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Title: Michael Faraday, Man of Science

Author: Walter Jerrold

Release date: September 3, 2014 [EBook #46763]

Language: English

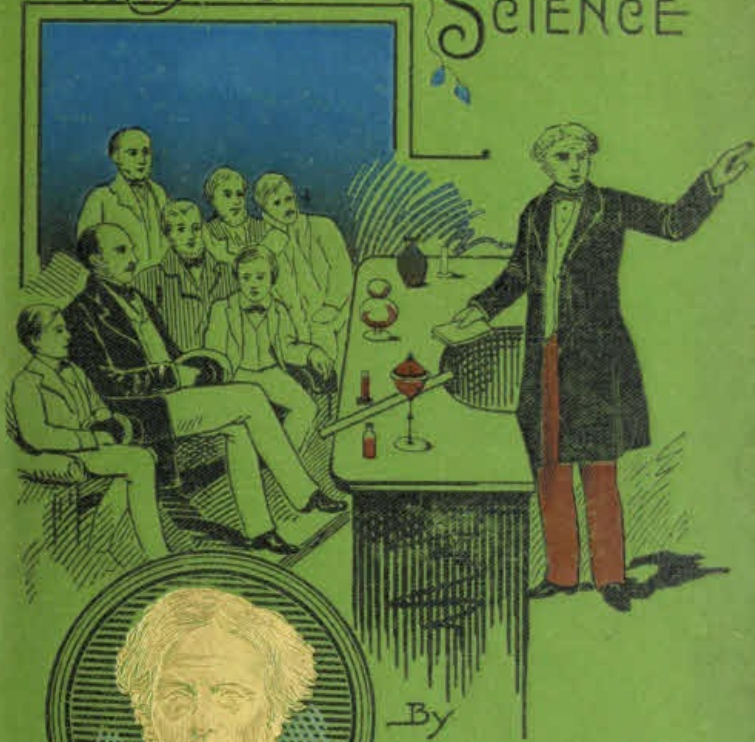
*** START OF THE PROJECT GUTENBERG EBOOK MICHAEL FARADAY, MAN OF SCIENCE ***

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Michael Faraday

MAN OF SCIENCE



By

WALTER JERROLD



MICHAEL FARADAY.

MICHAEL FARADAY:

Man of Science.

BY

WALTER JERROLD.

"Whose work was wrought for love, and not for gain."

"One rule his life was fashioned to fulfil;
That he who tends Truth's shrine and does the best
Of Science, with a humble, faithful will,
The God of Truth and Knowledge serveth best."

FLEMING H. REVELL COMPANY,
NEW YORK CHICAGO TORONTO

Publishers of Evangelical Literature.

MICHAEL FARADAY: Man of Science.

[iii]

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PREFACE.

"Tyndall, I must remain plain Michael Faraday to the last." In these words, with which he replied to Professor Tyndall's urgent appeal to him to accept the Presidency of the Royal Society, we have a key-note to the character of the illustrious yet modest scientist, the good and great man, whose life-story I have attempted to tell in the following pages.

A life-story such as that of Michael Faraday is both easy and difficult to tell—it is easy in that he passed a simple and unadventurous life; it is difficult, partly, perhaps, for the same reason, and partly because the story of his life-work is a story of the wonderful advance made in natural science during the first half of the present century. Any detailed account of that scientific work would be out of place in a biography such as the present, which aims at showing by the testimony of those who knew him and by an account of his relations with his fellow-men, how nobly unselfish, how simple, yet how grand and useful, was the long life of Michael Faraday.

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Besides this, we are shown—how many an illustrious name in the bed-roll of our great men brings it to mind—that with an enthusiastic love for a particular study, and unflagging

perseverance in pursuance of it, the most adverse circumstance of birth and fortune may be overcome, and he who has striven take rank among the great and good whose names adorn the annals of their country. Such lives are useful, not alone for the work which is done, but for the example which they afford us, that we also—to use Longfellow's well-known, yet beautifully true lines—

"May make our lives sublime,
And departing, leave behind us
Footprints on the sands of time."

"The true scientist," says Mr. Robert Buchanan in a recent work, "should be patient like Darwin and reverent like Faraday." The latter, indeed, seems to me to have been a truly typical scientist. Never have we seen an instance of a less selfish devotion to a man's chosen work. Born the son of a journeyman blacksmith, brought up amidst the most unpromising surroundings, with but the scantiest schooling, we find Michael Faraday educating himself during his spare time, and gradually acquiring, by indomitable perseverance, that scientific knowledge for which he thirsted. We find him seeking employment, even in the humblest capacity, in a place that must have appeared to his youthful mind as the very home of science. Once there, we find him advancing with marvellous rapidity not only in the acquirement of knowledge which had been gained by others, but, yet prouder position, we find him ever adding to that store of knowledge the discovery of new facts. The patience of the true scientist was assuredly his. We find him acknowledged by his great contemporaries not only as an equal but as a leader among them. We find him with wealth and high social position within his reach. All this do we find—and not this alone; for we find him at the same time unspoiled in the slightest degree by his success; caring not in the least for the wealth that might be his, and declining honours which most men would have considered as but the fair reward of work which they had done. We find him also the object of love and admiration, not of his family and intimate friends alone, but of all persons with whom he came into contact. We find him exploring all the hidden workings of nature—making known discovery after discovery in the same modest and enthusiastic manner; and despite all these inquiries into the secrets of nature, we find him retaining unshaken that firm faith with which he had started—that beautiful and unquestioning trust in

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"A far off divine event
To which the whole creation moves."

Much of Faraday's kindness and good nature, his considerateness and his simple earnest faith could be revealed only by his letters and by the records of those who had known him personally—on this account I have found it necessary somewhat freely to make use of illustrative quotations. After studying his life, however, the kindness, nay more, the true brotherhood of the man with all men is the feeling which most firmly clings to us; we do not alone remember the great electrician, experimentalist, and lecturer, but we have an ever-present idea of the sterling goodness of the man.

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"A purer, less selfish, more stainless existence, has rarely been witnessed. At last came the voice which the dying alone can hear, and the hand which the living may not see, beckoned him away; and then that noble intellect, awakening from its lethargy, like some sleeper roused from a heavy dream, rose up and passed through the gates of light into the better land, where, doubtless, it is now immersed in the study of grander mysteries than it ever attempted to explore on earth."

In closing this preface I have much pleasure in recording my deep indebtedness to Miss Jane Barnard, a niece of the great Professor, and for some two and twenty years a member of his household, for several reminiscences of her uncle; and also for her kindness in allowing me to look through the many interesting manuscripts of Faraday's which are in her possession.

WALTER JERROLD.



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MICHAEL FARADAY.

CHAPTER I. AS CHILD—NEWSBOY AND BOOKBINDER.

"A virtuous household, though exceeding poor!
Pure livers were they all, austere and grave,
And fearing God; the very children taught
Stern self-respect, a reverence for God's word,
And an habitual piety."

WORDSWORTH.

Among those of our great men who, born in humble circumstances and unfurnished with the benefits of early education, have yet secured for themselves honourable positions in the history of the world's progress, Michael Faraday holds a remarkable place. Born the son of a journeyman blacksmith, Michael yet gained for himself a conspicuous position among the very first scientists of his day, and at the time of his death was acknowledged as one of the leading philosophers—electricians—chemists—of this nineteenth century.

Our interest in a great man makes us always interested also in his family—we become anxious to know who and what he was apart from that which has made him great. Who were his parents? from where did they come? what were they like? what did they do? and a number of similar questions are at once started as soon as we commence considering the lives of our "great and good." In the case of Faraday we have only scanty information as to his family, but thus much we have gleaned:—

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During the whole of last century there was living in or near the village of Clapham, in Yorkshire, a family of the name of Faraday. Between the years 1708 and 1730 the Clapham parish register shows us that "Richard Faraday, stonemason, tiler, and separatist," recorded the births of ten children, and it is probable that he had in his large family yet another son, Robert. Whether, however, Robert was his son or only his nephew is a matter of doubt, but it is known of him that he married Elizabeth Dean, the possessor of a small though comfortable house called Clapham Wood Hall, and that he was the father of ten children, one of whom, James, was born in 1761, and became the father of Michael Faraday.

Robert and Elizabeth Faraday's six sons were each of them brought up to some trade or craft, and were thus all of them fitted to go out into the world and fight the battle of life. One son became a grocer and (as his grandfather, "Richard Faraday," had been) tiler; one a farmer; one a shoemaker, and so on. The third son, James, to us the most interesting member of this large family, although he appears to have been of somewhat weak constitution and unfitted for so laborious a vocation, became a blacksmith, served his apprenticeship, and exercised his craft for some time in the neighbourhood of his birthplace. When he was five-and-twenty years old (in 1786), James married; his wife being Margaret Hastwell, the daughter of a farmer living near Kirkby Stephen, a place some few miles away from Clapham, over the Westmoreland border. For two years or thereabouts did the young blacksmith and his wife remain in the neighbourhood of Clapham; but after that time had elapsed they determined to come up to London, and seek their fortunes in the great metropolis. To the young men and women of our rural places the very name of London has about it, even to-day, a ring as of genuine coin, that tempts them to leave in large numbers the homes of their childhood that they may plunge into the vortex of city life. A hundred years ago this strange attractive power of the metropolis was probably much greater, owing to the difficulty of reaching it and the vague stories that were told of its wealth. They who had "been to London" were looked upon in rural places as veritable travellers, and were to their "home-keeping" friends objects of greater curiosity than anyone who to-day returns from the farthest or wildest portion of the earth's surface. The old story of "the London streets being paved with gold"—the story that had buoyed up the spirits of the youthful Whittington—seems yet in the last century to have gained some credence. Whether they were induced to do so by promises of work, or merely attracted to London as a centre where work would probably be plentiful, we cannot say; but it is at any rate certain that the Faradays removed from the Yorkshire village to a London

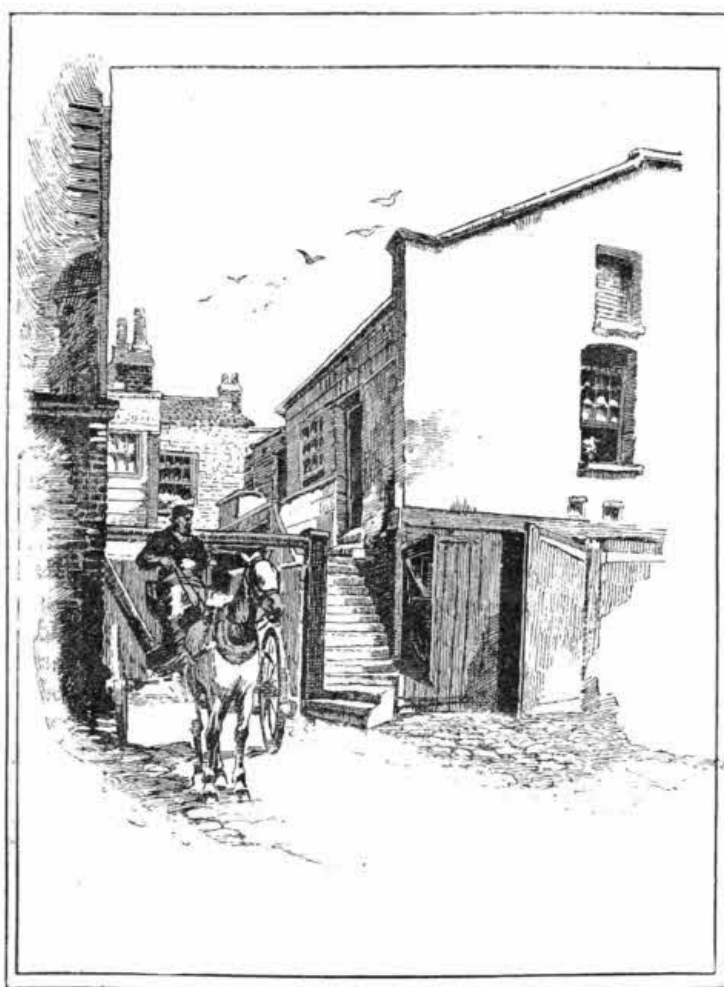
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suburb some time before the autumn of 1791. For it was on the 22nd of September in that year that there was born to them at Newington Butts their third child, Michael, the future illustrious chemist and philosopher, upon the story of whose life we are now about to enter.

Of Michael's early years we have but a very meagre account. When he was about five years old his family removed from Newington Butts, and went to live in Jacob's Well Mews, Charles Street, Manchester Square, where they occupied rooms over a coach-house. James Faraday found employment at this time in Welbeck Street, while his young son passed his time, as children so circumstanced generally do, in playing in the streets; in after years, indeed, that son, become a prominent man, would point out where in Spanish Place he used to play at marbles, and where in Manchester Square he had at a later time been proud of having to take care of his younger sister, Margaret. It was from Jacob's Well Mews, too, that Michael went to school, and received such scant education as was to be his before it became necessary that he, as a youth of thirteen, should step into the ranks of the workers and begin the battle of life in earnest; such education as he received was of the "most ordinary description (to use his own words), 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."

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When Faraday was a boy nine years of age, in the first year of the present century, there was a time of much distress, when the rate of wages was very low, and the price of food very high: corn, indeed, which is at the present time about forty shillings per quarter, cost then as much as £9 for the same quantity. The distress, was felt very generally throughout the country, and the Faraday family severely felt the hard times; Michael, we are told, was allowed one loaf each week, and, it is added (poor Michael!), that the loaf had to last him that time.



THE HOUSE IN JACOB'S WELL MEWS.

Near by where the Faraday family lived in Jacob's Well Mews there was, at No. 2, Blandford Street, a worthy bookseller named Riebau. In 1804, when Faraday was a boy of thirteen, he was employed as an errand boy by Mr. Riebau, "for one year on trial"—a trial that, as we shall shortly see, proved highly satisfactory. Michael's duty as errand boy, when he commenced, was to carry round the newspapers which were lent out by his master. He would get up very early each Sunday morning, and take the papers round, so that he might be able to call again for them while it was yet fairly early; frequently he would be told that he "must call again," as the paper was not done with. On such occasions he would beg to be allowed to have it at once, as the next place at which he had to call might be a mile off, and he would lose so much time going twice over his rounds that he would not be able to get home and make himself neat, so that he might go with his parents to their place of worship. Mr. Riebau's shop, it may be noted, has changed but little since the early part of this century, it is still a stationer's business, and on the front of the house is placed a plaque bearing the simple inscription "Michael Faraday, Man of Science," with the date of his apprenticeship there. This plaque has furnished the simple yet sufficient title for this volume.

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His father, it may here be noted, had joined the Sandemanian Church, or the followers of Robert Sandeman, who, with his father-in-law, the Reverend John Glas, had seceded from the Scotch Presbyterian Church, and with him had started the sect which was named after Sandeman, or, as they are still called in Scotland, Glasites. In joining the Sandemanian Church, James Faraday was following the family tradition, for the large family of Clapham Faradays, to whom we have referred, were all members of the same body. Michael's mother, although she had not formally become a member of the Church, used regularly to attend as one of the congregation. Michael, as we shall learn, joined the Church later on, and continued a devout and sincere member of it up to the time of his death.

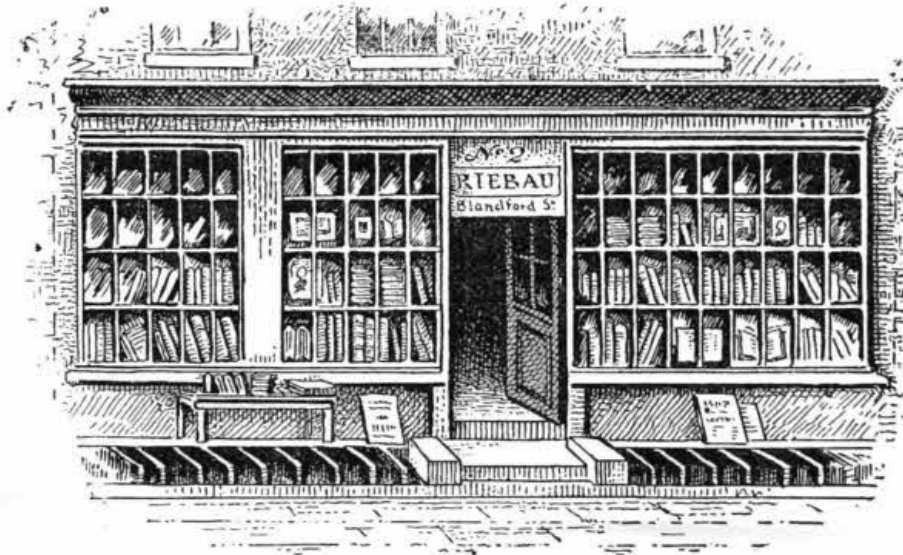
For about a year did young Faraday continue as Mr. Riebau's errand boy; for about a year, as Professor Tyndall puts it, "he slid along the London pavements, a bright-eyed errand boy, with a load of brown curls upon his head and a packet of newspapers under his arm." We learn from one of his nieces that in his later years he rarely saw a newsboy without making some kind remark about him; as he said on one such occasion, "I always feel a tenderness for those boys, because I once carried newspapers myself." He was reproached, he says, as a boy, with being a great questioner. "He that questioneth much," says Lord Bacon, "shall learn much;" but this truth is too often forgotten by their elders when children are "inquisitive," and, as in Faraday's case, what is but the natural questioning of an awakening mind is put down to idle curiosity, and the child is told (as we may often hear) "not to ask so many questions."

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Although Faraday says he was thus "charged with being a great questioner," he could not recall what kind of questions he put; though he tells one story against himself which shows that all questioning, even that of a young philosopher, is not necessarily wise. He had called at a certain house to leave a newspaper, and whilst waiting for the door to be opened he put his head between the iron bars that separated the house from the next, and while in that position asked himself, somewhat strangely, which side of the railing he was on? No sooner had he started the question than the door behind him opened, he drew suddenly back, and, hitting himself so as to make his nose bleed, he forgot all about his question, which, without being answered, was yet it would seem somewhat definitely settled.

When his year as errand boy expired, Michael was apprenticed to Mr. Riebau to learn the trade of bookbinder and stationer. His indentures are dated October 7th, 1805, and contain in one line an excellent testimonial to his character: "In consideration of his faithful service no premium is given." Of the earlier part of his seven years' apprenticeship we know but little. His father wrote in 1809 to a brother at the old home at Clapham, "Michael is bookbinder and stationer, and is very active at learning his business. He has been most part of four years of his time out of seven. He has a very good master and mistress, and likes his place well. He had a hard time for some while at first going; but, as the old saying goes, he has rather got the head above water, as there are two boys under him."

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"MICHAEL FARADAY, MAN OF SCIENCE, APPRENTICE HERE."

In that he was placed within reach of many and good books, which should go a great way towards deciding his scientific and speculative bent of mind, a position such as that in Mr. Riebau's shop was as good a one as he could have had. Not only were many scientific books, that had hitherto been unavailable, now placed ready to his hand, but he had in Riebau a kind and considerate master; he was allowed, and it was a valuable privilege, to be out occasionally of an evening that he might attend the lectures on natural philosophy which a Mr. Tatum was delivering at that time at his house in Dorset Street, Fleet Street. Michael saw bills announcing the lectures in shop windows, and became anxious to hear them, which he was enabled to do owing to the kindness of his master, Mr. Riebau, and the generosity of his elder brother Robert, who at the time was following their father's business, and made Michael a present on several occasions of the shilling which was charged for entrance to the lectures.

Towards the end of the year 1809 Faraday's family removed from Jacob's Well Mews, where their home had been for thirteen years, and went to live at 18, Weymouth Street, near Portland Place, and there, on October 30th of the following year, James Faraday died. He had been out of health

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for some years, and seems indeed to have been quite physically unfitted for so laborious an occupation as that of blacksmith. In 1807 he had written to a brother at Clapham, "I am sorry to say I have not had the pleasure of enjoying one day's health for a long time. Although I am very seldom off work for a whole day together, yet I am under the necessity (through pain) of being from work part of almost every day." He then concludes his letter in that spirit of simple yet earnest devotion that appears to have been characteristic of the whole family: "But we, perhaps, ought to leave these matters to the overruling hand of Him who has a sovereign right to do what seemeth good to Him, both in the armies of heaven and amongst the inhabitants of the earth."

Michael's strong affection for his parents became, as he grew older, one of the most marked features of his character; his great love for his mother is shown in many ways, notably in every letter which he wrote to her. The following story illustrates, as do many others that are told of him, Faraday's depth of feeling with regard to his family. After he had become recognised by the world as the great man that he was, and when sitting to Noble for his bust, it happened that the sculptor, in giving the finishing touches to the marble, made a clattering with his chisels: noticing that his sitter appeared moved, he said he feared the jingling of the tools had distressed him, and that he was weary. "No, my dear Mr. Noble," said Faraday, putting his hand upon his shoulder, "but the noise reminded me of my father's anvil, and took me back to my boyhood."

Gradually Faraday's interest widened in those matters which later on were to entirely engross his attention. His apprenticeship at first gave him many opportunities of reading philosophical and scientific works. "I loved," he afterwards wrote, referring to this time, "to read the scientific books which were under my hands, and, amongst them, delighted in Marcet's *Conversations in Chemistry*, and the electrical treatise in the *Encyclopædia Britannica*. I made," he adds, and the item is interesting as giving us a first glimpse at his experiments, "I made such simple experiments in chemistry as could be defrayed in their expense by a few pence per week, and also constructed an electrical machine, first with a glass phial, and afterwards with a real cylinder, as well as other electrical apparatus of a corresponding kind." Watts' *On the Mind*, was, he said, the first thing that made him really think; while his thoughts were directed towards science by an article on electricity, which he lighted upon in an encyclopædia entrusted to him to bind. Such glimpses into the early reading—showing us how the bent of his genius is decided—are always interesting in the life of one who, as Tennyson says, "Has made by force his merit known."

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Into Faraday's early reading—or that part of his reading which bore upon the science with which his name is so intimately connected—we have indeed something more than a glimpse, for he compiled (during 1809-10) a note book in which he wrote down the names of such books and articles connected with the sciences as interested him. This note book he called, "*The Philosophical Miscellany*": being a collection of notices, occurrences, events, etc., relating to the arts and sciences, collected from the public papers, reviews, magazines, and other miscellaneous works; intended to promote both amusement and instruction, and also to corroborate or invalidate those theories which are continually starting into the world of science."

Thus ambitiously did Michael Faraday, a youth of not yet twenty years, start upon his career as an investigator; thus early did he evince a desire to "corroborate or invalidate those theories which are continually starting into the world of science." Among books and articles to which reference is made in the interesting *Miscellany*, there are papers by Dr. Darwin,^[1] papers on a "Description of a Pyro-pneumatic Apparatus," and "Experiment on the Ocular Spectra of Light and Colours," frequent references to "lightning," "electric fish," and other electrical phenomena, showing his early leaning towards this particular branch of investigation. There is a reference to the short essay on the *Formation of Snow*, which forms the reading for December 5th, in that interesting, and at the present time neglected, work, Sturm's *Reflections on the Works of God*. This book has perhaps been supplanted in a great measure by the many popular treatises on science and natural history which recent years have produced, but which, nevertheless, have not taken the place of the *Reflections*, the simplicity and directness of which give to the volume a perennial charm such as but few books can maintain. Other papers, such as that on "How to Loosen Glass Stopples," included in the *Miscellany*, show us Faraday's interest in the science of everyday life, to which in his later years we owe those delightfully interesting lectures on "The Chemical History of a Candle," lectures to which fuller reference is made later on in this volume. One other reference in the *Miscellany* is at any rate worthy of passing note for obvious reasons, or for reasons which are obvious as soon as we learn how closely connected is the career of Faraday with that of his great benefactor and predecessor in the field of research, Sir Humphry Davy. The reference is from the *Chemical Observer*, to the effect that "Mr. Davy (he was knighted in 1812) has announced to the Royal Society a great discovery in chemistry—the fixed alkalies have been decomposed by the galvanic battery."

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From the lectures at Mr. Tatum's house our young philosopher gained something more than a knowledge of the subjects discussed—he gained several friends, intercourse and exchange of ideas with whom were to form no inconsiderable part of his education; that he might illustrate the lectures, too, he set to study perspective, being kindly assisted in his work by Mr. Masquarier, a French refugee artist who was lodging at the time at Mr. Riebau's, and whose kindness to him Faraday never in after years forgot to acknowledge. About a dozen lectures at Mr. Tatum's were spread over rather more than eighteen months (February, 1810—September, 1811). At them, Faraday became acquainted with Benjamin Abbott, a confidential clerk in the City—an acquaintance that ripened into life-long friendship; here also he met Huxtable, a medical student, to whom he addressed the earliest note of his which is extant. Other kindred spirits with whom Faraday entered into friendly relations at the Dorset Street lectures, were Magrath,

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Newton, Nichol, and many more. There is a perverted and ridiculous story told of Faraday's first hearing Davy lecture, to the effect that "Magrath happening, many years ago, to enter the shop of Mr. Riebau, observed one of the bucks of the paper bonnet zealously studying a book which he ought to have been binding. He approached; it was a volume of the old *Britannica*, open at 'Electricity.' He entered into talk with the journeyman, and was astonished to find in him a self-taught chemist, of no slender pretensions. He presented him with a set of tickets for Davy's lectures at the Royal Institution; and daily thereafter might the nondescript be seen perched, pen in hand, and his eyes starting out of his head, just over the clock opposite the chair. At last the course terminated; but Faraday's spirit had received a new impulse, which nothing but dire necessity could have restrained." This circumstantial yet exaggerated story, couched as it is in the worst of tastes, is yet quoted with approval in a recent work supposed of some authority.

Magrath, as we have seen, Faraday had met earlier, and, as he tells us himself, the kindness of giving him tickets for Davy's lectures was done him by Mr. Dance.^[2] The story quoted above says also that he might be seen *daily*, and that "at last" the course terminated. To show us how garbled is this account and in what it is true, we will turn to an account of this incident—this important incident—in his life, which Faraday himself wrote out later at the request of a correspondent. "During my apprenticeship," he says, "I had the good fortune, through the kindness of Mr. Dance, who was a customer of my master's shop, and also a member of the Royal Institution, to hear four of the last lectures of Sir H. Davy in that locality. The dates of these lectures were February 29th, March 14th, April 8th and 10th, 1812. Of these I made notes, and then wrote out the lectures in a fuller form, interspersing them with such drawings as I could make. The desire to be engaged in scientific occupation, even though of the lowest kind, induced me, whilst an apprentice, to write, in my ignorance of the world and simplicity of my mind, to Sir Joseph Banks, then President of the Royal Society. Naturally enough, 'no answer' was the reply left with the porter."

The four lectures which Faraday heard during the spring of 1812 were, as we shall see in the next chapter, to mark an epoch in his life. At each of these lectures, we are told, the delighted youth listened to Sir Humphry Davy, from a seat in the gallery immediately over the clock directly facing the illustrious lecturer;^[3] both speaker and listener being unaware of the close inter-connection there was destined to be between their two careers. But of this in the next chapter, for between Faraday's hearing Davy's lectures and his correspondence with that great man, there are one or two other interesting facts in connection with the life of our bookbinder's apprentice and would-be philosopher. In July of this year it was that Michael commenced his long and interesting series of letters to Benjamin Abbott, letters that show us how keenly alive Faraday was to all things connected with the work with which he was anxious to become more intimately connected, and at the same time how anxious he was to make up for his deficiencies of education.

In all his letters we find a charm in the simple earnestness of the man, in his straightforward search for truth, in the unreserved openness which characterised him when corresponding with one whom he not only called a friend, but treated as such on all occasions. Simplicity, in its best and highest meaning, was, if we can in one word sum up the character of a man, the chief feature of Faraday in all his relations throughout life. Through all his letters to his intimate friends, too, there runs a vein of unaffected pleasantry which shows us at once that he was no "mere scientist," no "dry-as-dust" philosopher, which is a character too often given by thoughtless and careless persons to men who earn their laurels in any special field of research. We find that the great chemist or philosopher is not only a great scientist, but that he is also, as Faraday undoubtedly was, a man of a simple, earnest, reverent nature, a man whose married life was one series of years of love-making, who was a cheerful, pleasant friend and companion, and intense and earnest lover of children.

