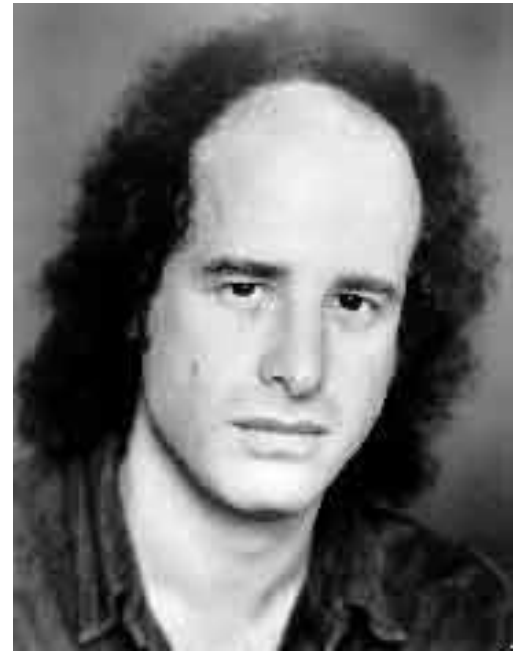


Magnetism, Electricity, and *The Baghdad Battery*

Tobey Clark
Ancient Inventions
HCOL 185G

Philosophical Introduction by Steven Wright

"I went to the hardware store and I bought some batteries... they weren't included..."



Electricity – who needs it!

- Radio, television
- Heating and cooling
- Household items
- Autos/transportation
- Medical devices
- Computers
- The internet/WWW
- Facebook/Twitter



Lighting up the night!

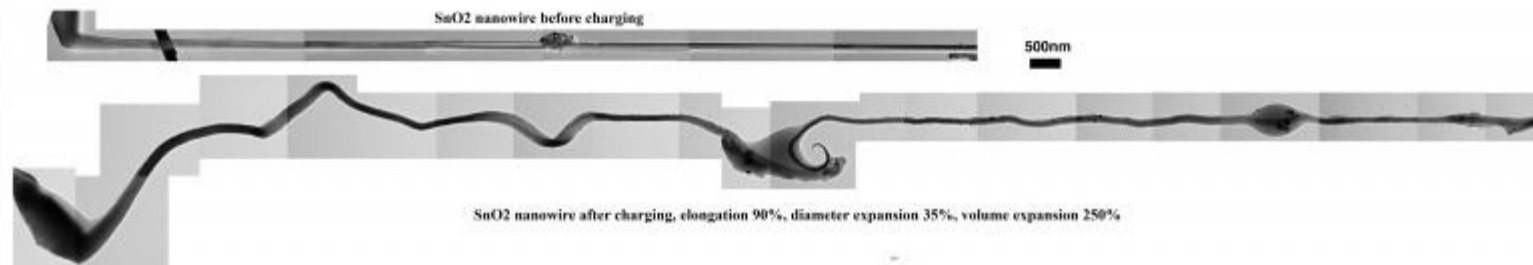
Batteries – who needs them!

- Portable devices
 - Cell phone/smart phone
 - Tablet, notebook and laptop computers
 - iPad/Pod, video games, GPS, digital cameras
 - Military, space, & espionage devices
 - Pacemakers, defibrillators, brain stimulators
- *Technologies which have enabled a dramatic change in culture!*
 - *But, the weak link in advancing consumer and business technologies – THE BATTERY!*



Batteries – Smallest

- Rechargeable, lithium-based battery
- Team at Sandia National Laboratories led by Jianyu Huang
 - Bulk lithium cobalt cathode three millimeters long,
 - an ionic liquid electrolyte,
 - anode a single tin oxide (SnO_2) nanowire 10 nanometers long and 100 nanometers in diameter
 - one seven-thousandth the thickness of a human hair.



