CHAPTER XVI.

NOTES OF LIFE FROM 1855 TO 1860.

"Here NEWTON dawned, here lofty wisdom woke,
And to a wondering world divinely spoke."

"A chief of men who through a cloud,
Not of strife only, but detractions rude,
Guided by faith and matchless fortitude,
To peace and truth thy glorious way hast ploughed,
And on the neck of crowned science proud,
Hast viewed God's trophies, and this work pursued.

IN the summer of 1855 my father published the *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, which was dedicated to Prince Albert, not only as Chancellor of the University of Cambridge, "the birthplace of Newton's genius, and the scene of his intellectual achievements," but as a Prince of such noble and patriotic views, who had given such an impulse to the arts and sciences of England, that if fully seconded the result must have been "a complete national encouragement of science and consolidation of our scientific institutions."

Brewster's admiration of Newton dated from an early age. There is a tombstone on the south wall of Greyfriars Church, Edinburgh, erected in memory of Colin Maclaurin, Professor of Mathematics in Marischal College, Aberdeen, on which is recorded in two words Newton's recommendation of him. My father thus writes in his Life of Sir Isaac:—"When a youth at

College, I have often gazed upon this simple monument, and pondered over the words, to be envied by every aspirant to scientific fame, 'NEWTONE SUADENTE.'" In 1814 he visited the Manor of Woolsthorpe, the birth-place and paternal estate of Sir Isaac,—saw the celebrated apple-tree, which was said by one of its falling apples to have suggested to Newton the laws of gravity,—and brought away a portion of one of its roots. There was much similarity between the genius, the characteristic individuality, and the career of both. Had they been contemporaries doubtless there would have been mutual warm personal sympathies. As it was, there was something approaching to the known and the personal in the affectionate admiration which Brewster ever cherished for Newton. Four years after he wrote the shorter Life, several statements deeply affecting the character of the great author of the *Principia* had been given to the world in a work of great interest, *The Life of Flamsteed*, by Baily, printed and circulated at the expense of the Board of Admiralty,—which were very injurious to the fame of the philosopher.

> "Gnats are unnoticed wheresoe'er they fly,
> But eagles gazed upon by every eye;"

so that Newton had had his full share during life, of controversies, accusations, and irritating scientific feuds, but had come out of them all as the acknowledged chief of English science. That this great man should be attacked more than a hundred years after his death, was to Brewster's mind a personal grief and an English scandal. He therefore for twenty years made it one of his objects in life to search out every proof and evidence by which he could defend Newton from the charges against his sanity, his probity, and his justice, which

were circulated when the hand and the tongue of the accused and his contemporaries were safely mouldering in the grave. In 1837 Sir David "applied to the Hon. Newton Fellowes, one of the trustees of the Earl of Portsmouth, for permission to inspect the MSS. and correspondence of Sir Isaac Newton, which through his grand-niece, Miss Conduitt, afterwards Lady Lymington, had come into the possession of that family." Mr. Fellowes kindly granted this request, and aided by his son, the late Mr. Henry Arthur Fellowes, my father had the fullest opportunities at Hurtsbourne Park for collecting entirely fresh material for his great work. Mr. Baily had mentioned "the valuable collection of Newton's MSS. belonging to the Earl of Portsmouth," but stated that "he found nothing in it to throw any light on the special object of his inquiries," and in his book published only eleven of Flamsteed's letters to Newton. My father, however, found forty in addition to those, which he considered of great importance in judging of the difficult and delicate controversy between these two distinguished individuals, and in which he believed that Newton had been grievously traduced. There was another point on which Brewster's heart was set on vindicating his unseen friend and master. Of undoubted orthodoxy himself, he could not endure that Newton should be considered a Socinian or Unitarian, and in his first work had not scrupled to declare him to be a Trinitarian. Ampler information, however, came before him, and he considered it a duty to investigate the matter more fully. I remember his delight when he came upon passages clearly showing, as he thought, that Sir Isaac was neither a Socinian nor an ordinary Arian, and his mortification was deep when he could not find

any word or note in Newton's writings that could prove him to be beyond what is, I believe, called an "advanced Arian." He held that Jesus "was the Son of God, as well by His resurrection from the dead as by His supernatural birth of the Virgin," although there is never any recognition of His equality with the Father. His biographer always believed, however, that the proofs were negative, and seemed to cling to what he considered a fact, that there was no distinct declaration of Newton's rejection of the doctrine of the Trinity. He lived in communion with the Church of England, and studied and loved the Word of God. He was described by one bishop "as knowing more of the Scriptures than them all," and by another as having "the whitest soul he ever knew;" and while we must grieve that he had not grasped the whole of Scriptural truth for himself, yet it is delightful to find this great man of science warmly interested in the welfare of immortal souls. He was often consulted about the spiritual state of his friends, and prayed for them. One eminent mathematician "thanked God that his soul was extremely quiet, in which Newton had the chief share;" and Dr. Morland, a Fellow of the Royal Society, wrote, "I have done, and will do, my best while I live to follow your advice to repent and believe." The whole of this book, though it involved severe labour, was most congenial work to Brewster. He especially enjoyed the correction of its sheets, feeling then that the heaviest part was accomplished, and he corrected every line with peculiar and loving care.