Perhaps I cannot better conclude this chapter than by giving a few passages from his early letters, passages that will fully bear out much of what is said in the preceding paragraph. It was in July, 1812, three months before the articles of his apprenticeship ran out, that Faraday began his letters to Abbott; he was not as yet twenty-one years of age, his early education, as we have seen, had been chiefly the three R's, yet we find these letters eminently remarkable for their correctness and fluency, not less than for their kindness, courtesy, and candour. His first letter to Abbott is, indeed, doubly interesting, for it gives us the earliest account we have of any of his experiments. After writing a good deal on what he considers to be the advantage of a correspondence, he continues: "I have lately made a few simple galvanic experiments, merely to illustrate to myself the first principles of the science.... I, sir, I my own self, cut out seven discs of the size of halfpennies each! I, sir, covered them with seven halfpence, and I interposed between seven, or rather six, pieces of paper soaked in a solution of muriate of soda!!! But laugh no longer, dear A.; rather wonder at the effects this trivial power produced. It was sufficient to produce the decomposition of sulphate of magnesia—an effect which extremely surprised me; for I did not, could not, have any idea that the agent was competent to the purpose."

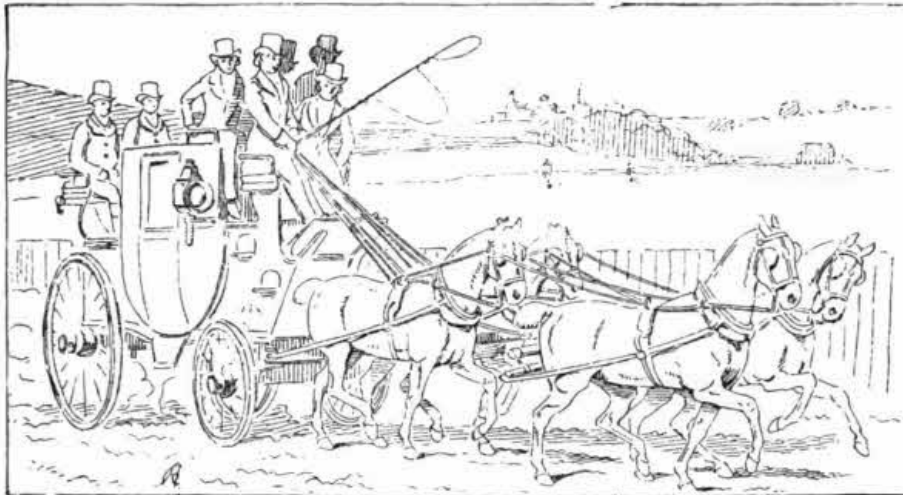
Again, to the same friend, he writes: "What? affirm you have little to say, and yet a philosopher? What a contradiction! What a paradox! 'tis a circumstance I till now had no idea of, nor shall I at any time allow you to advance it as a plea for not writing. A philosopher cannot fail to abound in subjects, and a philosopher can scarcely fail to have a plentiful flow of words, ideas, opinions, etc., etc., when engaged on them; at least, I never had reason to suppose you deficient there. Query by Abbott: "Then pray, Mike, why have you not answered my last before now since subjects are so plentiful?" 'Tis neither more nor less, dear A., than a want of time. Time, sir, is all I require, and for time will I cry out most heartily. Oh that I could purchase at a cheap rate some of our

modern gents' spare hours, nay, days; I think it would be a good bargain both for them and me. As for subjects, there is no want of them. I could converse with you, I will not say for ever, but for any finite length of time. Philosophy would furnish us with matter; and even now, though I have said *nothing*, yet the best part of a page is covered."

[26]

A little later he writes, acknowledging a letter from his friend, a letter which found him paper-hanging—"but what a change of thought it occasioned; what a concussion, confusion, conglomeration; what a revolution of ideas it produced—oh! 'twas too much; away went cloths, shears, paper, paste, and brush, all—all was too little, all was too light to keep my thoughts from soaring high, connected close with thine."

This letter, after referring to his friend's electrical experiments, he finishes somewhat sadly, "You know I shall shortly enter on the life of a journeyman, and then I suppose time will be more scarce than it is even now." Little did he dream how great a change in his prospects one short half year would make.



[27]

CHAPTER II. THE TURNING POINT.

"And Nature, the old nurse, took
The child upon her knee,
Saying: 'Here is a story-book
Thy Father has written for thee.'

'Come, wander with me,' she said,
'Into regions yet untrod;
And read what is still unread
In the manuscripts of God!'"

LONGFELLOW.

There is a story told of Sir Humphry Davy, that, on being asked on a certain occasion to enumerate what he considered as his greatest discoveries, he named first one thing and then another,—now his wonderful safety-lamp, then some electrical discovery, finishing up with "but

the greatest of all my discoveries was the discovery of Michael Faraday."

In the autumn of 1812, as we have seen, Faraday was a bookbinder, whose apprenticeship was just at an end, and who was contemplating, as the only thing possible, the taking up of life as a journeyman at the craft at which for seven years he had been working; indeed, a journeyman bookbinder he became, for in October of that year he engaged himself to a Mr. De la Roche, who, though a quick-tempered, passionate man, seems to have really cared for Faraday, so much so, indeed, that he said to him, "I have no child, and if you will stay with me you shall have all I have when I am gone." But Michael was not thus to be tempted from the path which he desired to tread, as he wrote afterwards to Davy's biographer, "My desire to escape from trade, which I thought vicious and selfish, and to enter into the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy, expressing my wishes and a hope that if an opportunity came in his way he would favour my views; at the same time, I sent the notes I had taken of his lectures."

[28]

Shortly after Sir Humphry received Faraday's application, speaking to a friend—the honorary inspector of the models and apparatus—he 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?" was Pepys' reply, "do? 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," said Davy, "we must try him with something better than that."

Notwithstanding the fact that his similar application of some months before to Sir Joseph Banks had met with no answer, Faraday, in his desire to leave trade for science, had thus addressed another of the leading men of the day. Davy's reply was "immediate, kind, and favourable." It was this—

"December 12th, 1812.

"To Mr. Faraday,

"Sir,—I am far from displeased with the proof you have given me of your confidence, and which displays great zeal, power of memory, and attention. I am obliged to go out of town, and shall not be settled in town till the end of January; I will then see you at any time you wish. It would gratify me to be of any service to you; I wish it may be in my power.

[29]

"I am, Sir, your obedient humble servant,

"H. DAVY."



SIR HUMPHRY DAVY.

The young bookbinder's delight on receiving the great and kindly-natured man's note may easily be imagined, as also may his anxiety for Davy's return. Five weeks, however, are soon passed,

and Michael duly met Sir Humphry "by the window which is nearest to the corridor, in the ante-room to the theatre" at the Royal Institution. Davy was much impressed by the sincerity and modesty of the applicant, but yet advised him to continue at his bookbinding, going so far, indeed, as to say that he would get the Royal Institution binding for him, and would recommend him to his friends.^[4] With this, for the present, Faraday had to be content. He returned to his binding, delighted that he had met and conversed with the greatest chemist of his time, but still anxious for an opportunity to leave that trade to which, as he had said, he was so averse, and to become wholly the servant of that science to which he was so attached.

[30]

The change in his vocation was to come far more rapidly than he could have anticipated. He was still living, at this time (early in 1813), at 18, Weymouth Street, and one night, not very long after his interview with Davy, just as he was undressing to go to bed, there came a loud knock at the front door. Michael went to the window to see if there was any evidence as to whom the unwonted visitor might be. A carriage was there, from which a footman had alighted and left a note for "Mr. M. Faraday." It proved to be from Sir Humphry, who had already an opportunity of serving the young enthusiast. The note requested Michael to call on Davy the next morning. This he did, and learned that an assistant in the laboratory of the Royal Institution was required at once, the former assistant having been dismissed the day before. Michael instantly expressed his willingness to accept the position; he was to have twenty-five shillings a week salary, and two rooms at the top of the Institution building.

It was not long before arrangements were all completed. A meeting of the managers of the Institution was held on March 1st; the following is entered in the minutes of that day's proceedings:—"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 those 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."

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The duties of the assistant were specified by the managers in the following manner, his work being something other than the washing of bottles, which Pepys had recommended. It is a fact, also, that Faraday, almost from the commencement of his engagement, was concerned in more important work than that herein particularised. He was "to attend and assist the lecturers and professors in preparing for, and during, lectures; when any instruments or apparatus may be required, to attend to their careful removal from the model room or laboratory to the lecture-room, and to clean and replace them after being used, reporting to the manager such accidents as shall require repair, a constant diary being kept by him for that purpose. That, in one day in each week, he be employed in keeping clean the models in the repository, and that all the instruments in the glass cases be cleaned and dusted at least once within a month." As has been said, Faraday's work was almost from the first of a higher nature; he is reported to have set in order the mineralogical collection soon after his arrival.

But a very short while elapsed between Michael's appointment as assistant and his taking up the duties of his post, for, on the 8th of March, he writes to Abbott, dating his letter from his new home, the two rooms at the top of the Institution. His letter tells us that he was already concerned in the active duties of his post, as the following passages show: "It is now about nine o'clock, and the thought strikes me that the tongues are going both at Tatum's and at the lecture in Bedford Street; but I fancy myself much better employed than I should have been at the lecture at either of those places. Indeed, I have heard one lecture already to-day, and had a finger in it (I can't say a hand, for I did very little). It was by Mr. Powell on mechanics, or rather, on rotatory motion, and was a pretty good lecture, but not very fully attended.

[32]

"As I know you will feel a pleasure in hearing in what I have been or shall be occupied, I will inform you that I have been employed to-day, in part, in extracting the sugar from a portion of beetroot, and also in making a compound of sulphur and carbon—a combination which has lately occupied in a considerable degree the attention of chemists."

About a month after writing the letter of which the above forms a part, Faraday again wrote to his friend Abbott, giving him an account of some experiments, in which he had been assisting Sir Humphry Davy, on "the detonating compound of chlorine and azote, and of four different and strong explosions of the substance, explosions from which neither he nor Davy had altogether escaped unhurt." "Of these," he says, "the most terrible was when I was holding between my thumb and finger a small tube containing 7-1/2 grains of the compound. My face was within twelve inches of the tube; but I fortunately had on a glass mask. It exploded by the slight heat of a small piece of cement that touched the glass above half-an-inch from the substance, and on the outside. The explosion was so rapid as to blow my hand open, bear off a part of one nail, and has made my fingers so sore that I cannot yet use them easily. The pieces of the tube were projected with such force as to cut the glass face of the mask I had on." In the other three experiments also they each of them got more or less cut about by the explosion of the "terrible compound," as Faraday calls it, Davy, indeed, in the last one, getting somewhat seriously cut.

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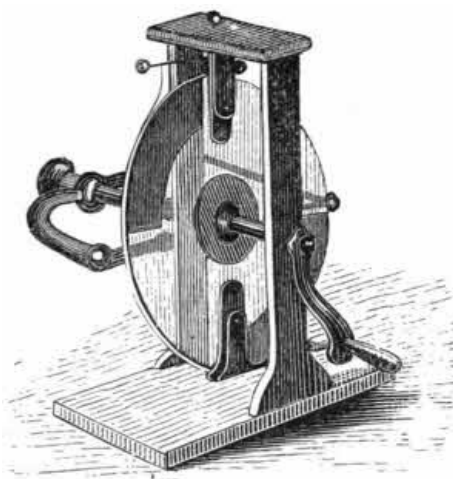
He writes thus frequently to Abbott during the summer of 1813, giving him in the later letters some well thought-out ideas on lectures and lecturing, which we shall have occasion to glance at when we are considering Faraday himself in the capacity of a lecturer,—one of the most popular and yet truly scientific lecturers of any time. In this year, his twenty-first, Faraday joined the City

Philosophical Society, which had been founded about five years earlier by Mr. Tatum, at whose house the meetings were held. The Society consisted of some thirty or forty individuals, "perhaps all in the humble or moderate rank of life;" and certainly all of them anxious to improve themselves and add to their knowledge of scientific subjects. Once a week the members gathered together for mutual instruction; each member opening the discussion in his turn by reading a paper of a literary or philosophical nature, any member failing to do so at his proper time being fined half-a-guinea. In addition, the members had what they modestly called a "class book," but probably very like what we should now call a manuscript magazine; in this each member wrote essays, and the work was passed round from one to another.

Michael, it will be seen, was not neglecting any opportunity of educating himself; as he had said in starting his correspondence with Abbott, one of his objects was to improve himself in composition and to acquire a clear and simple method of expressing that which he had to say. Yet another method had he of furthering his self-education. In the scanty notes which he wrote about his own life he says, "During this spring (1813) Magrath and I established the mutual [34] improvement plan, and met at my rooms up in the attics of the Royal Institution, or at Wood Street at his warehouse. It consisted, perhaps, of half-a-dozen persons, chiefly from the City Philosophical Society, who met of an evening to read together, and to criticise, correct, and improve each other's pronunciation and construction of language. The discipline was very sturdy, the remarks very plain and open, and the results most valuable. This continued for several years." It is a matter for wonder how Faraday, with all these attempts to improve his language and method, and to avoid even the slightest peculiarity, managed yet to retain in all his work a remarkable simplicity and naturalness of style.

On September 13, 1813, Faraday wrote to his uncle and aunt, giving them an account of himself because he had nothing else to say, and was asked by his mother to write the account:—"I was formerly a bookseller and binder, but am now turned philosopher, which happened thus: Whilst an apprentice, I, for amusement, learnt a little of 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, by the interest of Sir Humphry 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 engaged in observing the works of nature and tracing the manner in which she directs the arrangement and order of the world. I have lately had proposals made to me by Sir Humphry Davy to accompany him, in his travels through Europe and into 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, I have to repeat that, even though I may go, my path will not pass near any of my relations, or permit me to see those whom I so much long to see." [35]

This Continental trip with Davy forms one of the chief episodes in Faraday's life. He had, though two-and-twenty years of age, never before been further than a few miles out of London. The country through which he passed, the sea, and the mountains, all came to him as a revelation. The letters which he wrote home from abroad, and the journals which he kept, all express his wonder at the strange sights, and all breathe the kindness of nature and affection for home and those at home which all his life long were strongly marked characteristics. His letters to his mother are especially pleasing. He was away for but little over eighteen months, yet an account of his travels merits a chapter to itself. The commencement of 1813 marked an epoch in his life, the close of the same year marked another.





CHAPTER III. "HOME THOUGHTS FROM ABROAD."

"One rule his life was fashioned to fulfil:
That he who tends Truth's shrine, and does the best
Of Science, with a humble, faithful will,
The God of Truth and Knowledge serveth best."

"Wednesday, October 13th, 1813.—This morning formed an epoch in my life."

Thus commences the first entry in that journal, in which, all the while that he was away, Faraday noted down particulars of what he saw and thought. And, indeed, the young traveller's remark is by no means an exaggeration, as we recognise when we consider that he had never been out of sight of the metropolis, that he was accompanying one of the leading chemists, and that he and Davy, Englishmen both, were allowed free passports through France, although this and that country were at the time at war with one another. The fact that Davy was a scientist overshadowed the fact that he was an Englishman in the eyes of the French authorities; as the former, he was permitted to travel anywhere, and to use libraries, museums, etc., at any time; as the latter, he would have been instantly taken prisoner. This was an early and pleasing recognition of the universality of science, of its more than political or national interest, nay, of its international importance.

[37]

So minute are the descriptions of things seen, so clear and simple is the language employed, that Faraday's journal is most delightful reading; while the letters written home and to his friends are no less pleasing; perhaps, indeed, they are more so as they are so eminently characteristic of the man. They are remarkable for the unaffected spirit of affection which breathes through them, and show us, as indeed was shown in all ways throughout his life, the keen sensitiveness of his feelings and the genuine earnestness with which he was at all times seeking for self-improvement.

On reaching Plymouth, Faraday gives expression in his diary to the wonder which moved him at seeing the country for the first time. The journey, of course, had to be done by road, as it was long before the time of railways; but coach or carriage riding, during fine autumn weather, through some of the most delightful scenery of rural England, must at any time be preferable to, though less expeditious than, railway travelling; and that Michael felt the full benefit of it is shown by the following passage from the journal:—

"*Friday, October 15th.*—Reached Plymouth this afternoon. I was more taken by the scenery to-day than by anything else I have ever seen. It came upon me unexpectedly, and caused a kind of revolution in my ideas respecting the nature of the earth's surface. That such a revolution was necessary is, I confess, not much to my credit; and yet I can assign to myself a very satisfactory reason, in the habit of ideas induced by an acquaintance with no other green surface than that within three miles of London. Devonshire, however, presented scenery very different to this; the mountainous nature of the country continually put forward new forms and objects, and the landscape changed before the eye more rapidly than the organ could observe it. This day gave me some idea of the pleasures of travelling, and has raised my expectations of future enjoyment to a very high point."

[38]

If the surface of the earth gave our amateur traveller cause for wonder, what must have been his feelings when he first went down to the sea-shore? or when, on the night of October 17th, he was on board in mid-channel, with the "immense waves," as he graphically puts it, "striding one after another at a considerable distance?" or when, again, to use his own words, the vessel "sank down into the valleys between the great waves, and we had nothing in view but the wall of waters around us." He carefully observed, on this occasion, remaining on deck all night for that purpose, the phosphorescence of the sea. The next day they reached the harbour of Morlaix, on the French coast, where, after much examination of luggage, and searching in all possible and impossible places for contraband goods by the French Customs' officers, they took up their lodging for a couple of nights. And on the 22nd, the carriage having been successfully put together (to ensure

comfortable accommodation Sir Humphry had brought his own with him), the party commenced their tour, reaching Paris, where a stay of three months' length was made, on the 29th. Faraday's observant nature is made evident to us in every page of his journal, and the light, humorous style in which much of it—that part which admits of such treatment—is written, gives evidence of the abiding cheerfulness of his disposition.

On the road to Paris there was a temporary stoppage, owing to the breaking of one of the horses' traces. While the accident was being repaired by the postillion, Faraday found, to his great delight, a glow-worm, the first that he had seen, and which gave him much food for reflection. So great an impression did the first sight of the luminous little grub make on him, that, writing to his mother six months afterwards, and enumerating some of the more important things he had seen in his travels, he says, "I have seen a GLOW-WORM!"

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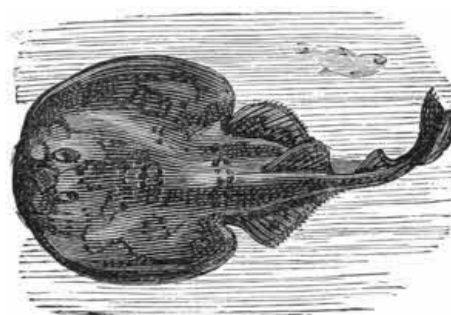
In Paris Davy stayed some three months, and Faraday records the great disadvantage under which he laboured through not knowing the French language. Despite this, however, he attended lectures with Davy, and accompanied him on visits to the laboratories of the various French chemists of the day, among others to that of Chevreul, who was even then (he was three years older than Faraday) well known as one of the rising chemists of the day.^[5] It was well for Davy, and his assistant too, perhaps, that the Paris authorities did not read the entries which the young Englishman "with a round chin, a brown beard, a large mouth, and a great nose,"^[6] made in his journal, for he records as follows a visit which he paid to the Galerie Napoléon:—"It is," he wrote, "both the glory and the disgrace of France. As being itself, and as containing specimens of those things which proclaim the power of man, and which point out the high degree of refinement to which he has risen, it is unsurpassed, unequalled, and must call forth the highest and most unqualified admiration; but when memory brings to mind the manner in which the works came here, and views them only as the gains of violence and rapine, she blushes for the people that even now glory in an act that made them a nation of thieves."^[7]

Although he thus discoursed in his journal about what he saw and thought, he did not by any means neglect his favourite science, and his journal during the stay in Paris contains frequent reference to the experiments which Sir Humphry was carrying on with a new substance which had been discovered a short while before by a French chemist—M. Courtois. This substance, now known as iodine, was the source of much interesting research. Not only about the time of its discovery, but during the whole of the century it has afforded scope to chemists for much speculation and useful experiment.

[40]

The race-prejudice, which early in the present century affected English opinion of all things French, is to be traced even in Faraday, who, with all his fairness and open-mindedness, seems always congratulating himself on not belonging to the people among whom he finds himself. This insular spirit finds expression in such passages as the following, which he wrote after staying indoors all day with nothing better to do than to note the difference between the rooms in Paris and those he was accustomed to in England. He sums his views up thus:—"French apartments are magnificent, English apartments are comfortable; French apartments are highly ornamented, English apartments are clean; French apartments are to be seen, English apartments enjoyed; and the style of each kind best suits the people of the respective countries."

From Paris the small party—which consisted of Sir Humphry and Lady Davy and Faraday, whose nominal position was that of "assistant in chemistry and experiments"—went south to Montpellier, near the coast of the Mediterranean and some seventy-five miles from Marseilles. After about six weeks' stay they again started on their travels; and after a cold and adventurous journey across the Alps, reached Turin on February 22nd, at the close of the Carnival. From Turin they went to Genoa—where Faraday was much interested in several water-spouts which he saw in the bay—and then on to Florence. Various experiments were made by Davy at each place, on iodine, on the electricity of the torpedo fish, etc.; while at each place Faraday found some opportunity of helping to satisfy his craving for improvement. Of the stay at Florence the journal gives but little account other than of Davy's experiment to find out of what a diamond is composed, and of the various attempts which were made with the assistance of the "Duke's burning glass" to burn diamond. After noting these experiments, Faraday concludes: "As yet it appears that the diamond is pure carbon."



TORPEDO FISH.

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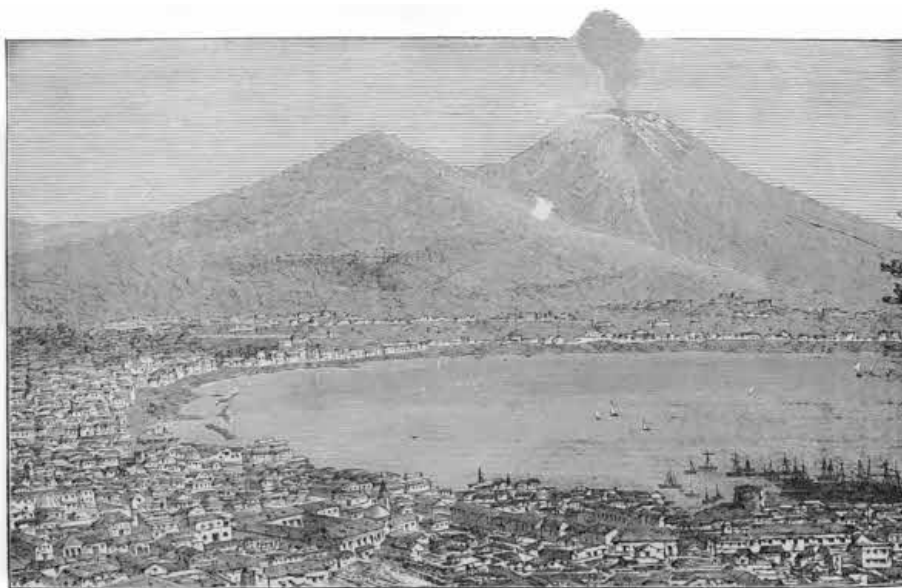
From Rome, which was the next halting-place on their travels, Michael wrote home to his mother a long letter, every line of which breathes a spirit of true affection. "I trust that you are well in health and spirits, and that all things have gone right since I left you.... Mr. Riebau and fifty other friends would be inquired after, could I but have an answer. You must consider this letter as a kind of general one, addressed to that knot of friends who are twined round my heart; and I trust that you will let them all know that, though distant, I do not forget them, and that it is not from want of regard that I do not write to each singly, but from want of convenience and propriety; indeed, it appears to me that there is more danger of my being forgot than of my forgetting. The first and last thing in my mind is England, home, and friends. It is the point to which my thoughts still ultimately tend, and the goal to which, looking over intermediate things, my eyes are still directed. But, on the contrary, in London you are all together, your circle being little or nothing

diminished by my absence; the small void which was formed on my departure would soon be worn out, and, pleased and happy with one another, you will seldom think of me. Such are sometimes my thoughts, but such do not rest with me; an innate feeling tells me that I shall not be forgot, and that I still possess the hearts and love of my mother, my brother, my sisters, and my friends.... Whenever a vacant hour occurs I employ it by thinking on those at home. In short, when sick, when cold, when tired, the thoughts of those at home are a warm and refreshing balm to my heart. Let those who think such thoughts useless, vain, and paltry, think so still; I envy them not their more refined and more estranged feelings: let them look about the world, unencumbered by such ties and heartstrings, and let them laugh at those who, guided more by nature, cherish such feelings. For me, I still will cherish them, in opposition to the dictates of modern refinement, as the first and greatest sweetness in the life of man." [42]

It is in his letters such as this that we get to understand Faraday, and to appreciate how it was that his friends, members of his family, nay, even persons who casually met him, were always struck by the simplicity and loveliness of the man. Altogether, Michael got much pleasure, and a great deal of experience, both of life and of science, during his Continental tour, although it was not a source of unmixed delight. His engagement was to accompany Davy in the capacity of secretarial and scientific assistant, but some work certainly not included under that head fell to him owing to Sir Humphry's valet not accompanying the party at the last moment. Had he been with Davy alone this would have been of little matter, for Davy was a kind and considerate man, and would have dispensed with a servant's attendance, and have recognised in Faraday the scientific assistant only; but—unfortunately for Michael—Lady Davy, as has been mentioned, accompanied her husband, and she was not so considerate; and, in consequence, Faraday was treated at times almost as a servant. This, occasionally, was very trying to him; but Michael was too much of a philosopher to give in because circumstances were not as he could wish, and he wrote to his friend Abbott, that though he had to sacrifice much, "the glorious opportunity he enjoyed of improving in the knowledge of chemistry and the sciences continually determined him to finish the voyage with Sir Humphry Davy." A decision of this nature is characteristic of Faraday at all times: he rarely started any work without having carefully considered it; but, having started it, he was not one to take his hand from the plough before the furrow was completed. [43]

This quality is well illustrated in a story which is told of Faraday when he had become a well-known chemist. He was arranging some apparatus with a scientific instrument maker, when a small piece of glass fell to the ground; Faraday made several unsuccessful efforts to pick it up, when his companion said that it was not worth troubling over. "Perhaps not," said Faraday; "but I do not like to fail in accomplishing anything that I have attempted."

The months of May and June were spent by the small party mostly in Italy—first in Rome, then Naples, and afterwards travelling from place to place. At Naples a stay of some days was made, and Faraday's journal gives us an interesting account of two visits to Mount Vesuvius. On the second day the party, largely increased by other visitors, had a picnic on the Mount. "Cloths were laid on the smoking lava, and bread, chickens, turkey, cheese, wine and water, and eggs roasted on the mountain, brought forth, and a species of dinner taken at this place. Torches were now lighted, and the whole had a singular appearance; and the surrounding lazzaroni assisted not a little in adding to the picturesque effect of the scene. After having eaten and drunk, Old England was toasted, and 'God save the king!' and 'Rule, Britannia' sung; and two very entertaining Russian songs by a gentleman, a native of that country, the music of which was peculiar and very touching."



NAPLES AND MOUNT VESUVIUS.

From Naples the journey is continued up north through all the magnificent scenery of Italy; the journal giving us occasionally delightful word-pictures of the landscape, and recording the young traveller's observations on various natural phenomena. Now, as we have seen, glowworms attract his attention, then waterspouts, and the magnificent spectacle presented by Vesuvius; and again his attention is occupied with the beautiful fire-flies that appeared "in innumerable quantities; at [44]

a distance they covered the side of the mountain, and near us they passed over the fields, hovered on the edge or crossed the road, often attaching themselves to the harness, and emitting their bright and harmless flashes of light in a rapid and beautiful manner."

In July our party found themselves settled in Geneva, where some three months were passed very enjoyably in congenial society. Davy was the guest of the elder De la Rive, with whom he experimented in chemistry, and with whom, they both being ardent sportsmen, he went out fishing and shooting. "On these occasions," says Professor Tyndall, "Faraday charged Davy's gun, while De la Rive charged his own. Once the Genevese philosopher found himself by the side of Faraday, and in his frank and genial way entered into conversation with the young man. It was evident that a person possessing such a charm of manner and such high intelligence could be no mere servant. On inquiry De la Rive was somewhat shocked to find that the *soi-disant domestique* was really *preparateur* in the laboratory of the Royal Institution; and he immediately proposed that Faraday thenceforth should join the masters instead of the servants at their meals. To this Davy, probably out of weak deference to his wife, objected; but an arrangement was come to that Faraday thenceforward should have his food in his own room."

