

## Mechanical Engineering in Ancient Egypt, Part 98: Maces, Axes, Bows and Arrows Industries

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### ABSTRACT

*This paper investigates the production of maces, axes and bows and arrows as weapons during ancient Egypt. The design and features of every one of the three weapons is analysed and their features are presented. The paper presents also how the ancient Egyptians authorized their use of the three weapons. The present location of every example presented is traced and a final conclusion about the three weapons is outlined.*

**Keywords:** *Mechanical engineering, ancient Egypt, mace production, axe production, bow and arrows production.*

### INTRODUCTION

This research paper is the 98<sup>th</sup> paper in a series of research papers aiming at investigating the evolution of Mechanical Engineering in ancient Egypt through studying the production of maces, axes and bows and arrows during the Predynastic to New Kingdom of ancient Egypt.

Shaw (1991) in his book about the Egyptian warfare and weapons studied the weapons and military technology in Egypt starting from the Predynastic era. He presented the mace head of King Scorpion in display in the Ashmolean Museum at Oxford, a wooden shields model from the Middle Kingdom in display in the Egyptian Museum of Egypt, some examples of the Egyptian battle axe from the Old Kingdom to the New Kingdom, examples of the Egyptian spear from the Old to the New Kingdoms and chariot from the Second Intermediate Period [1]. Crouwel (2013) in his work about the six chariots of Pharaoh Tutankhamun presented the terminology of the chariots powered by two horses, a trolley carrying a boat model, a trolley relief from the tomb of Sebeknekht, scenes of military chariots from the tomb of Thutmose IV, chariot wall painting from the tomb of Rekhmire, a scarab with a chariot relief and Cartouche of Pharaoh Thutmose I, relief from Abu Simbel Temple of Pharaoh Ramses II recording one of his battles and other reliefs from the temples of Ramses II and Ramses III [2]. Wernick (2014/2015) in his paper about the

ancient Egyptian shields and their handles examined the shields handles found in the tomb of Pharaoh Tutankhamun. He demonstrated the use of central vertical handle since the New Kingdom and their contemporaries. He presented a model specimen from the tomb of Mesehti at the Egyptian Museum of Egypt, a siege scene in the tomb of Intef from the First Intermediate Period, a scene of spear and shield holders from the tomb of Akhtoy, shield scenes from the reigns of Merenptah, Seti I, Ramses II and Ramses III [3]. Hassaan (2016) in his work about models industry in ancient Egypt presented a wooden model for soldiers from the 11<sup>th</sup> Dynasty of the Middle Kingdom carrying shields, arrows and bows [4].

Abo el-Magd (2016) presented a number of warfare scenes of soldiers carrying shields, chariots and diggers during the battles against Hittite, Syrians, Nubians and Libyans [5]. Wade (2017) in his paper about sword and knife presented a photo for the ancient Egyptian Khopesh produced in 1450 BC and a relief for Pharaoh Ramses II using the Khopesh [6]. Reunov (2020) in his paper about weapons of ancient Egypt discussed the key aspects of the origin and evolution of pole, small arms and throwing weapons. He proposed a system of features allowing attributing weapons as belonging to a ceremonial category [7]. Wikipedia (2021) wrote an article about Narmer macehead from the First Dynasty of ancient Egypt. They presented different views for the

macehead explaining its inscriptions. The inscriptions included the name of the King in a Serekh, counting of 400,000 cattle, 1,422,000 goats and 120,000 captives [8].

### THE ANCIENT EGYPTIAN MACE

The ancient Egyptians used the mace a personal weapon used to attack fighters in the hand-to-hand combat. This was the first weapon appeared in ancient Egypt and continued in use up to the 19<sup>th</sup> Dynasty as will be illustrated by the following examples:

- The first example is a stone mace-head from Naqada II, 3500-3200 BC shown in Fig.1 [9]. The mace head was carved from stone



Figure1. Mace- head from Naqada II [9].

- The third example is a 63 mm maximum diameter marble mace-head from Naqada II, 3500-3200 BC in display in the Metropolitan Museum of Art at New York and shown in Fig.3 [11]. It has a piriform without sharp edges.



