicate this process is explained, and the results of how these legs were manufactured in plaster is shown in a sequence of photographic images [2]. Stewart could find no evidence of how the seat was fixed into the seat frame but he did find evidence, in pressure marks on the gold of the frame, that suggested a rebate had projected about 12 mm over the frame. He had a rebate cut into the seat frame into which he placed a loose board. The armchair's back panel was slid into place in its thin vertical frame before the frame was fixed onto the back seat rail with tenons. These tenons were located into opposing mortises in the back seat rail and then secured with wood pegs. The ends of the exposed dowels were covered with original gold patches. An additional vertical centre brace was placed behind the back panel and fastened with tenons into a mortise in the underside of the top rail of the back panel and a mortise in the centre of the back seat rail. Stewart recognized that the structure of the armchairs back panel was a structural weakness as its frame was made of thin wooden rails and the tenons of the centre brace were weak where the greatest force would be put upon it.

3. Other Old Kingdom Armchairs

However, this method of armchair construction was commonly employed by carpenters during the Old Kingdom. Armchairs with vertical back panels that are directly attached to the back seat rail are depicted in a number of Old Kingdom tomb scenes including an example in the late 4th Dynasty tomb of the royal scribe, Seshemnefer, G 5080, fig. (4).

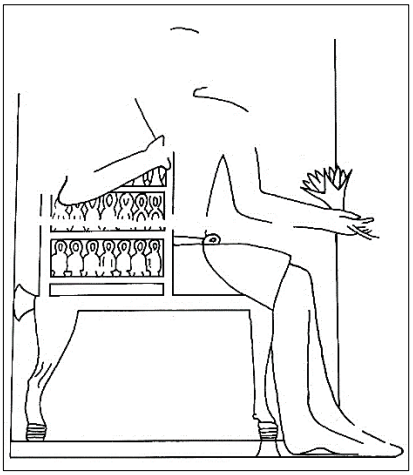


Figure (4) Armchair, wall relief found in the late 4th dynasty tomb of the royal scribe, Seshemnefer, G 5080.

The armchair on which Seshemnefer sits is shown as a side elevation, and provides enough visual information to confirm that its constructional characteristics are similar to Hetepheres armchair although it is unknown whether the framework was gilded or painted. The legs are of a lion form which rest on ribbed drums. They are connected to the horizontal side seat rails, certainly with mortise and tenon joints, and on the end of the side seat rail has been placed a papyrus flower finial. The frame of the armchair's back panel is connected perpendicular to the seat and is supported by the frame of the arm panel. The arm panel has been divided into three horizontal registers of *tyet* – hieroglyph signs separated by two wooden rails. Like the papyrus flowers used within the Hetepheres arm panels these *tyet* - hieroglyphs were most probably carved in the round from wood and placed as an open-work motif within the arm panel.

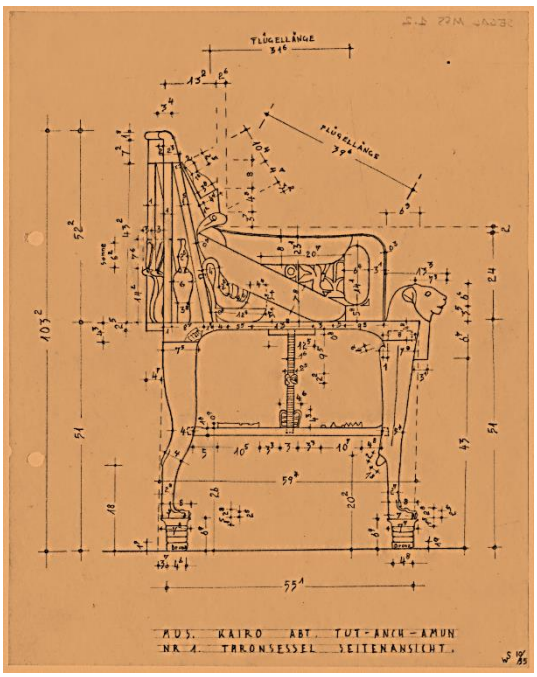
4. The Armchair of Tutankhamun

Many of the design and constructional features seen in the Hetepheres armchair are repeated in Tutankhamun's armchair, fig. (5).