For reasons such as these we can well understand that Faraday's life during his Continental journeying was not altogether as pleasant as he had anticipated it would be. In his letters his reserve on this matter is marvellous, for it is only twice, and in writing to his intimate friend, Abbott, that he refers at all to his, at times, uncomfortable situation, and then it is to give point to what he has been saying in reply to his friend's complaint as to the sordid and unintellectual surroundings amid which he is compelled to live. In his journals also Faraday's reticence with regard to those with whom he travelled is noticeable; he wrote impressions of what he saw, and of what he thought that was worth record, and this was done merely for his own future use and pleasure—he would never wish to recall any petty humiliations which circumstances compelled him to suffer, and they were very properly allowed to pass unrecorded. Indeed, in the note quoted above, particulars of which were given Professor Tyndall by M. De la Rive, we learn more of the discomforts of his post than Faraday himself ever allowed to escape. It is indeed a great pity for his own good fame that Davy should have allowed a "weak deference to his wife" to influence him in such a matter, as it was a great pity when a few years later he allowed a petty spirit of jealousy to make him oppose the election of Faraday as a Fellow of the Royal Society.

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From Geneva many letters were written home to his mother and friends. This is characteristic: "Here, dear mother, all goes well. I am in perfect health, and almost contented, except with my ignorance, which becomes more visible to me every day, though I endeavour as much as possible to remedy it." It is strange how different we find the Faraday of the letters and the Faraday of the journal. In the first case the cheerful kindness, the affectionate, sympathetic side of the man's nature at once strikes us; while in the journal the clear and simple description, uncoloured by personal feeling or prejudice, is no less remarkable.

The three months' stay at Geneva at an end, the small party, bidding farewell to their hospitable and kindly host, De la Rive, turned south again. In De la Rive, Michael, by his intelligence, his scientific enthusiasm, and his unassuming cheerful disposition had won a life-long friend. The route south may well be described briefly in Michael's own words, from a letter to his mother written early in November at Rome: "On leaving Geneva we entered Switzerland, and traversed that mountainous and extraordinary country with health and fine weather, and were much diverted with the curious dresses and customs of the country.... From Switzerland we passed through the States of Baden, on the Lake of Constance (they are very small), across an arm of the kingdom of Wurtemberg, and into Bavaria. In this route we had seen, though slightly, Lausanne, Vevey, Zurich, Schaffhausen and the falls of the Rhine, in Switzerland, and Munich, and many other towns in Germany. On leaving Munich we proceeded to and across the Tyrol, and got to Padua, and from Padua to Venice. You will remember very well, I have no doubt, the picture which hung in the parlour over the fireplace, and which represented the Rialto and the Great Canal of this town. The first I have had the pleasure of crossing several times, and the second I have partly traversed in a Venetian gondola.... After seeing Venice for three days we left it, and came towards Italy, passing Bologna and Florence."

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Before reaching Florence the two philosophers went out of their way to inquire into a phenomenon at Pietra Mala which was much talked about. From certain tracts of ground in the neighbourhood sheets of flame of various sizes were said to burst out; the fire was said to burn anything combustible, although the ground where the flames were was not even heated; locally, it was said to be the remains of an ancient volcano. "Though it was raining hard, yet that would not deter Sir Humphry from visiting those places; but, at the same time, it made us wish to be as quick as possible. Sir Humphry therefore went to the first place, and I went to the *Acqua bollenti*, conducted by a man of the village, who carried some fire, some straw, and some water. I found the place in a cultivated field, not far from a mountain, apparently of limestone. It was simply a puddle perhaps formed by the present showers of rain. Much gas rose from the earth, and passed through the water, which made it appear boiling, and had given rise to its name; but the water and the ground were quite cold. I made another puddle with the water we brought, near the one I found there, and I saw that the gas rose up through it also; and it appeared to be continually passing off from a surface of more than eighteen inches in diameter. The soil appeared deep, and close to the spot supported vegetation readily. The man inflamed some straw, and then laid it on the ground; immediately the gas inflamed, and the flame spread to some distance from the straw over the surface of the earth, waving about like the flame of weak spirits of wine; this flame burnt some moments. On putting a light to the bubbles which rose through the water they inflamed, and sometimes a flame ran quickly from them over the whole surface of the water. I filled a bottle

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with the gas, but I could not distinguish any smell in it. In pouring water into the bottle, and lighting the jet of gas that came out, a large clear flame was obtained. The whole of this flame was a very pale blue, like spirits of wine. It inflamed paper and matches readily, as might be expected; and when I held a dry bottle or knife over it, they appeared to become dim by condensing water: but this was uncertain, as the weather was so rainy. The water had no taste, and appeared pure rain water. I brought some of it and the gas away, and returned to the village." In the "almost deserted laboratory of the Florence Academy" experiments with the Pietra Mala gas convinced Davy that it was "light hydrocarburet, pure."

The second stay in Rome extended over nearly four months, during which time the grand Carnival took place. Faraday had at this part of his tour a great deal of his time to himself, and earnestly devoted himself to continuing the study of the French and Italian languages, on which indeed he had been working all the while he had been away from home. But he also continued his observations on men and manners, for during the Carnival week he twice attended masked balls in a domino, besides being present at the horse-races on the Corso, and at other of the events of the Carnival. He was, however, anxious to be on his way home to England, and his letters occasionally show how sad he felt at not knowing how soon the return would be.

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It was, however, to be earlier than he anticipated. On January 25th, 1815, he wrote to Abbott: "Now for news! We shall part in a few weeks (pray write quickly) for Naples, and from thence proceed immediately to Sicily. Afterwards our road is doubtful; but this much I know, that application is made for passports to travel in the Turkish Empire, and to reside in Constantinople; that it is Sir Humphry's intention to be among the Greek islands in March, and at Athens early in the spring.... Adieu, dear friend. With you I have no ceremony. The warmest wishes that friendship can dictate are formed for you by M. Faraday." Thus had he written towards the end of January—within three months he was to be shaking hands with his friend at home!

While on the road to Naples, Faraday heard of the escape of Napoleon from Elba on March 7th, and records it thus briefly in his journal: "Tuesday, March 7th.—I heard for news that Bonaparte was again at liberty. Being no politician, I did not trouble myself about it, though I suppose it will have a strong influence on the affairs of Europe." It is strange how quietly Davy and his "assistant" passed through Europe at a time when war was convulsing nearly the whole of it; quietly and apparently unconcernedly they went their way, seeing who and what was to be seen at the various stopping-places, prosecuting their researches in different branches of chemistry, and adding in many ways to their stores of knowledge, seemingly unaffected by

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"The time that tried men's souls."

At Naples Faraday again ascended Vesuvius, and on this occasion had the grand experience of seeing it in active eruption. He writes a full and graphic account in the journal, from which one passage, descriptive of the eruption itself, may well be quoted. This time Faraday had ascended with a guide only, Sir Humphry having stayed part way up the mountain to see Monte Somma. "I saw a large shower of red-hot stones in the air," writes Faraday, "and felt the strong workings of the mountain; but my care was now to get to the crater, and that was soon done. Here the scene surpassed everything. Before me was the crater, like a deep gulf, appearing bottomless from the smoke that rose from below. On the right hand this smoke ascended in enormous wreaths, rolling above us into all forms; on the left hand the crater was clear, except where the fire burst out from the side with violence, its product rising and increasing the volume of volatile matter already raised in the air. The ground was in continual motion, and the explosions were continual, but at times more powerful shocks and noises occurred; then might be seen rising high in the air numbers of red-hot stones and pieces of lava, which at times came so near as to threaten us with a blow. The appearance of the lava was at once sufficient to satisfy one of its pasty form. It rose in the air in lumps of various size, from 1/2 lb. to 25 lb. or more. The form was irregular, but generally long, like splashes of thick mud; a piece would often split into two or more pieces in the air. They were red-hot, and, when they fell down, continued glowing for five, ten, or fifteen minutes.... I was there during one explosion of very great force, when the ground shook as with a strong earthquake, and the shower of lava and of stones ascended to a very great height, and at this moment the smoke increased much in quantity. The guide now said this place was not safe, from its exposed situation to the melted lava and to the smoke, and because it oftentimes happens that a portion of the edge of the crater is shaken down into the gulf below. We therefore retreated a little, and then sat down, listened, and looked."

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We have seen from the letter to Abbott at the end of January that a somewhat lengthened tour had been planned out. On March the 21st Faraday's journal says, "We left Naples at five o'clock." From that time the return was rapid. At Rome there was some delay owing to the lack of post-horses; the French troops under Murat were advancing, and everybody was leaving the city; the Pope had fled, and the cardinals were flying. After a delay of a couple of days carriage-horses were hired at a great expense, and the travellers proceeded on their homeward flight. At Mantua delay again occurred, as the passports had to be "signed, re-signed, and countersigned." "At last," says Faraday, "we saw the outside of the town, having, much against our will, remained two hours and a-half in it."

Faraday's last letter home is written from Brussels on April 16th; it is to his mother, and is well worth reading: "My very dear Mother,—It is with no small pleasure I write you my last letter from a foreign country, and I hope it will be with as much pleasure you will hear I am within three days of England. Nay more, before you read this letter I hope to tread on British ground.... I am not acquainted with the reason of our sudden return; it is, however, sufficient for me that it has taken place. We left Naples very hastily, perhaps because of the motions of the Neapolitan troops, and perhaps for private reasons. We came rapidly to Rome, we as rapidly left it. We ran

up Italy, we crossed the Tyrol, we stepped over Germany, we entered Holland, and we are now at Brussels, and talk of leaving it to-morrow for Ostend; at Ostend we embark, and at Deal we land on a spot of earth which I will never leave again. You may be sure we shall not creep from Deal to London, and I am sure I shall not creep to 18, Weymouth Street; and then—but it is of no use. I have a thousand times endeavoured to fancy a meeting with you and my relations and friends, and I am sure I have as often failed: the reality must be a pleasure not to be imagined or described.... You may be sure that my first moment will be in your company. If you have opportunities, tell some of my dearest friends, but do not tell everybody—that is, do not trouble yourself to do it.... My thoughts wander from one to another, my pen runs on by fits and starts; I do not know what to say, and yet cannot put an end to my letter. I would fain be talking to you, but must cease. Adieu till I see you, dearest mother; and believe me ever your affectionate and dutiful son,

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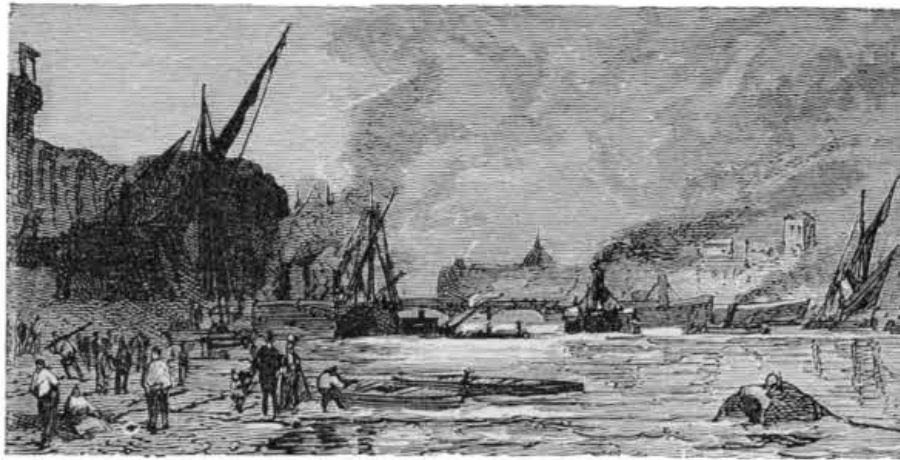
"M. FARADAY."

"'Tis the shortest and (to me) the sweetest letter I ever wrote you."

Thus ended Faraday's wanderings—

"But who may tell
What forms he brought away,
To stand reveal'd at mem'ry's spell,
And glad some distant day!"

He returned home better equipped for continuing the work of chemical research, for which he had so intense a liking, with his stores of knowledge vastly increased, and his energy and application not one whit abated. How he again took up the thread of his work must be told in another chapter.



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CHAPTER IV. BACK AT WORK.

"A choice that from the passions of the world
Withdrew, and fixed me in a still retreat;
Sheltered, but not to social duties lost,
Secluded, but not buried; and with song
Cheering my days, and with industrious thought;
With the ever-welcome company of books;
With virtuous friendship's soul-sustaining aid,
And with the blessings of domestic love."

WORDSWORTH.

His friends and relations having had due attentions from him, Faraday at once began to cast about for work. On going abroad with Davy he had relinquished his position at the Royal Institution, though Sir Humphry had promised to befriend him on their return; this promise was, much to Faraday's gratification, duly fulfilled. Within a fortnight of his return Michael found himself re-engaged at the Institution in the capacity of "assistant in the laboratory and mineralogical collection, and superintendent of the apparatus," a high-sounding office that

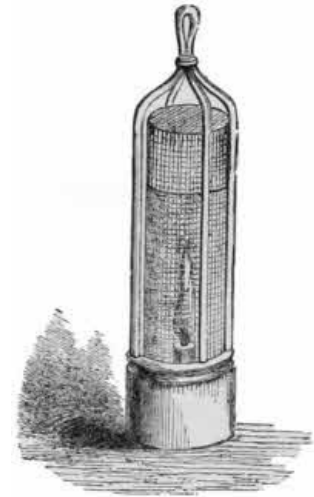
carried with it the none too substantial honorarium of thirty shillings a week, and, as before, rooms in the building. It was, however, a distinct rise, both in position and in wage, and Faraday, we may be sure, was pleased to get back to his well-loved Institution on such terms.

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A life spent in scientific research is, generally, an apparently uneventful one. Faraday's life, far from being an exception to this rule, was rather an accentuation of it. The story of his life is indeed highly interesting; but its interest lies in it, not as a story of action and change, but as a life that may be said to have realised almost wholly the ideal which was set before it. From the very first moment when Faraday gave expression to his hate for trade and his love for science, his whole life was a practical illustration of his feelings; as we shall find on following him through his great and honourable career, there were many occasions on which he refused not only titles and such like honours, but pecuniary benefits which might fairly be considered his dues—no, "his work was wrought for love and not for gain," as the line which I have placed on the title page of this little book so well expresses it.

The tour on the Continent, as has been noted, was the most striking episode in Faraday's long life. From May 7th, 1815 (the date on which he rejoined the Institution), onwards, his life was a time of steady intellectual growth, spent in chemical research, in the explaining of phenomena, and in what is by no means his least claim on our regard, the popularisation of scientific knowledge. We have seen in his early correspondence with Benjamin Abbott how, on his very earliest acquaintance with lecturing and lectures at the Royal Institution, he began to study the different styles of the various lecturers, to note their peculiarities, and in what lay the secret of their success; we have seen, too, how he was striving to improve himself in composition—in the clear and intelligent method of stating things. He was preparing himself betimes for what he felt to be part of his true vocation; how eminently successful—beyond his wildest imaginings—he was, will be seen as we follow his life-story year by year.

It was, as Faraday frequently acknowledged, his good fortune to assist Sir Humphry Davy in his experiments not only while abroad, but after their home-coming. One of the most important of all Davy's discoveries was made in the year of their return. On August 3rd he acknowledged a letter which he had received from Dr. Gray, directing his attention to the awful destruction of human life by explosions in coal mines. On October 31st, Davy announced to his correspondent that he had discovered a "safety lamp;" on November 2nd he read a paper on fire-damp before the Royal Society, and on December 14th submitted to Dr. Gray models of lamps and lanterns made on the principle of his discovery, "that fire-damp will not explode in tubes or feeders of a certain small diameter." In his experiments, in connection with this discovery, Davy received considerable help from his laboratory assistant, who must have been much gratified by that passage in Davy's paper on the "safety lamp," in which the great discoverer expressed himself as "indebted to Mr. Michael Faraday for much able assistance." This was "Mr. Michael Faraday's" first public recognition, and must have been very delightful to him, especially coming as it did from the man of all others for whom, in his scientific capacity, Michael had the most profound admiration.



THE DAVY SAFETY LAMP.

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Davy gained, as is well known, much honour and no inconsiderable amount of money for his discovery. There are, however, circumstances in which the safety lamp is *not* safe; Faraday, and, it is to be presumed, Davy himself, was aware of this. It is illustrative of Faraday's stern regard for truth that, although he was at the time Davy's own assistant, he did not, and would not, attest before a parliamentary committee to the universal safety of the Davy lamp.

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Early in 1816 we find Faraday beginning to put into practice those ideas on lectures and lecturing which he had so carefully considered before. On the point of giving his first lecture, though, he seems to doubt himself, and in a letter to Abbott occurs the following passage—"I intend making some experiments on that subject (lecturing) soon; I will defer it (his letter on lecturing) till after such experiments are made. In the meantime, as preparatory and introductory to such a course of experiments, I will ask your opinion of, and observations on, English composition—style, delivery, reading, oratory, grammar, pronunciation, perspicuity, and in general all the branches into which the *belles lettres* divide themselves; and if by asking I procure, I shall congratulate myself on the acquisition of much useful knowledge and experience."

The first lecture—on the "General Properties of Matter"—was duly and successfully delivered before the City Philosophical Society on January 17th. Before trusting himself to go upon the platform, Faraday carefully wrote out his lecture, word for word, as it was to be delivered; a plan which he followed in the case of each of the other six lectures which he gave before the same Society during the year. These lectures I have had the pleasure of seeing, as they are neatly written out and bound by their author. They are, with many similar treasures, in the possession of Miss Jane Barnard, a niece of Faraday.

This year was an important one in several ways; not only did Faraday give his first lecture, but also his first printed paper appeared in the *Quarterly Journal of Science*, which was edited by Mr. Brande, who succeeded Sir Humphry as chief of the Royal Institution. The paper was on an analysis of native caustic lime, which had been undertaken at Davy's instigation. That his scientific friends and patrons were beginning to recognise something out of the common in their

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laboratory assistant is shown in various ways, notably by such a passage as the following, taken from Faraday's note-book: "When Mr. Brande left London in August, he gave the *Quarterly Journal* in charge to me; it has had very much of my time and care, and writing, through it, has been more abundant with me. It has, however, also been the means of giving me earlier information on some new objects of science."

Faraday's common-place book—a kind of continuation of his *Philosophical Miscellany* of six years earlier—gives us a good deal of information as to his intellectual progress at this time; it shows us not only what scientific subjects were interesting him, but also how zealously he was continuing his study of composition and the mode of expressing what he had to say clearly and definitely. There are passages from the *Spectator*, alongside of tests with arsenic, a description of a visit to a silk-ribbon dresser's, along with an account of Zerah Colburn, the American calculating boy. Sir Humphry Davy wrote to Faraday, saying, "Mr. Colburn, the father of the American boy who has such extraordinary powers of calculation, will explain to you the method his son uses in confidence. I wish to ascertain if it can be practically used."

It has been remarked of Faraday that his was a poet-nature expressing itself through science; and this estimate seems largely true, but the verses which he wrote in his common-place book, "On Love," if they be his own composition, are extremely poor; there are other verses though which will merit quotation. They are written by Mr. Dryden, a fellow-member of the City Philosophical Society, and are entitled "Quarterly Night," October 2nd, 1816, being descriptive of one of the periodical gatherings of the Society. The following passage is of especial interest to us, as it shows how Faraday impressed a young contemporary:—

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"But hark! A voice arises near the chair!
Its liquid sounds glide smoothly through the air;
The listening Muse with rapture bends to view
The place of speaking and the speaker too.
Neat was the youth in dress, in person plain;
His eye read thus, *Philosopher-in-grain*;
Of understanding clear, reflection deep;
Expert to apprehend, and strong to keep.
His watchful mind no subject can elude,
Nor specious arts of sophist e'er delude;
His powers, unshackled, range from pole to pole;
His mind from error free, from guilt his soul.
Warmth in his heart, good humour in his face,
A friend to mirth, but foe to vile grimace;
A temper candid, manner unassuming,
Always correct, yet always unpresuming.
Such was the youth, the chief of all the band;
His name well known, Sir Humphry's right hand.
With manly ease towards the chair he bends,
With Watts' logic at his finger-ends,
'I rise (but shall not on the theme enlarge)
To show my approbation of this charge:
If proved it be, the censure should be passed
Or this offence be neither worst nor last.
A precedent will stand from year to year,
And 'tis the usual practice we shall hear.
Extreme severity 'tis right to shun,
For who could stand were justice only done?
And yet experience does most clearly show
Extreme indulgence oft engenders woe.
In striving then to hit the golden mean—
To knowledge, prudence, wisdom, virtue seen—
Let Isaac then be censured, not in spite
But merely to evince our love of right.
Truth, order, justice, cannot be preserved
Unless the laws which rule us are observed.
I for the *principle* alone contend,
Would lash the crime, but make the man my friend."

Faraday's progress during these first few years after his reinstatement at the Royal Institution was rapid: his lectures to the City Philosophical Society, his published papers, and his letters, all give evidence of it. In 1817, as in the previous year, he delivered six lectures before the Society. It is interesting to find that instead of being written out word for word, the lectures were now delivered from notes, showing how the young lecturer was becoming so assured of his own command of language as to make the earlier method no longer necessary. His common-place book for this year continues to show a wide range of reading and thoughtfulness. In the summer, when the lectures at the Institution had ceased for the recess, Faraday availed himself of an invitation from his friend Huxtable, who was living at South Moulton, and spent a month holiday-making in Devonshire. His early impressions of that county, when he passed through it with Davy on their way to the Continent, must have made him especially delighted to visit it once more; more particularly as he had an opportunity on this occasion of making geological excursions and

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of studying "wavellite, hydrargellite, and such hard things." A letter which he wrote from Barnstaple to his mother during this holiday is interesting, referring as it does to those country occupations amid which she, in her girlhood, passed her time:—"I have seen a great deal of country life since I left town, and am highly pleased with it, though I should by no means be contented to live away from town. I have been at sheep-shearings, merry-makings, junketings, etc., and was never more merry; and I must say of the country people (of Devonshire, at least) that they are the most hospitable I could imagine. I have seen all your processes of threshing, winnowing, cheese and butter-making, and think I could now give *you* some instruction, but all I have to say to you on these subjects shall be said verbally."

Each year of his life at this period Faraday found himself becoming busier than the previous one. Another five chemical lectures (on the metals, well known and little known) were given before the City Philosophical Society during 1818, completing a course, extending over three years, of seventeen lectures on the chemical science, no mean accomplishment for a young man from twenty-three to twenty-six years of age. So much was his time now becoming occupied that we find a great falling-off in his letters this year, a falling-off not only in number, but also in length. The correspondence with Abbott, commenced six years earlier, practically comes to an end in 1818; there was not, it is necessary to mention, the slightest abatement in the warmth of affection of the two friends; it was that, to a great extent, perhaps, the correspondence had done its work, and what is undoubtedly the more powerful reason, our young scientist was beginning to find his time so well occupied with his favourite work that he could not devote enough of it to the writing of long letters. Abbott was yet, and always, sure of the heartiest hand-shake and the most unaffected welcome from one who to the end of his life was the staunchest of friends.

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On July 1st, 1818, Faraday read a highly interesting paper before the members of the City Philosophical Society, on "Observations on the Inertia of the Mind," in which he drew, in an able manner, an analogy between a state of the mind and what in the physical world is known as the inertia of matter. It may be of interest to note a few passages from this lecture to illustrate the thoughtfulness and thoroughness of Faraday's work at this time, and also to give an example of his early style as a lecturer.

"Unlike the animated world around him, which remains in the same constant state, man is continually varying, and it is one of the noblest prerogatives of his nature, that in the highest of earthly distinctions he has the power of raising and exalting himself continually. The transition state of man has been held up to him as a memento of his weakness; to man *degraded* it may be so with justice; to man as he ought to be it is no reproach; and in knowledge that man only is to be contemned and despised who is *not* in a state of transition....

"By advancement on the plain of life, I mean advancement in those things which distinguish men from beasts—sentient advancement. It is not he who has soared above his fellow-creatures in power, it is not he who can command most readily the pampering couch or the costly luxury; but it is he who has done most good to his fellows, he who has directed them in the doubtful moment, strengthened them in the weak moment, aided them in the moment of necessity, and enlightened them in their ignorance, that leads the ranks of mankind....

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"There is a power in natural philosophy, of an influence universal, and yet withal so obscure, in its nature so unobtrusive, that for many ages no idea of it existed. It is called *inertia*. It tends to retain every body in its *present* state, and seems like the spirit of constancy impressed upon matter. Whatever is in motion is by it retained in motion, and whatever is at rest remains at rest under its sway. It opposes every *new* influence, strengthens every *old* one. Is there nothing in the human mind which seems analogous to this power?...

"Inertia is an essential property of matter; is it a never-failing attendant on the mind? I hope it is; for as it seems to be in full force whenever the mind is passive, I trust it is also in power when she is actively engaged. Was the idle mind ever yet pleased to be placed in activity? Was the dolt ever willing to resign inanity for perception? Or are they not always found contented to remain as if they were satisfied with their situation? They are like the shepherd Magnus: although on a barren rock, their efforts to remove are irksome and unpleasant; and they seem chained to the spot by a power over which they have no control, of which they have no perception. Again: in activity, what intellectual being would resign his employment? Who would be content to forego the pleasures hourly crowding upon him? Each new thought, perception, or judgment is a sufficient reward in itself for his past labours, and all the future is pure enjoyment. There is a labour in thought, but none who have once engaged in it would willingly resign it. Intermissions I speak not of; 'tis the general habit and tenor of the mind that concerns us, and that which has once been made to taste the pleasures of its own voluntary exertions will not by a slight cause be made to forego them.

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"Inertia, as it regards matter, is a term sufficiently well understood both in a state of rest and of motion. As it is not my intention to attempt a description of functions of the mind according to strict mathematical terms, I shall resign the exclusive use of the word at present, and adopt two others, which, according to the sense they have acquired from usage, will, I believe, supply its place with accuracy. Apathy will represent the inertia of a passive mind; industry that of an active mind.

"It is curious to consider how we qualify ideas essentially the same, according to the words made use of to represent them. I might talk of mental inertia for a long time without attaching either blame or praise to it—without the chance even of doing so; but mention apathy and industry, and the mind simultaneously censures the one and commends the other. Yet the things are the same, both idleness and industry are habits, and habits result from inertia....

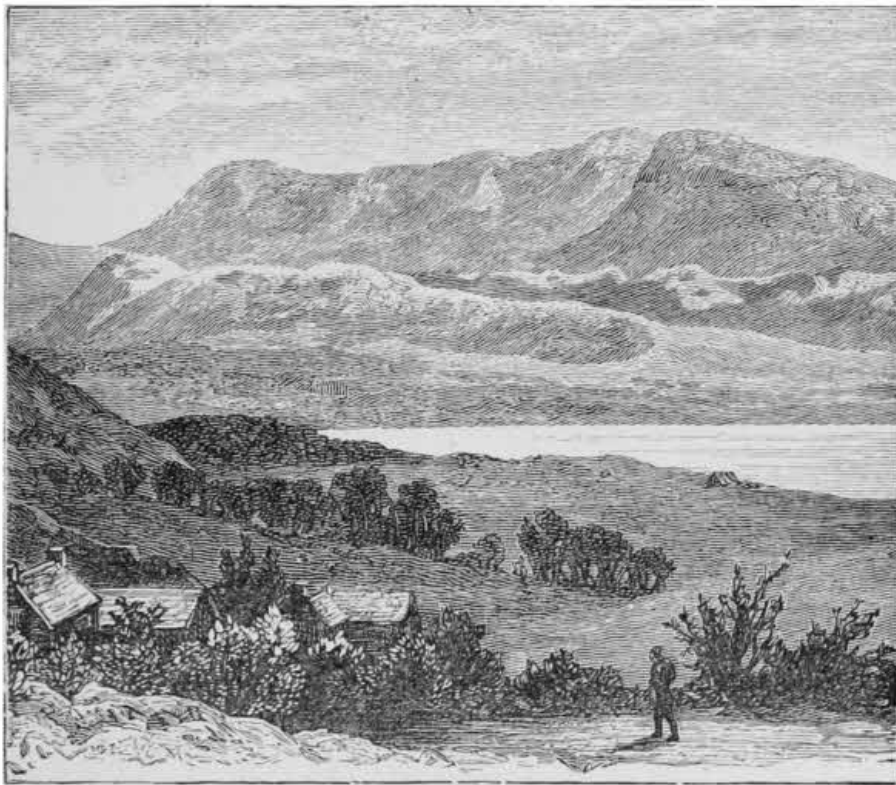
"Inertia has a sway as absolute in natural philosophy over moving bodies as over those at rest. It therefore does not retard motion or change, but is as frequently active in continuing that state as in opposing it. Now, is this the case with mental inertia?"

