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MECHANICAL ENGINEERING IN ANCIENT EGYPT, PART 59: SYMBOLS INDUSTRY (EARLY DYNASTIC TO MIDDLE KINGDOM)

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ABSTRACT

The objective of this paper is to investigate the development of mechanical engineering in ancient Egypt through the design and use of symbols during the Early Dynastic to Middle Kingdom Periods. This study covers the applications of symbols in personal and official establishments. This research highlights the use of symbols in a wonderful symbolism way saving a lot of words and space to express.

KEYWORDS: Mechanical engineering history, ancient Egypt, symbols in ancient Egypt, symbol meaning, symbol applications, Early Dynastic to Middle Kingdom.

INTRODUCTION

This is the 59th part in a series aiming at investigating the mechanical engineering technology in ancient Egypt. It focuses on the production and use of various symbols as a personal object and within tombs and temples. They became important features in the ancient Egyptian society extended from the Early Dynastic Period down to the Ptolemaic Period.

Watts, 1998 in his book about the art of ancient Egypt studied the representation of Dieties in the ancient Egyptian art presenting the symbols of: Crook and Flail, Ba, Scarab, and the Crowns. He presented the symbols used as hieroglyphs such as: Kheper, Shen, Ankh, Djed, Sa, Was, Wadjet, Ka and Tyet.[1] Johnstone, 2003 in his book about encyclopedia of spells presented a scene for an ancient Egyptian Queen offering vases to Hathor where a good number of symbols appeared in the scene. He presented also some of the ancient Egyptian

symbols in the shape of amulets such as: Ankh, Scarab and Wadjet eye.[2] Sapsford, 2008 in his Ph. D. thesis presented a scene for a jewellery workshop from the 5th Dynasty of the Old Kingdom where some symbols were used in the hieroglyphic writing on the tomb walls and a scene from Ankhmahor, Vizier of Kings Teti and Pepi I of the 6th Dynasty.[3] Magdolen, 2009 investigated the symbol of the ancient Egyptian goddess 'Seshat' and its reinterpretation. He presented two versions of the symbol 'Seshat' and an engraving fro the 18th Dynasty using the 'Seshat' symbol. Besides, he presented actual existence of symbol from the Old Kingdom, Middle Kingdom, New Kingdom, Third Intermediate Period and Ptolemaic Period.[4]

Warson, 2010 in his article about ancient Egyptian symbolism presented a number of engravings and symbol models for some of the symbols such as: Ankh, Dijed, Was, Pshent, Hegjet, Deshet, Shenu, Jeb, Sa, Ba, Uraeus, Nekhbet and Swty.[5] Le Suer, 2012 in his book about birds in ancient Egypt presented scenes and artefacts including ancient Egyptian symbols such as: Nekhbet, Shenu, Ankh, Was, Flail, Atef, Uraeus, Winged solar disk, Swty, Hathor, Khepresh, Hedjet, Crook and flail.[6] Forshaw, 2013 in his Ph. D. Thesis presented scenes including some ancient Egyptian symbols such as: Crook, Maat, Was, Ankh, Pshent, Djed, Shenu, Atef, Nekhbet, Nemes, Khepresh, Sesen and Deshret.[7] Berio, 2014 in his paper about the ancient Egyptian constellations presented a number of scenes including the symbols: Ba, Maat, Jeb, Deshret, Was, Seba, Atef and Uraeus. He showed that the Crook symbol was simulating the position of a set of stars.[8] El-Sherbiny, 2015 in her M. Sc. Thesis presented the coffin of Ipi-Ishatef from the 11th Dynasty with two Wadjet eye symbol, false door of Ika from the Old Kingdom showing Ika holding a Sekhem symbol, Pharaoh Tutankhamun statue using the Nemes Headdress.[9] Ferguson, 2016 in his paper about the ancient Egyptian concept of Maat outlined that Maat included the connotations of order, harmony, rightness and true witness. He pointed out its use in religion, ethical and cosmological contexts.[10] Lansberry, 2017 in his article about Egyptian serpent power presented scenes including symbols such as: Ka, Maat feather, Wadjet eye, Hedjet, Deshret, Pschent, Was, Atef and Scarab.[11] Mark, 2017 wrote an article about symbols of he ancient Egyptians. He presented the Ankh, Djed, Was symbols and investigated the significance of combining a number of symbols.[12] Wikipedia, 2017 wrote an article about the Ankh symbol. They pointed out that it was symbolizing life in ancient Egypt. They presented a scene for Pharaoh Hatshepsut carrying the Ankh in her right hand and an engraved scene for Pharaoh Merenptah offering an Ankhm Djed and Was to Ptah.[13]

