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ANNALS OF PHILOSOPHY;

OR, MAGAZINE OF

CHEMISTRY, MINERALOGY, MECHANICS,

NATURAL HISTORY,

AGRICULTURE, AND THE ARTS.

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ANNALS

OF

PHILOSOPHY.

JANUARY, 1818.

Article I.

*Biographical Account of Delametherie.**

Jean Claude Delametherie was born at Clayette, a small town of Maconnois, on Sept. 4, 1743. His father was a physician; and we are informed that the medical profession had been exercised by his ancestors for several successive generations; the family bore a respectable rank, and was possessed of considerable property. From a very early period of his life, the subject of our memoir exhibited marks of a peculiar character: he took no interest in childish sports; but preferred reading books of a grave and abstruse kind, and was often absorbed in profound reflection. At the age of 15 he was sent to Thiers, in Auvergne, for the purpose of receiving instruction in the belles lettres; and at 18 went to prosecute his studies in Paris. As he had an elder brother, who was to occupy his father's profession, Jean Claude was destined for the church, and with this intention was placed in the seminary of St. Louis; but in consequence of his brother's death, he renounced the study of theology, and entered upon that of medicine in his 22d year. After spending five years in acquiring a knowledge of his profession, he returned to his father's house, and engaged in the practice of it; but it would appear that he was never fond of the employment, and after some time abandoned it in disgust. He assigned as his motive the uncertainty of the art, and the very little accurate knowledge which it is in our power to acquire

* The facts which form the basis of this account are taken from an elaborate paper by M. Blainville, in the Journ. de Phys. t. lxxxv. p. 78.

respecting it; and it is probable that he was also impelled to the change by his speculative turn of mind, which led him to prefer a mode of life in which he would be less confined to a regular routine of business. The decided bent of his genius was indeed for theory and speculation; and of this he gave a very unequivocal specimen, in his "Essay on the Principles of Natural Philosophy," which he wrote while he was still under his father's roof. It contained so many free sentiments, on various topics in which the feelings and prejudices of mankind are the most intimately concerned, that the booksellers of Paris would not venture to publish it; but it appeared at Geneva in 1778. The work was reprinted in 1787, and again in 1805, having undergone successive improvements in each edition. In this essay he discusses a variety of the most abstruse metaphysical questions, and gives his sentiments upon all of them with the most perfect confidence, although he not unfrequently maintains opinions directly opposite to those which are commonly regarded as the most important and the best established.

Upon quitting the paternal roof, he seems to have determined to pass the remainder of his life in a state of perfect freedom from all restraint; and with this intention he renounced all his claim upon the family property, on consideration of receiving a moderate annuity. He resolved never to enter into the matrimonial state from the same feeling, and partly, as it appears, from the gloomy and melancholic cast of his mind, which led him to doubt whether life ought to be regarded as a good, and consequently whether it was consistent with benevolence to bring human beings into existence. The peculiar traits of his character, which had displayed themselves at a very early period of life, were now become more confirmed; and, what was originally an unusual degree of gravity and sedateness, had now degenerated into spleen and austerity. Having discarded all his cares of a personal and private nature, he repaired to Paris, associated himself with the literary men of that place, and henceforth had no business or occupation but science. About the year 1780 he published his "Physiological Views;" a work which, like the former, was full of theory, and in which he indulges in the most unbounded freedom of speculation. Among other opinions which he broached in this work, it is maintained that animals and vegetables are produced by the crystallization of the semen, exactly in the same manner as minerals are by the accretion of their particles; and extravagant as this opinion may appear, it is only a specimen of many others of a similar kind that might be extracted from his works.

Soon after his removal to the metropolis, he became a frequent contributor to the Journal de Physique; and in the year 1785 he became the editor of it, an office which he retained until a very short time before his death. In many respects he was well adapted for this office; he was laborious, well informed, and high principled; but unfortunately his good qualities were alloyed by some of an opposite kind. He was extremely jealous of his literary reputation, of the most acute sensibility to supposed affronts or injuries, and of a haughty and unbending spirit; so that his literary life was almost a perpetual scene of warfare. His hatred of tyranny of all description, and his love of impartiality and strict justice, tinged or biassed by his peculiar temperament, led him generally to oppose his contemporaries and his countrymen, and to prefer to them those persons who, having lived in former ages, or residing in distant countries, were removed from rivalship, and were not liable to wound his pride or self-love. Thus, almost as a matter of course, he set himself in decided opposition to the new chemical nomenclature, personally opposed Lavoisier, and generally objected to all the doctrines of the modern pneumatic chemistry. It was with this object that in 1789 he published his work on pure air, as he still continued to stile oxygen; a work in which he endeavours to prove that Bayen had all the merit that is usually attributed to Lavoisier and his associates, in the discovery of the gaseous bodies. In the same spirit he afterwards opposed Haüy's doctrines on the subject of crystallography; he endeavoured to show that he was not original in his idea of applying the crystalline form of bodies to determine their species; and for the purpose, as he supposed, of doing justice to the party that had been defrauded of his literary rights, he republished the Sciagraphia of Bergman.

Delametherie about this period particularly directed his attention to the study of mineralogy and geology; and in 1795 published what is perhaps his best work, or at least that which is the least objectionable, his "Theory of the Earth;" it contains a good view of the best ascertained facts and best established opinions, while there is less of that extravagant speculation which is so profusely scattered over his former productions. A circumstance occurred at this time which caused him a severe disappointment. By the death of Daubenton, the Professorship of Natural History in the College of France became vacant; and Delametherie conceived himself the person most qualified to fill his place, and had some reason to expect the appointment. It was, however, conferred upon Cuvier, a man much his junior, and whose reputation at that time was not so fully established, as to afford an obvious reason for the preference. Delametherie's mortification was, however, alleviated by an arrangement which was afterwards made, according to which he was constituted joint Professor with Cuvier, the departments of geology and mineralogy being placed under his sole superintendance. As a part of the duties of his office, he now became a public lecturer on mineralogy, an employment which he executed with much zeal, and with considerable success. His class was numerously attended; and he employed every means to make his lectures interesting to his pupils, by the exhibition of his specimens, which he freely permitted them to examine, and by taking short excursions with them into the neighbourhood of Paris, and illustrating his doctrines by a reference to natural phenomena. The substance of his lectures was afterwards published in two works, one on mineralogy, and the other on geology, forming a series of five volumes, which may be regarded as "The Theory of the Earth" with some additions and alterations.

The stormy period of the French revolution, which now raged in all its horrors, was felt by the family of Delametherie; and although his own income was both scanty and precarious, he very generously resigned the annuity which he had reserved out of the paternal estate. But the sale of his journal became suspended by the increasing troubles of the times; and for a period of two or three years he appears to have endured great privations; which were, however, mitigated by the liberality of his colleague Cuvier, who gave up to him a large proportion of the emoluments of their joint office. When France again acquired a state of comparative tranquillity, and science began to resume her rank in public estimation, Delametherie was found ready at his post; he recommenced his journal, in which he always inserted a number of his own papers; and in the year 1804 he published his "Considerations on Organized Beings," a work, as usual, containing much information, but unfortunately blended with a large proportion of mere speculative theory. In 1812 Delametherie had a severe attack of apoplexy; but he recovered from it so far as to pursue his usual literary occupations for five years, although harrassed by a variety of complaints, indicating a complete breaking up of his constitution, until a second apoplectic attack carried him off on July 1, 1817, in the 74th year of his age.

His moral and intellectual character may be pretty exactly appreciated from the narrative of his life; he was a man of strict honour and integrity, of regular habits, capable of acts of great generosity, and totally devoid of all anxiety for the gratifications of luxury, or the frivolous pursuits of vulgar ambition. But unfortunately these good qualities were obscured by pride, self-love, irascibility, and jealousy; and the operation of these being more obvious and more frequently called into action, his defects were more known than his virtues, and he did not obtain the estimation in society to which, upon a fair balance of his qualities, he was justly entitled. This circumstance he felt acutely; while at the same time it aggravated the evil, and tended to give a degree of harshness to his disposition, which was not natural to it. When not under the influence of temper, he was kind and humane; and, except on the score of literary reputation, was free from all selfish feelings.

With respect to the scientific character of Delametherie, he may be justly entitled to the commendation of unwearied application and extensive knowledge; but perhaps neither his industry nor his information were productive of the advantage, either to himself or to society, which might have been derived from them under different management. In all his writings he is perpetually dwelling upon the value of facts, and is always upbraiding his opponents with being too hasty in the formation of their theories; yet there is scarcely a single writer, among his contemporaries, who abounds so much in speculation, and who, considering the extent of his writings, has added so little to the stock of actual knowledge. His judgment on scientific topics was frequently warped by his temper; he almost systematically differed from those around him; and it accordingly has sometimes happened that he proved to be in the right; but this was certainly more owing to his objecting to every thing, than to any superior sagacity in discerning the truth. With respect to his talents as the editor of a scientific journal, the capacity in which probably he will alone be remembered by posterity, we may observe the same mixture of qualities. He was eminently laborious and punctual; but although he valued himself for his impartiality, and his strict observance of literary justice, his jealous and irritable temper was perpetually biassing his judgment, causing him to form an unjust estimate of the merits of those whom he considered as his rivals, and involving himself in disputes with those who either differed from him, or, as he conceived, did not treat him with due respect. He commenced his office as editor of the Journal de Physique in March, 1785, and continued it until April, 1817, a period of 31 years. In the first number of the year he always wrote a sketch of the progress of science during the preceding year; and, besides these, inserted a great number of other articles; so that the whole of his papers amounts to nearly 120. His other works, which have been mentioned above, and a few others of minor importance, when added to his memoirs, make him one of the most voluminous writers of the age; and it appears that he was proud of the quantity of his publications; and used to boast of this circumstance as a proof of his literary desert; forgetting that he would have been much more entitled to our gratitude, and would have much better consulted his own reputation, if he had given to the world a smaller quantity of matter in a more matured form.

It would be an operose, and not a very useful task, to give an analysis of all the works, or a view of all the opinions of one who wrote so much, and probably wrote without much premeditation. Something, however, of this kind may be expected concerning a man who, notwithstanding his defects, will always have his name associated with one of the most splendid eras of natural science. With respect to his general principles of philosophy, Delametherie appears to have been a decided atheist; he thought that creation and annihilation, in the strict sense of the terms, were impossible; and that all the properties which had to matter are the effects of powers necessarily inherent in bodies, and without which they cannot exist. These opinions he maintained without any reserve, and brought them forwards in his writings when the subject appeared to call for them; but it does not seem that he took any particular pains to make converts to these doctrines, or was more anxious to impress them upon the minds of his readers, than any other of his opinions. They were regarded by him as lying at the foundation of his speculations, but in no other respect as being of any peculiar moment. The great phenomena of attraction and repulsion he supposed to depend upon the afflux and efflux of certain subtile fluids to and from bodies, which, as it were, carried other bodies along with them in their current. He seems to have regarded Galvanism as the most powerful agent in nature, or rather the prime cause of all the changes that are perpetually going forwards around us; he not only speaks of it as the first step in all physical and chemical operations, but he extends its influence to the vital properties of sensibility and muscular contraction. In his arrangement of natural objects he recurs to the antiquated division of them into four elements: under the denomination of fire he includes, not only caloric, but the other imponderable fluids, light, electricity, and magnetism. With respect to air, his ideas do not seem to have been well defined; but it may be conjectured that he regarded oxygen, or, as he termed it, pure air, as the basis of all the other gases, and that they were formed by the combination of this with some other substance. Water he regarded as an undecomposable body, the ponderable part of air; and of course in all those processes where water is supposed to be generated by the combination of oxygen and hydrogen, the water was conceived to be merely an educt, not a product. He remained to the last a firm opposer of the antiphlogistic theory, and triumphed not a little in the latter part of his life, when he observed that the fundamental doctrines of Lavoisier were called in question, or controverted by subsequent experiments. This was particularly the case with respect to the doctrine that acidity necessarily depends upon oxygen; yet his opinion, which he wished to substitute in its room, that acidity essentially depends upon fixed or condensed heat, is much more hypothetical, and less intelligible.

Delametherie perhaps excelled the most as a geologist and mineralogist; and on these topics, contrary to what we often find to be the case, his opinions are the best matured, or at least his speculations are more plausible. He conceived that every part of the globe had at some period of its existence been in the liquid state, and that the waters had formerly covered the highest mountains; but it does appear that he adopted exclusively either of the hypotheses which have divided geologists into the two rival sects of the Volcanists and the Neptunists. Mineral substances he divided into 10 classes: gases, waters, combustible non-metallic bodies, combustible metallic bodies, acids, alkalies, earths, salts, volcanic substances, and fossils. It has been already observed that he disapproved of the plan of making crystalline forms the basis of a mineralogical system; this he regarded as one only among other properties which ought to be employed for this purpose.

His most singular opinions were those on organized bodies: he supposed that they were originally produced by the crystallization of their seed; that their vital powers depend upon Galvanism, which is evolved by the superposition of alternate strata of medullary and muscular parts; that there is a strict analogy between animals and vegetables, both in their structure and functions; and that there is no part or property in one of these classes to which a corresponding part or function may not be demonstrated in the other. As his mineralogy is the best, so it may be asserted that his physiology is the worst part of his works; it abounds the most with mere speculation and false analogies, and is the least supported by absolute facts or correct deductions.

We may sum up our remarks upon the character of Delametherie by saying, that he possessed many valuable qualities, both moral and intellectual, but that, along with these, he had some natural defects of temper and disposition, which were unfortunately fostered by his acquired habits, so as, in a considerable degree, to destroy both his happiness and his utility. Upon the whole he must be regarded as a man more to be respected than esteemed, who, although ardently bent upon the promotion of science, and indefatigable in the pursuit of it, accomplished much less than might have been expected from the same portion of talent and industry, had they been differently directed, and placed under the controul of a better regulated judgment.

Article II.

On Phosphuretted Hydrogen. By J. Dalton.

(To Dr. Thomson.)

RESPECTED FRIEND, *Manchester, Nov.* 16, 1817.

Having been lately engaged in investigations on the phosphurets, I had to review the experience of others, as well as my own already published, relating to phosphuretted hydrogen gas, and to make very material corrections and additions. I hasten, therefore, to communicate the facts observed, without going into detail of experiments, that others may, if they choose, avail themselves of the train into which I have been led.

1. There is but *one* combination of phosphorus and hydrogen, as far as can be deduced from experiments hitherto made; all the varieties of phosphuretted hydrogen have arisen from the circumstance that free hydrogen is liable to be produced less or more in all the processes used for the generation of phosphuretted hydrogen.

2. Phosphuretted hydrogen may be obtained in great purity from phosphuret of lime by the method recommended by Dr. Thomson (*Annals of Philosophy*, vol. viii. p. 89), *provided the phosphuret has been well secluded from the atmosphere;* but if it has been previously exposed for a few hours to the atmosphere, the gas will be much more copious, and contain from 50 to 80 per cent., less or more, of *free* hydrogen, and only the rest phosphuretted hydrogen.

3. Pure phosphuretted hydrogen may easily be withdrawn from hydrogen by liquid oxymuriate of lime; it absorbs the former gas, and converts it into phosphoric acid and water, almost as readily as green sulphate of iron absorbs nitrous gas; and the latter or free hydrogen is left unaffected.

4. Pure phosphuretted hydrogen may be mixed with safety in narrow tubes ($\frac{3}{10}$ of an inch diameter) with pure oxygen; and in due time the mixture may be transferred into any sort of vessel without explosion, and kept many hours without any sensible chemical action. An electric spark fires it instantly, with a violent explosion and a brilliancy surpassing that of any other gas. Prudence requires that very small portions of the mixture should be exploded; with a strong tube having the glass $\frac{1}{8}$ of an inch thick, I do not think it safe to explode more than 15 water grain measures of phosphuretted hydrogen at once.

5. One volume of phosphuretted hydrogen requires, as nearly as I have ascertained, two volumes of oxygen for its complete combustion. Phosphoric acid and water are formed.

6. Pure phosphuretted hydrogen, by being electrified for one or two hours in due quantity, expands nearly $\frac{1}{3}$ of its original volume. Phosphorus is deposited, and the residual gas is hydrogen mixed with less or more of phosphuretted hydrogen which may have escaped decomposition, and which is determinable by exploding with oxygen. If any atmospheric air be present (which is almost unavoidable in the small quantity of five or six per cent.), at first electricity perceptibly diminishes the gas; but it soon begins to expand, though in that case it can scarcely be made to exceed 25 per cent. on the first volume.

7. Water freed from air absorbs fully $\frac{1}{7}$ of its volume of this gas. This was first announced by Sir H. Davy, of what he calls *hydrophosphoric gas*, which appears from this and other properties to have been nearly pure phosphuretted hydrogen. The gas, I find, is capable of being expelled again by ebullition, or by agitation with any other gas in the usual way, but not without a loss of less or more phosphorus.

8. One volume of pure phosphuretted hydrogen mixed with from two to five volumes of pure nitrous gas afford a most brilliant explosion by one or more electric sparks, as was discovered by Dr. Thomson. When duly proportioned (I find 1 to $3\frac{1}{2}$, and not 1 to 3, as Dr. Thomson), the result is phosphoric acid and water, with azotic gas two or three per cent. less than $\frac{1}{2}$ the volume of nitrous gas. When more or less than $3\frac{1}{2}$ of nitrous gas is used, the residue of gas after the explosion contains oxygen gas or hydrogen gas accordingly; rarely any phosphuretted hydrogen. Dr. T. says that no alteration is produced by mixing nitrous gas and phosphuretted hydrogen. This is correct if we are to understand *immediately;* but not otherwise: for, by standing one, two, or three hours, the whole phosphuretted hydrogen is consumed (if the nitrous gas be in excess), and there is left a mixture of nitrous gas, nitrous oxide and azotic gases, amounting to about half the volume of the original mixture. Dr. T. found that a bubble of oxygen causes a mixture of nitrous and phosphuretted hydrogen to explode; by analogy I concluded that a mixture of phosphuretted hydrogen and oxygen would explode by a bubble of nitrous gas, and found it accordingly.

9. Nitrous oxide and phosphuretted hydrogen explode by a spark, but undergo no change by simple mixture for several hours at least. The due proportions are nearly three to one.

Experiments on phosphuretted hydrogen are most likely soon to determine the controverted question respecting the constitution of phosphoric acid, as well as those concerning the quantities of azote and oxygen in the nitrous compounds.

I remain yours,

JOHN DALTON.

ARTICLE III.

Some Account of a late Mission to Ashantee.

IN the "*Voyage du Chevalier Des Marchais,*" published in 1730, by Le Pere Labat, is a map of Guinea drawn by Danville. In this map, between 30 and 40 G. miles north of Cape Coast Castle, is represented the southern frontier of the kingdom of *Asianté.* Its breadth from west to east is between 50 and 60 miles: its northern frontier is not defined. M. Des Marchais makes no mention of this country in his travels (which indeed were confined to the eastern districts of Guinea); but in the map it is called *Royaume tres puissant,* and is divided into seven provinces.

During the last 80 or 90 years the Ashantees appear to have been progressively subjecting the districts lying to the south-east between their own territory and the sea, till at length they began to excite the notice and suspicion of the European forts and factories on the Gold Coast. From information transmitted by the Governor of Cape Coast Castle to the African Society, it appears that in October, 1815, the Ashantees were in force at the back of Acra (Acron of Danville), where they remained till the month of May in the following year. At this time a battle took place between them and the people of Adjumacoon and Agoonah, in which the Ashantees were victorious. They then proceeded westward along the coast, driving before them the Fantees, a tribe inhabiting the territory surrounding Cape Coast Castle, and under the protection of the British garrison of that fortress. On June 2, about 4000 Fantees, chiefly women and children, took refuge in the castle, which circumstance induced the necessity of opening immediately a negotiation with the general of the Ashantee army; the result of which was, that peace was restored to the country under protection of the Company; and the Ashantees, having received presents to a considerable amount, quitted the coast about the end of June.

The friendly intercourse which had thus taken place seemed to offer a favourable opening for a direct communication with the King of Ashantee: accordingly the Company sent out instructions to the Governor of Cape Coast Castle authorizing him to dispatch a mission or embassy to Ashantee, which, besides attending to the peculiar interests of the Company, should endeavour to obtain satisfactory information on the nature of the country, the soil and products; the names, distances, latitude, and longitude, of the chief places; the manners of the people; their laws, customs, and government; the objects of commerce, particularly gold and ivory; and, if possible, to procure permission for some children of the chiefs to be educated at Cape Coast Castle.

Three gentlemen (two writers and a medical man) were entrusted with the conduct of the expedition, which set out from Cape Coast Castle on April 21, 1817.

After a circuitous route, calculated at from 150 to 200 miles, the embassy arrived at Cormarçie, the capital, and experienced a very favourable reception from the King. Their intercourse was of necessity at first carried on through the dubious medium of interpreters; but the envoy in a short time acquired the language of the country, and thus was enabled to open a direct communication with the King. The embassy still remained at Cormarçie when the last vessels sailed from the coast: by these, letters were received from persons of the embassy, and from others, containing various particulars more or less interesting, some of which have found their way into the newspapers, and other periodical publications. One of the editors of this journal has likewise been favoured with th[illegible] of a communication of peculiar authenticity, from which the following particulars are extracted:

Cormarçie is situated in 6° 30′ N. latitude. The space which it occupies is vaguely estimated at somewhat less than that of Liverpool. None of the buildings exceed one story in height; they are all constructed of wattled bamboo, having the interstices filled up with clay: the doors and windows are very roughly executed, and are made of the soft spongy wood of the silk cotton-tree (bombax). The size of the houses depends on the consequence and wealth of the owner, and they are each surrounded with a court yard. The palace stands in the centre of the town, and is a very extensive building, or rather cluster of buildings. The streets, from 15 to 20 feet wide, are arranged parallel and at right angles to one another; and there are two spacious market-places. The town is surrounded by a ditch, which always contains water, even in the driest seasons, and during the rains is of considerable breadth: it is crossed by bridges in various parts. The surrounding country is composed of low hills, with valleys between; and abounds in underwood intermixed with abundance of large trees; which latter, however, are applied to no use, their timber being too hard to be worked by the tools of the natives. Cotton is cultivated in gardens in the suburbs, and also grows plentifully about the country. The same is the case with tobacco; but the consumption of this article in all its usual forms being very great, there are large quantities of Portuguese roll tobacco annually imported into the country.

Almost the only fruits cultivated here are papaws, oranges, limes, and a few pine-apples: the two former are in great abundance. One man has a few cocoa-nut trees in his garden, which are much admired.

No kinds of corn are cultivated, the inhabitants depending chiefly for subsistence on yams and plantains. Ground nuts are grown in large quantities, and are principally used by the traders on their journeys; they are first roasted, and then made into a coarse flour, and in this state form the most portable kind of food. Sweet potatoe, ochrè, and tomata, are also cultivated to a considerable extent. Cassava is grown only as food for hogs and cattle. They prepare palm oil, but it always fetches a high price. Palm wine is the common fermented liquor of the country, and is very largely consumed.

The animal food consists of mutton, beef, buffalo, hogs, deer, and monkeys, which latter are the most esteemed. Neither the King nor any of his family taste beef, it being contrary to his religion, or *fetish*.

Elephants and camels abound; but neither the one nor the other are domesticated. Panthers are both numerous and daring even in the very skirts of the town, from three to four persons nightly being carried off out of their houses.

There is said to be a gold-mine near the capital, which, however, the King will not allow to be worked, all the supplies of this metal in the country being obtained, either from washing the sandy earth, or in barter from the Dinkaras and Waisaws. About 30 miles from Cormarçie is a plantation belonging to the King, where he often goes, being conveyed in a basket on men's shoulders. The road to this place is a very fine one, but is the only one in the country, all the other outlets being merely paths.

It is the custom of the King (Poco) to sit three times each day in public, in order to hear and decide disputes; and his generals, captains, and caboceers also pay their respects to him three times a day, when he regales them with palm wine. The laws are very severe, death being the general punishment: the sentence, however, may in many cases be commuted for a large sum of money. The gainer of a cause always pays the expenses of the suit. It is not unusual, in cases where the King is a party, for him to submit his cause to the determination of the caboceers, and other principal men. If the affair is decided against him, as happens not unfrequently, it is his custom to make an apology, and a proportionate compensation, to the injured party. The government, however, is a pure despotism, and the Sovereign is the universal heir. One of his generals, the second in command in his army, having offended him, the King deprived him of his command, took away his 300 wives and his slaves, leaving only two of each for his use, and appointed him overseer of the ferry over the Bossumpra and of the fishing canoes. After, however, the degraded favourite had occupied his new post for about six weeks, he was found hanging, having first dispatched his two wives and his slaves.

The wives of the King are said to amount to 3334. They inhabit a particular quarter of the city which is walled in; and it is death for any person even to pass near the gate leading to their residence. When any of them walk abroad, they are attended by a train of boys and eunuchs, and by a military guard, who shoot without scruple all who do not fly on their approach.

Human sacrifices are so frequent as to render Cormarçie on this account a very disgusting residence for an European. They "play with a man," as they term it, every 43 days. A criminal, or, if none is to be had, a prisoner of war, if of high rank the more acceptable, is brought out into an open space, and taken possession of by 12 or 14 men hideously painted, and dressed in tiger skins, each being armed with two knives. They commence by thrusting a knife through the cheek, transfixing the tongue, so as to prevent their victim from uttering any cries; they then insert a knife near the shoulder-blade on each side of the backbone; and, lastly, pass a cord through the cartilage of the nose. The poor wretch is then made to dance, and is mangled with deliberate cruelty for five or six hours. He is then led before the King's residence, that the Sovereign may be gratified by the spectacle of his last sufferings, and finally of his decapitation. Whenever the King goes to visit the tombs of his ancestors he is obliged to propitiate them by the slaughter of from six to 12 human beings. The son of the King of Akim, a child seven or eight years old, taken at the conquest of the country, was placed in a brass pan on a man's head, the people dancing around him in front of the chief temple, or *fetish house*: he was then ripped open, his head cut off, and the mangled carcass thrown into the enclosure of the temple, as a present from the King. The daily sight of these and similar cruelties produces its natural effect on the manners of the people, who make no scruple of sacrificing any person at the instigation of revenge or gain: and though no one by law is allowed to sacrifice a human being without the consent of the King being previously obtained, yet it is frequently done by the rich, either as an offering to their ancestors, or from respect to their own *fetish*. The ditch round the town is the general receptacle for these dead bodies, in consequence of which all water for domestic use is obtained from wells.

The dress of the higher classes is chiefly silk, or finely-wrought cloths, the manufacture of their own country, intermixed with silk, which they obtain by unravelling the manufactured silk which they get from the European traders and interweaving it with their own cotton. A profusion of gold ornaments is also worn. The lower orders wear cotton cloths of blue, white, and black stripes, the manufacture of their own country: whence it may be inferred that the Indian and Manchester articles which they purchase on the coast are employed in their commerce with the interior of Africa.

The only river which the embassy passed on its way to Ashantee is the Bossumpra. It flows through the Assim country: about four days' journey from Cormarçie it is as broad as the Thames at Vauxhall, and is deep. Hence it takes an easterly direction, entering the Akim country at the back of Acra. It is not navigable, being obstructed by rocks and numerous falls, and is supposed to be the Volta, or a branch of that river.

Eighteen miles north of Cormarçie runs the river Tando, which at this place is a broad deep stream: it appears to run west, and is probably a branch of the river of Assinee. The rains never set in at Cormarçie before the month of August.

The territory of Ashantee proper is but of small extent; but the whole kingdom, including the conquered countries, is reputed to extend from the capital 20 days' journey to the east, 15 to the west, 12 to the south, and 40 to the north.

Article IV.

Design for a Bridge across the Mersey, at Runcorn. J. C. Loudon.

(With a Plate.)

Sir,

I send you herewith some sketches, with explanatory marks, of a design for a suspended bridge, which I had pared for the committee at Runcorn (see Phil. Mag. for last); but from some untoward circumstance, the choice made before I learned that it was time to give in the plans had constructed a model for a similar design; which I men here, merely to record that I have sent it to a friend in Poland be presented to the Royal Society of Warsaw. It was in that in the spring of 1813, that the idea of a suspended bridge occurred to me, as suitable for crossing the Vistula, there ne 2000 feet wide. Having passed the following winter in Pet burgh, the magnificent ramifications of the Newa, the want a permanent communication between the two principal parts the city (sometimes unconnected for two or three weeks toget by the floating ice), and the inspection of numerous desig and models for bridges adapted to these circumstances, induc me to pursue the subject still farther. After my return to Englan in July, 1816, I made some sketches; and having shown o of these to Mr. Telford, that gentleman obligingly showed n his design for Runcorn (since engraved), which I conclude was approved of, and therefore paid no attention to the subjec till in May last I saw an advertisement inviting artists to give i designs, &c. I have no other object in wishing to publish my design than that of inducing scientific men to direct their atten tion to a subject which is of considerable importance, not onl to this country, but to every other.

I am, Sir, your most obedient servant,

Bayswater House, Aug. 10, 1817. J. C. Loudon.

Data.

As the merits of every design must necessarily have a reference to the object in view, the author of that now submitted begs leave to premise the data and information on which he has proceeded in its arrangement. It is considered as desirable to establish a communication between the counties of Lancaster and Chester, by a bridge across the Mersey, at Runcorn Gap, about eight miles from Warrington; and it is a *sine qua non* that the navigation of the Mersey, which is considerable, be unintern.

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rupted, even during the erection of the bridge. For this reason it is supposed to be laid down as data by the committee that the middle opening of this bridge shall not be less than a thousand feet, and that the road or arch shall be so far elevated as to leave of that width a clear space of not less than 70 feet in height above high water mark.

The bottom and sides of the river are a compact sand-stone rock; the section at Runcorn is agreeable to that given in an engraving of a design for a bridge in this situation by Mr. Telford, and of that copy which was presented by him to the Royal Institution in April last. The design now submitted consists of a road constructed of cast and wrought iron, suspended in equilibrio from cast-iron fulcrums or piers, but differing from other roads suspended from catenarian arches (from Mr. Telford's and Capt. Brown's, for example) in the form of, and distribution of the weight on the piers, in the suspension of each part singly and directly from the piers, and as to a mode of deriving fixed points of resistance from the rock, in lieu of abutments of masonry.

Description.

Of the 18 figures referred to, the first three are descriptive of the general appearance of the bridge; the fourth to the 10th, of the details of its construction; and the remainder are chiefly diagrams explanatory of the principles on which it acts. In Fig. 1, elevation: Fig. 2, plan: and in Fig. 3, profile,

A, represents the fulcrums or piers; being connected ranges of hollow tapering columns, or cylinders of cast-iron, placed perpendicularly, and braced by stays, struts, tie plates, &c. (See Fig. 3.)

B, the jointed iron rods which suspend the road, and which are not fixed to, but merely lie loose on, the ridge piece of the fulcrums in grooves, as seen in Fig. 3. That part which slides or passes over the fulcrums is composed of short links, so as to slide with little friction.

C, iron rods continued from where the others are attached to the road, down to the stratum of rock, and there fixed. These rods are intended as a substitute for an abutment of masonry, which would otherwise require to be formed at the end of the road, of such power as to resist the strain of the road indicated by the diagonals 1 to 13 from the fulcrum to the abutment, and amounting, even when the bridge is unloaded, to 450 tons.

Were there no rock, then a stratum of connected blocks of stone, wood, or cast-iron, might be substituted, at such a depth as that the load of earth over them might produce the power required, as counterpoise.

Or, supposing the ground to be soft, and of uniform texture, for a considerable depth, then might piles be driven and conjoined a few feet below the surface of the ground by a pavement of stone, or framework of timber or cast-iron. To the tops of these piles the rods C and D might be fastened, each preserving the same degree of inclination under the road which it has over it. The power of the rods to draw these piles diminishes in the same ratio as the angle of incidence, viz. the acute angle which the rods form with the pavement, or heads of the piles; and will be indicated by the diagonals of parallelograms constructed on the same principle as those in Fig. 11, at 1, 2, 3, &c.

For the sake of simplicity, and economy in excavation, the rods are conjoined in pairs under the road, each pair being passed through a strong ring, or link, as at Y, Fig. 3, and afterwards carried down together to the rock.

If the rock is compact at the surface, then, by increasing the dimensions of the rods, a smaller number than that shown in the elevation will be sufficient to counteract every possible strain to which they will be liable.

In the case of a bridge on this principle consisting of a series of equimensurate openings, of course no such rods would be requisite any where but at its termination or abutments.

D, extremities of those rods which form the basis of the roadway, and also some of the suspending rods, inflected over the fulcrum or wall of masonry, S, and made fast to the rock. If there is a command of the ground for 100 or 200 yards at each end of the bridge, in the direction of its length, even these small fulcrums are unnecessary, as observed above. (See C.)

E, roadway, the basis of which is composed of iron rods, as arranged in Fig. 8, to which is bolted the wrought-iron framework, exhibited in Fig. 7, the covering being convex cast-iron plates screwed together (but not to the framework), as at W, Fig. 7. The whole is then covered with clay, chalk, and gravel, as in the section Fig. 6, with a protecting rail for the foot-paths, as at X, X, Figs. 5 and 6, and an outside cast-iron parapet, as at Fig. 4.

F, stays to the columns of the fulcrums.

G, H, I, struts to these stays, composed of flanched plates of cast-iron.

K, L, M, N, O, P, horizontal plates flanched, and with the flanch arched towards its juncture with the stays, so as to abut on them, and thus to serve as binders; that is, both as struts and ties.

Q, foundation of the pier on the rock.

R, excavation to the rock, in order to admit of fixing the rods C, C, thereto, by Lewis's or otherwise, as well as laying the foundation of S.

S, abutment or fulcrum of masonry at each shore or termination of the bridge.

T, basement of the road, composed of rods connected, as shown on a larger scale in Fig. 8.

U, wrought-iron framework, placed on and fixed to the basis, as seen on a larger scale in Fig. 7, and to which, and to the basis, the suspending rods are attached by any ordinary mode, or as shown in Figs. 9 and 10.

V, the convex cast-iron plates laid on the wrought-iron framework, and attached to each other; but, if thought necessary, not to the framework, to allow for the difference of expansion between cast and wrought-iron.

W, in Fig. 7, shows the same plates on a larger scale, and laid down across the road, so as under a pressure always to abut against each other, and not against the sides of the road.

Fig. 4, elevation of part of the centre of the bridge on an enlarged scale, showing the suspending rods as jointed; the railing or parapet, &c.