These passages from Faraday's early lectures serve to show us not only how he was attaining the art of expressing himself clearly, but how thoroughly he went into a subject on which he had once entered. It is not possible to follow in detail the work on which Faraday was engaged. We have seen him learning assiduously, and essaying to teach in the friendly circle of the Philosophical Society. His work during the next few years continued on very similar lines to those which we have been regarding. Year by year, about this time, his scientific writing increased—his work was increasing, his friends were increasing—he was beginning to be "somebody," though as yet but in a small world. He had commenced a correspondence with Professor G. de la Rive—the gentleman who at Geneva had been so struck by him when he was acting as Davy's travelling factotum—a correspondence which on the death of De la Rive was continued with his son, Professor Auguste de la Rive. [63]

In 1821 Faraday married. Before, however, we treat of this important step in his life, let us glance at the journal which he kept of a walking tour he took in Wales during the summer of 1819. This journal gives us further evidence of the genuine enjoyment which he found in scenery and nature in her wilder and more impressive aspects; it also gives further evidence of his simple yet direct way of describing things, of that true descriptive power of which his Continental journal was often a good illustration. At five o'clock in the morning of July 10th, he mounted the top of the *Regulator* coach at the White Horse Cellar, Piccadilly, and at ten o'clock of the same evening was set down at Bristol. Not at all a bad coach-ride for one day's journey. He afterwards visited Cardiff, and went over the Dowlais Ironworks at Merthyr; thence he and his companion wandered about at their own sweet will, unconfined by any artificial circumstances. They walked in that manner which adds so great a charm to a walking tour, never knowing one day whither they should bend their way on the next. The following is a delightful bit descriptive of a visit to the Fall of Scwd-yv-hên-rhyd, or Glentaree, formed by the descent of the River Hên-rhyd.

"*Monday, 19th.*—Proceeding onward into Brecknockshire, we suddenly heard the roar of water where we least expected it, and came on the edge of a deep and woody dell. Entering among the trees, we scrambled onwards after our guide, tumbling and slipping, and jumping, and swinging down the steep sides of the dingle, sometimes in the path of a running torrent, sometimes in the projecting fragments of slate, and sometimes where no path or way at all was visible. The thorns opposed our passage, the boughs dashed the drops in our faces, and stones frequently slipped from beneath our feet into the chasm below, in places where the view fell uninterrupted by the perpendicular sides of the precipices. By the time we had reached the bottom of the dingle, our boots were completely soaked, and so slippery that no reliance could be placed on steps taken in them. We managed, however, very well, and were amply rewarded by the beauty of the fall which now came in view. Before us was a chasm enclosed by high perpendicular and water-worn rocks of slate, from the sides of which sprang a luxuriant vegetation of trees, bushes, and plants. In its bosom was a basin of water, into which fell from above a stream divided into minute drops from the resistance of its deep fall. Here and there lay trunks of trees which had been brought down by the torrent—striking marks of its power—and the rugged bed of shingles and rocky masses further heightened the idea other objects were calculated to give of the force it possessed when swelled by rains. We stepped across the river on a few tottering and slippery stones placed in its bed, and passing beneath the overhanging masses ran round on projecting points, until between the sheet of water and the rock over which it descended; and there we remained some time admiring the scene. Before us was the path of the torrent, after the fine leap which it made in this place; but the abundance of wood hid it ere it had proceeded many yards from the place where it fell. No path was discernible from hence, and we seemed to be enclosed on a spot from whence there was no exit, and where no cry for help could be heard because of the torrent-roar." [64]

Yet another passage should be quoted from this journal; a passage descriptive of an ascent of Cader Idris during a thunder-storm. A thunder-storm was, all his life long, one of the most moving things to Faraday. It seemed always to quicken him into new life. [65]



CADER IDRIS.

"*Sunday, July 26th.*—Ascent of Cader Idris. The thunder had gradually become more and more powerful, and now rain descended. The storm had commenced at the western extremity of the valley, and rising up Cader Idris traversed it in its length, and then passing over rapidly to the south-east, deluged the hills with rain. The waters descended in torrents from the very tops of the highest hills in places where they had never yet been observed, and a river which ran behind the house into the lake below rose momentarily, overflowing its banks, and extended many yards [66]

over the meadows. The storm then took another direction, passing over our heads to the spot in the west at which it had commenced, and having been very violent in its course, seemed there to be exhausted and to die away. The scene altogether was a very magnificent one—the lightning's vivid flash illuminated those parts which had been darkened by its humid habitation, and the thunder's roar seemed the agonies of the expiring clouds as they dissolved into rain; whilst the mountains in echoes mocked the sounds, and laughed at the fruitless efforts of the elements against them."

The journeying was continued on to Dolgelly and Llangollen; and then back again to London, and to work on in his old indefatigable manner. Sir Humphry Davy was in Italy in 1818-19, investigating the questions with regard to the unrolling of papyri recovered from the ruins of Herculaneum. In February, 1819, he wrote to Faraday saying, "I have sent a report on the state of the MSS. to our Government, with a plan for the undertaking of unrolling; one part of the plan is to employ a chemist for the purpose at Naples; should they consent, I hope I shall have to make a proposition to you on the subject." At the end of the same year Davy again wrote to his protégé in a similar strain, but nothing ever came of it. And delighted as Faraday would doubtless have been to re-visit Italy, he probably would not have undertaken the few months' work at Naples if it had meant, as it would doubtless have done, his severing his connection with the Royal Institution.

A much more important step was about to be taken by Faraday. He had a friend, also a member and elder of the Sandemanian Church, by name Barnard. Mr. Barnard was a silversmith who lived in Paternoster Row, and thither Faraday often went, attracted by the charms of Mr. Barnard's third daughter, Sarah. Faraday was at this time twenty-nine years of age, the lady who was to exercise so great an influence over his life was but twenty, and what is more she did not favour his advances. At last, in July, 1820, he wrote to her, and in a letter characterised by the depth no less than the warmth of his affection, begged at any rate to be heard. Such letters, intended for the eyes of but one person, are, as a rule, and it is well they should be, too sacred to be freely reproduced for all the world to read. The letters have, however, before been printed, and it may assist us in forming a correct picture of Michael Faraday—of the earnest, affectionate nature which was his—to re-peruse a passage such as this:— [67]

"Again and again I attempt to say what I feel, but I cannot. Let me, however, claim not to be that selfish being that wishes to bend your affections for his own sake only. In whatever way I can best minister to your happiness, either by assiduity or by absence, it shall be done. Do not injure me by withdrawing your friendship, or punish me for aiming to be more than a friend by making me less; and if you cannot grant me more, leave me what I possess, but hear me."

Miss Barnard showed the letter from which this passage is quoted to her father, whose reply was merely to the effect that "love made philosophers into fools." Doubtful of her own decision on so momentous a question as this, involving the life-long happiness of two persons, Miss Barnard postponed making an immediate decision by accompanying a married sister to Ramsgate.

Faraday made up his mind "to run all risks of a kind reception at Ramsgate." He went there, and after a week of delightful holiday-making, returned to London on August the 7th, having won the consent of her for whom he had evinced so strong a passion. Within twelve months (on June 12th, 1821), Michael Faraday and Sarah Barnard were married, and took up their residence in the Royal Institution. The union proved a perfect one, and a wedded life of nearly half-a-century's duration and of unclouded love was the result. From this time forward the kindness, the affection, the love of home and of those persons forming "home," which had been earlier so marked in Faraday's letters to his mother, become even yet more marked in the letters written to his wife any time between his marriage and his death. Some of these we shall note as we come to treat of the period in which they were written.

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**From a drawing by] MRS. MICHAEL FARADAY.
[Alexander Blaikley.**

The year 1820 was an important one to Faraday for other though less significant reasons: in it his first paper was read before the Royal Society, and he was also engaged with a Mr. Stodart, surgical instrument maker, in experimenting on alloys of steel with a view to improving its quality. For many years after, we are told, Faraday used to present his friends with razors made of a particular alloy discovered at this time. The paper embodying the results of these experiments in alloys was duly published in the *Quarterly Journal of Science*.

A description of our hero (for hero he was—one of our true "heroes of peace"), written by a friend about the time of his marriage, is interesting as assisting us to realise what manner of man he really was in the flesh. "A young-looking man of about thirty years of age, well made, and neat in his dress, his cheerfulness of disposition often breaking out in a short crisp laugh, but thoughtful enough when something important is to be done."

We find Faraday now a young man of thirty, happily married, with a large circle of friends who are finding in him something of that genius which year by year henceforward was to manifest itself; we find him not only gaining the goodwill of these friends for his talents, but gaining their affectionate regard by his unselfishness and unremitting good nature. After their marriage in June, 1821, Mr. and Mrs. Faraday took up their residence in the Institution, where they continued to live for close upon forty years. Although fortune seemed thus to be smiling upon Michael Faraday it must not be supposed that his position at the Royal Institution was a highly remunerative one, his position was yet nominally that of laboratory assistant, and the return which he received for his services was a salary of one hundred pounds per annum, a suite of rooms, and coal and gas.

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[70]

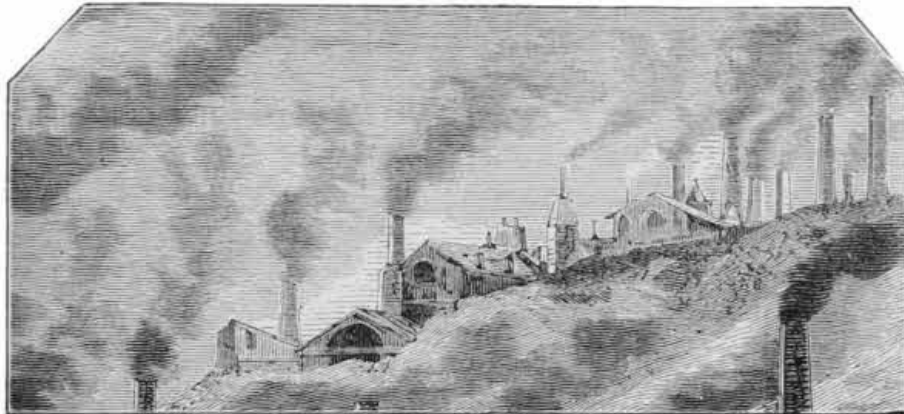
One month after his marriage Faraday made his confession of sin and profession of faith before the Sandemanian Church. It is characteristic of his whole attitude towards religion, and the great and serious regard which it demands from every *individual*, that when his wife asked him why he had not told her what he was about to do, he simply yet earnestly answered, "That is between me and my God." Truth in all things was what he aimed at, and his whole life may be said to be a

seeking after truth in the various branches of knowledge; to half know a thing was never sufficient for him, he could not rest there; he must test its truth, and either cast it away, having proved it worthless, or accept it with delight, having proved its truth. This is evidenced in all his life-work, in his social intercourse no less than in his scientific work, in his letters and journals no less than in his lectures and published papers.

A circumstantial account has appeared in some of the newspapers of Faraday's secession from the Sandemanian Church, and his penitent return to it. Not having seen any reference to such a secession in the biographies of Faraday I wrote to Miss Barnard, who in the following note, most emphatically denies the truth of the story:—"Faraday never seceded from the Church of which he became a member early in life (1821). It is true that for a few weeks in 1844 there was a cessation of his communion with this Church, but the reasons for this were absolutely private, and had nothing to do with any conflict in his mind between his faith in the Scriptures and his scientific work. The statement is altogether without foundation, and neither the scene described nor anything like it ever took place.

"10 Aug., 1891.

JANE BARNARD."



[71]

CHAPTER V. "SCIENCE WHICH I LOVED."

"If I would strive to bring back times, and try
The world's pure gold, and wise simplicity;
If I would virtue set as she was young,
And hear her speak with one, and her first tongue;
If holiest friendship naked to the touch,
I would restore and keep it ever such;
I need no other arts but study thee,
Who prov'st all these were, and again may be."

BEN JONSON.

The year of Faraday's marriage which, as we have seen in the previous chapter, was also important to him in other ways, was marked by one unpleasant incident which was talked about for some time afterward; but although Faraday was then spoken of in no measured terms, it has been conclusively shown that far from any blame being attached to him, the facts of the case are much to his credit. To put the matter shortly it was this. Dr. Wollaston had an idea as to the possibility of electro-magnetic rotation; he expected, in other words, to be able to demonstrate that the "wire in the voltaic circuit would revolve on its own axis." He was at the Institution one day in the early part of 1821, and was making an experiment in the laboratory with Sir Humphry Davy. Faraday, who was not present during the experiment, came in in time to hear the conversation that followed. He afterwards made various experiments on this subject, and was invited by the editor of the *Annals of Philosophy* to contribute an historical sketch of electro-magnetism. This sketch appeared in the *Annals* of the same year; Faraday repeating nearly all of the experiments to which he referred. These experiments of Faraday's led him to the discovery, early in September, of the "rotation of a wire in voltaic current round a magnet, and of a magnet round the wire." He could not make the wire and the magnet revolve on their own axis. "There was not the slightest indication that such was the case."

[72]

Before he published the paper descriptive of these "new electro-magnetical motions," Faraday essayed to see Dr. Wollaston that he might get permission to refer to Wollaston's experiments. The doctor was out of town, and the paper was published "by an error of judgment" without any reference to his opinions and intentions. Directly afterwards Faraday was extremely distressed at hearing rumours which "affected his honour and his honesty." He wrote at once, not only to Stodart, but directly to Dr. Wollaston, whom he met, and after mutual explanation the matter dropped. Faraday, however, continued his electro-magnetic experiments. It is one of these that is referred to by his brother-in-law, who was with him one Christmas Day when: "All at once he

exclaimed, 'Do you see, do you see, do you see, George?' as the small wire began to revolve. I shall never forget the enthusiasm expressed in his face, and the sparkling in his eyes."

In the summer of 1822 Faraday was at Swansea for a fortnight with Phillips, the editor of the *Philosophical Magazine*. Before starting, however, he took his wife and her mother down to Ramsgate, whither he addressed to his wife three letters, in which are evident the deep feelings which were his in regard to their relations. The first letter was written on his arrival in town after leaving Ramsgate. After detailing what he has done, he breaks off, "And now, my dear girl, I must set business aside. I am tired of the dull detail of things, and want to talk of love to you; and surely there can be no circumstance under which I can have more right. The theme was a cheerful and delightful one before we were married, but it is doubly so now.... Oh, my dear Sarah, poets may strive to describe and artists to delineate the happiness which is felt by two hearts truly and mutually loving each other; but it is beyond their efforts, and beyond the thoughts and conceptions of anyone who has not felt it. I have felt it and do feel it, but neither I nor any other man can describe it; nor is it necessary. We are happy, and our God has blessed us with a thousand causes why we should be so. Adieu for to-night."

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The letters from Swansea give an account of his journey, and of his host's house, of work at the copper furnaces, and other places; of the many people there are at Mr. Vivian's (with whom he was staying), and of the late and long dinner, which he made up his mind to avoid if possible. He stayed out walking one evening, got back after dinner had commenced, and so stole up to his own room that he might write a long letter to his wife, in reply to one which he had received from her. "I could almost rejoice at my absence from you," he wrote, "if it were only that it has produced such an earnest and warm mark of affection from you as that letter. Tears of joy and delight fell from my eyes on its perusal."

Early in the following year Faraday was experimenting on chlorine, a subject that had attracted a great deal of Davy's attention. At Davy's suggestion he enclosed some of the gas in an hermetically sealed glass tube, that he might "work with it under pressure, and see what would happen by heat." What "happened" was that on several occasions the tube exploded, twice doing injury to Faraday's eyes. On one of the occasions when Faraday was at work, Dr. Paris happened to enter the laboratory, and seeing an oily liquid in the tube rallied him on his carelessness in using dirty vessels. When, afterwards, the end of the tube was filed off, there was an explosion, and the oily matter disappeared. Early on the following day Dr. Paris received this note:—

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"Dear Sir,—The *oil* you noticed yesterday turns out to be liquid chlorine.

"Yours faithfully, M. FARADAY."

He had in fact succeeded in converting chlorine gas into a liquid by means of its own pressure. This was an important discovery which led to numerous experiments with other gases, and with like results.

On May 1st, 1823, Faraday's certificate as a candidate for fellowship in the Royal Society was read for the first time. Such a distinction was no doubt a coveted one in Faraday's eyes, and it must have been extremely painful to him when he found that Sir Humphry Davy was opposed to his election. It is interesting to observe, however, that the very first signature on his certificate is that of Dr. Wollaston. Such being the case it seems impossible that the old charge against Faraday in regard to electro-magnetic rotation could have been revived, and yet so it was. Wollaston himself had expressed perfect satisfaction, and the matter seemed definitely settled. Much as this revival of an untrue charge must have distressed a man of Faraday's uncompromising integrity, to find Davy, of all men, opposing him must have been yet more distressing. That Davy's opposition was active may be surmised from the following, which is told by Faraday himself: "Sir H. Davy told me I must take down my certificate. I replied that I had not put it up; that I could not take it down, as it was put up by my proposers. He then said I must get my proposers to take it down. I answered that I knew they would not do so. Then he said, I, as President, will take it down. I replied that I was sure Sir H. Davy would do what he thought was for the good of the Royal Society."

[75]

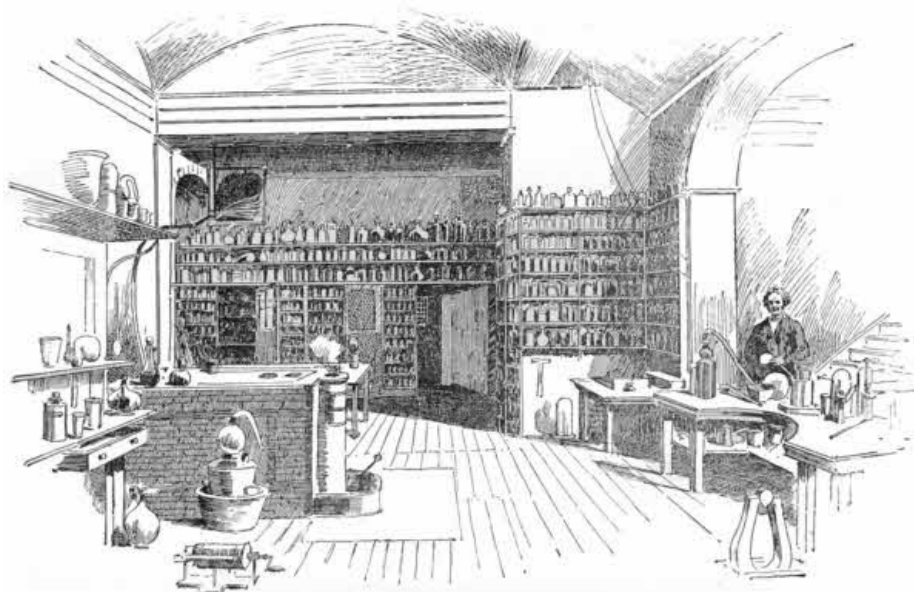
This attitude of Davy's naturally pained Faraday exceedingly; many years afterwards some allusion by a friend to his early life led up to a mention of it; Faraday rose abruptly from his seat, and took a rapid walk up and down the room, saying, "Talk of something else, and never let me speak of this again. I wish to remember nothing but Davy's kindness." There were tears in his eyes as he spoke, showing how deeply the man was moved. Faraday also said that Davy had walked for an hour about the courtyard of Somerset House, arguing with one of his proposers that Faraday should not be elected. We know none of the reasons for Davy's opposition, and his attitude in this affair must ever remain a cloud on his fair fame; that he, a self-made man, who had risen to the first position among modern chemists, should oppose at this stage of his career a man somewhat similarly circumstanced, who was also moving upwards step by step to one of the highest positions among modern philosophers, as he loved always to be called, is indeed as strange as it is regrettable. The fact, sad as it is, has to be noted; but we will not dwell upon it; more gratifying is it to learn how, when the ballot was taken, Michael Faraday was almost unanimously elected a Fellow of the Royal Society, there being but one black ball. This, in after years, he proudly mentioned, was the only one among his innumerable honours that he had sought for. Scarce a year passed afterwards but some fresh distinction was conferred upon him.

Early in 1824 John Wilson Croker, with Sir Thomas Lawrence, Sir F. Chantrey, and Sir H. Davy founded the Athenæum Club, which still flourishes. For a short while Faraday acted as honorary secretary to the Club; but his more congenial scientific labours could not be neglected, and he

soon retired from the secretaryship, in which he was succeeded by his friend Magrath, who continued to hold the post for many years. [76]

Faraday's notes and papers contributed to the scientific journals and other periodicals were frequent, but it would profit little here to detail them. One discovery he made about this time is well worthy of mention as it has had an important effect on a particular industry—the discovery was that of benzol, benzine, or as Faraday named it, "bicarburet of hydrogen." This is prepared now in large quantities, being employed in the manufacture of aniline colours.

We have it on the authority of Sir Roderick Murchison that Faraday's first lecture at the Royal Institution was delivered in the following circumstances. Brande, who had succeeded Sir Humphry Davy as the Professor of Chemistry, was delivering a course of lectures; one day the lecturer, owing to illness or some other cause, was absent, but his assistant (Faraday) took his place, and lectured with so much ease that he won the complete approval of his audience. In this connection too, it is interesting to note that it was towards the close of this same year that Faraday began his experiments in magnetic electricity, the particular branch of research which was to occupy a great part of his later life, and in which he was destined to make some of his most brilliant discoveries.



THE LABORATORY, ROYAL INSTITUTION.

It is pleasing to find that whatever may have been Davy's object in opposing Faraday's election into the Royal Society, he did not bear him any continued ill-will; this is shown us not only by Davy's expressions of goodwill in his letters, but by such things as an entry in the minutes of a meeting of the managers of the Royal Institution in February, 1825. From this entry we learn that Sir Humphry Davy, "having stated that he considered the talents and services of Mr. Faraday, assistant in the laboratory, entitled to some mark of approbation from the managers, and these sentiments having met the cordial concurrence of the board; *Resolved*:—That Mr. Faraday be appointed Director of the Laboratory, under the superintendence of the Professor of Chemistry." [77] [78]

It was after receiving this appointment that Faraday occasionally invited members of the Institution to evening meetings in the laboratory, when he generally had something new and interesting to show them. In these meetings in the laboratory was the origin of those regular Friday evening meetings in the theatre, which commenced in 1826, which have had for many years a world-wide reputation, and which have drawn together, week after week and year after year, large numbers of persons interested in science and in its popular exposition. In 1826, the year in which the first regular Friday evening meetings took place, seventeen lectures were delivered, six of them being given by Faraday himself, on such a variety of subjects as "Caoutchouc," "Lithography," "Brunel's Tunnel at Rotherhithe," etc. His aim in inaugurating these "Friday evenings" may be gathered from the scanty notes which he made for introducing one of the earliest of the lectures:—"Evening opportunities—interesting, amusing; instructive also:—scientific research—abstract reasoning, but in a popular way—dignity;—facilitate our object of attracting the world, and making ourselves with science attractive to it."

These notes, slight as they are, give us an idea of what Faraday's objects were, and are at the same time interesting, as they may fairly be said to represent the aim of a large part of his lecturing work throughout his career, the aim that is, which always seemed to be his, to make the subject of which he was speaking amusing, interesting, and instructive. No other man had ever succeeded in attracting the world to science by making the science attractive to them. High as is Faraday's position as a scientist and philosopher, he is also to be remembered with much gratitude as, in point of time as well as of ability, the first of all true popularisers of science. This may not at first sound a very high title to bestow, but yet it is far from an insignificant one, and one that must indeed have gratified Faraday; much as he was pleased with the acknowledgment of himself as one of their peers by such men as Davy, De la Rive, and other scientists, the knowledge that he was interpreting the wonders of Nature to a vast number of persons hitherto ignorant, or in a measure ignorant, of her marvellous ways, was yet more pleasing to him. We can fully understand his echoing the sentiment which the late James Russell Lowell, speaking of the [79]

poet, expresses in the following beautiful verses:—

"It may be glorious to write
Thoughts that shall glad the two or three
High souls, like those far stars that come in sight
Once in a century;—

"But better far it is to speak
One simple word, which now and then
Shall waken their free nature in the weak
And friendless sons of men;

"To write some earnest verse or line,
Which, seeking not the praise of art,
Shall make a clearer faith and manhood shine
In the untutored heart.

"He who doth this in verse or prose,
May be forgotten in his day,
But surely shall be crowned at last with those
Who live and speak for aye."

In 1827 Faraday's first book—*On Chemical Manipulation*—was produced. Faraday had published a short while before an account of some discovery he had made with respect to the existence of fluid sulphurs; in this year he writes:—"I have just learned that Signor Bellani had observed the same fact in 1813. M. Bellani complains of the manner in which facts and theories which have been published by him are afterwards given by others as new discoveries; and though I find myself classed with Gay-Lussac, Sir H. Davy, Daniell and Bostock, in having thus erred, I shall not rest satisfied without making restitution, for M. Bellani in this instance certainly deserves it at my hand." This is worthy of note as a slight illustration of the true integrity of Faraday's character; much as he valued any original discovery he might make, he valued much more that absolute truth which made him render honour to any predecessor even at his own expense; this was done, too, always as a matter of course, without the slightest spirit of grudging. His behaviour on such occasions, which are indeed too trying to most persons, had perhaps a great deal to do with the feeling which he awakened in all who came in contact with him. Never, perhaps, was there a more unselfish, as there was never a more universally beloved, man. "His friendship," as Professor Tyndall says, "was energy and inspiration."

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Faraday was appointed member of a "committee for the improvement of glass for optical purposes;" one of the results of his investigation was that when delivering, in 1829, the Bakerian lecture at the Royal Institution, he took for his subject, "The Manufacture of Glass for Optical Purposes." For further investigation of this subject a special experimenting room and furnace had been built at the Institution in 1827, and a special assistant—Sergeant Anderson—engaged to assist Faraday. One chief object of these experiments was to improve the glasses of telescopes. This desired result was, however, not attained, although some notable work was done; the glass then manufactured, for instance, became invaluable in some of Faraday's later researches. In 1830 the glass-making investigation stopped, and in the year following the committee presented their report to the Royal Society which had appointed them.

The recognition of Faraday's importance in the world of science was now made more manifest each year; not only were honours done him by various English and Continental societies, but in 1826 the managers of the Royal Institution "relieved him from his duty as chemical assistant at the lectures because of his occupation in research." In 1829 he was invited to attend the meetings of the managers. In 1827 he had been offered the Professorship of Chemistry in London University, but much as he felt the honour which was done him, Faraday declined it, and from the noblest of motives, as will be seen in this passage from his letter to Dr. Lardner on the subject.

[81]

"I think it a matter of duty and gratitude on my part to do what I can for the good of the Royal Institution in the present attempt to establish it firmly. The Institution has been a source of knowledge and pleasure to me for the last fourteen years; and though it does not pay me in salary for what I *now* strive to do for it, yet I possess the kind feelings and goodwill of its authorities and members, and all the privileges it can grant or I require; and, moreover, I remember the protection it has afforded me during the past years of my scientific life."

In 1829 he was offered, and accepted, as it did not interfere with his Royal Institution work, a post as lecturer in chemistry at the Royal Academy, Woolwich.

In the same year died Sir Humphry Davy—the great chemist to whom Faraday owed so much, and to whom, as we have shown, he remained deeply attached to the last. Davy had fought his way up as Faraday had done, but, unlike Faraday, had been in a measure spoiled by his success; he had very little self-control, and but little method and order, and was, perhaps, too anxious about his fame,—about how he would stand in the eyes of men. With Faraday it was far different—he aimed at truth in his knowledge, and cared but little for what the world might consider as success. He was known to say, referring to his experiments under Davy, "that the greatest of all his great advantages was that he had a model to teach him what to avoid." Faraday and Davy were, nevertheless, friends to the last, and the death of the latter at the comparatively early age of fifty-two must have been a great blow to the younger man.

[82]

The year 1831 is an important one in the life of Michael Faraday, for it was then that he commenced his brilliant series of experiments in electro-magnetism. It is on his electrical research that his chief claim to be remembered as a scientist rests. He had earlier experimented in the same connection, but hitherto without attaining the results which he had anticipated. But from this time forward he devoted much energy to this branch of research, with such success that if we pick up any of the most recent works on electrical science we inevitably find an important position given in it to the name and discoveries of Michael Faraday. This is not the place to enter into a description of these experiments, though reference to them will of course be made later on in this biography in the chapter devoted to a consideration of Faraday's discoveries. In the year 1833 Faraday was appointed Fullerian Professor of Chemistry in the Royal Institution for life, without the obligation of having to deliver lectures in connection with the professorship.

