

## MECHANICAL ENGINEERING IN ANCIENT EGYPT, PART IV: JEWELLERY INDUSTRY (BRACELETS)

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### **Abstract: -**

This is the 4<sup>th</sup> research paper in a series of papers aiming at investigating the history and development of mechanical engineering in Ancient Egypt. The paper presents the development of bracelets industry during the ancient Egypt history from predynastic to late period. Samples of their scenes and bracelet products are presented. The paper highlights the deterioration of the bracelets industry in the intermediate periods of the ancient Egypt history and the impact of the strongest dynasties on the quality and sophistication of it.

**Keywords:-***Mechanical engineering history, Ancient Egypt, jewellery industry, bracelets.*

## I. INTRODUCTION

Ancient Egyptians had sophisticated levels of Mechanical Engineering Technology. They used this technology in the production of small and giant units astonished the modern world and sustained the environmental conditions and survived for thousands of years. The aim of this series of research papers is to highlight the Ancient Egyptian efforts in establishing engineering aspects helped them in selecting proper materials and processing means for their outstanding products..

Scott (1972) studied the Egyptian jewellery covering a period from predynastic to 19<sup>th</sup> dynasty. She presented some bracelets from 11<sup>th</sup> and 12<sup>th</sup> dynasties [1]. Fischer (2000) presented some scenes from old kingdom reflecting the women situation in Ancient Egypt. The scenes showed husbands and wives (or mothers) wearing necklaces and bracelets [2]. Hardwick et. Al. (2003) presented a gallery for the Egyptian antiques in the Ashmolean Museum from the 1<sup>st</sup> dynasty to the Byzantine period. Their presentation covered two bracelets from the 7<sup>th</sup> – 8<sup>th</sup> dynasties of the first intermediate period [3]. Teeter (2011) presented 120 objects in the Oriental Institute Museum of the University of Chicago exhibit telling the story of the emergence of the Egyptian civilization from the earliest beginning (4000-2600 BC). This included a shell bracelet from the 1<sup>st</sup> dynasty [4].

## II. The predynastic period

The bracelets industry started in a very early time line in the Ancient Egyptian history. It started before 3500 BC. The Ancient Egyptians used raw materials available in their hands and can have accepted mechanical properties such as bone and tortoise shell. Fig.1 shows a bone bracelet produced during the period 3850-2960 BC. This model is existing in the Metropolitan Museum of Art [5]. Another model manufactured from tortoise shell and belongs to the predynastic period is located in the Metropolitan Museum of Art of USA [6] and another model is located in Petrie Museum of UK [7]. The shell bracelet of Petrie Museum is show in Fig.2 [7]. Both models in Figs.1 and 2 are manufactured from one stock without joint or fastener.



**Fig.1 Bone bracelet from predynastic Egypt [5].**



**Fig.2 Shell bracelet from predynastic Egypt [6].**

## III. The early dynasties

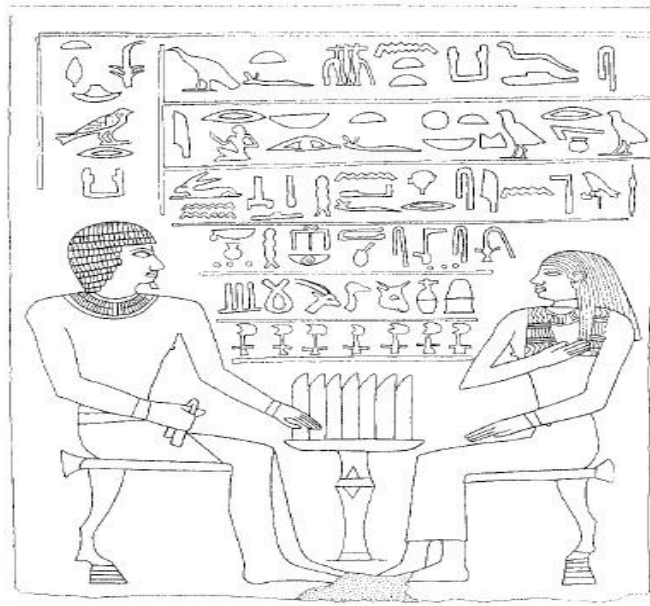
From the beginning of the dynastic periods, the design and production start to gain certain level of sophistication through material selection and shape. Fig.3 shows four models of such bracelets which belong to Pharaoh Djer the third Pharaoh of the first dynasty [8]. They are constructed of multi-colours beads manufactured from lapis lazuli, turquoise, amethyst and gold. The beads themselves have different shapes. Each bracelet is jointed by clasps at the ends. They have number of strands ranging from one to three.