Figure (5) Armchair of Tutankhamun: Front elevation, GEM 4573, Cairo, JE 62028, Carter 91. *(Photograph: John Ross. Reproduced with permission of the Griffith Institute, University of Oxford).*

This is not surprising as the general form and materials used in both armchair's manufacture was similar, being constructed of a wood substructure that is encased in gold sheet, and together with the commonality of carpentry and metalworking skills has led to an outcome which is recognized as pure Egyptian. Both armchairs stand on legs of lion form, they have a solid seat, a back panel and a pair of arm panels. However, the armchair discovered in the tomb of Tutankhamun displays a number of potential constructional improvements to the design. This is not surprising as innovation, through time, is the driving force of creative human improvement. We see the first attempts to provide a chair with an inclined back panel in the Middle Kingdom. Preserved in the British Museum, London is a 12th dynasty limestone stela EA 223, that shows Gebu seated on a chair with lion shaped legs. The chair's back panel in inclined and supports Gebu's lumber region, the top rail of the back panel is moulded to a profile similar to that found on Tutankhamun's armchair [4]. The primary source material for analysing Tutankhamun's armchair come from the excavation records made at the time of the tomb's discovery by Howard Carter and the detailed photographic record of the deposit made by Harry Burton (1879-1940) that are now both preserved in the Griffith Institute - University of Oxford [5]. Eaton-Krauss has used these resources together with notes and drawings made by Walter Segal to document the furniture discovered in the tomb of Tutankhamun [6]. These sources provide an accurate account of the armchairs design characteristics but fail to show the method of the armchair's construction. This failure of providing the armchairs constructional characteristics was partly rectified in two orthographic drawings made between 1934 and 1935 by the architect Walter Segal (1907-1985) [7]. His two scale drawings of the front and side elevations of the armchair provide an important secondary source of evidence for the positions of some of the mortises and tenons that were used in the armchair's construction. Although he was unable to disassemble the armchair, the position and sizes of the mortises and tenons that are shown in his drawing of the side elevation of the armchair, fig. (6-a). Had to be extrapolated by his understanding of ancient Egyptian joinery and the positions of the dowels that fasten the joints together by visual inspection. Unfortunately, a number of joint details are missing from the armchair's side elevation and no joints were recorded on his drawing of the front elevation, fig. (6-b). Also, he did not draw the back elevation of the armchair although a view of this elevation, without constructional details, was drawn by Carter [7]. The back elevation was also photographed by John Ross, fig. (6-c).

a



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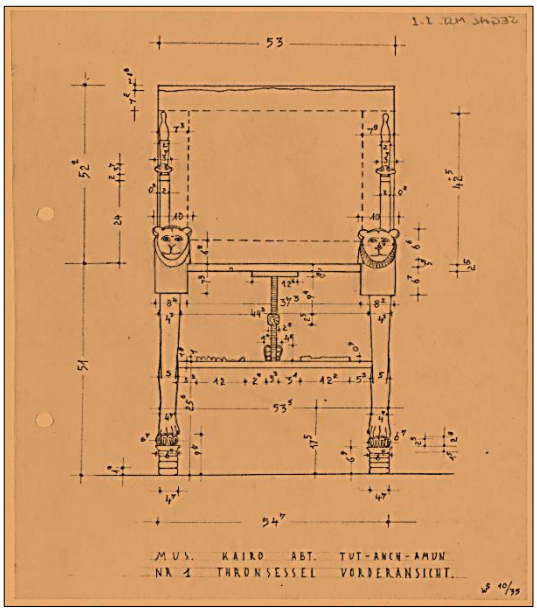

c

Figure (6) **a.** side elevation, **b.** front elevation of Tutankhamun's armchair (*Drawing: Walter Segal)*, **c.** armchair of Tutankhamun; back elevation, GEM 4573, Cairo JE 62028, Carter 91 (*Photograph: John Ross*) *Reproduced with permission of the Griffith Institute, University of Oxford*)

