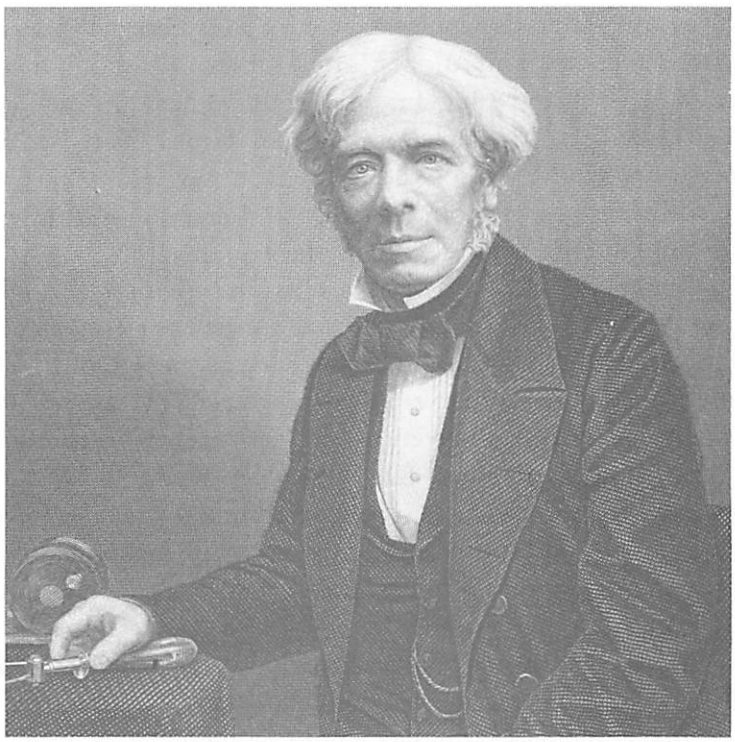

23 MICHAEL FARADAY

1791-1867

This is the age of electricity. It is true that our era is sometimes called the space age and sometimes called the atomic age; however, space travel and atomic weapons, whatever their potential importance, have relatively little impact upon our everyday lives. But we use electrical devices constantly. In fact, it seems safe to say that no technological feature so completely permeates the modern world as does the use of electricity.

Many men have contributed to our mastery of electricity:

Charles Augustine de Coulomb, Count Alessandro Volta, Hans Christian Oersted, and André Marie Ampère are among the most important. But towering far above the others are two great British scientists, Michael Faraday and James Clerk Maxwell. Though the work of the two men was in part complementary, they were in no sense collaborators, and each man's individual achievements entitle him to a high place on this list.

Michael Faraday was born in 1791, in Newington, England. He came from a poor family and was largely self-educated. Apprenticed to a bookbinder and bookseller at the age of fourteen, he used the opportunity to read extensively. When he was twenty, he attended lectures given by the famous British scientist, Sir Humphry Davy, and was fascinated. He wrote to Davy, and eventually got a job as his assistant. Within a few years, Faraday was making important discoveries of his own. Although he lacked a good background in mathematics, as an experimental physicist he was unsurpassed.

Faraday's first important innovation in electricity was made in 1821. Two years earlier, Oersted had found that the needle of an ordinary magnetic compass would be deflected if an electric current flowed in a nearby wire. This suggested to Faraday that if the magnet were to be held fixed, the wire might move instead. Working on this hunch, he succeeded in constructing an ingenious device, in which a wire would rotate continuously in the vicinity of a magnet as long as an electric current flowed through the wire. In fact, what Faraday had invented was the first electric motor, the first device to use an electric current to make a material object move. Primitive as it was, Faraday's invention was the ancestor of all the electric motors in use in the world today.

This was a tremendous breakthrough. However, its practical usefulness was limited, as long as there was no method of generating electric currents other than the primitive chemical batteries of the day. Faraday was convinced that there must be some way of using magnetism to generate electricity, and he kept looking for such a method. Now, a stationary magnet will *not* in-

duce an electric current in a nearby wire. But in 1831, Faraday discovered that if a magnet is passed through a closed loop of wire, a current will flow in the wire *while the magnet is moving.* This effect is called electromagnetic induction, and the discovery of the law governing it ("Faraday's law") is generally considered to be Faraday's greatest single achievement.

This was a monumental discovery, for two reasons. First, Faraday's law is of fundamental importance in our theoretical understanding of electromagnetism. Second, electromagnetic induction can be used to generate continuous electric currents, as Faraday himself demonstrated by building the first electric dynamo. Although the modern electric generators that supply power to our cities and factories are far more sophisticated than Faraday's device, they are all based on the same principle of electromagnetic induction.

Faraday also made contributions to the field of chemistry. He devised methods for liquefying gases, and he discovered various chemical substances, including benzene. Of greater importance is his work in electrochemistry (the study of chemical effects of electric currents). Faraday's careful experiments established the two laws of electrolysis which are named after him, and which form the foundations of electrochemistry. He also popularized much of the important terminology used in that field, such as anode, cathode, electrode, and ion.

It was Faraday who introduced into physics the important idea of magnetic lines of force and electric lines of force. By emphasizing not the magnets themselves but rather the *field* between them, he helped prepare the way for many advances in modern physics, including Maxwell's equations. Faraday also discovered that if polarized light is passed through a magnetic field, its polarization will be altered. This discovery is significant, because it was the first indication that there is a relationship between light and magnetism.

Faraday was not only brilliant, but also handsome, and he was a very popular lecturer on science. Nevertheless, he was modest and singularly indifferent to fame, money, and honors.

He declined a knighthood, and also declined an offer to become president of the British Royal Society. He had a long, happy marriage, but no children. He died in 1867, near London.

Faraday lectures at the Royal Institution on December 27, 1855.