Working in the same demesne, and familiar with the marvellous discoveries of Newton, it seemed as if it were with reluctance that Brewster admitted of errors

either of omission or commission in those great labours. Although obliged to admit, by stern scientific facts, the superiority of the undulatory theory of light, yet it seemed as if his mind lingered reluctantly over the beautiful Newtonian doctrine of emission. He evidently grieved that the elder philosopher had missed the great discovery made by Wollaston and Fraunhofer of the black lines in the Solar Spectrum, upon which he himself so improved, by increasing the 600 previously discovered, to upwards of 2000 by patient observation and the use of excellent instruments. It is beautiful to observe how these and other masters of science, each in his day, add a quota of riches to the treasure-house of discovered knowledge. Newton's theory of the sevenfold colours of the spectrum, which he likened to the seven notes of the musical chord, was of value in its time, although reduced by Brewster to the primary colours, blue, red, and yellow, which again did good service, although that again may be considered as disproved by the more recent researches of Clerk-Maxwell and Helmholtz. Brewster's mind clung, however, to his own trinity of colour, which he never gave up. A pretty experiment showing the tremulous movement of a red spot upon a green ground, or blue upon orange, was a great favourite; he exhibited it as shown by a mat of worsted work at a meeting of the British Association, explaining the phenomenon by his favourite theory of colours. Blue and red, yellow and green, without being softened by a due proportion of their complementary hues, seemed to give positive physical pain to his sensitive vision, whether in dress, paintings, or furniture. Upon one occasion he resolved to bring home a present which should be at the same time a

scientific lesson. The result was a dress in which red had its sufficient complement of green, and blue its proper companion, orange. Unscientific eyes were compelled to grieve that it appeared also to possess the uncommon quality of never wearing out! He carried this theory into his study of pictures, criticising severely some of the ancient masters and their disciples for their utter neglect of what he considered the scientific harmony of colouring. He was much at home in the studio of Mr. Salter Herrick, with whom and his sister he spent a good deal of his time in London. Mr. Herrick gives me the following recollections, which are amusingly descriptive of my father's ways in a gallery or exhibition, although I may add that his admiration for, and pride in a few pictures which came up to his ideal were as characteristic—lingering long before them, and taking friends to admire with him their beauties :—

"As regards art, Sir David often deplored the want of scientific knowledge in the whole English school. He seemed to me to regard the few pictures that show real harmony of colour in each Exhibition rather as the result of *a feeling* for colour than as the result of knowledge. He would take an instrument from his pocket, about two inches long, with two holes in it, which allowed of shifting glasses to show the complementary colours, by which he would demonstrate that, even where a picture appeared to be true in colour, the disproportion in the *hues* of the reds and yellows, with their complementaries, showed how much further a little real knowledge of the principles of colour would have carried the artist. It seemed also to me, from the manner he passed from picture to picture, in the Royal Academy, as if when he found one out of har-

mony it struck him painfully, as a false note in music. The pre-Raphael pictures I believe he regarded as a mistake. When I pointed out pictures by the leading pre-Raphaelites, he would simply exclaim, 'Hideous!' Sometimes on such occasions he illustrated the extreme delicacy of hues by the prismatic colours in pieces of decayed glass, which he carried in his waistcoat pocket."

In the summer of this year Sir David Brewster was chosen a juror of the Paris Exhibition for the department of Optical Instruments, and he spent much time and energy in the fulfilment of his congenial duties. He wrote thus :—

"PARIS, 34 AVENUE D'ANTIN, CHAMPS ELYSÉES,
Wednesday, July 11th, 1855.

"I left London on Monday at 1.30, and got on board the packet-boat at Folkestone at 4.30, the wind, as I thought, blowing a hurricane. Rain began to fall; the cabins were crowded, and every part of the ship filled with human beings, principally women. It was such a scene that I did not think I could support it for three hours. The rain, however, ceased, the cabins were quitted by numbers, and I lay down on my back, having twice or thrice had the serious intention of leaving the boat and returning to Scotland. The day, however, improved, the sea became comparatively calm, and we reached Boulogne, after a *beautiful* passage, in two hours eight minutes. An English gentleman and I got a whole carriage to ourselves, in which we went to bed, occasionally getting up to admire the display of summer lightning, which continued for three hours, and was the finest sight of the kind I ever saw.

"When admitted into the Exhibition, I luckily

found there Baron Segur, M. Mathieu, M. Wartmann of Geneva, and Mr. Tyndall, all particular friends, and the two first members of the same jury with me in the Crystal Palace of 1851. M. Mathieu, the brother-in-law of Arago, kissed me on both cheeks, according to French custom; and Baron Segur, one of the Académiciens Libres of the Institute, charged himself with getting my tickets. . . . At three o'clock I attended the first meeting in the Palais de l'Industrie. My brother jurors had resolved to make me president of our jury, which is Class VIII.; but the Emperor himself appointed the Maréchal Le Vaillant, a very able person, to that office, and I am chosen vice-president. The affairs of the Exhibition are managed by the presidents and vice-presidents of the different classes, presided over by Prince Napoleon, and we assembled yesterday at three o'clock to settle some important questions. The Prince, to whom I was introduced, presided, and spoke beautifully. He is *the very image* of his uncle Napoleon, and corpulent, but a noble-looking person. I found at this meeting our friend Babinet, who inquired after you, and Professor Willis, Sir William Hooker, Dr. Royle, and several members of the Academy of Sciences.

"The Exhibition here is *magnificent*, and has been shamefully traduced. The Galerie des Machines far surpasses anything in our old Crystal Palace. It is 4500 feet long! With love to Lydia and David, and kisses to the children, I am, my dearest Maria, your affectionate father, D. BREWSTER."

