

Mechanical Engineering in Ancient Egypt, Part 73: Scarabs Inscription

Galal Ali Hassaan

Department of Mechanical Design & Production, Faculty of Engineering,
Cairo University, Giza, Egypt
Email: galalhassaan@ymail.com

Abstract:

This paper is the 73rd Research paper in a series investigating the evolution of mechanical engineering in ancient Egypt. It investigates the inscription of scarabs during a time span from the Middle Kingdom to the Late Period of ancient Egypt. It outlines the type, design, material, decoration, inscription, owner and present location of each scarab. The type of script used in the inscription of the scarabs is outlined and the technique of presenting the text on each scarab is also investigated.

Keywords — Mechanical engineering; ancient Egypt; scarabs, inscription, Middle Kingdom to Late Periods.

I. INTRODUCTION

This is the 73 paper in a series of research papers aiming at exploring the role of ancient Egyptians in the evolution of mechanical engineering. The paper focuses on the inscription of scarabs during a time era from the Middle Kingdom to the Late Period of ancient Egypt.

Myer (1894) in his book about scarabs outlined that the oldest inscribed scarab was for King Nebka from the 3rd Dynasty made of pottery and glazed pale green. He classified scarabs as: religious, historical (containing Cartouches and names), physiographical (containing animals and plants), funeral, amulets and seals [1]. Petrie (1917) in his book about scarabs and cylinders presented line drawings for scarabs from different historical eras including a scarab of Senusret I and Senusret II from the 12th Dynasty, scarab of Mer-Khepr-Ra from 13th Dynasty, and a scarab of Thutmose II from the 18th Dynasty. He presented inscribed scarabs from the 1st-7th Dynasties, 7th Dynasty, 9th Dynasty, 11th-27th Dynasties and 30th Dynasty. [2].

Giveon (1978) in his study about the impact of Egypt on Canaan presented inscribed scarabs from 12th to 19th Dynasties of Egypt [3]. Den-Tor (1994) studied the presence of Middle Kingdom Egyptian scarabs bearing private names and titles of

officials in Middle Bronze Age Canaan. He stated that they reached Canaan not earlier than the time of the 13th Dynasty and were used as funerary amulets [4].

Watts (1998) studied a shabti box from the 19th Dynasty, reign outlined that the ancient Egyptians used the 'Kheper' (scarab) hieroglyph for meaning 'to become' or 'to evolve' and used it as an amulet in life and symbolizing rebirth in death. He presented one of Wah's scarabs from the 12th Dynasty (inscribed) [5]. Levinson and Levinson (2001) pointed out that heart scarabs were employed from the 13th Dynasty to the 17th Dynasty of ancient Egypt and were frequently used during the 18th to 30th Dynasties [6].

Teeter (2003) in her publication about scarabs, seals and seal impressions from Medinet Habu provided a catalogue for 349 items from Medinet Habu of Egypt. It included scarabs from the 18th Dynasty, 18th-20th Dynasties, 18th-21st Dynasties, 18th-25th Dynasties, 18th-26th Dynasties, 19th-21st Dynasties, 20th Dynasty, 20th-21st Dynasties, 20th-22nd Dynasties, 20th-25th Dynasties, 21st-24th Dynasties, 21st-25th Dynasties, 21st-26th Dynasties, 22nd Dynasty, 22nd-25th Dynasties, 22nd-29th Dynasties, 25th Dynasty, 25th-26th Dynasties. She presented a collection of heart scarabs presenting their inscription and translation [7].

Cooney and Tyrrell (2005) pointed out that scarab production had the feature of being an art from Old Kingdom to Late Period. They presented a number of inscribed scarabs in display in the Los Angeles Country Museum of Art from the 13th Dynasty, 15th Dynasty, 16th Dynasty, 18th Dynasty, 19th Dynasty and New Kingdom [8].

Cooney (2008) in her paper about the Egyptian scarab outlined the different types of Egyptian scarabs including: heart scarabs, commemorative scarabs and scarab amulets. She presented an inscribed heart scarab from the New Kingdom or later, a commemorative scarab for Pharaoh Amenhotep III and Queen Tiye from the 18th Dynasty, an inscribed scaraboid from the New Kingdom or later, an inscribed scarab of Pharaoh Thutmose III from the 18th Dynasty, an inscribed scarab from the Middle Kingdom to Second Intermediate Period and an inscribed scarab of the Hyksos King Sheshi [9].

Sparavigna (2009) in her study of Egyptian seals and scarabs presented some inscribed scarabs in display in the Egyptian Museum of Torino. She outlined also that some of the designs of Hyksos scarabs continued to the 26th Dynasty [10]. Sagrillo (2011) in his study of the heart scarab of King Sheshonq III from the 22nd Dynasty of ancient Egypt presented the scarab where it was inscribed on its bottom surface by eight bounded lines of hieroglyphic script text based on chapter 30B of the book of dead. He presented in the inscription in a separate image including two Cartouches of the Pharaoh in the last line, then an English translation for the hieroglyphic text [11].