Formerly unobserved increase in length and twist of the anode in a nanobattery (Image: DOE Center for Integrated Nanotechnologies)

<http://www.gizmag.com/worlds-smallest-battery-created/17237/>

Batteries – Biggest

- A rechargeable battery system, which at 2,000 square meters is bigger than a football field and weighs 1,300 tons, was manufactured by power components specialist ABB* to provide electricity to Fairbanks, Alaska's second-largest city, in the event of a blackout



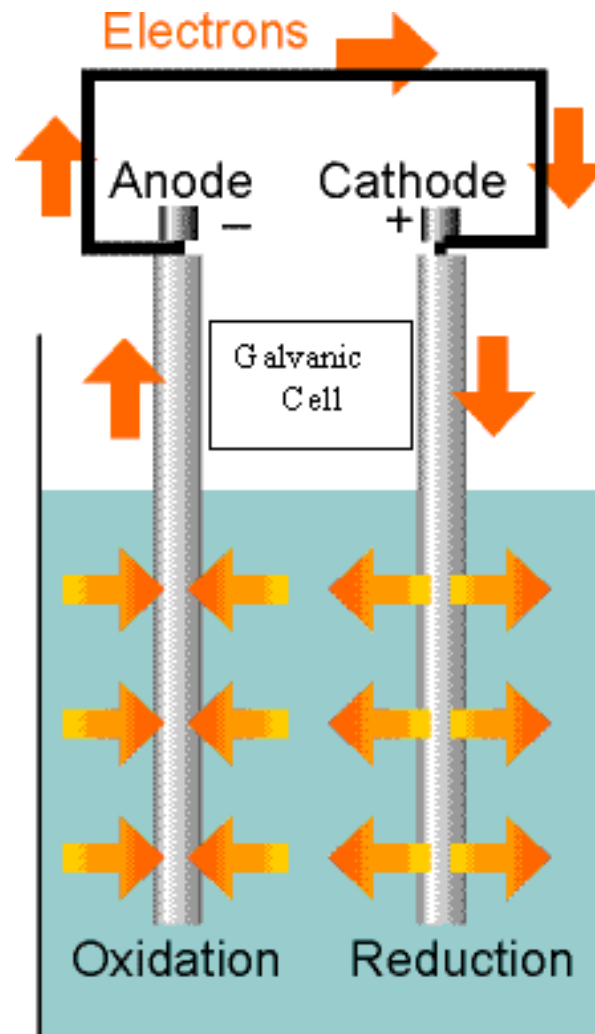
* ABB Asea Brown Boveri Ltd, Germany

Battery Basics

- Electrolytic cell or electrochemical cell
 - Device for the storage of electrical energy in the form of chemicals and for the re-conversion of these chemicals into direct current electricity; multiple cells make up a battery
- Composition
 - Liquid, paste, or solid electrolyte
 - The electrolyte is an ionic conductor
 - a positive electrode; and
 - a negative electrode
- Function
 - When the electrodes are connected to a device to be powered, called a load, an electrical current flows

Battery Basics

- Each electrode undergoes a half-cell reaction
- Voltage driving force
- Current is flow of electrons
- Negative electrode (Anode) undergoes oxidation
 - liberation of electrons
- Positive electrode (Cathode) undergoes reduction
 - uptake of electrons

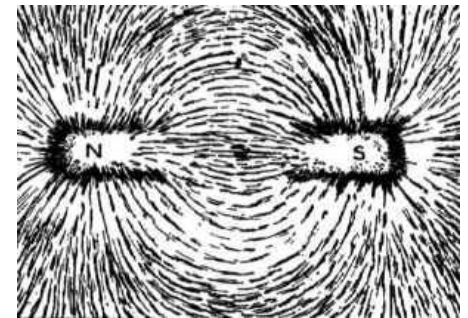


So how did electrical systems develop?

- Alien invasion
 - Area 51, Nasca Lines?
 - The Day the Earth Stood Still
 - Aliens developed electricity so they could turn it on and off!
- What did humans know about electricity and what did they invent before 1492?
 - Not as evident as weaponry, civil and mechanical inventions discussed in this class
 - Most technical texts on electricity start their history in the Renaissance
 - *In fact, magnetism and electricity was well known to inventors in Babylon, Alexandria, and Xian*

Magnetism

- Traditional story 4000 B.C.
 - Cretan shepherd named Magnes walking in a field, his sandals with iron nails become stuck to a stone
 - lodestone or magnetite, a natural magnetic material Fe_3O_4
 - Lodestone rich country near the town of Magnesia gave the name to magnetic materials
 - Mysterious force from iron, cobalt or nickel metal magnets