This parapet railing is so contrived, chiefly by means of the hollow pyramidal pillars, Z, Z, as to admit of the expansion of the wrought-iron frame and cast-iron parapet, independently of each other. Thus the parapet railing is attached to a strong cast-iron plinth or blocking course (see Fig. 6), which is cast to fit the outer rib of the frame, without being screwed to it, but with projections which pass under, or catch on the small cross ribs, so as to prevent the possibility of overturning.

The hollow pillars are firmly fixed by screws, and each has a vertical opening, equal to that of a vertical section of the parapet. In these openings, as in mortices, the ends of each length or division of the parapet are inserted as tenons without being fixed; and of course the wrought-iron framework may thus expand by heat, or be deranged by a strain, with no other effect than drawing the parapet a few lines out of the mortice, or the cast-iron parapet may expand, inserting itself a few lines further, &c. as the case may be, without the slightest injury to the fabric. Fig. 16 is a horizontal section of one of the pyramidal pillars, with the ends of the parapet railing so inserted.

Fig. 5, enlarged surface plan, or vertical profile of the road, in which Z, Z, are the pyramidal pillars X, X, single iron rods for the protection of the footpath, and the cast-iron blocking-course, or abutment, &c. to the parapet.

Fig. 6, enlarged section. (See Fig. 5.)

Fig. 7, enlarged view of one of the wrought-iron frames composing the road.

W, convex plates laid on ditto. (See descriptions of Figs. 1, 2, and 3.) If it is desired to form the road of timber, then only the outer part of this frame is to be used, and all the rest framed and covered with fir or oak planking, &c.

Figs. 8, 9, and 10, enlarged view of the rods forming the basis of the road.

Y, (in Fig. 8,) the plate to which the cross ribs of the frame, Fig. 7, are attached as at Fig. 9.

Z, screw boxes of a particular construction, to tighten the rods in the first erection, and afterwards if required.

Fig. 11, diagram to show the distribution of the weight and strain on one half of the road or bridge.

By (dynamics, or) a well-known law in mechanics,* if the road were suspended from a catenarian arch (the tangent of a curve giving the direction of the motion, &c.), and its total weight between the fulcrums represented by the line A, D, B, the total strain on each fulcrum will be as the side of the parallelogram A, C, or nearly 2⅓ the weight of the road.

By the same law, if in the small parallelograms 1, 2, 3, &c. to 13, the short side represent the weight of that portion of the bridge destined to be supported by each rod, the long side of the parallelogram will represent the strain on the fulcrum from which the rod is suspended, and the diagonal line the strain on the abutment, or, in this case, the drawing power in the line of the road.

The circumstance of the suspending rods being delineated as straight lines in these figures, instead of being represented in the catenarian, or other nondescript curves which they will assume in nature, is of little practical consequence, as the tangents to such curves, would on the whole indicate rather less strain than is here given.

Fig. 12, a diagram to show the ratio of the increase of strain on the different rods as it increases from the fulcrums towards the centre of the bridge and the abutments, the use of which is to give the exact diameters of the rods at all the different points of suspension.

e, *e*, the ratio of the suspending rods. *f*, *f*, the ratio of the longitudinal basement rods under the road. *g*, *g*, the ratio of strain on the diagonal rods *z*, *z*, in Fig. 8, owing to the divergency of the rods towards the fulcrums. This ratio of strain is found from Figs. 14 and 15. *h*, *h*, ratio of the increase of strain on the cross rods of Fig. 8, from the same cause. (See Figs. 14 and 15, &c. on a larger scale.)

Fig. 13, Supposing the road to be formed of timber laid on iron rods, instead of cast-iron, &c. in that case this represents a mode which might be advantageously adopted in the centre of the middle opening, as saving suspending rods, and tending to lessen resiliency.

Figs. 14 and 15. (See Fig. 12, *h*, *h*.)

Fig. 16, cast-iron plate, three feet by 20, as a basis to the road in Fig. 17.

Fig. 17, a design preferable to Fig. 1, but constructed on the supposition that the data are altered, and permission given to rest one pier in the middle of the river, and to remove the other two, each 50 or 100 feet towards the shores. At the spot where the bridge would pass, the bed of the river might be widened,

* Young's Nat. Phil. sec. II.—Robison's Elements of Mechanical Philosophy, part I.

if deemed requisite for the more commodious passage of vessels. It is questioned, however, whether one pier in the centre would produce any practical inconvenience, especially if the two side piers were removed 50 or 100 feet towards the shores.

In this design the central fulcrum, which may be formed of masonry or cast-iron, is 95 feet, and the two others each 85 feet in height, above high water-mark; and those on shore are formed rather higher than in Fig. 1, because, in order to preserve the requisite height for masted vessels, this plan requires that the upper surface of the road should be about 25 feet higher than in the design, Fig. 1.

Over these fulcrums an iron web of chain-work, or any number of lengths of jointed rods (say 30), are to be laid, and stretched so that the catenarian segment may not depend more from the chord line than 25 feet in the two larger openings, and proportionally in the lesser. This will leave 65 feet clear through the whole extent of the two large openings of 600 feet each, besides from 80 to 90 feet in the angles close under the fulcrums; thus affording ample room for the passage of vessels.

The ends of these 30 rods may be inflected over the abutment fulcrum, and fastened to the rock, as in Fig. 1; and the strain on these fulcrums may be lessened by rods similar to C, C, in that figure.

A basis is now secured on which to place the road; but as it would be extremely incommodious to ascend and descend with the line of segments, in order to avoid this, and have the road on the line of chords, let it be raised so as to form one continued inclined plane from the shore to the summit of the central fulcrum. For this purpose the rods in each segment may be connected crosswise at the distance of (say) 20 feet by a plate and slender columns (say 11), raised from each plate, of a sufficient height to support the road on the chord lines of the arcs, or in any one plane. This road may either be constructed as in Figs. 1 and 8; or better, by simply fixing such plates, as Fig. 16, to the plates or beams which connect the tops of the columns. A railing, clay, gravel, &c. as in Fig. 1, may be added, &c. &c.

The advantages this construction would have over a road suspended from an arch or arches of rods or chains, are,

1. That a greater number of rods may be used, and consequently a greater degree of strength acquired.*

2. That the whole of this strength can be equally brought

* Since writing the above, I have seen at Mr. Brown's Chain Cable Manufactory, Isle of Dogs, a model in which a road is *suspended* from an inverted catenarian arch by 16 chains, placed in fours over one another. This is evidently much more secure, and suitable for alteration, renewal, or repair, than trusting to four chains of equal strength with these 16, and may serve to direct the reader's attention to the comparative advantage of my design.

into use, the load being regularly and equably placed on the rods, so that each bears no more than its due proportion.

3. That less altitude is required for the fulcrums.

If it be asked why this construction would not suit a span of 1000 feet, it is answered, that it would require the two fulcrums to be nearly 130 feet above high water-mark; and that as the road must pass over the tops of these fulcrums, and should not any where be steeper than 1 in 12,* it would require a mound or inclined plane of 1000 feet on each shore; thus doubling the length of the bridge, as it would be either by Figs. 1 and 17. Were it not for this objection, three openings, arranged in the style of Fig. 17, may, without hesitation, be affirmed preferable to Fig 1.†

Fig. 18, diagram to show the ratio of strain in the fulcrum, according to the depth of the catenarian segment. Thus, when it depends 50 feet from a chord line of 1000, the strain is as the horizontal line at 50, or about 2¼ times its weight on each fulcrum; where 100, as at the line 100; where 150, as at the line 150, &c.

Estimate.

The dimensions and calculations on which the following estimate is founded were taken from the sketch herewith sent, which is on too small a scale to admit of perfect exactitude. All fractional parts have, therefore, been omitted, though they are so amply allowed for in the totals, that the gross amount of *metal* may be considered as exceeding, rather than falling short, of what the castings would actually weigh.

Cast-iron Fulcrums.

It may be premised that the whole of these fulcrums, excepting the ridge piece, are proposed to be cast *riddled*, or covered with circular holes or blanks, equal in contents to, from one-third to one-half the solid contents of the figures. The advantage of this mode is, that sufficient strength is obtained, with a saving of from one-third to one-half of metal:

Cast-iron fulcrums 808 tons, at 10*l.* per ton..........	£8080
Labour in fixing at 1000 per fulcrum..................	2000
Suspending rods, 2080 cwt. at 50*s.*	5160

* Smeaton.

† A design on this principle would be suitable for crossing the Forth at the Queen's Ferry; and if any of your Scotch readers will favour me with a section of that part of the river, I will send you a design *raisonée*, and an approximation to the cost of such a work. If an idea shall ever be entertained of constructing a bridge across the Irish Channel, this design (Fig. 17), or something very near it, will be resorted to.

Road.

50 prepared frames of wrought-iron (Fig. 7), each weighing 50 cwt. at 75*l.* per frame, for 50 frames, is	3750
750 tons of cast-iron plate (W, Fig. 7), at 9*l.* per ton	6750
4100 feet of cast-iron railing, and basis, weighing one cwt. per foot, 410 tons at 10*l.*	4100
Fitting the whole together	500
400 tons of gravel, clay, and chalk, and laying down, &c. over the cast-iron	400

Miscellaneous.

Excavating to the rock, and preparing it for the cast-iron fulcrums, fender, piles, &c.	1000
Excavating (at R) to fix the rods, C, C	100
The two fulcrums or abutments, S S	650
The two lodges, earth-work at the ends, and all unforeseen expenses	4551
	40000

If the road is formed of timber, this estimate may safely be reduced to 30,000*l.*

Remarks.

The novelty of this bridge seems to require that some *rationale* should be given of its construction, and sufficiency to answer the proposed ends. This may either be done *experimentally*, *algebraically*, or *geometrically*. Experiments in matters of this sort are of little use, unless made on a scale nearly as large as the erection itself; and therefore, excepting for some particular purposes, they have not been attempted. The algebraic calculus, though much the most convenient and accurate method is not generally understood. The geometrical mode, therefore, of exhibiting the composition and the resolution of forces by lines, and the relation of the forces ascertained by a scale, has been adopted in the following remarks, as easy of comprehension, and in respect to practice as equally satisfactory to the mathematician with either of the other modes.

I. *On the Strength of the suspending Rods, and those forming the Basis of the Road.*

The total weight of the road and rods is as follows, viz.:

	Tons.
Suspending rods, and rods forming the basis of the road ..	109
Wrought-iron frames	125
Cast-iron convex covering plates	750
Cast-iron parapet railing and plinth	410
Clay, gravel, and chalk	400
	1794
(or say)	1800

Now as there are 100 suspending rods, this will give 18 tons of weight to each rod. Supposing the greatest load that can possibly come on the road to be 100 six horse waggons weighing 12 tons each, this will give an additional 12 tons to each rod; thus 12 and 18 = 30 tons may, therefore, be considered as all the *weight* which such rods can possibly, or in all probability, become liable to sustain; but which weight, as will presently appear, is totally independent of the strain produced by position.

As it has been ascertained* from experiment that an iron bar will sustain, without injury or derangement to its particles, half the weight which will tear it asunder, we may conclude that a rod requiring 70 tons to break it will be sufficient for No. 1, in Fig. 11, the lowest situation, being that where there is little or nothing more than the perpendicular weight to be sustained.

But on the rods 13, supposing the short sides or ends of the parallelograms to indicate 30 tons, the long side will indicate 100. This, therefore, will demand a rod which would require 220 tons to break it.

Taking as a standard that it requires 28 tons to break a rod of one inch diameter,† then a round rod that will require 70 tons to break it must be $1\frac{58}{100}$ diameter, and one not to break under 220 tons must be $2\frac{83}{100}$ diameter. An average so as to calculate their total weight is thus easily obtained. The strain on the basis chains of that part of the road between the fulcrums accumulates from one towards 13, and balances itself at 13; that is, the strain from 1 at the one fulcrum to 13 at the centre, is counterpoised by the strains from 1 at the other fulcrum to 13 in the centre. The total amount of this strain (by measurement), the bridge being fully loaded, is 660 tons to each bundle of 26 rods. Supposing this strain to be resisted by the two longitudinal rods of the basis at 13 in the centre, they would require to be of $4\frac{85}{100}$ diameter in that part. To render this unnecessary, advantage is taken of the wrought-iron sides of the frames Fig. 7, which, being all closely and strongly screwed together, and to the basis of rods, are pulled lengthwise with the rods, and sustain part of their strain. As they are at an average six inches deep by half an inch in thickness, it seems needless attempting to prove their adequacy for this purpose.

Half the same amount of strain would have to be provided for at each pier or abutment, were it not thrown off among the rods, *c, c*. Thus, by being divided among 20 rods, *c, c*, and the two basement rods, D, D, at each abutment, it is easily overcome. Did it all centre in the longitudinal basement rods, D, D, they would require to be of $4\frac{85}{100}$ in diameter; and the difficulty of fixing them, keeping them fixed, and repairing them when tney become deranged, would be inconceivably great.

* By Brunton, Middleton, and Co. and various others.

† Dr. Thomson's *Annals*.

It is the characteristic of this design so to subdivide every strain and weight, as to render them easily subordinate to human power, whether in erecting, adjustment, repair, or renewal.

II. *As to the Stability of the Fulcrums.*

The lofty and seemingly lightly constructed fulcrums, as seen in the elevation, appear to be the most vulnerable parts of this design; but on turning the eye to the vertical profile of these fulcrums at A, Fig. 2, and its end profile, Fig. 3, it is observed to be in effect an immense wedge, with its head, or greater end, inserted in the bed of the river, and having the rods distributed over its apex or edge.

The use of these fulcrums is evidently twofold: to support the mere weight and gravity of the road and rods, and to sustain whatever strains they may be subjected to, by the vibratory motion of the road, when very heavy carriages are passing over it.

In regard to its fitness for supporting the mere weight or gravity: half the weight of the whole road and rods, supposing the former loaded to its utmost limit, will be only 1500 tons, to be supported by eight columns whose smallest diameters are 18 inches, and thickness of metal one inch (less one half: see introductory remarks to the estimate), the area of the smallest section of each column will be 27 inches. Now taking the cohesion of cast-iron at 50,000 lb. per inch,* and doubling this for its resistance to compression,† we have a power equal to the support of 2200 tons in each column, which, however, is only required to carry the eighth part of 1500 tons, *i.e.* something under 200 tons.

But a column of 180 feet in height, although its base be three feet diameter, and it be *stayed* to three-fourths of its height, may possibly be supposed liable to bulge or bend in the middle with a weight of 200 tons. There have been no experiments made on hollow cast-iron cylinders that I know of, from which to calculate the exact weight requisite for this purpose; but I may venture to assert, that in this design the braces, struts, and tie plates, are so arranged, with a view to counteracting any tendency of this sort, that the feeling of every practical mechanic will instantly tell him it can never possibly occur under so comparatively trifling a weight as 200 tons, on a column capable of sustaining 2000, and fixed in a range so braced and stayed as to be in effect a solid cast-iron wedge.

3. The strain from the vibratory motion of the road, when under the weight and impulse of heavy carriages, does not easily admit of calculation; but an attempt shall be made to show that for this strain also there is more than sufficient strength.

As the road does not *rest on, or touch, any part of the fulcrums,*

* Dr. Young's Lect. XIII.; and Rees's Cyclopedia, Art. Str. of Mat.
† Robison, in third edit. of Encycl. Brit. Art. Str. of Mat.

but is merely suspended from their apex or ridge-piece, and as all the rods lie loose in grooves in the ridge-piece (see Fig. 3), it follows that any resilience or vibratory motion of the road could only affect the fulcrum by the friction of the rods (formed of roller links in that part) in sliding a few feet in the groove, when a heavy weight (say 24 tons) passed along the bridge. This sliding or motion supposed to take place in these grooves could only take place in consequence of such immense weight being in motion on the road, and would by no means be a general thing. It would operate by rubbing on the cylinder in a downward direction on the side in which the weight was operating, and in an upward direction on the opposite side. As the form of the ridge-piece is a semicylinder, these motions would be equal on each side, and would of course balance each other. Thus balanced, they may be considered as resolved into a perpendicular pressure; and taking the friction of metal on metal (ungreased) at a quarter the pressure,* its amount is not worth taking into calculation. It may be observed that, by the mode in which the rods are distributed over the fulcrums, the weight of no one part, including its strain and friction, operates on any single point or column of the fulcrum, but always on two separate and distant columns. Thus suppose two waggons, or a weight of 25 tons, entering on the bridge at either abutment, it would first bring the rods 13, 13, (see profile) into a state of tension, then 12,12, and so on. When it arrived under the first fulcrum, its weight would still be on two columns. When in the centre, it would be equally divided between both fulcrums, and the strain between both abutments; and as it proceeded from the centre to the shore, every effect it produced on the rods would resolve itself into a perpendicular pressure on two distant parts of the fulcrum, and a strain on two parts of the rock. The whole of this operation is widely different from the effect of a weight on a road in part suspended by an inverted arch, and in part resting on its fulcrums; where a continual action and reaction on one, or on two points, must tend in some degree to diminish the stability and safety of the fabric.

III. *As to the Resistance to Resiliency, or undulating Motion.*

In all the chain and rope bridges which have hitherto been erected (at least as far as I can learn), this motion has occasioned a prejudice against them, both on account of its incommodiousness, and the injurious effects of the friction produced on the edifice.†

There are only two ways in which this motion is to be resisted: by the ponderosity of the materials, or by construction. The first is a clumsy method, not likely to answer all the ends in

* Dr. Young, Lect. XIII.

† Sir Howard Douglas on Military Bridges.

view so well as the second, which is that attempted in the design submitted.

The first part of the construction calculated to resist resiliency is the entire suspension of the road from one shore to the other. Did it rest on a solid body of cast-iron or masonry at the fulcrums, instead of being suspended from them, that part of the road being fixed would become a point of resistance to reflect back the impulse propagated horizontally by a heavy body moving from the fulcrums along the road in either direction, and would thus (in a lightly constructed and highly loaded road at least) occasion, first a springing or undulatory motion, and then, not having exhausted itself, a degree of lateral resiliency. But by the road in this design being every where suspended, it nowhere affords points of resistance; whatever motion is generated never can increase, because it meets with no interruption; it will, therefore, expend itself in gentle pulsations lengthwise.

Lateral resiliency is occasioned by an interrupted longitudinal motion. As above hinted, it can hardly take place in this road; but if it should, the divergency of the suspending rods will oppose a salutary counteraction.

IV. *As to the Mode of Execution.*

A few hints shall be submitted under this head, lest some should imagine this design more difficult of carrying into effect than an inverted arch.

The fulcrums, being previously fitted together where cast, may be erected with scarcely any other scaffolding than what they themselves afford. Triangles may be screwed to the columns, and the separate pieces hoisted up, and dropped in their places, &c. &c. The rods forming the basis of the road are to be elevated, and fixed in their situation, by the following arrangement:

Form a catenarian arch of six or eight common chains, and let it be stretched from shore to shore over the tops of the fulcrums, but having pulleys, with ends of ropes over them, fixed every 40 feet asunder. Raise this arch so as to be a few yards higher than the situation of the road. This being done, and the basis chains all attached, and in order, place that length of basis belonging to the centre opening of the bridge on a platform of boats directly under the suspended arch: then let 26 or 52 men seize the ropes dependent from the chains, and hoist up the basis rods to their situation. One or two men may then mount by the fulcrums, and belay or fasten the ropes. The basis rods of the two sides are to be raised in like manner; and, when elevated, joined under the fulcrums.

The permanent suspending rods are now to be laid over the fulcrums, and to be attached (beginning at the fulcrums) to the basement rods, fixing with them the outside plates of the wrought-iron frames, as shown at Fig. 9. This must of course be done so as what is on one side of a fulcrum may always be balanced by what is on the other. Where the road has been hoisted too high, it can always be lowered a little; but at all events the length of the suspending rods is supposed to be so adjusted beforehand as that, when left to themselves, they will retain the road in its proper place, without requiring any alteration.

The suspending arch of chains may now be removed, and the remainder of the bridge filled in at pleasure.

I make no mention of machines to be made use of for drawing the rods into place, hoisting the plates, &c. nor of various other details, perfectly known to practical men, and which always occur to the mind with the occasion of using them.

V. *As to the comparative Merits of this Design with that of a Road suspended from a catenarian Arch.*

1. The first advantage of the design submitted is, that it requires much less weight and strain in proportion to the weight of the road to be supported. The weight of the centre part of the road, 1000 feet in length, is 900 tons. With the strain taken by measurement of Fig. 11, it amounts only to 1320 tons, or a strain of 660 tons on each fulcrum.

Supposing the road weighing 900 tons, to be supported by a catenarian arch, of which 13, 13, should be tangents; that is, by an arch or segment which should depend from the chord line about 70 feet: then (by admeasurement of A, C, Fig. 11, A, D, B, representing 900 tons,) the total strain on the fulcrums would be 3960 tons, or 1980 tons on each fulcrum, *instead of* 660, *according to my design.*

The great difference in the amount of strain between these two modes arises from this, that in the arch every separate strain is communicated to the fulcrum, through the same oblique lever, or curve of the arch, as is the centre strain; whereas in the design submitted every separate strain is communicated in direct lines to the fulcrum, and the nearer the fulcrum such strains approach, the more acute is the angle formed with the fulcrum by the line through which their influence is communicated, and of course that influence is proportionally diminished.

Hence it appears that the strain on the rods of an inverted arch, however much it may depend from the chord line, will ever be much greater than by the construction submitted, and as near as possible in the above ratio of one to three.

For in Fig. 18, where the strain on an inverted arch is shown at three different depths of segment, viz. at 50, 100, and 150, from the chord line, the line under the figures shows the strain by the construction submitted (Fig. 1), which in all the three cases amounts to about one-third of the other. When it is considered that in an inverted arch this strain must be borne by four, eight, or 16 rods; while in the construction submitted it is borne by 50, the advantage of the latter must be further obvious.

2. To support this comparatively greater strain of the catenarian arch, a proportionally stronger fulcrum is required; and if it is attempted to lighten the strain by raising the fulcrum to a considerable height, it must evidently be attended with very considerable danger from the vibratory motion of such an enormous weight on a high tower, however strong. At all events it must be attended with a greater risk of danger than in the use of the sort of fulcrums in the design submitted, where the strain is communicated in separate portions, and is easily subjected to calculation.

3. Resiliency, or undulatory motion, is much more certain of taking place in a road suspended from a catenarian arch, than it is in the case of a road suspended agreeably to the construction submitted. Every inverted catenarian arch, however loaded, must be liable to have its equilibrium disturbed by a certain increase of weight in any one part. The point where the weight is applied will sink, and those adjoining will rise, and so will every part of the road, as the load passes along successively, and thus an undulating motion is produced. This motion proceeds to the pier on which the road rests; it there meets with resistance, increasing the undulation, and producing lateral resiliency, and this, reacting on the moving weight, redoubles its effects. In this way a motion disagreeable to passengers, and dangerous to the fabric, is unavoidably generated. The only question is, whether it will be produced by a small or moderate weight on a ponderous and extensive arch, and to this question it is not easy to give a satisfactory reply. Much will depend on the roughness of the road, and the rapidity and impetus of the moving body. There cannot be much doubt that this sort of motion would not so readily take place in the design submitted, because then every weight as it passes along pulls (so to speak) directly to a fixed point.

These discussions apply to every description of catenarian arch in which the rods or chains are placed over the road, but do not affect such as Fig. 17, where they are all placed under the road. In this case any number of rods may be adopted; and from there being no high tower, there can be no danger from vibration.

Compared with the construction now submitted, there are other disadvantages attending a road *suspended from a catenarian arch,* such as inequality of strain and pressure, difficulty of attaching the rods at the abutments, &c.: but these and other objections may be considered as local and peculiar; while those above enumerated apply to every possible mode of suspending a road *from* an arch.

Article V.

An Analysis of the Salts prepared by Mr. Henry Thompson from the Cheltenham Waters. By Richard Phillips, F.L.S. and M. Geol. Soc.

The various saline compounds procured from the waters of Cheltenham are introduced to public notice with such high pretensions to peculiar and superior qualities, that the investigation of their nature cannot fail to be useful; for if it should be proved that the encomiums bestowed by Mr. Thompson upon the excellence of his preparations are justly merited, it must be advantageous to be enabled to imitate, when it may be impossible to procure them.

In order to effect this examination, I procured some of the salt which is described as "crystals of real Cheltenham salts, made from the waters of Mr. Henry Thompson's Montpelier Spa at Cheltenham." These salts are asserted "to contain all the native chalybeate and other properties for which the waters at Cheltenham are so universally esteemed," &c. &c. To this Mr. Thompson adds, that "it is the opinion of physicians that neither the alkaline foundation [base], nor the chalybeate nature in Mr. Thompson's Cheltenham's salts, can be equalled by those artificial compounds in the spurious Cheltenham salts that are made in imitation of them." The crystalline form of this salt is sufficient to convince any one who has the slightest knowledge of the subject, that it is chiefly sulphate of soda, or common Glauber's salt.

It is, however, well known that some salts during crystallization take up other substances which are foreign to their nature, without producing any remarkable alteration in their appearance.

In order to ascertain whether any such event had occurred to this salt, and especially whether it contained carbonate of soda, of which the waters hold a small quantity in solution, I dissolved 120 grains in distilled water; and having put a piece of turmeric paper into the solution, I found that after some time it was distinctly reddened, indicating the presence of an alkali.

To determine the quantity of the carbonate of soda, I added to the solution dilute sulphuric acid of known strength, and I found that when $\frac{1}{40}$th of a grain of sulphuric acid had been used litmus paper was reddened by the solution: therefore a quarter of an ounce of the salt in question, which is the quantity mentioned by Mr. Thompson as a dose, contains scarcely $\frac{1}{40}$th of a grain of dry carbonate of soda.

I then dissolved another portion of the salt, to try whether, as is asserted by Mr. Thompson, it contains any chalybeate impregnation: but the addition of tincture of galls did not produce the slightest indication of the presence of oxide of iron, although it is capable of detecting less than the 10000th part of a grain of the oxide.

The result of this experiment was not unexpected; for it could scarcely be supposed that the salt should contain oxide of iron even in a state of mixture, and much less in that of combination; for carbonate of iron is readily decomposed by ebullition, and the oxide of iron is precipitated, before the salt can be crystallized.

I next examined whether this Glauber's salt is mixed with common salt, as is usually the case. To 100 grains dissolved in distilled water some nitric acid was added, and afterwards solution of nitrate of silver, until no further precipitation ensued; the precipitated horn silver weighed, after fusion, three grains, indicating about 1·3 gr. of common salt; whereas an equal portion of the common Glauber's salt of the shops, when similarly treated, yielded such a quantity of precipitate as showed that it contained only $\frac{1}{30}$th part as much common salt.

From these statements, it is evident that the "real Cheltenham salts" contain no "chalybeate property;" that they are merely sulphate of soda, or Glauber's salt, mixed with a minute quantity of carbonate of soda, productive of no good effect, and a small portion of common salt, incapable of a bad one.

The next saline preparation is described by Mr. Thompson as the "efflorescence of real alkaline Cheltenham salts," &c. Of this it is requisite merely to state, that it is the preceding Glauber's salt deprived of its water of crystallization; and that it contains no chalybeate property whatever, as asserted by the proprietor.

Among other merits which Mr. Thompson ascribes to the salts I have just noticed is this, that "the aperient and tonic qualities are nicely proportioned by nature." Now if by "tonic qualities" be meant "chalybeate nature," I have shown that they are totally destitute of it; and if it be meant that the sulphate of soda resembles what is usually produced, no one will disturb its claim to the distinction: but with the next described compound the case is different; and although it is asserted to be from nature, neither nature nor art has ever produced it. This salt is termed by Mr. Thompson the "efflorescence of real magnesian Cheltenham salts made from the waters of the Chalybeate Magnesian Spa;" and it is asserted to be "a subsulphate from nature which combines both a pure and a subsulphated magnesia in its composition."

Although this salt must be deprived of the encomium bestowed upon it, yet supposing that it might possess some claim to attention, it was submitted to examination.

Five hundred grains of this preparation were put into distilled water, and boiled; the whole was dissolved, excepting 0·3 of a grain; this insoluble portion was white, and probably magnesia, or its carbonate. I did not determine which, because the dose in which it is exhibited scarcely amounts to $\frac{1}{10}$th of a grain.

This salt loses 44 per cent. by being heated; and the remaining 56 parts consist principally of Epsom salt mixed with about $\frac{1}{15}$th part of a grain of magnesia, or its carbonate, and a small portion of muriate of magnesia, or of common salt; I have not examined, nor does it matter, which.

The last preparation to be noticed is called by Mr. Thompson "Murio-sulphate of magnesia and iron." Of the existence of any compound to which this name is applicable, I am as ignorant as of the subsulphate of magnesia asserted to exist in the last-described salt; nor is it indeed clear what is intended to be conveyed by this appellation; it may mean either a binary compound of muriate of magnesia and sulphate of iron; or a quaternary one ot muriatic acid, sulphuric acid, magnesia, and iron; but the salt in question is neither of them.

One hundred grains heated to redness lost 37·5 gr. A similar quantity put into water left 0·1 of a grain undissolved, which was evidently peroxide of iron. Tincture of galls added to the solution did not give any evidence of its containing oxide of iron; and from two separate solutions of 100 grains of the salt I obtained, by nitrate of barytes, 121 grains of sulphate of barytes; and by nitrate of silver, 3·3 grains of horn silver. Now these quantities of sulphate of barytes and of horn silver indicate about 61 of sulphate of magnesia and 1·4 of muriate of magnesia.

This salt, then, described by Mr. Thompson as "murio-sulphate of magnesia and iron," consists of about

Peroxide of iron	0·1 gr.
Sulphate of magnesia	61·
Muriate of magnesia	1·4
Water	37·5
	100·0

In plain English, this salt consists of Epsom salt deprived of part of its water of crystallization, discoloured by a little rust of iron, and liable to become rather damp by exposure to the air, on account of the deliquescence of the muriate of magnesia which it contains.

It has been justly observed of these preparations "that not one of them is similar to the water which is drank at the Spa." In order to obviate this difficulty, Mr. Thompson prepared the "original combined Cheltenham salts," by evaporating the waters to dryness. I shall presently state my reasons for believing that this process cannot remedy the defect described; and in corroboration of my opinion I may remark, that Mr. Thompson has allowed that "the medical gentlemen who gave it a trial [the original combined Cheltenham salt] did not make a favourable report of it." It is presumed that the tonic effect of the waters depends upon the oxide of iron which they contain; and there can be no doubt that its power would be extremely lessened, if not totally destroyed, by boiling the saline and chalybeate contents of the water to dryness; for it is well known that the protoxide of iron which exists in the waters, would be converted into peroxide by the operation; and whenever peroxide of iron is exhibited in a solid form, several times as much of it are required to produce an equal effect as a given quantity of the protoxide of iron in solution: it is, therefore, evidently improper to convert any part of the small quantity of protoxide of iron which these waters contain into peroxide, because the diminished power of the oxide of iron cannot be compensated without greatly increasing the purgative effect; and by this also the resemblance between the salts and the waters from which they are produced is destroyed.

I have already stated Mr. Thompson's opinion of what he terms the artificial and spurious Cheltenham salts: I have never examined any of these preparations; but I have no hesitation in asserting that, by proper management, such a combination of purgative and chalybeate salts may be effected as would be much more efficacious, and more nearly resemble the Cheltenham waters, than any compound that can be obtained by evaporating these waters to dryness.

Article VI.

A new Quadratic Theorem: an improved Method of extracting the Square Root from Trinomials, Quadrinomials, Pentanomials, and Hexanomials. By Joseph Reade, M.D.

SIR,

Should the following method of extracting the square root from compound quantities meet your approval, you will please to insert it in your Journal. That the mathematical reader may the better be enabled to estimate the advantages of this theorem, I shall work an example, first according to the method at present in use, and, secondly, I shall work the same sum according to my own method, that a comparison may be made. In this paper I shall confine myself to the extraction of the square root, as much more necessary and useful than the cube, biquadratic, or higher powers.

Rule at present in Use.

1. Range the quantity according to the dimensions of some letter, and set the root of the first term in the quotient.

2. Subtract the square of the root then found from the first

term, and bring down the two next terms to the remainder for a dividend.

3. Divide the dividend by double the root, and set the result both in the quotient and divisor.

4. Multiply the divisor thus increased by the sum last put in the quotient, and subtract the product from the dividend, and so on as in common arithmetic.

According to this rule, let us now extract the square root from the compound quantity:

$$\begin{array}{l} 4a^4+12a^3x+13a^2x^2+6ax^3+x^4(2a^2+3ax+x^2 \text{ sq. root} \\ 4a^4 \\ \hline 4a^2+3ax)\,12a^3x+13a^2x^2 \\ \qquad\qquad 12a^3x+\ \ 9a^2x^2 \\ \hline 4a^2+6ax+x^2)\,4a^2x^2+6ax^3+x^4 \\ \qquad\qquad\qquad 4a^2x^2+6ax^3+x^4 \\ \hline \qquad\qquad\qquad\quad 0 \quad 0 \quad 0 \end{array}$$

Let us now work this sum according to the improved theorem, and mark the difference:

Rule.

1. Arrange the compound quantity according to the dimensions of some letter, and set the root of the first term in the quotient underneath.

2. Multiply the root by 2, and divide the second term by the product, placing the quotient under the second term.

3. Multiply the last quotient by 2, and divide the third term by the product, placing the quotient under the third term.

4. Square the last quotient, and by the product divide the last term; if nothing remain, the square number is measured by the square root thus found. Like signs give +, unlike signs −.

This rule answers for quadrinomials, pentanomials, and hexanomials; for by cutting off the mediate terms, as may appear from the following examples, pentanomials and hexanomials are reduced to quadrinomials. In trinomials the second or last term must be squared. According to this rule, extract the square root from

$$\begin{array}{ll|l|l} 4a^4 + 12a^3x & & +\ 13a^2x^2 & +\ 6ax^3 + x^4 \\ 2a^2 + \ \ 3ax & & & + \qquad x^2 + 0 \text{ square root.} \end{array}$$

Here the root of the first term $4a^4$ is $2a^2$, which we place in the quotient under the first term: secondly, we multiply this root by 2, giving for a product $+ 4a^2$, by which we divide the second term $+ 12a^3x$. The quotient $+ 3ax$ is placed under the second term. We now pass over the mediate term $+ 13a^2x^2$

placed within crotchets: and, thirdly, we multiply the last quotient $+ 3\,a\,x$ by 2; the product is $+ 6\,a\,x$, by which we divide the third term $+ 6\,a\,x^3$; the quotient $+ x^2$ is placed under the third term: fourthly, we square $+ x^2 = + x^4$, by which we divide $+ x^4$; nothing remains; therefore the quantity is truly measured by the square root $2\,a^2 + 3\,a\,x + x^2$. Mathematicians must at once see the many advantages this simple theorem has over the complex one at present in use, especially where the higher geometry is connected with algebra. We remark that by the old method we are obliged, as in the foregoing example, to employ six lines, or 24 terms; in the other only two lines, or eight terms; the saving in time and calculation is, therefore, immense; for in fact we change compound into simple division.