However, another secondary source is more useful and comes in the form of a film documentary, the English translation being 'The Throne of Tutankhamun', made in 1982 at the Egyptian Museum, Cairo. It was co-produced by Shadi Abdel Salam and the Antiquities Organization. Unfortunately, at present, this visual record is not available on any streaming platform and was supplied to the author by Prof. Dr. Nesrin El Hadidi, Professor of Wood Conservation, Organic Conservation dept, Faculty of Archaeology, Cairo Univ. This film documentary follows the museum's photographer, Mostafa and Mahmoud, a master's student, accompanied by his inquisitive nephew Salah, photographing the already disassembled armchair. Scenes show Samir Abaza, the main conservator at the Egyptian Museum cleaning and reassembling the armchair. One scene in the documentary (*7.11 - 7.39- These numbers indicate the start and end times, in minutes and seconds, of the material and processes being discussed*), shows him handling one of the uraei that would be attached to the back seat rail of the armchair. He is working at a long table on which are placed the remaining thirty individual elements needed for the armchair's reassembly. This scene shows the positions of the mortises and tenons used in the armchair's construction that had mostly been identified by Segal. However, what is surprising is the size of some of the joints revealed by the film documentary are not as substantial in size as one would expect to see on such a piece of elite furniture. The armchair's legs are formed in the shape of a lion's front and back legs and are attached by large tenons that protrude from the top of each leg and locate in mortises beneath the seat. Segal only shows the mortise and tenon joint, as a hidden detail line, on the front leg, fig. (6-a). Between each pair of lion shaped legs is placed, at knee level, a horizontal stretcher. A tenon has been cut at each end of the stretcher and locates in a mortise in the leg. In the middle of each stretcher is a vertical tie bar, shaped in the form of a *sema* – hieroglyph, and tenoned into a mortise in the stretcher and a small rectangular block dowelled to the underside of the seat. This new constructional arrangement, not seen on the Hetepheres armchair, was designed to give increased rigidity to the under frame and is still commonly employed by carpenters. The spaces to each side of the vertical tie bar had once been fitted with a pair of openwork decorative elements depicting the heraldic plants of Upper and Lower Egypt, fragments of this arrangement are preserved on the upper surface of the stretcher. Three vertical elements, a centre brace and two stiles, are attached to the curved back edge of the armchair's seat [8]. These act to brace the curved back panel which is another new design feature. The outer stiles are attached by pairs of pegs to the seat (30.11 - 30.22), fig. (7-a), this is an unusual arrangement as the centre brace is tenoned into a mortise in the seat. The top of all three elements (centre brace and two stiles) have been cut with tenons, and locate into mortises in the curved top rail of the back panel (30.55 - 31.22), fig. (7-b). Surprisingly, the bottom of the curved back panel is anchored to the seat with just two very small tenons, (27.56 - 28.25), fig. (7-c), a constructional arrangement that appears to be an unsatisfactory method of holding the inclined curved

back panel in position. The curved back panel is additionally braced by a pair of openwork arm panels which feature a crowned winged uraeus sat on a *neb*-basket. The film documentary confirms Segal's drawing that one small tenon is attached just below the loop in the serpent's tail and another small tenon is located at the very top of the double crown of Egypt, just below the back panel's top rail. The arm panels are also fixed to the armchair's seat with a pair of more substantial mortise and tenon joints. One at the front of the arm panel and the other below the *neb*-basket hieroglyph. This arrangement is *confirmed* in the film documentary (16.13 - 16.21), fig. (7-d), but missing from Segal's drawing as previously referred to in fig. (6-a). Between the spaces created by the inclined back panel, stiles, centre brace and seat are fitted six rearing uraei. The four on the back of the seat are wearing gilded sun disks, fig. (6-c), and those on the sides wear crowns. Segal's drawing, fig. (6-a), shows the uraeus placed within the triangular space created by the inclined back panel, seat and vertical stile, wearing the crown of Upper Egypt. On the other side of the armchair this space is filled with an uraeus wearing the crown of Lower Egypt. All these rearing uraei, are fitted to the seat with small mortise and tenon joints (31.52 - 32.01), fig. (7-e). Finally, a carved lion head is fitted above each front armchair leg. Segal was unable to determine the method of fixture but the film documentary establishes that a pair of dowels were used to make the connection with the seat (31.51-31.53), fig. (7-f).