McDonald et. Al. (2014) made a detailed analysis for an Egyptian scarab from the Second Intermediate Period and the New Kingdom. Their analysis demonstrated the existence of very thin and very thick hard-soldering, using the casting process even for very small items, the re-use without remelting of some smaller elements with different copper and silver content [12]. Hassaan (2017) in his study of scarab statuettes in ancient Egypt presented inscribed scarabs from the 13th Dynasty, 14th-15th Dynasties, Second Intermediate Period, 15th Dynasty, 18th Dynasty, 18th-19th Dynasties, 21st-22nd Dynasties and 26th Dynasty [3]. Wikipedia (2018) wrote an article about the heart scarab of

ancient Egypt. They outlined that the scarab inscription referred to chapter 30 from the book of dead. They presented examples of the inscribed heart scarabs [14].

II. INSCRIBED SCARABS OF THE MIDDLE KINGDOM

The Middle Kingdom comprised the 11th and 12th Dynasties over a time span from 2050 to 1710 BC [15]. We have four examples of using scarabs as a media for writing by the ancient Egyptians presented as follows:

- The first example is a 15.9 mm height and 10.7 mm width amethyst scarab of Singer Kem Sheta from the Middle Kingdom (2050-1710 BC) in display in the British Museum and shown in Fig.1 [16]. It was inscribed on its bottom surface in a column of a hieroglyphic script text surrounded by a decorating profile.



Fig.1 Scarab of Kem Sheta from the Middle Kingdom [16].

- The second example is a 21 mm height and 15 mm width glazed steatite scarab of Steward Senebtifi from the 12th Dynasty (1981-1802 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.2 [17]. It had the same design as the scarab of Fig.1 where the hieroglyphic text was located in the middle of the scarab bottom surface surrounded by a decorating surface.
- The third example is a 19 mm height glazed steatite scarab from the 12th-13th Dynasties

(1981-1640 BC) shown in Fig.3 [18]. It was inscribed by three different designs of patterns located inside an oval contour.



Fig.2 Scarab of Senebtifi from the 12th Dynasty [17].



Fig.3 Scarab from the 12th-13th Dynasties [18].

- The fourth example is 17 mm height lapis lazuli scarab of Princess Sithathoryunet from the 12th Dynasty, reign of Kings Senusret II and Amenemhat III (1887-1813 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.4 [19]. It has the same design of the previous two examples in Figs.1 and 2 with the hieroglyphic script text engraved inside a decorating contour.



Fig.4 Scarab of Sithathoryunet from the 12th Dynasty [19].

III. INSCRIBED SCARABS OF THE SECOND INTERMEDIATE PERIOD

The Second Intermediate Period of ancient Egypt comprised the 13th to the 17th Dynasties over a time span from 1802 to 1550 BC [20]. The ancient Egyptians continued to produce inscribed scarabs even during their weak historical periods as will be depicted through the following three examples:

- The first example is a heart scarab of Official Sobekhotep from the 13th Dynasty (1802-1725 BC) shown in Fig.5 [21]. This may be the first example of heart scarabs with funerary text from the book of dead. The text was engraved on the bottom surface of the scarab using the hieroglyphic script with text written in eight bounded columns. .



Fig.5 Heart scarab from the 13th Dynasty [21].

Dynasty [23].

- The second example is a 38 mm height and 25 mm length jasper heart scarab of King Sobekemsaf II from the 17th Dynasty (1590 BC) in display in the British Museum at London and shown in Fig.6 [22]. The figure shows the bottom of a holding golden case of the jasper scarab. It was inscribed in 5 bounded rows using the hieroglyphic script with text from chapter 30B of the book of dead of the ancient Egyptians.



Fig.6. Scarab of Sobekemsaf II from the 17th Dynasty [22].

- The third example is a 43 mm height jasper heart scarab of Ptahneferu from the 17th Dynasty (1580-1550 BC) in display in the British Museum and shown in Fig.7 [23]. It was of the man-headed scarab types inscribed on its bottom surface using the hieroglyphic script engraved within 12 bounded rows.



Fig.7. Scarab of Ptahneferu from the 17th

IV. INSCRIBED SCARABS OF THE NEW KINGDOM

The New Kingdom of ancient Egypt comprised three Dynasties: 18th, 19th and 20th flourished in a time span from 1570 to 1077 BC [24]. Since this is the most powerful period of ancient Egypt history, it is expected to find extensive use of inscribed scarabs for different and innovative purposes as will be depicted in the following too many examples:

- The first example is a limestone heart scarab from the 18th Dynasty (1570-1342 BC) shown in Fig.8 [25]. It was inscribed using the hieroglyphic script in nine bounded rows. Some data are missing about it. The inscription is clear is probably it was from the book of dead. Royal Cartouches were engraved in the 4th and 5th rows.