Let us now work a few sums according to this method, beginning with a trinomial. Extract the square root from

$$\begin{array}{llll} a^4 & - 4\,a^2 & x^2 & + 4\,x^4 \\ a^2 & - 2 & x^2 & + 0 \text{ square root.} \end{array}$$

Here the root of the first term a^4 is a^2, which we place in the quotient: secondly, we multiply this root by 2, giving for a product $+ 2\,a^2$, by which we divide the second term $- 4\,a^2\,x^2$; the quotient is $- 2\,x^2$, which we place under the second term: thirdly, as this sum is a trinomial, we square the last quotient $- 2\,x^2$, giving $+ 4\,x^4$, which, subtracted from $4\,x^4$, leaves nothing; therefore the square root is $a^2 - 2\,x^2 + 0$.

Extract the square root from the following quadrinomial:

$$\begin{array}{lllll} a^4 & - 4\,a^3\,b & + 8\,a\,b^3 & + 4\,b^4 & \\ a^2 & - 2\,a\,b & - 2\,b^2 & - 0 & \text{square root.} \end{array}$$

Here the root of the first term a^4 is a^2, which we place in the quotient: secondly, we multiply this root by 2, giving for a product $2\,a^2$, by which we divide the second term $- 4\,a^3\,b$; the quotient is $- 2\,a\,b$, which we place under the second term: thirdly, $- 2\,a\,b \times 2 = - 4\,a\,b$ and $+ 8\,a\,b^3 \div - 4\,a\,b$ gives $- 2\,b^2$ for the third term. Lastly, $- 2\,b^2 \times - 2\,b^2 = + 4\,b^4$, which subtracted from the last term leaves nothing. Therefore the square root is $a^2 - 2\,a\,b - 2\,b^2 - 0$.

This last example is taken from the Philosophy of Arithmetic, an elementary work of considerable merit, by Mr. John Walker, late Fellow of Trinity College, Dublin.

Extract the square root of the following pentanomial:

$$\begin{array}{l|l|l} a^4 + 4\,a^3\,x & + 6\,a^2\,x^2 & + 4\,a\,x^3 + x^4 \\ a^2 + 2\,a\,x & & + \quad x^2 + 0 \text{ square root.} \end{array}$$

Extract the square root from the following hexanomial:

$$\begin{array}{l|l|l} a^2 - 6\,n\,a & + 2\,z\,a + 9\,n\,n & - 6\,n\,z + z\,z \\ a - 3\,n & & + z \quad + 0 \text{ square root.} \end{array}$$

Extract the square root from the following pentanomial, and prove it by involution:

$$\begin{array}{ll|l|ll}
x^4 & - 4x^3 & + 20x^2 & - 32x & + 64 \\
x^2 & - 2x & & + 8 & + 0 \text{ square root} \\
x^2 & - 2x & & + 8 &
\end{array}$$

$$\begin{array}{llllll}
x^4 & - 2x^3 & + 8x^2 & & & \\
 & - 2x^3 & + 4x^2 & - 16x & & \\
 & & + 8x^2 & - 16x & + 64 & \\
\hline
x^4 & - 4x^3 & + 20x^2 & - 32x & + 64 &
\end{array}$$

Should the operator wish to save himself the tedious multiplications consequent to this proof by involution, he may either substitute a letter according to the binomial theory of Newton, or he may use the following more simple and concise method: Multiply the first by the last term of the square root, and double the product: secondly, square the mediate term of the root, and subtract from the mediate terms of the square quantity; if nothing remain, we may be certain the calculation is correct. Thus in this last example we multiply the first term of the root $+ x^2$ by the last term $+ 8 = + 8x^2$, which doubled $= + 16x^2$, and the mediate term $- 2x$ squared $= + 4x^2$, which added $= + 20x^2$; subtracted, leave nothing. The advantage of this method may be well illustrated by extracting the square root according to the rule at present recommended by authors, and then involving the root back again to the square quantity, when it will be found that, according to the theorem herein recommended, the evolution and involution may be performed in two lines, instead of 12, required by the other. This, independent of its simplicity and accuracy, must, I presume, recommend its adoption.

Extract the square root from

$$\begin{array}{ll|l|ll}
a^2 & + 4ax & + 4ab + 4x^2 & + 8bx & + 4b^2 \\
a & + 2x & & + 2b & + 0
\end{array}$$

Here to measure the mediate terms $+ a \times + 2b = 2ab$ and $+ 2ab$ doubled $= 4ab$, and $+ 2x$ squared $= 4x^2$, which subtracted from the mediate terms of the compound quantity leaves nothing. The square root of a pentanomial or a hexanomial never exceeds a trinomial. In a pentanomial the root is extracted from the first, second, and fourth terms: in a hexanomial, from the first, second, and fifth terms. Indeed a pentanomial is nothing more than an abbreviated hexanomial.

Extract the square root of the following hexanomial:

$$\begin{array}{ll|l|ll}
a^2 & + 4ab & - 2ax + 4b^2 & - 4bx & + x^2 \\
a & + 2b & & - x & + 0 \text{ square root.}
\end{array}$$

For the mediate terms $a\ x$ doubled $= 2\,a\,x$ and $+\ 2\,b$ squared $= 4\,b^2$, which subtracted leaves nothing,

Extract the square root of

$$\begin{array}{l|l|l} a^2 - 8\,a^2\,b & +\ 2\,a\,b^2 + 16\,a^2\,b^2 & -\ 8\,a\,b^3 + b^4 \\ a - 4\,a\,b & & +\ \ b^2 + 0 \end{array}$$

For the mediate terms $+\ a \times +\ b^2 = a\,b^2$, which doubled $= 2\,a\,b^2$, and $-\ 4\,a\,b$ squared $= 16\,a^2\,b^2$, which subtracted leave nothing.

Extract the square root of

$$\begin{array}{l|l|l} a^4 - 2\,a^3\,x & +\ 3\,a^2\,x^2 & -\ 2\,a\,x^3 + x^4 \\ a^2 - \ a\,x & & +\ \ x^2 + 0 \end{array}$$

For the mediate terms $a^2 \times x^2 = +\ a^2\,x^2$, which doubled $= 2\,a^2\,x^2$, and $-\ a\,x$ squared $= +\ a^2\,x^2$, which added $= +\ 3\,a^2\,x^2$.

Extract the square root from the following hexanomial:

$$\begin{array}{l|l|l} a^4 - 4\,a^2\,b & -\ 16\,a^2 + 4\,b^2 & +\ 32\,b + 64 \\ a^2 - 2\,b & & -\ \ 8 + 0 \end{array}$$

For the mediate terms $+\ a^2 \times -\ 8 = -\ 8\,a^2$, which doubled $= -\ 16\,a^2$, and $-\ 2\,b$ squared $= +\ 4\,b^2$.

Some mathematicians, sensible of the tediousness by evolution, have advised the extraction of the roots of the most simple terms, connecting them together by the signs + or −, as may be judged most fit, then involving this compound root to the proper power; if it be the same with the given quantity, the square root is found as in the following example: $a^2 + 2\,a\,b + 2\,a\,x + b^2 + 2\,b\,c + c^2$. According to this irregular method, like sailing without a compass, the first, fourth, and sixth terms, are supposed to give the square root; whereas in reality it is extracted from the first, second, and fifth terms, as may be seen according to the following working:

$$\begin{array}{l|l|l} a^2 + 2\,a\,b & +\ 2\,a\,c + b^2 & +\ 2\,b\,c + c^2 \\ a + \ \ b & & +\ \ c + 0 \end{array}$$

For the mediate terms $a \times c = a\,c$, which doubled $= +\ 2\,a\,c$, and b squared $= +\ b^2$.

Some may prefer the following method of working these sums. Extract the square root from

$$\begin{array}{r|l|l} & +\ a^4 & a^2 \\ +\ 2\,a^2 & -\ 2\,a^3\,b & -\ a\,b \\ \hline & +\ 3\,a^2\,b^2 & \\ \hline -\ 2\,a\,b & -\ 2\,a\,b^3 & +\ b^2 \\ +\ b^2 & +\ b^4 & 0 \end{array}$$

For the mediate terms $+ a^2 \times + b^2 = a^2 b^2$, which doubled $= 2 a^2 b^2$, and $- a b$ squared $= + a^2 b^2$, which added $= + 3 a^2 b^2$, exactly measuring the mediate quantity.

Sir, I remain your obedient servant,

JOSEPH READE, M. D.

ARTICLE VII.

Lemmas and Propositions. By Mr. J. Adams.

(To Dr. Thomson.)

SIR, *Stonehouse, Oct.* 9, 1817.

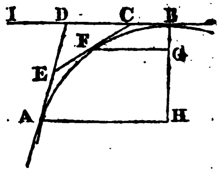
SHOULD the following lemmas and propositions merit a place in your *Annals of Philosophy*, your inserting them therein will much oblige

Your humble servant,

JAMES ADAMS.

Lemma I.

The angles made by ordinates and tangents at different points of a curve are unequal, those being less that are nearest the vertex.

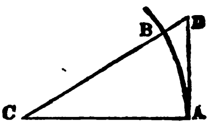


Let A F B be a curve of continued curvature; A H, F G, ordinates to the abscissa B H; and let the tangents A D, F C, to any two points, A, F, on the same side of the vertex B, intersect each other in the point E, and the tangent B I in the points D and C.

From this construction it will appear that the external angle, A D I, is greater than the internal angle, I C E; that is, the angle D A H greater than the angle C F G. Q. E. D.

Lemma II.

The arc of a *circle* is less than its corresponding tangent.



With the radius C A describe the arc A B, draw the tangent A D, and join C D.

Per mensuration $\frac{1}{2}$ C A × A D = the area of the triangle C A D, and $\frac{1}{2}$ C A × A B = area of the sector C A B; therefore, area of triangle C A D : area of sector C A B :: A D : A B. But the triangle is greater than the sector; therefore A D is greater than A B; that is, the tangent greater than the arc. (Dr. Hutton's Course of Mathematics, vol. iii. p. 39.)

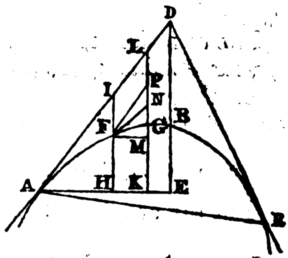
Otherwise.

By putting the radius C A $= r$, the arc A B $= a$, and tangent A D $= t$; we have from the nature of series, $t = a + \frac{a^3}{3r^2} + \frac{2a^5}{15r^4} + \frac{17a^7}{315r^6} + \&c.$

It is also apparent from the tables of natural tangents and circular arcs to radius unity.

Proposition I.

Any arc of continued curvature is less than its corresponding tangent.



Let A B be an arc of continued curvature, concave towards the ordinate A E, whose vertex is B, and let the tangent at A meet the abscissa E B in D.

Conceive the curve A B to be divided into indefinitely small portions, either equal or unequal, such as F G; through the points F G draw H I, K L, parallel to E D; and let F N be a tangent to the curve at F: also draw F P parallel to A D, and F M parallel to A E.

Now since F G is an indefinitely small part of the curve A F B, it will evidently coincide with its *osculating circle;* therefore F N will be a tangent of the *circular arc* which coincides with F G, and F N greater than F G. (Lemma II.) By construction F P is parallel to A D; therefore the angle D A E is equal to the angle P F M; but D A E is greater than N F M. (Lemma I.) Hence the angle P F M is greater than the angle N F M, and consequently F P greater than F N. It has been shown that F N is greater than F G; much more, then, is F P, or its equal I L, greater than F G.

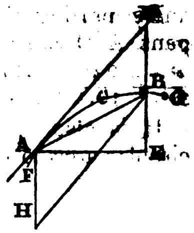
In like manner it may be proved that each of the increments of A D is greater than its corresponding arc; therefore the sum of all the increments of A D is greater than the sum of all the increments of A F B; that is, the tangent A D is greater than the arc A F B.

Corollary.

To the curve A B continued, draw the tangent D R, and join A R. We then have, according to the proposition, the tangent R D greater than the arc R B. Hence it follows that the sum of the tangents A D and R D is greater than the curve A B R.

Proposition II.

The ultimate ratio of the arc A C B, chord A B, and tangent A D, is that of equality.



Let A C B be any part of the curve F G, A B its chord, and A D a tangent at A: through the point B draw the straight line D E, and let A E be at right angles thereto. Then in the right angled triangles A E B, A E D, we have

$AD^2 - (DB + BE)^2 = AB^2 - BE^2 \therefore$
$AD^2 - AB^2 = (DB + 2BE) DB =$
$(DE + EB) DB.$

Conceive the point B to move along the curve B C A towards the point A, and let D E be always parallel to its original position; on this supposition, D B, the subtense of the angle of contact, would be continually diminished; and if the point B actually coincided with the point A, D B would vanish, and then $AD^2 - AB^2 =$ zero; therefore $\frac{AD}{AB} =$ unity, the limit of ratio of A D to A B.

But the arc A C B being always within the triangle A B D, we may therefore conclude *à fortiori* that $\frac{ACB}{AB} =$ unity. Hence the ultimate ratio of the arc, chord, and tangent, is that of equality.

Corollary.

The ordinate B H will at last be equal to the vanishing arc A C B; because if the parallelogram A H B D be completed, B H will always be equal to A D.

Article VIII.

On the various Uses of the Septaria.

(To the Editors.)

Covent Garden Chambers,
London, Dec. 6, 1817.

GENTLEMEN,

Should you deem the following remarks on the various uses of the septaria worthy of a place in your *Annals*, they are very much at your service; and I shall be glad to contribute, from time to time, towards the success of your work.

I am, Gentlemen, your very obedient servant,

Thos. Gill.

On various Uses of the Septaria.

The septaria, *ludus Helmontii*, or loam-stone, is usually found accompanying the London clay, in nodules of different forms and sizes, and is of a pale yellow colour. It is procured on the banks of the Thames at low water, in the island of Shepey, and in various other places; but the best, I believe, is found on the estate of Lord Mulgrave, near Whitby, and at a distance from the sea shore, where it has not been impregnated with the salt water. This is employed for *Roman cement*, after being calcined to an olive-brown colour, and ground to powder: it does not effloresce, as is too commonly the case with such as has been obtained from the sea shore; and if it be mixed up for use with water containing a dilute solution of sulphate of iron, it will become very considerably harder, and more durable. This, I believe, is nearly the only use it has hitherto been put to in this country; but it is capable of being employed in a variety of other ways, with very considerable advantage; and, particularly in *fine casting*, of gold, silver, or molu, &c. where it forms a most excellent *facing*, after being slightly calcined till it is of a red colour and then finely powdered; in this state it lines the moulds when it is sifted over them, and the impression of the patterns or models is again taken upon it with an exceedingly smooth coating: it never burns through by the heat of the melted metal, and gives an extraordinary degree of sharpness to the casts. Indeed, I have no doubt that by the use of it minute casts in iron may be made from cameos, &c. equally perfect with those lately brought into this country from Germany, and which are so deservedly admired. It will also be found useful in taking impressions of gems in glass, in the manner of Tassie, when used instead of *Tripoli;* which earth it also very much resembles in its property of polishing gold, silver, ivory, varnished wares, &c.; after being calcined to an olive-brown colour and levigated, and then either finely sifted, or, which is better, washed over, letting it remain suspended in the water for half a minute; when it will be found to give a beautiful black lustre to articles of gold or silver, by rubbing them with a little of it, applied upon the palm of the hand, or the smooth side of leather; and indeed it forms an excellent plate powder for domestic use.

These are only a few of the many uses the septaria has been put to; but enough, I should presume, are pointed out, to call the attention of your readers to this valuable production, and to its more extensive employment in the arts of this country.

Article IX.

On the Blow-pipe: from a Treatise on the Blow-pipe by Assessor Gahn, of Fahlun.

The substance to be submitted to the action of the blow-pipe must be placed on a piece of charcoal, or in a small spoon of platina, gold, or silver; or, according to Saussure, a plate of cyanite may sometimes be used. Charcoal from the pine is to be preferred, which should be well ignited and dried, that it may not crack. The sides, and not the ends, of the fibres must be used; otherwise the substance to be fused spreads about, and a round bead will not be formed. A small hole is to be made in the charcoal, which is best done by a slip of plate iron bent longitudinally. Into this hole the substance to be examined must be put in very small quantity; if a very intense heat is to be used, it should not exceed the size of half a peppercorn.

The metallic spoons are used when the substance to be examined is intended to be exposed to the action of heat only, and might undergo some change by immediate contact with the charcoal. When the spoon is used, the flame of the blow-pipe should be directed to that part of it which contains the substance under examination, and not be immediately applied to the substance itself. The handle of the spoon may be inserted into a piece of charcoal; and if a very intense heat is required, the bowl of the spoon may be adapted to a hole in the charcoal. Small portions may be taken up by platina forceps. Salts and volatile substances are to be heated in a glass tube closed at one end, and enlarged according to circumstances, so as to form a small matrass.

When the alteration which the substance undergoes by the mere action of heat has been observed, it will be necessary to examine what further change takes place when it is melted with various fluxes, and how far it is capable of reduction to the metallic state.

These fluxes are,

1. Microcosmic salt; a compound of phosphoric acid, soda, and ammonia.

2. Subcarbonate of soda, which must be free from all impurity, and especially from sulphuric acid, as this will be decomposed, and sulphuret of soda will be formed, which will dissolve the metals we wish to reduce, and produce a bead of coloured glass with substances that would otherwise give a colourless one.

3. Borax, which should be first freed from its water of crystallization.

These are kept powdered in small flasks; and when used a sufficient quantity may be taken up by the moistened point of a knife: the moisture causes the particles to cohere, and prevents their being blown away when placed on the charcoal. The flux must then be melted to a clear bead, and the substance to be examined placed upon it. It is then to be submitted to the action, first of the exterior, and afterwards of the interior flame, and the following circumstances to be carefully observed:

1. Whether the substance is dissolved; and, if so,
2. Whether with or without effervescence, which would be occasioned by the liberation of carbonic acid, sulphurous acid, oxygen, gaseous oxide of carbon, &c.
3. The transparency and colour of the glass while cooling.
4. The same circumstances after cooling.
5. The nature of the glass formed by the exterior flame, and
6. By the interior flame.
7. The various relations to each of the fluxes.

It must be observed that soda will not form a bead on charcoal, but with a certain degree of heat will be absorbed. When, therefore, a substance is to be fused with soda, this flux must be added in very small quantities, and a very moderate heat used at first, by which means a combination will take place, and the soda will not be absorbed. If too large a quantity of soda has been added at first, and it has consequently been absorbed, a more intense heat will cause it to return to the surface of the charcoal, and it will then enter into combination.

Some minerals combine readily with only very small portions of soda, but melt with difficulty if more be added, and are absolutely infusible with a larger quantity: and when the substance has no affinity for this flux, it is absorbed by the charcoal, and no combination ensues.

When the mineral or the soda contains sulphur or sulphuric acid, the glass acquires a deep yellow colour, which by the light of a lamp appears red, and as if produced by copper.

If the glass bead becomes opaque as it cools, so as to render the colour indistinct, it should be broken, and a part of it mixed with more of the flux, until the colour becomes more pure and distinct. To render the colour more perceptible, the bead may be either compressed before it cools, or drawn out to a thread.

When it is intended to oxidate more highly a metallic oxide contained in a vitrified compound with any of the fluxes, the glass is first heated by a strong flame, and when melted is to be gradually withdrawn from the point of the blue flame. This operation may be repeated several times, permitting the glass sometimes to cool, and using a jet of large aperture with the blow-pipe.

The *reduction* of metals is effected in the following manner: The glass bead, formed after the manner already pointed out, is to be kept in a state of fusion on the charcoal as long as it remains on the surface, and is not absorbed, that the metallic particles may collect themselves into a globule. It is then to be fused with an additional quantity of soda, which will be absorbed by the charcoal, and the spot where the absorption has taken place is to be strongly ignited by a tube with a small aperture. By continuing this ignition, the portion of metal which was not previously reduced will now be brought to a metallic state; and the process may be assisted by placing the bead in a smoky flame, so as to cover it with soot that is not easily blown off.

The greatest part of the beads which contain metals are frequently covered with a metallic splendour, which is most easily produced by a gentle, fluttering, smoky flame, when the more intense heat has ceased. With a moderate heat the metallic surface remains; and by a little practice it may generally be known whether the substance under examination contains a metal or not. But it must be observed that the glass of borax sometimes assumes externally a metallic splendour.

When the charcoal is cold, that part impregnated with the fused mass should be taken out with a knife, and ground with distilled water in a crystal, or, what is much better, an agate mortar. The soda will be dissolved; the charcoal will float, and may be poured off; and the metallic particles will remain in the water, and may be examined. In this manner most of the metals may be reduced.

Relations of the Earths and Metallic Oxides before the Blow-pipe.

I. THE EARTHS.

Barytes, when containing water, melts and spreads on the charcoal. Combined with sulphuric acid, it is converted, in the *interior* flame, into a sulphuret, and is absorbed by the charcoal, with effervescence, which continues as long as it is exposed to the action of the instrument.

Strontites. If combined with carbonic acid, and held in small thin plates with platina forceps in the *interior* flame, the carbonic acid is driven off; and on the side of the plate farthest from the lamp a red flame is seen sometimes edged with green, and scarcely perceptible but by the flame of a lamp. Sulphate of strontites is reduced in the *interior* flame to a sulphuret. Dissolve this in a drop of muriatic acid, add a drop of alcohol, and dip a small bit of stick in the solution; it will burn with a fine red flame.

Lime. The carbonate is easily rendered caustic by heat; it evolves heat on being moistened, and is afterwards infusible before the blow-pipe. The sulphate is easily reduced to sulphuret, and possesses, besides, the property of combining with fluor at a moderate heat, forming a clear glass. The fluor should be rather in excess.

Magnesia produces, like the strontites, an intense brightness in the flame of the blow-pipe. A drop of solution of cobalt being added to it, and it being then dried and strongly ignited, a faint reddish colour like flesh is produced, which, however, is scarcely visible by the light of a lamp. And magnesia may by this process be detected in compound bodies, if they do not contain much metallic matter, or a proportion of alumina exceeding the magnesia. Some inference as to the quantity of the magnesia may be drawn from the intensity of the colour produced.

All these alkaline earths, when pure, are readily fusible in combination with the fluxes into a clear, colourless glass, without effervescence; but on adding a further quantity of the earth, the glass becomes opaque.

Alumina combines more slowly with the fluxes than the preceding earths do, and forms a clear glass, which does not become opaque. But the most striking character of alumina is the bright blue colour it acquires from the addition of a drop of nitrate of cobalt, after having been dried and ignited for some time. And its presence may be detected in this manner in compound minerals where the metallic substances are not in great proportion, or the quantity of magnesia large. Alumina may be thus detected in the agalmatolite.

II. THE METALLIC OXIDES.

Arsenic flies off accompanied by its characteristic smell, resembling garlic. When larger pieces of white arsenic are heated on a piece of ignited charcoal, no smell is perceived. To produce this effect the white oxide must be reduced, by being mixed with powdered charcoal. If arsenic is held in solution, it may be discovered by dipping into the solution a piece of pure and well-burned charcoal, which is afterwards to be dried and ignited.

Chrome. Its green oxide, the form in which it most commonly occurs, and to which it is reduced by heating in the common air, exhibits the following properties: it is fusible with *microsmic salt*, in the *interior* flame, into a glass which at the instant of its removal from the flame is of a violet hue, approaching more to the dark blue or red, according to the proportion of chrome. After cooling the glass is bluish green, but less blue than the copper glass. In the *exterior* flame the colour becomes brighter, and less blue, than the former. With *borax* it forms a bright yellowish or yellow-red glass in the *exterior* flame; and in the *interior* flame this becomes darker and greener, or bluish-green. The reduction with soda has not been examined.

Molybdic Acid melts by itself upon the charcoal with ebullition, and is absorbed. In a platina spoon it emits white fumes, and is reduced in the *interior* flame to molybdous acid, which is blue; but in the *exterior* flame it is again oxidated, and becomes white. With *microcosmic salt*, in the *exterior* flame, a small proportion of the acid gives a green glass, which by gradual additions of the acid passes through yellow-green to reddish, brownish, and hyacinth-brown, with a slight tinge of green. In the *interior* flame the colour passes from yellow-green, through yellow-brown and brown-red, to black; and if the proportion of acid be large, it acquires a metallic lustre, like the sulphuret, which sometimes remains after the glass has cooled. Molybdic acid is but little dissolved by *borax*. In the *exterior* flame the glass acquires a grey-yellow colour. In the *interior* flame a quantity of black particles is precipitated from the clear glass, and leaves it almost colourless when the quantity of molybdenum is small, and blackish when the proportion is larger. If to a glass formed of this acid and microcosmic salt a little borax be added, and the mixture fused in the *exterior* flame, the colour becomes instantly reddish-brown; in the *interior* flame the black particles are also separated, but in smaller quantity. By long continued heat the colour of the glass is diminished, and it appears yellower by the light of a lamp than by day-light. This acid is not reduced by soda in the interior flame.

Tungstic Acid becomes upon the charcoal at first brownish-yellow, is then reduced to a brown oxide, and lastly becomes black without melting or smoking. With *microcosmic salt* it forms in the *interior* flame a pure blue glass, without any violet tinge; in the *exterior* flame this colour disappears, and reappears again in the *interior*. With *borax*, in the *internal* flame, and in small proportion, it forms a colourless glass, which, by increasing the proportion of the acid, becomes dirty-grey, and then reddish. By long exposure to the *external* flame it becomes transparent, but as it cools it becomes muddy, whitish, and changeable into red when seen by day-light. It is not reduced.

Oxide of Tantalum undergoes no change by itself, but is readily fused with *microcosmic salt* and with *borax*, into a clear colourless glass, from which the oxide may be precipitated by heating and cooling it alternately. The glass then becomes opaque, and the oxide is not reduced.

Oxide of Titanium becomes yellowish when ignited in a spoon, and upon charcoal dark brown. With *microcosmic salt* it gives in the *interior* flame a fine violet-coloured glass with more of blue than that from manganese. In the *exterior* flame this colour disappears. With borax it gives a dirty hyacinth colour. Its combinations with soda have not been examined.

Oxide of Cerium becomes red-brown when ignited. When the proportion is small it forms with the fluxes a clear colourless glass, which by increasing the proportion of oxide becomes yellowish-green while hot. With *microcosmic salt*, if heated a long time in the *internal* flame, it gives a clear colourless glass. With *borax*, under similar circumstances, it gives a faint yellow-green glass while warm, but is colourless when cold. Exposed again for some time to the *external* flame, it becomes reddish-yellow, which colour it partly retains when cold. If two transparent beads of the compound with microcosmic salt and with borax be fused together, the triple compound becomes opaque and white. Flies off by reduction?

Oxide of Uranium. The yellow oxide by ignition becomes green or greenish-brown. With *microcosmic salt* in the *interior* flame it forms a clear yellow glass, the colour of which becomes more intense when cold. If long exposed to the *exterior* flame, and frequently cooled, it gives a pale, yellowish, red-brown glass, which becomes greenish as it cools. With *borax* in the *interior* flame a clear, colourless, or faintly-green glass, is formed, containing black particles, which appear to be the metal in its lowest state of oxidation. In the *exterior* flame this black matter is dissolved if the quantity be not too great, and the glass becomes bright yellowish-green, and after further oxidation yellowish-brown. If brought again into the *interior* flame, the colour gradually changes to green, and the black matter is again precipitated, but no further reduction takes place.

Oxide of Manganese gives with *microcosmic salt* in the *exterior* flame a fine amethyst colour, which disappears in the *interior* flame. With *borax* it gives a yellowish hyacinth-red glass.

When the manganese from its combination with iron, or any other cause, does not produce a sufficiently intense colour in the glass, a little nitre may be added to it while in a state of fusion, and the glass then becomes dark-violet while hot, and reddish-violet when cool: is not reduced.

Oxide of Tellurium, when gently heated, becomes first yellow, then light-red, and afterwards black. It melts and is absorbed by the charcoal, and is reduced with a slight detonation, a greenish flame, and a smell of horse-radish. *Microcosmic salt* dissolves it without being coloured.

Oxide of Antimony is partly reduced in the *exterior* flame, and spreads a white smoke on the charcoal. In the *interior* flame it is readily reduced by itself, and with soda. With microcosmic salt and with borax it forms a hyacinth-coloured glass. Metallic antimony, when ignited on charcoal, and remaining untouched, becomes covered with radiating acicular crystals of white oxide. Sulphuret of antimony melts on charcoal, and is absorbed.

Oxide of Bismuth melts readily in a spoon to a brown glass, which becomes brighter as it cools. With *microcosmic salt* it forms a grey-yellow glass, which loses its transparency, and becomes pale, when cool. Add a further proportion of oxide, and it becomes opaque. With *borax* it forms a grey glass, which decrepitates in the *interior* flame, and the metal is reduced and volatilized. It is most readily reduced by itself on charcoal.

Oxide of Zinc becomes yellow when heated, but whitens as it cools. A small proportion forms with *microcosmic salt* and with *borax* a clear glass, which becomes opaque on increasing the quantity of oxide. A drop of nitrate of cobalt being added to the oxide, and dried and ignited, it becomes green. With *soda* in the *interior* flame it is reduced, and burns with its characteristic flame, depositing its oxide upon the charcoal. By this process zinc may be easily detected even in the automolite. Mixed with oxide of copper, and reduced, the zinc will be fixed, and brass be obtained. But one of the most unequivocal characters of the oxide of zinc is to dissolve it in vinegar, evaporate the solution to dryness, and expose it to the flame of a lamp, when it will burn with its peculiar flame.

Oxide of Iron produces with *microcosmic salt* or *borax* in the *exterior* flame, when cold, a yellowish glass, which is blood-red while hot. The protoxide forms with these fluxes a green glass, which by increasing the proportion of the metal passes through bottle-green to black and opaque. The glass from the oxide becomes green in the *interior* flame, and is reduced to protoxide, and becomes attractable by the magnet. When placed on the wick of a candle, it burns with the crackling noise peculiar to iron.

Oxide of Cobalt becomes black in the *exterior*, and grey in the *interior* flame. A small proportion forms with *microcosmic salt* and with *borax* a blue glass, that with borax being the deepest. By transmitted light the glass is reddish. By farther additions of the oxide it passes through dark blue to black. The metal may be precipitated from the dark blue glass by inserting a steel wire into the mass while in fusion. It is malleable if the oxide has been free from arsenic, and may be collected by the magnet; and is distinguished from iron by the absence of any crackling sound when placed on the wick of a candle.

Oxide of Nickel becomes black at the extremity of the *exterior* flame, and in the *interior* greenish-grey. It is dissolved readily, and in large quantity, by *microcosmic salt*. The glass, while hot, is a dirty dark red, which becomes paler and yellowish as it cools. After the glass has cooled, it requires a large addition of the oxide to produce a distinct change of colour. It is nearly the same in the *exterior* and *interior* flame, being slightly reddish in the latter. Nitre added to the bead makes it froth, and it becomes red-brown at first, and afterwards paler. It is easily fusible with *borax*, and the colour resembles the preceding. When this glass is long exposed to a high degree of heat in the *interior* flame, it passes from reddish to blackish and opake; then blackish grey, and translucent; then paler reddish-grey, and clearer; and, lastly, transparent; and the metal is precipitated in small white metallic globules. The red colour seems here to be produced by the entire fusion or solution of the oxide, the black by incipient reduction, and the grey by the minute metallic particles before they combine and form small globules. When a little soda is added to the glass formed with borax, the reduction is more easily effected, and the metal collects itself into one single globule. When this oxide contains iron, the glass retains its own colour while hot, but assumes that of the iron as it cools.

Oxide of Tin in form of hydrate, and in its highest degree of purity, becomes yellow when heated, then red, and when approaching to ignition black. If iron or lead be mixed with it, the colour is dark-brown when heated. These colours become yellowish as the substance cools. Upon charcoal, in the *interior* flame it becomes and continues white; and, if originally white and free from water, it undergoes no change of colour by heating. It is very easily reduced without addition, but the reduction is promoted by adding a drop of solution of soda or potash.

Oxide of Lead melts, and is very quickly reduced, either without any addition, or when fused with microcosmic salt or borax. The glass not reduced is black.

Oxide of Copper is not altered by the exterior flame, but becomes protoxide in the interior. With both *microcosmic salt* and *borax* it forms a yellow-green glass while hot, but which becomes blue-green as it cools. When strongly heated in the *interior* flame it loses its colour, and the metal is reduced. If the quantity of oxide is so small that the green colour is not perceptible, its presence may be detected by the addition of a little tin, which occasions a reduction of the oxide to protoxide, and produces an opaque, red glass. If the oxide has been fused with borax, this colour is longer preserved; but if with microcosmic salt, it soon disappears by a continuance of heat.

The copper may also be precipitated upon iron, but the glass must be first saturated with iron. Alkalies or lime promote this precipitation. If the glass containing copper be exposed to a smoky flame, the copper is superficially reduced, and the glass covered while hot with an iridescent pellicle, which is not always permanent after cooling. It is very easily reduced by soda. Salts of copper, when heated before the blow-pipe, give a fine green flame.

Oxide of Mercury before the blow-pipe becomes black, and is entirely volatilized. In this manner its adulteration may be discovered.

The other metals may be reduced by themselves, and may be known by their own peculiar characters.

Article X.

On the Height of the Himalaya Mountains.

In the proceedings of the Royal Academy of Sciences at Paris, inserted in the last number of the *Annals*, is an account of a memoir by Alex. Von Humboldt "On the Height of the Mountains of India." It is there stated that "the 12th volume of the Asiatic Researches will give us important information on the subject." The Editors lose no time in presenting to their scientific readers the following paper:

On the Height of the Himalaya Mountains: abstracted from a Paper by H. T. Colebrooke, Esq. inserted in the Asiatic Transactions, Vol. XII.

The chain of the Himalaya mountains, constantly covered with snow, is visible from Patna, on the Ganges, and from other places in the plains of Bengal, at the distance of at least 150 geogr. miles, forming a continued chain bearing to the E. of N., and extending through more than two points of the compass, and in clear weather appearing like white cliffs with a very distinctly defined outline.

The continuation of the same chain of mountains divides Butan from Tibet, and is distinctly visible from the plains of Bengal, a distance, calculated from the observations made by Captain Turner on his journey to Tisholumbo, of from 165 to 200 geogr. miles. Now it requires an elevation exceeding 28,000 feet for an object to be barely discernible in a mean state of atmospherical refraction at so great a distance as that last mentioned.

