Faraday as a Discoverer

by

John Tyndall

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Preface

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.

'Dr. Tyndall.'

From a letter written by Faraday himself soon after his appointment as Davy's assistant, I extract the following account of his introduction to the Royal Institution:-- 'London, Sept. 13, 1813.

'As for myself, I am absent (from home) nearly day and night, except occasional calls, and it is likely shall shortly be absent entirely, but this (having nothing more to say, and at the request of my mother) I will explain to you. I was formerly a bookseller and binder, but am now turned philosopher,[2] which happened thus:-- Whilst an apprentice, I, for amusement, learnt a little chemistry and other parts of philosophy, and felt an eager desire to proceed in that way further. After being a journeyman for six months, under a disagreeable master, I gave up my business, and through the interest of a Sir H. Davy, filled the situation of chemical assistant to the Royal Institution of Great Britain, in which office I now remain; and where I am constantly employed in observing the works of nature, and tracing the manner in which she directs the order and arrangement of the world. I have lately had proposals made to me by Sir Humphry Davy to accompany him in his travels through Europe and Asia, as philosophical assistant. If I go at all I expect it will be in October next--about the end; and my absence from home will perhaps be as long as three years. But as yet all is uncertain.'

This account is supplemented by the following letter, written by Faraday to his friend De la Rive,[3] on the occasion of the death of Mrs. Marcet. The letter is dated September 2, 1858:--

'My Dear Friend,--Your subject interested me deeply every way; for Mrs. Marcet was a good friend to me, as she must have been to many of the human race. I entered the shop of a bookseller and bookbinder at the age of thirteen, in the year 1804, remained there eight years, and during the chief part of my time bound books. Now it was in those books, in the hours after work, that I found the beginning of my philosophy.

There were two that especially helped me, the "Encyclopaedia Britannica," from which I gained my first notions of electricity, and Mrs. Marcet's "Conversation on Chemistry," which gave me my foundation in that science.

'Do not suppose that I was a very deep thinker, or was marked as a precocious person. I was a very lively imaginative person, and could believe in the "Arabian Nights" as easily as in the "Encyclopaedia." But facts were important to me, and saved me. I could trust a fact, and always cross-examined an assertion. So when I questioned Mrs. Marcet's book by such little experiments as I could find means to perform, and found it true to the facts as I could understand them, I felt that I had got hold of an anchor in chemical knowledge, and clung fast to it. Thence my deep veneration for Mrs. Marcet--first as one who had conferred great personal good and pleasure on me; and then as one able to convey the truth and principle of those boundless fields of knowledge which concern natural things to the young, untaught, and inquiring mind.

'You may imagine my delight when I came to know Mrs. Marcet personally; how often I cast my thoughts backward, delighting to connect the past and the present; how often, when sending a paper to her as a thank-offering, I thought of my first instructress, and such like thoughts will remain with me.

'I have some such thoughts even as regards your own father; who was, I may say, the first who personally at Geneva, and afterwards by correspondence, encouraged, and by that sustained me.'

Twelve or thirteen years ago Mr. Faraday and myself quitted the Institution one evening together, to pay a visit to our friend Grove in Baker Street. He took my arm at the door, and, pressing it to his side in his warm genial way, said, 'Come, Tyndall, I will now show you something that will interest you.' We walked northwards, passed the house of Mr. Babbage, which drew forth a reference to the famous evening parties once assembled there. We reached Blandford Street, and after a little looking about he paused before a stationer's shop, and then went in. On entering the shop, his usual animation seemed doubled; he looked rapidly at everything it contained. To the left on entering was a door, through which he looked down into a little room, with a window in front facing Blandford Street. Drawing me towards him, he said eagerly, 'Look there, Tyndall, that was my working-place. I bound books in that little nook.' A respectable-looking woman stood behind the counter: his conversation with me was too low to be heard by her, and

he now turned to the counter to buy some cards as an excuse for our being there. He asked the woman her name--her predecessor's name-- his predecessor's name. 'That won't do,' he said, with good-humoured impatience; 'who was his predecessor?' 'Mr. Riebau,' she replied, and immediately added, as if suddenly recollecting herself, 'He, sir, was the master of Sir Charles Faraday.' 'Nonsense!' he responded, 'there is no such person.' Great was her delight when I told her the name of her visitor; but she assured me that as soon as she saw him running about the shop, she felt-though she did not know why--that it must be 'Sir Charles Faraday.'

Faraday did, as you know, accompany Davy to Rome: he was re-engaged by the managers of the Royal Institution on May 15, 1815. Here he made rapid progress in chemistry, and after a time was entrusted with easy analyses by Davy. In those days the Royal Institution published 'The Quarterly Journal of Science,' the precursor of our own 'Proceedings.' Faraday's first contribution to science appeared in that journal in 1816. It was an analysis of some caustic lime from Tuscany, which had been sent to Davy by the Duchess of Montrose. Between this period and 1818 various notes and short papers were published by Faraday. In 1818 he experimented upon 'Sounding Flames.' Professor Auguste De la Rive had investigated those sounding flames, and had applied to them an explanation which completely accounted for a class of sounds discovered by himself, but did not account for those known to his predecessors. By a few simple and conclusive experiments, Faraday proved the explanation insufficient. It is an epoch in the life of a young man when he finds himself correcting a person of eminence, and in Faraday's case, where its effect was to develop a modest self-trust, such an event could not fail to act profitably.

