Clearly, the men and women who populate the history of science and engineering were all very intelligent and talented and they all made significant contributions to our understanding of the physical world. Choosing any one individual who stands out among such an illustrious group is a difficult task, but, if forced to do so, I would choose Michael Faraday, whose long career covered more than half of the 19th century.

To my knowledge, Faraday (1791-1866) is the only person for whom two physical units were named. One, the faraday or faraday constant is — per Encyclopedia Britannica — equal to the amount of electric charge that liberates one gram equivalent of any ion from an electrolytic solution. That is equal to the charge of Avogadro’s Number of electrons or roughly 96,485 coulombs. The unit was named the faraday in recognition of Faraday’s contributions to the science of electrolysis, which we will explore further in a bit.

The second unit named for Faraday is the farad, his name with the last two letters removed. Interestingly, the farad was proposed as a unit of charge in 1861, but was soon adopted for its current use, a unit of capacitance. By definition, a one farad capacitor charged to one volt will have, on each plate, one coulomb of charge, positive on one plate, negative on the other.

But enough about units. Let’s talk about the man. Michael Faraday was born on September 22, 1791, in the village of Newington, which is now a part of London, England. His father was a tradesman with poor health and rather limited income, so there was no money for tutors or private schools. Faraday learned the basics of reading, writing, and mathematics in a church school, but if he learned any science at all, it is likely that it was very basic. At that time, it was much more important to learn a trade so, at the age of 14, he was apprenticed to a bookbinder. This leads us to the first stage of his long and varied career.

The Bookbinder. In the 18th century, books were generally sold “in boards” which meant they were just loose paper or held together in some kind of temporary binding. These pages were then taken to a bookbinder who put them in a more permanent, secure binding. Located in central London, the Ribeau shop, where Faraday worked, received many new manuscripts to be bound as well as some classics for rebinding. Faraday was quick to observe that this river of knowledge flowing through the bindery would not be diminished if he took a few sips.

So, he started to read some of the books that he worked on binding. As he read, he took copious notes, creating his own collection of scientific knowledge and philosophy. He was educating himself.

As his interests expanded, Faraday learned about a series of scientific lectures being offered to the public at the Royal Institution of Great Britain. He attended these lectures by leading scientists including the great chemist, Sir Humphry Davy. Again, Faraday kept careful notes about all that he learned. Eventually, he dared to contact Davy and applied for a job. In 1812, Davy did science a great favor by hiring Faraday as a laboratory assistant, thereby beginning the next phase of Faraday’s career.
Faraday being Faraday, he didn’t stop there. He substituted an electromagnet for the bar magnet and got the same result. He then concluded that what induced the current was a changing magnetic field and recognized that he could change the field either by moving the electromagnet or by changing the current that energized the electromagnet (see image above). A further leap of reason and/or intuition led him to put two coils of wire on an iron ring, change the current in one, and observe a changing current in the other. He had invented the transformer. He also built rudimentary generators and motors, foreshadowing the practical use of electromagnetism.

The Chemist. The first decade of the 19th century was a time of great advances in the field of chemistry and Humphry Davy was at the center of the activity. By 1810, he had used the process of electrolysis to isolate several elements, thereby advancing the understanding of matter. After hiring Faraday in 1812, Davy continued his chemical investigations with Faraday’s assistance, with Faraday becoming increasingly capable of working independently. Electrolysis was of special interest to Faraday and he advanced both the theory and practice of the process. In 1834, he published a report on electrolysis, giving us the words electrode, electrolyte, cathode, anode, cation, and anion.

In addition to his experiments in basic chemistry, Faraday was also involved in various projects of an applied nature. For instance, a major problem for the Royal Navy was “bottom fouling” wherein marine plants and animals attacked or attached themselves to the hulls of ships, drastically reducing their speed and maneuverability. To combat this, ship’s hulls were lined with sheet copper, but the copper soon corroded and made another kind of mess. Davy and Faraday were enlisted to solve this problem. They were partially successful, and the Royal Navy sailed royally on.

Faraday’s interests continued to broaden. In 1821, he was asked to review the work of Hans Christian Oersted and he added studies in physics to his considerable accomplishments in chemistry.

The Physicist. Ever since the 1800 invention of the voltaic pile — what we now call a battery — scientists had been looking for a connection between electricity and magnetism. Finally, in 1821, Oersted, a Danish physicist, observed that a current-carrying wire would cause a magnetic compass to deflect. He had discovered electromagnetism. Upon reading Oersted’s description of his discovery, Faraday immediately repeated the experiment and, in short order, conducted other experiments that advanced the theory of electromagnetism. I can imagine him asking, “If an electric current can cause a magnet to move, might not a moving magnet cause an electric current?” He answered his question by plunging a magnet into a coil of wire and observing the deflection of a galvanometer. He had discovered electromagnetic induction.

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