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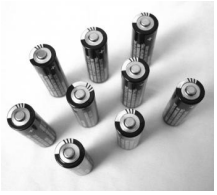
History of the Battery

From ancient Baghdad to modern rechargeable batteries



It took a long time for batteries to look like this
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The world we live in is pretty much based on electricity, most of the products we use/consume every day being manufactured with the help of electric current or powered by it. Furthermore, most of our portable devices contain miniature power supplies, capable of producing a relatively limited amount of current following a chemical reaction, but quite enough in order to allow the respective product to work for a certain period of time.

Yes, we're talking about batteries, those things that no gadget-wielding person could live without, which allow us to listen to music while on the go, work on computers wherever we might be, talk on our mobile phones... and much, much more. However, whenever we pick up a couple of AA's at our local grocery store, we don't really comprehend just how many years of work, research and development are behind those small, metallic products. Within this article, we'll try to shed some light on the battery's long history, as well as point out the main steps of the development of this concept. And our first stop in this journey is way back in time, around 2,000 years ago.

Ancient batteries or Baghdad batteries

Although you might find this pretty strange, the truth of the matter is that the earliest batteries were developed around two millenniums ago, in the ancient Mesopotamia. Unearthed back in 1936 somewhere near Baghdad, these "batteries" were nothing more than terracotta jars, each containing a rolled-up sheet of copper that housed an iron rod.

Scientists believe that, by adding a food acid (lemon juice, vinegar, etc.), which played the role of an electrolyte, these things were actually able to product electrical current. They've even constructed replicas of these ancient batteries, which are working quite well. Of course, since there are no documents or archaeological evidence regarding the possible uses of these "galvanic cells," their actual functional use still remains a mystery, with no resolution in sight.

Early developments - the 1700's

Electricity has been one of scientists' favorite "playgrounds" throughout the 1700's and the 1800's. So, it's no wonder that the term "battery" also emerged in this period, being used for the first time by Benjamin Franklin in order to describe a series of charged glass plates.

Another very important name from this period is that of Luigi Galvani, an Italian scientist who carried out extensive studies on electricity in general and "animal" electricity in particular. Between 1780 and 1786, he demonstrated the electrical basis of nerve impulses, his work becoming an inspiration for fellow scientists and even the official "father" of the battery, Volta.

World's first battery - the "Voltaic Pile" by Alessandro Volta

Alessandro Volta's work was carried out pretty much in the same time frame as that of Galvani. However, it was Volta that, back in 1800, created what would be later known as the world's first true battery, which was dubbed the "Voltaic Pile." The pile consisted of pairs of

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copper and zinc discs piled on top of each other, separated by a layer of cloth or cardboard covered in brine, which served as the electrolyte.

The main merit of the Voltaic pile was its being able to generate a continuous, stable current, at the same time retaining much of its charge in time. Unfortunately, the earliest Voltaic piles generated a very small amount of power, but things got better with the more evolved models.

The 19th century, an age of "cells" and experimentation

Daniell and Grove cells

After Volta's initial discovery, other scientists continued to study the concept behind batteries, achieving more or less notable results. One such person is John Frederic Daniell, who invented the Daniell cell, which consisted of a copper pot filled with a copper sulphate solution, in which was immersed an unglazed, porous earthenware container filled with sulphuric acid. Within this container was immersed a zinc electrode.

What made the Daniell cell so interesting was the fact that it was actually able to generate a 1.1-volt current that was more reliable and lasted longer than the one created by the Voltaic pile. This was possible due to the fact that the electrolyte deposited copper (a conductor) rather than hydrogen (an insulator) on the cathode. Furthermore, this cell was safer and significantly less corrosive than the Voltaic pile.

The next "cell" developed during this period was the Grove cell, introduced by William Robert Grove in 1844. This particular cell (actually, the world's first fuel cell) consisted of a zinc anode introduced in sulfuric acid and a platinum cathode introduced in nitric acid, both separated by porous earthenware. This setup allowed the Grove cell to develop nearly 2 volts and a pretty high current, but, at the same time, generated poisonous nitric oxide fumes when operated. Another major disadvantage of the Grove cell was that it recorded a sharp drop in voltage as the charge diminished. The Grove cell was used, for a period, by the American telegraph networks, but it was later on replaced by evolved versions, due exactly to the shortcomings listed above.

World's first rechargeable battery

One of the major drawbacks of all the "cells" and "piles" developed in the first half of the 19th century was that they had a limited lifetime and, once the chemical reactions powering them were depleted, the batteries would become permanently drained. However, things took a turn for the better in 1859, when Gaston Plante invented the lead-acid battery, the first battery capable of recharging itself when a reverse current was passed through it.

The lead-acid battery is formed of a lead anode and a lead oxide cathode, both of which are immersed in sulphuric acid. The electrodes react with the acid to produce lead sulfate. The reaction at the lead anode "generates" or "releases" electrons, while the reaction at the cathode consumes them, creating a difference in electric potential and, thus, a current. However, given their nature, these electrical reactions can actually be reversed when a reverse current is sent through them. This way, the battery is recharged, without requiring users to add supplementary compounds to the mix.

And if the processes described above seem somehow familiar, you should know that this is exactly the principle behind modern car batteries, which has suffered very few modifications over time (the chemical compounds used might have changed a bit, and the design of the

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cell itself has been seriously improved, but the basic way these things work is pretty much the same).

Plante's first battery was formed of lead sheets separated by rubber strips and rolled into a spiral. It was initially used to power the lights in train carriages while stopped at a station, and then, after being improved in the hands of Camille Alphonse Faure, in 1881, it became quite easy to mass produce and to use within various vehicles (mostly cars).

