

ISMAIL AL JAZARI, HIS BOOK, MACHINES AND QUALITY

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ABSTRACT

Ab_Ul_Iz is known short name or **Ibn Ismail Ibn al-Razzaz Al-Jazari** (1206 AD) was an important Islamic mechanical engineer and scholar (scientist) of the middle age periods . He served the Artuks a Seljuks dynasty in Diyarbakir as a chief engineer - as did his father before him. He invented the crankshaft and some of the first mechanical clocks, driven by water and weights. He authored and drew 60 inventions in his book "**Al-Jami Bain Al-Ilm Wal-Amal Al-Nafi Fi Sinat'at Al-Hiyal**".

He uses some kind of symbols for understanding of his drawings like using of electronic circuits. We look that he draws and manufactures his machines with a quality understanding.

Al-Jazari described fifty mechanical devices in six different categories, including water clocks combination locks, hand washing device, machines for raising water, double acting pumps with suction pipes and the use of a crank shaft in a machine, accurate calibration of orifices, lamination of timber to reduce warping, static balancing of wheels, use of paper models to establish a design, casting of metals in closed mould boxes with green sand, and more.

In this study, his book and quality mind will be examined with his drawing and original text.

1. INTRODUCE

Ab Ul Iz Ismail al Jazari lived in Diyarbakir (12th century) at Artuk Seljuqs period. He had spent twenty-five years in service of Seljuqs Sultans (Nasiruddin Abul Fath Muhammed bin Karaaslan and his father).

Al-Jazari described fifty mechanical devices in six different categories, including water clocks (one of his famous clocks were reconstructed successfully at the london Science Museum in 1976), combination locks, hand washing device, machines for raising water, double acting pumps with suction pipes and the use of a crank shaft in a machine, accurate calibration of orifices, lamination of timber to reduce warping, static balancing of wheels, use of paper models to establish a design, casting of metals in closed mould boxes with green sand, and

More. He is also credited for one of the first recorded designs of a humanoid robot.

First his work was machine of Vudu(preparing top ray, washing hands and face etc. Before salah) for Sultan. Sultan was like his machine and said him that, at the time of writing his book. We have only his manuscript now. There are a number of manuscripts of Al jazari's work. There are in İstanbul, London, Paris, Dublin, Leiden etc.

Ibn Ismail Ibn al-Razzaz Al-Jazari (1206 AD) was one of history's greatest engineers. He invented many automata and some of the first mechanical clocks, driven by water and weights. He was called Al-Jazari after the area where he was born. Since the pre-Islamic times, al-Jazira has been an economically prosperous region with various agricultural (fruit and cereal) products, as well as a prolific manufacturing (food processing and cloth weaving)

system. Al-Jazira, which is the traditional Arabic name for northern Mesopotamia or Jazira is a town in the south-east Anatolia in Turkey (near Diyarbakir). His tomb is in that town. Al-Jazari draws on the works of its predecessors both from the Greeks (Philon, Heron and Archimede) and Islamic world (Banu Musa brothers, Al-Khuwarizmi and Ridwan). His contribution was very important for the diffusion of knowledge in the Arabic world and after in Europe due to the translations of his books like "*The Book of Knowledge of Ingenious Mechanical Devices*" which contains more than 150 automata and mechanical devices.

Eilhard Wiedemann was a first most important contribution to Al jazari's works. Eilhard Wiedemann (1852-1928) made the study of Islamic science, medicine, mathematics and technology his life's work, and in these fields his writings are of great importance. His many articles are scattered among a number of learned German Periodicals. He was work with Fritz Hauser who was engineer in Germany. Al jazari's work were deal with by Wiedemann and Hauser in seven articles in various learned periodicals. These articles have several merits, and in particular they give a fairly clear understanding, to anyone with some measure of technical knowledge, of the design, construction, and operation of each of devices.

In 1974 Donald R. Hill translated and annotated Al Jazari's book in Boston –USA. His manuscripts is translated, drawing and additional guided to understanding. That book name was "*The Book of Knowledge of Ingenious Mechanical Devices*".

In 1951, Ibrahim Hakki Konyali first time mentioned about that manuscript with a magazine in Turkey . Dr. Ayhan Songar , Dr. Toygar Akman wrote about Al jazari's work . Prof. Dr. Kazim Çeçen made one of Al jazari's machine (Water Clock) in Istanbul Technical Universty in 1980's. 1997 first book published in Konya about Al jazari's life and his Works then 2004 his manuscripts translated in Turkish.