From time to time between 1818 and 1820 Faraday published scientific notes and notices of minor weight. At this time he was acquiring, not producing; working hard for his master and storing and strengthening his own mind. He assisted Mr. Brande in his lectures, and so quietly, skilfully, and modestly was his work done, that Mr. Brande's vocation at the time was pronounced 'lecturing on velvet.' In 1820 Faraday published a chemical paper 'on two new compounds of chlorine and carbon, and on a new compound of iodine, carbon, and hydrogen.' This paper was read before the Royal Society on December 21, 1820, and it was the first of his that was honoured with a place in the 'Philosophical Transactions.'

On June 12, 1821, he married, and obtained leave to bring his young wife into his rooms at the Royal Institution. There for forty-six years they lived together, occupying the suite of apartments which had been previously in the successive occupancy of Young, Davy, and Brande. At the time of her marriage Mrs. Faraday was twenty-one years of age, he being nearly thirty. Regarding this marriage I will at present limit myself to quoting an entry written in Faraday's own hand in his book of diplomas, which caught my eye while in his company some years ago. It ran thus:--

'25th January, 1847.
'Amongst these records and events, I here insert the date of one which, as a source of honour and happiness, far exceeds all the rest. We were married on June 12, 1821.

'M. Faraday.'

Then follows the copy of the minutes, dated May 21, 1821, which gave him additional rooms, and thus enabled him to bring his wife to the Royal Institution. A feature of Faraday's character which I have often noticed makes itself apparent in this entry. In his relations to his wife he added chivalry to affection.

Footnotes to Chapter 1

[1] Here is Davy's recommendation of Faraday, presented to the managers of the Royal Institution, at a meeting on the 18th of March, 1813, Charles Hatchett, Esq., in the chair:--

'Sir Humphry Davy has the honour to inform the managers that he has found a person who is desirous to occupy the situation in the Institution lately filled by William Payne. His name is Michael Faraday. He is a youth of twenty-two years of age. As far as Sir H. Davy has been able to observe or ascertain, he appears well fitted for the situation. His habits seem good; his disposition active and cheerful, and his manner intelligent. He is willing to engage himself on the same terms as given to Mr. Payne at the time of quitting the Institution.

'Resolved,--That Michael Faraday be engaged to fill the situation lately occupied by Mr. Payne, on the same terms.'

[2] Faraday loved this word and employed it to the last; he had an intense dislike to the modern term physicist.

[3] To whom I am indebted for a copy of the original letter.

Chapter 2

Early researches: magnetic rotations: liquefaction of gases: heavy glass: Charles Anderson: contributions to physics.

Oersted, in 1820, discovered the action of a voltaic current on a magnetic needle; and immediately afterwards the splendid intellect of Ampere succeeded in showing that every magnetic phenomenon then known might be reduced to the mutual action of electric currents. The subject occupied all men's thoughts: and in this country Dr. Wollaston sought to convert the deflection of the needle by the current into a permanent rotation of the needle round the current. He also hoped to produce the reciprocal effect of causing a current to rotate round a magnet. In the early part of 1821, Wollaston attempted to realise this idea in the presence of Sir Humphry Davy in the laboratory of the Royal Institution.[1] This was well calculated to attract Faraday's attention to the subject. He read much about it; and in the months of July, August, and September he wrote a 'history of the progress of electro-magnetism,' which he published in Thomson's 'Annals of Philosophy.' Soon afterwards he took up the subject of 'Magnetic Rotations,' and on the morning of Christmas-day, 1821, he called his wife to witness, for the first time, the revolution of a magnetic needle round an electric current. Incidental to the 'historic sketch,' he repeated almost all the experiments there referred to; and these, added to his own subsequent work, made him practical master of all that was then known regarding the voltaic current. In 1821, he also touched upon a subject which subsequently received his closer attention--the vaporization of mercury at common temperatures; and immediately afterwards conducted, in company with Mr. Stodart, experiments on the alloys of steel. He was accustomed in after years to present to his friends razors formed from one of the alloys then discovered.

During Faraday's hours of liberty from other duties, he took up subjects of inquiry for himself; and in the spring of 1823, thus self-prompted, he began the examination of a substance which had long been regarded as the chemical element chlorine, in a solid form, but which Sir Humphry Davy, in 1810, had proved to be a hydrate of chlorine, that is, a compound of chlorine and water. Faraday first analysed this hydrate, and wrote out an account of its composition. This account was looked over by Davy, who suggested the heating of the hydrate under pressure in a sealed glass tube. This was done. The hydrate fused at a blood-heat, the tube became filled with a yellow atmosphere, and was afterwards found to contain two liquid substances. Dr. Paris happened to enter the laboratory while Faraday was at work. Seeing the oily liquid in his tube, he rallied the young chemist for his carelessness in employing soiled vessels. On filing off the end of the tube, its contents exploded and the oily matter vanished. Early next morning, Dr. Paris received the following note:--

'Dear Sir,--The oil you noticed yesterday turns out to be liquid chlorine.

'Yours faithfully,
'M. Faraday.'[2]