Meaning of the Ancient Egyptian Symbols

Before presenting the use of symbols by the ancient Egyptians during their daily life we present some of the simple meanings of some of their symbols to be able to understand their thinking and culture. Tables 1, 2 and 3 present the shape and meaning of 31 symbols.

Table 1: Symbols signs and meaning

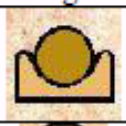
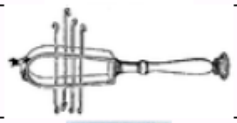
Symbol	Sign	Meaning	Reference
Akhet		Represented the horizon from which the sun emerged and disappeared	[14]
Ankh		represented eternal life	[15]
Amenta		represented the underworld or land of the dead	[14]
Atef		Osiris wears the Atef crown as a symbol of the ruler of the underworld	[16]
Ba		Ba is someone's personality. It would leave the body at the time of death	[17]
Crook and Flail		Symbol of royalty, majesty and dominion	[17]
Deshret		The formal name for the Red Crown of Lower Egypt	[18]
Hedjet		The formal name for the white crown of pharaonic Upper Egypt	[19]

Table 2: Symbols signs and meaning

Symbol	Sign	Meaning	Reference
Ka		It is a symbol of the reception of life powers through the hands from the God	[20]
Khepresh		The khepresh was an ancient Egyptian royal headdress known also as the Blue Crown	[21]
Leb		It represents a heart, the center of all consciousness (as they believed)	[14]
Maat		Maat symbol, means truth, justice, morality and balance	[22]
Menat		The Menat was to ensure good luck and fortune and to protect against evil spirits	[14] , [23]
Nebu		Nebu is the Egyptian symbol for gold	[24]
Nemes		It symbolized the pharaoh's power	[25]
Nekhbet		Patron of Upper Egypt and one of the two patron deities for all of ancient Egypt when it was unified	[14] , [26]
Pet		The Pet symbolizes the heavens	[14]
Pschent		The Pschent represented the pharaoh's power over all of unified Egypt	[27]
Sa		It was a general symbol for protection from earliest times onwards	[28]
Seba		Seba was the star symbol in ancient Egyptian culture and it represented the star-gods	[29]
Sekhem		symbol of authority and is often incorporated in names and words associated with power and control	[14] , [30]

Table 3: Symbols signs and meaning

Symbol	Sign	Meaning	Reference
Scarab		It is a symbolic of eternity	[14] , [31]
Sema		Represents the unification of Upper and Lower Egypt	[14]
Shenu		Its use aimed to represent divine protection	[29]
Sistrum		It was also shaken to avert the flooding of the Nile and to frighten away Set	[32]
Sphinx		Sphinx represents is to undertake the journey of purification	[33]
Tiet		Tiet is associated with Isis and is often called the knot of Isis or the blood of Isis	[14]
Uraeus		Uraeus symbolized the absolute authority and power of Kings	[29]
Wadjet		Wadjet was closely associated with a powerful protective deity	[34]
Was scepter		The *'was'* scepter symbolized divine power and was an emblem of authority	[14] , [35]
Winged solar disk		The winged sun disc as a symbol of protection	[36]

Use of Symbols in the Early Dynastic Period

The Early Dynastic Period of the ancient Egypt history comprises the 1st and 2nd Dynasties over a time period from 3100 to 2686 BC.[37] The genius ancient Egyptians recorded using symbols during this early time more than 4700 years ago as depicted in the following examples:

- The first example is a 640 mm length Palette of King Narmer, the founder of the 1st Dynasty (3100 BC) showing the King crushing the head of an Egypt's enemy in display in the British Museum and shown in Fig.1.[38] The King was shown in the palette wearing the White Crown (Hedjet symbol) of Upper Egypt.
- The second example is an 88 mm ivory statuette of King Den from the 1st Dynasty, 2970-2928 BC wearing the White Crown (Hedjet symbol) in display in the British Museum and shown in Fig.2.[39]

Fig. 1: Palette from 1st Dynasty. [38]

Fig. 2: Den's statuette from 1st Dynasty.[39]

- The third example is an ivory label from the tomb of King Den of the 1st Dynasty showing the King crushing the head of an Egypt's enemy in display in the British Museum and shown in Fig.3.[40] The label includes a number of symbols: Uraeus, Flail, Was scepter, Sistrum and Shenu. This may be the first time to appear the Uraeus symbol on the forehead of the King.
- The fourth example is a cartouche for King Den based on the Shenu symbol as appeared in the Abydos king list and shown in Fig.4.[40]

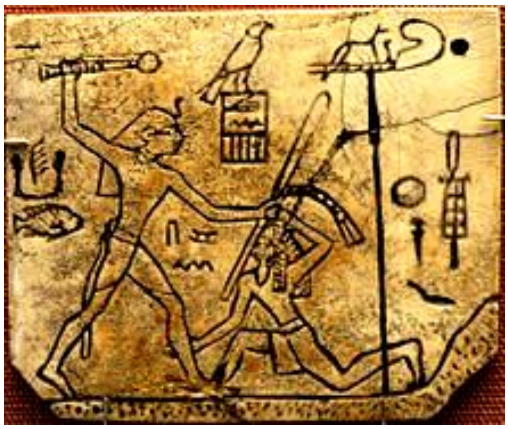


Fig. 3: Ivory label from 1st Dynasty.[40]

Fig. 4: Cartouche of King Den.[40]

Use of Symbols in the Old Kingdom Period

The Old Kingdom Period of ancient Egypt comprises the 3rd to 6th Dynasties over a time span from 2686 to 2181 BC.[41] During the Old Kingdom, the unified state was stabilized and there was an ambition of the Kings to use the accumulated knowledge in astronomical, mathematical, mechanical and architectural science to establish outstanding projects such as pyramids, temples and statues. This was exactly what is happened setting a huge mechanical

engineering foundations producing structures sustained for thousands of years up to now. Here, we present some of their achievements highlighting the use of symbols:

- The first example is a statue for King Djoser, the founder of the 3rd Dynasty (2686-2649 BC) wearing Nemes Headdress (Nemes symbol of royalty) in display in the Egyptian Museum at Cairo and shown in Fig.5.[42] The Uraeus symbol didn't appear on the forehead of the King and it is not clear if the King is holding this symbol in his right hand.
- The second example is a scene for King Djoser from the his underground galleries wearing the White Crown of Upper Egypt (Hedjet symbol) and holding the Flail symbol in his right hand as shown in Fig.6.[42] The scene depicts another symbols such as a Scepter (in front of the King), two Shens behind him and a Sekhem (without stem in his left hand).

Fig. 5: Djoser statue from 3rd Dynasty.[42]

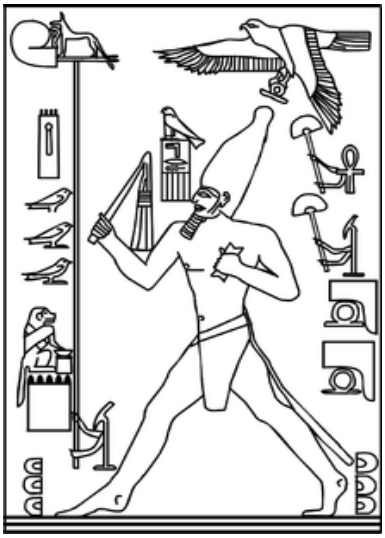


Fig. 6: Djoser scene from the 3rd Dynasty.[42]