**Fig.3 Bracelets of Pharaoh Djer of the 1<sup>st</sup> dynasty [8].**

## The old kingdom

The old kingdom of Ancient Egypt comprised the densities, 3,4, 5 and 6 [9]. Men and ladies used bracelets in one or two hands as clear from Fig.4 [10]. The scene is for the metalworker of the royal ornaments Werkashe and his mother [10].



**Fig.4 A scene from the old kingdom [10].**



**Fig.5 Scene from the 5<sup>th</sup> dynasty [11].**

The ancient Egyptians of the old kingdom used semi-precious stones to decorate metallic bracelets. This technique is illustrated by the two bracelets of Queen Hetepheres I of the 4<sup>th</sup> dynasty (rein of Pharaoh Snefro). The models are shown in Fig.6 [12]. They are manufactured from silver decorated by turquoise, lapis lazuli and carnelian. The decoration takes the shape of a butterfly and a number of scarabs from both sides.



**Fig.6 Bracelets of Queen Hetepheres I of the 4<sup>th</sup> dynasty [12].**

A different design style depending on semiprecious stones beads is shown in Fig.7 [13]. The two models shown in Fig.7 belong to Princess Khnumit of the 4<sup>th</sup> dynasty.



**(a)**



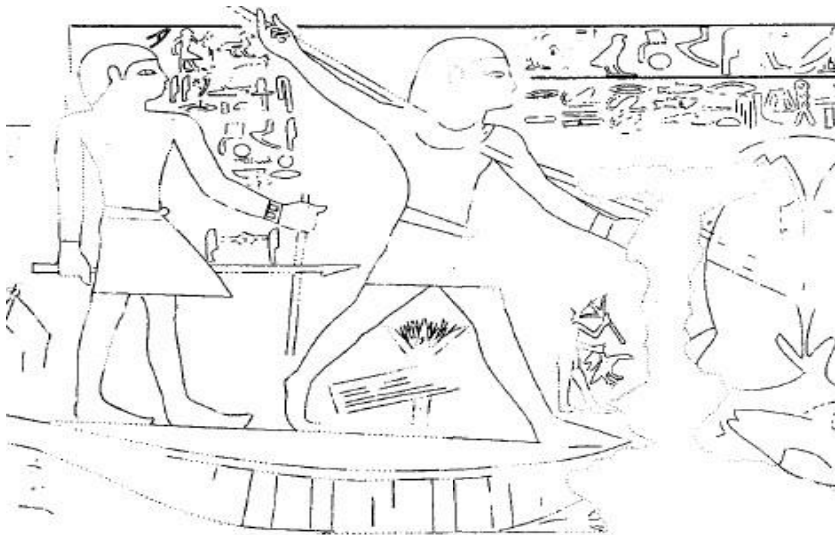
**(B)**

**Fig.7 Princess Khnumit of the 4<sup>th</sup> dynasty bracelets [13].**

The model in Fig7 (a) uses long cylindrical beads forming 10 parallel horizontal strands with 5 colours. The model in Fig.7 (b) uses small semi-circular beads in about 20 horizontal strands with 4 colours.

## **V. The first intermediate period**

The first intermediate period of the ancient Egypt history covers the dynasties 7, 8 and 9 [9]. As a documentation mean by the ancient Egyptian, we see fishing men from the 8<sup>th</sup> or 9<sup>th</sup> dynasty wearing a bracelet only in one hand as shown in Fig.8 [14].



