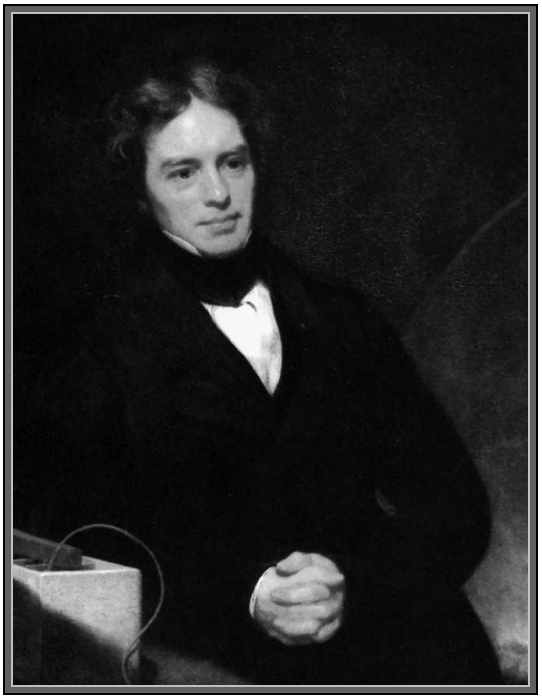
FARADAY AS A DISCOVERER

[Illustrated & Biography Added]



By

John Tyndall

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ABOUT THE AUTHOR

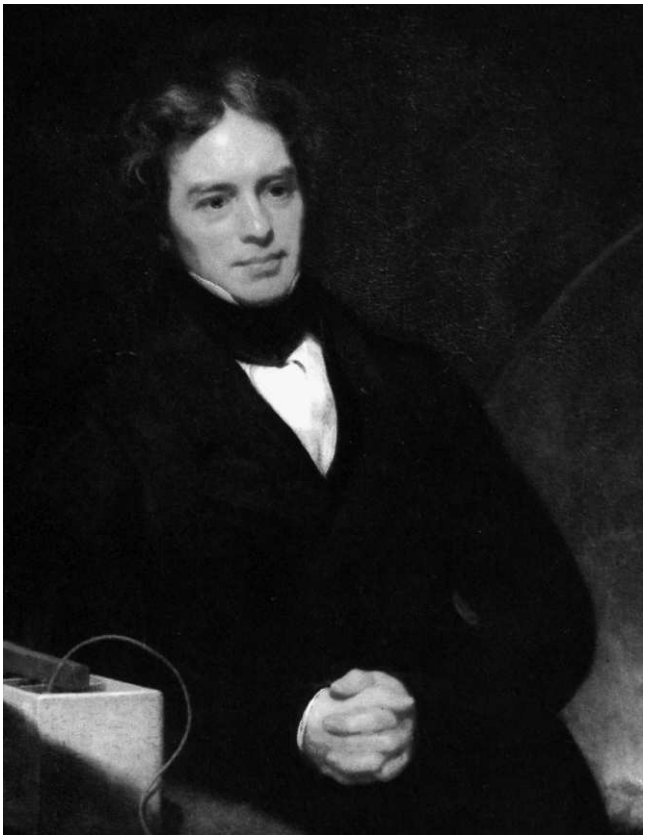
John Tyndall (1820 – 1893) was a prominent 19th-century Irish physicist. His initial scientific fame arose in the 1850s from his study of diamagnetism. Later he made discoveries in the realms of infrared radiation and the physical properties of air. Tyndall also published more than a dozen science books which brought state-of-the-art 19th century experimental physics to a wide audience. From 1853 to 1887 he was professor of physics at the Royal Institution of Great Britain in London.

Tyndall was born in Leighlinbridge, County Carlow, Ireland. His father was a local police constable, descended from Gloucestershire emigrants who settled in southeast Ireland around 1670. Tyndall attended the local schools in County Carlow until his late teens, and was probably an assistant teacher near the end of his time there. Subjects learned at school notably included technical drawing and mathematics with some applications of those subjects to land surveying. He was hired as a draftsman by the Ordnance Survey of Ireland in his late teens in 1839, and moved to work for the Ordnance Survey for Great Britain in 1842. In the decade of the 1840s, a railroad-building boom was in progress, and Tyndall's land surveying experience was valuable and in demand by the railway companies. Between 1844 and 1847, he was lucratively employed in railway construction planning.