"PARIS, 1855.

"I have just come from a committee of British

jurors, who have been passing resolutions respecting the great progress made in France in the mechanical arts, and calling upon the Government for an increased encouragement of Science in England. We were very unanimous on the subject. Professors Owen and Wheatstone, Mr. Graham, Master of the Mint, Mr. Rennie, Mr. Fairbairn, Mr. Cockerel, Mr. Manby, Dr. Hoffman, and the two De la Rives, were among the number. I was the chairman, and got up the meeting."

"PARIS, *July* 1855.

"On Monday last I spent a very pleasant day at the weekly meeting of the Institute, where I met with many of my distinguished colleagues. Sir John Herschel, who has been for some time dangerously ill, is proposed for the next vacant place among the eight foreign Associates of the Institute. I shall have the pleasure of voting for him next Monday. I saw there M. Leverrier, who asked me to dine that day at the Observatoire, where I met Dumas, General Morin, and a large party. I handed Madame Leverrier, a very handsome and clever person, to dinner, and was obliged to speak the most awful French you ever heard. She could speak a little English, which was sometimes called for in an emergency.

"I have had a hard day's work in examining microscopes, some of which were magnificent. The more I see of the Exhibition the more I admire it.

"Next to the Pavilion, containing the jewels of the Empress, the most popular objects here are the stands which several opticians have erected, with six, eight, or ten stereoscopes, containing binocular pictures. They are always crowded, but the ignorant spectators are

generally seen looking in with only one eye. In passing, I have often astonished them by making them look with both."

This busy summer, his life was still further enlivened by the arrival from India of David, his eldest surviving son, with his wife and family; he had married in 1849,[1] but his wife, till this return home, was personally unknown,—she soon, however, became warmly beloved and cherished, possessing peculiar affinities with her father-in-law's mind, while for nearly two years the old philosophic house was cheered with the sights and sounds of pattering feet, merry voices, and rosy cheeks of childhood.

During the autumn we went to pay a most congenial visit to Mr. and Mrs. Bateman at Cardross House, in Perthshire, which they then rented; the other guests were Mr.[2] and Mrs. Fairbairn, and Dr. and Mrs. Romney Robinson—he, the celebrated astronomer of Armagh, for many years much esteemed and admired by my father, and she, one of the sisters of the happy family group of Edgeworthstown. The microscope was the favourite subject of experiment and conversation between the two old philosophers during that happy visit, a friendly pond in the neighbourhood furnishing excellent specimens of that wonderful teeming world, into which the microscopic lens is a window through which we may descry the marvels else invisible. One remarkable individual, rolling about like a tiny hippopotamus, was greatly appreciated, and was pronounced to be the *Proteus amœba*, one of the lowest forms of life. Dr.

[1] Married, October 6, 1849, to Lydia Julia, eldest daughter of Henry Blunt, Esq., of Her Majesty's Indian Army.

[2] Now Sir William Fairbairn, Bart.

Robinson's anecdotes about the microscope much interested my father. One in particular I jotted down, of an Italian infidel who scoffed at the Bible allusion to the "fine linen of Egypt," for he said that there had been no flax grown in Egypt, and that all the material found in its ancient tombs was cotton. A microscopic friend of Dr. Robinson, in examining the fibres of linen and cotton with the microscope, found that there was a very decided difference between them; the cotton being quite flat, with sharp turned-up edges, which is the reason that it is bad for dressing wounds,—linen, on the other hand, being composed of round smooth tubes. The stuff found in the Pyramids and elsewhere was subjected to this test, and it was found that in every case it was true "linen," and in many cases of peculiarly "fine linen." Some of the Indian muslins, which are the finest in the world, contain 120 threads in the eighth of an inch, but the old Egyptian linen can sometimes boast of 130 in that space.

In the late autumn of 1856, Sir David made arrangements which allowed him to spend the winter in the south of France, the climate of Cannes having been advised for the health of one of his family. The rest of the party preceded him, and he arrived in the beginning of December at the Château de Ste. Marguerite, which had been carefully prepared for his reception. This lovely villa, which is still called by some "Sir David Brewster's house," was then unfinished, but notwithstanding was a most comfortable residence. The views of the Estrelles and the Mediterranean, the Iles des Lérins, the promontory and gulf of Napoule were lovely—the climate exquisite, the society most congenial, and the neighbouring library and philosophical

instruments of Lord Brougham were at my father's disposal in his absence, yet nothing seemed to prosper that winter. Climate, friends, scenery, the interests of the Château Eléonore Louise,[1] availed little. He was thoroughly uncomfortable, to the despair of an Italian courier, first-rate cook, and man-housemaid all in one, who would have done anything in the world to please "Seer David," he and a young Niçoise peasant, his aide-de-camp, having both the deepest reverence and admiration for their master, whose scientific eminence had somehow transpired. The mystery was not solved for some time, when it appeared that Nice possessed attractions which could not be found at Cannes. On the 17th of November, Sir David had travelled to Cannes by diligence, with three young English ladies on their way to winter at Nice, on account of delicate health. Many congenial subjects of conversation were found, and the breaking down of the diligence in the Estrelles at midnight led to greater intimacy. That day's journey was his first introduction to Miss Jane Kirk Purnell, second daughter of Thomas Purnell, Esq., Scarborough. He followed her to Nice in January, and spent a congenial winter in the large English society there. On March 26, 1857, he was united to this lady,—a marriage which brought a great accession of happiness to his future life; he found in her a most attached and appreciating companion during the years of brilliant life, social and scientific, which yet remained. After their marriage they went by the beautiful Riviera to Leghorn, and thence by sea to Civita Vecchia, arriving at Rome on the 6th of April. It was my father's first visit, and the six weeks of his stay were occupied by

[1] Lord Brougham's villa.

an amount of energetic sight-seeing which few men of his age could have accomplished. He kept an almost equally minute journal as in 1814, looking at every object in its relation to science.