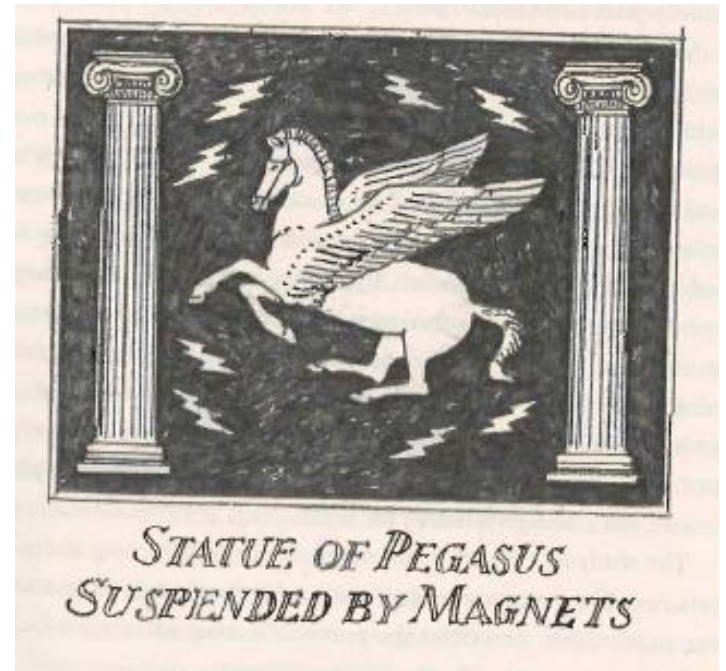


Magnetism and Greek Culture

- Thales of Miletus, famous ancient scientist in the sixth century BC, said the “*Magnet has life*”
- Plato talks about magnetic induction in 400 BC – magnet can give its power to other iron pieces, e.g. a ring of metal can be connected from one source magnet
- Lucretius – theory of atoms, emission of invisible particles, and understanding that electricity are related to magnetism but not the same

Magnetism and Greek Culture

- Image of the sun god hung suspended by magnets in the Temple of Serapis in Alexandria in 400BC.
- Anglo-Saxon monk Bede wrote that the horse of Bellerophon – Pegasus weighing 5000 lbs was levitated by the use of magnets in Rhodes



Schlesinger, The Battery

Magnetism and China

- Artificial magnets used for compass needles
 - needles were heated red hot, pointed north, and hammered by a craftsman
 - molecules to align in a north-south direction
 - the next myth busters experiment!
- Shih Huang Ti
 - burial site filled with treasures
 - protected by tomb doors which strongly attracted metal tools which might be used to break in

Evidence of Electricity

- Shock of torpedo fish and electric eels
- Fireflies and lightning bugs
- Lightning
- Static electricity

Amber

- Greek word for amber was “*elektron*” leading to electricity
- Fossil resin of pine trees becomes charged when rubbed by fur and can attract objects
 - Triboelectricity, when amber is rubbed by fur, the fur acquires electrons (- charge), amber loses electrons (+ charge)
- Amber was a precious item
- Location where the most amber was found in Greece was a mythological site where Phaethon was struck down by lightning

Baghdad (Babylon) Discovery

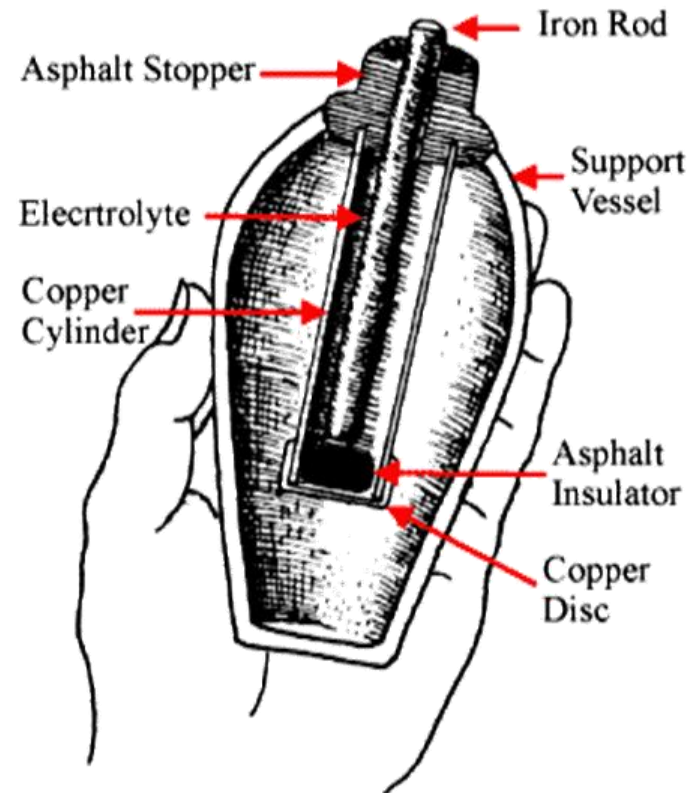
- An oval shaped, clay jar containing a copper tube, an iron rod, and asphalt
 - Discovery in 1936 in an ancient tomb uncovered during construction of a new railway at Khujut Rabu'
 - 60 miles south of Baghdad, the location in the ancient city of Babylon
 - Dated from the Parthian occupation between 248 BC and 226 AD.
 - Similar jars discovered in Ctesiphon



