

Michael Faraday

with a few things on the road until the party should get to Paris, doing those things which could not be trusted to strangers or waiters." At Paris he would "get a servant." But at Paris no servant was to be got, and so Faraday, out of gratitude to his patron, continued on in the anomalous position of being partly his patron's assistant in scientific work, partly his body servant. All this to a man of Faraday's humility of disposition and sensible understanding would have been natural and easy enough had it not been for the slights put upon him by Lady Davy. Unfortunately Lady Davy was a woman who could not recognize that genius and ability have rights which even money and social position must not ignore.

"The constant presence of Sir Humphry Davy," wrote Faraday to a friend, "is a mine inexhaustible of knowledge and improvement." But he added: "I have several times been more than half decided to return hastily home; but second thoughts have still induced me to try what the future may produce. The glorious opportunities I enjoy of improving in the knowledge of chemistry and the sciences continually determine me to finish this voyage with Sir Humphry Davy. But if I wish to enjoy these advantages I have to sacrifice much; and though these sacrifices are such as an humble man would not feel, yet I cannot quietly make them." And again: "Sir Humphry Davy has at all times endeavored to keep me from the performance of those things which did not form a part of my duty, and which might be disagreeable. I should have little to complain of were I traveling with Sir Humphry alone, or were Lady Davy like him."

Such was the unworthy treatment which social presumption and an undiscerning, unfeeling mind put upon one of the purest souls and most gifted intellects then living. But Faraday gained much from this "voyage," which lasted nearly two years, or until April, 1815. He was a

constant companion to Davy during the entire time Sir Humphry was engaged on the solution of a number of problems, several of which were difficult enough to add even to his already world-wide fame. Indeed, Faraday was a witness of the solutions of these problems during the whole process of their development from embryonic germ-thoughts to full fruition. No small opportunity of education, this alone! Again, in Davy's company he met the foremost men of science in France, Italy, and Switzerland, and got in touch with what they were doing to extend the boundaries of scientific knowledge. Among others he met the aged Volta, the discoverer of the "Voltaic pile," the founder of the modern science of chemical electricity, whose work he himself was destined to do so much towards extending and making more important. And when he returned to England it was with the authoritative reputation of being a "rising man." He was at once taken on again at the Royal Institution; and, although his position was not much improved, there was some improvement in it. Besides being reappointed to his old post of assistant in the laboratory he was made superintendent of apparatus. But his salary was only 30 shillings (\$7.50!) a week, with apartments in the building.

Faraday's beginning at the Royal Institution was humble enough. The position which Davy's interest had first secured for him was only that of a menial assistant—bottle-washer, bulb-blower, etc. And when he returned to the institution after his two years of travel with Davy he was not relieved from menial drudgery even then. But his abilities were not long in manifesting themselves, and his promotion soon became rapid. In the year 1816 (one year after his return) he was chosen to deliver a course

of lectures on the general properties of matter at the City Philosophical Society—his first engagement as a lecturer. In the same year he began to publish results of experimental researches in the scientific journals of the day. In the year 1821, when he was but thirty years of age, he made his first discovery in the relationship between magnetism and electricity, showing that magnetic currents tend to move round and round each other in circles at right angles to each other. In 1825, twelve years from the time he had entered the Royal Institution as assistant, he was made director of the laboratory, the position that Davy had held. In 1829 he became for a time a lecturer at the Royal Military Academy at Woolwich. In 1831, after seven years of thought and experimenting, he completed those researches into the properties of magnetism and electricity by which he became the founder of the modern science of magneto-electricity. The publication of these researches placed Faraday foremost in the ranks of physicists throughout the world. In 1833 he was appointed to the newly established Fullarian professorship of chemistry in the Royal Institution, a position which he was to hold for life without the obligation of delivering lectures. The year previous the University of Oxford had bestowed upon him the honorary degree of D. C. L., a magnificent tribute from the most conservative degree-conferring institution in the world to the splendid position held in the realm of science by the quondam bookbinder's apprentice, whose only education had been what he could pick up by himself nights and mornings. Two years later the queen bestowed upon him a pension of £300 (\$1,500) a year. Thus, successful, honored, respected, loved, and free from all pecuniary anxiety, he

lived his life to the end, devoting it wholly to the studies which he loved so well, and which he was so splendid an instrument in advancing. In the same Institution that has been the scene of his labors at the first he remained to the last. He had entered it in 1813. His connection with it was severed only by his death. The period of his service was fifty-four years, although during the last two years of his life, owing to failing powers, he was relieved from all actual service. He died August 21, 1867.