2. HIS WORKS AND QUALITY

Al Jazari use some symbols like electronics works in his manuscript. He wrote and designed his machine very carefully. Pictures is nice and colours is not pale. He said that he had got some technical principle from Archimend and other old scientist.

In 1206 al-Jazari presented his sultan with the Book of Knowledge of Ingenious Mechanical Devices, devised for both educational and entertainment value. In this singularly important work, he described contemporary labor-saving devices and unusual clocks, including some of his own designs. Even though the book does not contain descriptions of the astrolabe or balance, for which Arab scientists were famous, it plainly displays stronger and weaker aspects of Arabic engineering.

Most of the machines, with varying degrees of utility, used age-old principles of mechanics, including systems of weights, pulleys, gears, cams, and levers. The crankshaft was first described by al-Jazari, if not invented by him.

Al-Jazari noted a number of practical joke devices in his text. Some were trick drinking vessels that appeared to contain water but could not be emptied. Others looked empty but produced water when tipped over.

In producing these not-so-useful inventions, al-Jazari was typical of his age. That time engineers had a reputation for frivolous machines that dated back to the writings of the

ancient Greeks. Had he lived in a different society, al-Jazari might have put his ingenuity to a different purpose.

His introduction give us his personality and quality principles.

“In the name of God the Compassionate the Merciful

Oh god pray for keep safe and bless our Lord Muhammad the seal of the Apostles his family and his Companions. Praise be to God, creator of His work in the heavens, consignor of the secret of His wisdom to the earths which He made as a proof of His dominion, and as a certain sign of His ommipotance. I praise Him for the instruction he has give and I seek more of His increasing gifts and this are the manifestation of His wisdom praise appropriate to some part of His beneficence and His abundant generosity. The grace of God be upon our Lord Muhammed, the noblest type of humankind and upon his family and his followers, beneficence be upon them.

I have studied the books of the earlier[scholars] and the works of the later [craftsmen]-masters of ingenious devices with movements like pneumatic[movements], and water machines for the constnat and solar hours, and the transfer by bodies of bodies from their natural positisons. I have contemplated in isolation and in company the implications of proofs. I considered the treatment of this craft for a period of time and I progressed, by practising it from the stage of book learning to that of witnessing and I have taken the view on this matter of some of the ancients and those more recent [scholars]. I was fervently attached to the pursuit of this subtle science and persisted in the endeavour to arrive at the truth. The eyes of opinion looked to me distinguish myself in this beloved science. Types of [machines] of great importance came to my notice, offering possibilities for types of marvellous control.

The kings of my time and philosophers of my epoch took and interest in me, and from this the seeding of my confidence bore fruit, I spent the nights of my industry and caused my sleeping ambition to stand up and awoke my sleeping genius. I was engrossed in diligence and consumed strength and position. I found that some of the earlier scholars and sages had made devices and had described what they had made. They had not considered them completely nor had they followed the correct path for all of them, for every [part] of constructional knowledge was not verified in the practise, and so wavered between the true and the false. So I assembled the divisions that they had seperated and put forth branches from roots where they had been correct, and devised specimens which worked splendidly, light internally and externally. And when I found diffucultly such as to lengthen the journey I hated [he thought] that my diligence might go the ways of the wind and that trace of what I had made night be woven into tabestry of the night without morning. So my soul asked of me to pass on a record of that to [someone]whom I would appoint to unroll his parchment and [whom]I desired to instruct. Then I turned aside from what I had resolved and abandoned my intention ,apprehensive of the disapproval of a censorer directing a penetrating gaze.

I am in the service of the sultan al-Salih Nasir al-Din Abi al-Fath Mahmud bin Muhammed bin Qara Arslan bin Dawud ibn Sukman bin Artug, the king of Diyarbakir, may God preserve him with those whom. He chooses to preserve. That is following my services to his father and his brother, God sanctify their souls, before the King ship passed to him – a [total] period of twenty - five years, the first of them year 577. God, may He be exalted, he singled him out with distinctions of intellegence, high –mindedness, justice and probity, so that he surpasses in justice and probity the king of the present age, and excels the lords of near and far in beneficence and graciousness. There is no subtlety of the subtleties of

government that he has not mastered through the penetration of his intellect, and no mystery of the mysteries of learning that he has not understood by the height of his zeal. I never began to construct a device of mine without his anticipating it [i.e. its purpose] by the subtlety of his perception. He is completed by the refinement of his opinion and his wisdom.