In the year 1834 a boy living in a distant part of England wrote to Professor Faraday, saying that he was desirous of taking up a scientific career. Doubtless remembering his own beginning, Faraday sent "by return of post a kind and courteous reply," which that boy, grown to man's estate, and known as Doctor J. Scoffern, gratefully referred to in a graceful tribute which he wrote after Faraday's death. It was during this early part of Faraday's success that he once gave evidence in a judicial case, when the scientific testimony was so diverse that the judge, in summing up, levelled something very like a reproach at the scientific witnesses, saying, "Science has not shone this day." Faraday would never again appear as a witness in a court of law.

This is, perhaps, the most fitting place in which we can refer to some slight account of Faraday's home-life in the Institution, which is given by his brother-in-law George (Mrs. Faraday's youngest brother) and Miss Reid (her niece). George Barnard was much with the Faradays in these earlier times. "All the years I was with Harding I dined at the Royal Institution," he says. "After dinner we nearly always had our games just like boys—sometimes at ball, or with horse-chestnuts instead of marbles—Faraday appearing to enjoy them as much as I did, and generally excelling us all. Sometimes we rode round the theatre on a velocipede, which was then a new thing." It is said "that sometimes of an early summer morning the philosopher was to be seen going up Hampstead Hill on this velocipede." Barnard tells, too, of Faraday's unflagging good spirits and his faculty for entering with keen enjoyment into any fun that was going forward—pic-nics up the river, with rustic cookery, charades, or anything else the party seemed bent upon, Faraday would join in with delight; how he used to attend Hullmandel's conversaziones, where he met many of the leading singers and artists of the day—Garcia and Malibran, Sir Edwin Landseer, Clarkson Stanfield, J. M. W. Turner, and indeed most of the members of the Royal Academy. The last-named artist often applied to Faraday for chemical information about his pigments; upon Turner, and all artists who made similar requests, Faraday would always impress the importance there was in their prosecuting experiments with regard to their colours themselves, giving them a hint to put some of their colour and colour-washes in a bright sunlight, covering up one half and leaving the other exposed, and then observing the effect of light and gases on the latter. Mr. Barnard says that during their various country trips Faraday was in the habit of just "rambling about geologising or botanising."

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Mrs. Faraday's niece, Miss Reid, was peculiarly well fitted to give reminiscences of her uncle, as she was for nearly twenty years (from 1826) one of the family at the Royal Institution. When she first went there Miss Reid was only a little child; and when her aunt was going out she was taken down to Faraday's laboratory, where, as she afterwards wrote, "I had, of course, to sit as still as a mouse, with my needlework; but my uncle would often stop and give me a kind word or a nod, or sometimes throw a bit of potassium into water to amuse me."

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"In all my childish troubles," Miss Reid continues, "he was my never-failing comforter, and seldom too busy, if I stole into his room, to spare me a few minutes; and when perhaps I was naughty and rebellious, how gently and kindly he would win me round, telling me what he used to feel himself when he was young, advising me to submit to the reproof I was fighting against."

"I remember his saying that he found it a good and useful rule to listen to all corrections quietly, even if he did not see reason to agree with them."

"If I had a difficult lesson, a word or two from him would clear away all my trouble; and many a long wearisome sum in arithmetic became quite a delight when he undertook to explain it."

The same lady gives some admirable notes of a holiday the small family party spent at Walmer, in Kent. How they drove down on the outside of the coach, and how full of fun Faraday was, when they reached Shooter's Hill, over Falstaff and the men in buckram; "not a sight nor a sound of interest escaped his quick eye and ear."

"At Walmer we had a cottage in a field, and my uncle was delighted because a window looked directly into a blackbird's nest built in a cherry tree. He would go many times in a day to watch the parent birds feeding their young."

Sunrise and sunset were never-failing sources of delighted admiration to him; at such times he was the best of companions, and it has been described as a great treat to watch the glorious sight with him.

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"He carried Galpin's *Botany* in his pocket, and used to make me examine any flower new to me as we rested in the fields. The first we got at Walmer was the *Echium vulgare*, and is always associated in my mind with his lesson. For when we met with it a second time he asked, 'What is the name of that flower?' 'Viper's bugloss,' said I. 'No, no, I must have the Latin name,' said he."

On one occasion he called his wife and niece into his room to "see a spectre." It was about ten

o'clock in the evening, a thick white mist had risen. He then placed a candle behind them as they stood by the window, and they saw two gigantic shadowy beings projected on the mist and imitating, of course, every movement they made. Faraday had gone to Walmer for rest and refreshment, and his niece says that she, the young one of the party, had to inveigle him away from his books and papers to which he would return, and tempt him out on some excursion to see or find something, on which occasion he was nothing loth. We see, indeed, at all times of his life how keen was the delight he took in the company of young people; how beautifully he could enter into the spirit which animated their play, as though he was still a child himself, and this valuable faculty was his up to the latest.

Of the Walmer excursion his niece further says:—"One day he went far out among the rocks, and brought home a great many wonderful things to show me; for in those days I had never seen nor heard of hermit crabs and sea anemones. My uncle seemed to watch them with as much delight as I did; and how heartily he would laugh at some of the movements of the crabs! We went one night to look for glow-worms. We searched every bank and likely place near, but not one did we see. On coming home to our cottage he espied a tiny speck of light on one of the doorposts. It came from a small centipede; but though it was put carefully under a glass, it never showed its light again.

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"My uncle read aloud delightfully. Sometimes he gave us one of Shakespeare's plays or Scott's novels. But of all things I used to like to hear him read *Childe Harold*; and never shall I forget the way in which he read the description of the storm on Lake Lemman. He took great pleasure in Byron, and Coleridge's 'Hymn to Mont Blanc' delighted him. When anything touched his feelings as he read—and it happened not infrequently—he would show it not only by tears in his voice, but by tears in his eyes also. Nothing vexed him more than any kind of subterfuge or prevarication, or glossing over things."

His niece mentioned on one occasion a professor who had been discovered abstracting some manuscript from a library. He instantly said, "What do you mean by abstracting? You should say stealing; use the right word, my dear."

Indecision of any kind Faraday could not bear; not only should one decide, but quickly. Indeed he thought that in trifling matters immediate decision was important; it was better to decide incorrectly than to remain hesitating. As soon as he left his study and laboratory Faraday had the happy faculty of being able to throw aside his science, and would, on going into the sitting-room, "enter into all the nonsense that was going on as heartily as any one; and as we sat round the fire he would often play some childish game, at which he was usually the best performer; or he would take part in a charade, and I well recollect his being dressed up to act the villain, and very fierce he looked. Another time I recollect him as the learned pig."

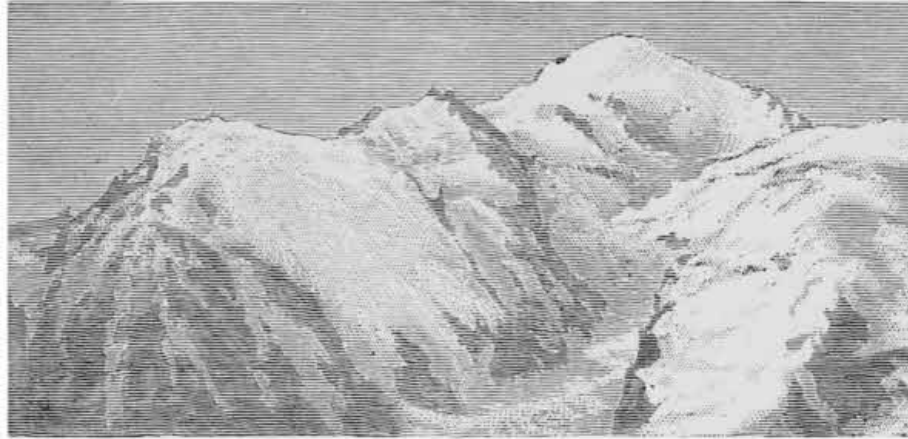


FARADAY'S STUDY.

As we learn such things as these about him we cease to wonder that Faraday was the object of so much admiration and love from all persons, old and young, with whom he came in contact. His wonderful work as a scientist will, it is to be hoped, never be remembered as his only claim on our regard; for as one of the best and kindest and most helpful of men, whose singular modesty and gentleness of character endeared him to all, he certainly deserves to be kept ever in our recollection. We must not, as a friend wrote of him, allow the name of Faraday "to be nothing but a peg on which to hang discoveries;" but must also recollect that his "time, thoughts, purse, everything was freely given to those who had need of them."

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CHAPTER VI. AS TEACHER AND PREACHER.

"'Tis the man who with a man
Is an equal, be he king,
Or poorest of the beggar clan,
Or any other wondrous thing
A man may be."

KEATS.

By the commencement of the year 1835 we find Michael Faraday, not yet forty-four years of age, generally acknowledged as one of their peers by the leading men of science, not only in England but also on the Continent. We find him elected member of many of the most important scientific and philosophical societies of this and other countries; we find him honoured by the University of Oxford with the degree of D.C.L.; and, as we shall shortly see, we find the Government proposing to confer a pension on him in consideration of the services which he has already rendered to science. Truly a wonderful change to be wrought in the life of a man who thirty years before was carrying round newspapers as a common errand boy. It is, however, always gratifying to note, and especially pleasing to remember, that however successful he might be, Faraday was never spoiled by the honours that were done him; he was always the same kindly, helpful, simple man that he had been. Those persons who had the great good fortune to visit him at the Royal Institution, either at the time of which we are treating or during his later life, never failed to find a cordial welcome; "a friendly chat in those quiet rooms was one of the greatest pleasures it was possible to enjoy. The frugal simplicity of the furniture was characteristic of Faraday."

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The Faradays lived quietly to themselves at the Institution, though they often, after the Friday evening lectures, went round to Berkley Street to tea to Mr. Richard Barlow's house, that gentleman and his wife always being at home to their friends after the Friday evenings. On such occasions as these gatherings, Faraday, we learn, used to be the centre of much interest and delight; for he had, as may be gathered from what has already been said of his character, that happy disposition which placed him at once in sympathy with any person with whom he might be speaking; especially was this rare sympathy his with regard to children, with whom he seemed at once able to place himself on an equal footing; and this it was that made his lectures to young people not only so interesting but so widely popular as they were. This subject, however, deserves fuller consideration, and will be found treated in a later chapter.

Had he chosen to do so at this period of his career, Faraday might have been in receipt of a pretty considerable income. In 1830, indeed, he had undertaken several commercial analyses, and his income from this source alone came to as much as a thousand pounds. Such work interfered with his research, and was therefore unhesitatingly given up, and two years afterwards his professional gains amounted to but little more than a hundred and fifty pounds for

the year, and in after years they did not reach even that sum.

Early in 1835 Faraday received an intimation from Sir James South that had Sir Robert Peel remained in office he had intended conferring a pension upon him. Faraday wrote in reply, saying that he could not accept a pension. The matter after this remained in abeyance for a while. During the summer Faraday spent a short holiday in Switzerland, whence he wrote to his old friend Magrath: "The weather has been most delightful, and everything in our favour, so that the scenery has been in the most beautiful condition. Mont Blanc, above all, is wonderful, and I could not but feel at it what I have often felt before, that painting is very far beneath poetry in cases of high expression; of which this is one. No artist should try to paint Mont Blanc; it is utterly out of his reach. He cannot convey an idea of it, and a formal mass or a commonplace model conveys more intelligence, even with respect to the sublimity of the mountain, than his highest efforts can do. In fact, he must be able to dip his brush in light and darkness before he can paint Mont Blanc. Yet the moment one sees it Lord Byron's expressions come to mind, as they seem to apply. The poetry and the subject dignify each other."

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In the autumn of the same year, shortly after his return from the Continent, the subject of a pension for Faraday was re-opened. The independence and openness of his character came out in a remarkable manner in this matter. He was asked to wait upon Lord Melbourne, the Prime Minister, at the Treasury, which he did on October 26th. However he may have spoken of Faraday personally, Lord Melbourne spoke of literary and scientific men with but scant courtesy, and in effect seemed to consider the awarding them pensions as a piece of State humbug. We have seen how Faraday resented a slur cast upon science in a court of law, and he was no less indignant on this occasion; he returned home and wrote a letter, the tone of which though dignified was very decided. This letter, in which he declined to accept or even further to consider the acceptance of a pension from the Government, Faraday intended to forward at once to Lord Melbourne. He finally, however, allowed somewhat wiser counsels to prevail; his father-in-law, while justly proud of Michael's scientific attainments, was also a shrewd business-like man, and persuaded him to write a letter, which, although it was not one whit less dignified in its tone was less decided in its refusal of the proposed pension.

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After many fruitless efforts to make Faraday change his decision, a lady, who was a friend both of the philosopher and of the Prime Minister, asked the former what he would require at the hand of Lord Melbourne to make him change his mind on the subject. "I should require," he replied, "from his lordship what I have no right or reason to expect that he would grant—a written apology for the words he permitted himself to use to me." To Melbourne's credit, be it said, that as soon as he knew of this he apologised amply for, as he expressed it, the "too blunt and inconsiderate manner in which he had expressed himself."

On December 24th of the same year the pension of three hundred pounds a year was awarded to Michael Faraday for his services to the cause of science. A pension, it may here be mentioned, half of which was continued to the Professor's widow, and on her death to his niece, Miss Jane Barnard. He was not yet forty-five, we must recollect, when he was thought to have fairly earned this reward. Early in 1836 further honour was done to him by his being appointed scientific adviser to the Trinity House; in accepting the position he wrote a characteristic letter, of which the following is a portion; it was addressed to Captain Pelly, Deputy-Master: "I consider your letter to me as a great compliment, and should view the appointment at the Trinity House, which you propose, in the same light; but I may not accept even honours without due consideration. In the first place my time is of great value to me, and if the appointment you speak of involved anything like periodical routine attendances I do not think I could accept it. But if it meant that in consultation, in the examination of proposed plans and experiments, in trials, etc., made as my convenience would allow, and with an honest sense of a duty to be performed, then I think it would consist with my present engagements.... In consequence of the goodwill and confidence of all around me, I can at any moment convert my time into money, but I do not require more of the latter than is sufficient for necessary purposes. The sum, therefore, of £200 is quite enough in itself, but not if it is to be the indicator of the character of the appointment. But I think you do not view it so, and that you and I understand each other in that respect; and your letter confirms me in that opinion. The position which I presume you would wish me to hold is analogous to that of a standing counsel. As to the title it might be what you pleased almost. Chemical adviser is too narrow; for you would find me venturing into parts of the philosophy of light not chemical. Scientific adviser (the title afterwards decided upon) you may think too broad—or in me too presumptuous—and so it would be, if by it was understood all science.... The thought occurs to me whether, after all, you want such a person as myself. This you must judge of; but I always entertain a fear of taking an office in which I may be of no use to those who engage me."

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This letter is, as I have said, characteristic of the writer; it is characteristic of his sensitiveness to any honour done to him, and of his unworldliness, of his conscientiousness in making sure that he will be able to perform anything that he may undertake, and of a half-diffidence with regard to himself as to whether he was able to do all that was anticipated of him. For nearly thirty years, with credit to himself and to the Brethren of the Trinity House, did Michael Faraday continue as their scientific adviser. Frequently do we find him experimenting on lights and lighting—visiting the various lighthouses round the coast, trying the electric light for them, comparing the various lights, and reporting to the Brethren—such work as this is, as has been said, to be frequently noted in looking over a record of the mass of work which during these years Faraday was doing. It is pleasing to notice here that on her husband's death Mrs. Faraday presented such of his portfolios, of well-ordered and indexed manuscripts, as referred to this part of his work to the Trinity House. So carefully were these notes made and kept that it is possible now to refer quite

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easily to any particular piece of work on which Faraday was engaged during these thirty years.

In this same year (1836) there appeared the *Life of Sir Humphry Davy*, by his brother, Dr. John Davy. In this work statements were made with relation to Faraday and his patron which were not true; and painful indeed though it must have been to the former, he felt compelled to deny them. This he did in a long letter to his friend R. Phillips, editor of the *Philosophical Magazine*, in which periodical the letter was published. "I regret," Faraday wrote, "that Dr. Davy has made that necessary which I did not think before so; but I feel that I cannot, after his observation, indulge my earnest desire to be silent on the matter, without incurring the risk of being charged with something opposed to an *honest* character. This I dare not risk; but in answering for myself I trust that it will be understood that I have been driven unwillingly into utterance."

The subject must indeed have been a painful one; to have to assert his own right to be the discoverer of certain chemical results which were being credited to Davy. In one or two cases, when he found that he had been preceded in the discovery of anything he was the first to acknowledge that all honour was due to his predecessor, and that strict regard for true honesty in all things very properly would not allow him to be silent now. He concludes his letter to Phillips in these words, "Believing that I have now said enough to preserve my own 'honest fame' from any injury it might have risked from the mistakes of Dr. Davy, I willingly bring this letter to a close, and trust that I shall never again have to address you on the subject."

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It was at about this time that another incident occurred which illustrates Faraday's absolute integrity of character—integrity that would not wink at anything that was in the slightest degree not straightforward, even though it was against his own interest, which, indeed, rather shunned doing a good deed that might seem dictated by mere self-interest. His brother was working at the time as a gas-fitter, and there was a possibility of his getting the Athenæum Club work in connection with his trade. Michael, writing on the subject, said, "Few things would please me more than to help my brother in his business, or than to know that he had got the Athenæum work; but I am exceedingly jealous of myself, lest I should endeavour to have that done for him as my brother which the Committee might not like to do for him as a tradesman, and it is this which makes me very shy of saying a word about the matter."

During these years Faraday was getting through a vast quantity of work, his experimental researches in electricity were taking up a great part of his time, but other matters were not neglected. He was frequently lecturing before the Royal Institution or the Royal Society; while he wrote a large number of scientific papers for the various philosophical periodicals to which he contributed. Besides presenting series after series of his brilliant *Experimental Researches* to the Royal Society, he had also to attend to his lectures at Woolwich, and his work for the Trinity House. He must indeed, hard-working man that he was, have found his long day very fully occupied; and it is scarcely to be wondered at that in 1839 the strain began to tell upon him, and a period of rest became necessary. As years went on, such periods of rest were more frequent and yet more vitally important.

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In 1837 the British Association^[8] held its Annual Meeting at Liverpool, and Faraday attended it, and was made, as he put it, "a most responsible person," President of the Chemical section. From Liverpool he wrote home to his wife, "To-day I think we made our section rather more interesting than was expected, and to-morrow I expect will be good also. In the afternoon Daniell and I took a quiet walk; in the evening he dined with me here. We have been since to a grand conversazione at the Town Hall, and I have now returned to my room to talk with you as the pleasantest and happiest thing I can do. Nothing rests me so much as communion with you. I feel it even now as I write; and I catch myself saying the words aloud as I write them, as if you were within hearing. Dear girl, think of me till Saturday evening. I find I can get home very well by that time; so you may expect me.

"Ever, my dear Sarah, your affectionate husband,

"M. FARADAY."

This reference to getting home on Saturday evening is especially interesting, for Faraday always took his wife home to her father's house every Saturday evening, that she might see her family; they all went to church together on the Sunday. This was an unvarying rule of Faraday's for very many years, as long, indeed, as it was possible.

Faraday's mother, after having lived to see "her Michael" come to be one of the great men of his time, died at Islington in March, 1838. The loss must have been keenly felt by Faraday, for between mother and son the tenderest affection had always subsisted. She was justly proud of the position which her boy had won for himself; and he ever retained that beautiful chivalrous kindness and deference to his mother that had characterised him all along. The passages from his earlier letters to his mother which have been given in previous pages are evidence of this, and his kindly consideration was ever the same. Much as the death of his mother, and, a few years later, of his brother Robert, affected him, Faraday had in his beautiful clear-sighted faith in his religion a source of inextinguishable solace, and looking forward to a reunion hereafter could see a "beautiful and consoling influence in the midst of all these troubles."

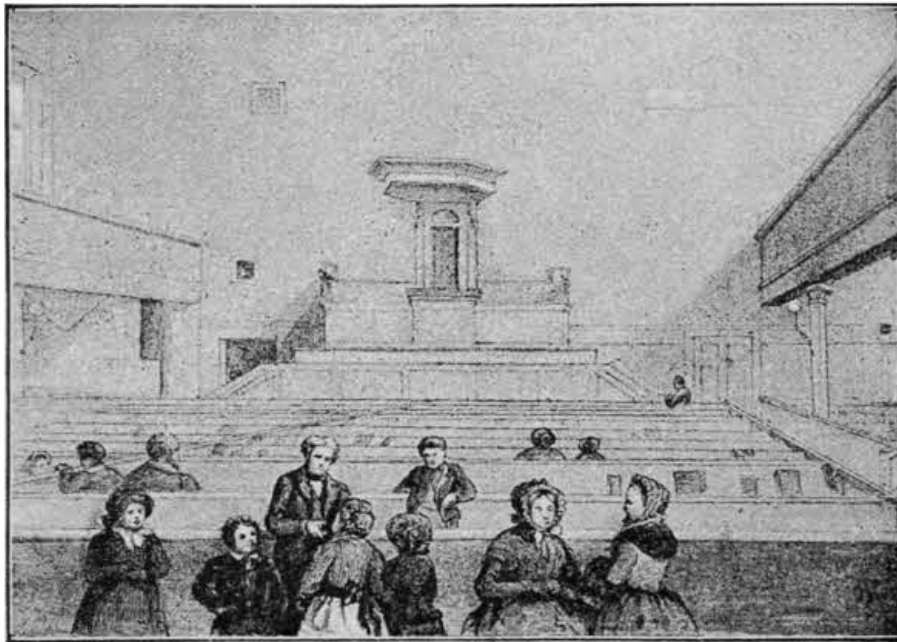
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Severe and long-continued mental work, as I have said, began to tell upon Faraday in 1839, and he was ordered by his doctor to take an absolute rest. He suffered from loss of memory and similar symptoms of an overworked brain. His wife, as her niece tells us, used to carry him off to Brighton, or somewhere down into the country for a few days when he became dull and low-spirited, and the rest soon restored him. During such a sojourn at Brighton, towards the close of 1839, Professor Brande wrote to him, saying that the doctor said Faraday was to remain

thoroughly idle for a time; and he (Brande) kindly offered at the same time to do anything he could to relieve Faraday of any routine work. He had indeed read some of Faraday's electricity lectures at the Institution, although, as he terms it in his letter to Faraday, "he began to fear the fate of Phæton in the chariot of Phœbus." As yet, however, Faraday would not take a very long-continued rest, and he was before long back in Albemarle Street working, although less than he had been doing.

In the year 1840 Faraday's health made it necessary that his scientific labours should be reduced, and just about this time, although he was still adding to his series of *Experimental Researches*, he was husbanding his strength as far as possible. This year, too, deserves especial note, for it was now that he became an elder in the Sandemanian Church; he had before on some occasions exhorted those present at week-day meetings, but it now devolved upon him to deliver regular sermons. Faraday, as we have already seen, on more than one occasion, was not a man to undertake anything without doing it to the best of his abilities; and if this was his character in matters of everyday concern, how much more so should we expect it to be, and not without reason, his character in so vital a question as that concerning his religion. Or perhaps it would be more correct to say concerning the more obvious exercise of his religious faith, for the spirit of his religion coloured all that he did; it was indeed the moving force of his soul, and was not confined to any narrow circle.

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**INTERIOR OF THE OLD SANDEMANIAN MEETING-HOUSE,
PAUL'S ALLEY.**

The flow and energy which characterised Faraday as a lecturer were replaced in his sermons by a simplicity and earnestness that together are best described as true devoutness. His sermons were always extemporaneous, although the outlines of them were carefully prepared beforehand, a small card having noted down on either side of it the heads of the elder's discourse and reference to such passages in the Bible as he wanted to quote. One of these cards is given that it may show with what slight notes the earnest and reverent preacher provided himself. A friend, describing him officiating at the chapel, which was situated in Paul's Alley, Redcross Street, City, but which has long since been pulled down, and the Church transferred to Barnsbury Grove, N., said, "He read a long portion of one of the Gospels slowly, reverently, and with such an intelligent and sympathising appreciation of the meaning, that I thought I had never before heard so excellent a reader."

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- 2 Peter iii. 1, 2, 14. *A prophetic warning to Christians.*
- First, the power and grace and promises of the gospel.
- i. 3, by His power are given great and precious promises,
- 4, divine nature and brethren exhorted to give diligence,
- 5, whilst in this life up to v. 8.
- *Then* cometh a warning of the state into which they *may*
- fall, 8, 9, if they forget—as he stirs them up, 12, 13, 15, as
- escapers from the corruption, i. 4.
- iii. 14. *Wherefore, beloved, seeing ye LOOK for such things,*
- their hope and expectation—it is to stir up their pure mind,
- iii., 1, by way of remembrance—hastening the day of the,
- v. 12, awful as that day will be, 12, 7, because of the

- deliverance from the plague of our own heart.
- 2 Cor. iv. 18, 17, 16, look not at things seen—temporal.
- Titus ii. 13, looking for the hope and glorious appearing.
- Heb. x. 37, yet a little while, and He that shall come will come.

-
- The world make His forbearance a plea to forget Him or
 - deny Him.
 - iii. 4, 5, perceiving Him not in His works. His people see
 - His mercy and long-suffering and look for His promise, 12,
 - 14, and salvation, 15, and learn that He knoweth how to
 - reserve, ii 3, 9, and preserve, hence

-
- they are not to be slothful, Prov. xxiv. 30.
 - nor sleeping—Matt xxv. 1. Sleeping virgins
 - nor doubting iii. 4.
 - nor repining Heb. xii. 12, 3, 5, lift up hands
 - Jas. v. 7, 8, be patient—husbandmen
 - waiteth, but waiting, Luke xii. 36, 37, 39, 40,
 - Peter 41, v. 58, 58 refers to days of long-suffering.

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- Wherefore, beloved, seeing ye know these things, beware, etc.,
 - danger of falling away in many parts, i. 9, ii. 20, 21, 22,
 - great pride of the *formal* adherers, ii. 19, 13.
 - But the assurance is at iii. 18—i. 2, 8.

COPY OF ONE OF THE CARDS FROM WHICH FARADAY PREACHED.

Another of his listeners said, "His object seemed to be to make the most use of the words of Scripture, and to make as little of his own words as he could. Hence a stranger was struck first by the number and rapidity of his references to texts in the Old and New Testaments, and secondly, by the devoutness of his manner." Yet another friend, who had been privileged to hear Faraday preach before his small flock, said of his sermons, "They struck me as resembling a mosaic work of texts. At first you could hardly understand their juxtaposition and relationship; but as the well-chosen pieces were filled in by degrees their congruity and fitness became developed, and at last an amazing sense of the power and beauty of the whole filled one's thoughts at the close of the discourse."

This, his first period of eldership in the Church, continued from 1840 until 1844, when a slight misunderstanding having arisen between himself and the brethren, he for a time relinquished the office; occupying it again, however, later on in life. His earnest religious feeling was an abiding source of consolation to him in all his trials; it affected in no slight degree his life and life-work at all points, although, to his credit be it said, that it was rather the spirit of his religious feeling which was thus manifested, and it is not by any means to be understood that he was in even the slightest degree given to cant, such a thing being far from possible with him. His religion was a something too sacred and too immediately between himself and his God, as he said, for him to refer to it, except when circumstances especially called for it. Then, in the earnest sympathetic words of comfort, which he addressed to those persons with whom he was intimate when they were in trouble, we may trace the true deep current of religion, which was so essentially a part of his nature.

It is interesting to connect the name of our philosopher with a great institution such as the establishment of the penny post. In 1840 Sir Rowland Hill tells us in his autobiography that he was sorely puzzled to find an ink that, having obliterated the postage stamps, should not be removable. "In my anxiety," he says, "I went so far as to trouble the greatest chemist of the age. Kindly giving me the needful attention, though in an extremely depressed state of health, the result of excessive labour, a fact, of course, unknown to me when I made the application, Mr. Faraday approved of the course which I submitted to him: viz., that an aqueous ink should be used both for the stamp and for obliteration."

Referring to this same year we find an interesting entry in Crabb Robinson's Diary. "*May 8th.*—Attended Carlyle's second lecture.... It gave great satisfaction, for it had uncommon thoughts and was delivered with unusual animation.... In the evening heard a lecture by Faraday. What a contrast to Carlyle! A perfect experimentalist, with an intellect so clear! Within his sphere, *un uomo compito*. How great would that man be who could be as wise on Mind and its relations as Faraday is on Matter!"

Faraday's life as a scientific experimentalist and discoverer is divided into two periods by an interval of four years, during which he did but little, or, compared with his previous performances but little, work. Such a time of rest was indeed rendered absolutely necessary by loss of memory and giddiness, which had troubled him occasionally before, and which now put a stop to his experiments. This period of partial rest commenced with a three months' trip in Switzerland, where he was accompanied by his wife and her brother. Dr. Bence Jones says, "In

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different ways he showed much of his character during this period of rest. The journal he kept of his Swiss tour is an image of himself. It was written with excessive neatness, and it had the different mountain flowers which he gathered in his walks fixed in it as few but Faraday himself could have fixed them. His letters are free from the slightest sign of mental disease. His only illness was overwork, and his only remedy was rest."

