BIOGRAPHICAL MEMOIR

OF

SIR HUMPHRY DAVY.

BY BARON CUVIER*.

From the Edinburgh New Philosophical Journal for July 1833.

A CELEBRATED academician, who had risen from the humblest condition to the highest ecclesiastical and literary honours, said, on the day of his admission into the academy, "Should there be found in this assembly a young man born with a love for labour, but wholly destitute of assistance or encouragement, and in whom the uncertainty of his destination weakens his susceptibility to the excitement of emulation, let the sight of my situation at the present moment inspire him with hope." Nothing indeed can be at once more affecting or encouraging, than to witness merit, by the power of perseverance, surmounting the obstacles which misfortune had opposed to it, and, gradually emerging from obscurity, become at last an object of general notice, and obtain, with the just approbation of all, the advantages which our societies can confer on those by whom they are merited.

Conspicuous examples of this kind are afforded by the two celebrated chemists, with whom I propose to occupy your attention during the present meeting, both of whom were born in a state almost of entire privation, yet each supported with firmness the difficulties of his condition. From the time when they

* This interesting Eloge of Sir H. Davy, not yet published, was communicated to us in proof-sheet, through the goodness of our friend Mr Pentland of Paris.—EDIT.

had made some progress in science, and their first works were made known to the public, they became the objects of general favour; were received in the world, and in proportion as their discoveries increased, they advanced to fortune, and were loaded with honours; no jealous voice interrupted this unanimity of sentiment regarding them, or, if such was ever raised, it was not till they had obtained a position in society which sheltered them from its effects, and reduced those who were jealous to the necessity of being only envious *.

Sir HUMPHRY DAVY, Baronet, formerly President of the Royal Society of London, Foreign Associate of the Academy of Sciences in the Institute, was the son of Robert Davy and Grace Millet, and was born at Penzance, a small town in the county of Cornwall, the most remote portion of England towards the west, on the 17th day of December 1778.

His family is said to have possessed at one period considerable landed property in the parish of Ludgvan, near Penzance; but Robert Davy, his father, was reduced to a very small farm on the banks of the Boye, called St Michael, from a rock bearing some resemblance by its situation, and by having a convent upon it, to that distinguished by the same name on the coast of Normandy. With a view to increase his limited income, he exercised in Penzance, for a long period, the profession of gilder and carver in wood; but not succeeding in his profession, he abandoned it, and soon after died, in 1794, leaving his widow in a destitute situation with five children, the youngest of whom was little more than four years of age. This respectable woman did not, however, lose courage; occupied incessantly with the education of her children, in order to procure the means of supporting them, she opened a shop, and subsequently kept a lodging-house, for those whose health led them to visit this county, which is celebrated above the rest of England for the mildness of its climate.

Her eldest son, the young Humphry, turned to the best account the limited means of instruction which this remote county presented, and some of his teachers have since pretended to boast

* The other individual alluded to, is the celebrated Luis-Nicolas Vauquelin, who died on the 15th October 1829.—TRANS.

of a scholar so celebrated; but he has always said, that if there was any thing original in his ideas, it was owing to the negligence and indifference of the persons entrusted with his education, who permitted him to indulge, without restraint, in all the caprices of his fancy. Many men of genius, in relating the history of their early lives, could make the same observation. That mode of instruction, indeed, which is calculated for the majority, is not easily adapted to those eccentric intellects whose first ideas are superior to those of their companions, and not unfrequently to those of their masters. The exertions used to make them conform to the common method, have only the effect of obstructing their progress. It is fortunate, therefore, both for themselves and for society, that they should be thus neglected. Left to himself, Davy occupied his time in hunting, fishing, and traversing this picturesque country, already attempting to celebrate its beauties in verse, for from his infancy he was both an orator and a poet. He had the power of expressing his impressions in a very vivid manner; and when he entered the school, his little companions were accustomed to surround him, and forget every thing else, in listening to the recital of what he had seen. His reading did not make a less forcible impression on his mind than his observations; no sooner had a translation of Homer fallen in his way, than he began to compose an epic poem, of which the subject was Diomede; a composition, says one of his former schoolfellows, very incorrect, and abounding in violations of the established rules, and of good taste, but full of life and varied incident, displaying a richness of invention, and a freedom of execution, which evince a true poet.

It was necessary, however, that he should engage in more serious occupation, and his mother bound him for five years as an apprentice to an apothecary named Borlase, a member probably of the same family as the minister of the parish of Ludgvan, to whom we are indebted for a natural history of the county of Cornwall, and an account of its antiquities, two works which are still of considerable value on account of the documents which they contain. This apothecary, as is always the case in England, likewise practised surgery and medicine. Young

Davy was often obliged to visit his patients, and convey to them medicines, an occupation quite in accordance with his early habits, and which had the effect of rendering him still more active. While traversing this rich country, he recited aloud either Homer's verses or his own; for he had already composed many. It was at this time that he wrote his ode on Mount St Michael, and a poem on Mount's Bay, two of his best verse compositions. The play given to his active faculties by these solitary walks, led him to explore some of the mysteries of metaphysics, and as far as may be judged from some letters and stanzas written at this period, which were afterwards published, but in a very modified form, under the title of *Life*, he was absorbed in all the abstractions of pantheism, and spoke of God and of the world, like a Bramin, or a professor of German philosophy.