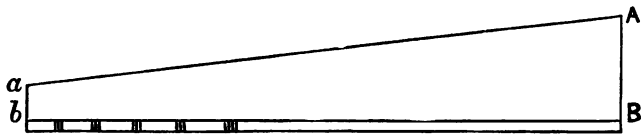
The subject of optical illusions had long been very interesting to him, and especially the class of phenomena which he described in Natural Magic "as that false perception in vision by which we conceive depressions to be elevations, and elevations depressions, or by which intaglios are converted into cameos, and cameos into intaglios."

The following extracts from the journal I put together, as bearing on this curious subject:—

"*April 29th, Rome.*—Visited the church of St. Agostino, in which is the celebrated statue of the Madonna, to whom so many votive offerings have been made. She is covered with diamonds and precious stones of all kinds, her fingers with rings; silver lamps lighted are hung before her. The walls are covered with pictures, representing the accidents and events in consequence of which the offerings were made, and hundreds of silver hearts are put up on the pillars in glass cases, so that the church is like a jeweller's shop. Above the arches there are ornamental paintings, like festoons of flowers, hanging from two pillars; but in place of appearing in relief, as they ought to do, and as in some positions they actually do, they seem hollow like intaglios. This is the first time that I have seen this illusion in the case of a painting *in plano*.

"*May 5th.*—I went again to the church of St. Agostino, and found all the windows in some degree darkened. The optical illusion did not appear, as might have been expected.

"*May* 11*th*.—Went at eleven with Lord Northesk, Mrs. Dennistoun, and Lord Rosehill to the Vatican, to see the MSS. M. Tessier, who was to have shown them, was unwell. We walked through the library and saw better than before the many charming objects it contains. After entering its long gallery at its middle, we went to the right, and saw the curious optical illusion of steps. The light that came in at the side windows, and the dark spaces between, gave the long vista the appearance of steps.



The observer at *AB* saw *AB* reduced to *ab*, and the flat floor appeared to rise to *b* by steps.

"*Thursday, June* 4*th, Padua*.—The church of Santa Giustina is also beautiful with its many domes. In resting near the main door I was surprised to observe that the nearest of these vaulted roofs, viz., those above our head, appeared extremely shallow, while the next appeared much deeper, and the third deeper still. Every one of our party saw the same effect, and could hardly be convinced that it was an illusion of perspective, which I found it to be by placing myself under the remotest of the three roofs, which then appeared the shallowest.

"*June* 8*th, Venice*.—I observed to-day an interesting optical illusion when looking at some Terrazzo Scagliola pavement, consisting of a number of black, white, and reddish-brown marbles. With two eyes it seems to be uneven, with slight heights and hollows, the hollows

appearing to be where there are fewest black and white pieces. I cannot explain this on the principle of the chromatic stereoscope. It appears to arise from the distinctions of the black and white pieces, which makes us suppose them nearer the eye. . . .

"A brightly painted landscape, in which no relief appears when viewed with both eyes, has a distinct semi-relief when viewed by both eyes with a reflection from a distant mirror. Does this arise from the greatly increased distance of the reflected picture? For reflections can hardly produce any effect. I could not place the picture at a greater distance to try the experiment."

Of some of these observations he made use in a very interesting paper "On some Optical Illusions connected with the inversion of Perspective," which was, I believe, read at a meeting of the British Association, but I give it here as being probably new to most of my readers.

"One of the most remarkable cases of this kind, which has not yet been explained, presented itself to the late Lady Georgiana Wolff, and has been recorded by her husband, Dr. Wolff. When she was riding on a sand beach in Egypt, all the footprints of horses appeared as elevations, in place of depressions, in the sand. No particulars are mentioned in reference to the place of the sun, or the nature of surrounding objects, to enable us to form any conjecture respecting the cause of this phenomenon. Having often tried to see this illusion, I was some time ago so fortunate as not only to observe it myself, but to show it to others. In walking along the west sands of St. Andrews, the footprints both of men and of horses appeared as elevations. In a short time they sank into depressions, and subsequently rose into elevations. The sun was at this time not very far from

the horizon on the right hand, and on the left there were large waves of the sea breaking into very bright foam. The only explanation which occurred to me was that the illusion appeared when the observer supposed that the footprints were illuminated with the light of the breakers, and not by the sun.

"Having, however, more recently observed the phenomenon when the sun was very high on the right, and the breakers on the left very distant, and consequently very faint, I could not consider the preceding explanation as well founded.

"Upon attending to the circumstances under which they were now seen, I observed that the human footprints were all covered with dry sand that had been blown into them, so that they were much brighter than the surrounding sand, and the dark side of the impression next the sun; and hence it is probable that they appeared to be nearer the eye than the dark sand in which they were formed, and consequently elevations.