Fig.8 Heart scarab from the 18th Dynasty [25]

- The second example is a 95.2 mm height and 57.1 mm width limestone heart scarab from the 18th Dynasty (1570-1342 BC) shown in Fig.9 [26]. It was inscribed using the hieroglyphic script with a funerary text written in five bounded rows including a Royal Cartouche in the middle of the first row on the bottom surface and another

Cartouche on the top surface of the scarab.



Fig.9 Heart scarab from the 18th Dynasty [26]

- The third example is a 101.6 mm height and 69.8 mm width limestone heart scarab from the 18th Dynasty (1570-1342 BC) shown in Fig.10 [27]. It was inscribed on its bottom surface using the hieroglyphic script with a funerary text written in five bounded rows. The top surface was inscribed by a scene of a woman wearing a headdress and a hieroglyphic text in a bounded column above the scene.



Fig.10 Heart scarab from the 18th Dynasty [27]

- The fourth example is a 14 mm height and 10 mm width faience scarab of Pharaoh Ahmose from the 18th Dynasty (1550-1525 BC) in display in the

Metropolitan Museum of Art and shown in Fig.11 [28]. The bottom of the scarab was inscribed by a simple text (name of the Pharaoh) engraved inside an oval contour.



Fig.11 Scarab of Ahmose from the 18th Dynasty [28]

- The fifth example is a 64.8 mm height and 43.8 mm width stone heart scarab from the New Kingdom (1550-1069 BC) in display in the Johns Hopkins Archaeological Museum at Baltimore, USA and shown in Fig.12 [29]. It was inscribed using the hieroglyphic script in 11 bounded rows with text from chapter 30 B of the book of dead read from right to left.



Fig.12 Heart scarab of from the New Kingdom [29]

- The sixth example is an 81 mm height and 52 mm width schist heart scarab from Late New Kingdom to the 26th Dynasty (1543-525 BC) was in display by Live Auctioneers for sale with estimated price 16,000 to 18,000 US\$ and shown in Fig.13 [30]. It was inscribed on its bottom using the hieroglyphic script in 10 bounded rows with text from chapter 30 B of the book of dead. Some of its translation: ' *O, my heart of my mother O, my heart of my transformations, do not stand against me as witness, do not oppose me in the divine tribunal, do not show any enmity against me in the presence of the keeper of the balance. You are my ka . which was in my body* [30].



Fig.13 Heart scarab of from the Late New Kingdom to 26th Dynasty [30]

- The seventh example is a 42 mm height hard stone heart scarab from the New Kingdom (1540-1075 BC) sold by Sothebys for 10,623 US\$ and shown in Fig. 14 [31]. It was inscribed using the hieroglyphic script engraved inside 8 bounded rows with text from chapter 30B of the book of dead.
- The eighth example is a 12 mm height glazed steatite scarab inscribed with the throne name of Pharaoh Thutmose I of

the 18th Dynasty (1504-1492 BC) in display in the Metropolitan Museum of Art and shown in Fig.15 [32]. It was just a historical scarab holding the throne name of the Pharaoh.



Fig.14 Heart scarab of from the New Kingdom [31]



Fig.15 Scarab of Thutmose I from the 18th Dynasty [32].

- The ninth example is a scarab of Thutmose I and Hatshepsut from the 18th Dynasty (1503-1493 BC) in display in the National Museums – Grand Palace at Bangkok, Thailand and shown in Fig.16 [33]. It was inscribed on its bottom surface by two Cartouches, one for Thutmose I and the second for Hatshepsut with a hieroglyphic text above them and a river boat symbol below them.



Fig.16 Scarab of Thutmose I and Hatshepsut from the 18th Dynasty [33].

- The tenth example is a glazed steatite scarab of Pharaoh Hatshepsut from the 18th Dynasty (1479-1458 BC) in display in the Metropolitan Museum of Art at NY and shown in Fig.17 [34]. It was inscribed on its bottom surface by the Cartouche of the Pharaoh and a hieroglyphic text around it.



Fig.17 Scarab of Hatshepsut from the 18th Dynasty [34].

- The eleventh example is a 17 mm height and 13 mm height width glazed steatite scarab of Princess Neferure, daughter of Pharaohs Hatshepsut and Thutmose II from the 18th Dynasty (1479-1485 BC) in display in the Metropolitan Museum of Art and shown in Fig.17 [34]. It was inscribed on its bottom surface by a hieroglyphic text related to the Princesses.



Fig.18 Scarab of Princess Neferure from the 18th Dynasty [35].