But the county of Cornwall is not merely a picturesque country; its primitive rocks, their various relations, the metallic veins which they contain, and deep mines, sunk at a period antecedent to any authentic record, render it a country pre-eminently geological and chemical, and such an individual as we have described Davy to be, could not listen to conversations on the working and uses of metals, the different processes to which they are subjected, and the relations which subsist between them and the rocks in which they are enclosed, without having his attention drawn to those branches of natural science which treat of the structure of the globe, and the nature of the materials of which it is composed. A fortuitous circumstance was the means of engaging his youthful mind in active study. Mr Gregory Watt, son of our late Associate, who brought to perfection the steam-engine, and made it an agent which will change the entire aspect of society, was sent to Penzance on account of an affection of his breast, and lodged in the house of Mrs Davy. The young apothecary, attracted by his handsome figure and elegant manners, became desirous of gaining his friendship; but the English are backward to form friendships, especially when there is a difference of fortune or rank. To recommend himself to notice, Davy entertained Mr Watt with chemistry, of which he had already acquired a slight and practical knowledge in the house of his master, although it did not fit him to converse on the subject with one well versed in its principles. Some one to whom he mentioned his intention, procured for him an English translation of Lavoisier's chemistry. In two days he had made himself completely master of it, and it is very remarkable, that, in entire ignorance of the objections which Priestley and others of his countrymen had raised against the theory advanced in that celebrated work, he declared that there occurred to him another explanation of the phenomena; and he began seriously to engage in developing it. The animated discussions which he had with Mr Watt on this subject, had only the effect of confirming his resolution; the poet and the metaphysician decided at once on becoming a chemist. The state of his affairs was such, as to render it no easy matter to procure even the requisite instruments; but in this, as in every thing else that he undertook, his courage and perseverance surmounted all obstacles. Old tobacco-pipes, and a few glass-tubes purchased from a travelling vender of barometers, formed his first apparatus. The surgeon of a French ship, stranded near Land's End, shewed him his instruments, and having observed a utensil of very common and familiar use among us, the form of which apparently differs in the two countries, he conceived the possibility of rendering it the principal piece in a pneumatic machine; and to this purpose, so different from that for which it was intended, it was in reality applied. It is thus that, in the case of many great men, privation has proved the most useful master.

The experience which he acquired on this occasion was never afterwards lost. During his whole life, Mr Davy never wanted a resource in his investigations; the simplicity of his apparatus was always as remarkable as the originality of his experiments, and the elevation of his views; and even when he travelled into places the most remote from scientific aid, he was never more at a loss to bring to the test of experiment any new idea that occurred to him, than he was when he commenced his first labours in the shop of his master at Penzance.

After some further exercise, he took from his own neighbourhood the subject of his first experiment. He wished to ascertain with what kind of air the vesicles of fuci are filled, and determined, with as much precision as the most accomplished chemist could have done, that marine plants act on the air in the same manner as land plants. This was in 1797, when he was not quite eighteen years of age.

About this time, Dr Beddoes, who had been obliged by political dissensions to leave the Chair of Chemistry in the University of Oxford, came to establish himself at Bristol, where he formed, with the assistance of the family of the celebrated Wedgwood, an establishment called *The Pneumatic Institution*, the principal object of which was to try the action of various gases on diseases of the lungs; he commenced at the same time a periodical collection, entitled *Contributions from the Western Provinces*, in which he inserted the researches of the physicians and chemists of that part of England. It was to this individual that Davy addressed his essay, and Beddoes, surprised at finding a young apothecary of Penzance capable of such investigations, was very anxious to attach him to his institution.

For this purpose, it was necessary to dissolve the contract of apprenticeship which he had formed with Borlase, according to the somewhat Gothic practice which prevails in Great Britain. Mr Davies Gilbert now President of the Royal Society, undertook the negotiation, which was speedily completed; for the apothecary, who apparently cared but little for scientific discoveries, and still less for metaphysics and poetry, shewed no reluctance to restore to liberty a youth whose qualities he regarded with no favourable eye, although destined to become so soon after the light of chemistry, and the honour of his country *.

But Beddoes estimated men by a different standard; and speedily discerning the intellectual qualities of his new assistant, he did not employ him merely in that capacity, but entrusted him with his laboratory, and permitted him to perform all the experiments he judged necessary to extend his knowledge of gases, and gave the use of his amphitheatre to deliver lectures.

* It is due to the character of Davy's first master to state, that the readiness with which he surrendered the indenture, originated in motives entirely the reverse of those here ascribed to him. It was because he appreciated the talents of the young chemist, and from a wish to promote his advancement, that the arrangement was effected with so much facility. See Paris' Life of Sir H. Davy, i. 55.—Trans.

It was in the Pneumatic Institution that Davy discovered, in 1799, the properties of *nitrous oxide gas*, or as it is now called, protoxide of azote, and the extraordinary effects it produces on certain organizations *. Many persons on inhaling it experience only uneasiness and symptoms of asphyxia; others are affected with decided asphyxia; but in some it produces intoxication of a peculiar kind, exciting sensations of the most delicious nature, and so superior to all other kinds of pleasure, that they would permit themselves to die in that state without making the slightest effort to escape from it.

It is easy to imagine the eagerness with which this new manner of producing intoxication was received in a country where the old method was practised to a much greater extent than at present, as it led to the hope of an agreeable variation in an enjoyment become too monotonous; the name of the young chemist of Penzance was therefore speedily popular throughout the three kingdoms.

In order to do him full justice, however, it must be added, that the courage which he had shewn was not less remarkable than the singularity of the discovery. He gives a fearful description of the state into which it threw him. The loss of voluntary motion did not at first diminish his sensations; he saw and heard all that was going on around him; but in proportion as the species of asphyxia increased, he lost the power of perceiving external things; a crowd of images rose in his mind, and he seemed to be making discoveries, and forming theories of the most sublime description. But let it not be supposed that this mode of intoxication more than any other can teach any thing new. When a friend snatched from him the receiver of the dangerous gas, his first words were only the old formula of idealism, *Nothing exists but thought; the universe is composed only of impressions and ideas of pleasure and pain.* This system had been long the subject of his thoughts. He made a still more dangerous experiment by respiring carbonic gas, but it produced only pain and depression; and it is not impro-

* Researches, chemical and philosophical, chiefly concerning nitrous oxide and its respiration. 8vo. London, 1800. Translated into French, *Annales de Chimie*, tom. xli. p. 305; xlii. p. 33 and 276; xliii. p. 97 and 324; xliv. p. 43 and 218; xlv p. 97 and 169; also into *Bibliotheque Britannique*, tom. xix. xx. xxi.

bable that these rash attempts contributed to produce that sudden change in his constitution which terminated in his premature death.

At this period Bristol was filled with enthusiastic young men, fond of novelty, and forward to express their sentiments, whose speeches, in the midst of those dissentions which the French revolution had excited in England, caused this town to be regarded as the principal seat of democracy.