Figure3. Mace- head from Naqada II [11].

- The fifth example is a mace-head for King Scorpion from Naqada III, 3200-3000 BC in display in Ashmolean Museum at Oxford and shown in Fig.5 [13]. The mace head was inscribed using scenes carved on the surface of the mace head registering the

about 5500 years ago simulating the face of a human being with sharp edges for the ears to cause severe injury upon hitting the enemy. The location of this artefact was not quoted.

- The second example is a 93 mm diameter diorite disc shaped mace-head from Naqada II, 3500 – 3200 BC in display in the British Museum at London and shown in Fig.2 [10]. The mace-head was professionally carved from a white-black diorite cylinder of 48 mm height and 93 mm diameter taking this smooth concave shape and perfectly drilled about its axial centreline.

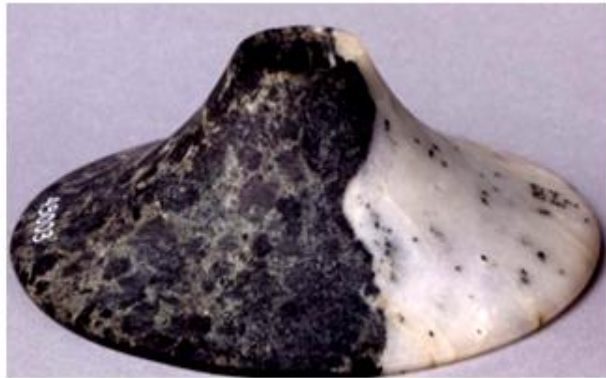


Figure2. Disc-shaped Mace- head from Naqada II [10].

- The fourth example is a 44 mm height alabaster mace-head from Naqada III, 3250-3100 BC in display by a private collection and shown in Fig.4 [12]. It has a piriform without sharp edges.



Figure4. Alabaster Mace- head from Naqada III [12].

royal activity of the King opening a new irrigation canal more than 4000 years ago.

- The sixth example is a Siltstone palette of King Narmer, the founder of the 1<sup>st</sup> Dynasty, 3150-3125 BC in display in the Egyptian Museum at Cairo and shown in

Fig.6 [14]. The face of the palette shown in Fig.6 depicts the King holding a mace with

his right hand and holding a captive by his left hand and striking him with the mace.



**Figure5.** Scorpion mace- head from Naqada III [13]. **Figure6.** Narmer's palette from the 1<sup>st</sup> Dynasty [14].

- The seventh example is a stone piriform shaped mace-head from the Early Dynastic Period, 3050-2613 BC in display in the Museum of National Science at Houston and shown in Fig.7 [15]. The surface was perfectly shaped simulating a pear fruit with a smooth finish even for the hole around its axial centreline.
- The eighth example is an ivory 52 x 45 x 3 mm label for the sandal of King Den, 6<sup>th</sup>

King of the 1st Dynasty, 2990-2950 BC in the British Museum and shown in Fig.8 [16]. The small label registers the King striking the head of a captive from Egypt's enemies using a mace in his right hand. The label is marvellous since in an area of only 2340 mm<sup>2</sup>, the designer could put a lot of data and a major scene painted in black and could sustain environmental effects for about 5000 years.



**Figure7.** Mace- head from Early Dynastic [15]. **Figure8.** Royal label for King Den, 1<sup>st</sup> Dynasty [16].

- The ninth example is a 70 mm height ovoid alabaster mace-head from the Early Dynastic, 2960-2770 BC in display in the Museum of Fine Arts at Boston and shown in Fig.9 [12]. The mace head was polished and drilled in its axial centreline.

- The tenth example is a limestone 65 mm maximum diameter mace head for King Teti, founder of the 6<sup>th</sup> Dynasty, 2345-2333 BC in display by the Museum of Fine Arts and shown in Fig.10 [17]. The mace-head takes the shape of a certain type of strawberries.



**Figure9.** Mace- head from Early Dynastic [12]. **Figure10.** Royal mace-head from the 6<sup>th</sup> Dynasty [17].

- The eleventh example is a n 0.545 m wooden mace model from the 12th Dynasty, 1981-1802 BC in display by the Metropolitan Museum of Art at New York and shown in Fig.11 [18]. The mace-head a piriform shape and the hand diameter increases gradually from the head side to the free end of the mace.