**Fig.8 fishing scene from the 8<sup>th</sup> or 9<sup>th</sup> dynasty [14].**

Even though this historical period was one of the weak periods of ancient Egyptians, gold bracelets were manufactured also during this period. Fig.9 shows two pure gold bracelets without clasp or joints and casted as one part [15]. They are found in Tomb number 7762 of a child [15]. Another gold model of a bracelet from the 8<sup>th</sup> dynasty is shown in Fig.10 [16]. It looks that the design and finishing of the bracelet in Fig.10 is better than those in Fig.9.



**Fig.9 Two bracelets from 7<sup>th</sup> - 8<sup>th</sup> dynasties [15].**



**Fig.10 Bracelet from the 8<sup>th</sup> dynasty [16].**

## VI. The middle kingdom

The middle kingdom covers both dynasties 11 and 12 [9]. The ancient Egyptians continued wearing bracelets for ornament as we can see in the stela of the steward Mentuwyser during the reign of Pharaoh Senwosret I of the 12<sup>th</sup> dynasty. The stela is shown in Fig.11 and it is available in the Metropolitan Museum of Art, NY [17].



**Fig.11 Stela of steward Mentuwyser of the 12<sup>th</sup> dynasty [17].**

The undecorated works continued to appear in the middle kingdom (2055 – 1650 BC). A sample of undecorated bracelet from the 11<sup>th</sup> dynasty is shown in Fig.12 [18]. It is manufactured from gold and has no joints or clasp and the surface is smooth and filleted from all sides not to harm its user (high level product design technology). Its diameter is 63.5 mm.



**Fig.12 Undecorated gold bracelet from the 11<sup>th</sup> dynasty [18].**

The middle kingdom comprises of the wealthiest dynasties of ancient Egypt, the 12th dynasty. Fig.13 shows a bracelet of a unique design. It is consisted two gold parallel bangles joined together by gold and silver amulets taking the shape of turtle, hare, snake baboon, falcon and some ancient Egyptian symbols [19]. This bracelet is existing in the British Museum.



**Fig.13 Uniquely designed middle kingdom bracelet [19].**

Another unique design of multiple materials bracelets is shown in Fig.14. It belongs to Princess Sithathor, the daughter of Pharaoh Senusret II of the 12<sup>th</sup> dynasty [20]. The bracelet has a flexible design composed of about 40 parallel strands of beads. It has about 5 different colours such that the colours appear in vertical colour bands. It has a big gold clasp.





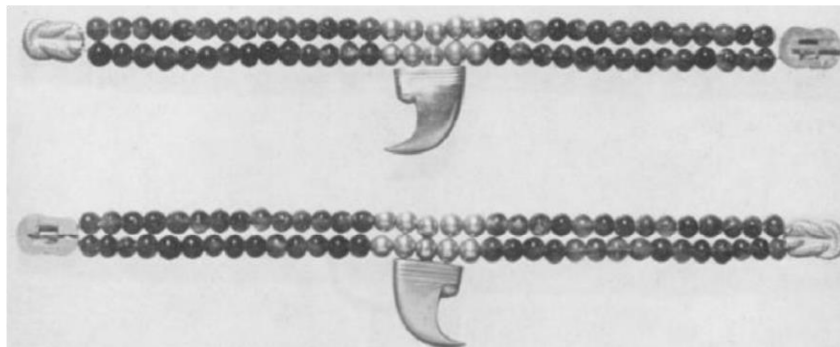
**Fig.14 Flexible wide bracelet of Sathathor [20].**

Another design of the flexible bracelets is shown in Fig.15 [21]. It consists of three groups of bead strands. Each group consists of 10 parallel bead strands. Each strand comprises 7 beads. There is a clasp at its ends. It is manufactured from silver, green faience, blue paste and carnelian. It is located in the Metropolitan Museum of Art.



**Fig.15 Bracelet from late 12<sup>th</sup> – early 13<sup>th</sup> dynasties [21].**

Another model of flexible bracelets from the 12<sup>th</sup> dynasty is shown in Fig.16 for Princess Sithathor [22]. It has only two strands of ball-beads. Each strand composes 33 beads, 5 of them in the middle is manufactured from gold. The other beads are manufactured from turquoise and carnelian. There is an amulet in the middle. The bracelet is joined by a clasp at the ends.