These youths, in concert with their correspondents in different parts of the kingdom, had formed a design to raise their friends to situations which were most likely to make them the objects of public favour, and in prosecution of their plan, they resolved to use their efforts to place the young professor in a sphere of wider influence. Our former associate, Count Rumford, had established in London the Royal Institution, designed to spread among the higher classes of society the useful discoveries of science. Being naturally of an unaccommodating disposition, he had already quarrelled with Dr Garnet, his professor of chemistry; and it was resolved to propose Davy, who was urged to come forward and be presented to him.

Every one will remember that, with all his great and noble qualities, Count Rumford was not distinguished for affability; the almost infantine appearance of the candidate, who always looked younger than he really was, joined to manners somewhat provincial, and the remains of a Cornwall accent, rendered the Count even more repulsive than usual, and Davy's timidity, increased by such a reception, was little calculated to remove the effect of his first appearance. The persons by whom he was introduced had to employ much art and solicitation to obtain permission for him to give some lectures, in a particular apartment of the house, on the properties of gases; but more than this was not needed. From the first, the variety of his ideas and their ingenious combinations, the warmth, vivacity, perspicuity, and originality of their exposition, all the interest which the united talents of the poet, the orator, and the philosopher can confer on the teaching of chemistry, had the effect of enchanting the small number who had ventured to come and hear him. They immediately spoke of him with so much enthusiasm, that the place of meeting was unable to accommodate the influx of auditors, and his lectures had to be transferred to the great amphitheatre of the establishment.

The Royal Institution was at that time supported by all that was most elevated in Great Britain, both in birth and in intellect; ladies of the highest rank attended the lectures, as well as the most distinguished noblemen and youths of the country.

The youth of a professor who had scarcely advanced beyond the age of boyhood, his handsome figure, and ingenious manners, contributed not less than his lively eloquence to conciliate the affection of such a public. In a short time he became so much in fashion, that not an evening party appeared complete when he was not present. This was such an entire revolution in his condition, that he required not less courage to continue his labours in this sudden prosperity, than he needed to commence them in the midst of misfortune. Some even pretend that he permitted himself to be more elated by his reception in the great world, than was due to his genius and circumstances. But what young man of twenty would have better resisted such a temptation? He did not at least renounce science; for in the midst of the pleasures which it was so natural for one of his age to wish to enjoy, he ceased not for a moment to multiply the titles which had been the means of obtaining them for him.

But who ought to have experienced greater happiness? From the time of his first regular course, which was given in May 1801, a continued series of lectures, experiments, and discoveries, which succeeded each other with unparalleled rapidity, and which have elucidated the most important branches of Physics and Chemistry, essentially modified their doctrines, and led to the most beneficial and unexpected applications to the wants of society, secured for their author the admiration of the civilized world, and the gratitude of his country. Nominated a member of the Royal Society in 1803, and appointed secretary in 1806; commissioned by the Board of Agriculture to teach the application of Chemistry to that branch of public economy; united in 1812 to a lady of great wealth, and high intellectual endowments; and honoured, the same year, with knighthood, being the first person so distinguished by the Prince Regent; created Baronet in 1818, when this Prince mounted the throne;

and, finally, elected to the distinguished station of President of the Royal Society in 1820, on the death of Sir Joseph Banks, by a majority of two hundred against thirteen, an office which he continued to hold for seven years:—the young apprentice of Penzance enjoyed without interruption all the honours which a great state could confer on those who do it honour. These marks of esteem were confirmed by the approbation of foreigners. Crowned by the Institute in 1807, when the war with England was at its height; associated with that body in 1817; called upon in like manner to enjoy the honours of all the celebrated academies; Mr Davy had to boast of the approbation of Europe as well as of his own country. But our nature does not admit of perfect happiness in the present world; and when all around us is prosperous, we not unfrequently carry within ourselves the poison that embitters our existence. In the exposition which I am about to give of Mr Davy's labours, continued without interruption for upwards of twenty-five years, and published in sixty different memoirs and papers, it will be understood that I can attend only to the principal results and fundamental discoveries. I shall, therefore, pass rapidly over his first experiments, made in the Royal Institution in 1803, to determine the proportions of tannin in the different substances used in tanning *. Those of the following year (1802), on the different combinations of azote with oxygen, that is to say, on nitrous oxide and the nitrous gas now named protoxide and deutoxide of azote, and on the proportions of their elements, as well as those of hydrogen and azote, which are acquiring a more general importance in Chemistry, were the natural consequences of his first observations on nitrous gas, and the invention of a new eudiometer resulted from them†. A solution of muriate, or of sulphate of iron, impregnated with nitrous gas, was found to absorb oxygen with greater facility than any other substance.

* An account of some experiments and observations on the constituent parts of certain astringent vegetables, and on their operation in tanning.—*Roy. Soc. London*, 24th Feb. 1803; *Phil. Trans.* xcxiii. p. 233; *Nicholson's Journal*, v. p. 256.

† An Account of a New Eudiometer.—*Nicholson's Journal*, 4to, vol. v. p. 175; *Biblioth. Brit.* vii. p. 246; *Ann Chim.* tom. xlii. p. 301.

We are unable to bestow much time on his mineralogical discoveries, although they are doubtless far from unimportant. In 1805, his analysis of a stone from Devonshire, which had been named *wavellite*, furnished to this science a new species. It is a combination of pure alumina with water *.

The same year he published a new method of analyzing stones containing a fixed alkali, by means of the boracic acid †.

He proved more evidently than had been previously done, and contrary to his own conjectures on the subject, that the diamond produces on combustion only pure carbonic acid ‡. In 1822, he proved that iron and silex are dissolved in the thermal waters of Lucca §. Rock-crystal and other stones often contain in cavities in their interior gases and liquids; and as these substances must have been inclosed at the time of their formation, a knowledge of their nature was not without interest in the ancient history of the globe. Mr Davy found them to consist of pure water and pure azotic gas ‖.

Much light was likewise thrown on many branches of physics by the observations made in the course of his researches. The nature of the changes of colour produced by heat on the surface of steel ¶; the formation of mists over the surface of rivers **; the application that may be made of liquids formed by the con-

* An Account of some analytical experiments on a mineral production from Devonshire, consisting principally of alumina and water.—*Roy. Soc. Lond.* 28th Feb. 1805; *Phil. Trans.* xcv. p. 155; *Biblioth. Brit.* xxx. p. 303; *Ann. de Chimie*, lx. p. 297.