**Figure11.** *Wooden mace from the 12<sup>st</sup> Dynasty [18].*



**Figure12.** *Faience mace- head model from 12<sup>th</sup> Dynasty [19]*

- The twelfth example is a 57 x 50 mm height ceremonial faience mace-head model from the 12th Dynasty, 1938-1759 BC in display in the Brooklyn Museum at New York and shown in Fig.12 [19]. The model simulates a piriform decorated by scenes of black leafs persisting its color for more than 3800 years.
- The thirteenth example is a wooden mace with piriform head from the tomb of Neferhotep, Accountant during the 13th Dynasty of the Middle Kingdom, 1803-1649 BC in display in the Egyptian Museum and shown in Fig.13 [20]. It has an overall length of about 0.55 m and decorated by five carved slots from both ends.



**Figure13.** *Mace of Neferhotep from the 13<sup>st</sup> Dynasty [20].*

- The fourteenth example is a relief for Thutmose III, the 6th Pharaoh of the 18th Dynasty, 1479-1425 BC on the North wall of the Great Hypostyle Court of Karnak shown in Fig.14 [21]. The relief depicts the Pharaoh smiting Egypt's enemies during the battle of Megiddo using a mace in his right hand.



**Figure14.** *Relief from Karnak during the 18<sup>st</sup> Dynasty [21].*

- The fifteenth example is a statue for Tutankhamun, the 13th Pharaoh of the 18th Dynasty, 1332-1323 BC in display in the Egyptian Museum at Cairo and shown in Fig.15 [22]. The pharaoh was shown holding a mace in his right hand. The mace head was roughened by irregular geometric shapes carved on it (or produced using a metal casting process).

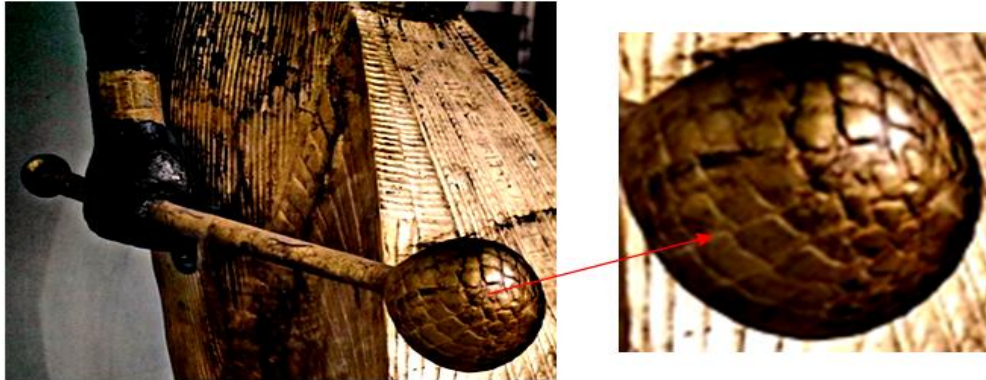


Figure15. Statue for Pharaoh Tutankhamun from the 18<sup>th</sup> Dynasty [22].

- The sixteenth example is a gilded maces for Pharaoh Tutankhamun, of the 18th Dynasty, 1332-1323 BC in display in the Egyptian Museum at Cairo and shown in Fig.16 [23]. They were ceremonial ones covered by gold sheets allowing them to survive for more than 3350 years. The head was roughened by intersecting lines forming rhombus shapes of different sizes and engraved on the head surface.