The late Lieut. Col. Colebrooke, while in Rohilkhand, completed two observations: one taken at Pilibhit, where the elevation of a peak distant 114 English miles (according to bearings from two stations, the distance between which was measured) was found to be 1° 27′: the other at Jethpur, where the elevation of the same peak, distant 90 English miles, was observed to be 2° 8′. From these elements, allowing $\frac{1}{8}$ of the intercepted arc for terrestrial refraction, the peak observed by Lieut. Col. Colebrooke must have an elevation equal to about 22,000 feet above the level of the plains of Rohilkhand. This allowance of $\frac{1}{8}$ of the intercepted arc is deduced from Major Lambton's observations in the peninsula of India, according to which the refraction was found to vary from $\frac{1}{4}$ to $\frac{1}{18}$.

Colonel Crawford, during a long sojourn at Cat'hmandu in 1802, took the angles of several selected points, of which he determined the distances by trigonometrical measurement, having taken the bearings from various stations in the valley of Nepál, the relative situations of which were ascertained by a trigonometrical survey proceeding from a base of 852$\frac{1}{4}$ feet, carefully measured four times, and verified by another base of 1582 feet, measured twice. The positions of the same mountains were also settled by observations of them made in the plains of Bahar in the progress of the great survey.

The angles of elevation of the mountains above the stations of Sambhu and the Queen's Garden, near Cat'hmandu, were taken with an astronomical sextant and an artificial horizon. Among the most remarkable is an observation of a mountain pointed out as Mount Dhaibun. It was seen under an angle of 5° 4′ 21″, and ascertained to be distant 35¼ g. m. The elevation, calculated from this measure, is 20,140 feet above the station from which the altitude was taken, and which is itself more than 4,500 feet above the level of the sea, as concluded from barometrical observations. Another, seen under a similar angle, 5° 3′ 58″, but less distant by four miles, exceeds the elevation of the station by 17,819 feet. Both these mountains are but little to the eastward of north from Cat'hmandu. The following are as little north of east, viz. one nearly in the position of Cala-bhairava, distant 59 g. m., with an altitude of 2° 48′ 6″, and consequently 20,025 feet high: another in its vicinity with an angle of 3° 23′ 6″, distant 48 g. m., and elevated 18,452 feet: and a third, as much more remote, being 68 g. m., with an altitude of 2° 7′ 21″, and a consequent elevation of 18,662 feet above Cat'hmandu.

All these mountains are perceivable from Patna: the first, or the supposed Dhaibun, at a distance of 162 g. m., and Cala-bhairava, or the mountains in its vicinity at that of 153, 150, and 145 g. m. These are the nearest of the Himalaya which are visible from that city. The most remote are seen in the N. E. quarter at the prodigious distance of 195 g. m., ascertained by their position, which is determined by bearings taken by Col. Crawford from stations approaching within 100 miles of their site.

Mount Dhaibun, or at least the peak which was indicated to Col. Crawford under that name, and which is not surpassed by any of the points measured from Cat'hmandu, was viewed by Gen. Kirkpatrick, if indeed it be the same mountain, from a position 10 miles nearer to it, on Mount Bhirbandi: and his animated description of the sublime prospect contains presumptive evidence that the remoter glacieres of the Himalaya are still more elevated; for he speaks of a neighbouring mountain not less stupendous, yet surpassed by one of the pyramidical peaks of the snowy chain seen peeping over its towering summit. It may readily be credited that the more accessible mountains which approach Cat'hmandu, as Jibjibia, Dhaibun, and Dhunchá, may be inferior in heighth to the abrupter peaks in the chain of the Himalaya.

Among the loftiest in that chain is one distinguished by the name of Dhawala-giri, or the White Mountain, situated, as it is understood, near the source of the Gandhac river, called in its earlier course Salagrami, from the schistous stones containing remains or traces of ammonites found there in the bed of the river, and thence carried to all parts of India, where they are worshipped under the name of Salagrama, the spiral retreats of antediluvian molluscas being taken by the superstitious Hindu for visible traces of Vishnu.

A high peak, among the most conspicuous of those which are seen from the plains of Gorak'hpur, and on that account selected by Mr. Webb for a measurement, conducted by means of observations taken at different stations in that province, was pointed out to him as recognized by the mountaineers to be Dholagir (Dhawala-giri). Mr. Webb took the bearings from four stations, and altitudes from three; and the particulars of his observations are as follow:

At station A, situated near Khatur, bearing of the snowy peak P, corrected for magnetic variation, and error of adjustment, by an azimuth observed at the same time	N. 30°	12′	E.
Altitude	2	48	
At station B, Nowa-newada on the Rapti:			
Bearing of P	N. 49	30	E.
At station C, two furlongs W. of Sengaon:			
Bearing of P	N. 35	49	E.
Altitude	2	19	
At station D, two furlongs W. of Bhopetpur:			
Bearing of P	N. 60	1	E.
Altitude	1	22	

B bears from A by the survey W. 2° 5′ N. distant = 43·4 B. m.
D bears from A ....W. 7 5 N. .... = 73 5 B. m.
The bearing of C from A is not used, the side A C measuring only 16·3 B. m.

C to B..............	W. 13° 54′ N.	distant =	29·4 B. m.
C to D..............	W. 15 0 N.	...... =	60
B to D..............	W. 14 3 N.	...... =	30·5

From these data Mr. Webb computes the distance of the peak P from the stations A, C, and D, at the numbers undermentioned, viz.: from the station A, by the triangle A P B, 89·6; and by the triangle A P D, 89·1: mean of both computations, 89·35 miles, or 471,768 feet. From the station D, by the last triangle, 135·9; and by C P D, 136·8: mean of both, 136·35 miles, or 719·928 feet. From C, by the last of these triangles, 103·4; and by C P B, 102·3: mean of both, 102·85 miles, or 543,048 feet. He remarks that several other bearings of the same peak were taken from different stations; and that, by laying off the rhumb-lines of bearing on the map, they intersect at very inconsiderable distances from the position of the peak, as deduced from those which were selected for calculation.

Let us proceed to compute the height of Dhawalagiri (vulg. Dholagir) with the foregoing measures of distance and the observed altitudes.

At the station A we have the distance 471,768 feet, 77·85 geogr. miles,* or in a parts of a circle 1° 17′ 51″; the chord of

* The geographic mile, or 60th part of a degree of a great circle, is here taken at 6060 feet.

of which, in feet, is 471,758. The altitude observed being 2° 48′, and the refraction being taken at $\frac{1}{12}$ of the intercepted arc, the angles are S = 3° 20′ 26″ 15‴ and P = 86° 0′ 38″ 15‴, with the side S B = 471,758; whence we have the side B P, or height of the mountain = 27,558 feet.

By a similar calculation of the altitude of the same mountain, observed from the stations C and D, viz. 2° 19′ and 1° 22′, or, corrected for refraction, 2° 11′ 32″ and 1° 12′ 6″, with the distances above found, which in parts of a circle are 1° 29′ 36″ 36‴ and 1° 58′ 48″, and, reduced to the chords of the arcs in feet, 543,031 and 719,893, the height comes out 27,900 and 27,573; or, on a mean of the three, 27,677 feet above the plains of Gorak'hpur; and reckoning these to be 400 feet above the mouth of the Ganges, as may be inferred from the descent of the stream of rivers, the whole height is more than 28,000 feet above the level of the sea.

The following table exhibits a comparison of this result with other computations made on different rates of refraction:

Station.	Distance in miles.	Interc arc in deg.	Alt. by observ.	Height, allowing for refraction. $\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{1}{11}$	$\frac{1}{12}$	$\frac{1}{13}$	$\frac{1}{18}$
A	89·35	1° 17′ 51″	2° 48′	24875	26663	27110	27476	27558	27626	27855
C	102·85	1 29 36 6‴	2 19	24348	26716	27308	27792	27900	27991	28294
D	136·35	1 58 48	1 22	21338	25494	26554	27384	27573	27773	28286
			Mean	23520	26091	26784	27551	27677	27797	28145
			Extreme difference	3537	1222	774	408	342	365	439

It is apparent, from inspection, that the observations at the stations A and D agree best; and, if that computation be nearest the truth wherein the extreme differences are the least, the conclusion will be that the height is about 27,550 feet; such being the elevation deduced from the mean of observations calculated according to middle refraction.

The limit of error arising from refraction must be taken at less than 850 feet, as the observations at A and C coincide for the height of 26,690 feet, $\frac{1}{6}$ of the contained arc being allowed for refraction, and those at C and D for an elevation of 28,290 feet, $\frac{1}{18}$ being allowed; while those at A and D do so for the mean altitude of 27,565 feet, refraction being taken at the middle rate of $\frac{1}{12}$; and a larger allowance than $\frac{1}{6}$ of the intercepted arc (which would exceed mean celestial refraction for like altitudes) cannot be requisite without very wide disagreements in observations made on different days, which would mark extraordinary refraction; but this is not the case with those in question.

The limits of error in respect of the observations themselves, whether for the distance or for the altitude, are more confined, since the uncertainty in the distance, amounting to $\frac{1}{4}$ of a mile in one instance, and $\frac{1}{2}$ a mile in the rest, induces uncertainty in the computed elevation to no greater extent than 76 or 99 feet for the nearer stations, and 180 feet for the most remote. An error of a whole minute in an observation of altitude affects the consequent calculation in the proportion of about 200 feet for the more distant station, and 130 to 150 feet for the nearer. But the instrument which was used should with due care give angles true within that quantity; and the observer was enjoined to take the angles to the nearest minute.*

It would be an extreme supposition that the errors have in every instance been the highest possible, and on the side of excess. Assuming, however, that they are so, the elevation as observed from the two nearest stations is not reduced below 26,457 feet and 26,467 feet, or, on the mean of both, 26,462 feet above the plains of Gorak'hpur.

We may safely, then, pronounce that the elevation of Dhawalagiri, the *white mountain* of the Indian Alps,† exceeds 26,862 feet above the level of the sea; and this determination of its height, taken on the lowest computation of a geometrical measurement, is powerfully corroborated by the measurement of an inferior, though yet very lofty mountain, observed from stations in Rohilkhand.

ARTICLE XI.

ANALYSES OF BOOKS.

I. *Philosophical Transactions for the Year* 1817, *Part II.*

THIS part contains the following papers:

Description of a Thermometrical Barometer for measuring Altitudes. By the Rev. Francis John Hyde Wollaston, B. D. F.R.S.

Observations on the Analogy which subsists between the Calculus of Functions and other Branches of Analysis. By Charles Babbage, Esq. M.A. F.R.S.

Of the Construction of Logarithmic Tables. By Thomas Knight, Esq. Communicated by Taylor Combe, Esq. Sec. R.S.

Two general Propositions in the Method of Differences. By the Same.

Note respecting the Demonstration of the Binomial Theorem inserted in the last Volume of the Philosophical Transactions. By the Same.

On the Passage of the Ovum from the Ovarium to the Uterus in Women. By Sir Everard Home, Bart. V.P.R.S.

Some farther Observations on the Use of Colchicum Autumnale in Gout. By the Same.

* The writer of this was acquainted with the instrument, and knew the degree of precision which it comports.

† *Sans.* Dhawala (white), Giri (mountain). It is the Mont Blanc of the Himalaya.

Upon the Extent of the Expansion and Contraction of Timber in different Directions relative to the Position of the Medulla of the Tree. By Thomas Andrew Knight, Esq. F.R.S. In a Letter addressed to the Right Hon. Sir Joseph Banks, Bart. G.C.B. P.R.S.

Observations on the Temperature of the Ocean and Atmosphere, and on the Density of Sea Water, made during a Voyage to Ceylon. In a Letter to Sir Humphry Davy, LL. D. F.R.S. By John Davy, M.D. F.R.S.

Observations on the Genus Ocythoë of Rafinesque, with a Description of a new Species. By William Elford Leach, M.D. F.R.S.

The distinguishing Characters between the Ova of the Sepia and those of the Vermes Testacea that live in Water, explained. By Sir Everard Home, Bart. V.P.R.S.

Astronomical Observations and Experiments tending to investigate the local Arrangement of the Celestial Bodies in Space, and to determine the Extent and Condition of the Milky Way. By Sir William Herschel, Knt. Guelp. LL.D. F.R.S.

Some Account of the Nests of the Java Swallow, and of the Glands that secrete the Mucus of which they are composed. By Sir Everard Home. Bart. V.P.R.S.

Observations on the Hirudo Complanata and Hirudo Stagnalis, now formed into a distinct Genus under the Name *Glossopora*: By Dr. Johnson, of Bristol. Communicated by Sir Everard Home, Bart. V.P.R.S.

Observations on the Gastric Glands of the Human Stomach, and the Contraction which takes place in that Viscus. By Sir Everard Home, Bart. V.P.R.S.

On the Parallax of the Fixed Stars. By John Pond, Esq. Astronomer Royal.

In the history of the meetings of the Royal Society a general account has been given of these papers,* but many of them are of so much importance as to require a more detailed analysis. Among these we may include Mr. Wollaston's description of his thermometrical barometer.

It has been long known that the temperature at which water boils is diminished in proportion to the diminution of the weight of the atmosphere; and this principle had been pointed out by Fahrenheit, and more lately by Cavallo, as a means that might be employed for measuring altitudes. Mr. Wollaston has contrived an apparatus by which this may be accomplished, even with more accuracy and convenience than the common barometer. The two great objects were, first, that very small portions of heat might be rendered perceptible; and, secondly, that the instrument should be portable Both these objects are attained by having the thermometer with a large bulb and a very

* *Annals*, ix. 323, 393, 468; x. 54, 139.

fine stem, and this only extending for a few degrees, corresponding to the range which may be supposed likely to be ever required. The thermometer which he has employed the most frequently has a scale of 3·98 inches to every degree of Fahrenheit, and has a thread of 22 inches. Upon comparison with the common barometer, it was found that a difference of 1° Fahrenheit is occasioned by 0·589 on the barometer; 30·603 on the barometer is equal to 213·367 on the thermometer; and 28·191 on the barometer is equal to 209·263 on the thermometer. The author gives a very minute description of the apparatus, and the mode of constructing it; from which we may conclude that every circumstance has been attended to which can contribute to its accuracy and convenience. The whole apparatus, consisting of the thermometer, the boiler, a stand, and a cover to protect it from the weather, is so contrived as to go into a tin cylindrical box, two inches diameter, and 10 deep, and weighs 1 lb. 4½ oz. The experiments that Mr. Wollaston has hitherto been able to make with the new instrument afford a very convincing proof of its accuracy; the height of Shooter's Hill, of Hampstead, and of the top of St. Paul's cupola, agreeing with the estimates formed by Gen. Roy within a foot or two. Although the instrument is principally adapted for measuring only small differences of altitude, yet, by making a series of observations, and adjusting it after each experiment, by forcing up a globule of the mercury into a bulb that is left for this purpose at the top of the stem, it may be employed for ascertaining the heights of the highest mountains.

Sir E. Home's paper on the impregnation of the female in the class mammalia, a subject which had eluded the researches of the most eminent physiologists, and, among others, of Haller and Hunter, affords a valuable addition to our knowledge. He fortunately met with a case of a young woman who died seven days after her first and only sexual intercourse; and, having first hardened the uterus and its appendages in alcohol, it was minutely examined. One of the ovaria exhibited a small fissure on its most projecting part; and upon opening it he found "a cavity filled up with coagulated blood, and surrounded by a yellowish organized structure." Upon examining the cavity of the uterus itself, its inner surface was found to be lined with an exudation of coagulable lymph; and among the fibres of this lymph, near the cervix, the ovum was detected; it was of an oval form, one portion of it white, and the other semitransparent; but by the action of the alcohol the whole became opaque. The os tincæ was closed with thick jelly, but the openings into the Fallopian tubes were pervious.

From this, and other analogous cases, the author has adopted an idea respecting the nature of the corpora lutea which is new, but for which he adduces some powerful arguments. The corpus luteum was supposed by Haller to be the effect of impregnation;

and as it follows from this view of the subject that actual impregnation takes place in the ovarium, many hypotheses have been formed to account for the manner in which the semen can pass along the Fallopian tube. The present writer, on the contrary, supposes that the corpus luteum is a compact glandular substance in which the ovum is formed, and that, from certain causes, it may pass into the uterus, where it is impregnated.

The small ovum was given to Mr. Bauer, of Kew, in order that he might examine it by his microscope, and we are presented with a very minute account of its appearance. It is described as consisting of a membrane, comparatively speaking of considerable thickness and consistence, forming a kind of bag of an oval form, nearly $\frac{12}{200}$ of an inch long, and about $\frac{8}{200}$ of an inch broad: on one side it has an elevated ridge down its longest diameter, and on the other side it appears open for nearly its whole length, the edges of the membrane being rolled inwards, so as to give it something of the shape of a shell of the genus voluta. The outer bag contained an interior smaller bag, one end of which was nearly pointed, the other obtuse; in the middle it was slightly contracted, so as to leave two protuberances, which, it is conjectured, were the rudiments of the heart and head. These protuberances were formed by two little corpuscles, which were contained in the interior bag, and were enveloped in a slimy substance like honey. The paper is accompanied by some characteristic engravings from Mr. Bauer's drawings.

The object of Mr. Knight's paper on the expansion and contraction of timber is to show that this effect is principally produced by means of what is called the silver grain of the wood, a series of cellular processes, which are extended in the form of radii, from the central medulla of the tree to the bark. In a paper which was inserted in the Philosophical Transactions for the year 1801, he endeavoured to prove that the motion of the sap depends upon the action of these processes, as they are affected by the different degrees of heat and moisture to which they are exposed; and he has been confirmed in this opinion by many experiments and observations, which he has had an opportunity of making since that period.

The first set of experiments which he relates consisted in taking thin boards of oak and ash, which were cut from the tree in different directions with respect to the silver grain, "so that the convergent cellular processes crossed the centre of the surfaces of some of them at right angles, and lay parallel with the surfaces of others." When both these pieces of wood were placed under similar circumstances, those which had been formed by cutting across the convergent cellular processes soon changed their form very considerably, the one side becoming hollow, and the other raised; and in drying, these contracted nearly 14 per cent. relatively to their breadth. The others retained, with very little variation, their primary form, and did not contract more than $3\frac{1}{4}$ per cent. in drying."

Mr. Knight's second experiment consisted in taking a transverse section, of about an inch in thickness, from the stem of a tree that was just felled. An incision was then made with a saw from the bark towards the central medulla, in the direction of the convergent cellular processes, when they were found almost entirely to prevent the action of the saw in consequence of their expansion; and when a second incision was made from the bark to the medulla, about an inch from the first, leaving a triangular wedge, the expansion of the silver grain kept the piece closely retained in the stem. When incisions were made in the other part of the block, but in such a direction as to cut the processes across, the saw was found to move with perfect freedom. From these facts the author was led to infer that the medullary canal must be subject to have its diameter considerably affected by variations in the quantity of moisture contained in the wood; and this conjecture seemed to be confirmed by an experiment, in which a plug of metal forced into the central space, which had been occupied by the medulla of a young stem, while this was in a dry state, was found too small to fill the cavity, when the stem was saturated with moisture. Mr. Knight conceives that the internal clefts which are frequently met with in timber may be produced by this kind of expansion and contraction; a cause which he conceives more likely to operate than either winds or frosts, to which they have generally been attributed. Another cause by which timber becomes warped in drying is pointed out, which has probably no connexion with the power by which the sap is raised in the living tree, but which arises from the greater or less solidity of the different parts of the trunk, according as they are nearer or more remote from the centre, the former being more compact, and of greater specific gravity, and therefore being less affected by the evaporation of its moisture.

Dr. Davy's observations, which were made during his voyage to Ceylon, were principally confined to three topics: "the specific gravity of the water of the ocean, and its temperature, and the temperature of the atmosphere." He first presents his principal results in the form of a table, and he afterwards informs us how they were obtained, and offers various remarks concerning them. The table consists of 13 columns: the first contains the date; the second, the latitude by observation; the third, the longitude by the chronometer; the fourth is the specific gravity of the sea water; the three next columns relate to the temperature of the air, its maximum in the course of the 24 hours, its minimum, and its mean; the next three columns give us the maximum, the minimum, and the mean temperature of the sea water; the 11th column contains the register of the barometer; the 12th, of the winds; and the last, the account of the weather generally. The observations were continued, without much interruption, from the middle of February to the middle of August, when the author arrived at Ceylon, commencing in the 49th degree of north latitude, and 6½ degrees west longitude, and proceeding round by the Cape of Good Hope and the Isle of France. The experiments on the density of the sea water were made on portions of water drawn from the surface of the ocean, its temperature being reduced by calculation to 80°, a number which was fixed upon because it is nearly the mean annual temperature of Ceylon, and of the sea generally in the intertropical regions. The results of these experiments show that the ocean resembles the atmosphere with respect to the general uniformity of its composition, the specific gravity of the water being very nearly the same in all the different trials. The number of observations recorded is 36; the highest specific gravity is 10277, and the lowest 12051. These variations seem to have no connexion with the temperature, or at least not to bear any regular proportion to it. The differences seemed rather to depend upon what may be regarded as incidental circumstances, as the roughness of the surface, a heavy fall of rain, and a succession of tropical squalls. Dr. Davy's observations controvert an opinion which has been adopted, that the different zones of the sea have each their peculiar specific gravity.

With respect to the temperature of the air and water, the observations were made every two hours with delicate thermometers. Dr. Davy conceives that the temperature of the atmosphere in hot climates has been frequently overrated from the thermometer not being sufficiently protected from the radiation of caloric by neighbouring bodies. The highest temperature that is noted is 82°; this occurred at 2° 10′ north latitude, about five days before they arrived at Ceylon; the uniformity of the temperature in these regions is very remarkable, the maximum and minimum not differing more than 3° or 4° in ordinary cases, and seldom more than 5° or 6°. The author has made an observation on the diurnal variation of the temperature of the atmosphere at sea which had not been before noticed, which, when the weather is fine, and the wind steady, appears to have few exceptions: the air was "at its maximum temperature precisely at noon, and at its minimum towards sun-rise." But many circumstances were found to disturb the regular progression: on the one hand, in a perfect calm the accumulation of heat, not only in the ship, but in the water itself, cause the greatest heat to occur some time after the hour of noon, and by showery and unsettled weather the regular variation was still more disturbed.

Contrary to what is commonly asserted, the diurnal change of temperature in the sea is very nearly as great as in the atmosphere. When there were the fewest disturbing causes, the weather fine, the surface smooth, and no land near, the maximum temperature of the sea is about three, p. m. and the minimum towards sun-rise. One of the most considerable of the causes that disturb the temperature of the ocean is currents, and these currents affect it in different ways, according to the cause which produces them. Superficial currents often depend upon prevailing winds, and these currents are then warmer or colder than the other parts of the sea, according to the quarter from which the wind blows. Currents often depend upon inequalities in the bottom of the ocean; and it is now admitted as a fact, established by many observations, that when the sea is shallow its temperature its diminished. The author gives us the result of his observations on the currents which he encountered during his voyage, which all accord with the general principles stated above. He gives us the particular account of the effect produced by the well-known current flowing from the south-east coast of Africa. In crossing this current the temperature of the ocean suddenly varied as much as 10 degrees, which is probably occasioned by a sudden transition from the water which lies over the bank of Lagullas, along which the current rapidly flows, into the stream itself.

A certain conjunction of circumstances, connected with the warm streams of water, and cold winds blowing over them, is employed by our author to explain a phenomenon which has been often described by travellers who have visited the Cape, commonly called the "Table-cloth." It consists in a cloud or mist, which covers the upper part of the Table Mountain, but which does not descend to the plain below. The phenomenon only occurs when the south-east wind blows, which is there a cold wind, and, passing over the warm currents in its way to the land, condenses a portion of aqueous vapour, and produces a mist, which is carried along the eastern side of the mountain, and covers the top, but does not descend on the western side, in consequence of the heat of the plain below, but is suspended over it, in the form of a sheet, whence it has derived its name.

(*To be continued.*)

Traité de Physique expérimentale et Mathématique, par J. B. Biot, Membre de l'Académie des Sciences, &c. &c. 4 *tom. 8vo.*

In the history of the proceedings of the Royal Academy of Sciences, which appeared in our last volume, some account was given of this treatise; but as it is a work which, both from its own merits, and from the celebrity of the author, must excite considerable interest with our readers, we conceive that a somewhat more detailed analysis of it will not be unacceptable to them. It will indeed be impossible, in the limits of a few pages, to enter into an examination of the manner in which M. Biot treats the various topics that pass under his review, or to pronounce upon the merits of the reasoning which he employs in the discussion of the controverted questions which necessarily forms a considerable proportion of all publications of this description. But to those who are not in possession of the work it may be important to know what are the subjects on which M. Biot treats, although we may be able to give little more than a mere table of contents.

This work contains about 2300 closely-printed octavo pages in a small type It abounds much in theoretical discussions, and in refined speculations; and, on all occasions where they could be introduced, the author employs mathematical reasoning and algebraical notation. Some extracts have already been given from the dedicatory epistle to Berthollet, in which he enters into a formal defence of the propriety of this method of proceeding. He admits that it is useless to employ an algebraical notation to express results which are so simple that they may be announced, comprehended, and appreciated, in simple and direct terms. It is still worse, or rather positively objectionable, to combine in this way parts or elements which are in themselves vague or hypothetical; for by doing so, "we only realize uncertainty, and give a body to error." But when we have observed with sufficient precision the different modes of the same phenomena, and have obtained correct numerical expressions of them, what inconvenience, he asks, can there be in uniting them by a formula, which may embrace the whole? When they are capable of being reduced to a simple law, but when this cannot be immediately perceived, is not this the best method of discovering it? Whereas, on the contrary, if the nature of their relations be essentially compound, which is commonly the case, is it not the only means which we possess to connect them into one whole, "and to obtain a common expression, which may be afterwards introduced, with all the generality of its indeterminateness, into the analysis of other phenomena, in which the first may bear a part?" To these remarks every one must assent; but they do not decide the point respecting the propriety of M. Biot's method, because it is a question of degree, rather than one of an absolute nature. No one will deny the propriety of introducing mathematics into all the departments of natural philosophy: in some they form the necessary foundation of the whole superstructure; and in all of them there are parts which, by this means, can be placed in a clearer light, and have their relations better illustrated, than by any other mode of expression. We must, however, confess that we are among the number of those who think that the sparing and cautious introduction of mathematical expressions into general physics is favourable to the progress of knowledge; for, although we may gain something on the score of accuracy and conciseness, we place science out of the reach of many who might profit by it, and might in their turn contribute to its advancement.

The treatise is divided into seven books. The first book is entitled, "Of general Phenomena, and of the Means of making Observations;" in which, after some remarks upon the nature of matter, the definitions that have been given of it, both physical and metaphysical, we have an account of its essential properties, and the effects necessarily resulting from them. This leads to the method by which these properties are to be ascertained, and their amount measured, by means of certain operations, and of peculiar instruments, which are detailed and described. The titles of the chapters which compose the first book are as follows: Of the Balance, and the Manner of using it; of the Construction of the Thermometer, and the Manner of using it; of the Destruction and Reproduction of Heat which are observed during the Change in the State of Bodies; of the atmospherical Pressure, and of the Barometer; Relations of the Barometer and the Thermometer; Laws of the Condensation and Dilatation of Air and the Gases, under different Pressures at the same Temperature; of Pumps, both for Fluids and for Air; Measure of the Dilatation of solid Bodies, of Gases, and of Liquids, by Heat; Laws of the Dilatation of Liquids at all Temperatures; of the Forces which constitute Bodies in the different States of Solids, Liquids, and Gases; of Vapours in general, particularly of their Formation, and of their elastic Form in a Vacuum; of the Method of measuring the Weight of Vapours under a given Volume at a determined Pressure and Temperature; of the Mixture of Vapours with Gases; of Evaporation; of the Hygrometer; of the Specific Gravity of Bodies; of the Means of obtaining the Specific Gravity of Bodies; of Capillary Phenomena; and of Elasticity.

The second book is on acoustics, a subject naturally connected with the last chapter of the former book, consisting of the peculiar effects which elastic bodies produce on one of the organs of sense. The second book is divided into 13 chapters, under the following titles: of the Production and Propagation of Sound; of the Perception and Propagation of continued Sounds; the usual Approximations in Music to express the Intervals of Sounds; Necessity of altering the Adjustment of these Intervals in Instruments with fixed Notes; Rules for this Temperament; transverse Vibrations of straight elastic Rods; longitudinal Vibrations of straight Rods; circular Vibrations of straight Rods; of the Vibrations of curved Rods, such as Forks and Rings; Vibrations of Bodies rigid or flexible, moved in all their Dimensions; of wind Instruments; on the Vibrations of aeriform Fluids different from Air; on the Reverberations of Bodies; Organs of hearing and speaking.

Before entering upon the third book, which is on electricity, M. Biot observes, that the properties of bodies about which he has hitherto been treating, are constantly inherent in them, and seem to be essentially attached to the matter of which they are composed. Heavy bodies, for example, cannot be deprived of their weight, nor their particles of the property of mutually attracting each other. There are, however, other kinds of qualities, which may be impressed upon bodies in a more transient manner, and which are developed in them, without the addition, so far as we can judge, of any tangible or ponderable principle. In treating of electricity, the first of the qualities or modifications of the kind here referred to, the author first lays down its general laws as they are ascertained by observation and experiment; then from these he deduces his theory, and afterwards describes the various kinds of apparatus. The number of chapters is 20, and they bear the following titles: general Phenomena of electrical Attractions and Repulsions; Distinction of the two Kinds of Electricities; of the Laws which the apparent Attractions and Repulsions of electrified Bodies follow; of the Laws according to which Electricity is dissipated by the Contact of Air and the Supporters which retain it imperfectly; Disposition of Electricity in Equilibrio in insulated conducting Bodies; of combined Electricities, and of their Separation by Actions without Contact; Theory of the Motions excited in Bodies by electrical Attractions and Repulsions; of the best Construction of electrical Machines, and the Conductors which form Part of them; of Electroscopes; of what are stiled *Electricités dissimulés,* under which are included the Condenser, the Electrophorus, the Leyden Jar, and electric Batteries; of electric Piles, and of the Phenomena which Crystals electrified by Heat present; Applications of Electricity; mechanical Effects produced by the repulsive Force of accumulated Electricities; of atmospheric Electricity, and Conductors for Lightning; of electric Light; of the Development of Electricity by simple Contact; Theory of the electromotive Apparatus, supposing its conducting Power to be perfect; chemical Effects of the electromotive Apparatus; Theory of the electromotive Apparatus, considered with regard to its imperfect conducting Power; Examination of the Changes which take place in the electromotive Apparatus in consequence of its Re-action upon itself; Modifications which result from its electric State; of secondary Piles; on the unequal Resistance which the two Electricities experience in crossing different Bodies, when they are very feeble.

Magnetism forms the subject of the fourth book. The following topics are discussed in it: general Phenomena of magnetic Attractions and Repulsions; general Considerations upon the Development of Magnetism in magnetic Bars, and their Analogy with electric Piles; Determination and Measure of the directing Forces exercised by the terrestrial Globe upon Magnets; upon the different Ways of magnetizing; general Distribution of Magnetism in Bars by the double Touch; Laws of magnetic Attractions and Repulsions; Research into the Intensity of free Magnetism in every Point of a Needle saturated by Means of the double Touch; of the Influence of Temperature upon the Development of Magnetism; of the best Form for Compass Needles; of the Action of Loadstones upon all natural Bodies; Laws of terrestrial Magnetism at different Latitudes.

The fifth book is on Light: it is divided into the three parts of catoptrics, dioptrics, and the analysis of light. Under catoptrics we have the general Laws of the Reflection of Light; of the plain Mirror; of curved Mirrors; of the Heliostate, and general Considerations on the Forces which produce the Reflection of Light at the Surface of Bodies. Under dioptrics we have general Laws of simple Refraction; of spherical Lenses; physical Theory of Refraction; of double Refraction; Construction of Micrometers with double Images. The analysis of light embraces the following Topics: of the Dispersion of Light produced by Refraction; Influence of the unequal Refrangibility of the Rays upon Vision across refracting Surfaces; of Achromatism. In a sequel to the subject of dioptrics we have six chapters on the following subjects: on the Reflections, Refractions, and Colours, of thin transparent Bodies; on the Fits of easy Reflection and easy Transmission; Application of the preceding Theory to the Reflection of the Rays of Light which have crossed thick Media; Explanation of permanent Colours of Bodies; on the Return of Rays reflected by Plates with plain and parallel Faces; on the Return of Rays by curved Plates; Explanation of the coloured Crowns which appear round the Stars; on the Colours produced by many successive Reflections; what takes place when Colours reflected or transmitted by thin Plates seem to emanate from their Substance.

The polarization of light is become quite a new science, and, accordingly, forms the subject of the sixth book. The following are the titles of the chapters that compose it: general Proceedings by which we produce permanent Polarization; of the Periods in which Polarization is produced and completed in crystallized Bodies possessing double Refraction; of the Colours given by thin crystallized Plates, when we present them to Rays under certain Incidences; experimental Laws of these Phenomena; oscillatory Motion of the Axis of Polarization deduced from the preceding Phenomena; Examination of the Modifications experienced by the Molecules of Light, when they cross many Plates in Succession, which produce the moveable Polarization; Processes which result from them to develop coloured images in thick Plates by the crossing of their Axes; of the physical Properties which the Molecules of Light assume in the Interior of Crystals; critical Examination of the Phenomena produced under oblique Incidences by Laminæ and Plates parallel to the Axis of Crystallization; Experiments upon Plates of Rock Crystal cut perpendicularly to the Axis of Crystallization; Phenomena of successive Polarization observed in homogeneous Fluids; Examination and Laws of the Phenomena which Plates of Mica present under oblique Incidences; Phenomena of Polarization which are observed in Bodies imperfectly crystallized; Determination of the Laws according to which Light is polarized at the Surface of Metals.

The seventh and last chapter is on heat, both radiant and latent; it contains the following topics: on the Relations of Light and Caloric; Laws of the heating and cooling of Bodies in undefined Media; Influence of the State and Nature of Surfaces upon the Radiation of Caloric; Theory of its Equilibrium by mutual Exchange; Laws of the Propagation of Heat in solid Bodies; of the Capacity of Bodies for Caloric; and of Steam-Engines.