"After repeated examinations of them I found the footprints appeared as elevations as far as the eye could see them, and they were equally visible with one or both eyes. But whenever the eye rested for a little while on the nearest footprint it resumed its natural concavity. I have observed other illusions of this kind which were more easily explained, though they differ from any hitherto described. In the church of St. Agostino in Rome there is above each arch a painted festoon suspended on two short pillars, but instead of appearing in relief, as the painter intended, by shading the one side of them, they appeared concave, like an intaglio. In other positions in the church they rose into relief. Upon a subsequent visit to the church, I found that the

festoon, or suspended wreath, was *concave* when it was illuminated by a window *beneath* it, and in *relief* when the eye saw that it was illuminated by a window above it, the object being similarly illuminated in both cases. In the common cases of inverted perspective, the eye is deceived by looking at the inversion of the shadow in the cameo or intaglio itself; but in the present case the eye is deceived by perceiving that the body painting, supposed to be in relief, is illuminated by a light either above or below it.

"An optical illusion of a different kind presented itself to me in the Church of Santa Giustina at Padua. Upon entering the church we saw three cupolas. The one beneath which we stood appeared very shallow, the next appeared much deeper, and the third deeper still. They were all, however, of the same depth, as we ascertained by placing ourselves under each in succession, and observing that it was always the shallowest."

I select a few extracts from the rest of the journal as being in some measure characteristic :—

"*April 25th.*—Went with Mrs. Dennistoun, Mrs. Amos, and Lady B. to be presented to Cardinal Antonelli, who resides in the storey above the Pope's apartments in the Vatican. We ascended a magnificent stair of white marble, and saw in passing the large and splendid hall of entrance to the Pope's apartments, in which many of his guards were seated. On entering the Cardinal's apartments we met a gentleman, Count Medici Spada, who was just leaving the Cardinal, and who shook me warmly by the hand, complimenting me about what I had done in mineralogy. The Cardinal was with his friend outside of his own room, and received us at the door with a warmth of manner very unusual

in formal presentations, shaking each of us by the hand and expressing his happiness in receiving us. After some general conversation, which was very animated on his part, I said to him that I had heard he had made a collection of minerals. He replied, 'No, I have only made a collection of marbles,' which he proceeded to show us. They were in a beautiful cabinet, each drawer having shallow compartments to receive the specimens, which were all of one size, about six inches by four, and half-an-inch thick. In the same cabinet he showed us a beautiful collection of precious stones of all kinds. The uncut diamonds were placed in silver handles or cups in order to take them in the hand to observe their geometrical forms. In a separate box there were eight or ten gorgeous rings, in each of which was a magnificent emerald, sapphire, ruby, or turquoise, surrounded with brilliants. The pink oriental topaz, the colour of which was not produced by heat, was the finest I ever saw. The collection of agates was very fine, and also the ancient cameos were finely engraven. I was much struck with Cardinal Antonelli: a more interesting person I never met with. His looks, his manner, and his intelligence were all of a high order. He was tall, thin, and sallow, dressed in a singular blue cloth dress, like a dressing-gown, with red buttons.

"*Rome, Tuesday, May 12th.*—Sat for a crayon likeness of myself to Mr. Lehmann, at his request. Went with M. Volpicelli to see the photographs of M. Dupuis at the French Military Hospital, of which he is surgeon. He uses citric in place of acetic acid, and thus obtains very fine transparent negatives, in which the half tints are well given. He employs dry collodion, and his

plates may be used a month after they are made. His stereoscopic photos. of the ancient and modern buildings in Rome, a set of which he presented to me, are admirable.

"*Tuesday, May* 19.—Left Rome yesterday. From Montaroni we travelled in the dark to Sienna. About a quarter of an hour after sunset I saw a phenomenon of great beauty. From the sun then below the horizon there emanated five diverging beams of red light, very faint, but still distinctly visible to the height of 30° or 40°. What was very interesting was that the five beams formed angles with the horizon of 30°, 60°, 90°, 60°, and 30°, the middle beam being vertical. This arose from the openings between clouds below the horizon being accidentally at the distance required to produce equidistant radiations. During the journey from Acquapendente I observed the process by which a thunderstorm is produced. When there was not a cloud in the sky, there sprung up a small one several degrees above Monte St. Fuore Amiatta, the loftiest hill in the district, near which is the conical one of St. Soldau. This cloud gradually increased hour after hour, descending upon the mountain as it increased, and finally enveloping the whole and extending to some distance around. The clouds thickened and blackened till we saw the rain falling in torrents, thunder then followed, and the rain reached our carriage and became general for a short time. The sky, however, soon cleared, and the rest of the day was fine. Reached Sienna about half-past nine. The portiera at the gate proposed to examine our luggage, but we remonstrated,—and after an angry discussion with our postilion, a bold and powerful man, the portiera wished us a good journey and allowed

us to pass. The faccini followed us to the Hôtel Arme d'Inghilterra and insisted upon the fee, as if our luggage had been examined. At Radicofani I was particularly anxious to avoid the examination of my portmanteau, as it contained a sealed box wrapped in black paper containing plates of dry collodion that were to be used in London and Edinburgh for photographs. They were given me by M. Dupuis, surgeon to the French forces at Rome, and a distinguished photographer. Had the box been opened and exposed to light the plates would have been utterly spoiled. If the officer had seen the box, I could not have made him understand the matter, and he would certainly have supposed it to contain prohibited and valuable articles. Having been told on high authority that every custom-house officer, except Sardinian, could be bribed, I laid down before the officer a piastre. He thanked me very graciously, but returned it, saying it was not necessary.