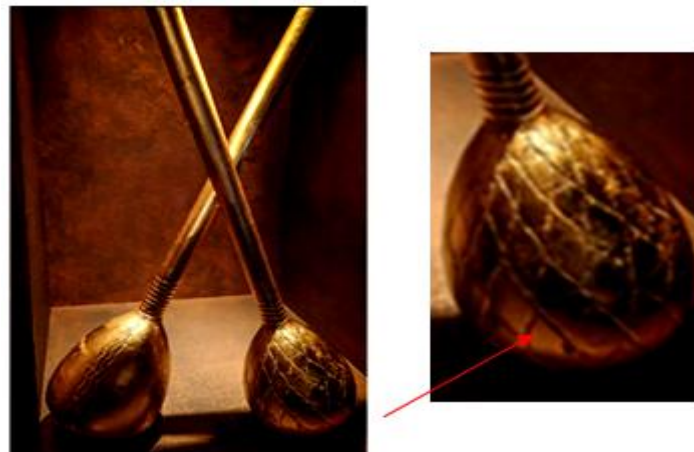


Figure16. Maces for Pharaoh Tutankhamun from the 18<sup>th</sup> Dynasty [23].

### THE ANCIENT EGYPTIAN BATTLE AXE

The ancient Egyptian battle axe was used as a warrior personal weapon since the Predynastic era (6000-3150 BC) [24]. Its use continued through ages in the ancient Egyptian army up to

the New Kingdom (from archaeological evidences). Here are some examples of the use of the battle axe and its design in ancient Egypt:

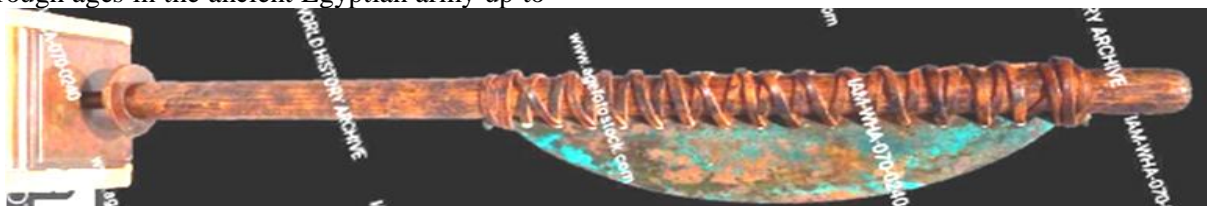


Figure17. Axe from the Predynastic Period [25].

- The first example is a Breccia axe from the Predynastic Period (Naqada I to Naqada III), 4000-3000 BC shown in Fig.17 [25]. The ancient Egyptian mechanical designer

secured the crescent-shaped blade of the axe to the axe's handle using 15 small holes in the blade and a single piece of rope going through the holes around the handle. This

fixture technique could survive for more than 5000 years.

- The second example is a metallic axe head from the Middle Kingdom, 2050-1710 BC in display in the British Museum and shown in Fig.18 [26]. The ancient Egyptian Mechanical designer used the same axe design of the Predynastic era except some alterations:
  - He used metal instead of stone.
  - He reduced the contact area between the blade and handle.

- He used 11 holes instead of 15.
- He used rivets instead of rope in forming the fixed joint between the blade and handle.
- The third example is a 641 mm bronze battle axe from the 12th Dynasty, 1981-1802 BC in display in the Metropolitan Museum of Art at New York and shown in Fig.19 [27]. It has the same design of the battle axe shown in Fig.18 except the use of lashing sleeves instead of rivets to construct the fixed joint between the blade and handle of the axe.



Figure18. Crescent battle axe from the Middle Kingdom [26].



Figure19. Bronze axe from the 12<sup>th</sup> Dynasty [27].

- The fourth example is a bronze battle axe with wooden handle from the New Kingdom, 1500-1292 BC in display in the World Museum of Liverpool, UK and shown in Fig.20 [28]. The design of the blade is completely different than this used from Predynastic to Middle Kingdom. Here, the blade has an ovoid tip and concave sides. The fixture between the blade and handle is also different. No holes. Most probably the blade is inserted in a slot with slight shrink fit then a golden leaf is used to secure the blade with the handle.



Figure20. Bronze axe from the New Kingdom [28].