A few passages from this Swiss journal are all that can be given. The first stay of any length was made at Thun, whence many walking excursions were undertaken, sometimes indeed Faraday walking as much as forty-five miles in the one day, a sufficient proof that he was not at all bodily ill. The journal gives us many a word-picture of the scenery and of the people, with now and then quaint observations and humorous reflections; let the following passages speak for themselves:—

"*July 18th.*—Took a long walk to the valley called the Simmenthal, which goes off from the valley of the lake.... The frogs were very beautiful, lively, vocal, and intelligent, and not at all fearful. The butterflies, too, became familiar friends with me, as I sat under the trees on the river's bank. It is wonderful how much intelligence all these animals show when they are treated kindly and quietly; when, in fact, they are treated as having their right and part in creation, instead of being frightened, oppressed, and destroyed.

"*Monday, 19th.*—Very fine day; walk with dear Sarah on the lake side to Oberhofen, through the beautiful vineyards; very busy were the women and men in trimming the vines, stripping off leaves and tendrils from fruit-bearing branches. The churchyard was beautiful, and the simplicity of the little remembrance posts set upon the graves very pleasant. One who had been too poor to put up an engraved brass plate, or even a painted board, had written with ink on paper the birth and death of the being whose remains were below, and this had been fastened to a board and mounted on the top of a stick at the head of the grave, the paper being protected by a little edge and roof. Such was the simple remembrance; but nature had added her pathos, for under the shelter by the writing a caterpillar had fastened itself and passed into its death-like state of chrysalis; and having ultimately assumed its final state it had winged its way from the spot, and had left the corpse-like relics behind. How old and how beautiful is this figure of the resurrection! surely it can never appear before our eyes without touching the thoughts.

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"*Tuesday, 27th.*—More pleasant rambles: fine. Now we shall think of a move, and really the changing character of the *table d'hôte* and other things make me in love with the thoughts of home. Dear England, dear home! dear friends! I long to be in and among them all; and where can I expect to be more happy, or better off in anything? Dear home, dear friends, what is all this moving, and bustle, and whirl, and change worth compared to you?

"*August 2nd.*—Interlaken.... The Jungfrau has been occasionally remarkably fine: in the morning particularly, covered with tiers of clouds, whilst the snow between them was beautifully distinct; and in the evening showing a beautiful series of tints from the base to the summit, according to the proportion of light on the different parts. At one time the summit was beautifully bathed in golden light, whilst the middle part was quite blue, and the snow of its peculiar blue-green colour in the clefts.... Clout-nail making goes on here rather considerably, and is a very neat and pretty operation to observe. I love a smith's shop, and anything relating to a smithy. My father was a smith."

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How beautiful is the following description of the waterfall at Brienz Lake: "The sun shone brightly, and the rainbows seen from various points were very beautiful. One at the bottom of a fine but furious fall was very pleasant. There it remained motionless, whilst the gusts and clouds of spray swept furiously across its place, and were dashed against the rock. It looked like a spirit strong in faith and steadfast in the storm of passions sweeping across it; and though it might fade and revive, still it held on to the rock as in hope, and giving hope, and the very drops which in the whirlwind of their fury seemed as if they would carry all away were made to revive it and give it greater beauty."

At length, on September 29th, the small party reach London again, and Faraday's journal ends thus:—"Crossing the new London Bridge street we saw M.'s pleasant face, and shook hands; and though we separated in a moment or two, still we feel and know we are where we ought to be—at home."

Faraday's allusion to his father in the extract above is very pleasing and interesting. We are told that he used to like to pay visits to the scenes of his boyhood and youth, and that he once went to the shop where his father had formerly been employed as a blacksmith, and asked to be allowed to look over the place. When he got to a part of the premises at which there was an opening into the lower workshop, he stopped and said, "I very nearly lost my life there once. I was playing in the upper room at pitching halfpence into a pint pot close by this hole, and having succeeded at a certain distance, I stepped back to try my fortune further off, forgetting the aperture, and down I fell; and if it had not been that my father was working over an anvil fixed just below, I should have fallen on it, broken my back, and probably killed myself. As it was, my father's back just saved mine."

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On his return from his Swiss trip, Faraday took up a great part of his work again, and was fully occupied with a few electrical experiments, lectures, and Trinity House work. What has been termed his second great period of research did not commence until 1845. He lectured frequently at the Institution—so frequently indeed that we cannot refer to them here, but must leave them to the chapter on his lectures. Indeed, merely to detail the work which Faraday did would take up considerably more than the whole space of this little book.

In 1844 Faraday became one of the special commissioners appointed to investigate the Haswell

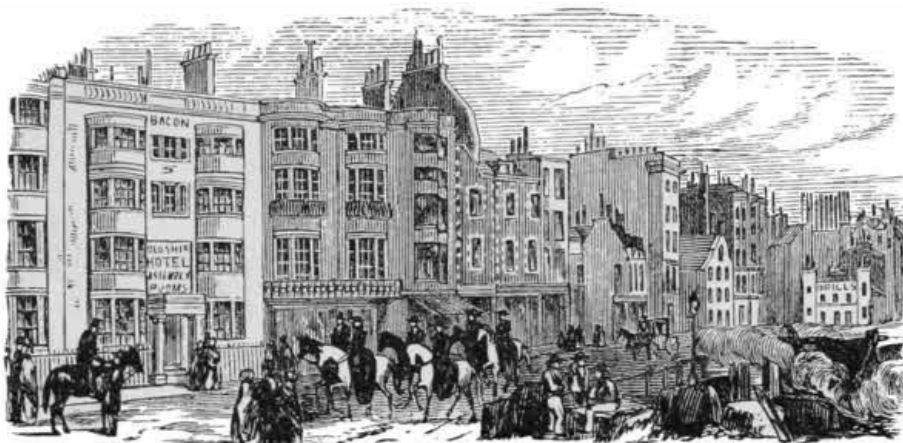
colliery explosion. In 1846 his brother Robert met with a fatal accident, and Faraday writes to his wife, who was staying at Tunbridge Wells:—"Dear Heart,—.... Come home, dear. Come and join in the sympathy and comfort needed by many.... My sister and her children have not forgotten the hope in which they were joined together with my dear Robert, and I see its beautiful and consoling influence in the midst of all these troubles. I and you, though joined in the same trouble, have part in the same hope. Come home, dearest.

"Your affectionate husband,

"M. FARADAY."

In 1849 he delivered his famous lectures on "The Chemical History of a Candle;" and in the following year he gave a series of six lectures on "Some Points of Domestic Chemical Philosophy—a Fire, a Candle, a Lamp, a Chimney, a Kettle, Ashes." His work during these years is shown in his many published letters, in his correspondence which for years he maintained with many of the leading scientists, not only in England but abroad—with De la Rive, Liebig, Humboldt, etc. His work, however, cannot be particularised, neither can the many honours that year after year were awarded to him. We find that he was a man nearly sixty years of age, in the front rank of the great chemists of his country, and acknowledged as such on every hand, and yet we find that he was still the same energetic and enthusiastic scientist, the same kindly and unselfish friend, the same honest and disinterested man that we have seen him all through. Such, indeed, he continued until the very last, his character but "deepening"—as he said of his love for his wife—as the years passed by. His chivalrous deference to women of all ages and ranks was also a remarkable feature of his character, no less at this later part of his life, than when he was a younger man; his chivalry has, indeed, been often referred to, but it was, I learn from Miss Barnard, one of his most readily observed good qualities.

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CHAPTER VII. OVERWORK—THE END.

"Have you found your life distasteful?
My life did, and does, smack sweet.
Was your youth of pleasure wasteful?
Mine I saved, and hold complete.

Do your joys with age diminish?
When mine fail me I'll complain.
Must in death your daylight finish?
My sun sets to rise again."

ROBERT BROWNING.

The year of the Great Exhibition was a busy one for Faraday; he was working in his old accustomed, unremitting manner at his magnetic, and electric, and general experiments, he was continuing to write those *Experimental Researches* which he sent in to the Royal Society, and upon which rests so large a part of his reputation as a scientist. He had given up his professorship at Woolwich Academy the previous year. He was lecturing, however, a good deal, and not alone on his own account, for during the summer he delivered a lecture on ozone for his good friend Professor Schönbein. His health, however, was far from being as good as it had been, and he had to take frequent rests; so that, although he was working as earnestly and enthusiastically as ever, it was, so to speak, only intermittently. That the loss of memory from which he had before suffered was still afflicting him at times, is made evident by such passages from his letters as the following pathetic one from a letter to Schönbein: "I have no doubt I answer your letters very badly; but, my dear friend, *do you remember* that *I forget*, and that I can no more help it than a sieve can help the water running out of it. Still you know me to be your old and obliged and affectionate friend, and all I can say is, the longer I know you the more I seem to cling to you. Ever, my dear Schönbein, yours affectionately." [108]

A pathetic interest attaches to the following reminiscence of Faraday by his niece (Miss Jane Barnard); she was reading to him an anecdote of the Duke of Marlborough's intimation to the king that as he felt that the time when his faculties would fade had arrived he did not wish again to attend any Council meeting, and that if he should attend he desired that no heed should be given to anything he said. Faraday after listening attentively to it, asked Miss Barnard to read that anecdote to him if at any time she felt that his judgment no longer controlled his wishes.

So numerous were the honours which were showered upon Michael Faraday during the last forty years of his life, that to enumerate them would be as tedious as it would be profitless; suffice it to say that he was elected a member of all the chief scientific and philosophical bodies in Europe. Indeed it is said that a Continental Professor addressed a letter to him as "Professor Michael Faraday, Member of all the learned Societies of Europe." It is worthy of note, however, that he was elected a member of the Senate of the University of London, and was asked to act as examiner for the same body, but declined.

During the periods of rest which his failing health made necessary, Faraday would go off to Brighton or Hastings with his wife, where he would spend a few days in quiet idleness. In February, 1851, he was at Brighton, where Mr. Masquerier, the French refugee who had in early life given him lessons in geometry, was living. In Crabb Robinson's diary the following entry, which is of much interest to us here, occurs against February 18: "(At Masquerier's, Brighton.) We had calls soon after breakfast. The one to be mentioned was that of Faraday, one of the most remarkable men of the day, the very greatest of our discoverers in chemistry, a perfect lecturer in the unaffected simplicity and intelligent clearness in his statement; so that the learned are instructed and the ignorant charmed. His personal character is admirable. When he was young, poor, and altogether unknown, Masquerier was kind to him; and now that he is a great man he does not forget his old friend." [109]

An interesting story is told by Dr. Scoffern of an incident that happened during this year; an incident that illustrates in a remarkable manner the unaltered good humour and geniality which belonged to Faraday as much during his later as his earlier years. Professor Brande was lecturing at the time on a newly-discovered method of purifying sugar by sugar of lead; while they were in the laboratory Scoffern accidentally let fall a retort of corrosive liquid. In an instant, he tells us, Professor Faraday "threw some soda upon the floor; then down on his hands and knees he went, sloop cloth in hand, like any humble housemaid. Laughing, I expressed my desire to photograph him then and there; he demurred to the pose, begged me to consult his dignity, and began laughing with a childish joyousness. Hilariously boyish upon occasion he could be, and those who knew him best, knew he was never more at home, that he never seemed so pleased as when making an 'old boy' of himself, as he was wont to say, lecturing before a juvenile audience at Christmas."

Faraday, as has been said earlier, attended some of the annual meetings of the British Association; in this year of 1851 the meeting was held at Ipswich, and on that occasion Dr. J. H. Gladstone says he first met Faraday to have any intercourse with him. "I watched him," he writes, "with all the interest of an admiring disciple, and there is deeply engraven on my memory the vivacity of his conversation, the eagerness with which he entered into some mathematico-chemical speculations of Dumas, and the playfulness with which, when we were dining together, he cut boomerangs out of card, and shot them across the table at his friends." [110]

Yet another story of Faraday's remarkable disinterestedness is given us by Dr. Scoffern, who, writing of the year 1852, says that he had made an abstract of a course of lectures which Faraday

had delivered on the subject of the non-metallic elements; this abstract he wished to embody in a book which he was about to publish. The kindly old chemist at once gave his permission, and would not even listen to any proposal as to sharing the profits of the work. Scoffern immediately suggested that he would be misunderstood by the publisher, who would not be able to comprehend such a piece of generosity on the great professor's part. "Oh," said Faraday, "we'll soon settle that by writing;" and he wrote out a formal letter of assignment.

Despite the fact that his time was always fully occupied, Faraday found time to write many letters, not only the long friendly, yet scientific letters to such men as De la Rive and Schönbein, but letters of advice and sympathy to his nephews and nieces, and other friends. His advice was always given in so kindly a spirit that it could not be taken amiss, and his sympathy was tendered in that rare manner—sincere and unostentatious—which characterises this feeling in its highest manifestation. The following passage, from a letter to his nephew, Frank Barnard, who was just starting life, is an illustration of this: "And so you are hard at work, and somewhat embarrassed by your position; but no man can do just as he likes, and in many things he has to give way, and may do so honourably, provided he preserves his self-respect. Never, my dear Frank, lose that, whatever may be the alternative. Let no one tempt you to it, for nothing can be expedient that is not right; and though some of your companions may tease you at first, they will respect you for your consistency in the end; and if they pretend not to do so it is of no consequence. However, I trust the hardest part of your probation is over, for the earliest is usually the hardest, and that you know how to take all things quietly."

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Although I have made but little special reference to the work on which our great hero was engaged when treating of different periods of his life; it becomes necessary here to refer to the part which Faraday took in exposing a popular delusion which was widely believed in at the time, and which yet has many supporters—the delusion as to table-turning. He wrote a long account fully exposing the error which so many people were willing to believe; and although his exposure convinced most persons who troubled themselves to follow him in his investigations, the popular mind refused to be disillusionised, and the turning of the tables was referred to electricity, magnetism, spirits, a new natural force, and other agencies. This occasion perhaps drew more emphatic utterance from Faraday than any other; he had no patience with people who would not be enlightened, and his feeling is shown in a letter written in July, 1853, to Professor Schönbein: "I have not been at work except in turning the tables upon the table-turners, nor should I have done that, but that so many inquiries poured in upon me, that I thought it better to stop the inpouring flood by letting all know at once what my views and thoughts were. What a weak, credulous, incredulous, unbelieving, superstitious, bold, frightened,—what a ridiculous world ours is, as far as concerns the mind of man. How full of inconsistencies, contradictions, and absurdities it is. I declare that, taking the average of many minds that have recently come before me (and apart from that spirit which God has placed in each), and accepting for a moment that average as a standard, I should far prefer the obedience, affections, and instincts of a dog before it. Do not whisper this, however, to others. There is One above who worketh in all things, and who governs even in the midst of that misrule to which the tendencies and powers of men are so easily perverted."

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In his Juvenile Lectures, delivered at Christmas of the same year, he again referred to this popular error, giving at the same time some sound advice to his young friends. "In conclusion, I must address a few words to the intending philosophers who form the juvenile part of my audience. Study science with earnestness—search into nature—elicit the truth—reason on it, and reject all which will not stand the closest investigation. Keep your imagination within bounds, taking heed lest it run away with your judgment. Above all, let me warn you young ones of the danger of being led away by the superstitions which at this day of boasted progress are a disgrace to the age, and which afford astonishing proofs of the vast floods of ignorance overflowing and desolating the highest places.

"Educated man, misusing the glorious gift of reason which raises him above the brute, actually lowers himself below the creatures endowed only with instinct; inasmuch as he casts aside the natural sense which might guide him, and in his credulous folly pretends to discover and investigate phenomena which reason would not for a moment allow, and which, in fact, are utterly absurd.

"Let my young hearers mark and remember my words. I desire that they should dwell in their memory as a protest uttered in this Institution against the progress of error. Whatever be the encouragement it may receive elsewhere, may we, at any rate in this place, raise a bulwark which shall protect the boundaries of truth, and preserve them uninjured during the rapid encroachments of gross ignorance under the mask of scientific knowledge."

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Faraday's high position in the world of science and his well-known thoroughness in investigating any subject in which he interested himself, made his utterances on the subject of spirit-rapping and table-turning convincing to a large number of people. He was, however, for many years occasionally pestered with questions about it, by persons who thought they could prove to him that he was wrong; perhaps in no matter did Faraday so nearly lose his patience as over this; at no other time did he so nearly exhibit that volcano of fiery passion which, according to Tyndall, underlay the sweetness and gentleness of disposition which were his ever-obvious qualities. He had, as Tyndall well puts it, "through high self-discipline converted the fire into a central glow and motive power of life, instead of permitting it to waste itself in useless passion. 'He that is slow to anger,' saith the sage, 'is greater than the mighty, and he that ruleth his own spirit than he that taketh a city!' Faraday was *not* slow to anger, but he completely ruled his own spirit; and thus, though he took no cities, he captivated all hearts."

Miss Barnard, from her long and intimate acquaintance with her uncle, quite endorses what Professor Tyndall says. She says that a most fiery passion was kept under by the most perfect master, and during all the years she knew him she could not recollect above two occasions when Faraday, even for a moment, let his passion get the better of him.

Lightly as he looked upon honours such as are the ones usually appreciated by more worldly men, Faraday was always well-pleased and more than gratified when recognised by leading men of science or literature. Many as were the distinctions which had been and were still being heaped upon him, he would especially value such a one as was offered him in 1854, when one who in a measure had been his pupil—Henry Mayhew—dedicated to him a volume on the *Wonders of Science*, illustrating the life and progress in scientific knowledge of young Humphry Davy. This dedication runs, "My dear sir, I inscribe your name on one of the fly-leaves of this little book, with the same devotion as youths are wont to carve upon the trunk of some forest tree the name of those whom they admire most in the world; and I do so for many reasons." And in concluding the dedication he shows us once more the helpfulness and goodness of Faraday's nature: "And now, my dear sir, let me, in conclusion, thank you for your generous encouragement of my labours when I was engaged in inquiring into the condition of the 'London Poor.' Many know your wisdom, but none are better acquainted with your goodness than yours very truly,

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"HENRY MAYHEW."

Never, when a success beyond the wildest imaginings of his youth had crowned his devotion to science, did Faraday forget the time of his early struggles, and the humble beginning which he had made. As we have before mentioned, he would frequently stop in the street to speak a kindly word of encouragement to young newspaper lads who were just starting in life in the way that he had done over half a century earlier. An incident such as that depicted in the illustration was, indeed, a not uncommon one, for, to refer again to the Professor's own words, he could not but feel a tenderness for such boys, because he had once carried newspapers himself.



FARADAY AND THE NEWSBOY.

In Miss Reid's recollections of her illustrious uncle, from which we have quoted in an earlier chapter, there was something said about the reading which interested the scientist in his hours of relaxation. This is always an interesting matter in connection with our great men; we are always glad to know what they read, and, if possible, why they read it. At a party about this time, Faraday joined in a discussion which was being carried on on the subject of novel reading, and some one of those present took a few notes of such works as he mentioned as being specially interesting or entertaining to him. He liked novels, he said, with some stir and life in them, such as *Paul Ferrol*, *Jane Eyre*, too—although of this he characteristically said, "there's a touch of mesmerism and mystery at the end which would be better away." Of Scott's novels he was always a great admirer, liking particularly *Ivanhoe*, *Guy Mannering*, and *Waverley*; he also spoke admiringly of Fanny Burney's novel, *Evelina*, a book that is hardly among the generally read novels of to-day. Writing in 1858 to Professor de la Rive on the death of Mrs. Marcet,^[9] Faraday

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mentions his early reading as follows: "Do not suppose that I was a very deep thinker, or was marked as a precocious person, I could believe in the *Arabian Nights* as easily as in the *Encyclopædia*. 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."

When, in 1857, Mr. Cyrus Field was in England preparing for the laying of the great telegraph cable across the Atlantic Ocean, he inquired of Faraday as to what he thought of its practicability; the philosopher doubted the possibility of transmitting a message. Field saw that an objection from so great an authority would prove well-nigh fatal, and that it must be removed at once; he therefore offered to pay Faraday sufficiently for his services if he would undertake such experiments as were necessary. Faraday declined the money, but undertook the experiments, and on their completion reported to Field, "It can be done, but you will not get an instantaneous message."

"How long will it take?" anxiously inquired the engineer.

"Oh, perhaps a second."

"Well, that's quick enough for me."

The year 1858 is an interesting one in the life of Michael Faraday; for over forty years he had lived in the Royal Institution, and during that time had risen from being a journeyman bookbinder with a small circle of friends, to being the first of living philosophers, with a fame known all over the world, and with friends wherever his fame had penetrated. In this year, however, while still retaining his connection with the Royal Institution, he removed with his wife to a house at Hampton Court, which had been kindly placed at their disposal by Her Majesty the Queen, at the instigation of the Prince Consort. Faraday writes in April to Prince Albert's secretary acknowledging the extreme kindness of Her Majesty, but expressing himself as doubtful whether to accept or to decline. The house it appeared wanted some repairs which Faraday felt doubtful about; he did not feel that he would be enabled to undertake them, but his mind was soon set at rest on this score, for in the summer of this year, writing to one of his nieces, he says, "The case is settled. The Queen has desired me to dismiss all thoughts of the repairs, as the house is to be put into thorough repair both inside and out. The letter from Sir C. Phipps is most kind." In writing to Sir C. Phipps himself Faraday said, "I find it difficult to write my thanks or express my sense of the gratitude I owe to Her Majesty; first, for the extreme kindness which is offered to me in the use of the house at Hampton Court, but far more for that condescension and consideration which, in respect of personal rest and health, was the moving cause of the offer. I feared that I might not be able properly to accept Her Majesty's most gracious favour. I would not bring myself to decline so honourable an offer, and yet I was constrained carefully to consider whether its acceptance was consistent with my own particular and peculiar circumstances. The enlargement of Her Majesty's favour has removed all difficulty. I accept with deep gratitude, and I hope that you will help me to express fitly to Her Majesty my thanks and feelings on this occasion."

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FARADAY'S HOUSE, HAMPTON COURT GREEN.

Faraday's house, standing pleasantly on Hampton Court Green, was, as will be seen from the illustration, a delightful creeper-embowered place, and with its open aspect and surrounding greenery, must have afforded a great and agreeable change to the tired philosopher and his wife. For some years after his removal Faraday made frequent runs up to town to the Institution, where he continued his research work and also delivered many lectures, notably, several courses of the now annual Juvenile Lectures. He was, however, not able to continue for long spells of work, but had to take occasional intervals of rest. He still made frequent reports in connection with Trinity House, but refused to take up any further work. He declined even to prepare his Juvenile Lectures for publication, although other reasons than his own incapacity for sustained work here influenced him, as we see by the following letter:—

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"Royal Institution, January 3, 1859.

"Dear Sir,—Many thanks both to you and Mr. Bentley. Mr. Murray made me an unlimited offer like that of Mr. Bentley's many years ago, but for the reasons I am about to give you I had to refuse his kindness. He proposed to take them by shorthand, and so save me trouble, but I knew that would be a thorough failure; even if I cared to give time to the revision of the MS., still the lectures without the experiments and the vivacity of speaking would fall far behind those in the lecture room as to effect. And then I do not desire to give time to them, for money is no temptation to me. In fact, I have always loved science more than money; and because my occupation is almost entirely personal, I cannot afford to get rich.

"Again thanking you and Mr. Bentley,

"I remain, very truly yours,

"M. FARADAY."

I have had to insist once or twice upon Faraday's deeply religious nature; it comes out very clearly in some letters written about this time, when he was an old man—having very nearly attained to the threescore years and ten of man's life. In his work and in his conversation he never obtruded his religious convictions, but the innate religious feeling of the man coloured his every relation with his fellow men. In that we have but few direct writings of his on this subject, a grave interest attaches to the following letter to his niece: "I never heard of the saying that separation is the brother of death; I think that it does death an injustice, at least in the mind of the Christian; separation simply implies no re-union; death has to the Christian everything hoped for contained in the idea of re-union. I cannot think that death has to the Christian anything in it that should make it a rare, or other than a constant thought; out of the view of death comes the view of the life beyond the grave, as out of the view of sin (that true and real view which the Holy Spirit alone can give to a man) comes the glorious hope; without the conviction of sin there is no ground of hope to the Christian. As far as he is permitted for the trial of his faith to forget the conviction of sin, he forgets his hope, he forgets the need of Him who became sin or a sin-offering for His people, and overcame death by dying. And though death be repugnant to the flesh, yet where the Spirit is given, to die is gain. What a wonderful transition it is! for, as the apostle says, even whilst having the firstfruits of the Spirit, the people of God groan within themselves, 'waiting for the adoption, to wit, the redemption of the body.' Elsewhere he says, that whilst in the earthly house of this tabernacle we groan, earnestly desiring to be clothed upon with our house which is from heaven.

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"It is permitted to the Christian to think of death; he is even represented as praying that God would teach him to number his days. Words are given to him, 'O death, where is thy sting? O grave, where is thy victory?' and the answer is given him, 'Thanks be to God, who giveth us the victory through our Lord Jesus Christ.' And though the thought of death brings the thought of judgment, which is far above all the trouble that arises from the breaking of mere earthly ties, it also brings to the Christian the thought of Him who died, was judged, and who rose again for the justification of those who believe in Him. Though the fear of death be a great thought, the hope of eternal life is a far greater.... You see I chat now and then with you as if my thoughts were running openly before us on the paper, and so it is. My worldly faculties are slipping away day by day. Happy is it for all of us that the true good lies not in them. As they ebb, may they leave us as little children, trusting in the Father of mercies and accepting His unspeakable gift."

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In 1860 Faraday became once more an elder in the Sandemanian Church, and retained that office for nearly four years, when he finally resigned it. The meeting of the British Association was held in this year at Oxford, and Faraday was once more present, as he liked to be, at this scientific gathering. A friend, apropos of this visit, wrote the following *jeu d'esprit*, which is worth remembering—

"'That P will change to F in the British tongue is true
(Quoth Professor Phillips), though the instances are few.'
An entry in my journal then I ventured thus to parody,
'I this day dined with Fillips, where I hobbled and nobbed with Pharaday.'"



FARADAY DELIVERING HIS CHRISTMAS JUVENILE LECTURES.

This same year is also notable as being the nineteenth, and last, in which Faraday delivered the Christmas Juvenile Lectures; for ten years in succession he had given them, the four lectures of this, his final course, being those well known and generally appreciated ones upon "The Chemical History of a Candle." An earlier course having been given some years before on the same subject. His failing health and memory made it necessary for him to discontinue much of his work, and in the following year his last experimental work was done, and (on June 20) his last Friday evening lecture delivered. A touching and pathetic interest attaches to the slight notes which he made for this, his last lecture. The notes are brief—but yet how much is there not expressed in them?

"Personal explanation—years of happiness here, but time of retirement; LOSS OF MEMORY and *physical endurance of the brain*.

"1. Causes—*hesitation and uncertainty* of the convictions which the speaker has to urge.

"2. *Inability to draw* upon the mind for the treasures of knowledge it has previously received.

"3. *Dimness*, and forgetfulness of one's former *self-standard* in respect of *right, dignity, and self-respect*. [123]

"4. Strong duty of *doing justice to others*, yet inability to do so.

"*Retire.*"

Thus did the old man of seventy years touchingly bid farewell to work which he had been carrying on for the greater part of half a century—to that work which had received from him the untiring devotion of a life-time. In 1862 his memory, which had previously troubled him, became even less trustworthy; though his cheerfulness, faith, and innate optimism were never clouded for a moment, as is well-shown in a letter which he wrote to the wife of his old friend Barlow. "I called at your house," Faraday wrote, "and I rejoice to think that your absence is a sign of good health. *Our love to you both*. I am enjoying the gradual decay of strength and life, for when I revive it is no great revival or desire to me, and that cheers me in the view of death near and round us."

In 1863 his chief work was in connection with the Trinity House, Faraday continuing to report upon the value of the magneto-electric light for lighthouses, and visiting yet again, as he had frequently done for years past, Dungeness and other stations for the purpose. Despite his incapacity for sustained mental work owing to his failing memory, Faraday continued fairly hale in body, and was yet active, for in February of 1863 he was at Dungeness, and in the autumn of the same year he was in Scotland for a fortnight, and wrote from Glasgow to one who for over forty years had been his loving companion, a letter breathing an affection unaltered by the lapse of years, unless indeed it were, to use his own expression, that it had grown *deeper*. We have seen the letters which he wrote in the early years of his marriage; it is fitting that we should quote from this one to show how unchanged he was, despite the many years which had passed over him. "I long to see you, dearest," he wrote, "and to talk over things together, and call to mind all the kindness I have received. My head is full and my heart also, but my recollection rapidly fails, even as regards the friends that are in the room with me. You will have to resume your old function of being a pillow to my mind, and a rest, a happy-making wife.... Dearest, I long to see and be with you. Whether together or separate, your husband, very affectionate,

"M. FARADAY."

