



The battery that changed the world

John B. Goodenough, M. Stanley Whittingham and Akira Yoshino are rewarded with the Nobel Prize in Chemistry 2019 for the development of the lithium-ion battery, the world's best rechargeable battery. It has provided the basis for wireless electronics and makes a fossil fuel-free world possible. The battery is now used to power mobile phones, laptops and electric vehicles, and to store energy from solar and wind power.

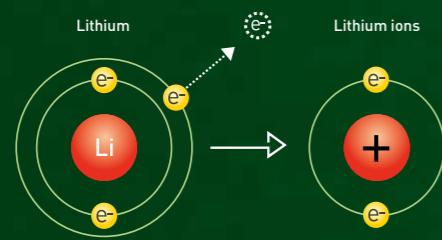
It has proven difficult to develop powerful rechargeable batteries. The foundation for lead batteries and alkaline batteries was laid back in the 19th century, but the research field then stood still for a long time, so it was a technological revolution when the first lithium-ion batteries entered the market in 1991.

One major advantage with the lithium-ion battery is that it is not based on chemical reactions that break down the electrodes and destroy the battery, but rather on lithium ions that flow backwards and forwards between the anode and cathode. These batteries can be charged hundreds of times before their performance declines.

Lithium is also the lightest metal and takes very little space, which is why lithium-ion batteries are lightweight despite having a high capacity and lasting many hours before needing to be recharged.

Lithium-ion batteries now power everything from mobile phones and laptops to hearing aids and pacemakers. They have enabled the development of long range electric vehicles and the storage of energy from renewable sources, such as solar and wind power. They contribute to a wireless and fossil fuel-free society, and are of the greatest benefit to humankind.

1	H		
3	Li	4	Be
11	Na	12	Mg
19	K	20	Ca
37	Rb	38	Sr
		21	Sc
		39	Y



An old element

The first lithium atoms were created shortly after the Big Bang. The element was discovered by Swedish chemists in 1817. Its name comes from the Greek word for stone, lithos, but it is the lightest metal despite its weighty name.

Lithium is reactive

Lithium has only one electron in its outer shell, which it happily releases. When this happens, a positively charged lithium ion is formed.

A 1976

Whittingham laid the foundation

In the 1970s, during the oil crisis, Stanley Whittingham worked on developing fossil fuel-free energy technology. He researched superconductors and discovered an extremely energy-rich material. From this, he created an innovative cathode in a lithium battery. It consisted of titanium disulphide which has spaces at the molecular level that can house - intercalate - lithium ions.

The battery literally had great potential, just over two volts, but the anode was partly metallic lithium, which is reactive and difficult to handle. The battery could even explode.

B 1980

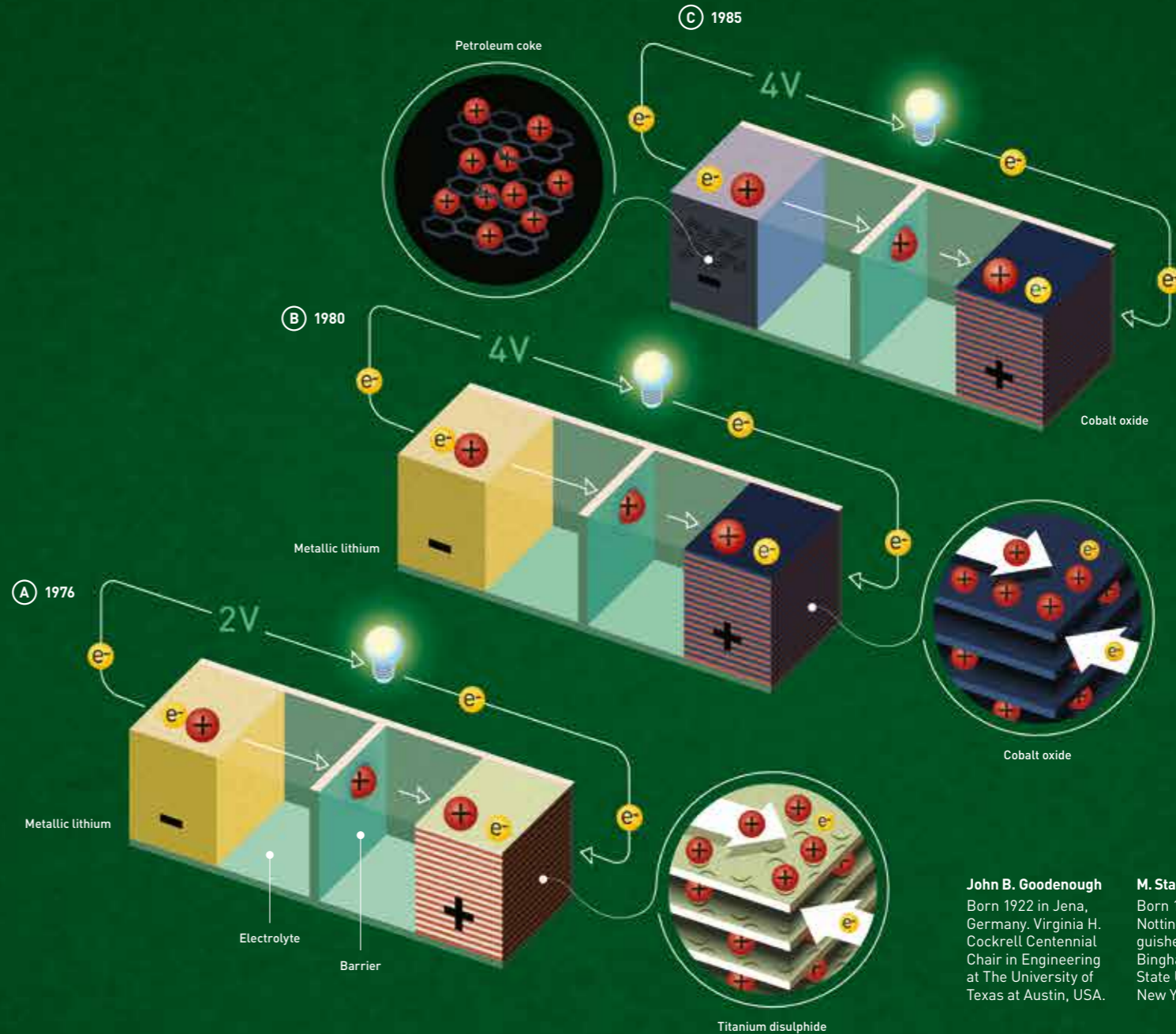
Goodenough makes the battery more powerful

Thanks to his specialist knowledge about the interior of matter, John Goodenough predicted that the cathode material would have an even higher potential if it was built using a metal oxide instead of titanium disulphide. After a systematic search, in 1980 he showed that cobalt oxide with intercalated lithium ions could provide a voltage as high as four volts. This breakthrough led towards lighter, more powerful batteries that can be used in mobiles and screwdrivers.

C 1985

Yoshino creates a sustainable battery

Akira Yoshino created the first commercially viable lithium-ion battery in 1985, using Goodenough's cathode as a basis. Instead of reactive lithium in the anode, he used petroleum coke, a carbon material which, like the cobalt oxide in the cathode, can intercalate lithium ions. The result was a light, sustainable battery. The first lithium-ion battery entered the market in 1991, which led to a technological revolution.



Li⁺ Lithium ion
e⁻ Electron

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