- The twelfth example is a 18 mm height and 13 mm width glazed steatite scarab of Pharaoh Thutmose III from the 18th Dynasty (1473-1458 BC) in display in the Metropolitan Museum of Art and shown in Fig.19 [36]. It was inscribed by a hieroglyphic text on its bottom surface for the throne name of the Pharaoh.



Fig.19 Scarab of Thutmose III from the 18th Dynasty [36].

- The thirteenth example is a 13 mm height and 16 mm width glazed steatite scarab of Pharaoh Thutmose III from the 18th Dynasty (1473-1458 BC) in display in the Metropolitan Museum of Art and shown in Fig.20 [37]. Using the hieroglyphic script, its bottom surface was inscribed in a column with the throne name of the Pharaoh surrounded by a bundle of lotus flowers from both sides.



Fig.20 Scarab of Thutmose III from the 18th Dynasty [37].

- The fourteenth example is an 83 mm height and 54 mm width heart scarab amulet of General Djehoety, General of Pharaoh Thutmose III from the 18th Dynasty (1439-1425 BC) in display in the National Archaeological Museum at Leiden and shown in Fig.21 [38]. It was neatly inscribed by a hieroglyphic funerary text written in 11 bounded rows.



Fig.21 Heart scarab amulet from the 18th Dynasty [38].

- The fifteenth example is an 17 mm height glazed steatite heart scarab of Pharaoh Thutmose III from the 18th Dynasty (1479-1425 BC) which was a private collection and shown in Fig.22 [39]. It was inscribed by the Cartouche of the Pharaoh in the middle of the bottom surface protected by an Uraus (cobra) from each side in an oval bounded area.



Fig.22 Scarab of Thutmose III from the 18th Dynasty [39].

- The sixteenth example is an 79 mm height and 54 mm width commemorative scarab of Pharaoh Amenhotop III from the 18th Dynasty (1388-1350 BC) in display in the Louvre Museum at Paris and shown in Fig.23 [40]. The bottom of the scarab was engraved by a hieroglyphic script text in 8 bounded rows covering the whole surface. This scarab was known as the 'hunt scarab' since it said that the Pharaoh killed 100 lions with his own arrows and he built a great lake for the Queen [40]. The inscription included three Cartouches in the 4th and 5th lines.
- The seventeenth example is an 93 mm height and 66 mm width steatite marriage scarab of Pharaoh Amenhotop III and Queen Tiye from the 18th Dynasty (1388-1350 BC) in display in

the Museum of Fine Art at Boston and shown in Fig.24 [41]. The bottom surface of the scarab was inscribed using the hieroglyphic script with text written in 10 bounded rows including three Cartouches in the 4th and 5th lines.



Fig.23 Scarab of Amenhotep III from the 18th Dynasty [40].



Fig.24 Marriage scarab of Amenhotep III from the 18th Dynasty [41].

- The eighteenth example is a scarab of Queen Tiye, Royal Great Wife of Pharaoh Amenhotep III from the 18th Dynasty (1388-1350 BC) in display in the National Museum, Grand-Palace at Bangkok and shown in Fig.25 [42]. The bottom of the scarab was inscribed by the Cartouche of the Queen and a hieroglyphic text above and below it.



Fig.25 Scarab of Queen Tiye from the 18th Dynasty [42].

- The nineteenth example is a 66 mm height and 25 width steatite 'wild bull hunt' scarab of Pharaoh Amenhotep III from the 18th Dynasty (1388-1350 BC) in display in the Cleveland Museum of Art at Ohio of USA and shown in Fig.26 [43]. The scarab was inscribed using the hieroglyphic script with text engraved in 16 bounded rows covering the whole surface. The text presented the courage of the Egyptian Pharaoh who could hunt 100 wild bulls using his own arrows.



Fig.26 Scarab of Amenhotep III from the 18th Dynasty [43].

- The twentieth example is a 16 mm height faience scarab of Pharaoh Amenhotep III from the 18th Dynasty (1388-1350 BC) in display by the Metropolitan Museum of Art and shown in Fig.27 [44]. The scarab was inscribed using the hieroglyphic script with the Pharaoh's Cartouche in the left side of the scarab bottom surface and a text covering the rest of the area beside the Cartouche.



Fig.27 Scarab of Amenhotep III from the 18th Dynasty [44].

- The twentieth first example is a glazed composition human headed scarab amulet from the 18th - 19th Dynasties (1375-1275 BC) in display by the British Museum at London and shown in Fig.28 [45]. The scarab was inscribed on its front surface by an ibis while on its back surface (not shown) it was inscribed using the hieroglyphic script with a funerary text from chapter 30 B of the book of dead [45].
- The twentieth second example is a stone human headed scarab amulet from the 19th Dynasty (1307-1196 BC) shown in Fig.29 [46]. The scarab was inscribed on

its back using the hieroglyphic script in a neatly engraved text set in a single column. It is not obvious if this scarab amulet has a funerary text on its bottom surface or not. The present location nor the dimensions are not given.