World-mysteries.com

Baghdad (Babylon) Discovery: *The “Specs”*

- 6-inch-high pot of bright yellow clay contained a cylinder of sheet-copper 5 inches by 1.5 inches.
- Copper cylinder was soldered with a 60-40 lead-tin alloy
- Bottom of the cylinder was capped with a crimped-in copper disk and sealed with bitumen or asphalt
- Another insulating layer of asphalt sealed the top and also held in place an iron rod suspended into the center of the copper cylinder.
- The rod showed evidence of having been corroded with an acidic agent



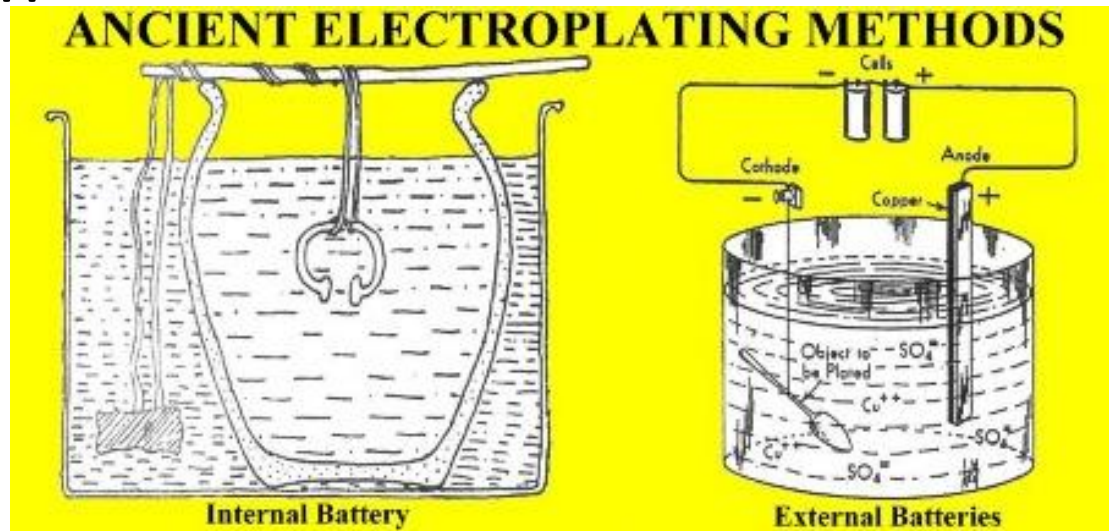
L. G. Janku

Baghdad (Babylon) Battery: *The First Electric Battery!*

- In 1938, Dr, Wilhelm Konig, an Austrian archaeologist working for the Iraq Museum in Baghdad studied the excavation. He recognized the find as a battery which was seconded by Walter Winton visiting physicist from London in 1967 who stated:
“Put some acid in the copper vessel... and you have a simple cell... I can’t see what else it would have been used for...”

Baghdad (Babylon) Battery: *What was the application?*

- Substitute for electric fish as an anesthetic (Keyser)
- Electroplating *Current from multiple cells jointed together sufficient for electroplating (Konig)*