**Fig.16 Two strands flexible bracelets from 12<sup>th</sup> dynasty [22].**

It consists of a rotating crank 2 (replacing the gear in Fig.1), slider at A, oscillating link 4, coupler 5 and an output slider at C. Therefore, it is a 6-bar mechanism having a unit degree of freedom allowing it to be driven through its crank OA. The output is taken through its second slider at C.

## VII. SECOND INTERMEDIATE PERIOD

This is the second weak period in the ancient Egyptian history which covered dynasties from the 13<sup>th</sup> to the 17<sup>th</sup> [9]. The model presented here reflects this weakness. It is manufactured from shell and produced in the 15<sup>th</sup> dynasty. The model is shown in Fig.17 [23]. It consists of 21 flat pieces joined together by sewing at the ends forming one flexible strand. There are two pieces at the end acting as a clasp to join the bracelet ends together. Even the length of the bracelet pieces is not uniform. The bracelet is located in the Royal Ontario Museum of Toronto, Canada.



**Fig.17 Flexible bracelet from the 2<sup>nd</sup> intermediate period [23].**

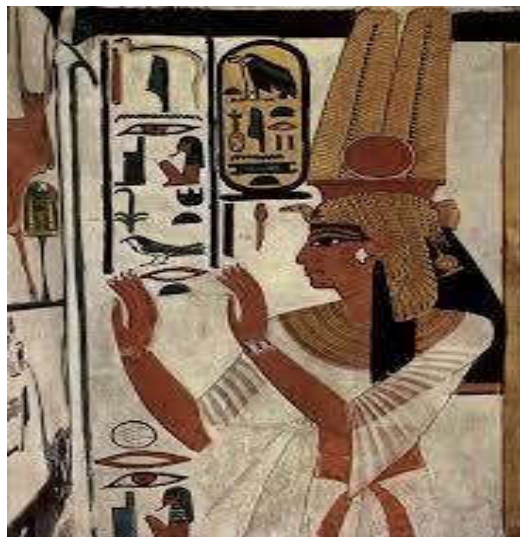
### **VIII. THE NEW KINGDOM**

The new kingdom of Ancient Egypt comprised the densities, 18, 19 and 20 [9]. It is one of the strongest and wealthy kingdoms of ancient Egypt. This appears in the coloured scenes drawn and inscribed in this strong kingdom and through the actual units of bracelets put in the tombs. For example Fig.18 shown 3 young girls exchanging perfumes and smelling aromatic plants. The scene is a coloured painting in the tomb of Nakht, one of the Nobles of the 18<sup>th</sup> dynasty [24]. The three girls wear bracelets in both hands.



**Fig.18 Coloured scene from Nakht tomb [24].**

Another example is from the tomb of Queen Nefertari (wife of Pharaoh Ramses II of the 19<sup>th</sup> dynasty). Fig.19 shown the queen worshipping and wearing bracelets in both hands [25].



**Fig.19 Coloured scene from tomb of Queen Nefertari [25].**

Moving to the actual bracelets of the new kingdom, we find a fantastic design and manufacturing of Queen Ahhotep, mother of Pharaoh Ahmos I shown in Fig.20 [26]. It is a bracelet constructed from 18 strands (to the left) and 30 strands (to the right) of uniform beads. In the right design, each five strands construct a band. Each band is decorated by right angle triangles of a specific colour different than that of the other bands. The bracelet is manufactured from gold, lapis

lazuli, carnelian and turquoise. In the left design, the bands are vertical 7 bands each band is from either gold or a semi-precious stone. A gold clasp is used to close the bracelet with the name of Pharaoh Ahmos inscribed on it.