- The third example is an engraving for King Djoser wearing the Red Crown of Lower Egypt (Deshret symbol) and shown in Fig.7.[43] This engraving may be from his step pyramid at Saqqara.
- The fourth example is a cobra wall in the tomb complex of King Djoser based on using the Uraeus symbol and shown in Fig.8.[44] The cobras were exactly identical and looking far away to watch any enemy planning to attack Egypt.
- The fifth example is a limestone stele from the King Snefru's bent pyramid at Dahshur from the 4th Dynasty (2613-2589 BC) including some symbols like: Pschent, Flail, Shenu, Nebu, Nekhbet and Uraeus in display in the Egyptian Museum at Cairo and shown in Fig.9.[45]

- The sixth example is the 4.8 m length, 24 ton Great Sphinx of Tanis from the Old Kingdom (2600 BC) in display in the Louvre Museum at Paris and shown in Fig.10.[46] The head was for one of the Kings wearing the Nemes with Uraeus symbol on his forehead.

Fig. 7: King Djoser from 3rd Dynasty.[43]

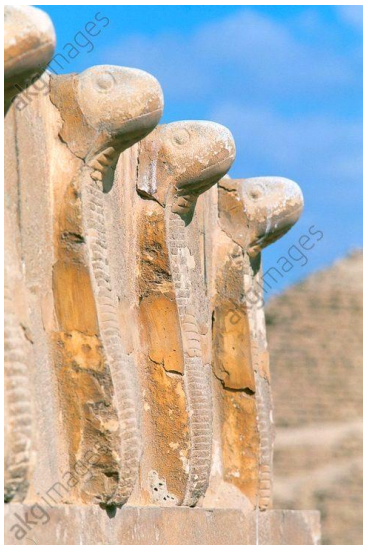


Fig. 8: Cobra wall from 3rd Dynasty.[44]

Fig. 9: Stele from 4th Dynasty.[45]

Fig. 10: Great sphinx of Tanis from Old Kingdom.[46]

- The seventh example is a sphinx for Queen Hetepheres II, wife of King Djedefre from the 4th Dynasty (2566-2558 BC) in display in the Egyptian Museum at Cairo and shown in Fig.11.[47] The mechanical designer showed the queen as a sphinx with the Queen's head wearing a headdress and without any other symbols.

- The eighth example is the 73 m length Great Sphinx of Giza build by King Khafre of the 4th Dynasty (2558-2532 BC) located near the Great Pyramid of King Khufu at Giza and shown in Fig.12.[48] The mechanical designer showed the sphinx having the head of King Khafre wearing the Nemes Headdress without any Royalty symbols. The sphinx was oriented such that the King looked towards the east with a symbol of feeling the direction Egyptian enemies may come from.

Fig. 11: Hetepheres sphinx from 4th Dynasty.[47]

Fig. 12: Giza Great sphinx, 4th Dynasty.[48]

- The ninth example is a 1.676 m height statue of King Khafre from the 4th Dynasty (2520-2494 BC) in display in the Egyptian Museum at Cairo and shown in Fig.13 [49]. The designer showed the King wearing the Nemes Headdress without any other symbols.
- The tenth example is a statue for King Neferefre from the 5th Dynasty (2448-2445) in display in the Egyptian Museum at Cairo and shown in Fig.14 [50]. The designer showed the King wearing the White Crown of Upper Egypt (Hedjet symbol) and holding a Crook symbol in his right hand.

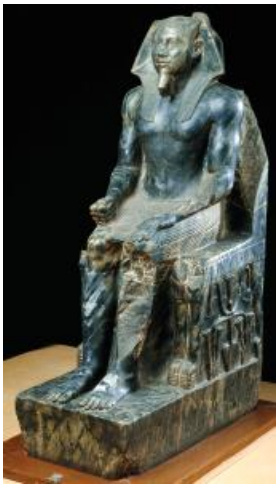


Fig. 13: Khafre statue from 4th Dynasty.[49]

Fig. 14: Neferefre statue, 5th Dynasty.[50]

- The eleventh example is an engraving for Queen Ankhnespepi II, wife of King Pepi I of the 6th Dynasty (2331-2287 BC) from her funerary complex at Saqqara and shown in Fig.15.[51] The designer showed the Queen wearing a headdress taking the shape of Nekhbet Symbol (the vulture).
- The twelfth example is a small sphinx for Prince Merenre, the son of King Pepi I of the 6th Dynasty (2331-2287 BC) in display in the National Museum of Scotland, Edinburgh and shown in Fig.16.[52] The designer showed the Prince wearing a Nemes headdress with Uraeus symbol on his forehead and holding a jar in each hand. This was a unique design of the Sphinx Symbol where its hands were a human hands not a lion hands as was in the designs of Figs.10, 11 and 12.