I was his presence one day and had brought him something which he had ordered me to make. He looked at me and he looked at what I had made and thought about it, without my noticing. He guessed what I had been thinking about, and unveiled unerringly what I had concealed. He said 'you have made peerless devices, and through strength have brought them forth as works; so do not lose what you have wearied yourself with and have plainly constructed. I wish you to compose for me a book which assembles what you have created separately, and brings together a selection of individual items and pictures'.

I followed the pattern he had imposed and accepted his judgement, for I had no recourse but to obey. I gave of my strength according to the required reading and I composed this book in which there are certain rents I have patched and basic matters the sub-divisions of which I have given and figures which I have designed. I do not know that I have had any predecessors in this, trusting in the generosity of those scholars who are expert in this. And those who have knowledge of aphorisms know that every man can accomplish only what he is capable of by his, inborn ability. And he can spend only of the provision given him by God, and let no soul spare, that which can benefit others. No soul is asked to do beyond its capability.

I assembled that in a book [lit. Introduction –mugaddima] comprising fifty specimens, and it is divided into six categories. I have been thorough in description and in particulars. In what I have written I have used foreign names passed on by earlier people and adherence to these has continued until today; and other expressions made necessary by time. For the people of every epoch have [their own] language, and every group of scholars have technical terms understood among themselves, and conversions familiar to them. For every specimen (shakl) I have drawn a picture, and have marked it with letters for guidance, and have [also] put alternatives for these letters.

Category I On the construction of clocks from which can be told the passage of the constant and solar hours-10 Chapters [it.specimens-ashkal]

Category II On the construction of vessels and figures suitable for drinking sessions-10 Chapters

Category III On the construction of pitchers and basins for phlebotomy and ritual washing-10 Chapters.

Category IV On the construction in pools of fountains which change their shape, and of machines for the perpetual flute -10 Chapters.

Category V On the construction of machines for raising water from standing water which is not deep, and from a running river-5 Chapters.

Category VI On the construction of different, dissimilar things -5 Chapters. [2]

3. AUTOMATIC VUDU MACHINE

Section 1

Description of its outside appearance and functioning and the construction of the dais (kursi) and the slave

It is a square-shaped dais about 1 sp. high and 2 sp by 2 sp. in area. On it is a kneeling slave holding a pitcher in his right hand a towel and comb in his left, which is raised, covering his

upper arm. On the corners of the dais are four columns which support a handsome castle with a dome on top of it and a bird on top of that. Directly beneath the pitcher is a half basin, soldered to the dais – many basins are positioned like that. In the floor of the basin is a handsome, crouching duck, its tail pressed against that side of the basin which adjoins the dais. Its neck is raised then bent[down] from the middle so that its beak touches the floor of the basin. So much for its appearance, now for its functioning: the servant fetches it and brings it in front of the master, the bird whistles and water pours from the pitcher's spout. He [i.e. the master] performs his ritual ablutions until they are completed. The water collects on the floor of the- basin and the duck drinks it all. The slave extends his hand with the towel and the comb. He takes the towel and dries himself with it, uses the comb and puts it back on his hand. The servant takes the basin away from the company. In the side of the dais is a tap, and he opens it to extract the water, all of which was drunk by the duck.

A square- shaped dais is made from copper, 1 sp. high and 2 sp. by 2 sp. in area. Upon it is placed a kneeling slave holding a handsome brass pitcher in his right hand. This pitcher is divided in the middle into two chambers, a chamber from the middle down and a chamber from the middle up. It is closed at the top by a plate. Two holes are made the handle, and [two pipes] are fitted to them: one pipe goes from the handle through the palm into the upper arm of the slave and a whistle's ball is fixed to it; and a pipe which goes through the palm and is bent down at the slave's elbow and terminates below the slave's skirt, for the time being. At the position of the spout a hole is made, in which the end of a siphon is inserted until it almost touches the [dividing] plate. It rises one finger's length inside the body of the pitcher and is then bent down until its end is lower than the end which is inside the pitcher. The visible part is adorned, and resembles the head and neck of a peacock- or something similar.