† *Roy. Soc. Lond.* 16th May 1815; *Phil. Trans.* xcv. p. 231; *Annales de Chimie*, tom. lx. p. 297.

‡ Some experiments on the combustion of the diamond and other carbonaceous substances.—*Roy. Soc. Lond.* 23d June 1811; *Phil. Trans.* civ. p. 557; *Ann. de Chimie et de Physique*, i. p. 16; *Bibl. Britan.* vol. lvii. p. 124.

§ Memoria sopra di un deposito trovato nei Bagni di Lucca.—*Atti della Real. Acad. Neapolit.* v. ii. p. 9; *Ann. de Chimie et de Physique*, tom. xix. p. 194.

‖ On the state of water and aëriform matter in cavities found in certain crystals.—*Roy. Soc. Lond.* 13th June 1822; *Phil. Trans.* v. cxii. p. 367; *Ann. de Chim. et de Phys.* tom. xxi. p. 132.

¶ Ann. of Philosophy, vol. i. p. 131; *Bibl. Brit.* vol. lv. p. 157.

** Some observations on the formation of mists in particular situations.—*Roy. Soc. Lond.* 25th Feb. 1819; *Phil. Trans.* vol. cix. p. 123; *Ann. de Chim. et de Phys.* xii. 195.

densation of gases as mechanical agents *; finally, the colour of the water of rivers and of the ocean †; were subjects that attracted his attention, and produced instructive and interesting papers.

Particular mention ought to be made of the course of lectures which he delivered before the Board of Agriculture in 1803, and which were published in 1813 ‡. It was thus that a young man of twenty-two, who had no practical experience of the subject, unexpectedly enlightened the proprietors and most experienced cultivators in Great Britain.

Such occupation, however, as we have been alluding to, may be said to have formed only a kind of diversion from his severer studies. His experiments on the decomposition of bodies by galvanic electricity were of a superior order, and it was to them that he owed his sudden elevation, by the unanimous voice of Europe, to the rank of one of the first chemists of our age. No one will dispute that there was never displayed, in such a lengthened investigation, a greater degree of perseverance, method, and precision; and rarely have these qualities been crowned with more brilliant success.

An observation casually made by Galvani in 1789, in which he had seen the parts of a dead animal become convulsed when a metallic communication was established between a nerve and the muscle, had excited the attention not only of the learned but of the vulgar: some believed that they saw in it the explanation of all the vital phenomena, and the means of recalling even the dead to life. Volta referred these facts to their true cause, viz. the electricity produced by the contact of two metals; and, in his endeavours to render the influence of the metals more considerable, he increased the number of the plates, and separated them by others of less conductive power; thus constructing his famous pile, the constant source of an electricity

* *Roy. Soc. Lond.* 27th April 1823; *Phil. Trans.* v. cxiii. p. 193; *Ann. de Chim. et de Phys.* tom. xxv. p, 80.

† Salmonia (2d edit.), p. 316; *Bibl. Univ.* tom. xl. p. 114.

‡ Elements of Agricultural Chemistry, in a Course of Lectures for the Board of Agriculture, 4to and 8vo, Lond. 1813. Translated into French, 12mo, Paris 1820, and into German, by F. Wolf, with additions by A. Thaer, 8vo, Berlin 1814.

which is continually renewed. Scarcely had physicians become acquainted with this new and admirable instrument, than they wished to try its effects on every kind of substance.

About the year 1800, Messrs Carlisle and Nicholson, introducing into the water metallic wires corresponding to the two poles of the pile, saw with surprise that oxygen was evolved near the positive thread, and hydrogen near the negative one.

The same year, perhaps before them, Ritter, in Germany, had arrived at a more precise result, by placing water in two separate vessels, but communicating with each other by means of sulphuric acid: oxygen and hydrogen were produced indefinitely, each at its pole. He thence concluded, not that the pile decomposed water, but that the two gases are only water combined with the two kinds of electricity. When an animal fibre, or even the fingers, formed the communication between the two vessels, muriatic acid also appeared at the positive wire; and some had even concluded, from this circumstance, that this acid was formed of hydrogen less oxygenated than water. Alkalies likewise appeared, of different kinds, according to the circumstances in which the operation was performed.

In 1803, two Swedish chemists, Messrs Hisinger and Berzelius, by repeated experiments, had ascertained the fact, that the decomposing action of the pile extends to bodies of every kind; that it invariably causes acids and oxygenated substances to appear towards the positive pole, and alkalies towards the negative one; thus opening a way to the explanation of these different anomalies.

Mr Davy had observed with attention the progress of these experiments, and, even in 1800, and under the eye of Beddoes, he had operated on water, placed in two separate vases, but employing a strip of bladder as the means of communication. In this experiment, muriatic acid likewise appeared *. In 1801 he had made known to the public a kind of pile, differing in some respects from that of Volta, in which a single plate of metal alternated with two liquids†. In 1802, he had ope-

* Notice of some observations on the causes of the galvanic phenomena, and on certain modes of increasing the powers of the galvanic pile of Volta.—*Nicholson's Journal*, 4to, vol. iv. p. 337, 380, and 394.

† An account of some galvanic combinations formed by the arrangement

rated on various liquids with a very powerful pile, and observed many singular disengagements of gas. He at last engaged in a series of profound investigations, which he prosecuted with the utmost perseverance for some years, and definitely established the theory of this new order of phenomena. The result was published in 1806 *, in a memoir, entitled *Bakerian Lectures*, so called because they were delivered in one of these foundations which are pretty numerous in England, the object of which is to direct the attention of the learned to certain special subjects in which the founder felt an interest. After the most minute precautions, he succeeded in demonstrating that, when water is pure, it is decomposed by electricity into gaseous matter alone, viz. into oxygen and hydrogen, in the proportions in which they enter into its composition. Submitting to the same agent bodies of different kinds, he carried to the highest degree of generalization the law of Hisinger and Berzelius; and, even reverting to the principle on which it was founded, he came to the conclusion that *chemical affinity is nothing else than the energy of opposite powers of electricity*—a conclusion which, combined with another law established in 1804 by Mr Dalton, on definite proportions, afforded to Berzelius principles for the establishment of an entirely new system of chemistry and mineralogy.