This very ample table of contents will afford a clear proof of the extensive view which M. Biot has taken of natural phenomena; and the manner in which he has treated all the different topics equally prove the profound and elaborate spirit of philosophical investigation for which this author is so justly distinguished. There is a general air of candour pervading every part of the work, which is highly creditable to the author; and an appearance of dispassionate good sense, which produces a feeling of confidence in all his statements. Different persons, according to their turn of mind and previous pursuits, will form different opinions respecting the propriety of introducing so much of mathematic and algebraic reasoning; but, admitting the principle, the execution is highly commendable. The arrangement of the materials is good, and its stile perspicuous; and it has very little, if any, of the obscurity which so frequently pervades works of science, arising from the fanciful introduction of new terms, or the no less fanciful employment of old terms in new senses. Many readers will regret that M. Biot has not given more of a regular historical detail in connexion with the different topics on which he treats. It no doubt adds much to the interest of works of this description, and seems a kind of tribute due to our precursors in science. M. Biot seldom refers to the labours of preceding authors, except in an incidental manner, and does not seem to have conceived it a part of his plan to state by whom the knowledge that we at present possess was originally discovered.

Article XII.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

The Society met on Nov. 6; but, in consequence of the death of the Princess Charlotte of Wales, the meeting was adjourned.

Nov. 20.—Sir Everard Home read the Croonian Lecture, the subject of which was the changes which the blood undergoes in the act of coagulation. A considerable part of the paper consisted of an account of a number of minute microscopical observations that had been made by Mr. Bauer, on the red particles of the blood. He attempted to form an estimate of their size, and gave a description of their appearance. Their colouring matter he conceives to be something superadded to their proper substance: he supposes that they possess a regularly organized structure; and by comparing them with the appearance which the muscular fibre exhibits, when highly magnified, he concludes that these particles are the immediate constituents of the fibre. With respect to the generation of vessels in effused blood, he imagines that it depends upon the gas which is extricated from blood during its coagulation: this, by insinuating itself between the adhering particles, produces tubular cavities, which are afterwards converted into more perfect vessels.

November 27.—A paper by Mr. Seppings was read, on the increased strength given to ships of war by the application of diagonal braces. It contained an account of some very ample trials that had been made of this method of constructing the framework of vessels, the result of which was such as completely to justify the expectations that had been raised, and to confirm the favourable reports that had been made on the subject.

On Monday, Nov. 31, the Society held its annual meeting, for the election of the officers for the ensuing year. There were elected,

President.—Right Hon. Sir Joseph Banks, Bart. G.C.B. &c.

Secretaries.—William Thomas Brande, Esq. and Taylor Combe, Esq.

Treasurer.—Samuel Lysons, Esq.

There remained of the old council: Right Hon. Sir Joseph Banks, Bart.; William Thomas Brande, Esq.; Samuel, Lord Bishop of Carlisle; Taylor Combe, Esq.; Sir Humphry Davy; Sir Everard Home, Bart.; Samuel Lysons, Esq.; George, Earl of Morton; John Pond, Esq.; William Hyde Wollaston, M.D.; Thomas Young, M.D.

There were elected into the council: George, Earl of Aberdeen; Davies Gilbert, Esq.; Charles Hatchett, Esq.; Captain Henry Kater; William, Lord Bishop of London; Right Hon. Charles Long; John Reeves, Esq.; Richard Anthony Salisbury, Esq.; Edward, Duke of Somerset; Glocester Wilson, Esq.

Since the last anniversary 21 members have died, one has withdrawn, and 25 new members have been admitted. The present number of members is 652, of which 40 are foreign members.

The Copley medal was adjudged to Captain Henry Kater, for his experiments on the length of the pendulum vibrating seconds.

On Dec. 11, a paper by Capt. James Burney was read, on the geography of the north-eastern part of Asia, and particularly respecting the question whether the continents of Asia and America are united. From the account of different travellers and navigators, especially among the Russians, it would appear that there is still a considerable part of what is usually laid down in the maps as forming the coast of the northern ocean, which has never yet been accurately traced. The maritime boundary of the country of the Tchuktchi has never been explored; and, so far as can be learned from the inhabitants themselves, they are ignorant of the extent of their own territory in the northern direction. Captain Bhering and Captain Cook, who successively made very important discoveries in the narrow part of the sea, composing what is now called Bhering's Straits, were never able to penetrate farther N. than about the 70° of latitude. Beyond this, on the American continent, we are completely without any information; and on the Asiatic side, we seem to have little certain knowledge, until we arrive at the River Kovyma, for about 20° of longitude. We have some imperfect accounts of a large tract of land lying beyond what is now marked on the maps as the N. E. part of Asia, to which the name of New Siberia has been given. This may either be an island detached from either continent, or it may be a part of America, stretching over to the westward; but respecting this country, if it actually exist, our information is very scanty.

On Dec. 18, a paper by James Smithson, Esq. was read, containing some remarks on vegetable colours. Among the substances which he examined were litmus, the colouring matter of the violet, of the blue hyacinth, of the blue paper which is employed for wrapping up loaf sugar, of the mulberry, and the pigment called sap-green. Some of these are employed by chemists as delicate tests of acids and alkalies; and various experiments were related respecting their action on these bodies, and the manner in which they were respectively affected by them. The author conceives it probable that some vegetable colours may be produced by a combination of principles, that the red colour of flowers may depend upon the union of carbonic acid with a blue matter, and that in other cases a vegetable principle may be combined with a small quantity of potash, analogous to the substance which has been called ulmin. The author also gave an account of some experiments which he had performed upon the green colour which is procured from certain insects: this he was led to conclude is of a different nature from the vegetable greens.

On the same evening a paper by Dr. John Davy was read, giving an account of the mountain called Adam's Peak, in the Island of Ceylon. This has been long celebrated as the resort of pilgrims from all parts of the country, in consequence of a superstitious tradition that the Indian god Boodha ascended into heaven from its summit, and left upon it the impression of his foot. The mountain is supposed by the author to be between

6,000 and 7,000 feet high. It has a level area at its top, of nearly a circular form. The summit is surrounded by a grove of trees of the genus rhododendron, but of a species which is said to grow in no other situation. The plants are accounted sacred, so that it was impossible to procure a specimen for examination. The mountain itself is composed of gneiss, the constituents of which exist in very different proportions in its different parts. In some districts hornblende predominates so much as almost to change the character of the rock; but this passes by insensible degrees into a more perfect gneiss, without exhibiting any exact limit of separation. The author observed some of the gems, which are the produce of Ceylon, imbedded in the gneiss which composes this mountain.

WERNERIAN NATURAL HISTORY SOCIETY.

The first meeting of the Wernerian Natural History Society for this session took place in the College Museum on Nov. 15. It was moved by Professor Jameson, and unanimously agreed to, that, in consequence of the melancholy event of the death of the Princess Charlotte of Wales, the Society should immediately adjourn, without proceeding to business.

The Wernerian Natural History Society met again on the 6th inst. when the following office-bearers were chosen:

President.—Robert Jameson, Esq. F.R.S.

Vice-Presidents. — Colonel Imrie, F.R.S.; John Campbell, Esq. F.R.S.; Lord Gray, F.R.S.; Sir Patrick Walker, F.L.S.

Secretary.—P. Neil, Esq. F.R.S.

Treasurer.—W. Ellis, Esq.

Librarian and Keeper of the Museum.—James Wilson, Esq.

Painter.—P. Syme, Esq.

Council.—Dr. Macnight, F.R.S.; C. S. Monteath, Esq. F.R.S.; Dr. Wright, F.R.S.; Dr. Yule, F.R.S.; D. Bridges, Esq.; Dr. D. Ritchie, F.R.S.; Dr Falconer, F.L.S.; T. Sivright, F.R.S.

Professor Jameson at this meeting read a communication from William Scoresby, jun. M.W.S. &c. entitled, "Narrative of an Excursion upon the Island of Jan Mayen, containing some Account of its Appearance and Productions." This remote and desolate spot, situated in lat. 70° 49′ to lat. 71° 8° 20″ N. and long. 7° 25′ 48″ to 8° 44′ W. was visited by Captain Scoresby, jun. on Aug. 4, 1817. On approaching it, the first object which strikes the attention is the mountain of Beerenberg, which rears its icy summit to the height of 6840 feet above the level of the sea. At this time all the high lands were covered with snow and ice; and the low lands, in those deep cavities where large beds of snow had been collected, still retained part of their winter covering, down to the very margin of the sea. Between capes North-east and South-east, Captain Scoresby observed three remarkable icebergs, having a perpendicular height of 1284 feet, and presenting a striking resemblance to frozen cascades. The beach where Capt. Scoresby landed was covered to a great depth with a sand having the appearance of coarse gunpowder, and which was a mixture of iron-sand, olivine, and augite. Here and there he met with pieces of drift wood. As he advanced towards the rocks he found rolled masses of lava, blocks of burned clay, and masses of red-coloured backed clay. Numerous pointed, angular rocks, probably belonging to the floetz formation, were seen projecting through the sand. These were basaltic-vesicular, and with numerous and beantiful imbedded grains and crystals of olivine and augite. Along with these was a rock which appeared to be very nearly allied to the celebrated mill-stone of Andernach. After leaving the sea shore, Captain Scoresby met with no other rocks but such as bore undoubted marks of recent volcanic action, viz. cinders, earthy slag, burned clay, scoriæ, vesicular lava, &c. He ascended to the summit of a volcanic mountain which was elevated 1500 feet above the sea, where the beheld a beautiful crater, forming a basin of 500 or 600 feet in depth, and 600 or 700 yards in diameter. The bottom of the crater was filled with alluvial matter, to such a height that it presented a natural flat of an elliptical form, measuring 400 feet by 240. From this eminence the country in all directions appeared bleak and rugged in the extreme; and the rocks, and hills, and mountains, every where presented to the eye such appearances as seemed to indicate the action of volcanic fire. The plants are very few in number: he determined the rumex digynus, saxifraga tricuspidata, arenaria peploides? silene acaulis, and draba hirta: all the others were unfortunately lost. Near the sea shore he observed burrows of blue foxes: feet marks of bears, and of another animal, which he conjectured to be the rein-deer. But few birds were seen, such as fulmars, divers, puffins, and terns.

GEOLOGICAL SOCIETY.

The first meeting for business took place on Nov. 21.

A letter from R. Anstice, Esq. accompanying a specimen of arragonite from the Quantock Hills, was read.

The Quantock Hills consist chiefly of greywacke, but are penetrated by a bed of mountain lime-stone running through a great part of their length. In a quarry near the village of Merridge, about six miles from Bridgewater, is a fissure in this limestone rock, which has been for some time famous for its calcareous stalactites. Recently this fissure has been cleared to a greater extent than before; and Mr. Anstice visited the spot in the month of August last, when he found that, after proceeding along it for about 40 yards, the passage suddenly became contracted.

The narrow part being enlarged at his desire, it was found to lead into a cavern about 20 yards in length, from six to ten yards in breadth, and from three to six feet in height along the middle. About one-third of its surface was covered with stalactites of arragonite (*flos ferri*) of great beauty. This cavern is situated in the greywacke; and Mr. Anstice remarks, that the arborescences of arragonite occur only in that rock, while those which are found adhering to the lime-stone are common calcareous stalactite.

A letter was read from Mr. Winch, mentioning the discovery of a tree about 28 or 30 feet long, with its branches, in a bed of *fire-stone* (one of the coal sand-stones) at High Heworth, near Newcastle. Of this organic remain the trunk and larger branches are siliceous; while the bark, the small branches, and leaves, are converted into coal: and Mr. Winch remarks, that the small veins of coal, called by the miners *coal-pipes*, owe their origin universally to small branches of trees. Mr. W. states it as a remarkable and interesting fact, that, while the trunks of trees found in the Whitby alum shale are mineralized by calcareous spar, clay-iron-stone, and iron pyrites, and their bark is converted into jet; those buried in the Newcastle sand-stones are always mineralized by silex, and their bark changed into common coal.

A paper by Dr. Berger was read, containing a theoretical explanation of the curvature of the beds of lime-stone which form the Jura mountains.

Dec. 5.—The reading of a paper by Mr. W. Phillips, entitled, "Remarks on the Chalk Hills in the Neighbourhood of Dover, and on the green Sand and blue Marl overlying it near Folkestone," was begun.

Dec. 19.—The reading of Mr. Phillips's paper was continued.

ROYAL ACADEMY OF SCIENCES AT PARIS.

Sept. 1, 1817.—The following papers were read:

A memoir on aneurism, by M. Provençal.

A description of the oyster-beds of Maremmes, by M. de Montègre.

An offer made by an anonymous individual to contribute a sum of 7000 fr. for the purpose of founding a prize for the encouragement of inquiries into subjects connected with statistics, was referred to a committee.

Sept. 8.—A letter from the Minister of the Interior was read, communicating the King's approval of the election of M. Piazzi into the class of Foreign Associates.

A paper, entitled "Researches on Chlore and on Hydrochloric Acid," by M. Rosier, was referred to the consideration of a committee.

M. Lamarck gave an account of a paper addressed to the Academy by M. Dupetit Thouars, on the renewal of the oark of trees.

M. Fourrier, in the name of the committee to which the offer of an anonymous person to establish a prize for statistics was referred, reported their unanimous opinion that the offer should be accepted. Upon which the Academy resolved that application should be made to the Minister of the Interior requesting his Majesty's authority to accept the sum thus liberally offered for the above-mentioned purpose.

M. Geoffroy-Sainte-Hilaire read a memoir on the structure of the *os hyoides* in different animals.

Sept. 15.—After some letters had been read, the remainder of the sitting was occupied by two memoirs: the one by M. Moreau de Jonnès, entitled, "A Geological and Mineralogical Examination of the Volcanic Mountains of Vauclin, in the Island of Martinique;" and the other by Gen. Sauviac, "On the Ocean."

Sept. 22.—M. Fevre presented the continuation of his "Essay on the Construction of Chemical Tables," which was referred to a committee.

A report was made on "Maps of the Kingdom of Portugal," by Jose Correa de Mello and Pedro Cardoso Giraldes.

M. Sylvestre, in the name of a committee, made a report on a memoir by M. Huzard, jun.; the object of which is an inquiry into the qualities which characterized the English horses before their amelioration, the present state of the breed, and the methods by which the English have succeeded in producing those qualities to which their horses are indebted for the high esteem in which they are now held.

M. Portal read a paper, entitled, "Considerations on Peritoneal Inflammation."

Sept. 29.—M. Arrago read a letter from M. Dupin giving an account of an Aurora Borealis observed by him at Glasgow.

The reading of M. Moreau de Jonnès's memoir was proceeded with.

A memoir by M. Lapostolle on conductors against lightning was referred to a committee.

Oct. 6.—M. Coquebert-Montbret began the reading of a very minute report on the circumnavigation of the globe, by M. Krusenstern.

A letter was read from M. Henri, *Ingenieur des Ponts et Chaussées,* dated Florac, depart. de la Lazère, giving an account of a mass of native oxide of iron in which are many particles of native iron, found in the bed of a torrent near Florac. Messrs. Haüy and Vauquelin were requested to examine the specimens accompanying the paper.

Oct. 13.—Two proof pieces of the medal struck in commemoration of the voyage of the corvette Urania were presented by the Minister of Marine.

M. Babinet, ancien élève of the Polytechnic School, presented a memoir in which he examines the precision of the formula given by M. Laplace on the deviation of bodies falling from a great height.

MM. Molard and Ampère read a report on the new lamp invented by Lord Cochrane; but the Academy being informed that a similar investigation had been undertaken by orders of the Minister of Marine, suspended further proceedings on the subject, and ordered the committee to give their assistance to the commissioners appointed by the Minister.

M. Girard gave in the report of a committee on the alidographe of M. de Saint-Far. This instrument resembles the common plane table, with the addition of a graduated arc, which may be read off to minutes, and to which a telescope may be adapted, in order to enable it to serve the purpose of a theodolite.

M. Cauchy read a memoir on the resolution of polynomials into real factors of the second degree.

Oct. 20.—The death of M. Genty, Correspondent of the Academy, was announced.

M. Coquebert-Montbret concluded his report on the voyage of M. Krusenstern round the globe.

A memoir by M. Opoix on a method of preserving butter fresh was read, and was referred to M. Thenard.

Oct. 27.—M. Sorlin presented a memoir on spherical trigonometry, which was referred to MM. Legendre and Delambre.

M. Girard read a memoir on the flowing of ether and certain other fluids through capillary glass tubes.

M. Bosc presented the report of a committee on a statistical description of the district of Maremmes, by M. Guillet. In this paper the most important article is a relation of the management of the oyster pools. The oysters are obtained by dredging off Oleron and the Isle of Aix, and such as are small and round are selected to be fattened in the pools. These pools are spaces on the river bank from 800 to 900 yards square in extent, and are surrounded with a dam to keep out the tide. The successful management of these pools depends on four circumstances: first, not to overcrowd the pools with oysters: secondly, to transfer the oysters once a year from the exhausted pool to one which has been vacant for an entire twelvemonth before: thirdly, to increase the depth of water during winter, that the oysters may not be hurt by the frost: fourthly, to prevent the rain-water from finding its way into the pools. Three years at least are required to bring the oysters to a marketable state, and the longer they remain the more fat and delicate they become.

MM. Laplace and Coquebert-Montbret were appointed to draw up the bill of mortality, to be inserted in the memoirs of the Academy, according to custom.

Article XIII.

Scientific Intelligence, and Notices of Subjects connected with Science.

I. *Lectures.*

Mrs. Lowry is about to recommence her Lectures on Mineralogy.

Mr. Guthrie, Deputy Inspector of Military Hospitals, will commence his Spring Course of Lectures on Surgery, on Monday, Jan. 19, at five minutes past eight in the evening, in the waiting room of the Royal Wesminster Infirmary for Diseases of the Eye, Marylebone-street, Piccadilly. To be continued on Mondays, Wednesdays, and Fridays.

Mr. Thomas Bell, F.L.S. will commence his Lectures on the Structure and Diseases of the Teeth, &c. at Guy's Hospital, on Friday, Jan. 9, at half-past five o'clock.

II. *Safety Lamp for Coal-Mines.*

A publication has been forwarded to the Editors, eutitled, a "Report upon the Claims of Mr. Geo. Stephenson relative to the Invention of his Safety Lamp, by the Committee appointed at a Meeting holden in Newcastle, on Nov. 1, 1817." The Editors of the *Annals*, not choosing to take any part in the controversy between the friends of Sir H. Davy and of Mr. Stephenson, have not inserted the Report of a Committee of Sir H. Davy's friends assembled at Sir Joseph Banks's; and for the same reason shall abstain at present from noticing the proceedings of Mr. Stephenson's friends. At some future time, however, they mean to take up the subject, and to give, with all the impartiality in their power, a history of the experiments instituted, and of the machines invented, for the purpose of preventing explosions in coal-mines.

III. *Fluor Spar in Scotland.*

Fluor spar, although abundant in England, is one of the rarest simple minerals found in Scotland. Hitherto it has been met with but in two places: at Monaltree, in Aberdeenshire, where it forms one of the constituents of a galena vein in granite; and in the remote island of Papa-Stour, one of the Shetlands, in vesicular cavities in amygdaloid, associated with chalcedony, calcareous spar, and heavy spar. A few months ago Professor Jameson, during his investigation of the mineralogy of Renfrewshire, again met with this rare substance, near the village of Gourock, in vesicular cavities in porphyry.

IV. *Chromate of Iron in Shetland.*

Dr. Hibbert, who lately visited the Shetland Islands, with the view of determining their geognostical structure and relations, found in the Island of Unst considerable masses of that valuable substance the chromate of iron.

V. *Botanical Specimens from Switzerland.*

J. C. Schleicher, of Bex, in the canton de Vaud, who has long been known as a dealer in seeds and dried specimens of Swiss plants, is now in London, for the purpose of furnishing the herbaria of English botanists with the Alpine, and other indigenous plants of Switzerland. He has published a catalogue of genera and species, from which persons may select whatever specimens they wish at a very moderate price.

VI. *Davy's Safety Lamp.*

An addition has been made to this valuable apparatus by Mr. Newman, by which it appears probable that its utility will be increased. It consists in attaching to the lower part of the wire-gauze a convex lens. The effect of this is, that the miner will have it in his power to direct a strong light upon any particular part where it may be required, while the lens has the further advantage of covering a portion of the gauze, and preserving it from the coal dust and oil, by which, without considerable care, it is liable to be obstructed.

VII. *Effect of Hot Water on Flowers.*

The following fact, as far as we know, has not yet appeared in print. It is, however, deserving of record, as an interesting contribution to what has hitherto been discovered on the subject of vegetable physiology, and as enabling the lovers of flowers to prolong for a day the enjoyment of their short-lived beauty.

Most flowers begin to droop and fade after being kept during 24 hours in water: a few may be revived by substituting fresh water; but all (the most fugacious, such as the poppy, and perhaps one or two others excepted) may be completely restored by the use of *hot* water. For this purpose place the flowers in scalding water, deep enough to cover about one-third of the length of the stem: by the time the water has become cold the flowers will have become erect and fresh: then cut off the coddled end of the stems, and put them into cold water. *Probatum est.*

VII. *Third Volume of the Memoirs of the Society of Arcueil.*

The third volume of the memoirs of this respectable society has been lately received in London. It contains a number of valuable papers; but many of them have been written for some time, and their contents have been already made public: an account of several of them has been given in the preceding volumes of the *Annals*. We shall embrace an early opportunity of communicating to our readers an abstract of the more recent papers: in the mean time, it may not be uninteresting to have a list of the whole:

On the Properties of the different Species of Rays which may be separated by Means of the Prism from the Solar Spectrum. By M. J. E. Berard. (For an account of this paper see *Annals of Philosophy*, vol. ii. p. 161.)

Memoir upon a new detonating Substance. By M. Dulong. (For an account of this substance, see Thomson's Chemistry, vol. i. p. 215, fifth edit.)

Considerations on Vegetable Analysis and Animal Analysis. By M. Berthollet.

Observations on the Mercurial Precipitates, and on those of Sulphate of Alumine. By M. Berthollet.

Experiments to determine if Alcohol exists ready formed in Wine. By M. Gay-Lussac.

On a Method of imitating artificially the Phenomena of Colours produced by the Action of thin Plates of Mica upon polarized Rays. By M. Biot. (For an account of M. Biot's experiments on the manner in which light is affected by passing through thin plates of various substances, see *Annals of Philosophy*, vol. i. p. 225; vii. 4; viii. 294.

Description and Use of a repeating Goniometer. By M. Malus.

On a remarkable Law which is observed in the Oscillations of luminous Particles, when they cross obliquely thin Plates of Sulphate of Lime or Rock Crystal, cut parallel to the Axis of Crystallization. By M. Biot.

Continuation of the Observations on the inflammable Gases, styled Carburetted Hydrogen and Oxicarburetted Hydrogen. By M. Berthollet. (The paper of which this is stated to be the continuation is contained in the second volume of these memoirs.)

Experiments on the Proportion of the Elements of Nitric Acid. By M. Berthollet.

Observations on the Composition of Oxymuriatic Acid. By M. Berthollet.

On the Influence of the Pressure of the Air upon the Crystallization of Salts. By M. Gay-Lussac.

Researches upon the Laws of the Dilatation of Fluids at all Temperatures. By M. Biot. (A translation of this paper was inserted in the *Annals of Philosophy*, vol. ix. p. 363.)

Memoir on the Geography of the Plants of France, considered in its Relations with absolute Height.

Memoir on the Colour of thin Plates. By M. Arrago. (Some account of M. Arrago's experiments on light will be found along with those of M. Biot, as referred to above.)

Comparative Examination of the Intensity of Action which the extraordinary repulsive Force of Iceland Spar exercises upon the luminous Molecules of different Colours. By M. Biot.

General Considerations on double Flowers, and in particular on those of the Family of the Ranunculacea. By M. Delandolle.

Memoir on the Combinations of Phosphorus with Oxygen. By M. Dulong.

Notice respecting the Decomposition of the Sulphate of Barytes and of the Subcarbonate of Lime by Potash. By M. Berthollet.

On the Isothermal Lines and the Distribution of Heat over the Globe. By Alex. von Humboldt.

The Editors have received an account of some experiments that have been performed by Dr. Murray, of Edinburgh, on the composition of muriatic acid, which they regret they were not able to insert in the present number.

Article XIV.

New Patents.

George Manwaring, Esq. Marsh-place, Lambeth; for improvements in steam-engines. May 22, 1817.

Philip Hutchinson Clay, of London, gentleman; for a combination of machinery for repairing and improving turnpike and other roads and highways, and keeping the same in good order. May 22, 1817.

Seth Hunt, late of the United States of America, now living in Covent Garden, Esq.; for an improved escapement for clocks, and watches, and chronometers. Communicated to him by a foreigner residing abroad. May 22, 1817.

Seth Hunt, late of the United States of America, now of Covent Garden, Esq.; for certain combinations of improvements in machinery for making pins. Communicated to him by a foreigner residing abroad. May 23, 1817.

Gabriel Tigere, Duke's-court, Bow-street, gentleman; for a process of manufacturing writing paper in such a way that it will be extremely difficult, if not impossible, afterwards to extract or discharge any writing from such paper. June 3, 1817.

Charles Wyatt, of Bedford-row, coppersmith: for a new method or methods of preventing any disadvantageous accumulations of heat in manufacturing and refining sugar. June 3, 1817.

Benjamin Ager Day, of Birmingham; for certain improvements in chimney ornaments, which are so constructed that they may be used for fire-screens, flower or sweet jars, time-piece cases, candlesticks, toast-stands, and various other purposes. June 3, 1817.

John Parnall, brazier, of Saint Anstell, Cornwall; for a method of tinning, or covering with tin, sheets or plates of copper, brass, or zinc. June 10, 1817.

Thomas Whittle, a wharfinger at Chester, and George Eyton, of the same place, gentleman; for a new or improved kiln, for the purpose of drying malt, wheat, oats, barley, peas, beans, and other substances, by means of steam, assisted by air. June 10, 1817.

Under the head of Patents we have to announce to our readers that Mr. *Leger* Didot (not *Roger*, as mentioned by mistake, in the list of new patents contained in our last number) has just completed the specification of his patent for improvements upon the machines already in use, for making wove and laid paper, in continued lengths, or separate sheets; and we do it the more especially, as from the great length of the specification, and the extensive drawings necessary to elucidate it, there seems little probability of its being made public in any other way. In the improved machines the ordinary paper moulds can be carried forwards in an endless succession, and paper made upon them in sheets, with the usual wire marks, just the same as by hand, or it may be made of any required length, and without the marks. The same machine will also make paper upon an endless revolving wire web, as in a former patent machine of the same artist.

Article XV.

Scientific Books in hand, or in the Press.

The second part of the second volume of the Memoirs of the Wernerian Natural History Society will appear the first week in January.

Mr. Parkes has just completed a new edition of his Chemical Catechism.

Dr. Adams is about to publish a new edition of his Life of Mr. John Hunter.

Mr. Mill's History of British India is just ready for publication.

J. C. Curwen, Esq. M.P. is about to publish Letters written during a Tour in Ireland: they are principally on subjects connected with the Agriculture and internal Prosperity of that important Portion of the United Kingdom.

The Rev. J. Yates, M.A. is about to publish four Discourses on the Effects of drinking Spirituous and other intoxicating Liquors. This work is designed to serve as a popular and practical treatise, combining powerful persuasives, derived from the influence of spirituous liquors upon the morals and the understanding, with an accurate description of their effects upon the bodily frame; in compiling which the author has availed himself of the opinions and testimonies of Drs. Willan, Lettsom, Heberden, Linnæus, Rush, Trotter, Beddoes, Aikin, and various other writers.

Article XVI.

Magnetical and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Magnetical Observations, 1817. — *Variation West.*

Month.	Morning Observ. Hour.		Morning Observ. Variation.			Noon Observ. Hour.		Noon Observ. Variation.			Evening Observ. Hour.	Evening Observ. Variation.
Nov. 1	8h	20′	24°	32′	16″	1h	30′	24°	38′	52″		Owing to the shortness of the days, evening observation discontinued.
2	8	35	24	32	02	1	55	24	37	58		
3	8	35	24	31	46	1	30	24	40	00		
4	—	—	—	—	—	1	25	24	39	38		
5	—	—	—	—	—	1	35	24	39	36		
6	—	—	—	—	—	1	25	24	38	28		
7	8	35	24	31	53	1	25	24	39	26		
8	8	30	24	32	43	1	25	24	40	27		
9	8	35	24	32	10	1	55	24	38	47		
10	8	30	24	31	45	1	20	24	39	02		
11	8	20	24	31	16	—	—	—	—	—		
12	8	30	24	32	28	1	25	24	38	07		
13	8	30	24	33	37	1	20	24	42	27		
14	8	35	24	30	35	—	—	—	—	—		
15	8	55	24	31	52	1	40	24	35	55		
16	8	35	24	31	06	1	35	24	36	44		
17	—	—	—	—	—	1	25	24	37	16		
18	8	35	24	31	58	1	10	24	35	34		
19	8	35	24	31	00	1	25	24	35	14		
20	8	40	24	31	29	—	—	—	—	—		
21	8	30	24	31	10	1	20	24	38	21		
22	8	30	24	32	16	1	30	24	37	52		
23	8	35	24	31	28	1	45	24	37	08		
24	8	25	24	31	07	1	30	24	36	23		
25	8	25	24	30	37	1	30	24	33	52		
26	8	40	24	31	38	1	35	24	38	00		
27	8	40	24	32	00	1	40	24	37	48		
28	8	35	24	34	10	1	35	24	38	00		
29	8	40	24	32	17	1	35	24	35	54		
30	8	35	24	30	38	1	30	24	36	53		
Mean for the Month.	8	34	24	31	49	1	31	24	37	55		

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Nov.		Inches.				Feet.		
1	Morn....	29·835	36°	70°	W		Clear	35
	Noon....	29·923	49	50	W by S		Very fine	50
	Even	—	—	—	—		—	
2	Morn....	29·778	42	69	SSE		Cloudy	36
	Noon....	29·750	54	68	SSW		Cloudy	55
	Even	—	—	—	—		—	
3	Morn....	29·813	52	91	S by W		Foggy	51
	Noon....	29·800	53	79	S by E		Mizzle	54
	Even	—	—	—	—		—	
4	Morn....	—	—	—	—		—	50
	Noon....	29·635	53	77	SSE		Foggy	54
	Even	—	—	—	—		—	
5	Morn....	—	—	—	—		—	46
	Noon....	29·480	53	75	SSE		Very fine	54
	Even	—	—	—	—		—	
6	Morn....	—	—	—	—		—	48
	Noon....	29·500	54	80	SE		Foggy	55
	Even	—	—	—	—		—	
7	Morn....	29·310	53	68	S		Fine	49
	Noon....	29·200	57	62	SSE		Very fine	58
	Even	—	—	—	—		—	
8	Morn....	29·058	50	76	SSW		Showery	49
	Noon....	29·017	55	57	SW by S		Fine	56
	Even	—	—	—	—		—	
9	Morn....	29·240	47	67	SW by W		Fine	45½
	Noon....	29·356	51	52	WSW		Very fine	52
	Even	—	—	—	—		—	
10	Morn....	29·545	48	90	SW by S		Foggy	45
	Noon....	29·545	53	70	WSW		Cloudy	54
	Even	—	—	—	—		—	
11	Morn....	29·288	48	68	SE by S		Fine	47
	Noon....	—	—	—	—		—	54
	Even	—	—	—	—		—	
12	Morn....	29·328	49	88	SE		Cloudy	45
	Noon....	29·210	54	78	SSE		Cloudy	55
	Even	—	—	—	—		—	
13	Morn....	29·340	41	76	SW		Very fine	41
	Noon....	29·362	49	53	S		Cloudy	53
	Even	—	—	—	—		—	
14	Morn....	29·110	52	85	SE by S		Foggy	42
	Noon....	—	—	—	—		—	54
	Even	—	—	—	—		—	
15	Morn....	28·873	53	85	SSW		Rainy	48
	Noon....	28·980	50	70	W by N		Showery	54
	Even	—	—	—	—		—	
16	Morn....	29·455	45	87	SW		Very fine	44
	Noon....	29·500	53	75	SSW		Cloudy	54
	Even	—	—	—	—		—	
17	Morn....	—	—	—	—		—	45
	Noon....	29·785	56	76	SW by W		Cloudy	57
	Even	—	—	—	—	—	—	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Nov.		Inches.				Feet		
18	Morn....	29·788	51°	77°	SW by S		Cloudy	51°
	Noon....	29·788	56	88	SW by W		Drizzle	57
	Even	—	—	—	—		—	40
19	Morn....	30·005	41	77	WNW		Very fine	
	Noon....	30·020	50	62	NW by W		Very fine	50
	Even	—	—	—	—		—	38
20	Morn....	30·047	39	84	NW		Foggy	
	Noon....	—	—	—	—		—	—
	Even	—	—	—	—		—	37
21	Morn....	29·470	45	75	WSW		Drizzle	
	Noon....	29·425	49	71	W		Cloudy	50
	Even	—	—	—	—		—	38
22	Morn....	29·749	39	78	Calm		Fine	
	Noon....	29·720	47	59	WNW		Fine	47
	Even	—	—	—	—		—	40
23	Morn....	29·670	41	70	W by S		Cloudy	
	Noon....	29·627	43	61	W		Cloudy	44
	Even	—	—	—	—		—	42
24	Morn....	29·416	43	79	W by S		Cloudy	
	Noon....	29·368	48	67	W		Cloudy	48
	Even	—	—	—	—		—	35
25	Morn....	29·363	36	66	W by N		Very fine	
	Noon....	29·485	39	64	WNW		Fine	39
	Even	—	—	—	—		—	35
26	Morn....	29·590	45	79	W by N		Cloudy	
	Noon....	29·650	50	61	WNW		Cloudy	51
	Even	—	—	—	—		—	43
27	Morn....	29·675	47	70	W		Cloudy	
	Noon....	29·693	50	62	W		Cloudy	50½
	Even	—	—	—	—		—	41
28	Morn....	29·677	46	73	SW by W		Cloudy	
	Noon....	29·654	49	65	SW		Fine	50
	Even	—	—	—	—		—	44
29	Morn....	29·535	48	95	SW by S		Drizzle	
	Noon....	29·505	54	76	W by S		Cloudy	54
	Even	—	—	—	—		—	49
30	Morn....	29·530	52	86	W by S		Drizzle	
	Noon....	29·545	54	83	SW		Drizzle	54
	Even	—	—	—	—		—	

Rain fallen between noon, Nov. 1, and noon, Dec. 2, 1·827 inch.

Evaporation during the same period, 1·22 inch.

Difference, 0·607 inch.

The rain-gauge and evaporator are 16 feet 3 inches above the ground, and 497 feet above the Thames low water-mark, at low spring tides, at Somerset House.

Article XVII.

METEOROLOGICAL TABLE.