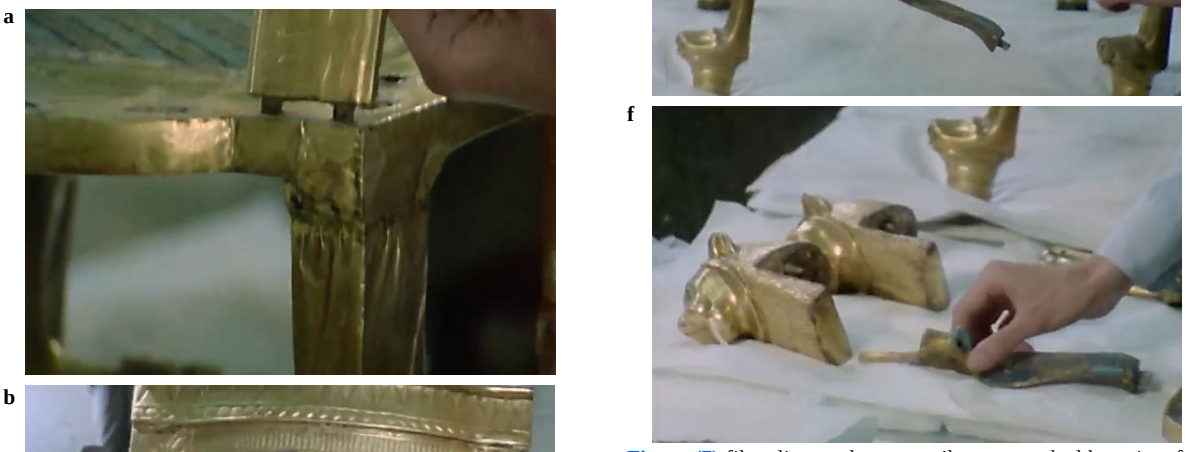

Figure (7) film clips; **a.** the outer stiles are attached by pairs of pegs to the seat rail (30.11-30.22), **b.** the top of all three elements (centre brace and two stiles) have been cut with tenons, and locate into mortises in the curved top rail of the back panel (30.55-31.22), **c.** the bottom of the curved back panel is anchored to the seat with just two very small tenons (27.56-28.25), **d.** the armrests are also fixed to the armchair's seat rails with a pair of more substantial mortise and tenon joints (16.13-16.21), **e.** all these rearing uraei are fitted to the seat rail with small mortise and tenon joints (31.52-32.01), **f.** the carved lion heads are fitted above each front armchair leg with a pair of dowels (31.51 – 31.53)

5. Conclusion

The armchair's of Hetepheres I and Tutankhamun are both remarkable pieces of furniture. With Hetepheres' we see that the armchair's designer relied on constructing the armchair's frame using a right-angled jointing structure using the already well-established mortise and tenon joint. The armchair exhibits two major weaknesses, the fragility of the leg to seat junction and the connection of the vertical back panel to the seat. Tutankhamun's armchair continues to use the same well attested jointing technology but its design has been significantly modified in an attempt to improve the stability of the framework. Now the legs are braced by four dowelled stretchers and vertical tie bars, that would improve the rigidity of the armchair's underframe. The size of the tenons on the ends of the stretchers and tie bars are of acceptable proportions and this structural system would prevent the legs from moving when the seat was dynamically loaded. Another improvement is seen in the structure of the armchairs triangulated back panel which incorporates an inclined curved back panel that is supported by two vertical stiles and a centre brace. Segal's drawing, fig. (6)*, clearly illustrates the triangulated form of this arrangement. The armchair's back panel is moving towards an ergonomic form of seating that supports and provides posture and comfort to the human back. Unfortunately, the constructional system employed, although innovative, lacks adequate fixing points to create a solid structure. Firstly, only two small tenons are used to connect the back panel to the seat, there should be at least three more mortise and tenon joints along this fixture line and all of them should be wider. Secondly, the openwork design of the arm panels provides only two opportunities to anchor it to the back panel, and both joints are inadequate as they are too small, and would result in the back panel moving when loaded. This failure of design was recognized by Egyptian carpenters who on other chairs introduced right angled braces to support the leg/seat and back panel /seat junctions, but on Tutankhamun's armchair they were deliberately not used. Perhaps, the visual, decorative, social, majestic and ceremonial status of the armchair outweighed the need for it to be a constructional secure design.*

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