It is impossible here to do more than faintly indicate the greatness of Faraday's genius in the realm of physical science. He had always been an original investigator. Even as a boy, with a pile battery of copper pennies and bits of zinc, he had decomposed sulphate of magnesia. He had not long been working with Davy before he had repeated all Davy's wonderful chemical investigations and had extended them. But it is as an investigator of magnetism and electricity that Faraday is most distinguished. These sciences may be said to have taken their final shape in his hands. A favorite theory with him, one at that time new to the world, though now admitted by every one, was that heat, light, chemical affinity, electricity, and magnetism, are all so many different phases of one indestructible force—a force which when lost to view in one phase instantly reappears in another. This belief was the pole star by which he directed his course in all his investigations and by which he was led to most of his brilliant results. One aspect of the theory he was able himself to establish. He proved the complete identity of all the different sorts of electricity—frictional, chemical, magnetic, etc. He also went a long way toward proving the interchangeableness of chemical affinity and

electric force. These were, of course, among the titles to his more strictly scientific reputation. But Faraday had a reputation that was equally distinguished, though not of such scientific import. Like Davy, he became the most popular lecturer on scientific subjects of his day. Though by the terms of his professorship he was not obliged to lecture, yet he often did lecture, and his lectures at the Royal Institution on Friday evenings always drew crowds. He had all of Davy's brilliancy of conception in experimental illustration, and more than Davy's facility of manipulation. His especial delight was the making common things the basis of his scientific instruction. No courses of lectures ever delivered have been more popular, or more profoundly influential in enabling ordinary people to understand the laws of nature, than his lectures on "*The Chemistry of a Candle*." And these lectures when published have been almost as popular and influential in book form as when they were the subject of spoken utterance.

MICHAEL FARADAY

SELECTED STUDIES AND REMINISCENCES

FARADAY'S EARLY LIFE AND EFFORTS AT SELF-EDUCATION

The home of Michael Faraday was in Jacob's Well Mews from the time he was five years old until he went to Blandford Street. Very little is known of his life during these eight years. He himself says, "My education was of the most ordinary description, consisting of little more than the rudiments of reading, writing, and arithmetic at a common day-school. My hours out of school were passed at home and in the streets."

Only a few yards from Jacob's Well Mews is a bookseller's shop, at No. 2 Blandford Street.

There Faraday went as errand boy, on trial for a year, to Mr. George Riebau, in 1804. He has spoken with much feeling "that it was his duty, when he first went, to carry round the papers that were lent out by his master. Often on a Sunday morning he got up early and took them round, and then he had to call for them again; and frequently, when he was told the paper was not done with, 'You must call again,' he would beg to be allowed to have it; for his next place might be a mile off, and then he would have to return back over the ground

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1791-1867

BIOGRAPHICAL STUDY

BY JOHN EBENEZER BRYANT, M. A.

Faraday is the scientist whose name and memory the world especially delights to honor. His life had such a humble beginning. It was advanced by such laudable and honorable means. It was distinguished by such splendid achievements, by such long-continued and ennobling success. It was pursued with such singlemindedness of purpose, such patient industry, such skill and fertility of resource in the use of simple means to accomplish wished-for ends. His character, too, was so essentially noble and sincere. His sense of right and wrong, of duty and justice and truth, was so impersonal, so unconsciously set to standards acknowledged as divine. In his whole career there was so much to love, so much to admire, so much for humanity to be proud of. Little wonder that his name and memory are held in honor.

Michael Faraday was born in Newington, in the Surrey side of London, September 22, 1791. His father was a journeyman blacksmith, whose delicate health made it

difficult for him to earn sufficient to support his family. But he was an honest-minded and sincerely religious man, who according to the scriptural injunction, "brought up his children in the way they should go;" and though he belonged to one of the smallest and most isolated sects of the time he had the gratification of seeing his son, even after he had become famous, remaining firm in the faith of his youth, and even taking upon himself the duties of "elder" in the humble congregation he worshiped with. Michael Faraday as a boy had little formal education. He learned to read and write and "cipher"—that was all. In his thirteenth year he became an errand boy to a bookseller and bookbinder, whose shop was near his home. But at the end of a year he was received by his employer as a duly bound apprentice to the bookselling and bookbinding trade—the premium usual to be paid upon such an engagement being remitted by the master because of the "faithful service" which his young apprentice had rendered him as errand-boy.

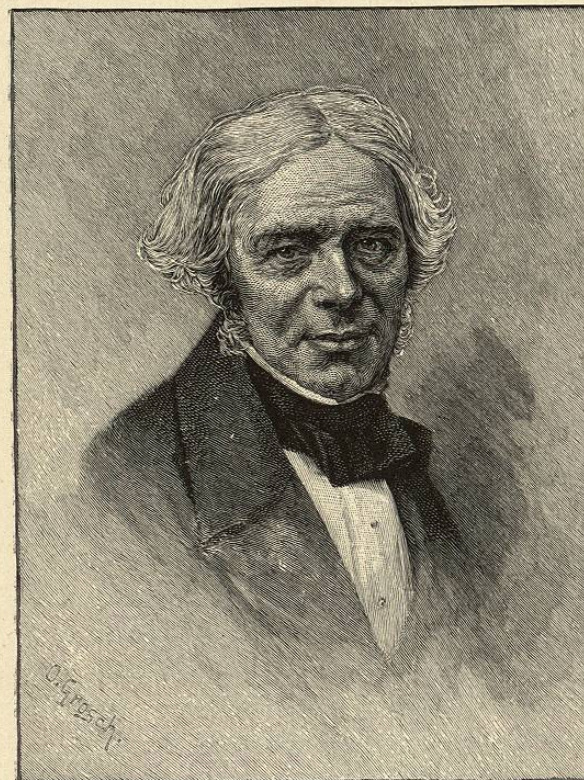
This apprenticeship was Faraday's real schooling. In the front shop he had access to many books, and his mind came in contact with the new ideas of the age. In the back shop he was trained to the use of tools and to transform by his own hands raw materials of various sorts into articles of use and beauty. He began immediately to apply himself sedulously to self-improvement. Almost from the very beginning his mind evinced its natural bent, and found its chief interest in those very subjects of nature-study which were destined to employ and make illustrious his maturer powers. In the bookshop were works on chemistry and electricity—both sciences at that time being new and but little understood depart-