- The fifth example is a 350 mm length bronze battle axe with wooden handle from the 18th Dynasty, 1500-1295 BC in display in the Metropolitan Museum of Art and shown in Fig.21 [29]. The blade has the same design as in that of Fig.20 and attached to the handle using a golden leaf with extensive windings for a more strength-joint.
- The sixth example is a ceremonial battle axe of Pharaoh Ahmose I, the founder of the 18th Dynasty, 1549-1514 BC in display in the Egyptian Museum at Cairo and shown in Fig.22 [30]. The axe was produced using copper, wood, gold and its blade was inlaid by semi-precious stones. The fixed joint was secured using golden leaves covering less area of the blade compared with this in Fig.21 and could sustain

environmental effects for more than 3500 years.



**Figure21.** Bronze axe from 18<sup>th</sup> Dynasty [29].



**Figure22.** Ceremonial Battle axe of Ahmose I [30].

- The seventh example is a 555 mm length bronze battle axe of Baki, Chief Weigher of the Gold of Amun during the reign of Thutmose I to Thutmose III, 3rd to 6th Pharaohs of the 18th Dynasty, 11504-1447 BC in display in the Metropolitan Museum of Art and shown in Fig.23 [31]. It has a typical design of battle axes of the New Kingdom except the slight curvature of its handle and its relatively big disk-end to secure the axe in the warrior hand.
- The eighth example is a colored relief in the temple of Hatshepsut, 5th Pharaoh of the 18th Dynasty, 1479-1458 BC shown in Fig.24 [32]. The relief depicts infantry holding battle axe in one hand and a palm branch in the other hand. The meaning is wonderful: fighting to defend their country and peace with everybody saying: 'Egypt is the land of peace and security'.



**Figure23.** Battle axe of Baki from 18<sup>th</sup> Dynasty [31].



**Figure24.** Relief in Hatshepsut's Temple [32].

- The ninth example is a relief for Ramses II, the 3rd Pharaoh of the 19th Dynasty, 1279-1213 in display in the Egyptian Museum at Cairo and shown in Fig.25 [33]. The relief shows the strong Pharaoh holding three different captives (from the East, West and South of Egypt) by his right hand and a battle axe by his left hand.



**Figure25.** Relief for Ramses II from 19<sup>th</sup> Dynasty [33]

## THE ANCIENT EGYPTIAN BOW AND ARROWS

The row and arrow is an ejector weapon used by the ancient Egyptian army since the time of the Old Kingdom, 2686-2181 BC [34]. Here of some examples of the bow and arrow used in ancient Egypt covering an era starting from the 4<sup>th</sup> to the 19<sup>th</sup> Dynasties.



**Figure26.** Relief of Archers using bow and during the 4<sup>th</sup> Dynasty [35].

- The first example is a relief for archers carrying bow and arrows during the reign of Khafre, the 4th King of the 4th Dynasty, 2558-2532 BC in display in the Metropolitan Museum of Art and shown in Figs.26 [35]. Every archer is pulling the string and ready to shoot the arrow.
- The second example is a 1.48 m length wooden bow from the Middle Kingdom,

2030-1650 BC in display in the Metropolitan Museum of Art and shown in Fig.27 [36]. The bow was manufactured with single curve and an increasing diameter from 23 mm at the centre to a very small diameter at the tip with very accurate production of the unit and successful selection of its material to sustain the environmental effects for more than 3700 years.