"*Florence, Friday, May 22d.*—Called in the forenoon on Dr. and Mrs. Somerville, and showed them the phenomenon of the radiant spectrum. Along with the doctor I called on my old friend and correspondent the Marquis Capponi, but did not see him, as he had gone to a meeting of the Accademia dell' Etrusca for improving the Italian language. I went to see the interesting Church of Santa Croce, with the tomb of Galileo to the left of the principal entrance, and the tomb of Michael Angelo Buonarotti directly opposite; on the right-hand side are the tombs of Macchiavelli, Dante, and Nobile.

"*Sunday, May 24th.*—Went at eleven o'clock to the Scotch Free Church, which meets in Mr. Hannay's house, and met with Mr. Menteith. At three went again to hear Mr. Hannay in the Swiss Church, where

the psalms were played on an organ without a human voice. I was here introduced to the celebrated poet Mr. Robert Browning, who reminded me that I had dined with him several years ago at Judge Talfourd's. Mrs. Browning, having just lost her father, was not there. Mr. Browning kindly offered to be of any use to us whilst here. I yesterday met a funeral attended by about six persons in masks. They were gentlemen, members of a Society who engage to take charge of and bury persons killed by accidents, or who have no relations. The Grand Duke is a member, and takes his turn in this office of charity. In the chapel called Misericordia, opposite the great Campanile, the religious services are performed for this class of persons. In an apartment next to it are a number of beds, carried on handspikes, for conveying the persons to church or to their grave.

"*Monday, May 25th.*—Went to see the Museum of Natural History and the Observatory. The Museum is, I believe, the finest collection in the world, occupying a vast number of apartments elegantly fitted up. The collection of physiological, botanical, and anatomical preparations is particularly interesting, while those of the mineral and animal kingdoms are hardly inferior in relative importance. I could not discover the order in which the minerals were arranged. The zeolites, in which I took a particular interest, seemed to be widely separated. As Professor Amici was not at the Observatory, I introduced myself to M. Donati, an intelligent and superior man, who showed me the instruments. He has taken photographs of part of the spectrum, and is engaged in examining the lines in the spectra of the stars. I mentioned to him what I had done on the

subject, and gave him a slight notice of my experiments on the spectrum.

"I then called upon Professor Amici, whom I found in the Via Rennini, in a fine palazzo which he had purchased from Prince Demidoff. He showed me his large achromatic telescope. The flint-glass was made by Guinand. In the Observatory I saw a very fine Newtonian telescope also made by him.

"*Tuesday, May 26th.*—I met Professor Amici to-day at the Museum of Natural History, in order to examine the telescopes and other instruments which belonged to Galileo, and which are carefully and elegantly preserved in the magnificent tribune erected to his memory by the Grand Duke. I was permitted by M. Politi, the keeper of the tribune and of the collection of physical instruments, to look through both the telescopes. One with a plain tube, and as plainly fitted up, was that with which he made his discoveries. The other was fitted up in a tube of leather, gilt in several places, and was a present from the Grand Duke. We took both of them to the garden, and looked at the most distant trees and houses. The aperture of Galileo's own instrument was reduced to about one-third of its area by a diaphragm made with a piece of card. The field looked like a small hole, and did not subtend an angle of more than twelve or fifteen minutes. There was comparatively very little colour, and the vision was very distinct when the object was not luminous. Astrolabes of Alphonso are in the tribune, and many very ancient ones. Among Galileo's papers was found a correct drawing of the ring of Saturn, but the whole of his body was visible. I saw also the original drawing made by his son of his escapement, which is very

ingenious. All these facts will appear in the new edition of his works now publishing at Florence, in about twenty volumes. We then examined the cabinet of physical instruments, the finest doubtless in the world; a collection of an historical kind, exhibiting the progress of invention in all departments of physical science. There is in it a natural loadstone of enormous size with an armature, but the poles are not correctly ascertained. In the tribune of Galileo are preserved all the instruments of the Accademia del Cimento, the brass globes compressed and non-compressed. I then went to the establishment in the Convent of Santa Maria del Novello, and saw their apparatus for making the celebrated perfumes. It is a very fine sight. The shop is filled with little bottles of alkerines, etc., which are most beautifully arranged. There is an elegant apartment with four doors containing mirrors on each of the four sides of the room for the reception of the Grand Duke or his friends when they visit the establishment. The Chiastro Viride, but particularly the Chiastro Grande, are beautiful. In the evening we went to a party at Mrs. Stuart Menteith's, where Messieurs Corridi, Govi, and other professors of the Instituto Technico, and many English, were present. We saw there the beautiful photographs of Mr. Bennets, taken at Naples, etc., with a fine pocket microscope by Amici, brought by M. Govi. We saw Froment's microscopic writing, and I showed with it the remarkable microscopic photographs sent me by Mr. Dancer of Manchester.

"*Wednesday, May* 27.—At eleven o'clock we drove with Mr. Hannay to Arcetri, to see the house of Galileo and the Tower of San Gallo, in which he made his

observations; but no traces of him now remain. . . . The house is a large and ugly villa, with a nice garden about a quarter of a mile from the tower at a lower level, and now belongs to a gentleman in Florence.

"*Saturday, May 30th.*—Reached Galileo's house, which is beyond the church, at the right hand, and is indicated by the following inscription above the door, cut in marble:—

QUI OVE ABITO GALILEO
NOVI SOLEGNO PREGARSTI, ALLER
POTENZA DEL GENIO LA MAESTA
DI FERDINANDO II. DEI MEDICI.