In 1865 he felt compelled to relinquish the active work in connection with the Trinity House, without altogether retiring from his position, for after thirty years' work, during which he had been treated by the Brethren with uniform kindness and consideration, he did not like to altogether sever his connection with friends with whom he had been so long and so harmoniously working. In accordance with Faraday's wishes Professor Tyndall undertook this work for him. In the same year he felt it necessary to communicate with the managers of the Royal Institution,

expressing his desire to be allowed, without severing his connection with it, to give up his active work for the Institution.

The last two years of his life were thus passed "waiting" as he once or twice expressed it. To an old friend of very many years' standing he had said, "Barlow, you and I are waiting—that is what we have to do now; and we must try to do it patiently." And again, in reply to a friend who inquired as to how he was, he simply replied, "Just waiting." Thus gradually and quietly the end approached. One of his nieces writes of her annual visit in 1867:

"I spent June at Hampton Court. Dear uncle kept up rather better than sometimes; but oh! there was always pain in seeing afresh how far the mind had faded away. Still the sweet unselfish disposition was there, winning the love of all around him....

"I shall never look at the lightning flashes without recalling his delight in a beautiful storm. How he would stand at the window for hours, watching the effects and enjoying the scene; while we knew his mind was full of lofty thoughts; sometimes of the great Creator, and sometimes of the laws by which He sees meet to govern the earth. [125]

"I shall also always connect the sight of the hues of a brilliant sunset with him, and especially he will be present to my mind while I watch the fading of the tints into the sombre grey of night. He loved to have us with him, as he stood or sauntered on some open spot, and spoke his thoughts, perhaps in the words of Gray's Elegy, which he retained in memory, clearly, long after many other things had faded quite away. Then, as darkness stole on, his companions would gradually turn indoors, while he was well pleased to be left to solitary communings with his own thoughts."



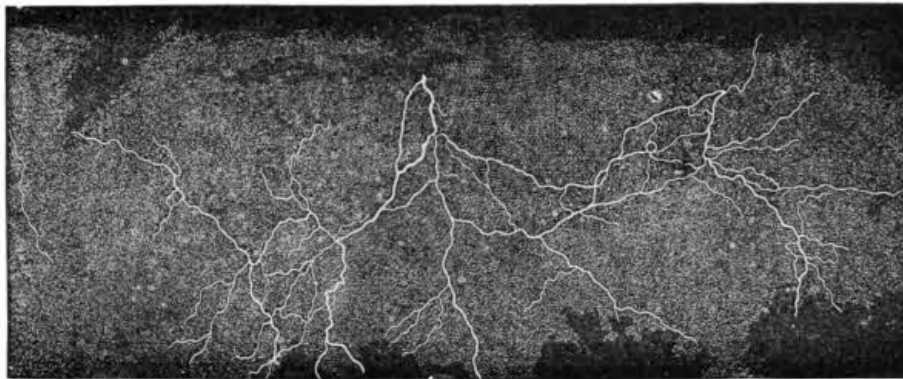
FARADAY'S TOMB AT HIGHGATE.

On the 25th of August, 1867, he passed quietly away, dying in his chair in his study at Hampton Court. His niece, Miss Barnard, from whose recollections we have learned much in earlier chapters, had spent a good part of her life with her aunt and uncle, and had helped to nurse the latter during the last few months. "My occupation has gone," she pathetically wrote to Dr. Bence Jones. On August 30th, the funeral took place, everything being conducted simply and quietly; it was, as Faraday had himself expressed a desire that it should be, strictly private. A plain headstone in Highgate Cemetery, with the following simple inscription, marks the place where lies all that was mortal of one of England's noblest sons. [126]

"MICHAEL FARADAY,
Born, 22nd September,
1791,
Died, 25th August,
1867"

If it were necessary to add anything to these simple words that mark his resting-place, there might be put, and it would apply to Faraday as truly as to any man that ever lived, the well-known line—

"An honest man, the noblest work of God."



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CHAPTER VIII. AS FRIEND AND LECTURER.

"I thought these men will carry hence
 Promptings their former life above,
And something of a finer reverence
For beauty, truth, and love."

LOWELL.

At various periods of Faraday's life his genial good-nature and kindness have been brought home to us in different ways. From that early time when he used to take care of his little sister Margaret in Manchester Square, up to the very latest course of Juvenile Lectures which he delivered at the Royal Institution in 1863, he had always the same love for young people; and, as is usual with persons of such a disposition, he was ever a great favourite of the children, whether of those who used to hear his Christmas lectures, or with those happier ones who met him more intimately. Intimate seems perhaps a curious word to use with regard to the relations of young children and an old man; but yet it is the only word that really expresses what is meant; that really indicates that instant bond of sympathy that seems to connect children with men and women who possess the power of attracting and delighting them by becoming from the first as one of themselves. This quality, this delightful quality, belonged to Michael Faraday in an eminent degree.

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Fortunate indeed were those children who listened to his Christmas Lectures to Juveniles, and fortunate also were those older people who were present on the same occasions. Many people who enjoyed the pleasure and privilege of hearing him at such a time recorded their impressions, and pleasant reading is the result. Lady Pollock, for instance, wrote: "When he lectured to children he was careful to be perfectly distinct, and never allowed his ideas to outrun their intelligence. He took great delight in talking to them, and easily won their confidence. The vivacity of his manner and of his countenance, his pleasant laugh, the frankness of his whole bearing, attracted them to him. They felt as if he belonged to them; and indeed he sometimes, in his joyous enthusiasm, appeared like an inspired child. He was not at all a man for evening parties; he was nothing of a ladies' man; but he was the true man for the juveniles, and would go to see a domestic charade when the boys acted in it, and suddenly appear behind the scene to offer a little help or suggest a new arrangement; and then, while he was in front, he would laugh and applaud so loudly, that his presence was the best encouragement which the young performers could have. Or he would help the young people to wonder at the feats of a conjuror, or he would join in a round game, and romp quite noisily. But all was done with a natural impulse. There was no assumption of kindness, no air of condescension."

Another writer, who had the rare privilege of meeting the great man socially, said: "Nothing indeed pleased him better than to be a boy again, and to mingle in the sports of the young, especially if they took a turn congenial at all to his own pursuits. He has been known to join a youthful party on a November evening to assist in a display of fireworks. There he might be seen running to and fro in a garden at night, with his pockets crammed with combustibles—now

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kindling lycopodium or burning potassium—then letting off blue fires, green fires, purple fires—sometimes dropping ignited crackers at the feet of the boys with an air of affected astonishment, or probably chasing the girls in order to streak their cheeks with phosphorus."

As a lecturer to children Faraday was indeed particularly successful and especially interesting. His first course of Christmas Juvenile Lectures was given in 1827—his last, on "The Chemical History of a Candle," was given in 1863, and during that time he gave in all nineteen of these courses. The first consisted of six lectures on chemistry, and the first lecture of the course was illustrated with no fewer than eighty-six experiments, which were, it is scarcely necessary to say, carried out on the platform. In his note-book Faraday made the following entry with regard to this course, "The six juvenile lectures were just what they ought to have been, both in matter and manner; but it would not answer to give an extended course in the same spirit."

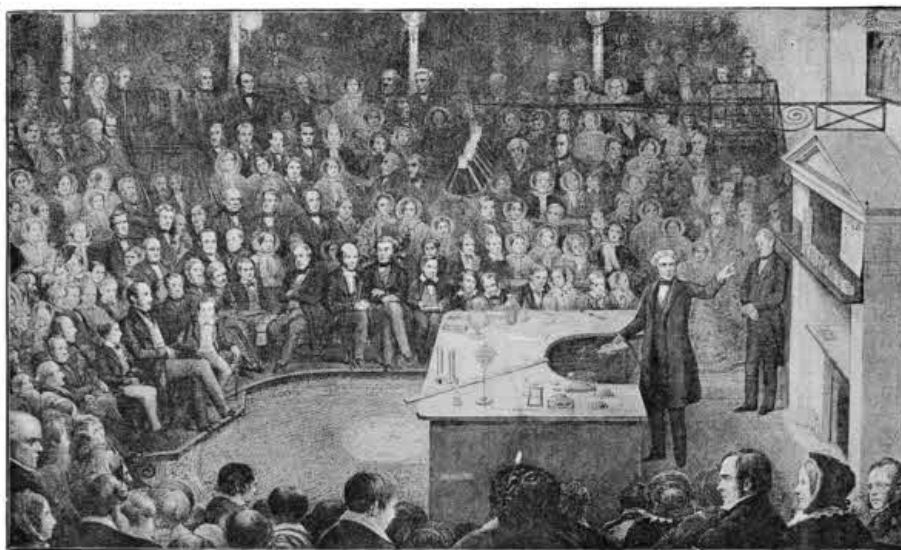
One secret of Faraday's success as a lecturer, both to juveniles and others, was the carefulness with which he always tried to ascertain what was the best method. In early years he would have a friend (Magrath, or some other) among the audience, who was to tell him afterwards of any peculiarities, either of manner or style, that wanted correcting; and Miss Reid tells us that in the early years of the Juvenile Lectures her uncle used to encourage her to tell him everything that struck her; and, when she did not fully understand him, where her difficulties lay. He would then enlarge upon those points in the next lecture, and thus he made a child's remark serve him in making things clear to children. He used also, at first, to have a card, on which was distinctly written the word *Slow*, before him; and if he forgot it and became rapid, his assistant Anderson had orders to place it before him. Sometimes also when his lecture hour was nearly expired, he would arrange to have a card with the word *Time* on it, placed within his view.

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One of his early courses for children treated of that subject which always possessed a great fascination for him, and in which he did much of his greatest work—electricity. The slight notes which he made for the first lecture of this course are interesting. "An extraordinary power that I have to explain; not fear boldly entering into its consideration, because I think it ought to be understood by children—not minutely, but so as to think reasonably about it, and such effects as children can produce, or observe to take place in nature—simple instances of its power." This first lecture was illustrated by eighty experiments.

We have dwelt upon his kindness and sympathy with children; but, it may be noted, he had none of his own, though from almost the earliest year of his married life he always liked to have one or other of his nieces with him. His love for children is well shown in an anecdote which Dr. Gladstone tells of his later life. He was at a soirée at the house of Mr. Justice Grove; the eldest daughter having heard him express himself disappointed at being too late to see any of the younger members of the family, brought down the little ones in their nightgowns to the foot of the stairs, when Faraday showed how gratified he was by saying to her, "Ah! that's the best thing you've done to-night."

Sometimes he would indulge in some slight practical jokes with the young people. For instance, a nephew visiting him in his study one morning, Faraday said to him, "Why, Frank, what a tall boy you are growing; you can almost touch that brass ball—just try." Nothing loth, the boy standing on tiptoe reached up and touched the ball with his fingers, when his playful uncle gave a turn to a wheel and the boy received a slight shock, and with it a first, and somewhat unexpected, lesson on the nature of electricity.



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FARADAY LECTURING BEFORE THE PRINCE CONSORT, PRINCE OF WALES AND DUKE OF EDINBURGH.

Reduction of the picture painted] [in 1856 by Alexander Blaikley.

The Prince Consort was a constant patron of the Royal Institution, and the young princes also were present at many of the Juvenile Lectures. After attending such a course H.R.H. the Prince of Wales, then a lad of fifteen, and his brother, H.R.H. Prince Alfred, Duke of Edinburgh, wrote from Windsor Castle the following letters to Professor Faraday:—

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"Dear Sir,—I am anxious to thank you for the advantage I have derived from attending your most interesting lectures. Their subject, I know very well, is of great importance, and I hope to follow the advice you gave us of pursuing it beyond the lecture-room; and I can assure you that I shall always cherish with great pleasure the recollection of having been assisted in my early studies in chemistry by so distinguished a man.

"Believe me, dear Sir, yours truly,

"ALBERT EDWARD."

Prince Alfred's letter was as follows:—

"Dear Sir,—I write to thank you very much for the pleasure you have given me by your lectures, and I cannot help hoping they will not be the last I shall hear from you. Their subject was very interesting, and your clear explanations made it doubly so.

"Believe me, dear Sir, yours truly,

"ALFRED."

It is interesting to learn Faraday's own views with regard to popular lectures, for never yet was there a truly scientific lecturer who was more truly popular; perhaps, indeed, there is no other single man who, without in any degree lowering his work for the purpose, succeeded so well in popularising scientific knowledge. These are his own words on the subject: "As to popular lectures (which at the same time are to be *respectable* and *sound*) none are more difficult to find. Lectures which *really teach* will never be popular; lectures which are popular will never *really teach*." His own success as a lecturer was owing largely to the power he had of adapting himself to all minds, from the deepest thinkers to the liveliest youth; this power gave him a "wide range of influence, and his sympathy with the young among his listeners imparted more life and colour to his discourses than they might otherwise have possessed. He had the art of making philosophy charming, and this was due in no little measure to the fact that to grey-headed wisdom, he united wonderful juvenility of spirit."

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"He was," to quote once more from Lady Pollock's recollections of the illustrious lecturer, "completely master of the situation; he had his audience at his command, as he had himself and all his belongings; he had nothing to fret him, and he could give his eloquence full sway. It was an irresistible eloquence, which compelled attention and insisted upon sympathy. It waked the young from their visions and the old from their dreams. There was a gleaming in his eye which no painter could copy, and which no poet could describe.... His enthusiasm sometimes carried him to the point of ecstasy when he expatiated on the beauty of nature, and when he lifted the veil from her deep mysteries. His body then took motion from his mind; his hair streamed out from his head, his hands were full of nervous action, his light, lithe body seemed to quiver with its eager life. His audience took fire with him, and every face was flushed.... A pleasant vein of humour accompanied his ardent imagination, and occasionally, not too often, relieved the tension of thought imposed upon his pupils. He would play with his subject now and then, but very delicately; his sport was only just enough to enliven the effort of attention. He never suffered an experiment to allure him away from his theme. Every touch of his hand was a true illustration of his argument." As he once remarked in giving advice to a young lecturer: "If I said to my audience, 'This stone will fall to the ground if I open my hand,' I should open my hand and let it fall. Take nothing for granted as known; inform the eye at the same time as you address the ear."

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It is of interest here—after seeing how Faraday as a lecturer impressed others—to note some of the remarks which he made on the subject of lectures, lecturers, and lecturing in his early correspondence with his friend, Benjamin Abbott. Several long letters on this matter passed between the friends, and Faraday (he was twenty-one at the time) not only speaks in a discriminating manner with regard to lectures, but he also treats with his native good sense of lecture rooms, apparatus, etc. All his remarks, he says in his earliest letter to Abbott on the subject, are the result of his own personal observation. The most necessary quality for a lecturer, says the youthful Faraday, is a good delivery; he then dwells upon the necessity of illustrating a lecture with experiments wherever possible. (How well he carried this rule into practice has been seen in an earlier part of this chapter, where we learned of some of his Juvenile Lectures being illustrated by upwards of eighty experiments.) "A lecturer," he goes on to say, "should appear easy and collected, undaunted and unconcerned,^[10] his thoughts about him, and his mind clear and free for the contemplation and description of his subject." He then says, and we instantly think of the "time" card he had placed before him later, "I disapprove of long lectures; one hour is long enough for anyone, nor should they be allowed to exceed that time."

The last of this series of letters on lectures commences in a style of genial banter, which, as it illustrates the lighter side of Faraday's character, merits quotation. "Dear Abbott," he writes, "As when on some secluded branch in forest far and wide sits perched an owl, who, full of self-conceit and self-created wisdom, explains, comments, condemns, ordains, and orders things not understood, yet full of his importance still holds forth to stocks and stones around—so sits and scribbles Mike; so he declaims to walls, stones, tables, chairs, hats, books, pens, shoes, and all the things inert that be around him, and so he will to the end of the chapter."

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This playful mood comes out, also, in one or two anecdotes which are told of him, when his fame was established. For instance, an old lady friend being much troubled by some rancid butter, thought that she had hit upon a method of improving it, which she did by mixing with it a quantity of soda, she having a somewhat high opinion of the purifying virtues of that alkali,

although, it is to be presumed, she little suspected the uses to which it was applied in the manufactures. By this addition of soda, she triumphantly claimed that her butter "was greatly improved." One evening, when Professor Faraday called upon her, the old lady produced a sample of her "improved" butter. A merry laugh rang out from the philosopher's lips as he exclaimed, "Well done, Mrs. W., you have improved your bad butter into very indifferent *soap*!"

Good-humoured and good-natured as Faraday habitually was, he did not like to be worried unnecessarily over unimportant matters; and willing as he was to place even his invaluable time at the disposal of almost anyone who claimed his attention, he had no patience with persons who came to him thoughtlessly, as the following story shows: A young man called on him one morning, and with an air of great importance confided to him the result of some original researches in electrical philosophy. "And pray," asked the professor, taking down a volume of Ree's *Cyclopædia*, "did you consult this, or any elementary work, to learn whether your discovery had been anticipated?" The young man replied in the negative. "Then why do you come to waste my time about well-known facts that were published forty years ago?" "Sir," said the visitor in self-excuse, and hoping to flatter the philosopher, "I thought I had better bring the matter to headquarters immediately." "All very well for you, but not so well for headquarters," replied the professor sharply, and he forthwith set his visitor to read the article in the *Cyclopædia*. [136]

Yet another story is told of a grave old gentleman who once waited upon Faraday that he might show to him "a new law of physics." The gentleman asked for a jug of water and a tumbler; they were brought, and he then produced a cork. "You will be pleased to observe," he then said, "how persistently this cork clings to the side of the glass when the vessel is half-filled."

"Just so," replied the professor.

"But now," continued the discoverer of a new law of physics, "mark what happens when I fill the glass to the brim. There! you see the cork flies to the centre—positively repelled by the sides!"

"Precisely so," answered Faraday in an amused tone, which showed that the "new law" was more familiar to him than to his visitor, who, somewhat abashed, said, "Pray, how long have you known this?" "Oh, ever since I was a boy," was the reply; but the innate kindness of his nature must show itself even in such a case, for, seeing the old gentleman's disappointed look, he added that he was not to be grieved, he might possibly some day alight upon something really new.

The last course of Faraday's Juvenile Lectures—on "The Chemical History of a Candle"—has been referred to once or twice. These lectures are indeed of very great interest, not only in themselves as chemical illustrations, but as being part of Professor Faraday's best known works, and the only juvenile lectures of his which are obtainable in the form of a book. The way in which he introduced his subject will show us how simple, and yet how explicit he was in explaining to his young audience the phenomena which he brought before them. [137]

"I purpose," he said, to quote the beginning of the initial lecture of the series of six, "in return for the honour you do us by coming to see what are our proceedings here, to bring before you in the course of these lectures, the chemical history of a candle. I have taken this subject on a former occasion, and were it left to my own will, I should prefer to repeat it almost every year—so abundant is the interest that attaches itself to the subject, so wonderful are the varieties of outlet which it offers into the various departments of philosophy. There is not a law under which any part of this universe is governed which does not come into play, and is touched upon in these phenomena. There is no better, there is no more open door by which you can enter into the study of natural philosophy, than by considering the physical phenomena of a candle. I trust, therefore, I shall not disappoint you in choosing this for my subject rather than any newer topic, which could not be better, were it even so good.

"And before proceeding, let me say this also—that though our subject be so great, and our intention that of treating it honestly, seriously, and philosophically, yet I mean to pass away from all those who are seniors amongst us. I claim the privilege of speaking to juveniles as a juvenile myself. I have done so on former occasions—and, if you please, I shall do so again. And though I stand here with the knowledge of having the words I utter given to the world, yet that shall not deter me from speaking in the same familiar way to those whom I esteem nearest to me on this occasion.

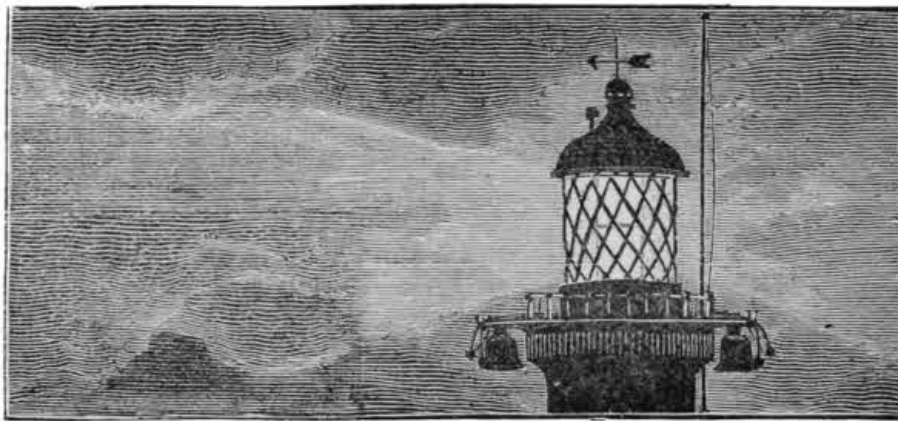
"And now, my boys and girls, I must first tell you of what candles are made. Some are great curiosities. I have here some bits of timber, branches of trees particularly famous for their burning. And here you see a piece of that very curious substance taken out of some of the bogs in Ireland, called *candlewood*—a hard, strong, excellent wood, evidently fitted for good work as a resister of force, and yet withal burning so well that where it is found they make splinters of it, and torches, since it burns like a candle, and gives a very good light indeed. And in this wood we have one of the most beautiful illustrations of the general nature of a candle that I can possibly give. The fuel provided, the means of bringing that fuel to the place of chemical action, the regular and gradual supply of air to that place of action—heat and light—all produced by a little piece of wood of this kind, forming, in fact, a natural candle. [138]

"But we must speak of candles as they are in commerce. Here are a couple of candles commonly called dips. They are made of lengths of cotton cut off, hung up by a loop, dipped into melted tallow, taken out again and cooled, then re-dipped until there is an accumulation of tallow round the cotton. In order that you may have an idea of the various characters of these candles, you see these which I hold in my hand—they are very small and very curious. They are, or were, the candles used by miners in coal mines. In olden times the miner had to find his own candles; and it was supposed that a small candle would not so soon set fire to the fire-damp in the coal mines as

a larger one; and for that reason, as well as for economy's sake, he made candles of this sort—twenty, thirty, forty, or sixty to the pound. They have been replaced since then by the steel-mill, and then by the Davy lamp, and other safety lamps of various kinds. I have here a candle that was taken out of the *Royal George*, it is said, by Colonel Pasley. It has been sunk in the sea for many years, subject to the action of salt water. It shows you how well candles may be preserved; for though it is cracked about and broken a good deal, yet, when lighted, it goes on burning regularly, and the tallow resumes its natural condition as soon as it is fused." [139]

We have not space to quote further from these delightful lectures, which however, as I have said earlier, can be got in a little volume by themselves. These lectures were, as indeed were most of Faraday's lectures, beautifully illustrated with a large number of experiments.

On one occasion, when suffering much in health, Faraday yet insisted upon taking his place at the lecture table at the Royal Institution; for an obstruction of voice, which was indeed too painfully apparent, he apologised, saying that "in an engagement where the contracting parties were one and many, the one ought not on any slight ground to break his part of the engagement with the many, and therefore, if the audience would excuse his imperfect utterance he would proceed." The audience murmured, and there were cries of "Put off the lecture;" but Faraday begged to be allowed to go on. A medical man rose and said it would in his opinion be dangerous for the Professor to proceed. Faraday still urged his desire to go on with the lecture; he could not give people all the trouble of coming there, having perhaps put off other engagements, for nothing. On this, as by a single impulse, the whole audience rose, and Faraday yielded to the generally expressed desire to spare him the pain and inconvenience of lecturing. After a fortnight's rest he reappeared, and continued the broken course, carrying it on later that his audience should not lose any of the eight lectures which they had anticipated. It was on a reappearance such as this after illness that "as soon as his presence was recognised, the whole audience rose simultaneously, and burst into a spontaneous utterance of welcome, loud and long."



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CHAPTER IX. NOTES ON HIS WORK.

"So that I draw the breath of finer air
Station is nought, nor footways laurel-strewn,
Nor rivals tightly belted for the race.
God speed to them! My place is here or there;
My pride is that among them I have place:
And thus I keep this instrument in tune."

GEORGE MEREDITH.

In treating of the life-story of Michael Faraday I have let particulars as to his various experiments and discoveries interfere as little as possible with the continuity of the narrative, and have thought it advisable to slightly refer to them in a special chapter. The value of his contributions to our fund of scientific knowledge is made manifest by the fact that whatever book on electricity and allied subjects we may take up now—works even bringing the science down to the very latest date—we always find the name and experiments of Michael Faraday quoted with great respect as a leader and an unquestioned authority. Indeed, our debt to him for his electrical work is incalculable; we are now seeing the electric light carried day by day into more streets, lighting more public places, nay, even being used in illuminating private buildings. This light we owe, primarily, to Michael Faraday. Writing nearly a quarter of a century ago Professor Tyndall answers this question as to "What is the use of it all?" thus explicitly and unhesitatingly—"As far as electricity has been applied for medical purposes, it has been almost exclusively Faraday's electricity. You have noticed those lines of wire which cross the streets of London. It is Faraday's currents that speed from place to place through these wires. Approaching the point of Dungeness the mariner sees an unusually brilliant light, and from the noble *phares* of La Hève the same light [141]

flashes across the sea. These are Faraday's sparks exalted by suitable machinery to sunlike splendour. At the present moment the Board of Trade and the Brethren of the Trinity House, as well as the Commissioners of Northern Lights, are contemplating the introduction of the Magneto-electric Light at numerous points upon our coasts; and future generations will be able to refer to those guiding stars in answer to the question, What has been the practical use of the labours of Faraday? But I would again emphatically say that his work needs no such justification; and that if he had allowed his vision to be disturbed by considerations regarding the practical use of his discoveries, those discoveries would never have been made by him."

In one of his very earliest lectures delivered before the City Philosophical Society on the subject of chlorine,^[11] Faraday referred to the question too often and too thoughtlessly put on hearing of a new discovery. "Before leaving this subject," he said, "I will point out the history of this substance, as an answer to those who are in the habit of saying to every new fact, 'What is its use?' Benjamin Franklin says to such, 'What is the use of an infant?' The answer of the experimentalist is, 'endeavour to make it useful.'" Truly the infant Electricity has already grown to goodly proportions. It is to his researches in connection with electrical science that we must look for the chief result of Faraday's work. His later years were almost exclusively taken up in the investigation of this fascinating subject. [142]

The value of his contributions to the sum of knowledge on this new branch of science was testified to in a remarkable manner during the past summer, when the centenary of his birth was celebrated in a fitting manner at that Institution which had been a "home" to him for so many years. It was indeed an unique incident in the history of modern science, when on the 17th of June, 1891, many of the leading living scientists met in the theatre of the Royal Institution to hear a lecture by Lord Rayleigh on the life-work of "one of England's greatest worthies." "A quarter of a century has not elapsed," wrote a contemporary journal,^[12] "since his death, and yet we find the highest nobles of the land vieing with the most illustrious professors of our own and of foreign universities in testifying their admiration for this man of the people, who rose to be a leader of scientific men." "When the history of electricity comes to be written," continues the same authority, "a chapter of great extent and first importance must be given to the prolific life-work of Faraday. He will be pointed to as the man who in the middle of the nineteenth century, waged an energetic and relentless warfare against the two fluid theories in electricity and magnetism, and who dealt its death-blow to the theory of action at a distance. And to show the powerful influence his master-mind exercised over contemporary science, the historian may merely refer to Clerk-Maxwell, Sir William Thomson, Rayleigh, Tyndall, and others, all admiring disciples and professed followers of the great Michael Faraday."