**Figure27.** Wooden single curve bow from the Middle Kingdom [36].

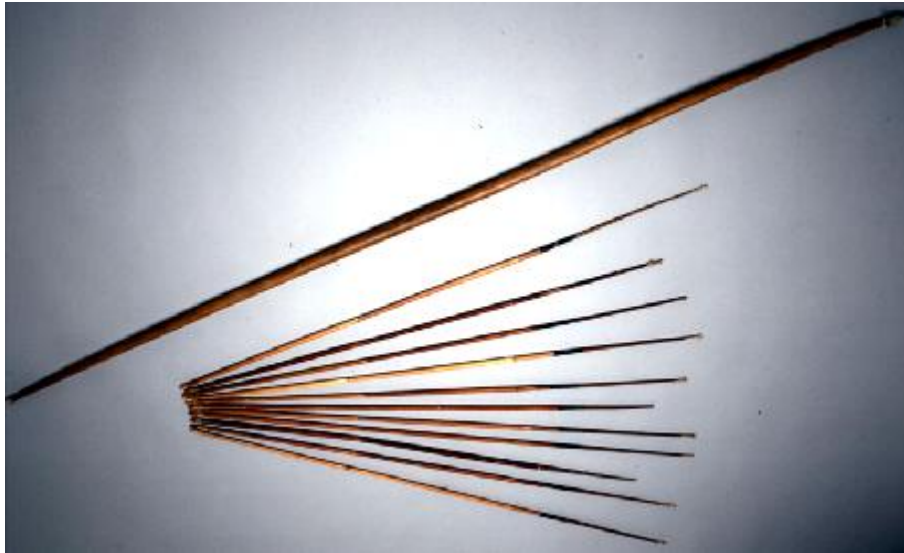
- The third example is a wooden model for Nubian archers carrying bow and arrows from the tomb of Mesehti, Governor of Assuyt during the 11th Dynasty, 2000 BC in display in the Egyptian Museum at Cairo and shown in Fig.28 [37]. Every archer was shown carrying a single curve bow and a number of arrows.



**Figure28.** Wooden model for archers from the 11<sup>th</sup> Dynasty [37].



- The fourth example is a typical reed arrows from the 12th Dynasty, 1991-1802 BC in display in the British Museum at London and shown in Fig.29 [38]. The arrows have length between 0.51 and 0.90 m. All the arrows have flint heads where the brilliant mechanical engineer could secure a fixed strong joint between a reed and stone elements.



**Figure29.** Reed arrows from the 12<sup>th</sup> Dynasty [38].

- The fifth example is a 1.533 m length wooden bow from the 12th Dynasty, 1981-1802 BC in display in the Metropolitan Museum of Art and shown in Fig.30 [39]. The bow has a slight double curvature near its end.



**Figure30.** Wooden bow from the 12<sup>th</sup> Dynasty [39].

- The sixth example is a wooden bows from the tomb of Senebtisi, woman lived during the end of the 12th Dynasty, 1800 BC in display in the Metropolitan Museum of Art and shown in Fig.31 [40]. The bows have single large curvature and may be used by the lady for hunting purposes.



**Figure31.** Wooden bows of Senebtisi from the 12<sup>th</sup> Dynasty [40].

- The seventh example is a wooden bow from the 18th Dynasty, 1550-1295 BC in display in the Metropolitan Museum of Art and shown in Fig.32 [41]. The bow has double medium curvatures near its ends.



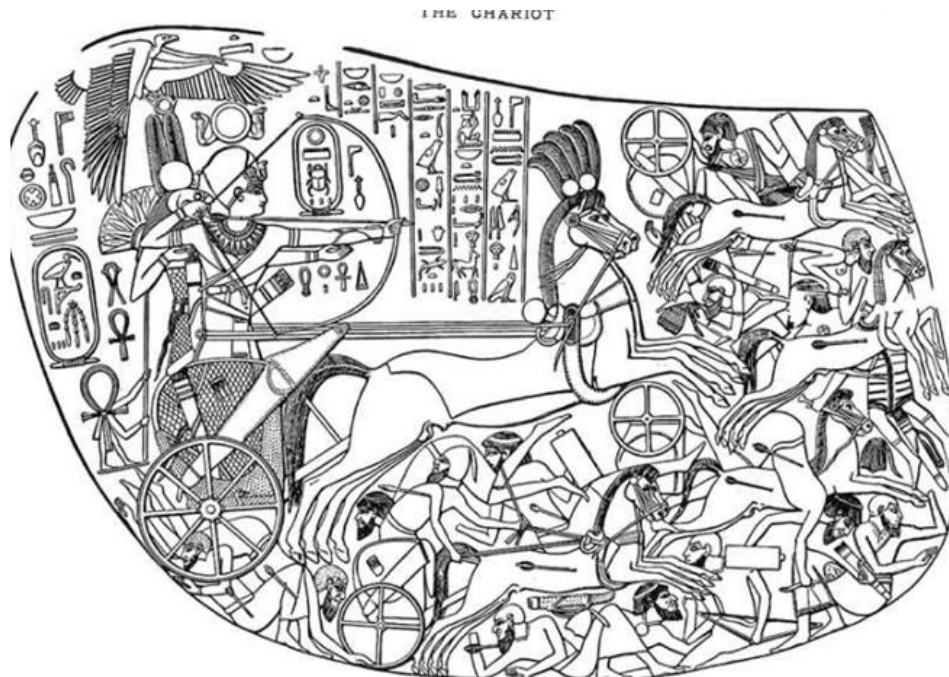
**Figure32.** Wooden bow from the 18<sup>th</sup> Dynasty [41].