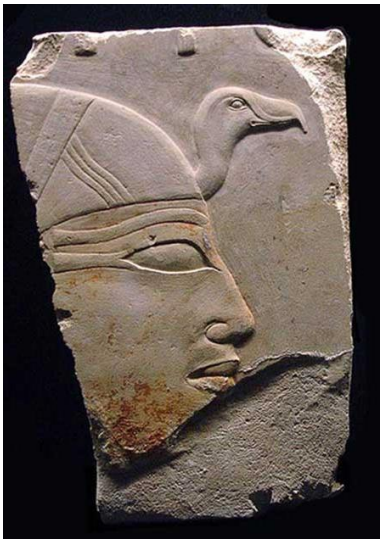


Fig. 15: Queen Ankhnespepi II from 6th Dynasty.[51]

Fig. 16: Merenre sphinx, 6th Dynasty.[52]

Use of Symbols in the Middle Kingdom Period

The Middle Kingdom comprised the 11th and 12th Dynasties of ancient Egypt over a time span from 2050 to 1800 BC [53]. Now, we will present examples from both 11th and 12th Dynasties about using symbols in ancient Egypt during the Middle Kingdom:

- The first example is a 0.77 m height head of King Mentuhotep II from the 11th Dynasty (2118-2069 BC) in display in the British Museum and shown in Fig.17.[54] King Mentuhotep II was shown wearing the White Crown of Upper Egypt (Hedjet) with Uraeus symbol on his forehead.
- The second example is an engraving for King Mentuhotep II of the 11th Dynasty wearing the Red Crown of Lower Egypt (Deshret) and holding a Crook symbol in his left hand and another symbol in his right hand as shown in Fig.18.[55]

- The third example is a statue of King Mentuhotep III of the 11th Dynasty (2069-2061 BC) in display in the Museum of Fine Art at Boston and shown in Fig.19.[56] The King is wearing the White Crown of Upper Egypt and holding the Crook and Flail symbols (destroyed).
- The fourth example is an 85 mm Sa amulet from the 11th Dynasty (2051-1981 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.19.[57] This application depends fully on using the 'Sa' symbol as an amulet produced from silver and electrum.

Fig. 17: Mentuhotep II head, 11th Dynasty.[54]

Fig. 18: Mentuhotep II, 11th Dynasty.[55]

Fig. 19: Mentuhotep III statue, 11th Dynasty.[56]

Fig. 20: Sa amulet, 11th Dynasty.[57]

- The fifth example is a stele of Zezen-Nakht from the 11th Dynasty (2040-1991 BC) in display in the Museum of Art, Ohio, USA and shown in Fig.21.[58] The stele showed the owner holding a Sekhem symbol in his right hand and a scepter in the left hand.

- The sixth example is a limestone panel from the temple of Mentuhotep II in Thebes from Late reign of King Mentuhotep II of the 11th Dynasty (2010-2000 BC) in display in the Metropolitan Museum of Art and shown in Fig.22.[59] The King was shown wearing the White Crown of Upper Egypt (Hedjet) with Uraeus on his forehead. Other symbols appear in the panel: Akhet, Shenu, Lotus, Seba and Feather.

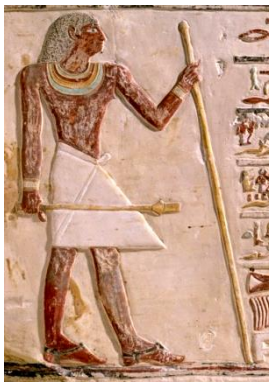


Fig. 21: Stele from 11th Dynasty.[58]

Fig. 22: Panel of Mentuhotep II from 11th Dynasty.[59]

- The seventh example is an ivory headrest from Deir el-Bersha dated to the 12th Dynasty (1985-1795 BC) in display in the British Museum and shown in Fig.23 [60]. The headrest pillars simulated the Tiet symbol.
- The eighth example is a statue of King Senusret I from the 12th Dynasty (1971-1928) in display in the Luxor Archaeological Museum and shown in Fig.24 [61]. The designer showed the King wearing the White Crown of Upper Egypt (Hedjet) and holding an Ankh symbol in each hand.