It was for this great and important service that the Institute, at its public sitting in January 1808, awarded to Mr Davy the prize founded for the advancement of galvanism, an honour which has not since been conferred on any one except M. Oerstedt for his brilliant discovery of the relations between galvanism and electricity. Soon after, Mr Davy, by prosecuting the same views, obtained a success still more flattering, because exclusively his own; I allude to the discovery of the metallic nature of fixed alkalies. For a long time chemists had been struck with

of single metallic plates and fluids, analogous to the new galvanic apparatus of Volta.—*Roy. Soc. Lond.* 18th June 1801; *Phil. Trans.* vol. xci. 397; *Biblioth. Brit.* vol. xvii. p. 237.

* On some chemical agencies of electricity.—*Roy. Soc. Lond.* 20th Nov. 1806; *Phil. Trans.* vol. xcvii. p. 1, 1807; *Ann. de Chimie*, tom. lxiii, p. 172 and 225; *Journal de Physique*, t. lxiv. p. 421; *Biblioth. Brit.* t. xxxv. p. 16.

the analogies of the fixed alkalies with alkaline earths, and of the latter with metallic oxides, and Lavoisier had even announced the possibility of these earths being oxides, incapable of being reduced by the ordinary means. With respect to the fixed alkalies properly so called, whatever conjectures had been formed as to their composition, results from some combinations with azote; the analogy with ammoniac had led to this idea; but in science the most happy conjectures are unavailing, if not confirmed by experience.

Mr Davy being in possession of such a powerful means of decomposition as the pile, did not despair of resolving the important problem. After having tried it without success on some aqueous solutions, he took potash sufficiently moistened to make it serve as a conductor, and having placed it in the circle of a powerful battery, the positive side produced a violent effervescence, while at the negative side there appeared small globules, resembling quicksilver in colour and lustre, but so combustible that they were covered almost while they formed, with a white crust of potash, and which, when thrown upon water, remained on the surface, and burned with a bright flame and considerable heat; it was the same upon ice, and it looked as if he had recovered the wild fire so famous in Byzantine history, to which it is probably owing that Europe is not at the present day under the influence of Mahometanism. The same phenomena presented themselves with soda, and whatever were the conductors, the produce of the combustion was always potash or soda; an envelope of naphtha was the only means of preventing these metallic globules from attracting oxygen, so as to counteract their tendency to combustion. It was in vain that some contended that these new substances were combinations of hydrogen, or even carbon, with the alkalies; rigorous analysis speedily exposed the error of such an hypothesis, and it remained demonstrated that potash and soda resulted from the combination of oxygen with bases resembling metals in their external characters, but infinitely lighter, and having an infinitely stronger attraction for oxygen. Potash contains 84 centiemes, and soda 76 centiemes, of metal. These bases, which are as perfect conductors of heat and electricity as the other metals, become soft at 12° of Reaumur, and at 30° become liquid like mercury, and evaporate at a red heat*. Klaproth, the first individual in our days who discovered a new metal, wished to question their metallic quality on the ground of their specific lightness; and in fact all the known metals are heavy, but in very different degrees. Tellurium, for example, is four times lighter than platina, and there is no reason why *sodium* and *potassium*, (the names by which Mr Davy distinguished the new substances) although six times lighter than tellurium, should be excluded from that class of substances to which they belong by all their other attributes.

This grand discovery was made in 1807, and formed the subject of the Bakerian Lecture for the month of November of the same year†. It could not fail to lead a mind like Davy's to new researches and new ideas; he tried the same process on many other earths, and Berzelius did the same, proving that they must all be regarded as oxides.

The great Swedish chemist, having electrified negatively some mercury in contact with a solution of ammonia, succeeded in producing an amalgam; and Mr Davy, who had arrived at the same result by more simple means‡, observed the mercury become solid, and lose three-fourths of its specific gravity, by the addition of a quantity of gas, scarcely equivalent to $\frac{1}{2300}$ of its weight; he was led, therefore, to think that the ammonia had likewise a base, and that perhaps the azote and hydrogen, of which it is composed, are themselves metallic oxides §. Rising

* The more correct statement is this:—Potassium at 50° Fahr. is soft and malleable, but melts at 136½°; sodium is soft and malleable at the common temperature of the atmosphere, and melts at 194° F.

† On some new phenomena of chemical changes produced by electricity, particularly the decomposition of fixed alkalies, and the exhibition of the new substances which constitute their bases, and on the general nature of alkaline bodies.—*Roy. Soc. Lond.* 12th and 19th November 1807. *Phil. Trans.* of London, vol. xcviii. p. 1. *Ann. de Chimie.* lxviii. p. 203–225. *Biblioth. Brit.* vol. xxxviii. p. 3.

‡ An account of some analytical researches on the nature of certain bodies, particularly the alkalies, phosphorus, sulphur, carbonaceous matter, and the acids hitherto undecompounded; with some general observations on chemical theory. *Roy. Soc. Lond.* 15th December 1808. *Phil. Trans.* vol. xcix. p. 39. *Ann. de Chim.* tom lxxii. p. 244, and lxxiii. p. 5. *Biblioth. Brit.* vol. xlii. p. 27. *Journ. de Phys.* tom. lxix. p. 360.

§ New analytical researches on the nature of certain bodies. 1st, Further inquiries on the action of potassium or ammonia, and on the analysis of am-to the highest generalities, he took into account nothing in nature but oxygen and unknown bases; varying even his explanations, as in algebra, in which a diversity of forms may lead to the same result, he inquired whether hydrogen might not be the principle of metallization, and whether oxides might not be reduced to combinations of bases with water, thus reverting, so to speak, to the ancient hypothesis of phlogiston, under another form. This tendency may be observed in many other of Mr Davy's memoirs, and perhaps he may be suspected in this of a little national jealousy. But although unsuccessful in overthrowing the French theory of combustion, he adduced at least such a striking exception, that instead of longer retaining the character of a general explanation, it became applicable only to particular cases of phenomena which required an explanation of a more elevated nature; and this forms the third and most important of his discoveries. It was already known by the experiments of Bertholet, that sulphuretted hydrogen, which does not contain oxygen, acts like an acid; oxygen, therefore, is not always the principle of acidity. On the other hand, the experiments of Mr Davy went to prove that it is the principle of alcalinity as well as of acidity, and thus its name was not justified by its nature. It was soon to be shewn that hydrogen has the power of producing acids, not less than oxygen.