In 1847 Tyndall opted to become a mathematics and surveying teacher at a boarding school (Queenwood College) in Hampshire. Recalling this decision later, he wrote: "the desire to grow intellectually did not forsake me; and, when railway work slackened, I accepted in 1847 a post as master in Queenwood College." Another recently arrived young teacher at Queenwood was Edward Frankland, who had previously worked as a chemical laboratory assistant for the British Geological Survey. Frankland and Tyndall became good friends. On the strength of Frankland's prior knowledge, they decided to go to Germany to further their education in science. Among other things, Frankland knew that certain German universities were ahead of any in Britain in experimental chemistry and physics. (British universities were still focused on classics and mathematics and not laboratory science.) The pair moved to Germany in summer 1848 and enrolled at the University of Marburg, where Robert Bunsen was an influential teacher. Tyndall studied under Bunsen for two years. Perhaps more influential for Tyndall at Marburg was Professor Hermann Knoblauch, with whom Tyndall maintained communications by letter for many years afterwards. Tyndall's Marburg dissertation

was a mathematical analysis of screw surfaces in 1850 (under Friedrich Ludwig Stegmann). He stayed at Marburg for a further year doing research on magnetism with Knoblauch, including some months' visit at the Berlin laboratory of Knoblauch's main teacher, Heinrich Gustav Magnus. It is clear today that Bunsen and Magnus were among the very best experimental science instructors of the era. Thus, when Tyndall returned to live in England in summer 1851, he probably had as good an education in experimental science as anyone in England.

ABOUT THE BOOK & FARADAY



Michael Faraday (1791 –1867) was an English scientist who contributed to the fields of electromagnetism and electrochemistry. His main discoveries include those of electromagnetic induction, diamagnetism and electrolysis.

Although Faraday received little formal education, he was one of the most influential scientists in history. It was by his research on the magnetic field around a conductor carrying a direct current that Faraday established the basis for the concept of the electromagnetic field in physics. Faraday also established that magnetism could affect rays of light and that there was an underlying relationship between the two phenomena. He similarly discovered the principle of electromagnetic induction, diamagnetism, and the laws of electrolysis. His inventions of electromagnetic rotary devices formed the foundation of electric motor technology, and it was largely due to his efforts that electricity became practical for use in technology.

As a chemist, Faraday discovered benzene, investigated the clathrate hydrate of chlorine, invented an early form of the Bunsen burner and the system ofoxidation numbers, and popularised terminology such as anode, cathode, electrode, and ion. Faraday ultimately became the first and foremost Fullerian Professor of Chemistry at the Royal Institution of Great Britain, a lifetime position.

Faraday was an excellent experimentalist who conveyed his ideas in clear and simple language; his mathematical abilities, however, did not extend as far as trigonometry or any but the simplest algebra. James Clerk Maxwell took the work of Faraday and others, and summarized it in a set of equations that is accepted as the basis of all modern theories of electromagnetic phenomena. On Faraday's uses of the lines of force, Maxwell wrote that they show Faraday "to have been in reality a mathematician of a very high order – one from whom the mathe-

maticians of the future may derive valuable and fertile methods." The SI unit of capacitance is named in his honour: the farad.

Albert Einstein kept a picture of Faraday on his study wall, alongside pictures of Isaac Newton and James Clerk Maxwell. Physicist Ernest Rutherford stated; "When we consider the magnitude and extent of his discoveries and their influence on the progress of science and of industry, there is no honour too great to pay to the memory of Faraday, one of the greatest scientific discoverers of all time".

FARADAY AS A DISCOVERER

By

John Tyndall

Preface to the fifth edition.

Daily and weekly, from all parts of the world, I receive publications bearing upon the practical applications of electricity. This great movement, the ultimate outcome of which is not to be foreseen, had its origin in the discoveries made by Michael Faraday, sixty-two years ago. From these discoveries have sprung applications of the telephone order, together with various forms of the electric telegraph. From them have sprung the extraordinary advances made in electrical illumination. Faraday could have had but an imperfect notion of the expansions of which his discoveries were capable. Still he had a vivid and strong imagination, and I do not doubt that he saw possibilities which did not disclose themselves to the general scientific mind. He knew that his discoveries had their practical side, but he steadfastly resisted the seductions of this side, applying himself to the development of principles; being well aware that the practical question would receive due development hereafter.

During my sojourn in Switzerland this year, I read through the proofs of this new edition, and by my reading was confirmed in the conviction that the book ought not to be suffered to go out of print. The memoir was written under great pressure, but I am not ashamed of it as it stands. Glimpses of Faraday's character and gleams of his

discoveries are there to be found which will be of interest to humanity to the end of time.

John Tyndall. Hind Head, December, 1893.

[Note.—It was, I believe, my husband's intention to substitute this Preface, written a few days before his death, for all former Prefaces. As, however, he had not the opportunity of revising the old prefatory pages himself, they have been allowed to remain just as they stood in the last edition.

Louisa C. Tyndall.]

Preface to the fourth edition.

When consulted a short time ago as to the republication of 'Faraday as a Discoverer,' it seemed to me that the labours, and points of character, of so great a worker and so good a man should not be allowed to vanish from the public eye. I therefore willingly fell in with the proposal of my Publishers to issue a new edition of the little book.

Royal Institution, February, 1884.

