Parthian Battery

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In June, 1936, while a new railway was being constructed near the city of Baghdad workers uncovered an ancient tomb. In the excavation that followed it was determined that the tomb was built during the Parthian period which ranged from 250 BCE to 250 CE

The artifacts consist of terracotta pots approximately 130 mm (5 in) tall (with a one-and-a-half-inch mouth) containing a copper cylinder made of a rolled-up copper sheet, which houses a single iron rod. At the top, the iron rod is isolated from the copper by bitumen plugs or stoppers, and both rod and cylinder fit snugly inside the opening of the jar, which bulges outward toward the middle. The copper cylinder is not watertight, so if the jar was filled with a liquid, this would surround the iron rod as well. The artifact had been exposed to the weather and had suffered corrosion, although mild given the presence of an electrochemical couple. This has led some to believe lemon juice, grape juice, or vinegar was used as an acidic electrolyte solution to generate an electric current from the difference between the electrochemical potentials of the copper and iron electrodes. König thought the objects might date to the Parthian period (between 250 BC and AD 224). However, according to St John Simpson of the Near Eastern department of the British Museum, their original excavation and context were not well-recorded, so evidence for this date range is very weak. Furthermore, the style of the pottery is Sassanid (224-640). Most of the components of the objects are not particularly amenable to advanced dating methods. The ceramic pots could be analyzed by thermoluminescence dating, but this has not yet been done; in any case, it would only date the firing of the pots, which is not necessarily the same as when the complete artifact was assembled. Another possibility would be ion diffusion analysis, which could indicate how long the objects were buried.

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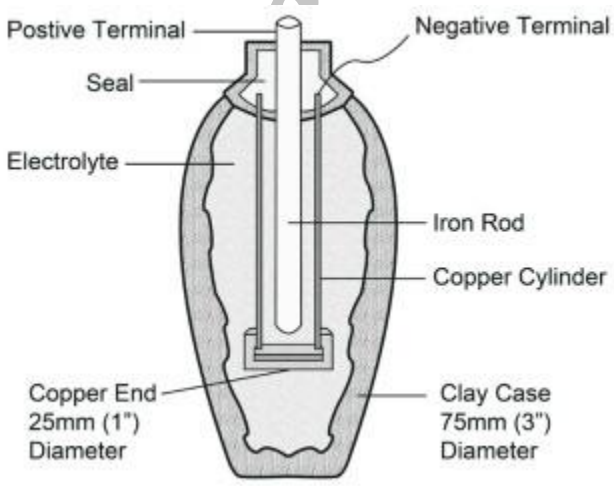
Electrical

Copper and iron form an electrochemical couple, so that, in the presence of any electrolyte, an electric potential (voltage) will be produced. This is not a very efficient battery as gas is evolved at an electrode, the bubbles forming a partial insulation of the electrode so that although several volts can be produced in theory by connecting them in series, their internal resistance from the formation of the gas bubbles becomes so great; that it severely limits the electrical current that can be produced from such a simple wet cell. König had observed a number of very fine silver objects from ancient Iraq that were plated with very thin layers of gold, and speculated that they were electroplated using batteries with these as the cells. After the Second World War, Willard Gray demonstrated current production by a reconstruction of the inferred battery design when filled with grape juice. W. Jansen experimented with benzoquinone (some beetles produce quinones) and vinegar in a cell and got satisfactory performance. However, even among those believing the artifacts to be electrical devices, electroplating as a use is not well-regarded today. Paul Craddock of the British Museum said "The examples we see from this region and era are conventional gold plating and mercury gilding. There's never been any untouchable evidence to support the electroplating theory." The gilded objects that König thought might be electroplated are now believed to have been fire-gilded (with mercury). Reproduction experiments of electroplating by Arne Eggebrecht consumed "many" reproduction cells to achieve a plated layer just one micrometre thick. Other scientists noted that Eggebrecht used a more efficient, modern electrolyte; using only vinegar, the battery is very feeble.



Non-electrical

Skeptical archaeologists see the electrical experiments as embodying a key problem with experimental archaeology, saying that such experiments can only show that something was physically possible, but do not confirm that it actually occurred. Further, there are many difficulties with the interpretation of these artifacts as galvanic cells. The bitumen completely covers the copper cylinder, electrically insulating it, so no current can be drawn without modifying the design. There are no wires or conductors with them. No widely accepted electrical equipment is associated with them. Controversial stone reliefs depicting arc lights have been suggested, however the voltages obtained are orders of magnitude below what would be needed

to produce arc lighting. A bitumen seal, being thermoplastic, is excellent for forming a hermetic seal for long-term storage. It would be extremely inconvenient, however, for a galvanic cell, which would require frequent topping up of the electrolyte (if they were intended for extended use). The artifacts strongly resemble another type of object with a known purpose — namely, storage vessels for sacred scrolls from nearby Seleucia on the Tigris. Those vessels do not have the outermost clay jar, but are otherwise almost identical. Since it is claimed these vessels were exposed to the elements, it is possible [opinion] that any papyrus or parchment inside had completely rotted away, perhaps leaving a trace of slightly acidic organic residue.

In the media

The idea that the battery could have produced usable levels of electricity has been put to the test at least twice. On the 1980 British Television series Arthur C. Clarke's Mysterious World, Egyptologist Arne Eggebrecht used a recreation of the battery, filled with grape juice, to produce half a volt of electricity, demonstrating for the program that the battery could electroplate a silver statuette in two hours, using a gold cyanide solution. Eggebrecht speculated that museums could contain many items mislabelled as gold when they are merely electroplated. However, doubt has recently been cast on the validity of these experiments. The Discovery Channel program MythBusters determined that it was indeed plausible for ancient people to have used the Parthian Battery for electroplating or electrostimulation. On MythBusters' 29th episode (March 23, 2005), ten hand-made terracotta jars were fitted to act as batteries. Lemon juice was chosen as the electrolyte to activate the electrochemical reaction between the copper and iron. Connected in series, the batteries produced 4 volts of electricity. The show's research staff proposed three possible uses: electroplating, medical pain relief (through acupuncture), and religious experience. It was discovered that, when linked in series, the cells indeed had sufficient power to electroplate a small token. For acupuncture, the batteries produced a "random" pulse that could be felt through the needles; however, it began to produce a painful burning sensation when the batteries were grounded to two needles at once. For the religious experience aspect of the batteries, a replica of the Ark of the Covenant was constructed, complete with two cherubim. Instead of linking the cherubim's golden wings to the low-power batteries, an electric fence generator was connected. When touched, the wings produced a strong feeling of tightness in the chest. Although the batteries themselves had not been used, it was surmised that any form of electrical sensation from them could equate to the divine presence in the eyes of ancient people. In the end, the Parthian Battery myth was found plausible on all three accounts.

References

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