Fig.28 Human headed scarab from the 18th – 19th Dynasties [45].



Fig.29 Human headed scarab from the 19th Dynasty [46].

- The twentieth third example is a 70 mm height and 50 mm width jasper heart scarab from the 19th Dynasty (1295-1186 BC) in display in the World Museum at Liverpool, UK and shown in Fig.30 [47]. The scarab was inscribed on

its bottom surface using the hieroglyphic script with funerary text engraved within 10 bounded rows.

- The twentieth fourth example is a 40 mm height and 30 mm width green stone heart scarab of Pahasha from the 19th – 20th Dynasties (1295-1079 BC) in display in the Metropolitan Museum of Art and shown in Fig.31 [48]. The scarab was inscribed on its bottom surface using the hieroglyphic script engraved in 9 bounded rows. Most probably it was inscribed by a funerary text from chapter 30A or 30B of the book of dead.



Fig.30 Heart scarab from the 19th Dynasty [47].



Fig.31 Heart scarab of Pakasha from the 19th – 20th Dynasties [48].

- The twentieth fifth example is a 58 mm height and 39 mm width serpentine heart scarab of Ramose from the 19th Dynasty (1295-1186 BC) in display in the World Museum at Liverpool and shown in Fig.32 [49]. The scrap was inscribed in 12 bounded rows using the hieroglyphic script with text taken from the book of dead.



Fig.32 Heart scarab of Ramose from the 19th Dynasty [49].

- The twentieth sixth example is a 38 mm height and 18 mm width greywacke heart scarab of Bak-en-Djehuti from the Late New Kingdom (1186-718 BC) in display in the Walters Art Museum at Baltimore and shown in Fig.33 [50]. The whole surface of the scarab bottom was inscribed using the hieroglyphic script with text engraved in 10 bounded rows from the book of dead.



Fig.33 Heart scarab of Bak-en-Djehuti from Late New Kingdom [50].

- The twentieth seventh example is a scarab of Pharaoh Ramses VIII from the 20th Dynasty (1129-1126 BC) in display in the Metropolitan Museum of Art and shown in Fig.34 [51]. The scarab was inscribed on the whole bottom surface using the hieroglyphic script in 3 unbounded rows within a marked semi-oval contour.



Fig.34 Scarab of Ramses VIII from the 20th Dynasty [51].

V. INSCRIBED SCARABS OF THE THIRD INTERMEDIATE PERIOD

The Third Intermediate Period of ancient Egypt comprised the Dynasties from the 21st to the 25th over a time span from 1069 to 664 BC [52]. The ancient Egyptians continued to use heart scarabs as one of their funerary activities during this Intermediate Period. Here some of the heart scarabs production during the Third Intermediate Period:

- The first example is a faience heart scarab from the 21st – 22nd Dynasties (1070-730 BC) in display in the Eton College at Windsor, UK and shown in Fig.35 [53]. It was inscribed on its bottom surface using the hieroglyphic

script with funerary text written in 7 bounded rows from chapter 30B of the book of dead. The scripts came in black color on a green background.



Fig.35 Heart scarab from the 21st – 22nd Dynasties [53].

- The second example is a 55 mm height and 40 mm width faience heart scarab from the 22nd – 26th Dynasties (945-525 BC) shown in Fig.36 [54]. It was inscribed on its bottom surface by writing a hieroglyphic text in five bounded rows.



Fig.36 Heart scarab from the 22nd – 26th Dynasties [54].

VI. INSCRIBED SCARABS OF THE LATE PERIOD

The Late Period of ancient Egypt comprised the Dynasties from the 26th to the 30th over a time span from 664 to 332 BC [55]. The use of heart scarabs in the funerary practice continued to be practiced during the Late Period of ancient Egypt as depicted by the following examples:

- The first example is a limestone heart scarab from the 26th Dynasty (663-525 BC) shown in Fig.37 [56]. It was inscribed on both top and bottom surfaces. The top surface encountered 4 Cartouches , three vertical and one horizontal with a winged scarab in the bottom surface. The bottom surface was engraved in three columns using some of ancient Egypt symbols.



Fig.36 Heart scarab from the 26th Dynasty [56].

- The second example is a limestone heart scarab of a Pharaoh from the 26th Dynasty (664-525 BC) that was in display by Sadigh Gallery for sale for 1,55 US\$ and shown in Fig.37 [57]. It was inscribed on its bottom surface using the hieroglyphic script with text written within 5 bounded rows.



Fig.37 Royal heart scarab from the 26th Dynasty [57].