1817.	Wind.	Barometer. Max.	Min.	Med.	Thermometer. Max.	Min.	Med.	Hygr. at 9 a. m.	Rain.
11th Mo.									
Nov. 2	S	30·19	30·11	30·150	57	41	49·0		
3	S E	30·10	30·06	30·080	54	49	51·5		
4	S E	30·06	29·91	29·985	55	45	50·0		
5	S E	29·88	29·85	29·865	54	44	49·0		
6	S	29·85	29·69	29·770	55	49	52·0		6
7	S W	29·69	29·43	29·560	58	50	54·0		·13
8	S W	29·61	29·35	29·480	55	44	49·5		5
9	W	29·90	29·61	29·755	51	40	45·5	63	
10	S W	29·89	29·66	29·775	55	44	49·5	95	
11	S E	29·70	29·68	29·690	52	38	45·0	62	·14
12	S W	29·73	29·49	29·610	55	38	46·5	100	2
13	S E	29·73	29·48	29·605	52	38	45·0	70	—
14	S E	29·48	29·26	29·370	54	49	51·5	86	·76
15	W	29·79	29·26	29·525	55	40	47·5	80	·10
16	S W	30·15	29·79	29·970	54	39	46·5		
17	S W	30·17	30·16	30·165	59	50	54·5	83	
18	W	30·38	30·16	30·270	57	35	46·0	67	
19	N W	30·45	30·43	30·440	49	30	39·5	85	
20	S W	30·43	29·87	30·150	46	38	42·0	96	
21	N	30·12	29·87	29·995	52	37	44·5	72	
22	N W	30·12	30·05	30·085	47	37	42·0	73	
23	W	30·05	29·82	29·945	46	41	43·5	65	
24	W	29·78	29·70	29·740	49	32	40·5	71	—
25	W	30·00	29·78	29·890	44	34	39·0	64	·15
26	N W	30·07	30·00	30·035	52	40	46·0	78	
27	S W	30·08	30·06	30·070	51	37	44·0	65	
28	S W	30·06	29·92	29·990	49	40	45·5	67	
29	S W	29·93	29·87	29·900	54	49	51·5	78	3
30	S W	29·87	29·79	29·830	54	52	53·0	79	5
12th Mo.									
Dec. 1	S W	29·79	29·54	29·665	54	46	50·0	80	·51
		30·45	29·26	29·878	59	30	47·11	76	2·00

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Eleventh Month.—2 to 4. Nearly calm: dripping mists, with alternate obscurity, by *Cirrostratus*, and sunshine. 5. A slight shower at night. 7. A gale at S.W.: showers by night. 8. Squally: several showers in the day. 9. Windy, fine, with *Cumulus*, *Cirrus*, and *Cirrostratus*. 10. Misty morning: *Cirrus*, *Cirrostratus*: fair day: windy at night. 11. Fine morning: then quickly overcast and wet, a.m. 12. Red sun-rise: then *Cirrostratus*, speedily general: cloudy till evening: windy at night. 13. Fine morning, with *Cirrostratus*: fair day: rather windy night. 14. Much *Cirrostratus* in the morning: rain by half past nine: fair evening. 15. Wet, gloomy morning: calm and lighter, mid-day: p.m. the wind went to W., and blew strong: clear night. 16. Coloured *Cirri* with *Cirrostratus* at sun-rise: misty: steady breeze, with some appearance of distant rain: cloudy evening. 17. Fair: somewhat windy night. 18. Fair: *snow* fell within a few miles of us: evening twilight luminous and orange-coloured. 19. *Cirrocumulus*, *Cirrus*, and *Cirrostratus*: abundant dew on the grass all day: very fine sky. 20. Very misty, a.m.: the trees drip much: fine, p.m. with dew and large *Cirri*. 21. Cloudy: rather windy: little or no dew this morning: *Cirrostratus*, *Cumulus*: the wind to N. at night. 22. Fair: *Cirri* in lofty bars, stretching N. and S., followed by *Cirrocumulus*, and a group of clouds among the smoke of the city. 23. Fine, clear morning: grey sky after. 24. *Cirrostratus*, with *Cirrus*, at sun-rise: a little light rain, p.m.: lunar corona, followed by a large faint halo. 25. Hoar frost: a steady gale through the day, with an appearance of *Nimbi* in the NW: rain after sun-set. 26—28. Fair: somewhat windy, with *Cirrostratus*, &c. 29. The hygrometer stood at 78° till noon: and a little rain fell, a.m. and at night: the bees came out in considerable numbers, continuing about the hive. 30. Overcast, windy: the maximum temp. at nine, a.m. or rather, the whole 24 hours warm alike.

Twelfth Month.—1. A wet day.

RESULTS.

Winds southerly and westerly.

Barometer:	Greatest height	30·45 inches.
	Least	29·26
	Mean of the period	29·878
Thermometer:	Greatest height	59°
	Least	30
	Mean of the period	47·11

Mean of the hygrometer, 76°. Rain, 2 inches. Evaporation, 1·02 inch, divided as follows: to the 9th, 0·27; to the 15th, 0·40; to the 23d, 0·23; to the end, 0·12.

Tottenham, Twelfth Month, 18, 1817. L. Howard.

ANNALS

OF

PHILOSOPHY.

FEBRUARY, 1818.

Article I.

Biographical Account of Lord Stanhope.

Charles Stanhope, third Earl Stanhope, was born in the year 1753. His grandfather, the first Earl Stanhope, was eminently distinguished both for his military and his political talents; his father, the second Earl, although less known in a public capacity, was likewise a man of ability, and particularly directed his attention to the study of the mathematics, in which he made considerable proficiency. The two first Earls Stanhope were both of them warmly attached to the Whig party, and on all occasions, both as members of the legislature and of the community at large, uniformly supported what is generally termed the liberal side of all political questions. The subject of our memoir was sent very young to Eton College, but at the age of ten was removed from it, in order to accompany his father's family to Geneva, who took up their residence for some time in that city, in consequence of the delicate health of the eldest son, who died shortly after, and thus left Charles to assume the title of Viscount Mahon, and to support the hereditary dignity of the family. They continued at Geneva for ten years, so that the late Earl passed in that city the period of life which is the most important for the formation of the character, and for the acquisition of those habits which must tend, in a great degree, to determine the future pursuits of the individual. His education was conducted under the inspection of M. le Sage, a man of considerable ingenuity, who is known as the author of a theory of gravity, as well as of various tracts on different topics connected with mineralogy, chemistry, and the other departments of natural philosophy. During his residence in Switzerland, the young nobleman made a considerable advance in his scientific pursuits, especially in those branches to which he afterwards so sedulously devoted himself. While he was still in Geneva, and of course before he was twenty years of age, he actually obtained a prize from the Society of Arts and Sciences at Stockholm, for the best essay on the structure of the pendulum: it was written in French, and was published among the Transactions of the Society. It appears, however, that the other objects which we conceive to be essential to complete the education of a man of rank, were not neglected, and that he even distinguished himself for his dexterity and adroitness in various athletic accomplishments, such as horsemanship, and the military exercises.

He may be considered as having almost inherited from his father and grandfather a peculiar set of political opinions, and those would be fostered by the mode of his education, and the associations which he would form by his residence at Geneva. He accordingly acquired a decided attachment to all those principles and measures which he supposed to be favourable to the liberty of the subject, in opposition to the privileges or encroachments, as he conceived them to be, of the aristocracy and monarchy. By most persons he was considered as carrying his notions of liberty to a very extravagant or even dangerous length; so that in the latter part of his life he was deserted by all his political associates, and, in his capacity as a member of the legislature, was not unfrequently left without a single individual to support his measures. Justice, however, requires that while we lament or condemn his rashness and impetuosity, we applaud his honesty and integrity. It does not appear that in any single instance he was swayed either by the gross motives of self-interest, or even by the more pardonable object of ambition. He seems always to have been influenced by a sense of duty, and, although mistaken in his judgment, he acted from conviction. He first appeared on the theatre of politics as a candidate for Westminster, in which he was unsuccessful; but he was returned for the borough of Wycombe, and continued a member of the Lower House until, upon the death of his father in 1786, he took his seat as a Peer of the realm. He was extremely assiduous in the discharge of his parliamentary duties during a great part of his life; and even those who are the most disposed to differ from him in his general views and system, must admit that, on various occasions, he either introduced or actively supported measures of undoubted utility. During his latter years he retired, in a great measure, from his attendance on parliament, probably irritated by the general opposition which he experienced, an opposition which he ascribed to the increasing prejudices of his antagonists, but which, at least in an equal degree, originated in the greater warmth with which he supported his opinions, and the more objectionable tendency of the opinions themselves.

But although Lord Stanhope was most known by his contemporaries as a politician, his reputation with posterity will depend more upon his talents as a philosopher, and it is indeed solely on this ground that he becomes an object of our attention. He appears indeed to have been no less assiduous in his endeavours to promote the progress of useful knowledge of all descriptions, than he was in his schemes of patriotism; and in both of them we may observe the influence of the same cast of character, and the same direction of his mental energies. He seldom entered into any speculations or experiments respecting abstract science, but generally confined his attention to the improvement of some of the mechanical arts, or to some inventions of direct or immediate practical utility. It may indeed be questioned whether any single individual among his contemporaries expended more time and money in the prosecution of his experiments on various topics of the above description; and in many of them there can be no doubt that his object was entirely and purely disinterested. Perhaps the only work which can be regarded of a strictly scientific nature, which was published by Lord Stanhope, was his treatise on electricity, in which he treats of the elements of the science, and endeavours to establish some new principles in the mode of action of the electric fluid. In this work he endeavours to prove the existence, and to explain the effect, of what he styles the *returning stroke*, by which he understands an electrical action, induced at a considerable distance from the principal discharge, depending upon the tendency of the fluid to equalize itself in all bodies; and on this account, after the thunder-cloud has deposited upon some part of the earth's surface its superabundant quantity of electricity, a neighbouring part of the surface becomes electrified with respect to another cloud that is contiguous to it, and of course a shock takes place of the opposite nature to the primary one, but sometimes scarcely less injurious in its effects. Some accidents from lightning have occurred since the publication of this hypothesis, which are the best accounted for by it, and which indeed could not be very easily explained upon any other principle. One of the most remarkable of these was a fatal accident that occurred in Scotland, of which an account is given by Mr. Brydone in the Phil. Trans. for 1779; and we have another very singular occurrence that took place near Manchester, narrated in the Memoirs of the Philosophical Society of that place, by Mr. Nicholson, of Liverpool. In his treatise on electricity, the great object of practical utility is not neglected; the best method of preserving buildings from the effects of lightning is minutely considered, and a set of exact directions are laid down for accomplishing this object; a point which was at that time the more important, as a considerable difference of opinion then prevailed respecting it, and a very warm controversy existed, in which, unfortunately, a question of science was involved in personal or political considerations. Lord Stanhope embraced the *philosophical* side of the question, and this has ultimately prevailed.

One of the objects of great practical utility to which his Lordship devoted much attention was the means of preserving buildings from fire. He endeavoured to accomplish this object by employing the simple and well-known principle that combustion can never take place where the air is excluded, even although the fire may act powerfully upon the surface of the combustible body. To illustrate his principle, and at the same time to put his method to the test of very ample experiment, he erected wooden houses of considerable size, rendered fire-proof according to his method, and, after filling the lower chamber with a collection of very inflammable materials, he set fire to it, and, although they burned with great fury, the flames were not able to penetrate into the upper chamber. At one of these experiments a great number of persons of distinction were present; and, during the burning of the combustible substances, sat without inconvenience in the upper apartment, partaking of a collation in which ice formed a prominent ingredient. An account of these experiments was published in the Phil. Trans. for 1778.

Another object which engrossed a considerable share of Lord Stanhope's attention was the employment of steam for the propulsion of vessels. For a period of 20 years he continued his experiments on this object, and is said to have expended very large sums of money in the prosecution of them. He is understood to have constructed two or three different kinds of apparatus which were adequate to the purpose; but in his expectation of accomplishing something that was still more perfect, he hesitated in making them public, and thus lost, in a great measure, the honour of the invention. Mr. Fulton, with less science, but with more decision, has immortalized himself by a discovery which, in its ultimate consequences, may prove, perhaps, one of the most important, even in this age of discovery. It is indeed well known that Lord Stanhope and Mr. Fulton were at one period in the habit of frequently meeting and conversing on topics connected with the improvement of the mechanical arts, and that of steam-vessels in particular. Probably no documents exist which can enable us to decide upon the share which each of them had in this invention, or to whom the priority of discovery belongs.

Besides these, which may be regarded as among Lord Stanhope's most important pursuits, he published a pamphlet on preventing frauds on the gold coin, and afterwards on Bank-notes, proceeding, in both instances, upon the obvious principle of employing very skilful workmen, whose performances could not be imitated by those who engage in attempts at forgery. He constructed a very ingenious and effective "arithmetical machine," which, by the mere revolution of a handle, was capable of working any sum in the four fundamental operations of addition, subtraction, multiplication, and division. Although there is reason to believe that the apparatus which he formed was strictly of his own invention, yet it must be observed that he was not original in his idea of forming an arithmetical machine, and that the general principle of them must probably be nearly the same. It has been asserted, upon grave authority, that his Lordship conceived the possibility of forming a reasoning machine, by which the results of certain combinations of ideas, or of elementary propositions, might be ascertained with as much ease and accuracy as those of figures. But it is scarcely necessary to observe that, independent of other difficulties, no *mechanical* process for reasoning can ever be employed until mankind have agreed upon certain general principles as decidedly as upon the value of certain numbers, and until all doubt has been removed respecting the import of words, or the combinations of them. A machine for resolving political queries would give very different answers, according as it was constructed under the superintendance of an advocate for reform, or an admirer of the infallible wisdom of our ancestors. Lord Stanhope is well known to have suggested some important improvements in the construction of the printing press, and to have been an early and active patron of the stereotype method of printing. He also wrote a scientific and ingenious essay on the method of tuning instruments; and invented a new system, which is considered as founded upon correct principles.

It is much to be lamented that, while Lord Stanhope was thus devoting his time and fortune to objects of real or supposed utility, and appeared to be guided by the purest philanthropy and the most honourable principles, either his natural disposition, or the circumstances of his life, produced a state of mind and conduct which deprived him of the endearments of domestic life, and even, in a considerable degree, of the consolations of friendship. His excessive zeal for politics, and the earnestness and good faith with which he embraced his own doctrines, seem to have rendered him incapable of supposing that those could be actuated by honourable motives who differed from him; and as it happened, unfortunately, that he was very nearly related to the family of Mr. Pitt, it led to a domestic schism, which eventually ended in the separation and estrangement of his own children. It appears, indeed, that Lord Stanhope possessed but a very small share, if any, of those amiable qualities which so essentially contribute to the real happiness of life, and which are poorly compensated by the more splendid endowments of learning or science, and cannot be superseded even by honour and integrity. Lord Stanhope died in December, 1816, in the 64th year of his age, exhibiting, in the last scene of his life, an unusual degree of philosophical resignation. He has left behind him a character which demands our respect, and which will probably be more highly estimated by posterity than it was by his contemporaries. The man of candour will regret that so much of what was valuable was obscured by what was repulsive, and the patriot will regret that so much public spirit and integrity was rendered useless by excessive zeal and undue attachment to speculative principles.

Article II.

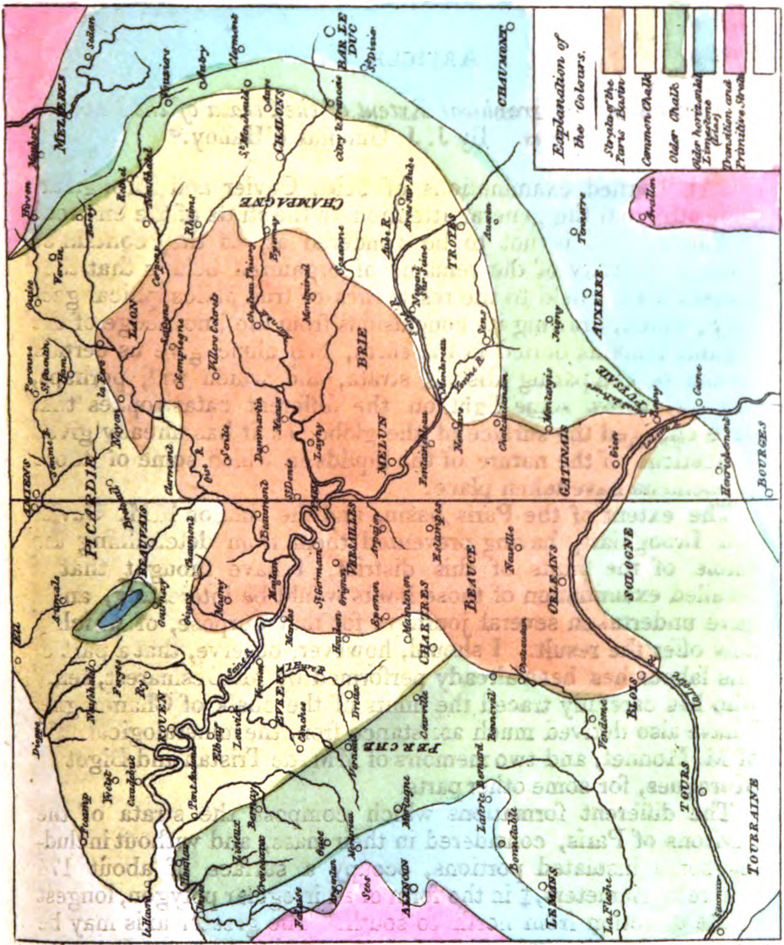
Memoir on the Geographical Extent of the Strata of the Environs of Paris. By J. J. Omalius d'Halloy.*

The learned examinations of MM. Cuvier and Brongniart have attracted the general attention to the strata of the environs of Paris. This is not to be wondered at, as they contain so great a quantity of the remains of organized beings that they present a vast field to the researches of true philosophical geology; which, drawing its conclusions from the knowledge of the organic remains buried in the earth, can alone give us certain means of comparing distant strata, and which will, perhaps, one day throw some light on the different catastrophes that have changed the surface of the globe, as it has already given indications of the nature of the liquids in which some of those phenomena have taken place.

The extent of the Paris basin, and the plan of MM. Cuvier and Brongniart, having prevented them from determining the whole of the limits of this district, I have thought that a detailed examination of those limits would be interesting, and I have undertaken several journeys for that purpose, of which I now offer the result. I should, however, observe, that a part of this labour has been already performed by M. Desmarest, sen.† who has carefully traced the limits of the chalk of Champagne. I have also derived much assistance from the mineralogical atlas of M. Monnet, and two memoirs of MM. de Tristan and Bigot de Morogues, for some other parts.

The different formations which compose the strata of the environs of Paris, considered in their mass, and without including some insulated portions, occupy a surface of about 174 square myriameters,‡ in the form of an irregular polygon, longest in the direction from north to south. The greater axis may be considered a line of 30 myriameters § drawn from Laon to Blois. The outline of this polygon passes near the towns of Laon, La Fere, Noyon, Clermont, Beaumont, Gisors, Mantes, Houdan, Chartres, Chateaudun, Vendome, Blois, Orleans, Cosne, Montargis, Nemours, Nugent-sur-Seine, Sezarme, Epernay, and Rheims. Throughout all this extent the Paris strata

* From the Annales des Mines, vol. i.
† Dictionnaire de Geographie Physique; part of the Encyclopedie Methodique.
‡ 7,100 sq. miles, English. § 328,091 English yards.



Sketch of a Geological Map of the Basin of Paris & part of the neighbouring Country by I. J. Omalius D'Halloy.

Engraved for Dr. Thomson's Annals – for Baldwin, Cradock & Joy, Paternoster Row, Feb.y 1. 1818

rest upon the chalk, which forms, as MM. Cuvier and Brongniart have observed, a vast belt around the Paris basin. (See Pl. LXXVII.)

That part of these limits north of the Seine is easily determined, being marked by its physical as well as its geological character. The Paris strata have, throughout, the form of a chain of hills, more or less indented, which rise above the chalky plain. This latter, as it approaches the foot of these hills, becomes lower, and of a more even surface than usual.

MM. Cuvier and Brongniart have described a great number of these *chutes* of the Paris strata towards the plain of chalk; but as they have not mentioned that near Damerie and Rheims, I will here describe it.

The chalk, which to the east of Paris is concealed by the strata of a posterior formation, begins to appear in the valley of the Marne below Dormans, and rises, as we proceed up the valley, so that, on arriving at the plain of Champagne, we see it forming the bases of the hills to the height of some metres above the level of the plain. This fact, which occurs also in several other parts of the borders of the Paris beds, proves, that a part of the valley of the Marne has been hollowed in the chalk, and indicates also that the low plain which occurs round the hills of the Paris strata has not merely arisen from its being the accidental form of the chalk originally, but that, to a certain extent, it is owing to the same cause as that which has worn the outer edges of the hills into the great number of irregularities which are every where met with.

I have not met with the plastic clay formation in this part, but from the observations of M. Desmarest, jun. it appears in the form of blackish earth, often of sand, sometimes of clay, and almost always impregnated with carbonaceous matter. These black strata, on which M. Desmarest proposes to publish, have much resemblance to those that are dug for the purposes of preparing sulphate of iron, and which are very common in the northern part of the Paris basin, and even in the chalky plain, where they constitute isolated deposits in the form of islands or small basins. The agreement of these black pyritous earths with the plastic clay will doubtless add much to the history of that formation of which it considerably increases the extent, at the same time that the occurrence of some of the fossils characteristic of the lime-stone with cerithia, in some of the beds of these black earths,* shows that there is a great connexion

* I have myself observed only two of the deposits of strata containing cerithia. One is at St. Marguerite, near Dieppe, where they form a small basin in the chalk. This consists of a series of beds of sand and clay, of which the first alternate with beds strongly impregnated with carbonaceous and pyritous matter, which are dug for making sulphate of iron, and beds of shells more or less broken, in which are distinguishable cerithia, and some bivalves, which I believe to belong to the genus cytherea. The other deposit is near Chateau-Thierry (Dep. of Aisne), where the valley of the Marne presents some blackish clay full of shells, among

between the plastic clay formation and that of the lime-stone with cerithia, a circumstance which was already suspected by MM. Cuvier and Brongniart.

The formation of the lime-stone with cerithia, which appears to rest immediately on the chalk between Damerie and Rheims, does not there contain any good building stone. Its beds are, on the contrary, soft and friable as at Grignon, and contain an immense number of shells. It is to this series of hills that the bed of fossils belongs, which is known by the name of Courtagnon. This name is given them because M. de Courtagnon was the first to form a large collection of these shells; they are, however, as abundant at Fleury-la-Riviere and Arthy, and more easily collected than at Courtagnon. We know that these shells are in general the same as those at Grignon. It would scarcely be expected that two deposits so far distant from each other could have so close a resemblance;* for, with a few exceptions, they consist of the same species disposed nearly in the same manner. But in respect to the state of preservation, the Courtagnon shells are superior to those of Grignon. They are harder, less bleached, and have a pearly lustre, approaching to that of recent shells. The coarse-grained lime-stone which contains them has a yellowish tinge, more like the colour of ochre than the Grignon beds. In some places it is quite friable, in others the grains are adherent; and as these different degrees of cohesion are irregularly met with in the same mass, we may suppose that the harder parts have acquired this property from the infiltration of a sort of calcareous gluten.

Above the lime-stone of a sandy appearance we see beds of compact white lime-stone alternating in the upper parts with greenish marls. I have not found any shells in situ in these

which are many oysteri cythereæ, and a cerithium similar to that found at St. Marguerite. It is very probable that this deposit is situated between the chalk and the lime-stone with cerithia, since the latter constitutes the sides of the neighbouring hills, and we meet with the chalk about a thousand yards higher up the valley.†

* The deposit of shells at Grignon owes its celebrity to the number and fine preservation of the shells it contains, and the facility of extracting them entire; but the bed to which this deposit belongs is not wanting in any of the places where even detached portions of the lime-stone with cerithia occur, and it perhaps extends to greater distances than has been suspected. This is not the place to offer proofs of this opinion. Not only within the basin of Paris, but also on its outskirts, we shall find the Grignon bed wherever we penetrate through the lime-stone containing cerithia. That bed, it is true, will not at first sight strike the observer, except when it is friable; and the shells are to be obtained entire from it as at Perne; at Viyray, near Liancourt; at Mount Ouen and Mount Javoult, near Gisors; at Septeuil, to the south-west of Mantes, &c.—*French Editor.*

† I visited this spot in August, 1813. It evidently forms part of the formation of the lime-stone with cerithia, and it is composed, as the author states, of plastic clay, pure in the inferior parts, and above mixed with sand lignites, pyrites, and the shells above noticed, also oysters in great abundance. This disposition occurs in a precisely similar way, and with the same shells, above the chalk at Marly, near Paris; at Vauxbuin, near Soissone, &c.—*French Editor.*

beds. I have found only some detached fragments of white lime-stone containing the casts of the inside of *cyclostoma mumia*, which, from some indications, I imagine to belong to the lower beds. Building stones containing great numbers of *cerithium lapidum* are also used in these cantons, principally in the neighbourhood of Dormans. It is a whitish, fine-grained lime-stone, rather porous, like the fresh-water (*calcaire d'eau douce*) lime-stone, and appears to me to be obtained from some beds situated between the true lime-stone containing cerithia, and that containing the cyclostomæ. As it resembles the latter much more than the common marine lime-stone, I should be tempted to think that it also was a fresh-water formation, and that those two beds belong to the same set of beds as the *clicart* of Mantes-la-Ville, described at p. 229 of the Mineralogical Geography of the Environs of Paris.*

The green marls are covered with another white lime-stone a little less compact than the preceding, and having the tubular cavities which are characteristic of certain parts of the fresh-water formation. It contains a large quantity of shells, among which are particularly distinguished two species of lymneæ, and a small bulimus. (*B. pusillus*, Brong.)

Lastly, the whole is surmounted with the buhr-stone (*meulières*) without shells, with the sands and clays which commonly accompany them, and which cover all the elevated plains of the neighbourhood.

This order of superposition, interesting from the series of beds it presents, is still more remarkable from the constancy and uniformity of its occurrence throughout the country that extends from Chateau-Thierry to near Rheims.

I consider all the strata situated above the lime-stone containing cerithia to belong to the fresh-water formation. This is sufficiently evident with respect to the beds which contain lymneæ, and even for those of the lower white lime-stone, which are easily recognised as agreeing with the lower part of the gypseous formation near Paris; but some explanation seems requisite in respect to the green marls, and the burh-stones without shells.

I think that I have shown † that the siliceous lime-stone belonged to the same formation as that which contains the lymneæ and other fresh-water shells.‡ This opinion gives an addi-

* Many geological circumstances, as well as the zoological agreements, induce me to suspect that the *cerithium lapidum* ought to be classed with the potamides of M. Brongniart, or cerithia of the fresh-water formations. This shell, which differs but little from the *Potamides Lamarkii*, seems to me to have this peculiarity, that it is found in the later marine beds, and in the earliest beds of fresh-water formation, and that it is the only fossil of the marine formation which exists in situ in that of fresh-water.

† Notice on the existence of a lime-stone of fresh-water formation in the departments of the Cher, &c. (Journal des Mines, vol. xxxii, p. 481.)

‡ Further observations which will be published in the second edition of the Mineralogical Geography of the Environs of Paris, induce us to agree entirely with this opinion of M. D'Halloy. We have now direct proof that the siliceous

tional reason for attributing the same origin to the buhr-stones (*meulières*) without shells; for we know that, on the one hand, these buhr-stones have much resemblance to certain flints (*silex*) of the siliceous lime-stone; and on the other, that they so much resembled the fresh-water buhr-stones with shells, that the authors of the Mineralogical Geography of the Environs of Paris had a difficulty to find decided characters to distinguish them. It seems to me that analogies so strong, and uncontradicted by any positive facts, are sufficient to establish this opinion.

We may, to a certain extent, reason in the same manner on the green marls of the neighbourhood of Damerie, which do not contain shells, and are placed between two sets of beds of fresh-water origin. I should here observe, that I have never met to the east of Chateau-Thierry with traces of marine beds later than the first fresh-water formation, as if the land in those parts had been too much elevated to be covered by the waters of the sea, which returned (perhaps repeatedly) to inundate the plain of Paris. This fact is important, and merits an attempt to verify it in a greater number of places.

The country of which I have just given an account is one of the best examples of the relations which exist between the geological disposition of the soil and its agricultural productions. The whole of the chalky plain is cultivated, and produces corn. The sides of the hills of lime-stone containing cerithia are covered with vines; and as this lime-stone is almost always friable, and has consequently spread itself over the chalky base of the hills, the culture of the vine extends also to the level of the plain. The real chalky soil is not in general fit for the growth of the vine; and it is well, in order to avoid an error that may arise from the habit one has, in speaking of Champagne, of associating the ideas of a chalky soil with one that produces good wines, to remark, that the vineyards producing what is called the Champagne wine are generally on the exterior limits of this district (*region physique*). Those of the western side, which produce the most esteemed wines, are, as we have just seen, on the beds of lime-stone with cerithia, and those of the eastern side are on beds below the chalk, properly so called; beds on which I shall say a few words at the end of this memoir. Any vineyards that occur in the interior of Champagne generally are situated on some portions of one or other of these strata, which are found isolated in the true chalk.

The fresh-water lime-stone, and the marls which accompany it, are not of sufficient thickness for the adoption of any peculiar system of cultivation: often, indeed, the solidity of the calcareous beds has caused them to form escarpments too vertical to be cultivated; but M. Desmarest, jun. has observed, that

lime-stone is a part of the first of the first or lower fresh-water formation, but we cannot admit the resemblance of the upper buhr-stones, whether they contain shells or not, to the flints (*silex*) of the siliceous lime-stone.—*French Editor*.

the marls of fresh-water formation are employed with advantage to render the chalky lands fit for the growth of the vine.

Lastly, the elevated plains of the formation of the buhr-stones are generally covered with forests or heaths, which, by the large rocks that are found scattered over the surface, recal to mind primitive countries.

The limits of the Paris beds in the part of the basin situated to the south of the Seine do not long maintain that decided physical demarcation which characterises those of the north. This arises from the changes of the geological constitution of the soil—changes which I am about to point out in a general manner.

General Considerations on the Disposition of the Strata of the Paris Basin: their Division into four principal Formations.

Although we are in the habit of considering the different formations of the Paris basin as being placed horizontally over each other, and they appear to be actually so in the central parts of the basin, we should observe, that in taking a general view of the strata, they have a decided inclination towards the south; and, to a certain extent, resemble a set of wedges placed like the tiles of a roof, with this peculiar circumstance, that the lowest wedge attains the greatest height.

1. *First marine Formation.*—This first series (*etage*) of beds is, as is well known, the lime-stone with cerithia. Its most elevated point appears to be at the northern extremity of the basin, in the hills of Laon, which are about 300 metres above the sea,* and where this lime-stone is not covered by any of the other formations. From the summits of these hills the level of this stratum gradually falls. It dips under the other deposits and disappears entirely on the south of the Marne and the Seine.

2. *First fresh-water Formation.*—The second series (*etage*), or first set of beds of fresh-water formation, which, as I have said above, I consider to be composed of the siliceous lime-stone, the gypsum, and the first fresh-water lime-stone and marls, does not begin to appear till some distance to the north of the Marne and the Seine. In the environs of Paris it does not rise above 150 metres, but it probably attains a greater elevation on the eastern side, and particularly towards the borders of Champagne. This formation prevails throughout a considerable space of a triangular shape. It dips under the later formations in the same manner as the preceding, and disappears near to a line drawn in the direction from north-west to south-east, from Houdan through Arpajon to Nemours. In the greater part of this surface, that is to say, in the part covered by the siliceous lime-stone, the lime-stone with cerithia is entirely wanting, as was remarked by MM. Cuvier and Brongniart. Its place is to be

* Lemaitre, Journal des Mines, No. 35, p. 853

traced only in some parts by the plastic clay which separates the siliceous lime-stone from the chalk.

3. *Second marine Formation.*—The strata of the third series (*etage*) have a disposition different from those of the two preceding; but before I describe it, I should state the geological extent which I attribute to this series.

MM. Cuvier and Brongniart, with the clearness and precision which they have shown throughout their work, have distinguished and characterized three particular sets of strata between the two fresh-water formations; namely, the marine marls above the gypsum, the sands and sand-stones without shells, and the upper sands and sand-stones with shells. Now, in considering these strata in a general manner, I think that we may perceive a large formation constituting the second marine epocha of the Paris basin. In fact, the sands and the sand-stones without shells are placed between two sets of beds, of which the fossils are nearly similar. The upper one is of the same nature as the strata without shells, which is here distinguished only by this negative character. The lower set of beds is not so different from it as it appears to be at first sight, since we know that a bed belonging to any formation may be of a calcareous or a quartzeous nature, according to its situation. This is actually the case in this instance, as at Etampes; the sand-stones and grits without shells rest immediately on a sandy deposit containing many shells, among which are distinguished a great number of pectunculi, cythereæ, &c.; that is to say, the same fossils as are found in the sand that in other parts covers the grit without shells. Lastly, the absence of organic remains in this latter mass is only a repetition of a fact of frequent occurrence, namely, that the mollusques diminish in numbers, and even disappear entirely, in liquids that deposit siliceous matters.*

The second marine formation, limited in this manner, is not so concentrated as the first fresh-water formation. It begins to appear sooner towards the north; but on the right bank of the Seine it in general is seen only in thin parcels. It is in greater masses to the south of that river, constituting the escarpments, capes, and islands (*ilot*), which form the characteristic features of the country extending towards Fontainebleau, Versailles, Epernon, &c. Probably the facility with which the sandy strata yield to the action of water is the cause of this physical disposition, by the denudation of the mass of sand that reached from these escarpments to the detached parcels on the right bank.

I do not know that the sandy strata have been observed at a greater height than 200 metres above the sea. They follow the general rule of inclining towards the south, and dip under the second fresh-water formation, disappearing totally to the south of a line drawn from Chartres to Nemours.

* We adopt entirely this opinion of the author on the extent of this second marine formation.—*French Editor.*

known under the name of *Brie*, is, on the contrary, damp, and covered with marshes, owing to the clays which accompany the siliceous lime-stone, and the buhr-stones with which the soil is almost every where covered.

The sandy strata of the second marine formation has not (as a predominating formation) a sufficient geographical extent to constitute a physical region; but all the elevated plains where it appears are covered with vast forests.

The *Beauce*, or the great elevated plain of fresh-water lime-stone between the Seine and the Loire, is remarkable for its uniformity, and the almost exclusive culture of corn (*graines cereales*).

The sandy deposit which covers the fresh-water lime-stone constitutes to the south-east of the Beauce a particular region, corresponding with the country generally called the Gatinais, a low damp country of little fertility, and for the most part covered with forests.