Fig. 23: Headrest from 12th Dynasty.[60]

Fig. 24: Panel of Mentuhotep II from 11th Dynasty.[61]

- The ninth example is a 3.2 m height seated statue of King Amenemhat II from the 12th Dynasty (1919-1885 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.25.[62] The designer shoed the King wearing the Nemes headdress with Uraeus on his forehead.
- The tenth example is a Sithathoriunet necklace, reign of King Sinusret II of the 12th Dynasty (1887-1878 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.26.[63] The necklace comprised a number of symbols: Ankh, Shenu, Scarab, Acket and Uraeus.

Fig. 25: Statue from 12th Dynasty.[62]

Fig. 26: Sithathoriunet necklace from 12th Dynasty.[63]

- The eleventh example is a necklace for King Senusret III from the 12th Dynasty (1878-1839 BC) in display in the Egyptian museum at Cairo and shown in Fig.27 [64]. The designer used the symbols: Nekhbet, Lotus, Shen, Shenu, Sphinx with Horus head and Swty.
- The twelfth example is a sphinx for King Senusret III from the 12th Dynasty in display in the Metropolitan Museum of Art and shown in Fig.28 [65]. The statue was based completely on using the Sphinx symbol showing the King a Nemes headdress with Uraeus symbol on his forehead.

Fig. 27: Senusret III necklace, 12th Dynasty.[64]

Fig. 28: Senusret III sphinx, 12th Dynasty.[65]

- The thirteenth example is a statue for King Amenemhat III from the 12th Dynasty (1853-1806 BC) in display in the Cleveland Museum of Art at Ohio, USA and shown in Fig.29.[66] The designer showed the King wearing the Nemes headdress with Uraeus on his forehead.
- The fourteenth example is a 1.5 m height sphinx for King Amenemhat III from the 12th Dynasty in display in the Egyptian Museum at Cairo and shown in Fig.30.[67,68] The head was designed to simulate the King face with head-features of the lion.

Fig. 29: Amenemhat III statue, 12th Dynasty.[66]

Fig. 30: Amenemhat III sphinx, 12th Dynasty.[67,68]

CONCLUSION

- This paper investigated the evolution of mechanical engineering in ancient Egypt through the production and use of symbols.
- The study covered a time span from the Early Dynastic to the Middle Kingdom Periods.
- The sign and meaning of 31 symbols used by ancient Egyptians were tabulated.
- During the Early Dynastic symbols appeared in palettes, label and statue
- The oldest evidence of using symbols by ancient Egyptians was the palette of King Narmer (more than 5100 years ago).
- During the Early Dynastic Period, the ancient Egyptians used the symbols: Hedjet, Uraeus, Flail, Was scepter, Sistrum and Shenu.
- During the Old Kingdom Period, they used the symbols: Hedget, Flail, Scepter, Shen, Sekhem, Deshret, Uraeus, Pschent, Shenu, Nebu, Nekhbet, Sphinx, Hedjet and Crook.
- They designed and produced sphinx statues for Kings and Queens.
- They could construct a King's sphinx of 73 m length with special design features more than 4500 years ago.
- They succeeded to give their sphinx design certain degree of emotions such as strength and tenderness.
- Their sphinx design was mainly with human head and other parts were for lions. However, in some other designs they used human hands and falcon heads.
- During the Middle Kingdom Period, they used the symbols: Hedjet, Uraeus, Crook, Flail, Sa, Sekhem, Akhet, Shenu, Lotus, Seba, Feather, Tiet, Ankh, Nemes, Scarab, Nekhbet, Sphinx and Swty.
- They used the Uraeus symbol on their Royal foreheads since the 1st Dynasty.

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