**Fig.20 Bracelet of Queen Ahhotep of 18<sup>th</sup> dynasty [26].**

Another bracelet model is from the rein of Pharaoh Thutmose III of the 18<sup>th</sup> dynasty. This model is shown in Fig.21 [27]. It is of the solid type consisting of two parts hinged in the middle and joined by a clasp at its end. It was found in the tomb of the 3 foreign wives of Pharaoh Thutmose III. It was manufactured from gold, carnelian, turquoise and glass. The Pharaoh cartouche is engraved from inside, while the bracelet is decorated from outside by semi-precious stones in vertical parallel columns.



**Fig.21 Bracelet of the 3 wives of Thutmose III [27].**

Another wonderful model from the 18<sup>th</sup> dynasty from the rein of Pharaoh Thutmose III is shown in Fig.22 [27]. 14 row of dual-conical beads. The number of beads per row ranges from 3 to 15. It is manufactured from gold, carnelian, lapis lazuli and turquoise glass. It is decorated by three cats in the centre of the bracelet manufactured from gold and a semi-precious stone. This nice bracelet is located in the Metropolitan Museum of Art, USA!



**Fig.22 Bracelets from the 18<sup>th</sup> dynasty [27].**

One more model for 18<sup>th</sup> dynasty bracelets belong to Pharaoh Tutankhamun. It is manufactured from heavy gold and turquoise [27]. It is decorated by engravings on the outside and inside surfaces of the bracelet. It is located in the Egyptian Museum at Cairo.





**Fig 2.3 Bracelet of Pharaoh Tutankhamun [27].**

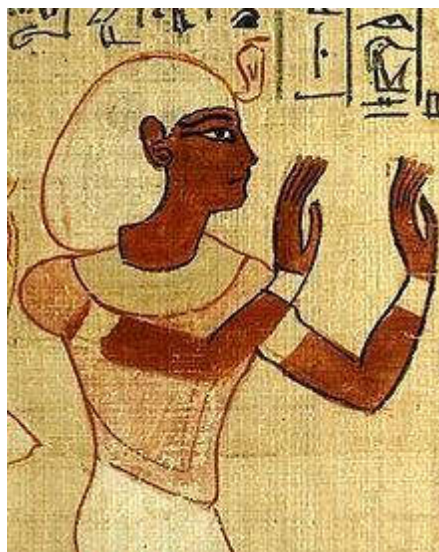
The last model is from the 19<sup>th</sup> dynasty and it belongs to the Pharaoh Ramses II. Fig.22 shows a pair of gold bracelet for Ramses II located in the Egyptian Museum [28]. The bracelet designer decorated each bracelet by two ducks holding a piece of a semi-precious stone piece on their back. Engraved decorations are used to decorate the outside surface of the bracelet and the duck.



**Fig.22 Bracelets pair for Pharaoh Ramses II of the 19<sup>th</sup> dynasty [28].**

### **IX.THE THIRD INTERMEDIATE PERIOD**

This period covers the dynasties from 21 to 25 [9]. The tradition of using bracelets continued during this period with almost same sophistication and interest. We can see this through wall paintings and real objects left in the ancient Egyptian tombs. Fig.23 show a scene for Herihor, the Egyptian Army Officer and High Priest of Amun Tembe at Thebe during the rein of Pharaoh Ramses XI of the 21<sup>st</sup> dynasty [29]. He looks worshipping and wearing bracelets in both hands.



**Fig.23 Scene of Herihor wearing bracelets [29].**

As physical actual model of the bracelets of this period, we see in Fig.24 a bracelet manufactured from gold and semi-precious stones from the 21<sup>st</sup> dynasty [27]. The decoration of the bracelet is wonderful. Semi-precious stones are used to produces thick objects such as flowers, baboon, Pharaoh cartouch on the outside surface of the bracelet. This bracelet is under presentation in the Egyptian Museum at Cairo.



**Fig.23 Bracelet from the 21<sup>st</sup> dynasty [27].**

Another model belonging to Pharaoh Psusennes I of the 21<sup>st</sup> dynasty is shown in Fig.24 [27]. They have two different designs. Both are manufactured from gold inlaid by lapis lazuli, carnelian and green feldspar. The left one is a one piece rigid bracelet while the right one is coposed of two rigid pieces hinged to each other and joined at the end by a clasp.