This same sandy soil, mixed with the mud deposited by the Loire, supports vineyards of such a considerable extent along the river from Orleans to Blois, that it may be considered as a small physical region separating the Beauce from the Solagne.

What has been stated of the physical and geological constitution of the part of the basin situated to the south of the Seine is sufficient to indicate that of its limits in those countries: I will therefore content myself with a rapid view of them.

We have seen in the work of MM. Cuvier and Brongniart that these limits could be traced decidedly from Mantes to Epernon. It is the same as far as Gué-de-Longroi to the east of Chartres, where the right bank of the Voise offers an inclination, which constitutes the border of the Parisian formations, opposite to the chalky plain of the environs of Chartres. This plain, as well as those to the north of the Seine, is at first low, and even rather rising towards the hills of the Perche.

The limits then run in a direction towards the south-west, passing near Bonneval, and follow, at a certain distance, the course of the Loire as far as opposite Vendome, when they turn towards Blois. But here there is no real physical demarcation. The soil of the Parisian strata is almost on the same level as the chalky plain, a circumstance caused by the cessation of all the inferior formations, as before stated.

From this point it becomes very difficult to trace the real limits of the strata of the Paris basin on the south of the Loire, because they are lost under the sandy deposits of indeterminate origin above mentioned. However some *affleurement*, and the artificial openings of quarries, discover the fresh-water lime-stone all along the left bank of the Loire, from Blois to Cosne, but with this difference, that the chalk which was concealed by the sand in the northern part of the Solagne rises above Gien, and forms elevations on both sides of the Loire, which inclose the small tongue of the fresh-water lime-stone that is formed along the river from Gien to Cosne. Thus the Parisian strata which, through so large a space cover the chalk, and are afterwards confounded with it on the same level, at length terminate in a valley lower than the chalk hills which surround it.

Taking up the limits of the Paris basin from this south-eastern extremity, we shall see that they are not much more clearly to be traced along the canal of Briare than in the neighbourhood of the Loire, but that they reassume their character to the north of Montargis, and particularly about Nemours, where the stand-stones without shells reappear.

Such is the extent of the Paris basin considered as a whole; for the different formations composing it are prolonged by ramifications of greater or less extent beyond these limits. The fresh-water beds in particular extend to considerable distances. I have already shown that they extended along the banks of the Loire and the Allier, and to the elevated plains of the Berry.* We know, moreover, that it forms another basin of considerable extent in the Dimagne of Auvergne. We again find them, though in smaller quantity, towards Tours and Le Mans.

The second marine formation forms also some isolated deposits beyond the limits of the basin; at least I think I can refer to this formation the deposits of white sand-stone found in the plains of Picardie, and as far as the departments of the north end of Jemappe, as well as those which are found in the chalk country between the Seine and the Loing.

The plastic clay, in the form of black pyritous earths, is also found in detached parts on the chalk to the north of the Seine; and it appears that there are other clay deposits at a considerable distance from the basin of Paris, which, although resting on strata older than the chalk, may be referred to this formation.

The lime-stone with cerithia, properly so called, appears on the contrary to be confined to the limits of the Paris basin; and this is a very remarkable circumstance in the history of this formation; at least I have not yet observed it elsewhere, although I have made a point of examining the places where, from mineralogical resemblances, the existence of this bed was supposed, and where I found the calcareous formations older than the chalk, properly so called, having the coarse texture and yellowish colour of the building stone of Paris.

* Journal des Mines, vol. xxxii. p. 43.

Article III.

Register of the Weather in Iceland, by two Danish Gentlemen sent to survey the Coasts, with a Supplementary Register by Mr. Gladstone.

(To Dr. Thomson.)

SIR, *Liverpool, July* 25, 1817.

I visited Iceland in the summer of 1813, at which time the Governor of the island presented me with a copy of a journal of the weather kept during the years 1811, 1812, and 1813, by two Danish officers, sent thither by the King of Denmark for the purpose of making a survey of the coasts. This document has never, I believe, been made public; nor did I think of doing so until my friend Dr. Traill, of this place, suggested to me that it might be an acceptable contribution to your journal.

I have, therefore, taken the liberty of transmitting it to you, together with a register of thermometer kept by myself during my stay in the island, from the 1st of May until the middle of August. To this is subjoined a continuation until the end of November following, which I subsequently received from Mr Park, the British Consul resident there.—You will also find amongst these papers some observations on the weather, made during a part of the summer of the preceding year (1812), which I likewise procured from the same gentleman. Of all these you will please to make such use as you may think proper.

I remain, respectfully, Sir, your most obedient servant,

David Gladstone.

Register of the Weather kept in the northern Part of the Island of Iceland (Eyafjord), from the Month of June, 1811, *until June,* 1813. *Extracted from the Journal of Captain Van Scheels.*

The barometer used is divided into degrees and lines (tenths) The thermometer used was Reaumur's, divided into degrees and tenths of a degree.

The letters, which express the degree of force and strength of the wind, denote as follows: A, the lowest degree; B, a breeze; C, a fresh breeze; D, a gale; E, a storm; F, a hurricane.—The terms used to express the kind of weather are supposed to stand in the following order: 1, clear (i. e. when scarcely a cloud is visible); 2, partially clear; 3, cloudy; 4, thick; 5, foggy. ☇, marks thunder; and Π, ice to be on the coast.

General Observations.

On July 10, 1811, thunder was heard at Axarfjord, and also by the author of this journal (Capt. Scheels) whilst on a journey. On the 5th of September, 1811, Capt. S. first observed the comet, which was visible this year under the constellation Ursa Major.

On July 7, 1812, thunder was heard at Eyafjord, and on the 19th the snow was so deep as to touch a horse's saddle.*

About February 10, 1813, a ring of a singular appearance was observed round the moon.

On April 25, 1813, the barometer was higher (28·97) than it was observed at any time since the commencement of Capt. Scheels's observations in September, 1807.

There was ice in the Bay of Eyafjord in 1811, and it did not leave the coast before the middle of July. In 1812 much more ice arrived from Greenland than in the preceding year; which had not disappeared from the eastern and northern coasts of the island about the 8th or 12th of August.

In 1808, also, a great deal of ice appeared on the coast.

In 1809 there was very little ice in the Bay of Eyafjord; but on July 17, from Drangajokul in Isafjord Syssel, a great quantity was seen out at sea, round Cape du Nord. In 1807 the whole northern coast was encircled with ice, except Faxéfjorden, which did not depart from Langesnes before August 20 or 22. In 1810 no ice appeared.

1811.	Barometer. †			Thermometer.			Wind.			Degrees of Wind.	Observations.
	Morning.	Mid-day.	Evening.	Morning.	Mid-day.	Evening.	Morning.	Mid-day.	Evening.		
June 1	28 1·4	28 1·4	28 1·5	— 1·2	0·0	— 2·0	NE	NE	NE	B	Thick snow.
Sun. 2	28 1·2	28 0·6	28 0·1	— 1·0	— 0·2	— 4·1	NE	NE	NE	B	Ditto, ditto.
3	27 11·5	27 10·8	27 10·4	— 4·5	0·0	— 3·8	—	—	—	B	Ditto, ditto.
4	27 10·5	27 10·1	27 10·3	— 2·4	0·7	— 3·0	—	—	NW	B	Ditto, ditto.
5	27 9·3	27 8·6	27 8·0	— 5·2	— 1·5	— 2·6	NW	NW	NW	D	Ditto, ditto.
6	27 8·7	27 9·3	27 9·6	— 2·2	0·7	— 1·8	NW	NW	Calm	C	Foggy.
7	27 11·4	28 0·2	28 0·9	5·5	8·2	10·0	SW	SW	SW	B	Cloudy.
8	28 1·3	28 0·7	27 11·1	6·0	8·6	3·0	S	NW	Calm	—	Clear.
Sun. 9	27 7·4	27 6·6	27 6·7	0·0	0·1	— 0·5	NE	NE	N	D	Rain, snow.
10	27 7·9	27 8·4	27 9·3	0·0	0·3	— 1·2	N	N	N	C	Thick ditto.
11	27 9·3	27 9·5	27 9·8	0·7	2·0	— 0·8	N	N	N	C	Thick snow.
12	27 9·6	27 9·4	27 9·2	1·5	3·5	— 0·5	N	N	N	C	Ditto, ditto.
13	27 9·5	27 9·6	27 9·3	3·5	4·8	0·3	N	N	N	C	Thick fog.
14	27 9·0	27 9·1	27 9·1	2·4	3·6	0·2	SW	SW	SW	C	Ditto, ditto.
15	27 7·9	27 8·6	27 9·3	— 1·0	2·8	0·5	SW	SW	SW	B	Cloudy.
Sun. 16	27 9·6	27 10·1	27 11·1	2·6	5·8	0·9	SW	W	Calm	B	Ditto.
17	27 10·0	27 10·1	27 11·1	8·5	11·8	1·8	NW	NW	NW	D	Ditto.
18	27 8.7	27 8·8	27 9·8	3·0	1·8	— 0·3	NW	NW	N	C	Snow, rain.
19	28 2·0	28 3·4	28 5·1	0·6	1·8	— 0·5	NW	NW	NW	B	Cloudy.
20	28 4·9	28 4·4	28 0·6	4·0	7·1	7·8	Calm	E	S	A	Clear.
21	27 10·6	27 9·3	27 7·1	10·0	11·4	10·0	SW	SW	SW	E	Cloudy.
22	27 8·0	27 11·1	27 11·4	11·2	14·0	10·0	SW	SW	SW	D	Ditto.
Sun. 23	27 10·0	28 0·5	28 0·6	13·6	15·9	7·2	S	S	NW	F	Ditto.
24	28 0·9	27 11·5	27 10·0	10·2	13·5	10·3	SW	SW	SW	E	Ditto.
25	27 11·2	27 11·3	27 11·3	11·0	13·3	10·5	SW	SW	SW	E	Ditto.
26	27 11·2	27 11·3	27 11·1	5·3	9·0	8·5	N	N	SW	A	Ditto.
27	28 11·4	27 11·6	28 0·3	9·0	13·3	11·0	SW	SW	SW	D	Ditto.
28	28 0·5	28 0·2	28 0·7	13·5	16·3	9·0	SW	SW	N	B	Rain.
29	28 1·5	28 1·3	28 1·1	9·3	9·0	10·2	S	S	N	A	Ditto.
Sun. 30	28 1·0	28 0·9	27 11·6	8·0	7·5	6·3	—	—	—	—	

* The Icelandic horses are small, not more than 10 or 12 hands high.

† The Barometer is noted in French inches.

1811.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
July 1	27 9·6	27 9·7	27 10·8	10·4	16·1	11·3	S	S	S	A	Cloudy.
2	28 0·1	28 0·2	28 0·2	8·5	10·7	7·0	—	—	NE	A	Ditto.
3	28 0·2	27 11·7	27 11·4	7·3	9 0	8·0	—	—	S	A	Rain.
4	27 11·8	27 11·7	27 11·6	10·3	12·5	9·0	—	—	—	A	Partially clear.
5	28 0·6	28 1·3	28 2·1	13·0	15·2	6·5	—	N	N	A	Cloudy.
6	28 1·3	28 1·1	28 0·5	10·0	9·3	8·5	—	—	Calm	A	Ditto, π
Sun. 7	28 0·3	28 0·3	28 0·3	9·5	11 5	6·4	N	N	N	A	Clear.
8	28 0·3	28 0·1	28 0·0	9·0	13·4	9·2	—	—	—	A	Ditto.
9	28 0·6	28 0·7	28 0·7	9·5	14·5	10·0	Calm	—	—	A	Cloudy.
10	28 0·3	28 0·0	27 11·6	6·0	5·0	4·5	N	—	—	A	Thick fog.
11	27 11·0	27 9·4	27 8·8	5·0	8·2	6·0	Calm	N	—	A	Rain, ⊕
12	27 8·3	27 8·0	27 8·6	7·5	11·2	6·5	SW	SW	SW	B	Rain.
13	27 9·1	27 9·8	27 10·6	6·3	12·0	6·0	W	N	N	A	Ditto, cloudy.
Sun. 14	27 10·3	27 10·4	27 10·3	6·0	7·0	2·0	Calm	NE	NE	B	Thick.
15	27 10·4	27 9·8	27 9·9	2·5	5·5	5·0	NE	—	—	B	Ditto.
16	27 10·2	27 9·8	27 9·7	8·0	14·3	7·5	E	E	Calm	A	Cloudy.
17	27 11·0	27 11·1	27 11·7	5·0	6·3	4·8	N	N	N	A	Ditto.
18	27 11·0	27 10·0	27 10·0	10·0	16·0	10·2	Calm	S	—	A	Clear.
19	27 9·4	27 10·0	27 10·0	10·0	13·6	8·5	S	—	S	A	Partially clear.
20	27 8·8	27 7·1	27 8·0	9·0	12·3	10·5	—	—	—	A	Rain.
Sun. 21	27 11·4	27 11·9	28 0·0	9·5	12·4	7·0	S	N	N	A	Clear.
22	27 10·6	27 8·6	27 8·0	4·5	9·3	5·0	N	E	E	A	Rain.
23	27 7·0	27 5·8	27 6·0	4·8	6·0	3·5	E	—	—	A	Ditto.
24	27 6·6	27 6·3	27 5·2	4·8	8·5	4·6	W	E	NE	A	Ditto.
25	27 6·0	27 9·3	27 10·4	4·5	6·5	5·7	N	N	N	A	Ditto.
26	28 0·3	28 0·4	28 2·1	8 6	10·5	5·3	NW	NW	NW	B	Cloudy, π
27	28 2·3	28 1·5	28 1·4	6·0	6·0	6·0	N	N	Calm	A	Foggy.
Sun. 28	27 11·1	27 10·8	27 10·7	2·8	4·0	3·6	N	N	N	A	Rain.
29	27 10·4	27 10·6	27 10·4	3·5	7·8	4·7	—	—	—	A	Ditto.
30	27 10·0	27 10·6	27 10·4	3·6	7·5	5·0	—	—	—	A	Ditto.
31	27 10·2	27 9·8	27 9·7	6·4	14·0	9·3	S	S	S	A	Thick.
Aug. 1	27 9·1	27 8·1	27 8·0	9·0	12·0	4·9	E	E	N	B	Rain.
2	27 10·1	27 9·4	27 8·7	8·7	10·0	6·0	—	NE	E	B	Ditto.
3	27 6·4	27 5·6	27 4·9	4·9	10·6	9·2	NE	E	—	B	Ditto.
Sun. 4	27 7·3	27 8·4	27 8·6	7·0	12·2	9·0	SE	SE	SE	B	Cloudy.
5	27 8·5	27 7·0	27 7·3	7·0	4·5	5·0	Calm	NE	NE	B	Rain.
6	27 10·3	27 11·0	27 11·3	6·0	5·3	4·6	—	—	—	B	Ditto.
7	28 0·4	28 0·4	28 0·4	4·6	8·4	4·6	NE	—	—	B	Ditto.
8	28 7·0	28 2·4	28 2·4	5·4	8·7	4·0	E	E	E	B	Cloudy.
9	28 3·8	28 3·6	28 3·6	4·2	6·5	3·7	Calm	N	N	A	Ditto.
10	28 4·1	28 3·6	28 2·4	2·8	5·3	4·7	—	—	—	A	Foggy.
Sun. 11	28 1 0	27 11·3	27 10·5	4·8	7·0	4·4	Calm	N	N	A	Rain.
12	27 10·3	27 10·5	27 10·8	4·6	6·9	5·0	NE	NE	NE	B	Ditto.
13	27 11·0	27 11·0	28 0·0	5·2	9·2	6·0	S	N	Calm	A	Cloudy.
14	28 0·6	27 10·2	27 6·5	5·5	8·2	6·5	Calm	S	S	A	Rain.
15	27 3·4	27 1·7	27 2·7	7·2	11·3	7·0	E	E	NE	B	Ditto.
16	27 7·1	27 8·3	27 9·0	3 5	3·7	4·0	NE	NE	—	D	Ditto.
17	27 8·0	27 7·0	27 6·6	3·7	8·2	4·7	Calm	Calm	S	A	Ditto.
Sun. 18	27 8·0	27 7·8	27 8·2	4·3	9·7	4·0	SW	SW	SW	B	Ditto.
19	27 10·2	27 11·0	28 0·0	3·2	4·0	2·3	NE	N	N	A	Thick.
20	28 0·0	27 11·0	27 10·1	1·3	12·0	5·4	N	—	—	A	Cloudy.
21	27 7·1	27 6·3	27 8·7	6·5	12·3	6·0	S	S	S	E	Rain.
22	27 8·5	27 8·0	27 7·3	7·2	11·7	8·5	—	—	S	A	Cloudy.
23	27 6·7	27 6·0	27 5·1	7·3	11·5	5·6	—	—	NE	A	Rain.
24	27 5·0	27 6·7	27 8·0	5·2	4·0	2·4	NE	NE	—	B	Ditto.
Sun. 25	27 9·9	27 9·0	27 8·9	2·0	6·5	2·7	Calm	NE	—	B	Ditto.
26	27 8·4	27 8·0	27 7·9	3·6	5·0	4·2	NE	—	—	E	Ditto.
27	27 8·0	27 8·4	27 7·3	4·5	6·3	4·0	—	—	—	D	Ditto.
28	27 4·0	27 3·3	27 3·0	3·1	3·7	2·4	—	—	—	E	Ditto.
29	27 6·0	27 8·1	27 10·3	3·1	5·0	4·1	—	—	—	B	Ditto.
30	28 0·1	28 0·1	27 11·9	3·0	6·0	4·9	—	—	—	B	Ditto.
31	27 11·9	28 0·6	28 2·0	3·2	3·5	2·5	—	—	—	B	Foggy.

1811.	Barometer. Morning.	Mid-day.	Evening.	Thermometer. Morning.	Mid-day.	Evening.	Wind. Morning.	Mid-day.	Evening.	Degrees of Wind.	Observations.
Sep. 1	28 3·3	28 3·4	28 3·3	1·7	4·5	4·7	N	N	N	A	Cloudy.
2	28 2·0	28 1·2	28 1·0	4·3	9·7	7·9	S	S	S	A	Ditto.
3	28 0·4	28 0·1	27 11·7	6·0	9·7	7·2	—	—	—	A	Ditto.
4	27 9·2	27 9·2	27 10·4	9·0	13·3	9·7	SW	SW	SW	B	Rain.
5	27 7·4	27 9·1	27 11·1	10·2	14·1	7·5	—	—	—	E	Cloudy.
6	27 11·1	27 10·2	27 10·8	3·0	8·3	6·3	S	S	S	A	Partially clear.
7	28 1·0	28 1·5	28 1·0	4·3	7·9	7·6	W	W	W	E	Ditto.
Sun. 8	27 9·4	27 9·6	27 9·9	8·8	11·0	6·3	SW	SW	SW	E	Cloudy.
9	27 9·4	27 9·9	27 9·7	7·0	11·5	8·4	—	—	N	B	Ditto.
10	27 7·0	27 6·2	27 6·2	7·3	11·1	4·5	—	—	SW	B	Ditto.
11	27 11·1	28 0·1	28 1·0	0·4	7·3	2·5	NW	NW	Calm	E	Thick.
12	28 1·0	27 9·0	27 9·0	— 1·5	6·0	3·5	Calm	Calm	SE	B	Rain.
13	27 9·1	27 9·3	28 1·0	6·0	6·4	4·3	E	E	E	B	Ditto.
14	27 0·0	27 11·3	27 11·7	5·6	8.9	6·5	W	E	W	A	Ditto.
Sun. 15	27 11·2	28 10·7	27 11·1	6·3	13·2	10·3	Calm	S	S	A	Cloudy.
16	28 0·5	28 0·5	28 0·4	6·9	13·4	10·2	SE	—	—	B	Ditto.
17	28 0·4	28 0·5	28 0·5	7·0	12·2	7·3	SW	SW	SW	B	Ditto.
18	28 0·0	27 11·3	27 11·5	7·0	12·1	7·5	S	S	S	A	Ditto.
19	27 11·1	27 10·1	27 10·0	5·0	13·0	8·7	SW	SW	SW	B	Rain.
20	27 8·2	27 7·5	27 7·1	6·4	11·2	7·0	S	S	S	A	Ditto.
21	27 5·0	27 5·5	27 5·9	9·2	9-5	7·0	—	—	—	A	Ditto.
Sun. 22	27 5·7	26 8·3	26 8·5	6·5	7·3	5·7	SE	SE	SE	B	Cloudy.
23	26 10·5	26 11·4	27 1·5	5·0	8·0	5·7	SW	SW	SW	B	Rain.
24	27 4·3	27 5·0	27 6·1	4·6	5·8	4·3	W	W	—	B	Ditto.
25	27 6·3	27 7·0	27 8·2	1·5	4·0	1·0	—	—	—	B	Partially clear.
26	28 0·2	28 1·4	28 1·8	— 0·6	4·8	1·8	—	—	—	B	Ditto.
27	28 0·2	28 1·7	28 1·5	1·0	5·2	— 1·2	S	S	S	A	Ditto.
28	28 1·6	28 1·0	28 0·8	1·6	4·2	— 0·8	N	N	N	A	Ditto.
Sun. 29	28 1·3	28 1·3	28 1·5	— 0·5	3·8	0·7	N	Calm	Calm	A	Ditto.
30	28 1·6	28 1·8	28 2·0	1·0	3·2	— 0·6	Calm	N	Calm	A	Ditto.
Oct. 1	28 3·6	28 3·8	28 3·6	1·2	4·8	1·6	S	SE	SE	B	Foggy.
2	28 2·3	28 1·8	28 0·7	1·3	5·8	3·7	SW	SW	SW	C	Cloudy.
3	28 0·3	27 11·6	27 11·2	1·8	7·2	8·4	SW	SW	SW	E	Ditto.
4	27 10·8	27 11·4	27 11·8	0·3	3·4	0·5	N	N	N	A	Ditto.
5	28 0·1	28 0·4	28 1·2	0·5	4·1	1·0	—	—	—	A	Partially clear.
Sun. 6	28 1·6	28 1·6	28 1·4	0·8	5·4	1·6	NW	NW	NW	B	Snow, rain.
7	28 1·3	28 1·0	28 1·0	1·4	6·8	3·0	—	S	S	A	Ditto, ditto.
8	28 0·3	28 0·5	28 0·8	2·1	6·6	2·8	—	E	SE	A	Ditto, thick.
9	27 11·0	27 9·8	27 7·3	3·2	4·8	3·8	E	—	E	A	Foggy.
10	27 6·7	27 6·0	27 4·0	4·0	6·2	6·0	S	SE	SE	B	Rain.
11	27 3·1	27 3·5	27 3·8	3·6	5·8	4·0	N	—	—	B	Cloudy.
12	27 4·1	27 4·8	27 5·5	4·5	6·2	4·0	—	N	W	A	Rain.
Sun. 13	27 1·6	27 7·0	27 7·2	2·0	3·6	0·5	—	—	N	A	Cloudy.
14	27 8·3	27 9·2	27 9·6	— 1·5	2·8	— 1·0	W	W	W	A	Partially clear.
15	27 7·8	27 7·4	27 5·8	2·0	4·7	2·8	—	—	—	A	Thick.
16	27 4·0	27 3·2	27 0·8	1·0	3·8	2·1	S	SW	SW	B	Foggy.
17	26 11·2	26 10·0	26 9·3	2·6	4·8	3·0	SW	—	—	B	Cloudy.
18	26 10·4	26 11·8	27 1·6	0·5	5·2	1·6	S	—	—	E	Ditto.
19	27 3·8	27 4·5	27 6·2	— 1·0	3·7	1·5	—	—	—	D	Ditto.
Sun. 20	27 7·3	27 6·1	27 5·9	0·8	3·6	1·0	N	N	N	A	Partially clear.
21	27 5·6	27 6·8	27 7·2	0·5	2·4	1·5	—	—	—	A	Thick, rain.
22	27 6·4	27 5·5	27 2·9	— 1·0	0·8	— 1·4	Calm	Calm	Calm	A	Foggy.
23	27 0·1	27 0·6	27 1·7	2·0	3·1	1·5	E	—	S	A	Ditto, rain.
24	27 3·7	27 4·3	27 3·5	0·5	2·0	— 0·1	S	—	Calm	A	Snow.
25	27 1·8	27 2·3	27 2·8	0·0	— 0·7	— 3·0	N	N	S	A	Much snow.
26	27 6·1	27 7·1	27 6·4	— 3·8	— 1·5	— 1·2	S	S	W	A	Cloudy.
Sun. 27	27 7·6	27 8·1	27 9·1	— 1·5	0·8	2·8	—	SE	SE	E	Ditto.
28	27 10·0	27 10·0	27 10·0	2·2	2·7	2·0	SE	SE	E	E	Ditto.
29	27 9·7	27 9·6	27 9·4	2·0	3·0	1·8	—	—	—	C	Ditto.
30	27 9·7	27 9·9	27 10·1	1·6	2·0	— 0·3	—	—	SE	C	Ditto.
31	27 9·8	27 9·7	27 9·5	— 1·2	2·8	— 0·8	—	—	—	B	Ditto.

1811.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
Nov. 1	27 8·0	27 6·0	27 4·2	1·8	3·0	1·5	N	N	SE	A	Rain.
2	27 1·1	27 0·7	27 0·1	1·6	3·8	3·0	SE	SE	—	B	Ditto.
Sun. 3	27 0·3	27 0·1	27 0·2	2·6	4·0	1·4	N	N	N	A	Ditto.
4	27 0·8	27 2·6	27 2·8	2·6	3·4	— 0·7	NE	NW	NE	A	Cloudy.
5	27 1·6	27 1·2	27 0·5	— 0·5	0·6	2·1	NW	W	W	A	Rain, snow.
6	27 2·3	27 4·1	27 6·3	— 0·6	0·8	0·0	NE	NE	NE	D	Ditto, ditto.
7	27 7·3	27 7·9	27 9·2	0 0	0·2	— 9 5	SW	SW	SW	E	Cloudy.
8	27 9·8	27 9·5	27 9·2	— 2·0	— 0·5	1·1	S	S	S	C	Rain, snow.
9	27 8·7	27 8·2	27 8·0	1·0	1·5	1·0	SW	SW	SW	B	Thick.
Sun. 10	27 7·8	27 7·5	27 7·1	— 0·6	— 0·8	— 2·5	SW	Calm	S	B	Clear.
11	27 7·9	27 8·6	27 11·4	— 5·0	— 4·4	— 7·0	SE	SE	NW	D	Ditto.
12	27 8·3	27 6·9	27 3·5	— 7·0	— 6·1	— 3·7	S	S	NW	D	Snow.
13	27 3·9	27 4·4	27 2·2	— 2·5	— 3·3	— 3·1	SW	SW	Calm	C	Cloudy.
14	26 11·5	26 11·0	27 0·6	— 1·5	0·0	0·1	E	NE	NW	D	Much snow.
15	27 2·7	27 4·1	27 9·0	— 1·5	— 1·0	— 2·1	SW	SW	SW	E	Cloudy.
16	27 10·9	27 11·0	27 6·6	— 1·2	0·5	0·8	N	Calm	SE	C	Rain.
Sun. 17	27 4·8	27 4·6	27 4·8	1·8	2·3	1·7	SW	SW	SW	C	Cloudy.
18	27 6·3	27 10·5	27 11·2	1·0	2·0	— 2·3	SW	SW	SW	B	Thick, snow.
19	28 1·3	28 1·2	27 8·4	— 5·9	— 5·6	3·9	—	—	—	D	Cloudy.
20	27 6·1	27 5·6	27 3·9	1·0	3·0	2·3	—	—	—	B	Ditto.
21	27 4·3	27 4·1	27 3·9	0·0	0·0	— 2·0	—	—	—	D	Ditto.
22	27 0·8	27 0·6	27 4·1	— 3·0	— 2·1	— 3·3	—	—	—	B	Ditto.
23	27 8·2	27 10·7	27 0·6	— 7·0	— 7·0	— 9·2	—	—	S	D	Ditto.
Sun. 24	28 0·5	27 11·9	27 9·1	— 9·0	— 6·8	— 6·1	Calm	Calm	S	A	Snow.
25	27 8·2	27 6·1	27 7·3	— 4·0	— 3·2	— 1·5	NW	NW	NW	D	Much ditto.
26	27 10·5	27 10·2	27 9·6	— 4·0	— 5·1	— 4·2	—	—	—	B	Ditto.
27	27 2 3	27 8·2	27 10·5	— 4·0	— 3·6	— 6·2	W	W	W	A	Ditto.
28	28 0·3	27 10·7	27 11·7	—10·1	— 5·5	— 2·2	SW	SW	SW	D	Cloudy.
29	27 11·7	27 11·6	27 8·6	— 3·1	— 4·8	— 2·2	S	S	—	A	Ditto.
30	27 0·7	27 1·1	27 1·4	— 3·0	— 3·2	— 5·0	E	E	NE	D	Much snow.
Dec. 1	27 1·6	27 2·2	27 3·8	— 6·5	— 5·2	— 8·3	N	NW	NW	B	Snow.
2	27 6·7	27 6·3	27 5·3	— 8·0	— 7·8	—16·2	Calm	Calm	S	A	Rain.
3	27 8·4	27 10·7	27 11·6	—13·0	— 9·3	—15·5	SW	NW	N	D	Much snow.
4	28 1·5	28 1·7	28 0·3	—13·0	—11·2	—15·2	W	W	NW	A	Partially clear.
5	27 11·2	27 9·9	27 3·6	—10·0	— 6·0	— 0·2	N	Calm	S	D	Cloudy.
6	27 0·7	27 0·3	27 1·1	— 1·0	— 1·5	— 3·9	S	S	S	A	Partially clear.
7	27 2·7	27 3·8	27 5·5	— 1·5	0·0	— 0·7	E	SE	S	A	Cloudy.
Sun. 8	27 8·0	27 8·6	27 9·1	0·5	— 0·5	— 2·9	N	N	N	A	Snow.
9	27 9·0	27 9·3	27 9·6	— 3·0	— 3·8	— 4·7	NW	NW	W	B	Cloudy.
10	27 10·7	27 10·1	27 6·9	— 5·2	— 8·5	— 9·2	S	S	S	A	Partially clear.
11	26 11·6	26 10·3	26 11·8	1·0	1·5	— 2·4	SW	SW	SW	E	Snow.
12	27 4·4	27 7·4	27 9·3	— 4·8	— 3·6	— 8·7	NW	NW	NW	B	Cloudy.
13	27 10·3	27 11·2	27 11·9	—11·5	—10·2	—16·2	Calm	Calm	S	A	Partially clear.
14	28 0·8	28 0·1	27 8·2	—18·0	—18·0	—13·5	N	N	—	A	Clear.
Sun. 15	27 1·3	27 0·5	27 6·0	— 8·2	— 7·6	— 3·3	N	NW	NW	A	Snow.
16	27 8·7	27 7·5	27 10·0	— 3·1	— 3·0	— 2·6	NW	NW	NW	C	Much ditto.
17	28 0·5	28 0·8	28 0·6	— 4·5	— 4·8	— 9·6	N	N	N	A	Cloudy.
18	27 11·4	27 11·0	27 10·1	—13·0	— 9·8	—14·0	S	S	—	A	Ditto.
19	27 9·4	27 10·9	27 11·8	— 8·0	— 7·5	—10·5	NW	NW	NW	A	Ditto.
20	28 4·2	28 5·0	28 5·7	—12·0	—11·6	—12·9	NW	NW	NW	A	Thick.
21	28 4·0	28 2·3	27 8·2	—18·0	—12·8	2·0	SW	SW	SW	D	Ditto.
Sun. 22	27 7·4	27 6·8	27 6·0	3·8	4·9	3·6	—	—	—	E	Cloudy.
23	28 4·1	28 4·6	28 6·5	— 8·0	—10·2	—11·7	W	S	S	A	Clear.
24	28 7·4	28 6·2	28 5·0	—12·6	—12·0	—11·5	SW	SW	SW	B	Cloudy.
25	28 6·7	28 6·3	28 6·5	— 3·6	— 2·0	— 6·5	NW	N	S	C	Ditto.
26	27 7·6	27 6·2	27 10·9	0·0	— 2·1	— 6·2	NW	NW	NW	F	Much snow.
27	28 6·7	28 6·3	28 6·5	— 5·6	— 6·0	— 7·0	NW	—	—	B	Cloudy.
28	28 5·1	28 2·8	28 1·8	— 8·2	— 6·1	— 1·7	W	W	SW	B	Ditto.
Sun. 29	28 0·5	27 11·9	27 11·2	0·0	— 2·5	— 0·6	SW	SW	W	C	Ditto.
30	27 7·4	27 9·4	27 10·6	— 7·9	— 6·8	—11·5	—	W	NW	B	Ditto.
31	27 11·0	28 0·1	28 0·8	— 9·9	—12·3	—14·1	NE	SE	NE	E	Snow.