<http://www.ancientskyscraper.com/322712.html>

Baghdad (Babylon) Battery: *The First Electric Battery!*

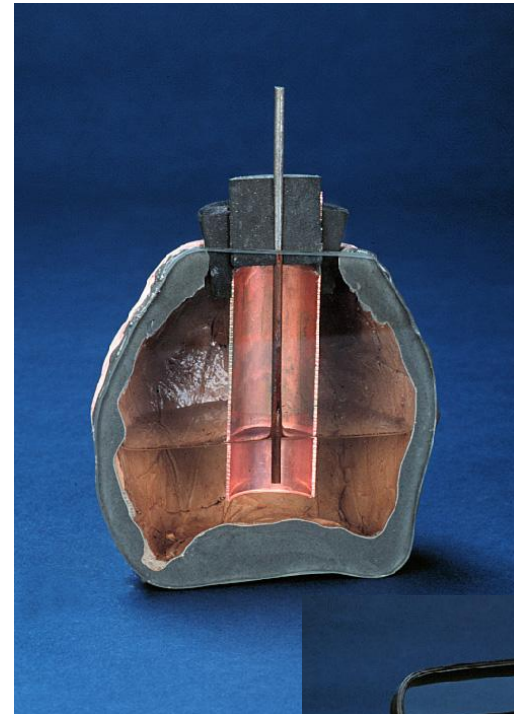
- Electroplating evidence
 - Copper vases plated with silver excavated from Sumerian sites date back to 2500 BC
 - In ancient Egypt, electroplated precious metals have been found
 - Similar method still used by local craftsman in Iraq
- *One of the most astounding discoveries in the archeology of science!... Or NOT?*

Baghdad Battery: *Or Not?*

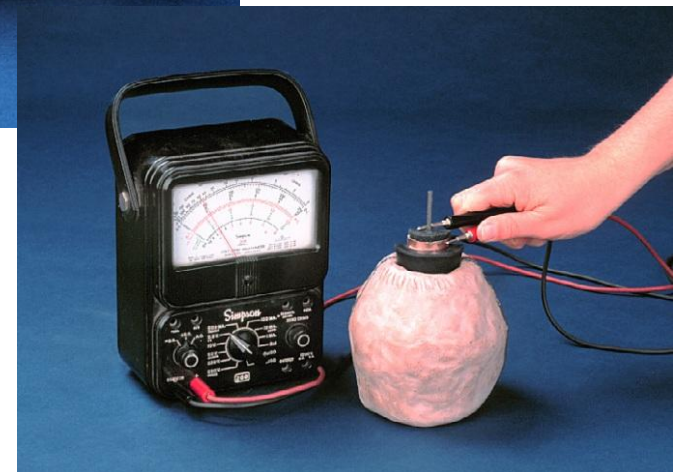
- The asphalt seal is a complete seal, so there would be no way of obtaining any electricity generated within the pot
- Similar objects from Seleucia were used for storing sacred papyri
- Absence of wires and the presence of bitumen insulators for the copper cylinder as the problem points of these so-called galvanic cells
- Electroplating could have been a firing process involving mercury called granulation
- The Parthian civilization was not particularly advanced

Baghdad (Babylon) Battery: *Construction*

- When constructed and filled with vinegar produces about 1.1 volt.
 - Crushed wine grapes? Fresh grape juice generated about 0.87V of electricity for gold plating a silver statue (Arne Eggebrecht, German Egyptologist)
- YouTube “How To...”
 - <http://www.youtube.com/watch?v=MIFZ4h4RUwE>



Smith College



Ancient Discoveries DVD



Summary

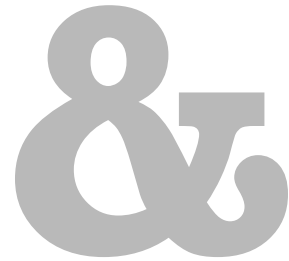
- Knowledge and application of magnetism and electricity occurred in ancient times
- Baghdad battery is an astounding scientific find of ancient times
- Batteries powering portable devices have led to a major cultural revolution in the world
- *Would you like to recreate ancient history by building a model of the Baghdad battery?*

Bibliography

- Ancient Inventions, P. James and N. Thorpe, Publisher: Ballantine Books (October 31, 1995) ISBN-10: 0345401026
- The Battery: how portable power sparked a technological revolution, Henry Schlesinger, Smithsonian Books, 2010, ISBN 978-0-06-144293-3

YouTube

- Older presentation
<http://www.youtube.com/watch?v=8Evm9hTWYxQ>
- Part of presentation (2:30 minutes)
http://www.youtube.com/watch?v=J1pYR_dyL1A
- Not battery, electroplater maybe
[http://www.youtube.com/watch?v=STNh9n1B44M\](http://www.youtube.com/watch?v=STNh9n1B44M)
- Electroplating tutorial
<http://www.youtube.com/watch?v=YvYCc8F-8rQ>



Questions

Comments

Discussion

Thank you!

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