For a long time chemists had attempted in vain to discover the base of muriatic acid; but after the explanations proposed by Bertholet, they supposed that this other acid, so celebrated for the uses to which it is applied in the arts, and which is obtained by causing muriatic acid to pass over oxide of manganese, and named *dephlogisticated muriatic acid* by Steele its discoverer, resulted from the combination of muriatic acid with oxygen of the oxide; it was consequently named *oxygenated muriatic acid*, and nothing appeared more simple than to extract from it the muriatic acid, by depriving it of this oxygen with which it was believed to be surcharged. MM. Gay-Lussac and Thénard attempted it, but could never succeed without the addition of water or at least of hydrogen. This pheno-

monia. 2d, On sulphur and phosphorus. 3d, On carbonaceous matter. 4th, Muriatic acid. *Roy. Soc. Lond.* 2d February and 16th March 1809. *Phil. Trans.* vol. xcix. p. 450. *Biblioth. Brit.* vol. xliv. p. 42.

menon appeared to them remarkable; water, they said, is an ingredient necessary to the formation of muriatic acid; but how does it happen to adhere so forcibly, that no means are sufficient to disengage it? May it not be only by one of these elements that it concurs in forming this acid? and may not the oxygen which is disengaged during the operation, and which is supposed to proceed from the oxygenated muriatic acid, be simply another element of water? Thus, neither oxygenated muriatic acid, nor common muriatic acid, would contain oxygen.

This opinion they ventured to express at the end of their memoir as a possible hypothesis; but they dared not support it in the face of their old masters, in whose eyes the theory of Lavoisier had acquired almost a religious sanctity *.

Mr Davy, who was under no such restraint, read a memoir in 1810 †, in which he advances this hypothesis, and supports it by a multitude of additional experiments ‡. The pretended oxygenated muriatic gas was therefore an agent of combustion equal with oxygen; at the same time when becoming to us a simple substance, it required a simple name; that of *chlorine* was given to it, subsequently abridged and changed to *chlore.*

A theory so new, it will readily be believed, was not so soon adopted as it was proposed. Mr Murray, a skilful chemist of Edinburgh, and Berzelius himself, defended the old theory with as much spirit as perseverance. Never was a scientific dispute conducted with so much propriety on both sides; to each experiment and explanation of an adversary, the other replied by experiments and explanations which seemed not less important, and the chemical world appeared in a state of suspense, when the appearance of a new substance caused the scale to turn in Mr Davy's favour, by associating with chlorine in its properties, and especially by producing combustion and acidification.

* Memoires de la Soc. d'Arcueil, tom. ii. p. 357.

† Researches on the Oxymuriatic Acid, its nature and combinations, and on the elements of the muriatic acid. *Roy. Soc.* 12th July 1810. *Phil. Trans.* vol. c. p. 231. *Ann. de Chem.* tom. lxxvi. p. 113 and 129. *Journ. de Phys.* tom. lxxi. p. 321. *Biblioth. Brit.* vol. xlv. p. 229.

‡ On some of the combinations of oxymuriatic gas and oxygen, and on the chemical relation of these principles to inflammable bodies. *Roy. Soc.* 15th November 1810. *Phil. Trans.* vol. ci. p. 1. *Ann. de Chem.* tom. lxxviii. p. 298. *Journ. de Phys.* tom. xlii. p. 358. *Biblioth. Brit.* tom. xlvii. p. 34, 245, 340.

This was *iodine*, discovered by M. Curtois, a dealer in saltpetre, well skilled in chemistry, a substance on which M. Gay-Lussac * and Mr Davy made some curious experiments†.

Fluoric acid, to discover the base of which many fruitless attempts had likewise been made, was soon arranged in the same class, according to a suggestion of M. Ampère ‡. At last, Gay-Lussac himself discovered a combination of carbon and azote *(cyanogène)* which acts like chlore, fluor, and iodine, and which produces acids without the addition of oxygen. Prussian blue is the well known produce of one of two acids and the oxide of iron.

Henceforth it is an admitted doctrine in chemistry, that acidity depends on the mode of combustion, and not on a material principle; and the name of Mr Davy is attached to this important proposition, not because he was the only individual by whom it was established, but because he was the first to announce it with precision. It is, in fact, this explanation of phenomena, under a clear and general form, which constitutes invention in the eyes of the majority, who are unable to follow in detail the various phases through which a truth is obliged to pass, before it become matured for ordinary minds.

By these three grand series of investigations, relating to the chemical action of the pile, the metallization of alkalies, and their combination without oxygen,—by the truths of primary importance which resulted from them,—by the multitude of new experiments, new views, and exquisite appreciation of all the phenomena which had concurred in the demonstration of

* Sur un nouvel acide formé avec la substance decouverte, par M. Courtois. Inst. 6th Dec. 1813. *Ann. de Chim.* tom. lxxxvii. p. 311. Note sur la combinaison de l'iode avec l'oxygène. Inst. 20. Dec. 1813. *Ann. de Chem.* lxxxviii. p. 319.

Mem. sur l'iode. Inst. 1er Août, 1814. *Ann. de Chem.* tom. xci. p. 1. *Bullet. Phil.* 1814, p. 112.

† Some experiments and observations on a new substance which becomes a violet-coloured gas by heat. *Roy. Soc.* Lond. 20th Jan. 1814. *Phil. Trans.* vol. civ. p. 74. *Ann. de Chem.* tom. xcii. p. 89. *Journ. de Phys.* tom. lxxix. p. 153. *Biblioth. Brit.* vol. lvi. p. 248.

Further experiments and observations on iodine. *Roy. Soc.* Lond. 16th June 1814. *Phil. Trans.* vol. civ. p. 487. *Biblioth. Brit.* vol. lvii. p. 243.

