Magnetism, Electricity, and

The Baghdad Battery

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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 (Sn02) nanowire 10 nanometers long and 100 nanometers in diameter
    • one seven-thousandth the thickness of a human hair.

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 Fe3O4
  – Lodestone rich country near the town of Magnesia gave the name to magnetic materials
  – Mysterious force from iron, cobalt or nickel metal magnets

http://howmagnetswork.com/history.html
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 craftsperson
  – 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 Phaethorn 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.
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 joined 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 craftsmen 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=MlFZ4h4RUwE
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

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\

• Electroplating tutorial
  http://www.youtube.com/watch?v=YvYCc8F-8rQ
Questions
Comments
Discussion
Thank you!

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