Preface to the second edition.

The experimental researches of Faraday are so voluminous, their descriptions are so detailed, and their wealth of illustration is so great, as to render it a heavy labour to master them. The multiplication of proofs, necessary and interesting when the new truths had to be established, are however less needful now when these truths have become household words in science. I have therefore tried in the following pages to compress the body, without injury to the spirit, of these imperishable investigations, and to present them in a form which should be convenient and useful to the student of the present day.

While I write, the volumes of the Life of Faraday by Dr. Bence Jones have reached my hands. To them the reader must refer for an account of Faraday's private relations. A hasty glance at the work shows me that the reverent devotion of the biographer has turned to admirable account the materials at his command.

The work of Dr. Bence Jones enables me to correct a statement regarding Wollaston's and Faraday's respective relations to the discovery of Magnetic Rotation. Wollaston's idea was to make the wire carrying a current rotate round its own axis: an idea afterwards realised by the celebrated Ampere. Faraday's discovery was to make the wire carrying the current revolve round the pole of a magnet and the reverse.

John Tyndall. Royal Institution: December, 1869.

Chapter 1.

Parentage: introduction to the royal institution: earliest experiments: first royal society paper: marriage.

It has been thought desirable to give you and the world some image of MICHAEL FARADAY, as a scientific investigator and discoverer. The attempt to respond to this desire has been to me a labour of difficulty, if also a labour of love. For however well acquainted I may be with the researches and discoveries of that great master—however numerous the illustrations which occur to me of the loftiness of Faraday's character and the beauty of his life—still to grasp him and his researches as a whole; to seize upon the ideas which guided him, and connected them; to gain entrance into that strong and active brain, and read from it the riddle of the world—this is a work not easy of performance, and all but impossible amid the distraction of duties of another kind. That I should at one period or another speak to you regarding Faraday and his work is natural, if not inevitable; but I did not expect to be called upon to speak so soon. Still the bare suggestion that this is the fit and proper time for speech sent me immediately to my task: from it I have returned with such results as I could gather, and also with the wish that those results were more worthy than they are of the greatness of my theme.

It is not my intention to lay before you a life of Faraday in the ordinary acceptation of the term. The duty I have to perform is to give you some notion of what he has done in the world; dwelling incidentally on the spirit in which his work was executed, and introducing such personal traits as may be necessary to the completion of your

picture of the philosopher, though by no means adequate to give you a complete idea of the man.

The newspapers have already informed you that Michael Faraday was born at Newington Butts, on September 22, 1791, and that he died at Hampton Court, on August 25, 1867. Believing, as I do, in the general truth of the doctrine of hereditary transmission—sharing the opinion of Mr. Carlyle, that 'a really able man never proceeded from entirely stupid parents'—I once used the privilege of my intimacy with Mr. Faraday to ask him whether his parents showed any signs of unusual ability. He could remember none. His father, I believe, was a great sufferer during the latter years of his life, and this might have masked whatever intellectual power he possessed. When thirteen years old, that is to say in 1804, Faraday was apprenticed to a bookseller and bookbinder in Blandford Street, Manchester Square: here he spent eight years of his life, after which he worked as a journeyman elsewhere.

You have also heard the account of Faraday's first contact with the Royal Institution; that he was introduced by one of the members to Sir Humphry Davy's last lectures, that he took notes of those lectures; wrote them fairly out, and sent them to Davy, entreating him at the same time to enable him to quit trade, which he detested, and to pursue science, which he loved. Davy was helpful to the young man, and this should never be forgotten: he at once wrote to Faraday, and afterwards, when an opportunity occurred, made him his assistant. (1) Mr. Gassiot has lately

favoured me with the following reminiscence of this time:—

'Clapham Common, Surrey,

'November 28, 1867.

'My Dear Tyndall,—Sir H. Davy was accustomed to call on the late Mr. Pepys, in the Poultry, on his way to the London Institution, of which Pepys was one of the original managers; the latter told me that on one occasion Sir H. Davy, showing him a letter, said: "Pepys, what am I to do, here is a letter from a young man named Faraday; he has been attending my lectures, and wants me to give him employment at the Royal Institution—what can I do?" "Do?" replied Pepys, "put him to wash bottles; if he is good for anything he will do it directly, if he refuses he is good for nothing." "No, no," replied Davy; "we must try him with something better than that." The result was, that Davy engaged him to assist in the Laboratory at weekly wages.

'Davy held the joint office of Professor of Chemistry and Director of the Laboratory; he ultimately gave up the former to the late Professor Brande, but he insisted that Faraday should be appointed Director of the Laboratory, and, as Faraday told me, this enabled him on subsequent occasions to hold a definite position in the Institution, in which he was always supported by Davy. I believe he held that office to the last.

'Believe me, my dear Tyndall, yours truly,

'J. P. Gassiot.