The gravity and Leclanche cells

The gravity cell was developed back in the 1860's by a scientist named Callaud and was actually a variant of the Daniell cell mentioned above. By removing the porous barrier, the whole system's internal resistance was seriously reduced, which meant that the output current was much stronger, compared to that generated by Daniell's cell. Due to the improvements mentioned above, this particular type of battery was used extensively by American and British telegraph networks, right up until the 1950's.

As the name says, the Leclanche cell was introduced back in 1866 by French scientist Georges Leclanche. This type of cell featured a zinc anode and a manganese dioxide cathode, both of which were surrounded by a porous material and then dipped in an ammonium chloride solution. The main advantage of this type of battery was that it provided a voltage of 1.4 to 1.6 volts, which helped it become quite popular within the areas of telegraphy, signaling and electric bell work.

The first zinc-carbon (dry) cell

While all of the battery cells developed earlier made extensive use of electrolytes, in 1887, Carl Gassner patented the zinc-carbon battery, which replaced the free liquid electrolyte with a mixture of ammonium chloride and Plaster of Paris. The manganese dioxide cathode was dipped in the resulting paste, and both were sealed in a zinc shell, which also acted as the anode.

The zinc-carbon design was later on improved by the National Carbon Company, which replaced the plaster of Paris with coiled cardboard, thus making the batteries smaller and easier to assemble. The result of this process was the Columbia dry cell, the first battery suitable to be used by large masses and that made portable electrical devices more practical.

The world's first alkaline battery

The first alkaline battery, which used a combination of nickel and cadmium electrodes, was introduced by Swedish scientist Waldmar Jungner back in 1899 (or 1900, depending on the particular source). It was a rechargeable battery and proved to be rather successful in Europe, but reached the US only after WWII, in 1946.

20th century - the modern age of batteries

Edison's Nickel-Iron battery

Besides the Ni-Cad battery mentioned above, Waldmar Jungner also created a nickel-iron battery, but since he deemed it to be inferior, he abandoned this design. However, the idea was picked up by none other than Thomas Alva Edison, who made a few adjustments and patented the design himself, in 1903. Edison hoped that Nickel-Iron cells would replace the

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lead-acid cells already used in the first cars. However, these cells provided pretty much the same level or reliability and autonomy as their lead-acid counterparts, so their scale of adoption was far inferior to what Edison expected.

The first 50 years of the 20th century

While the 19th century was all about steam power and electricity, the first half of the 20th century abandoned, to some extent, these concepts, and turned towards oil as the main area of interest. For this season, the developments in the area of batteries recorded over the first 50 years or so of the 20th century were rather negligible. Thus, several improvements over the previous solutions were developed (silver - zinc and Nickel - zinc batteries in 1927 and 1930, respectively), the most notable development being that of the mercury cell, introduced by Samuel Ruben and Philip Rogers Mallory back in 1942.

The battery is back - common alkaline battery

After the turmoil of WWII ended, researchers once again deemed the battery a worthy research subject. Thus, back in the 1950's, Lewis Urry, an engineer working for Eveready (now known as Energizer) developed a battery consisting of a manganese dioxide cathode and a powdered zinc anode with an alkaline electrolyte. These batteries hit the market in 1959, and proved to be quite a huge hit. The company Urry worked for, Eveready, also introduced a couple of other very useful batteries in the 1950's. For example, in 1956, it introduced the first 9-volt battery, followed by the first commercial watch battery in 1957 and the first rechargeable NiCd battery system in 1958.

The solar battery

In 1954, Gerald Pearson, Calvin Fuller and Daryl Chapin invented the first solar battery, which consisted of an array of several strips of silicon that was placed in sunlight and managed to capture free electrons and turn them into electrical current. The first public service trial of the Bell Solar Battery (Bell, because Bell Laboratories had funded the research) began with a telephone carrier system (Americus, Georgia) back in 1955.

Lithium, Lithium-Ion and Lithium-Polymer batteries

No history of the battery would be complete without mentioning what are, quite likely, the most popular types of batteries currently available on the market: Li, Li-Ion and Li-Polymer.

The first experiments regarding Li (lithium) batteries began way back, in 1912, under G.N. Lewis. However, the first commercial products of this type arrived just in the 1970's, with the first Li-Ion battery following in 1991. The Li-Ion batteries, developed by American chemist John B. Goodenough for Sony, were more stable than their lithium-only counterparts.

However, an even better Li-based design emerged in 1996, when Li-Polymer batteries were introduced. In their case, the electrolyte is stored in a solid polymer composite, with the

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electrodes and separators laminated to each other. This way, the form factor of a Li-Polymer battery can vary quite a lot, making it a prime choice for portable devices.

NiMH (nickel metal hydride) batteries

NiMH batteries were developed towards the end of the 1980's by Stanford R. Ovshinsky and represent a variant of the NiCd battery within which the cadmium electrode was replaced with one made of a hydrogen-absorbing alloy. The NiMH batteries last a lot longer than NiCd and are also a lot more eco-friendly, given the fact that, after all, Cadmium is a pretty toxic material.

Future developments

Although modern batteries have pretty much the same functioning principles as older batteries, by improving their chemical components, engineers from various companies have managed to pump a lot more functioning life into them. And this trend will most likely continue in the future, when batteries become a lot more important than they are today, especially since battery-powered electrical automobiles are regarded as one of the most important alternatives to today's fuel-powered (and polluting) cars. Also, fuel cells are gaining quite a momentum, which means that improved versions will be very popular as well.

As a conclusion, it's quite clear that, in some form or another, batteries are here to stay, and their role will be a lot more important in the future, as mankind focuses on cleaner, more eco-friendly ways of producing energy.

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