- The third example is a 54 mm height and 38 mm width green stone heart scarab from the 26th – 29th Dynasties (664-380 BC) shown in Fig.37 [58]. Its bottom surface was inscribed using the hieroglyphic script with a funerary text engraved in 14 bounded rows.



Fig.38 Heart scarab from the 26th – 29th Dynasties [58].

- The fourth example is a schist heart scarab from the Late Period (664-332 BC) which was in display by Barnebys for sale with 4,700 US \$ and shown in Fig.39 [59]. It was inscribed on its bottom surface with text taken from chapter 30B of the book of dead (not shown in Fig.39). The top surfaces are extremely smooth following the corner-rounding requirements of modern machine design.



Fig.39 Heart scarab from the Late Period [59].

- The fifth example is a 64 mm height schist heart scarab from the Late Period (664-332 BC) that was in display by Chiswick Auctions for sale with estimated price from 1,303 to 1,954 US \$ and shown in Fig.40 [60]. It was inscribed on its bottom surface using the hieroglyphic script with text from chapter 30B of the book of dead.



Fig.40 Heart scarab from the Late Period [60].

- They used decoration contours around the text during the Middle Kingdom.
- Heart scarabs with inscription text from the book of dead appeared during the 13th Dynasty and continued to appear down to the Late Period.
- They inscribed different types of scarabs using the hieroglyphic script.
- The inscribed heart scarabs with text written either in columns or rows.
- Texts were written either in single or eight columns.
- Most texts were written in 5, 7, 8, 9, 10, 11, 12, 14 and 16 rows.
- Royal historical scarabs were inscribed by one or more Cartouches of the Pharaoh (or Queen) besides some symbols and text.
- Some of the historical scarabs of the 18th Dynasty registered the courage of the Pharaoh in hunting large number of lions of wild bulls using his own arrows.
- Human headed scarab amulets appeared during the 18th and 19th Dynasties.
- The back of the scarab was inscribed during the 18th, 19th and 26th Dynasties.

VII. CONCLUSIONS

- The paper investigated the evolution of Mechanical Engineering in ancient Egypt through the inscription of scarabs during the Middle Kingdom to Late Period.
- It focused on the inscription of different types of scarabs.
- The ancient Egyptians used faience, serpentine, glazed composition, amethyst, steatite, lapis lazuli, jasper, limestone, schist and greywacke as raw materials for scarab production.
- They inscribed scarabs of height between 15.9 mm and 101.6 mm.
- They inscribed scarabs of width between 10 mm and 69.8 mm.
- They produced scribes of types: Historical, funerary, commemorative and marriage.
- They inscribed scarabs on their bottom surfaces, but sometimes inscribed the top surface.

REFERENCES

1. I. Myer, *Scarabs*, Edwin Dayton, NY., 1894.
2. W. M. Petrie, *Scarabs and cylinders with names*, Constable and Co. Ltd, London, 1917.
3. R. Givon, *The impact of Egypt on Canaan: Iconographical and related studies*, University of Zurich, Zurich, 1978, <http://doi.org/10.5167/>
4. D. Ben-Tor, *The historical implications of Middle Kingdom scarabs found in Palestine bearing private names and titles of officials*, *Bulletin of the American Schools of Oriental Research*, vol.294, pp.7-22, 1994.
5. C. Watts, *The art of ancient Egypt: A source for educators*, The Metropolitan Museum of Art, 1998.
6. H. Levinson and A. Levinson, *Venerated beetles and their cultural-historical background in ancient Egypt*, *SPIXIANA*, vol.27, issue 15, pp.33-75, 2001.
7. E. Teeter, *Scarabs, scaraboids, seals and seal impressions from Medinet Habu*, *Oriental Institute Publication No. 118*, 2003.
8. K. Cooney and J. Tyrrell, *Scarabs in the Los Angeles Country Museum of Art, Part I: Distributed propaganda or intimate protection*, *Archaeology of Egypt / Egyptology*, vol.4, issue 1, pp.1-14, 2005.
9. K. Cooney, *Scarab*, *UCLA Encyclopedia of Egyptology*, vol.1, issue 1, pp.1-11, 2008.