The left hand moves on an axle, the ends of which are fixed firmly in the sleeve at the elbow. The extension of the elbow goes into his cavity and on it [i. e. The extension] is a staple which is mentioned below. Then four columns are placed on the corners of the dais, each column slightly

higher than the slave's head. Above the columns a handsome castle is installed, above which is a dome , and on the dome is a dainty bird. This castle is thoroughly soldered, to serve as a tank. A cover is placed on top of it. To the floor of the castle a pipe is fixed which goes down through the right- hand column which is behind the slave, is turned under the deck of the dais and rises into the hollow slave. Its end is connected to the end of the pipe which comes up from the pitcher's handle and [goes] through the palm and sleeve of the slave .This pipe should be the same width as the pitcher's siphon so that water does not rise into the whistle's ball. If some water is poured into the castle it runs down through the pipe then rises through it and flows into the pitcher. It drives out the air which is in the pitcher, and this has no outlet except the pipe which rises from the pitcher's handle into the upper arm of the slave, and which has the whistle on it. This whistles and the whistling is thought [to come] from the beak of the bird on top of the dome.

Then a float is made, as described in a number of previous chapters. In the centre of its [upper] circle a staple is fixed, to which is [attached] a chain or a stout string. It is placed on the floor of the dais and a hole is made in the deck, vertically below the staple in the extension of the slave's left arm. The chain is lifted through the hole in the deck of the dais into the hollow in the slave

and its end is attached to the staple on the extension of his arm. When the float is resting on the floor of the dais its weight pulls the extension of the slave's elbow and lifts his hand with the towel and comb until his palm and fingers almost touch his shoulder. When water runs into the dais the float rises and the slave's hand sinks.

Section 2

On the construction of the basin and its Contents

A basin is made shaped like half a basin, having a wide floor and short sides, with a pedestal which rests on the ground. Its diameter adjoins the dais and it is at the same level as the dais. It is soldered securely to the dais. Then a handsome duck is made, having no legs. When it is placed on the floor of the basin its neck rises as far as the middle [of the neck] and is then bent down until its beak touches the basin's floor. A narrow siphon is inserted in its neck-one end of the siphon is the tip of the beak. The other end goes through its rump, through the side of the basin into the hollow of the dais, and is brought down a little lower than the level of the basin's floor. It is firmly soldered to the basin and to the dais. When water is poured into the floor of the basin it rises until it covers the bend in the duck's neck, [whereupon] it runs through the siphon into the hollow of the dais. No water can leak out of the basin, because the siphon is securely soldered to the basin. To the side of the basin near the bottom a tap is fitted from which, when it is opened, the water collected in the dais can be extracted.

Then an upright valve (faythün) is fitted to the upper end of the pipe which descends from the floor of the castle, as follows: it is a valve seat (tanür), half of which is [pushed] down over the end of the pipe, while the other half rises above the floor of the castle. In it is a plug which has an extension [rod] on its top which goes up to the top of the castle; and which has something on its end for turning the plug. In the centre of the [side of] the seat a hole is drilled laterally, as far as the centre [line] of the plug. Then a hole is made lengthwise through the plug from its underside to meet the hole from the seat. When water is poured into the floor of the castle it runs down through the hole in the valve into the pipe. When the extension on the top of the plug is rotated a little, the valve is shut and nothing flows from it into the pipe.

I have shown the Picture of that [fig. 1]: the basin *p*; the duck *q* with a siphon in its body; the dais *s*, with the float *f* inside it, upon which is a staple connected to the extension to the slave's arm by a chain *x*; the slave's hand *s* which moves on an axle in his sleeve, and which has a towel and a comb in it; then the pitcher-the plate *n* which divides the pitcher into two chambers; the spout *m* in which is a siphon going down into the upper chamber, its end almost touching the plate; the pipe *l* connected to it [i.e. the pitcher] which goes up from its handle, through the palm and sleeve of the slave, down through his hollow, turns under his skirt along the dais, and rises through column *l*; the top of the valve and its plug's extension *k* which goes up to the top of the castle; another pipe *y* which rises with this [i.e. the above mentioned] pipe from the pitcher and terminates at the end of the slave's upper arm, with the hisle's ball [fixed] in its end; three columns *t*; the castle *j*; the dome *z* with the bird *z* on top of it.

It is very clear that water is poured into the castle while valve *k* is closed; the whole assembly is placed in front of the master and the servant open valve *k* without being noticed, and the slave stands aside. The water descends and rises in pipe *l* and flows into the pitcher, covering the end of the siphon. The air in pitcher is driven out and rushes through pipe *y*. The ball whistles and it is thought that the whistling comes from the bird's beak. This continues until the water rises above the bend in the siphon and flows out of the peacock's beak over the hands of the one who is performing his ritual ablutions. It collects in the basin until the water in the castle is almost exhausted, whereupon the duck drinks all the water that is in the basin. The slave holds out his left hand, with the towel and the comb. He [i.e. the master] dries himself and uses the comb, then puts them back into his hand. The servant takes the basin outside the company, opens the tap, and drains the waters of the dais.