The number of the house is 1600. I went into the garden, but was told that there were no memorials of Galileo in the house. The woman who showed me the house pointed out what she called the meridian line on the back of it.

"*Sunday, May 31st.*—After hearing Divine service at Mr. Hannay's, Via Seraggo, I drove to Professor Amici's, Palazzo Demidoff, and went with him in his carriage to the Pitti Palace to see the Prince Héréditaire. We found there M. Frescobaldi, the equerry to the Prince, M. Antenoni, his *majordomo*, and M. Simonelli, his tutor. The Prince is rather good-looking, and short, and has very frank and agreeable manners. I showed him, in M. Amici's compound microscope, the microscopic photographs of Mr. Dancer, with which he was surprised and delighted. The Princess also came to see them. She is very beautiful and handsome, but looks in bad health, and not very happy. I spoke to her about her uncle, the late King of Saxony, and Dr. Carus, whom I had met at Taymouth some years ago.

M. Antenoni presented me with the interesting quarto volume on Florence which he drew up at the request of the Grand Duke, to be given to foreigners who were introduced to him.

"*Padua, June 5th.*—Went to the curious antique chapel painted by Giotto in 1306, while Dante lodged with him. We then drove to the University, and found Professor Santini, who showed us the great room, lately much ornamented, in which Galileo lectured. In the physical cabinet, which is very fine, and contains many excellent instruments, I met my old correspondent M. Zantedeschi, Professor of Natural Philosophy. Professor Santini kindly took a place in our carriage to show us the ancient and splendid Botanic Gardens, many of the trees in which are 200 or 300 years old. I was introduced to Professor Viziani, who has the charge of it. It is one of the finest establishments in Italy.

"In the physical cabinet of the University we saw the *vertebra* of Galileo, stolen by Dr. Crocchi when the body was exhumed in Florence in 1757. In one of the public streets we saw the tomb of Antenor. Professor Zantedeschi, now blind, called upon me with the different works on physical subjects which he has recently published.

"*Paris, June 22d.*—Called on M. Duboscq and the Abbé Moigno, and went with the former to M. Foucault's to see the new specula for reflecting telescopes, as made by depositing silver from its solutions on concave or convex surfaces of glass. Mr. Power, an Englishman, has a patent for the process, but M. Foucault has undertaken to perfect it. He showed me two telescopes thus made, one about 18 inches focus, and the

other in the Imperial Observatory. Both of them gave beautiful vision. After deposition the silver surface is slightly rough, or rather not well polished, but it is polished to perfection by a little cotton and a small quantity of rouge. The film of silver is at first transparent, transmitting green light, but it afterwards becomes opaque when the film is thicker. M. Foucault showed me the whole process from the commencement. A solution of nitrate of silver and alcohol and ammonia forms a brown fluid. To a hundred parts of this fluid three parts of the essence of cloves is added, and when the concave glass surface is covered with the fluid, the silver is deposited. In the two telescopes which I saw, the image is received upon a rectangular glass prism.

"M. Foucault told me that a mercurial surface in revolution, as suggested by Mr. Buchan, an American, for specula, becomes a parabola only at the pole. He drove me from the Observatory to the Academy of Sciences, where I met with MM. Mathieu, Milne Edwards, Babinet, Pelouse, Poinsot, Wertheim, Vernueil, and others.

"After reading the minutes the President adjourned the meeting on account of the death of Baron Thenard.

"*June* 23*d*.—M. Porro having called upon me, I accompanied him to his Institutio Technomathique, where I saw his great astronomical telescope with which he has discovered a new star in the trapezium of the Nebula of Orion, a discovery confirmed by Padre Secchi at Rome. This is a fine instrument, and is made with Guinand's flint-glass. The observer's eye is always at the same place, whatever be the position of the telescope, provision is made for the bending of the tube,—

the axis of the eye-piece being always coincident with that of the object-glass, however much the tube is bent. Mr. Porro's short telescopes are highly interesting, the tube being shortened by two plain reflectors. They cost about £5 each, £6 with a micrometer. His methods of determining the achromatism of object-glasses and the correctness of the curvature are very ingenious. He is well instructed in optics, and not sufficiently appreciated in Paris. He is a Sardinian, and was an officer of engineers. His machinery for grinding and polishing large lenses is very ingenious.

"M. Ferrier and M. Ernest Lacan called upon me. The latter is editor of *Le Journal de la Lumière*, and invited me to see his magnificent collection of photographs. M. Ferrier presented me with twelve of his fine binocular slides, taken in the East and in Spain.

"*Paris, Wednesday, June 24th.*—I went at ten to M. Lacan's, who gave me two fine photographs, one of part of the Louvre, the other an engraving from a photograph of a sketch by Rosa Bonheur. I called on M. Niépce de St. Victor, Commandant of the Louvre, and saw his beautiful heliographic invention. His photographic etchings upon steel plates placed in the camera are beautiful. His etchings on marble, etc., the lines being filled up with coloured wax, are interesting; but his engravings from photographs are singularly fine. I then went to M. Ferrier, where I saw a room with shelves, like those of a library, fitted with five or six thousand of his binocular slides, taken in Italy, Constantinople, etc. He sent me in the evening other twelve of these very beautiful stereoscopic pictures."

Sir David and Lady Brewster returned to England in June 1857, and soon after took up their abode at St.