‡ Ann. de Chimie et de Physique, tom. ii. p. 20. Mémoire sur un Classification naturelle pour les corps simple. Ann. id. tom i. p. 295 and 373. tom. ii. p. 5. et 105.

these truths,—Mr Davy, not yet thirty-two years of age, occupied, in the opinion of all that could judge of such labours, the first rank among the chemists of this or of any other age; it remained for him, by direct service rendered to society, to acquire a similar degree of reputation in the minds of the general public. The first opportunity of accomplishing this, was afforded by a request made to him, to point out proper means of preventing the fatal effects of the frequent explosions which take place in coal-pits.

There escapes insensibly from beds of coal, when they are wrought, a certain quantity of inflammable gas, which, mingling with a portion of atmospheric air, is kindled by the miners' lamps, and explodes with a dreadful detonation, frequently destroying great numbers of the workmen. Cavendish was acquainted with its nature, and especially its specific lightness, and his discovery suggested the principle on which aerostatic balloons were constructed. No one, however, had taken any steps to prevent these destructive effects, when one of these explosions happened in 1812 in a mine called Felling, and killed, in an instant, upwards of a hundred miners, under circumstances so appalling, that all belonging to the profession became alarmed. Each morning they took leave of their families like soldiers about to mount a breach. Roused by interest, a committee of proprietors of mines tried how to prevent the danger, and Mr Davy was invited to point out the means which science could afford for this purpose.

To others it would have seemed as if an impossibility had been asked; as if he had been required to carry fire into a magazine of powder, and yet prevent its explosion; but Mr Davy did not despair, and perhaps his genius never appeared in a more conspicuous light, or more deserving of admiration, than in this instance.

This was not one of those cases in which the result is attained by a consecutive series of experiments, accumulated by chance, rather than suggested by experience; the problem was proposed, and the means of solving it were to be sought for in the general principles of science, without expecting aid from others, or from chance.

Mr Davy began by analyzing the gas, determining the quantities of carbon and hydrogen of which it is composed, and the proportions by which its combination with common air produces more or less violent detonations. He then examined at what degree of heat combustion took place, and according to what laws it is propagated. He observed that it could not take place in tubes of small dimension, even when every circumstance was favourable to its production, because the size of the tubes sufficiently cooled the gas to prevent its combustion. He thence concluded that by preventing the air from coming in a volume on the wick, and causing it to enter by long and narrow apertures, and only in suitable quantities to support the light, detonation could not ensue, even though the proportions of the air should be most favourable to produce that effect.

He was thus led to construct a lantern, the communication to the interior of which was through the intervals of numerous concentric tubes, and which had a chimney covered with a plate pierced with small holes, or formed of metallic gauze. This first attempt did not give him satisfaction, but led to the conception of something more perfect. He submitted solids to numerous experiments, that he might seize the just degree of cooling power which they possess, and discovered many physical facts full of interest, among others the greater intensity of the heat of flame, than even that of metal at a white heat. Thus a wire of platina became red in a mixture, the combustion of which was too slow to produce flame,—a surprising fact, for which no explanation has been found. The result of all these experiments was, that a metallic gauze may be formed, the meshes of which may be of that precise diameter fitted to cool the inflamed air which traverses them, and at the same time prevent its combustion, and which may be permeable to air and light without being so to flame. The invention therefore was brought to the degree of simplicity necessary for the men to whom it was destined, and formed consequently a complete solution of the problem *.

* On the Safety Lamp for coal-miners, and some researches on flame. 8vo. London 1815.

On the fire damp of coal mines, and on methods of lighting the mine so as to prevent its explosion. *Roy. Soc. Lond.* 9th November 1815. *Phil. Trans.* v. cvi. p. 1. *Ann. de Chim. et Physique,* tom. i. p. 136.

A single envelope of this metallic gauze, whenever employed with requisite precaution, henceforth secures miners from the terrible danger which threatened their lives; air ready for explosion may surround their lamp without any other danger than that of extinguishing it, and even then, if there be suspended over the wick a spiral wire of platina, it will become incandescent by the decomposition of the detonating gas, and afford light to the miner as long as there are any remains of respirable air.

This instrument, now used in the greater number of mines, and introduced by Mr Davy himself into those of Hungary, has been the means of preserving the lives of many useful men: and its services would have been of even greater importance, had it not been for the indifference which has prevented its adoption in some countries, and negligence in observing the rules prescribed by its inventor in others. Men's minds are usually so little occupied with the thoughts of death, that the most trifling present annoyance has more influence than the greatest danger when it appears somewhat remote.

It now looked as if Mr Davy might be asked to make a discovery, adapted to the necessities of any particular case. The copper-sheathing of ships is oxidized by sea water, and in a numerous navy like that of England, the expense of renewing it is enormous. The Admiralty in 1823, asked him to suggest a preservative, and he was not long in complying with their wishes; he had only to refer to former discoveries to be enabled to add one more to their number.

According to his practice, he first sought to give a precise account of the phenomena. Copper immersed in sea-water, produces a bluish-green powder, on which is deposited the carbonate of soda, an obvious proof that the marine salt has been decomposed; but, according to his theory of muriatic acid, this could not take place without oxygen, and as no hydrogen appeared, it could not be the water that furnished this oxygen but the atmospheric air which it contained. On the other hand, according to his theory of the correspondence between chemical action and the electrical condition of bodies, it was in consequence of its positive electricity relatively to the salts contained in the water, that the copper disengaged oxygen; it followed, therefore, that the process would be stopped by rendering the surface of the copper slightly negative, and this his experiments on the voltaic pile rendered a matter of easy attainment. The metal which, alternating with copper in the pile, assumed most powerfully the positive state of electricity, iron for example, or what was still better, zinc, must necessarily produce the desired effect. On the experiment being tried, it was found that a single grain of zinc, a small nail of iron, protected upwards of a square foot of copper; and vessels whose sheathing had been prepared in this manner, performed a voyage to America and returned, without the copper presenting any appearance of oxidation. It was found, however, that strict attention required to be paid to the proper proportions, too great a quantity of the preserving metal rendering the copper too negative, a state in which there was deposited an earthy crust which attracted shell fish and marine plants; and it is even asserted, that, notwithstanding the accurate solution of the problem regarded in its purely chemical relations, this unforeseen circumstance occasioned the necessity of abandoning the practice altogether. Perhaps Mr Davy would have discovered a remedy for this inconvenience, had not the party whom jealousy had raised against him, rendered him unwilling to institute any further inquiries.