- The eighth example is an 0.727 m length arrow with composite stone tip from the 18th Dynasty, joint reign of Pharaohs Hatshepsut and Thutmose III, 1479-1458 BC in display in the Metropolitan Museum of Art and shown in Fig.33 [42]. The arrow was produced from reed, wood, quartz and adhesive forming a composite structure.



**Figure33.** Arrow from the 18<sup>th</sup> Dynasty [42].

- The ninth example is a scene in the tomb of Thutmose IV, 8th Pharaoh of the 18th Dynasty, 1398-1388 BC shown in Fig.34 [43]. The scene depicts the Pharaoh fighting in his chariot using a single curve bow. The activity was registered using the Cartouches of the Pharaoh and hieroglyphic text written in vertical bounded columns before the Pharaoh and un-bounded text behind him.



**Figure34.** Scene in Thutmose IV's Tomb from the 18<sup>th</sup> Dynasty [43].

- The tenth example is a colored scene of Tutankhamun, 13th Pharaoh of the 18th Dynasty, 1332-1323 BC on his gasket in display in the Egyptian Museum at Cairo and shown in Fig.35 [44]. The scene depicts the Pharaoh fighting in his chariot using a single curve bow. The activity was registered in vertical and horizontal bounded columns.



**Figure35.** Scene for Tutankhamen from the 18<sup>th</sup> Dynasty [44].



**Figure36.** Relief for Ramses II from the 19<sup>th</sup> Dynasty [45].

- The eleventh example is a relief showing Ramses II, the 3rd Pharaoh of the 19th Dynasty, 1279-1213 BC during the battle of Kadesh carved in his temple at Abu Simbel and shown in Fig.36 [45]. The relief depicts the Pharaoh fighting in his chariot using a single curve bow. The activity was registered using the hieroglyphic text written in bounded columns.

## CONCLUSION

- The paper investigated the evolution of mechanical engineering in ancient Egypt through studying the maces, axes and bows and arrows industries.
- The study covered a time span from the Predynastic to the New Kingdom.
- The ancient Egyptians produced mace-heads of different shapes such as disc, ovoid and piriform.
- They produced mace-heads with smooth, rough surfaces and simulating the head of human head.
- They authorized the uses of maces for military purposes through the production of physical models, tomb reliefs, inscriptions on labels and palettes and statues.
- They produced ceremonial mace-heads during the Predynastic and Middle Kingdom Periods.
- They designed and used battle axes during the Predynastic Period and continued to use them during ages reaching the New Kingdom.
- The used stone and metallic blades for the axes.
- The axe-blade took the shape of a crescent then changed to ovoid tip and concave sides.
- They secured the blade to the axe handle through using a fixed joint of different designs. They used holes in the blade with cord going around the handle, holes in both blade and handle with rivets holding them together, lashing sleeves, blade insertion in a handle slot and leaf going around the blade feet.
- They registered using the battle axe through the production of ceremonial units and wall reliefs during the New Kingdom.
- They registered using the bow and arrows during the 4th Dynasty as wall reliefs and during the 11th Dynasty as wooden models.
- They used single arc bows since the Middle Kingdom and the double arc bow since the 4th Dynasty.
- Single and double arc bows continues to be used down to the 19th Dynasty.

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**Citation:** Galal Ali Hassaan, "Mechanical Engineering in Ancient Egypt, Part 98: Maces, Axes, Bows and Arrows Industries", *International Journal of Emerging Engineering Research and Technology*, vol. 9, no. 1, pp. 13-25. 2021. DOI: <https://doi.org/10.22259/ijeert.090102>

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