Andrews. During the summer of this year he paid several visits to the Bridge of Earn, where some of his family were residing, and also to Whytehouse, near Kirkcaldy, the residence of the late John Fergus, Esq., M.P. for Fifeshire, in whose house he was more entirely at home than anywhere else out of his immediate family circle. In October he wrote :—"I think if you write *a little* every day, or every two days, so as to make it a pleasure and not a toil, you would not suffer from it. I find it a great pleasure to write, if I have my own time for finishing the article, but it is a great pain to be obliged to produce anything at a fixed time. By writing a little, and carefully correcting it, and even writing part of it *twice* when anything striking is to be produced, you would derive much pleasure from it. If I recollect rightly, I think you never made two copies of any of your writings. This is not always necessary, but, as I have already said, it may be well to do it in some parts."

His share of writing-work continued unabated, and his own composition was as careful and vigorous as ever. He still wrote for various periodicals, contributing at different times to *Hogg's Weekly Instructor*, *Meliora*, *Good Words*, and others, besides his steady work for the *North British*. He also published, in 1858, *A Treatise on the Kaleidoscope*, in which he gives an interesting account of the gradual development of the invention of that popular instrument, which he appropriately named from the Greek words—καλὸς, *beautiful*; εἶδος, *a form*; and σκοπεῖν, *to see*. The first idea of it occurred to him in 1814, in the course of the experiments on the polarization of light by successive reflections between plates of glass, for which he re-

ceived the Copley Medal. A few months later, during further experiments, the same multiplied images, with the addition of beautiful tints, again struck him. He tells us that "in giving an account of these experiments to M. Biot in March 1815, I remarked to him 'that the succession of splendid colours formed a phenomenon, which I had no doubt would be considered, by every person who saw it to advantage, as one of the most beautiful in optics.'" It was "in repeating, at a subsequent period, the very beautiful experiments of M. Biot on the action of homogeneous fluids upon polarized light, and in extending them to other fluids which he had not tried," that Brewster was led to discover the leading principles of the kaleidoscope, which he some time after completed, by "giving motion to objects, such as pieces of coloured glass, which were either fixed or placed loosely in a cell at the end of the instrument."

In July 1858 he was attacked by bronchitis, and could neither eat nor sleep, and felt so weak, that he had a strong impression of his near approaching death; he rallied from it, however, and in the September following attended the meeting of the British Association at Leeds; after which change of air at the Bridge of Allan, and pleasant visits to Mr. and Mrs. Bateman at Ferntower, and to Sir William and Lady Adelaide Murray at Ochtertyre, completed his recovery, and before winter he was once more in busy work with eye undimmed and energy unflagging. In July of 1859 he was again in London, whence he wrote to his wife:—"Having had no sleep since Thursday morning, I rose to-day (Saturday) refreshed for a hard day's work. . . . From Mrs. Corkran's I went with her

eldest son, a fine boy of fourteen or fifteen, to see the Museum of Patents at Kensington; and after long walking and omnibus driving, I went to Lord Brougham, whom I found occupied with deputations. I had, however, a long conference with him on my claim, which is to commence by sending my memorial to the Treasury. He is to dine to-day at Holland House with Lord Palmerston, and is to speak of it to him. After I had left him, and was two or three hundred yards from his house, I heard some person calling out my name, and on turning round I found his Lordship hatless, chasing me to call me back to see some beautiful photographs of Mignet, Biot, and himself. An old beggar-wife came up to him to ask charity, but he took her by the shoulder and told her to go about her business, the people in the street laughing at this singular scene. After I had left his Lordship, and the door was shut, he again emerged in order to tell me of a great meeting on negro emancipation which is to take place on Monday. He asked me to dine with him to-morrow, that he might get Madame De Bury to meet me, but I am engaged to dine with Mr. Herrick."

In September he and Lady Brewster went to attend the British Association, which met that year in Aberdeen. They were guests at Banchory House, which was always a pleasure; on that occasion Mr. Thomson entertained the Prince Consort, who presided at the meeting, and all enjoyed extremely the frank sociability of that man, "great" in the highest sense of the word. Sir David wrote the following account of a day at Balmoral:—

"Fasque, *Sept.* 1859.

"We left Banchory at five A.M., set off from Aber-

deen at six, and from Banchory-Ternan at seven, in five omnibuses containing each about twenty-five outside and fourteen inside, arriving at Balmoral, a distance of thirty-two miles, at one o'clock. About two o'clock, when the Highland games commenced on the lawn, the Queen and the royal party came out to the flower-garden to see them. Soon after this we all rushed to the great hall to a standing lunch, and when this was over, Jane and I went to a large tent prepared for the members of the Association. On our way there, the Queen and Prince Albert came past us, and recognising Jane, to whom H.R.H. had previously spoken, stopped and introduced her to the Queen. All the Highland clans in full dress were present at the games, and when they were over, and we had had coffee in the great hall, we set off for Aberdeen, and arrived there about half-past twelve o'clock. The day was upon the whole good, but at Ballater, about ten miles from Balmoral, it rained heavily, and the wet philosophers were obliged to dry themselves in the royal kitchen!"

While at Banchory House, he received by telegram the tidings that he was appointed Principal of the University of Edinburgh. This intimation caused a severe struggle in his mind between the claims of his *alma mater* on the one hand, and the reluctance with which he contemplated leaving his old St. Andrews home. He did not finally decide on acceptance till October 10th, and shortly after resigned his appointment at St. Andrews. He remained there, however, for a few months longer, till after the marriage of his daughter,[1] in the beginning of the year.

[1] Married to John Gordon Cuming Skene, Esq. of Pitlurg, Aberdeenshire, January 6, 1860.