**Fig.24 Two bracelets of Pharaoh Psusennes I of the 21<sup>st</sup> dynasty [27].**

A bracelet from the 22<sup>nd</sup> dynasty belonging to Pharaoh Sheshonq II is shown in Fig.25 [30]. It is manufactured from gold and simulating lotus flowers holding a scarab in its middle. The scarab is carved from lapis lazuli and acts as a clasp.



**Fig.25 Bracelet of Pharaoh Sheshonq II of the 22<sup>nd</sup> dynasty [30].**

A bracelet model from the 23<sup>rd</sup> dynasty belongs to Queen Kama. It is shown in Fig.26 [31]. It is extensively decorated by ancient Egypt symbols engraved on the outer surface of the bracelet.



**Fig.25 Bracelet of Queen Kama of the 23<sup>rd</sup> dynasty [31].**

From the last dynasty of this period, the 25<sup>th</sup> dynasty we have the bracelet model shown in Fig.26 [32]. It is manufactured from gold decorated by engravings and semi-precious stones providing about three different colours. The whole outer surface of the bracelet is decorated.



**Fig.26 Bracelet from the 25<sup>th</sup> dynasty [32].**

## **X. LATE PERIOD**

This period of the ancient Egyptian history covers the dynasties 26 to 31 [9]. Egypt lost its glory by the occupation of its territories from all sides, the north, south, west and east. This reflects to the development of the bracelets industry. One sample of bracelets produced during this historical period is shown in Fig.27 [33]. It is manufactured from limestone with eight scarabs distributed over the outer surface.



**Fig.27 Limestone bracelet from the 26<sup>th</sup> dynasty [33].**

Another model of bracelets manufactured in the 26<sup>th</sup> dynasty from Bronze is shown in Fig.28 [34]. From engineering point of view, the design is not successful either from material selection point of view or from product design point of view. One may think that this is not a bracelet, but it may be something else.



**Fig.28 Bronze bracelet from the 26<sup>th</sup> dynasty [34].**

We have a better model from the 27<sup>th</sup> dynasty shown in Fig.29 [32]. It is manufactured from gold and has a circular cross-section. It is decorated by engravings representing a face of a woman and other shapes on the whole surface.



**Fig.29 Bronze bracelet from the 27<sup>th</sup> dynasty [32].**

## **XI. Conclusions**

- Ancient Egyptians manufactured bracelets for the ornamental use since the predynastic period.
- During the predynastic period they used bone and tortoise shell in producing bracelets.
- Bracelets of the predynastic Egyptians had a very accurate internal circular profile.
- Bracelets with beads appeared in the ancient Egyptian society starting from the first dynasty.
- They produced single and multi-strands flexible bracelets in the first dynasty.
- Scenes of men and women wearing bracelets appeared starting from the old kingdom.
- Gold solid bracelets appeared in the fourth dynasty.
- Bracelets with up to 20 strands of multi-colored beads appeared in the fourth dynasty.
- Solid gold bracelets continued to appear in the 7<sup>th</sup>, 8<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> dynasties.
- Flexible bracelets with up to 40 strands of beads appeared in the 12<sup>th</sup> dynasty.
- The art of bracelet manufacturing was deteriorated during the second intermediate period of the ancient Egypt history.
- More development of the bracelet industry occurred during the new kingdom specially in the 18<sup>th</sup> dynasty.
- Hinged two-parts bracelets appeared in the 18<sup>th</sup> dynasty.
- Flexible bracelets of novel designs appeared in the 18<sup>th</sup> dynasty.
- The designers and technicians of ancient Egypt bracelets applied various techniques for bracelet decoration using semi-precious stones and colored pastes.
- Different designs were applied in the 19<sup>th</sup> dynasty of the new kingdom.
- Fantastic decoration of bracelets appeared during the 21<sup>st</sup> dynasty.
- Gold and semi-precious materials continued to be used in the bracelets industry during the 22<sup>nd</sup> to 25<sup>th</sup> dynasties.
- The art of bracelets design and production was highly deteriorated in the late period such that they used limestone and bronze in producing bracelets.



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