That which requires painting is painted, that which requires scraping is scraped, and everything is coated with [Sandarac] oil.
That is what I wished to describe clearly. [1]

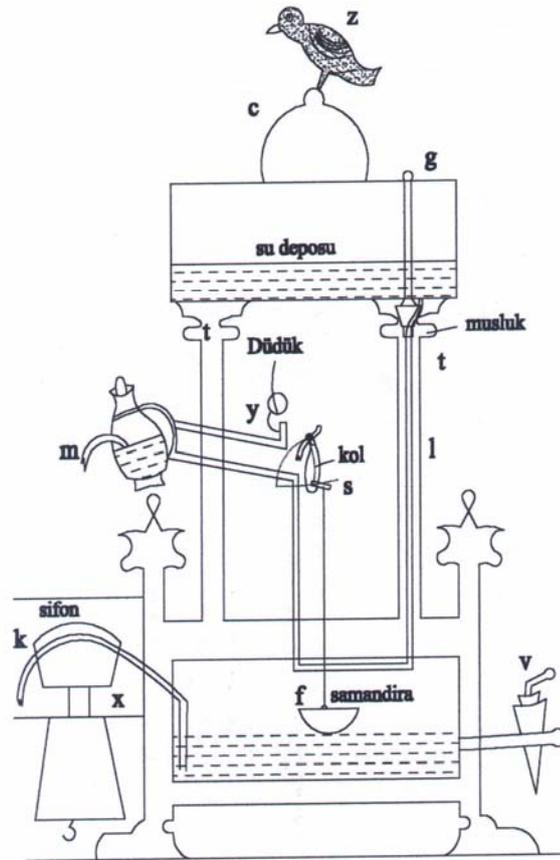
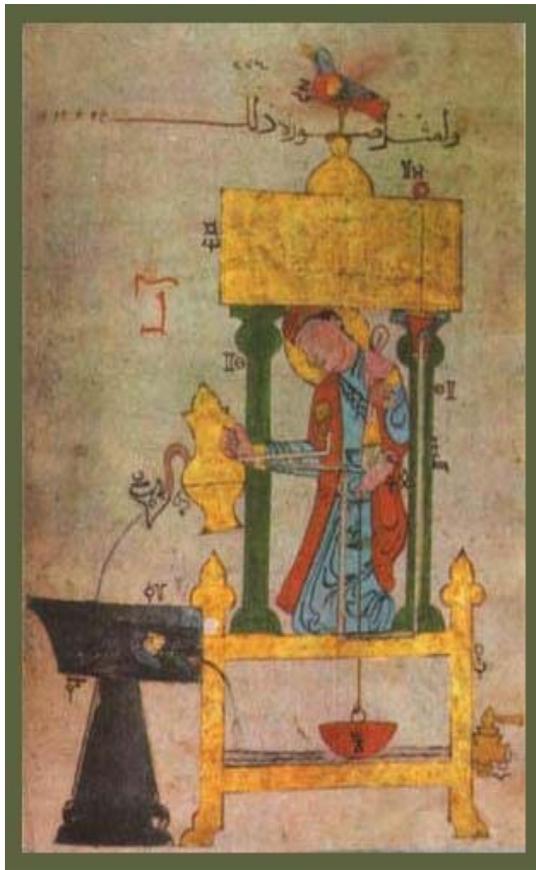


Fig. 1 Automatic Vudu machine

4. CONCLUSION

We know about life of Leonardo da Vinci, James Watt and other scientists but Al Jazari's life not more. We have only his book about and nobody follow him. All European scientist don't know him and his Works. We do not know what effect, if any, his work and upon later generations of engineers. Al Jazari's idea and useful machines are in his manuscript but after him no-one write and follow about him and Works. His drawings is shown several by several remarks. He certainly used a technique that is indispensable for all engineering drawing. Al Jazari, then, gives us the full engineering content of his work. For a given machine he tells us its appearance, purpose and functioning. He describes, step by step, the manufacture of its component parts, setting out, assembly and fitting, joints and connections, and testing. He was a master craftsman, fully conversant with all branches of his trade, consciously proud of his membership of the technical fraternity.

5. REFERENCES

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Figure 2: Tomb of Al Jazari