10. A. Sparavigna, *Ancient Egyptian seals and scarabs*, Torino, Italy, 2009.
11. T. Sagrillo, *The heart scarabs of King Sheshonq III (Brooklyn Museum)*, *The Journal of Egyptian Archaeology*, vol.97, pp.240-246, 2011.
12. L. McDonald et. Al., *Practice-based comparison of imaging methods for visualization of tool marks on an Egyptian scarab*, *Image and Signal Processing*, 6th International Conference, Cherbourg, France, Springer Verlag, pp.239-246, 2014.
13. G. A. Hassaan, *Mechanical Engineering in ancient Egypt, Part 47: Statuettes of scarabs*, *World Journal of Engineering Research and Technology*, vol.3, issue 3, pp.441-457, 2017.
14. Wikipedia, *Heart scarab*, https://en.wikipedia.org/wiki/Heart_scarab , 2018.
15. Wikipedia, *Middle Kingdom of Egypt*, https://en.wikipedia.org/wiki/Middle_Kingdom_of_Egypt , 2018.
16. British Museum, *Scarab* http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=144644&partId=1&searchText=scarab+amethyst&page=1, 2017.
17. Metropolitan Museum, *Scarab of the Steward of Cusae, Senebtifi*, <https://www.metmuseum.org/art/collection/search/555785> , 2018.
18. Alamy, *Scarab, Middle Kingdom, dynasties 12-13*, <https://www.alamy.com/stock-photo-scarab-middle-kingdom-dynasty-1213-ca-19811640-bc-from-egypt-memphite-162380068.html>
19. Metropolitan Museum, *Scarab of Sithathoryunet with the name of Amenemhat III*, <https://www.metmuseum.org/art/collection/search/545529> , 2018.
20. Wikipedia, *Second Intermediate Period of Egypt*, https://en.wikipedia.org/wiki/Second_Intermediate_Period_of_Egypt , 2018.
21. Ancient Egypt Online, *Heart scarab*, <https://www.ancientegyptonline.co.uk/heartscarab.html> , 2017.
22. G. Miniaci, S. Niece, M. Guerra and M. Hacke, *Analytical study of the first royal Egyptian heart scarab, attributed to a 17th Dynasty king, Sobekemsaf*, *Technical Research Bulletin*, vol.7, pp.53-60, 2013.
23. British Museum, *Heart scarab*, http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=117803&partId=1&searchText=scarab+jasper&page=2 , 2017.
24. Wikipedia, *New Kingdom of Egypt*, https://en.wikipedia.org/wiki/New_Kingdom_of_Egypt , 2018.
25. N. Damage, *Egyptian scarab, limestone heart scarab*, <https://www.pinterest.com/pin/443886106992310236/>
26. B. Bryant, *Carved light green limestone heart scarab*, <https://www.pinterest.com/pin/533676624576277511/?lp=true>
27. Sadigh Gallery, *Carved light green limestone heart scarab*, <http://sadigh.weebly.com/featured-artifacts/sadigh-gallery-s-ancient-egyptian-limestone-scarab-43936>
28. Metropolitan Museum, *Scarab inscribed with the name of Ahmose*, <https://www.metmuseum.org/art/collection/search/558605?rpp=90&pg=1&rndkey=20150817&ao=on&ft=%2A&when=2000-1000+B.C.&pos=17> , 2018.
29. A. Arico and K. Foley, *Heart scarab*, <http://archaeologicalmuseum.jhu.edu/the-collection/object-stories/ancient-egyptian-amulets/heart-scarab/>
30. Live Auctioneers, *A large inscribed Egyptian heart scarab*, https://www.liveauctioneers.com/item/8518657_26a-a-large-inscribed-egyptian-heart-scarab-published , 2018.
31. Sothebys , *An Egyptian green stone heart scarab* , New Kingdom, <http://www.sothebys.com/en/auctions/ecatalogue/2012/antiquities-n08918/lot.84.html> , 2018.
32. Metropolitan Museum, *Scarab inscribed with the throne name of Thutmose I*, <https://www.metmuseum.org/art/collection/search/560005?where=Egypt&mp=&pg=19&mp=&rpp=20&mp=&pos=365> , 2018.
33. J. Williams, *Scarab, Thutmose I, Hatshepsut meeting of National Museums, Grand Palace*, <https://www.pinterest.com/pin/368591550744003554/>
34. Metropolitan Museum, *Scarab inscribed King of Lower and Upper Egypt, Maatkare*, <https://www.metmuseum.org/art/collection/search/549730> , 2018.
35. Metropolitan Museum, *Scarabs inscribed for Neferure*, <https://www.metmuseum.org/art/collection/search/561079?rpp=30&pg=3&rndkey=20141005&ft=%2A&deptids=10&pos=80> , 2018.
36. Archive, *Scarab inscribed with the throne name of Thutmose III*, https://archive.org/details/mma_scarab_inscribed_with_the_throne_name_of_thutmose_iii_559878
37. Metropolitan Museum, *Scarab inscribed with the throne name of Thutmose III*, <https://www.metmuseum.org/art/collection/search/559870?rpp=90&pg=1&rndkey=20141123&ao=on&ft=%2A&where=Egypt&what=Sculpture&pos=31> , 2018.
38. M. Rayen , *Jewelry from ancient Egypt*, <http://farlang.com/ancient-egyptian-jewelry-and-amulets> , 2018.
39. Aton Gallery, *Scarab for Thutmose III*, <https://aton-gallery.com/skarabaus-fur-thutmosis-iii-mit-schoner-inschrift/>
40. *Fassion Egyptienne, Amenophis III*, <http://www.passion-egyptienne.fr/Amenophis%20III.htm>
41. Museum of Fine Arts, *Marriage scarab of Amenhotep III* , <https://www.mfa.org/collections/object/marriage-scarab-of-amenhotep-iii-164572> , 2018.
42. L. Ri, *Scarab, Royal Wife Tiye, National Museums, Grand-Palace*, <https://www.pinterest.com/pin/347621664978665743/>
43. Cleveland Museum, *Wild bull hunt scarab of Amenhotep III*, <http://www.clevelandart.org/art/1984.36>
44. Metropolitan Museum, *Scarab inscribed for Amenhotep III*, <https://www.metmuseum.org/art/collection/search/551412> , 2018.
45. British Museum, *Heart scarab / amulet*, http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=143689&partId=1 , 2017.
46. Archaic Wonder, *Egyptian human-headed heart amulet, New Kingdom, Dynasty 19*, <http://archaicwonder.tumblr.com/post/139812715820/egyptian-human-headed-heart-amulet-new-kingdom>