A similar cause had some years before arrested him in a labour from which the most important advantages to literature and history might have been expected to result.

Every one knows the degree of interest taken by the Prince Regent, now George IV., in the unrolment of the manuscripts found at Herculaneum. He supported a director and several workmen, who had already succeeded in unrolling more than a thousand; and as every thing encouraged the hope that chemistry would afford the means of facilitating the operation, Mr Davy was sent to Naples for the purpose in 1818. A careful examination of these rolls, and a strict inquiry into the causes which had reduced them to their present condition, led him to conclude that it would be impossible to devise a simple method of softening them; but he suggested numerous improvements on the plan followed, which were received with expressions of gratitude by the conservators of the collection. Another scientific Englishman, however, skilled in the study of manuscripts, Mr Elonsby, having attempted to decypher some of those which had been unrolled, the sentiments of the conservators underwent a sudden change, and so many impediments were thrown in the way of farther investigation, that the undertaking was entirely abandoned. This journey afforded to Mr Davy an opportunity of investigating a subject of interest in the history of the arts, viz. the nature of the colours used in painting by the ancients. Some on the walls of Pompei or Herculaneum were sufficient to form the subject of analysis. He found that they were nearly as numerous as our own, and that many seemed to have been even better prepared, since they had resisted the effects of time for so many ages *.

This journey likewise supplied many new observations on volcanoes †, but which always bore relation to the ideas he had previously embraced. The excessive incandescence of lava at the moment of its ejection, the noise that precedes it, and the water, salts, and exhalations by which it is accompanied, all tended to confirm the idea he had entertained from the time of his first experiments on alkalies, that the principal cause of these remarkable phenomena is the action of sea-water on metals, which he supposes to exist, not yet oxidized, in the interior of the earth. This supposition reconciled a great variety of views on the primitive state of the globe, and the various changes which its surface has undergone, by which he sought to unite in a single system all the observations of later times relating to the subject, from those of Herschel on nebulæ, to those of the latest naturalists on the nature and relative position of earthy deposits, and on the remains of animals and vegetables which they contain.

These hypotheses were not unworthy of a genius which had made so many real discoveries, but he did not assign to them the importance of truths of the first order. He did not give them to the world till the publication of a work in which his imagination expatiates on numerous other subjects and of a much higher nature, his *Consolations in Travel*, the last of his

* Some experiments and observations on the colours used in painting by the ancients.—*Roy. Soc. Lond.* 23d February 1815. *Phil. Trans.* vol. cv. p. 97. *Ann. de Chim.* tom. xcvi. p. 72. and 193. *Biblioth. Brit.* vol. lix. p. 226. and 336, and lx. p. 129.

† On the phenomena of Volcanoes.—*Roy. Soc. Lond.* 20th May 1828. *Phil. Trans.* vol. cxviii. p. 241.—*Ann. de Chimie et de Physique*, vol. xxxviii. p. 133.—*Biblioth. Univ.* vol. xxxix. p. 121.

labours, with which he continued to be occupied nearly to the time of his death *.

The progress and destination of the human species, and the fate of thousands of worlds, of which astronomers have perceived but a small proportion, are the subjects of a dialogue, in which the poet is not less conspicuous than the philosopher, and in which, among fictions, a great power of reasoning is applied to questions of the most serious nature. One would have said, that once escaped from the laboratory he had resumed the tranquil reveries and sublime thoughts which had formed the delight of his youth : it was in some measure the work of a dying Plato.

In the same way he had amused himself, during a previous indisposition, by giving in a series of dialogues all the information his experience as a fisher had supplied on the natural history of the trout and salmon ; and the curious observations which his work on this subject contains, will render it always of importance in the science of ichthyology †.

But it must be confessed, that however ingenious these writings may appear, science has to regret that his mind was diverted by them from its appropriate pursuits. The state of his health, however, rendered it necessary, for he became so weak, that at times an entire forgetfulness of all chemical researches was the only means of alleviating his distress.

He had not always the power of diverting his attention by intellectual exercises. Fishing, or some other occupation equally insignificant, filled up a portion of his time. In traversing with such rapidity so wide a field of science, he had likewise accelerated the course of his life, and his early triumphs were obtained at the price of premature infirmity. A third journey to Italy, and a residence of some duration at Florence and Rome, had not the effect on his present state of health that was anticipated.

Reduced to a state of considerable weakness, he was anxious to see his native country. Lady Davy and his brother Dr John Davy, who acted as his medical attendant, watched over him during the journey with the most tender solicitude. The sight of the fine prospects through which he passed, seemed for a

* Consolations in Travel, or the last days of a Philosopher. 8vo. London 1830.

† Salmonia, or days of fly-fishing, in a series of conversations. 12m London, 1823.

moment to restore some of the recollections of his youth, but it was only the last gleams of a torch about to be extinguished. Having reached Geneva, without any symptoms that indicated his end to be so near, he expired suddenly in the night of the 28th and 29th of May 1829.

Thus at the age of fifty years, and in a foreign land, was the career finished of a genius whose name will shine with lustre among the crowd of celebrated names of which Great Britain has to boast. But why should I say a foreign land? To such a man no country can deserve that name, and least of all Geneva, where he possessed numerous intimate friends and admirers, who were continually occupied in spreading his discoveries over the continent; the mourning, therefore, could not have been greater, nor the obsequies more honourable, for one of their most respected citizens. The Magistrates, the whole University, students and professors, as well as all the foreigners in the town, considered it their duty to assist; each hastened to shew that science is cosmopolitan; and, as a mark of their highest esteem, the Academy of Geneva accepted of a foundation made in his honour by Lady Davy, by which a prize will be awarded every two years to the newest and most useful chemical experiments; so that his name will still remain attached to the truths long after to be discovered, in a science where his own discoveries were so important.

presented by
Sir James McGregor