ments of knowledge. These works, by the instinct of genius, young Faraday at once picked out and began to make his own. He devised simple apparatus and performed for himself the experiments which these works described. He persuaded his elder brother to purchase for him a ticket of admission to some lectures on natural philosophy which were being given in a private house in the neighborhood. He made notebooks for himself, and in these he wrote out abstracts of what he read in his books and of what he heard in the lectures. He saved a few shillings and took lessons in drawing so that he might make diagrams in his notebooks illustrative of his work. Then, as he grew older and became more skillful in the use of tools, he contrived apparatus of greater and greater difficulty. Finally he made an electrical machine, and made it so well—turned it out such a workmanlike piece of mechanism—that his employer became proud of him and used to introduce him to his customers and show off the machine to them as a specimen of his apprentice's cleverness. Finally, one of these customers to whom young Faraday was introduced in this way, a Mr. Dance—his name should be held in honor—was so much pleased with him, and with his intelligence, and with the evidences of his interest in science which his well-made apparatus and well-kept notebooks showed, that he presented him with tickets to the concluding lectures which Sir Humphry Davy was just then giving at the Royal Institution.

Faraday's privilege to attend these lectures of Sir Humphry Davy was the great opportunity of his life. Davy was the foremost man of science then living. But as a lecturer he was even more famous than as an original

discoverer. And as a lecturer he was not more noted for the beauty, brilliancy, and easy simplicity of his experiments, than for the enthusiasm for science with which he inspired his auditors and spectators. Faraday heard the lectures, and witnessed the dazzling experiments with which they were accompanied, enraptured. But his delight did not deter him from putting forth all his efforts to obtain the utmost possible advantage from them. He took full notes of the lectures. He afterward wrote his notes out carefully in a book—his memory aiding him to make almost verbatim reports of the distinguished lecturer's utterances. He embellished what he wrote with well-drawn illustrations of the apparatus used in the experiments. Then he added many observations and reflections of his own. Afterward, by the suggestion of Mr. Dance, he sent his book to Sir Humphry Davy. At the same time he accompanied it by a statement to the effect that he "desired to escape from trade and enter the service of science," and he expressed the hope that "if opportunity offered" Sir Humphry "might favor his views." Davy, to use the words of his own letter of reply, was "far from being displeased with the proof" which Faraday had given him of his interest in science. "It displays," he said, "great zeal, power of memory, and attention." He invited Faraday to come to see him, and in the end recommended the young enthusiast to the managers of the Royal Institution as assistant in the laboratory. This was in March, 1813, when Faraday was in his twenty-second year.

To those who do not know how hard—how almost impossible—it was, at the time of which we are writing, for a boy or young man to get on in the world unless he had



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friends to help him and money to pay for his instruction and his promotion, it may seem that the self-improvement that Faraday accomplished as above outlined was not extraordinary. But it must be remembered that in those days books were few and very high-priced. All apparatus for scientific experiments was elaborately made and very expensive. The wages of apprentices like Faraday were not more than enough for food and clothing. The hours they had to work were long and laboriously occupied. Fees for such lectures as those of the Royal Institution were utterly beyond their reach. But more than anything else as a deterrent was the feeling then prevalent that people in Faraday's position, humbly born and poor, had no right to hope or to wish to fill any other positions than those they were born into. Faraday had soon to prove by bitter experience how strong an element in the social relationships of life this feeling was. Not long before the date of Faraday's engagement at the Royal Institution Sir Humphry Davy had married—a "rich and handsome widow." Not long after Faraday's engagement had begun, Davy, having resigned his position as professor at the Institution, determined to set out, accompanied by Lady Davy, upon a long tour on the continent. As, however, Sir Humphry had discovered Faraday's worth, he wished to take Faraday with him as an assistant. Faraday on his part wished very much to go. Davy then applied to the managers of the Institution for leave of absence for Faraday, and the matter was arranged. But at the last moment, when the party was just ready to start, Davy's valet refused to go away from home, being afraid of Napoleon! Davy now asked Faraday if in the meantime "he would put up