47. Liverpool Museums, Heart scarab, <http://www.liverpoolmuseums.org.uk/wml/collections/antiquities/ancient-egypt/item-317198.aspx> , 2018.
48. Metropolitan Museum, Heart scribe of Pakasha, <https://www.metmuseum.org/art/collection/search/567834>, 2018.
49. Global Egyptian Museum, A heart scarab of green serpentine inscribed for Ramose, <http://www.globalegyptianmuseum.org/detail.aspx?id=4487>
50. Commons Wikimedia, Egyptian heart scarab of Bak-en-Djehuti, Walters, [https://commons.wikimedia.org/wiki/File:Egyptian - Heart Scarab of Bak-en-Djehuti - Walters 42380 - Impression \(2\).jpg](https://commons.wikimedia.org/wiki/File:Egyptian_-_Heart_Scarab_of_Bak-en-Djehuti_-_Walters_42380_-_Impression_(2).jpg) , 2014.
51. M. Whitfield, Ramses VIII scarab, <https://www.pinterest.com/pin/475903885608376095/>
52. Wikipedia, Third Intermediate Period of Egypt, https://en.wikipedia.org/wiki/Third_Intermediate_Period_of_Egypt , 2018.
53. N. Adderley, Scarab amulets: Petitions for safety and preservation, <https://www.birmingham.ac.uk/research/activity/connections/Essays/NAdderley.aspx> , 2018.
54. Alamy , Heart scarab, Dynasty 22-26, 945-575, <https://www.alamy.com/stock-photo-heart-scarab-late-period-dynasty-2226-ca-945525-bc-from-egypt-upper-162351512.html> , 2018.
55. Wikipedia, Late Period of ancient egypt, https://en.wikipedia.org/wiki/Late_Period_of_ancient_Egypt , 2018.
56. Flickr, Brown limestone heart scarab with a winged beetle, <https://www.flickr.com/photos/sadighgallery/8867995862/>
57. Sadegh Gallery, Egyptian heart scarab, http://www.sadighgallery.com/HEART-SCARAB--Egyptian_p_58639.html , 2018.
58. Alamy , Heart scarab, Late Period, 26 – 29, <https://www.alamy.com/stock-photo-heart-scarab-owners-name-erased-late-period-dynasty-2629-664380-bc-162326804.html> , 2017.
59. Barnebys, Egyptian green schist inscribed heart scarab, Late Period, <https://www.barnebys.com/auctions/lot/447390184/egyptian-green-schist-inscribed-heart-scarab-late-period-c-664-332-b-c/>
60. Chiswick Auctions, An Egyptian green schist heart scarab, Late Period, <https://chiswickauctions.co.uk/lot/170614-lot-206/> , 2018.

BIOGRAPHY



Galal Ali Hassaan

- Emeritus Professor of System Dynamics and Automatic Control.
- Has got his B.Sc. and M.Sc. from Cairo University in 1970 and 1974.
- Has got his Ph.D. in 1979 from Bradford University, UK under the supervision of Late Prof. John Parnaby.
- Now with the Faculty of Engineering, Cairo University, EGYPT.
- Research on Automatic Control, Mechanical Vibrations , Mechanism Synthesis and History of Mechanical Engineering.
- Published 245 research papers in international journals and conferences.
- Author of books on Experimental Systems Control, Experimental Vibrations and Evolution of Mechanical Engineering.
- Chief Justice of the International Journal of Computer Techniques.
- Member of the Editorial Board of some international journals including IJET.
- Reviewer in some international journals.
- Scholars interested in the authors publications can visit:

<http://scholar.cu.edu.eg/galal>