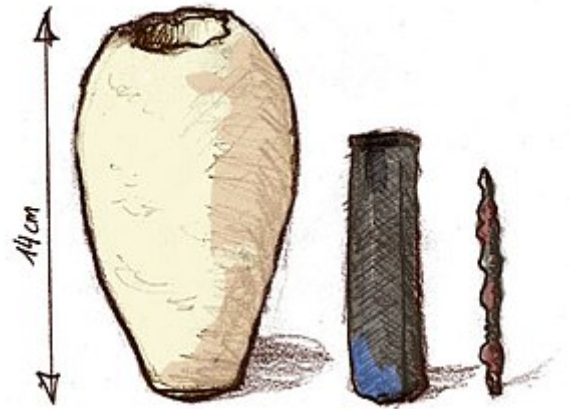


Baghdad Battery

The **Baghdad Battery** or **Parthian Battery** is a set of three artifacts which were found together: a ceramic pot, a tube of copper, and a rod of iron. It was discovered in modern Khujut Rabu, Iraq, close to the metropolis of Ctesiphon, the capital of the Parthian (150 BC – 223 AD) and Sasanian (224–650 AD) empires, and it is believed to date from either of these periods.

Its origin and purpose remain unclear. It was hypothesized by some researchers that the object functioned as a galvanic cell, possibly used for electroplating, or some kind of electrotherapy, but there is no electroplated object known from this period. An alternative explanation is that it functioned as a storage vessel for sacred scrolls.



Drawing of the three pieces

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Physical description and dating

The artifacts consist of a terracotta pot approximately 130 mm (5 in) tall (with a one-and-a-half-inch mouth) containing a cylinder made of a rolled copper sheet, which houses a single iron rod. At the top, the iron rod is isolated from the copper by bitumen, with plugs or stoppers, and both rod and cylinder fit snugly inside the opening of the jar. The copper cylinder is not watertight, so if the jar were filled with a liquid, this would surround the iron rod as well. The artifact had been exposed to the weather and had suffered corrosion.

German archeologist Wilhelm 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, and evidence for this date range is very weak. Furthermore, the style of the pottery is Sassanid (224–640).^{[1][2]}

Theories concerning operation

Its origin and purpose remain unclear.^[1] Wilhelm König was an assistant at the National Museum of Iraq in the 1930s. He had observed a number of very fine silver objects from ancient Iraq, plated with very thin layers of gold, and speculated that they were electroplated. In 1938 he authored a paper^{[3][4]} offering the hypothesis that they may have formed a galvanic cell, perhaps used for electroplating gold onto silver objects.^[1] This interpretation is rejected by skeptics.^[5]

Corrosion of the metal and tests both indicate that an acidic agent such as wine or vinegar was present in the jar.^[1] This led to speculation that the liquid was used as an acidic electrolyte solution to generate an electric current from the difference between the electrode potentials of the copper and iron electrodes.^[2]

Supporting experiments

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.

In 1978, Arne Eggebrecht reportedly reproduced the electroplating of gold onto a small statue. There are no (direct) written or photographic records of this experiment.^[a] The only records are segments of a television show.

Controversies over use

Lack of electrical connections

Though the iron rod did project outside of the asphalt plug, the copper tube did not, making it impossible to connect a wire to this to complete a circuit.^[6]

Electroplating hypothesis

König himself seems to have been mistaken on the nature of the objects he thought were electroplated. They were apparently fire-gilded (with mercury). 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 irrefutable evidence to support the electroplating theory".^[1]

David A. Scott, senior scientist at the Getty Conservation Institute and head of its Museum Research Laboratory, writes: "There is a natural tendency for writers dealing with chemical technology to envisage these unique ancient objects of two thousand years ago as electroplating accessories (Foley 1977), but this is clearly untenable, for there is absolutely no evidence for electroplating in this region at the time".^[7]

Paul T. Keyser of the University of Alberta noted that Eggebrecht used a more efficient, modern electrolyte, and that using only vinegar, or other electrolytes available at the time assumed, the battery would be very feeble, and for that and other reasons concludes that even if this was in fact a battery, it could not have been used for electroplating. However, Keyser still supported the battery theory, but believed it was used for some kind of mild electrotherapy such as pain relief, possibly through electroacupuncture.^{[2][8]}

Bitumen as an insulator

A bitumen seal, being thermoplastic, would be extremely inconvenient for a galvanic cell, which would require frequent topping up of the electrolyte for extended use.^{[5][9][10]}

Alternative hypothesis

The artifacts strongly resemble another type of object with a known purpose – storage vessels for sacred scrolls from nearby Seleucia on the Tigris.^[11] Since these vessels were exposed to the elements,^{[1][b]} it is possible that any papyrus or parchment inside had completely rotted away, perhaps leaving a trace of slightly acidic organic residue.^[12] Although the Seleucia vessels do not have the outermost clay jar, they are otherwise almost identical.^{[1][b]}

The object was looted along with thousands of other artifacts from the National Museum during the 2003 invasion of Iraq.^[13]

In March 2012, Professor Elizabeth Stone of Stony Brook University, an expert on Iraqi archaeology, returning from the first archaeological expedition in Iraq after 20 years, stated that she does not know a single archaeologist who believed that these were batteries.^{[14][15]}

Media tests of viability

The idea that the terracotta jars in certain circumstances could have been used to produce usable levels of electricity has been put to the test at least twice. On the third episode of the 1980 British Television series *Arthur C. Clarke's Mysterious World*, Egyptologist Arne Eggebrecht created a voltaic cell using a jar filled with grape juice, to produce half a volt of electricity, demonstrating for the programme that jars used this way could electroplate a silver statuette in two hours, using a gold cyanide solution.^[16] Eggebrecht speculated that museums could contain many items mislabelled as gold when they are merely electroplated.^[17]

The Discovery Channel program *MythBusters* built replicas of the jars to see if it was possible for them to have been used for electroplating or electrostimulation. On *MythBusters'* 29th episode (23 March 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. When linked in series, the cells had sufficient power to electroplate a small token and to deliver current to acupuncture type needles for therapeutic purposes, but not quite enough to deliver an electric shock to *MythBusters* co-host Adam Savage who was instead pranked by co-host Kari Byron who hooked him up to a 10,000 volt cattle fence shock generator.^[18] Archaeologist Ken Feder commented on the show noting that no archaeological evidence has been found either for connections between the jars (which would have been necessary to produce the required voltage) or for their use for electroplating.^[19]

See also

- Dendera light

- Coso artifact – misinterpreted by some to be a 500,000-year-old spark plug
- History of the battery
- Leyden Jar
- List of topics characterized as pseudoscience

Notes

- a. In Arran Froom's BBC article: "There does not exist any written documentation of the experiments which took place here in 1978," says Dr Bettina Schmitz, currently a researcher based at the same Roemer and Pelizaeus Museum. "The experiments weren't even documented by photos, which really is a pity," she says. "I have searched through the archives of this museum and I talked to everyone involved in 1978 with no results."
- b. Arran Froom's BBC article: "The artifact had been exposed to the weather and had suffered corrosion, although mild given the presence of an electrochemical couple."^[1]

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12. Lenny Flank (Feb 10, 2015). "The Baghdad Battery: An Update" (<https://www.dailykos.com/story/2015/02/10/1361589/-The-Baghdad-Battery-An-Update>). *Daily Kos*.
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