The meeting that thus did honour to the memory of Faraday, was probably the most fitting method of celebrating the anniversary of his birth that could have been devised; it was, we may feel sure, just such a celebration as Faraday would have felt most proud of. Wealth and social rank, as we have seen throughout his life, had no attraction for him; but he *did* like to receive the appreciation of capable men, in whose appreciation he found the highest honour to which it was possible to attain. [143]

Some of Faraday's earliest experiments, as was incidentally mentioned in an earlier part of this little book, were in connection with chlorine, etc., and then on the making of glass for optical purposes; and it was not, indeed, until he had been at the Institution for about eighteen years that he really entered with any degree of success into his electrical research. Here it is of interest to note a remark which he once made in this connection to the effect that it requires twenty years of work to make a *man* in physical science, the whole of the previous period being one of *infancy*. Once, however, he had reached this scientific manhood his work was done with remarkable rapidity; he would, once on the track, so to speak, of a discovery, mature it in a space of time so short as to be nothing less than marvellous; and one after another of his "experimental researches" were carried out, completed, described, and the resultant paper submitted to the Royal Society with a rapidity, and at the same time with an accuracy which has never been equalled. He was asked once what was the secret of his success, and answered that the whole secret might be told in three words, they were these "Work—Finish—Publish." Perhaps the centre word is the one on which Faraday would himself have lain most stress—he was always careful to finish everything before he announced it, which makes his almost unexceptional accuracy, considering the rapidity with which he worked, even more remarkable. It is, however, not inaccurate to say that the results which he definitely announced, were never found to be wrong; further developments have of course taken place, but the result of a research as announced by him was never found to be untrue, and has never had to be put aside. [144]

He had said, in the early part of his scientific career, "the thing that I am proudest of is that I have never been found to be wrong." And after the death of his friend, Professor A. de la Rive wrote, "I do not think that Faraday has once been caught in a mistake; so precise and conscientious was his mode of experimenting and observing." Dr. Gladstone commenting upon this says, "The extreme rarity of his mistakes, notwithstanding the immense amount of his published researches, is one of those marvels which can be appreciated only by those who are in the habit of describing what they have seen in the mist-land that lies beyond the boundaries of previous knowledge."

The proper treatment of Faraday's discoveries could of course only be undertaken by one who was himself a scientist; the technicalities of the laboratory and the lecture-theatre would be somewhat out of place in a book such as this, which but aims at presenting in a popular form the facts in connection with the life of one of the greatest of England's scientists—one of the best of her sons. It may, however, here be pointed out that to those who would become acquainted with

the details of Faraday's scientific work, with particulars of his numerous experiments, a delightful introduction has been afforded by Professor Tyndall, who in his little work on *Faraday as a Discoverer*, has summarised much of the great man's work, and explains in a clear and delightful manner much about the experiments which were undertaken and the discoveries which were made by his illustrious predecessor and friend. It is of interest to notice here what discovery of Faraday it is which Tyndall selects as the greatest—it is the discovery of electro-magnetism, of which he says: "The beauty and exactitude of the results of this investigation are extraordinary. I cannot help thinking while I dwell upon them, that this discovery of magneto-electricity is the greatest experimental result ever obtained by an investigator. It is the Mont Blanc of Faraday's own achievements. He always worked at great elevations, but a higher than this he never subsequently attained."

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The following impromptu lines with reference to Faraday's great discovery of magneto-electricity were written by Herbert Mayo:—

"Around the magnet Faraday
Was sure that Volta's lightnings play,
But how to draw them from the wire?
He drew a lesson from the heart.—
'Tis when we meet, 'tis when we part,
Breaks forth th' electric fire."

Of this same subject Tyndall wrote shortly after Faraday's death:—"Seven and thirty years have passed since the discovery of magneto-electricity; but, if we except the *extra current*, until quite recently nothing of moment was added to the subject. Faraday entertained the opinion that the discoverer of a great law or principle had a right to the 'spoils'—this was his term—arising from its illustration; and guided by the principle he had discovered, his wonderful mind, aided by his wonderful ten fingers, overran in a single autumn this vast domain, and hardly left behind him the shred of a fact to be gathered by his successors."

This indeed is a quality which has been insisted upon by all who have as fellow scientists treated of the work which was done by Michael Faraday,—this quality, that is, of completion, of thoroughness in finishing that which he had commenced; he seemed to become aware almost as though by intuition of the full meaning of a discovery, and of its true bearing with regard to previous knowledge.

Great as was Faraday's work in the service of science he not only did not aim at, but he frequently declined to accept what many men would have considered but just reward. He was a chemist, a scientist, a philosopher (to give him the name which he best liked, and of which he felt most proud), and did his work as such from the purest love for it, as I have tried to show in earlier chapters. He did not seek worldly position—he was above it; he did not seek for wealth, he had no use for it, as his wants were of the simplest; he did not seek for popular applause, for the suffrage of the multitude; but what he did all his life long most earnestly and most faithfully strive for was—Truth. He ever aimed at fulfilling what the Laureate has beautifully expressed in his dedication to *In Memoriam* wherein he says—

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"Let knowledge grow from more to more,
And more of reverence in us dwell,
That mind and soul according well
May make one music as before,
But vaster."

He sought to make knowledge grow from more to more, but it is to be recollected that he never for one more moment swerved from his faithful adherence to his Church. In all his research among physical phenomena he was never led to doubt, as some have done, the truth of that religion in which he always maintained a sincere and beautiful faith; his religion was, indeed, always a something far above his science, a something sacred and of moment to himself, as a single soul. We saw in his reply to his wife on his formally entering the Sandemanian Church shortly after his marriage, what was his attitude on this question. It was, as he had said, a matter between himself and his God; and thus we find in what he has written but very little about his religion, although one or two of his letters to relations, where he has been directly appealed to, breathe the sincere and earnest devotion of the man, and his true Christian spirit. His whole life was, however, a practical expression of his religious faith; as is shown to us by what has been said or written by all who came in contact with him.

The following tribute to his memory from Monsieur Dumas is yet one further proof of the universal feeling which his friendship inspired, "I do not know whether there is a *savant* who would not feel happy in leaving behind him such works as those with which Faraday has gladdened his contemporaries, and which he has left as a legacy to posterity; but I am certain that all those who have known him would wish to approach that moral perfection which he attained to without effort. In him it appeared to be a natural grace, which made him a professor, full of ardour for the diffusion of truth, an indefatigable worker, full of enthusiasm and sprightliness in his laboratory, the best and most amiable of men in the bosom of his family, and the most enlightened preacher among the humble flock whose faith he followed.

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"The simplicity of his heart, his candour, his ardent love of the truth, his fellow interest in all the

successes, and ingenuous admiration of all the discoveries of others, his natural modesty in regard to what he himself discovered, his noble soul—independent and bold—all these combined gave an incomparable charm to the illustrious physicist.

"I have never known a man more worthy of being loved,—of being admired,—of being mourned. Fidelity to his religious faith, and the constant observance of the moral law, constitute the ruling characteristics of his life.... There is more than one useful lesson to be learnt from the proper study of this illustrious man, whose youth endured poverty with dignity, whose mature age bore honours with moderation, and whose last years passed gently away surrounded by marks of respect and tender affection."

Several stories are told that illustrate the constant habit of experimenting which seemed to be innate in Faraday's mind, and also show how simple were the means which he often adopted to attain a required end. An example of the latter is given us by Sir Frederick Arrow in describing a visit which he, as one of the Committee of the Elder Brethren of the Trinity House, paid, to observe the Dungeness electric light, in June 1862. The committee accompanied Faraday, who had always been a most energetic worker in the cause of the Trinity House.

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"We dined," says Sir Frederick Arrow, "I think at Dover, and embarked in the yacht from there, and were out for some hours watching it, to Faraday's great delight—(a very fine night)—and especially we did so from the Varne lightship about equi-distant between it and the French light of Grisnez, using all our best glasses and photometers to ascertain the relative value of the lights; and this brings me to my story. Before we left Dover, Faraday, with his usual bright smile, in great glee showed me a little common paper-box, and said, 'I must take care of this; it's my special photometer,'—and then, opening it, produced a lady's ordinary black shawl pin—jet, or imitation perhaps—and then, holding it a little way off the candle, showed me the image very distinct; and then putting it a little further off, placed another candle near it, and the relative distance was shown by the size of the image. He lent me this afterwards when we were at the Varne lightship, and it acted admirably; ever since I have used one as a very convenient mode of observing, and I never do so but I think of that night and dear good Faraday, and his genial happy way of showing how even common things may be made useful."

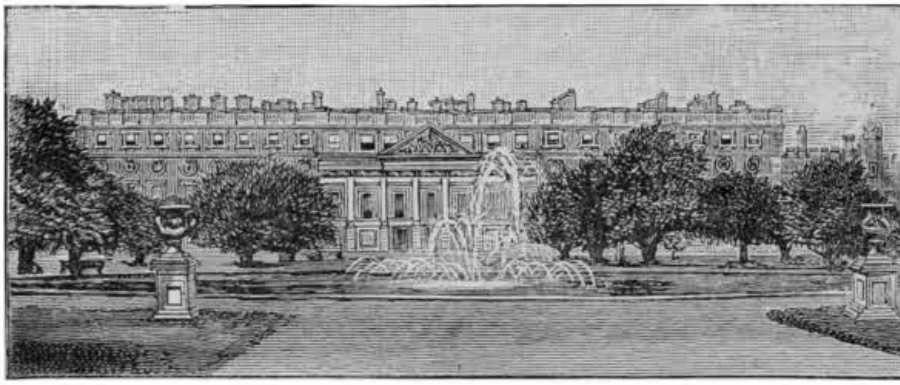
Such men as had occasion to work in the laboratory with Faraday, were always struck by his lively enthusiasm, and the great activity with which he worked—"his motions were wonderfully rapid; and if he had to cross the laboratory for anything, he did not walk at an ordinary step but ran for it, and when he wanted anything he spoke quickly."

In his methods of working he was most exact. Having carefully planned out in his own mind work to be done, he would enter the laboratory, and with his table unencumbered with anything beyond such things as he was using, would set to work in a grave, silent manner. After a time, however, as the experiment proceeded and the result which he had anticipated began to manifest itself, he would begin humming a tune, and even speak to his attendant of the expected result. On finishing such experimental work for the day, everything had to be put carefully away, all bottles stoppered, open vessels covered over, all instruments and materials returned to their various drawers, all rubbish cleared from the floor, and the laboratory left ready for the Professor to start work again. Faraday would then go upstairs to his study, and think further on the subject on which he happened to be working.

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In his later years we are told that he invariably carried about with him convenient sized cards on which he could jot down at once—in the street, in the lecture room, at a friend's, indeed anywhere—such thoughts as should flash across his mind.

A few words deserve to be said with regard to Sergeant Anderson, who for over thirty years acted as Faraday's laboratory assistant at the Royal Institution. In 1829, when Faraday was working at experiments on the manufacture of glass for optical purposes, a special furnace was erected at the Royal Institution, and Anderson was engaged to assist at it. After the glass experiments were over, however, Anderson, who had demonstrated his usefulness, was retained, and he continued throughout the rest of Faraday's life as his assistant, having won the good opinion not only of the Professor but of all with whom he had anything to do. There is one good story told of Anderson, who had been chosen for his post on account of the habits of strict obedience, which his military training had given him. His duty was to keep the furnaces always at the same heat, and the water in the ashpit always at the same level. In the evening he was released; but one night Faraday forgot to tell Anderson he could go, and early next morning he found his faithful servant still stoking the glowing furnace, as he had been doing all night long.



CHAPTER X. ABOUT THE ROYAL INSTITUTION.

"The heights by great men reached and kept
Were not attained by sudden flight,
But they, while their companions slept,
Were toiling upward in the night.

Standing on what too long we bore,
With shoulders bent and downcast eyes,
We may discern—unseen before—
A path to higher destinies.

Nor deem the irrevocable past
As wholly wasted, wholly vain,
If, rising on its wrecks, at last
To something nobler we attain."

LONGFELLOW.

The Royal Institution, which for so many years was "home" to Michael Faraday, must ever remain intimately associated with his name. It is not a hundred years since it was founded, yet its history is the history of Sir Humphry Davy, Michael Faraday, and John Tyndall—or perhaps it would be more correct to say that its history is in a large measure a history of experimental research during the century. Before regarding the Institution as it is especially connected with the life-story of Michael Faraday, it may be well to just glance at its origin.

Early in the year 1799 a party of noblemen and gentlemen met at the house of Sir Joseph Banks for the purpose of forming themselves, at the suggestion of Count Rumford, into a "Society for bettering the condition of the poor." Count Rumford and his friends were most anxious for the success of their undertaking; and having once made a start did not remain idle, but in January, 1800, succeeded in having their Society incorporated by Royal Charter. The Society started perhaps on a somewhat narrower basis than that on which it now stands; its original object was that it should be "an institution for diffusing the knowledge, and facilitating the general introduction of useful mechanical inventions and improvements; and for teaching by courses of philosophical lectures and experiments, the application of science to the common purposes of life." [151]

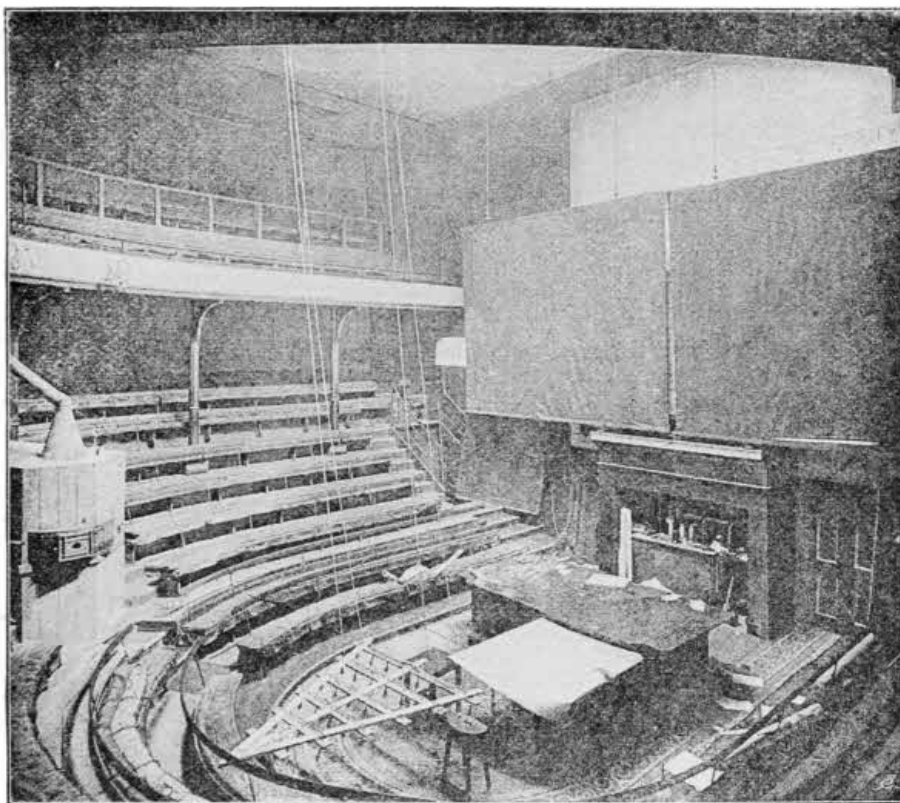
In a guide to London published in the early part of the present century, No. 21, Albemarle Street is thus referred to: "Here is also the Society's house for the encouragement of improvements in arts and manufactures, or the Royal Institution. The front of this house is barricaded by double windows, to prevent the entrance of cold in winter and heat in summer. Here is a room for experimental dinners, and a kitchen fitted up on the late Count Rumford's plan. Adjoining this is a large workshop, in which a number of coppersmiths, braziers, etc., are employed, and over this a large room for the reception of such models of machinery as may be presented to the Institution." It has been said that chemistry dates one of its chief epochs from the foundation of the Royal Institution laboratory.

The large building in Albemarle Street cannot be mistaken, for there are along the front of it fourteen great fluted Corinthian columns which give a striking appearance to the premises. These columns were built on to the face of the building in 1838, at a cost of five hundred pounds, by Mr. Lewis Vulliamy.



From photo by **ROYAL INSTITUTION, ALBEMARLE STREET. [H. Dixon & Son.]**

That the Royal Institution is, indeed, well worth visiting it must be quite unnecessary to say. Even was there not much to be seen which is of itself interesting, the place would have an attraction as being the place where so much has been done for the advancement of science by Faraday, his predecessors, Davy, Rumford, and Brande, and by Tyndall, and other successors.



From photo by **LECTURE-THEATRE, ROYAL INSTITUTION. [H. Dixon & Son.]**

On entering the building we find ourselves in a lofty hall; in front of us, at the head of a short flight of stone steps, is a large portrait of Sir Humphry Davy, while to the right we see Foley's fine and striking statue of Faraday, which was placed there as being the most fitting memorial of the great man's connection with the Institution. On going up the flight of steps to the right, we find ourselves in the well-appointed library, where we are shown under a glass case a beautiful little statuette of Faraday, and also a large photograph portrait of the philosopher. We next visit the lecture-theatre, our eyes being immediately drawn to the "seat over the clock," where Michael Faraday as a boy first sat, and listened and marvelled at the wonders of chemistry unfolded before him by the great Humphry Davy. This theatre it may be noted is one of the best for its acoustic properties in London. Well may we pause here—thinking of the great men who

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have lectured here, and of the great men who have come here to listen. It may be mentioned that the lectures are not strictly confined to scientific subjects, for it was here, in 1812, that Thomas Campbell gave his course of lectures on poetry, and that another poet—Thomas Moore—was also invited to lecture.

From the lecture-theatre we are taken downstairs to see the room where all the numerous instruments and materials are kept. Here we are shown the primitive electrical machine, which Faraday early constructed for himself, and many of the things which he used in his work; here, too, we have pointed out to us a large glass-case running along one side of the room, and divided into sections, each section containing the tools and appliances used by one or other of the great men of the Institution, Davy and Brande and Faraday himself. In several of the smaller rooms through which we are permitted to pass, we notice among the many portraits several of the subjects of this little work. And among other interesting things especially pointed out to us there is a locked glass-case "presented to the Royal Institution by Michael and Sarah Faraday" (it was characteristic of Faraday thus to put his wife in as one of the donors). This case contains several books which Michael had himself bound in those days when, disliking trade, he was seeking to enter the service of science. There are, besides, several books of Davy's and several manuscripts of his also, which his assistant had carefully kept.

And not only is the building worthy a visit on account of the many interesting relics it contains of some of our greatest scientists, and on account of the memoirs of its many great men, but even to the unscientific there is much that is attractive in the Friday Evening Lectures, which since that year 1826, when Faraday may be said to have inaugurated them, up to now, have been regularly carried on. No trouble is spared by the lecturers to make their matter understood, and innumerable experiments are presented on these occasions. The experiments, too, are such as often require a great expenditure of time and trouble in their preparation. As an instance of this I may mention an experiment which was made on the occasion of my latest attendance at a "Friday evening." The lecturer was Professor Harold Dixon; the subject of which he was treating was "The Rate of Explosion of Gases." To show the rapidity with which an explosion of a certain gas travelled, the lecturer had fitted up a leaden piping all round the theatre; the ends of the piping rested upon either end of the table at which Professor Dixon was lecturing. The piping was filled with gas, and the Professor applied a light at one end; a sharp explosion took place as the gas was fired, and was followed *almost instantaneously* by an explosion at the other end of the pipe—the explosion having in that very short time travelled through a length of two hundred and twenty feet of piping! I quote this instance to show that no trouble is spared in preparing an illustrative experiment, although such experiment may be demonstrated in a minute or less.

It may be appropriate, while considering the long connection of Faraday with the scene of his many experimental triumphs, to refer more particularly to that unique meeting which took place last summer (June 8th, 1891) in celebration of the hundredth anniversary of the birth of Faraday, and to which slight reference is made in the last chapter. The meeting, appropriately enough, took the form of a gathering in the theatre of the Royal Institution of many of the most able and distinguished chemists of the day; Lord Rayleigh delivering an address on the developments of Faraday's discoveries. The chair was taken by His Royal Highness the Prince of Wales, who referred in his opening remarks to the time when he had sat in that theatre and listened to Faraday himself. The letter from H.R.H., which is quoted on p. 131, was read, as was also the following letter which the Prince wrote to Mrs. Faraday on the occasion of her husband's death.

"Wiesbaden, September 10, 1867.

"Dear Mrs. Faraday,—Although I have not the pleasure of knowing you, I cannot resist sending you a few lines to tell you how deeply grieved and distressed I am to hear of the death of your husband, Professor Faraday. Having had the great pleasure of knowing him for some years, and having heard his interesting lectures when quite a boy, I can fully appreciate how great the loss must be, not only to you, but to the whole country at large, where his name was deeply venerated by all classes. His name will not only be remembered as a great and distinguished scientific man, but also as a good man, whose excellent and amiable qualities were so universally known. Pardon my trespassing so soon on your great grief, and believe me, dear Mrs. Faraday, yours very sincerely,

"ALBERT EDWARD."

A very interesting yet pathetic letter was read from Dr. Tyndall, which, coming as it did from a man who had so well known and so thoroughly appreciated Faraday, is of great interest to us. "As Faraday recedes from me in time," wrote Tyndall, "he becomes to me more and more beautiful. Anything, therefore, calculated to do honour to his memory must command my entire sympathy. But the utmost liberty I can now allow myself is to be shifted from my bed to a couch, and wheeled to a position near the window, from which I can see the bloom of the gorse and the brown of the heather. Thus, considerations affecting the body only present an insuperable barrier to my going to London on Wednesday."

Not very far from Albemarle Street, is Blandford Street, where it will be remembered Michael Faraday began the battle of life as a newsboy. Mr. Riebau's shop (No. 2) is yet standing, and is still a stationer's and bookseller's. Over the shop front is now to be observed a plaque, on which are the simple words, "Michael Faraday, Man of Science, apprentice here, 1791-1867." Professor Tyndall tells us of a pleasing story of a visit which he paid with the ex-bookbinder to this scene of his early labours. "Mr. Faraday and myself quitted the Institution one evening together, to pay a

visit 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 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 toward 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!*"

Turning to our right on coming out of No. 2, Blandford Street, we shall notice on the opposite side of the way a small turning down under an archway. That turning is the beginning of Jacob's Well Mews, where the Faraday family lived, and of which an illustration has been given on an earlier page of this book. The place is interesting and worthy of a visit, as showing us that however poor and unpromising may be the surroundings of a man's childhood, he may yet win for himself an enduring name, as has Michael Faraday, not only in the annals of his own country, but in those of knowledge—whose annals are concerned not with one, but with all countries. [158]

A most interesting and pleasant trip, too, may be taken to Hampton Court Green, where a visit can be paid to the house, the use of which Her Majesty the Queen so kindly gave to the Professor, and where he passed the greater part of the last ten years of his life. Of the very many visitors to the famous palace and gardens of Hampton Court, there are, I fear, not a very large proportion who notice the charming little house facing the Green, and not far from the entrance to the Palace where the Professor lived. "Faraday House," however, appears much the same as it did when he whose name it now bears was living there. With its front all overgrown with ivy and Virginian creeper, with its creeper-bowered archway from the gate to the front door, with its trees and shrubs all along the front, and with its view across the Green to the trees in the Palace grounds beyond, the old-fashioned house has a delightful aspect, and seems indeed an ideal spot to which a man of Faraday's simple, unpretentious, yet nature-loving character, could retire after a long life of arduous and useful work.

The following "in memoriam" poem, which appeared in the pages of *Punch* shortly after Faraday's death, so beautifully sums up much of the man's life and character, that it may be fittingly quoted as a conclusion to this short account of the life of the illustrious philosopher, a life which must impress all who have studied it as one of the purest and most unselfish of which we have any record. [159]

"Statesmen and soldiers, authors, artists,—still
The topmost leaves fall off our English oak:
Some in green summer's prime, some in the chill
Of autumn-tide, some by late winter's stroke.

Another leaf has dropped on that sere heap—
One that hung highest; earliest to invite
The golden kiss of morn, and last to keep
The fire of eve—but still turned to the light.

No soldier's, statesman's, poet's, painter's name
Was this, through which is drawn death's last black line;
But one of rarer, if not loftier fame—
A priest of Truth, who lived within her shrine.

A priest of Truth: his office to expound
Earth's mysteries to all who willed to hear—
Who in the book of science sought and found,
With love, that knew all reverence, but no fear.

A priest who prayed as well as ministered:
Who grasped the faith he preached, and held it fast:
Knowing the light he followed never stirred,
Howe'er might drive the clouds through which it past.

And if Truth's priest, servant of Science too,
Whose work was wrought for love and not for gain:
Not one of those who serve but to ensue
Their private profit: lordship to attain

Over their lord, and bind him in green withes,
For grinding at the mill 'neath rod and cord;
Of the large grist that they may take their tithes—
So some serve Science that call Science lord.

One rule his life was fashioned to fulfil:
That he who tends Truth's shrine, and does the best
Of Science, with a humble, faithful will,
The God of Truth and Knowledge serveth best.

And from his humbleness what heights he won!
By slow march of induction, pace on pace,
Scaling the peaks that seem to strike the sun,
Whence few can look, unblinded, in his face.

Until he reached the stand which they that win
A bird's-eye glance o'er Nature's realm may throw;
Whence the mind's ken by larger sweeps takes in
What seems confusion, looked at from below.

Till out of seeming chaos order grows,
In ever-widening orbs of law restrained,
And the Creation's mighty music flows
In perfect harmony, serene, sustained;

And from varieties of force and power,
A larger unity and larger still,
Broadens to view, till in some breathless hour
All force is known, grasped in a central Will,

Thunder and light revealed as one same strength—
Modes of the force that works at Nature's heart—
And through the Universe's veined length
Bids, wave on wave, mysterious pulses dart.

That cosmic heart-beat it was his to list,
To trace those pulses in their ebb and flow
Towards the fountain-head, where they subsist
In form as yet not given e'en *him* to know.

Yet, living face to face with these great laws,
Great truths, great myst'ries, all who saw him near
Knew him for childlike, simple, free from flaws
Of temper, full of love that casts out fear:

Untired in charity, of cheer serene;
Not caring world's wealth or good word to earn;
Childhood's or manhood's ear content to win;
And still as glad to teach as meek to learn.

Such lives are precious: not so much for all
Of wider insight won where they have striven,
As for the still small voice with which they call
Along the beamy way from earth to heaven."

THE END.

LONDON: KNIGHT, PRINTER, MIDDLE STREET, ALDERSGATE, E.C.

FOOTNOTES:

- [1] Erasmus Darwin, author of *The Botanic Garden, Loves of the Plants*, etc., and grandfather of the more famous Charles Darwin.
- [2] It may be noted here that there are several spurious stories told of Faraday's first visit to the Institution and his introduction to Davy. The story as told here is as Faraday himself told it to Davy's biographer.
- [3] It is interesting to note that Sir Humphry Davy was only thirteen years the senior of Michael Faraday.
- [4] Some of the books which Faraday bound for the Royal Institution are there now; kept carefully with other relics of the great chemist. See the chapter entitled "About the Royal Institution."
- [5] Chevreul, many readers will remember, lived to celebrate his hundredth birthday in 1886, and all his life continued experiments in his fascinating science. He died on the 10th of April, 1889.

- [6] So was Faraday described in the passport issued to him at Paris.
- [7] The works of art which Faraday refers to are the Laocoön, the Venus de Medici, the Dying Gladiator, and other sculpture brought from Rome to Paris by Napoleon after one of his Italian campaigns. Faraday must have been gratified at their return to Rome the year after his words were written.
- [8] Founded in 1831, for the purpose of stimulating scientific inquiry.
- [9] Author of *Conversations on Chemistry*, a work which had had a considerable influence on Faraday in his early youth.
- [10] It is interesting here to see what Tyndall says, referring to Faraday as a lecturer: "I doubt his unconcern, but his fearlessness was often manifested. It used to rise within him as a wave, which carried both him and his audience along with it. On rare occasions also, when he felt himself and his subject hopelessly unintelligible, he suddenly evoked a certain recklessness of thought; and without halting to extricate his bewildered followers, he would dash alone through the jungle into which he had unwittingly led them; thus saving them from ennui by the exhibition of a vigour which, for the time being, they could neither share nor comprehend."
- [11] A non-metallic element first discovered in 1774 by Scheele, and the subject of much research to succeeding chemists.
- [12] *Engineering* for June 19th, 1891.
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Transcriber's Notes:

Footnotes have been moved to the end of the text and renumbered consecutively through the document.

Illustrations have been moved to paragraph breaks near where they are discussed. This has sometimes left consecutive page numbers right next to each other.

Punctuation has been made consistent.

Variations in spelling and hyphenation were retained as they appear in the original publication.

Changes have been made as follows:

Page 135: "whe" changed to "who" (anyone who claimed his attention)

Page 157: "predecessor" changed to "predecessor" (predecessor?' 'Mr. Riebau,)

Page 158: "virginian" changed to "Virginian" (with ivy and Virginian creeper)



*** END OF THE PROJECT GUTENBERG EBOOK MICHAEL FARADAY, MAN OF SCIENCE ***

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