1812.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
Jan. 1	28 2·2	28 1·9	28 2·8	−17·0	−15·6	−15·0	N	N	N	D	Cloudy.
2	28 1·2	28 3·8	28 3·9	−15·1	−14·6	−14·3	NE	NE	NE	C	Ditto.
3	28 2·5	28 1·1	27 7·8	−18·6	−19·0	− 5·2	S	S	SW	C	Clear.
4	27 5·2	27 2·5	27 1·6	− 4·3	− 3·5	− 2·0	SW	SW	NW	E	Snow.
Sun. 5	27 5·5	27 6·8	27 10·4	− 8·3	−10·0	− 6·6	NW	NW	NW	D	Ditto.
6	28 2·1	28 2·9	28 1·8	−10·2	−10·0	− 1·6	S	S	S	E	Partially clear.
7	28 0·5	27 11·8	27 11·5	2·6	3·3	6·0	SW	SW	SW	D	Ditto.
8	27 10·9	27 10·6	27 10·8	5·8	4·2	2·2	—	—	—	C	Ditto.
9	27 10·1	27 9·2	27 11·9	3·8	2·6	1·3	—	—	W	B	Ditto.
10	28 1·8	28 1·1	28 2·0	− 1·0	1·2	− 1·1	NW	NW	NW	B	Clear.
11	28 2·9	28 2·5	28 2·6	− 3·0	− 2·4	− 2·9	SW	SW	SW	B	Ditto.
Sun. 12	28 2·4	28 1·6	28 0·3	2·0	3·7	1·2	S	S	S	A	Ditto.
13	27 11·1	27 10·3	27 9·5	− 1·0	2·0	− 1·8	SW	SW	SW	D	Ditto.
14	27 8·7	27 7·9	27 8·1	− 2·6	− 4·1	− 4·7	—	—	—	B	Cloudy.
15	27 8·6	27 9·4	27 10·1	− 3·2	3·0	2·8	—	—	—	C	Ditto.
16	27 8·4	27 7·9	27 6·3	1·0	3·8	2·8	—	—	—	B	Ditto.
17	27 7·6	27 6·8	27 6·1	− 2·0	− 2·5	− 2·7	NW	NW	NW	B	Ditto.
18	27 4·4	27 4·8	27 5·5	− 2·2	− 2·6	− 3·4	—	—	—	C	Snow.
Sun. 19	27 7·9	27 9·9	28 5·8	− 3·0	− 4·6	− 7·3	—	—	—	B	Cloudy.
20	28 6·7	28 6·3	28 5·4	−13·0	−11·5	−10·0	W	W	S	B	Clear.
21	28 3·3	28 2·6	28 2·0	−14·0	−10·4	−14·1	S	S	Calm	A	Ditto.
22	28 2·3	28 2·8	28 2·3	−12·0	−12·5	−13·3	Calm	Calm	S	A	Ditto.
23	28 0·4	27 10·3	27 8·9	− 3·1	− 2·8	2·0	SW	SW	SW	D	Cloudy.
24	27 6·9	27 6·7	27 6·1	1·5	9·0	− 1·5	—	—	W	B	Ditto.
25	27 5·9	27 4·6	27 3·7	− 3·5	− 2·8	− 6·6	W	W	SW	D	Partially clear.
Sun. 26	27 3·3	27 3·1	27 2·8	− 7·1	−10·2	− 5·0	SW	SW	SW	A	Much snow.
27	27 2·3	27 4·1	27 5·5	− 2·6	− 1·5	− 4·4	NW	NW	NW	B	Snow.
28	27 6·1	27 6·0	27 5·5	− 4·5	− 4·5	− 7·2	—	—	—	C	Ditto.
29	27 5·1	27 4·2	27 1·9	− 9·0	− 7·2	− 6·1	—	—	—	B	Much snow.
30	26 11·8	26 11·3	27 0·4	− 8·9	− 8·5	− 8·2	—	—	S	B	Ditto, ditto.
31	27 3·7	27 4·4	27 5·9	− 7·8	− 7·5	− 6·5	W	W	W	A	Thick.
Feb. 1	27 5·3	27 5·6	27 5·1	− 6·0	− 5·1	− 4·5	S	S	NW	A	Snow.
Sun. 2	27 4·2	27 5·2	27 5·7	− 9·0	− 8·0	− 9·3	W	W	NW	A	Clear.
3	27 6·8	27 6·9	27 7·4	− 6·2	− 4·6	− 7·1	NW	NW	—	A	Thick, snow.
4	27 8·2	27 8·1	27 8·3	− 9·6	−13·0	− 3·0	W	W	SW	A	Cloudy.
5	27 8·2	27 8·9	27 7·1	− 7·2	− 9·0	− 5·3	—	—	—	B	Ditto.
6	27 6·4	27 4·2	27 4·8	− 3·2	0·5	− 6·5	—	SW	SW	B	Ditto.
7	27 7·3	27 9·1	27 9·7	− 5·4	− 5·0	− 7·3	NW	NW	NW	A	Thick, snow.
8	27 8·6	27 5·0	27 1·6	− 9·2	− 8·1	0·5	S	S	SW	A	Thick.
Sun. 9	27 2·2	27 2·9	27 2·6	− 2·5	− 2·0	− 2·8	SW	SW	SW	B	Partially clear.
10	27 2·3	27 2·1	27 2·2	− 5·3	− 5·0	− 4·5	NW	NW	NW	A	Ditto.
11	27 2·1	27 1·7	26 11·8	− 6·9	− 5·9	− 8·1	—	—	—	A	Much snow.
12	26 10·7	26 10·4	27 0·3	− 8·5	−13·0	−14·2	SW	SW	SW	A	Cloudy.
13	27 2·2	27 2·5	27 2·8	−10·0	−10·3	−13·1	NW	NW	NW	A	Thick, snow.
14	27 3·7	27 4·5	27 7·2	−13·0	−13·3	−14·2	—	—	—	A	Foggy.
15	27 8·2	27 8·8	27 8·6	−14·0	−13·8	−15·2	W	W	NW	B	Partially clear.
Sun. 16	27 8·0	27 9·3	27 9·0	−22·0	−17·3	−20·5	SW	SW	Calm	B	Clear.
17	27 10·2	27 10·6	27 11·1	−15·0	−12·5	−15·6	S	S	S	B	Cloudy.
18	27 11·4	27 11·6	27 11·5	−17·1	−15·2	−14·5	W	W	W	A	Thick.
19	27 11·0	27 10·3	27 9·2	−16·0	−14·2	−20·6	—	—	—	A	Clear.
20	27 7·6	27 6·4	27 4·1	−20·0	−10·5	− 7·0	—	—	NW	B	Thick, snow.
21	27 2·8	27 1·6	27 0·9	−17·1	−14·5	−16·0	NW	NW	—	B	Much ditto.
22	26 11·7	26 11·2	27 0·3	−15·3	−13·1	−10·9	NW	—	—	C	Ditto, ditto.
Sun. 23	27 1·6	27 2·2	27 2·8	−10·0	− 7·5	− 8·6	—	—	NE	B	Ditto, ditto.
24	27 4·4	27 5·8	27 6·5	− 3·4	1·2	− 2·7	N	N	Calm	A	Cloudy.
25	27 7·4	27 7·8	27 8·5	− 4·0	1·5	− 2·2	S	S	S	A	Ditto.
26	27 7·3	27 6·4	27 1·8	0·0	2·3	2·0	S	SE	SE	E	Snow.
27	27 4·2	27 5·4	27 6·5	1·0	2·3	0·5	—	—	—	D	Thick.
28	27 11·8	28 0·3	28 3·7	− 8·0	− 8·5	−10·0	NW	NW	NW	B	Ditto, snow.
29	28 3·0	28 2·6	28 2·1	− 8·5	−10·0	−11·0	—	S	SW	A	Clear.

1812.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
Mar. 1	28 1·2	28 1·4	28 0·6	−15·5	−10·0	−11·2	S	S	S	D	Clear.
2	27 10·7	27 9·2	27 8·3	− 9·3	− 5·0	− 3·8	SW	SW	S	A	Ditto.
3	27 7·8	27 6·2	27 0·6	− 5·0	0·5	0·8	S	SE	SE	D	Cloudy, snow.
4	26 9·6	26 9·0	26 10·4	− 1·0	0·5	− 5·7	SW	SW	SW	B	Clear.
5	27 1·7	27 2·3	27 3·6	− 2·0	0·0	− 5·2	W	W	W	B	Cloudy.
6	27 4·0	27 4·6	27 6·2	− 4·8	− 3·1	− 5·4	W	NW	NW	C	Partially clear.
7	27 8·3	27 9·6	27 10·4	− 6·0	− 2·1	− 9·1	N	W	S	A	Cloudy.
Sun. 8	27 11·2	27 11·1	27 10·4	−12·0	− 2·0	0·0	W	W	W	A	Snow, rain.
9	27 9·4	27 8·6	27 8·5	4·0	7·4	3·8	—	—	—	B	Cloudy.
10	27 8·1	27 7·4	27 0·4	0·0	5·8	2·8	—	SW	SW	E	Much snow.
11	27 1·7	27 2·2	27 6·5	4·0	− 7·1	−11·0	S	N	NW	C	Snow.
12	27 9·7	27 10·4	28 2·9	−13·0	− 8·5	− 9·2	NW	NW	NW	B	Cloudy.
13	28 5·4	28 5·0	28 1·9	−10·0	− 7·6	− 7·0	N	S	S	A	Ditto.
14	28 3·2	28 5·8	28 7·9	− 6·0	1·1	− 3·0	S	—	—	A	Much snow.
Sun. 15	28 7·6	28 6·4	28 4·6	− 4·7	− 3·8	− 4·0	N	N	N	A	Clear.
16	28 3·8	28 3·6	28 5·0	0·0	4·8	− 2·6	S	SW	NW	A	Ditto.
17	28 5·6	28 6·2	28 5·7	− 4·3	− 2·0	− 8·2	NW	W	Calm	A	Partially ditto.
18	28 6·6	28 5·4	28 5·3	− 5·8	− 4·5	−10·2	N	—	—	A	Clear.
19	28 4·6	28 4·2	28 3·2	− 9·6	− 4·7	− 8·3	Calm	Calm	S	A	Ditto.
20	28 6·4	28 6·2	28 5·7	− 8·8	− 4·5	− 5·2	W	W	Calm	A	Cloudy.
21	28 5·6	28 4·3	28 3·4	− 4·2	− 2·0	− 5·3	Calm	SW	SW	A	Clear.
Sun. 22	28 1·8	28 5·2	28 7·1	− 4·2	3·0	−11·6	—	S	NW	D	Snow.
23	28 7·6	28 6·8	28 6·2	−13·2	− 2·0	−16·0	N	N	N	A	Clear.
24	28 5·5	28 3·8	28 1·8	−17·5	−10·3	−14·4	Calm	Calm	—	A	Ditto.
25	28 0·2	27 11·8	27 11·8	−11·0	− 4·7	− 9·4	N	NW	NW	D	Much snow.
26	28 1·8	28 2·8	28 5·8	−17·3	−14·5	−19·0	NW	—	—	D	Snow.
27	28 5·8	28 6·0	28 5·4	−18·0	−14·6	−21·0	—	N	S	A	Cloudy.
28	28 5·6	28 5·7	28 5·9	−21·7	−14·8	−19·1	N	—	—	A	Ditto.
Sun. 29	28 7·6	28 8·0	28 7·8	−20·0	−19·6	−24·1	W	W	W	A	Clear.
30	28 7·6	28 7·7	28 7·1	−25·0	−18·1	−24·0	S	—	—	A	Ditto.
31	28 6·4	28 4·8	28 4·1	−24·0	−12·8	−19·6	—	N	W	A	Ditto.
Apr. 1	28 3·8	28 1·8	28 0·6	−18·0	−10·3	−12·1	W	W	W	A	Clear.
2	28 0·0	27 11·8	27 11·1	−12·0	− 5·6	−11·2	SW	SW	SW	A	Partially clear.
3	27 11·6	27 11·8	28 0·9	−11·0	− 4·3	−13·7	S	S	NW	A	Ditto, ditto.
4	28 1·3	28 1·6	28 1·1	−12·0	− 5·8	−10·2	W	W	SW	A	Ditto, ditto.
Sun. 5	28 1·7	28 3·0	28 4·2	−11·0	− 0·7	− 9·8	NW	NW	Calm	A	Clear.
6	28 3·6	28 3·4	28 3·1	− 9·0	− 2·4	0·0	W	W	SE	B	Partially clear.
7	28 2·9	28 3·2	28 3·6	− 1·5	3·0	− 1·0	SE	S	Calm	B	Ditto.
8	28 3·2	28 2·7	28 1·8	− 3·8	5·5	2·2	Calm	—	SW	E	Ditto.
9	28 1·6	28 1·5	28 1·1	− 2·5	5·0	1·0	S	W	Calm	A	Ditto.
10	28 1·2	28 1·2	28 1·3	0·8	3·8	− 0·6	W	S	—	A	Ditto.
11	28 2·4	28 2·8	28 3·2	− 1·0	2·3	− 1·6	Calm	Calm	Calm	—	Clear.
Sun. 12	28 4·0	28 4·7	28 5·2	− 1·5	3·0	1·5	W	NW	S	A	Rain.
13	28 6·1	28 6·7	28 5·3	− 4·3	− 6·1	− 7·0	NW	NW	NW	B	Snow.
14	28 5·6	28 5·3	28 5·3	− 7·2	− 4·8	−13·8	—	—	Calm	B	Ditto.
15	28 5·7	28 4·7	28 3·7	−15·0	− 9·2	−14·9	N	W	N	A	Clear.
16	28 3·2	28 2·8	28 1·8	−15·0	− 4·6	− 7·4	N	N	N	A	Cloudy, snow.
17	27 11·2	27 9·3	27 8·1	− 4·2	− 1·0	2·2	—	Calm	SW	D	Ditto.
18	27 9·2	27 9·6	27 9·9	4·0	5·0	0·1	SW	S	—	B	Ditto.
Sun. 19	27 9·1	27 9·7	28 0·3	0·0	4·5	− 0·8	S	SW	W	A	Partially clear.
20	27 11·3	27 11·7	27 0·5	− 1·0	3·8	0·5	Calm	W	—	A	Ditto, ditto.
21	28 1·2	28 1·8	28 2·5	− 4·0	0·5	− 1·0	Calm	—	Calm	A	Ditto, ditto.
22	28 2·8	28 2·4	28 1·6	− 1·5	4·5	− 1·0	—	W	W	A	Ditto, ditto.
23	28 0·3	27 11·2	27 10·8	4·2	7·8	6·4	SW	SW	SW	E	Thick.
24	28 0·1	28 0·8	28 1·5	1·3	5·1	3·2	—	—	—	D	Cloudy.
25	28 2·2	28 3·1	28 1·8	0·0	4·8	− 0·5	Calm	S	S	A	Ditto.
Sun. 26	28 2·3	28 2·8	28 3·6	− 1·0	3·2	− 2·0	S	W	—	A	Ditto.
27	28 4·3	28 4·5	28 5·2	− 2·0	− 4·6	− 0·5	SW	SW	SW	B	Ditto.
28	28 4·6	28 4·1	28 5·4	− 1·0	− 6·3	0·0	—	—	—	B	Partially clear.
29	28 6·1	28 6·4	28 6·6	− 2·4	3·8	− 1·0	S	W	W	A	Clear.
30	28 6·3	28 6·1	28 6·5	3·0	5·5	1·5	—	—	—	A	Ditto.

1812.	Barometer. Morning.	Barometer. Mid-day	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
May 1	28 7·0	28 7·3	28 7·4	3·8	6·7	1·0	S	W	NW	A	Partially clear.
2	28 6·6	28 6·2	28 6·2	4·6	7·8	— 2·8	W	—	NW	D	Ditto, ditto.
Sun. 3	28 8·3	28 8·3	28 7·0	— 5·5	— 4·4	— 6·8	NW	NW	Calm	C	Clear.
4	28 6·2	28 4·8	28 4·5	— 6·0	— 4·4	— 7·3	NE	NE	NE	B	Cloudy.
5	28 4·0	28 3·5	28 2·8	— 5·7	— 4·5	— 8·0	NW	NW	NW	B	Ditto.
6	28 3·1	28 3·8	28 4·2	— 4·1	0·0	— 6·2	NE	NE	NE	B	Much snow.
7	28 5·1	28 5·3	28 4·7	— 7·0	— 2·8	— 9·8	Calm	NW	NW	A	Thick.
8	28 3·2	28 2·8	28 0·7	— 6·6	— 3·2	— 5·0	N	W	N	A	Cloudy.
9	27 10·7	27 9·2	27 7·8	1·5	1·5	— 0·5	SE	SE	E	B	Much snow.
Sun. 10	27 7·6	27 8·1	27 8·4	1·8	3·8	— 0·9	N	N	N	A	Ditto, ditto.
11	27 10·3	27 11·0	27 11·4	— 8·0	4·0	0·2	NW	NW	NW	B	Cloudy.
12	28 0·5	28 2·1	28 2·8	0·0	3·7	— 1·8	N	W	Calm	A	Partially clear.
13	28 1·6	28 1·3	28 0·7	1·6	3·6	— 1·4	N	W	—	A	Cloudy.
14	28 0·0	27 11·8	27 11·5	— 1·0	3·0	1·5	Calm	Calm	W	A	Ditto.
15	27 10·8	27 11·5	28 2·8	7·8	9·6	— 1·8	NW	W	NW	D	Snow.
16	28 5·8	28 6·2	28 7·5	1·2	3·9	— 0·4	N	N	N	A	Cloudy.
Sun. 17	28 6·7	28 5·6	28 4·8	8·0	10·5	4·8	W	W	SW	D	Partially clear.
18	28 6·5	28 6·1	28 4·8	6·5	5·3	1·0	N	N	N	A	Ditto.
19	28 5·5	28 6·2	28 6·8	8·0	3·8	— 0·9	NW	NW	E	D	Ditto.
20	28 7·3	28 6·7	28 6·1	4·2	6·3	1·2	S	W	Calm	A	Ditto.
21	28 5·7	28 5·4	28 5·2	— 1·0	3·2	— 1·8	N	N	N	A	Ditto.
22	28 4·8	28 5·2	28 3·9	2·5	5·1	1·0	—	W	Calm	A	Ditto.
23	28 3·6	28 3·2	28 2·8	8·0	9·3	3·0	N	W	N	A	Ditto.
Sun. 24	28 1·5	28 1·0	28 0·6	5·6	7·1	— 1·0	Calm	Calm	Calm	—	Snow, foggy.
25	27 11·5	27 11·2	27 10·4	0·0	— 1·4	— 2·0	N	N	N	A	Ditto.
26	28 0·6	28 0·9	28 1·1	— 2·8	— 1·7	— 3·6	N	N	N	B	Ditto.
27	28 0·1	27 11·3	27 10·2	0·5	2·8	— 2·3	NE	NE	Calm	A	Ditto.
28	27 9·9	27 9·6	27 10·2	0·0	1·8	— 2·3	N	N	N	A	Ditto.
29	28 0·5	28 0·2	27 11·9	7·0	4·8	1·6	—	—	—	A	Foggy.
30	28 0·4	28 0·6	27 0·8	3·8	5·8	1·0	—	—	—	A	Ditto.
Sn. 31	28 0·2	27 11·9	27 11·9	3·4	5·7	1·2	—	—	—	A	Ditto.

(To be continued.)

Article IV.

On the Suspension of Clouds.

(To Dr. Thomson.)

SIR,

I have often in the course of my reading looked for an explanation of the suspension of clouds; but if I may judge from the very crude conjectures thrown out on this subject by the best writers, no satisfactory solution has hitherto appeared.

De Luc, if I recollect right, supposes the particles of vesicular vapour constituting clouds, each to contain a portion of hydrogen gas, which enables them, like so many little air balloons, to support themselves in the atmosphere at a certain elevation.

This hydrogen he conceives to be derived from a fancied decomposition of a portion of the water itself; but unfortunately he neither gives any explanation of the *cause*, nor any proof of the *effect*; though, had there been any foundation for his surmise, the presence of this gas in foggy atmospheres, on the tops of lofty mountains, and on other places where humidity was present, could not fail of being detected.

Mr. Luke Howard, on the contrary, thinks he explains the suspension of vesicular vapour in the atmosphere by supposing its particles to be similarly electrified, and, consequently, to repel each other; but this repulsion, although by preventing their condensation it might retard, would not altogether prevent their descent; since a globule of water, however minute, must still be heavier than the circumambient air, and, consequently, gravitate to the earth as certainly as, although less rapidly than, a volume of the same fluid, however considerable its dimensions.

The suspension of the clouds must, therefore, be considered unaccounted for by either hypothesis, nor am I aware of any other that possesses superior claims to attention, and, accordingly, in that part of your System of Chemistry which treats on meteorology, and which I regret to find omitted in the late edition, no explanation of this phenomenon is proposed.

It is the obscurity which seems to hang over the subject, rather than any confidence I feel in my own speculations, that has induced me to propose the following hints, which, if without value in themselves, may yet be of some service in directing the attention of your better informed readers to a neglected department of science.*

The quantity of moisture which the air is capable of dissolving must depend partly on the temperature and partly on the density of that fluid.

Near the earth's surface, the high temperature of the air causes it to preserve a larger portion of aqueous vapour in an elastic form: in the most elevated regions, owing to the extreme rarity of the air, atmospheric pressure scarcely opposes any check to the natural tendency of water to assume an aëriform state, so that it remains in the form of vapour independent, perhaps, of any chemical solution.

Hence as we ascend in the atmosphere, the quantity of moisture held in solution by it must go on diminishing, until we arrive at that point beyond which the effect of the diminished pressure predominates over that of its chillness, so that from this point upwards the quantity of aqueous vapour goes on increasing.†

This medium point is the region of the clouds, which are known by actual observation to occupy a certain height in the atmosphere, above which they rarely extend.‡

* It is much to be regretted that no systematic work on meteorology has appeared at least in this language.

† See Professor Leslie's late work on the Relations of Heat and Moisture.

‡ This will appear more clearly from the following plan: the numbers given are of course supposititious:

Let us suppose then an *ascending** portion of air to have arrived at such a height that its diminished temperature no longer allows of its retaining the whole of the moisture it had dissolved when near the surface: the consequence will be, that a portion of water is disengaged in the state of what is termed vesicular vapour, that is, holding intermixed with it a portion of atmospheric air. Now as the air is considerably rarer at the height of two or three miles (the usual elevation of the clouds) than nearer the surface, it may easily happen, that the watery vesicles in the progress of their descent meet at length with a stratum of air of such density as to be just equivalent to the weight of the vesicular vapour joined with that of the air intermixed with it; and here they will remain suspended, until the air within becoming of nearly equal density with the atmosphere without, or the particles coalescing into larger drops, the whole becomes too heavy for the atmosphere to support.

Nor is this a mere hypothesis; the presence of intermixed air seems confirmed by the fact, that hail-stones, which are evidently derived from this source, always are found hollow in the centre, and the flakes of snow which fall so slowly through the atmosphere owe their low sp. gr. to the same cause.

Indeed it is scarcely possible to conceive a disengagement of moisture to take place, without, at the same time, supposing a a certain portion of air to be intermixed with it; and, accordingly, this idea seems to be very general, judging from the term "vesicular vapour," in common use, as applied to the moisture of fogs and clouds.

To apply this theory to particulars; two of the principal modifications of clouds, according to Mr. Howard's nomenclature, are the cirrus and the cumulus; the cirrus, including those light fleecy clouds which occupy the higher portions of the atmosphere; the cumulus, those denser and less elevated clouds which increase from above in convex or conical heaps.

The cirri would seem to be formed immediately from the disengagement of the vesicular vapour, and, therefore, to occupy that line of elevation at which the quantity of moisture held in an

Miles above the surface.	Rate of evaporation in consequence of the diminished pressure.	Affinity of air for moisture.	
6	128	2	
5	64	4	
4	32	8	
3	16	16	Medium point
2	8	32	
1	4	64	
0	2	128	

Hence the smallest quantity of moisture will be contained in the atmosphere at the medium point.

* I need not here insist upon the beautiful provision made by nature for preserving a constant circulation in the atmosphere, by causing every accession of heat to be accompanied by a decrease in density.

aëriform state is at its minimum; hence we see the reason why they continue for so long a time without having their density increased; evaporation goes on from the upper surface, while the ascending portions of air are adding to its bulk on the inferior; and unless the latter exceeds the former, the cloud will remain stationary. But when the quantity of aqueous vapour disengaged exceeds what is carried off from it by evaporation, the vesicular vapour gravitates slowly downwards, and increasing in bulk as it descends, constitutes that modification of cloud called the cumulus. It would appear then that the cumulus usually occupies that line of elevation at which the density of the atmosphere is exactly equivalent to the weight of the vesicular vapour joined with that of the air intermixed with it.

It now only remains to remark, that this theory is not intended to supersede the one given by Mr. Howard and others, respecting a repulsion between the particles of vesicular vapour, in consequence of their being similarly electrified; but is only meant to explain a circumstance which appears unaccounted for by the electrical hypothesis; namely, the reason why these globules, even in their attenuated condition, maintain themselves for so long a time in the still rarer atmosphere through which they float.

Should these remarks appear to you worth printing, you would oblige a constant reader by inserting them in your next number.

Nov. 28. PHILO-CHEMICUS OXONIENSIS.

ARTICLE V.

On the Alimentary Matter procured from Bones.

IN consequence of the scarcity of provisions which prevailed at Geneva, as well as in so many other parts of Europe, during the last year, the attention of the inhabitants was forcibly directed to the various methods of procuring food, and among others, to the nutriment supposed to be contained in bones. A series of experiments on this subject was published some time ago by Proust, and more lately by Cadet de Vaux; but the results which they obtained were not confirmed by some trials that were made in this country, and seem to have been scarcely credited. The Society for the Promotion of the Arts at Geneva appear, however, to have been more successful; they have actually employed this method of providing food to a considerable extent, and have published a detail of their processes in the Bibliotheque Universelle for September last, from which the following account is extracted.

There are two distinct processes to which the bones are subjected; one by which what is called the "geleé" is obtained from them; and the other a complicated operation by which the "gelatine" is procured. In the first operation the bones are well washed, and are then broken into small fragments, with a mallet on a hollow block; they are then boiled in a common vessel for three hours; no compression is employed, nor is the water raised above the boiling point; $\frac{1}{6}$ part of its weight of bones is added to the water, and during the process the fat which rises to the surface is skimmed off, and afterwards added to the product. By this means a jelly is procured, which is generally strong enough to become concrete on cooling. The bones may be boiled again three successive times, and still furnish a considerable quantity of jelly; by four boilings of three or four hours each, 1 lb. of bones will furnish 4 lb. of jelly, which is supposed to contain as much nutritive matter as common soup made from 6 lb. of meat.

In order to preserve the bones, when they are collected in large quantity, and during warm weather, after having been washed and broken, they are to be boiled in water for half an hour, in order to deprive them of the fat and marrow which they contain; they are then boiled for half an hour in a caustic alkaline ley, and after being well dried in the open air, they may be preserved for years if they be kept dry. The alkaline liquor is formed by adding $1\frac{1}{4}$ lb. of common potash, and the same quantity of quick lime, to 50 lb. of water; the clear fluid, when drawn off, is sufficient for 100 lb. of bones.

In the second process, to procure what is termed the "gelatine," the process that has been described above is to be employed in the first instance, to extract all the parts that are soluble by boiling, after which the bones are in a proper state for this further process; old bones, however dry they may appear, are equally proper for it. The object of it is stated to be, not to procure the "geleé," but the proper "gelatine," which is chemically united to the phosphate of lime. The agent employed is diluted muriatic acid; 100 lb. of the bones require 50 lb. of acid and 150 of water; the digestion is to be continued for three weeks, at a temperature of about 65°. The bones by this process are deprived of all their earthy matter; they are then well washed in water for 24 hours; the outside membrane of the bone is pared off, and serves for the making of glue. The remainder of the bones is then dried in the open air; it consists entirely of the compact "gelatine," and, if kept dry, may be preserved for an indefinite length of time, without undergoing any alteration. About $\frac{1}{4}$ of the weight of the entire bone consists of this "gelatine;" by being macerated for some hours in tepid water, and afterwards boiled over a slow fire, it is dissolved, and composes a highly nutritive soup. It is estimated that one ounce of the dry "gelatine" is equally nutritious with 1 lb. of meat.

The minuteness with which the processes are detailed, scarcely permits us to doubt of their general accuracy, so far as respects the quantity of animal matter which may be procured from bones. Our readers must, however, be aware of the want of correctness in the terms that are employed by the Committee in describing the products which they obtained. The terms "geleé" and "gelatine" are really synonymous; the "gelée" of the first process, when freed from the fat and other extraneous substances, is the only real jelly; while the "gelatine" of the second process is albumen, a substance different from jelly, which, as Mr. Hatchett has shown, composes the proper animal matter of the bones.

Article VI.

On Reversion of Series, as connected with the Equation $\psi\, \alpha^{-1} \psi\, \alpha\, x = x$.

(To Dr. Thomson.)

SIR, *Bath, Nov.* 10, 1817.

The three remarkable cases of reversion of series, alluded to in the paper which you did me the honour to insert in the *Annals* for this month, deserve to be reconsidered. What I said concerning them was an after thought, too hastily appended to the principal subject; and on revisal I am sorry to perceive that I have adopted a conclusion which is erroneous. The remarks I now proceed to offer, in lieu of the former, will be found perfectly correct, and some of the results so *novel* as to atone (I hope) with mathematicians for this παθος ανθρωπινον. As early an admission as possible will be regarded as a particular favour by Your very obedient servant,

W. G. Horner.

Explicitly stated, the cases in question are,

I. When $x = \psi\, y = a + b\, y + c\, y^2 + d\, y^3 + e\, y^4 + \&c.$

And $y = \psi\, x = a + b\, x + c\, x^2 + d\, x^3 + e\, x^4 + \&c.$

This case has been considered by Mr. Babbage in the Journal of Science, vol. ii.; who has rightly observed, that it is nothing else than a different mode of denoting the general solution of $\psi^2 x = x$.

II. When $x = \psi\, y = a + b\, y + c\, y^2 + d\, y^3 + e\, y^4 + \&c.$

And $y = - \psi - x = - a + b\, x - c\, x^2 + d\, x^3 - e\, x^4 + \&c.$

III. The singular case, appropriately so called, since only one specimen of it has hitherto been discovered, in which the even powers are absent, and

$x = \psi\, y = y + a\, y^3 + b\, y^5 + c\, y^7 + d\, y^9 + e\, y^{11} + \&c.$

$y = \frac{1}{\sqrt{-1}} \psi (\sqrt{-1}\, x) = x\, a\, x^3 + b\, x^5 - c\, x^7 + d\, x^9 - e\, x^{11} + \&c.$

All these, it is obvious, are merely distinct varieties of the general equation $\psi\, \alpha^{-1}\, \psi\, \alpha\, x = x$, arising from interpreting $\alpha\, x$ by x, or $-x$, or $x\sqrt{-1}$. To solve this equation, we first accommodate it to the circumstances of a *particular* solution, by making $\psi\, x = f\, \alpha\, x$, which reduces the equation to

$$(f\, \alpha\, \alpha^{-1} f\, \alpha\, \alpha\, x =)\, f^2\, \alpha^2\, x = x,$$

and gives the particular values

$$x = (\psi\, y =) f\, \alpha\, y$$

$$\text{and } y = (\alpha^{-1}\, \psi\, \alpha\, x =)\, \alpha^{-1} f\, \alpha^2 x$$

Next, having found an example which satisfies these conditions, we proceed to *generalize* the solution, by assuming $\psi\, x = \varphi^{-1} f\, \varphi\, \alpha\, x$, which gives

$$(\varphi^{-1} f\, \varphi\, \alpha\, \alpha^{-1}\, \varphi^{-1} f\, \varphi\, \alpha\, \alpha\, x =)\, \varphi^{-1} f^2\, \varphi\, \alpha^2\, x = x$$

$$\text{and} \begin{cases} x = \varphi^{-1} f\, \varphi\, \alpha\, y \\ y = \alpha^{-1}\, \varphi^{-1} f\, \varphi\, \alpha^2\, x \end{cases}$$

Since $\alpha^2\, x = x$, whether αx be x or $-x$, our first two cases both merge into the formula $f^2\, x = x$, of which a very comprehensive particular solution is

$$f\, x = \frac{a - b\, x}{b + c\, x}$$

[See my former paper]. Hence we immediately deduce for

CASE I.—*General Solution.*

$$x = \varphi^{-1} f\, \varphi\, y = \varphi^{-1} \frac{a - b\, \varphi\, y}{b + c\, \varphi\, y}$$

$$y = \varphi^{-1} f\, \varphi\, x = \varphi^{-1} \frac{a - b\, \varphi\, x}{b + c\, \varphi\, x}$$

CASE II.—*General Solution.*

$$x = \varphi^{-1} f\, \varphi - y = \varphi^{-1} \frac{a - b\, \varphi(-y)}{b + c\, \varphi\, (-y)}$$

$$y = -\varphi^{-1} f\, \varphi x = \varphi^{-1} \frac{a - b\, \varphi\, x}{b + c\, \varphi\, x}$$

Any exemplification whatever of these very simple cases will be regarded by adepts as superfluous. They will, therefore, permit me, as their information is out of the question, to pursue a method of illustration which will have the advantage of rendering the principles of the functional calculus quite intelligible to those who have not previously made it an object of attention. I start from the most elementary example of Case I. that can possibly be given, viz.

$$x = 1 - y \text{ and } \therefore y = 1 - x$$

To generalize this solution:—*Select any formula containing y and not x. Assume it to be = z, and thence find the v*

y in terms of z. [In functional symbols, make $\phi y = z$ ∴ $y = \phi^{-1} z$.] *For z, in the expression of this value, substitute the whole expression which arises from substituting the selected function of y, for y in the right hand scale of the first given equation.* The result is a new value of x. *For y, in this value, substitute x,* and it will give the simultaneous new value of y.

Ex. 1.—A simple multiple, $(\phi y =)\ a y = z \therefore y (= \phi^{-1}) = \frac{z}{a}$

Whence $x = \frac{1 - a y}{a}$ and $y = \frac{1 - a x}{a}$

Ex. 2.—The multiple of a power, $a y^3 = z \therefore y = \sqrt[3]{\frac{z}{a}}$

Whence $x = \sqrt[3]{\frac{1 - a y^3}{a}}$ and $y = \sqrt[3]{\frac{1 - a x^3}{a}}$

Ex. 3.—A compound quantity, $y^2 + 2y = z \therefore y = \sqrt{z + 1} - 1$.

Whence $x = \sqrt{2 - 2y - y^2} - 1$ and $y = \sqrt{2 - 2x - x^2} - 1$.

Ex. 4.—A circular transcendental, $sin. y = z \therefore y = arc$ to $\sin. z$

Whence $x = $ *arc to sin.* $(1 - sin. y)$, and $y = $ *arc to sin.* $(1 - sin. x)$

Ex. 5.—An exponential, $a^y = z \therefore y = \frac{\log. z}{\log. a}$

Whence $x = \frac{\log. (1 - a^y)}{\log. a}$ and $y = \frac{\log. (1 - a^x)}{\log. a}$

Were these results expanded into infinite series, each pair of series would manifestly exhibit the relation which characterizes Case I. *To adapt them to Case II.*, it is only requisite to substitute $- y$ for y in the values of x, and to prefix the negative sign to the values of y.

Ex. 3, for instance, would be transformed to

$x = \sqrt{2 + 2y - y^2} - 1$ and $y = - \sqrt{2 - 2x - x^2} + 1$

CASE III.—The particular equation to be resolved in this case is $f^2 - x = x$, or rather, exchanging x for $- x$,

$$f^2 x = - x,$$

of which the only solution immediately obvious is

$$fx = x \sqrt{-1},$$

which is not capable of further extension.

Recourse must be taken to another artifice. Among the functions of circular arcs which furnish pairs of convertible equations, such as

$$\sin. y = \cos. x \therefore \sin. x = \cos. y;$$
$$\tan. y = \cos. x \therefore \tan. x = \cos. y,$$

there occurs one, which involves an impossibility; and on endeavouring to neutralize this by introducing the imaginary coefficient $\sqrt{-1}$, we pass from the conditions of the first, to those of the third case. The formula $f^2 x = - x$ seems indeed to indicate such a process, and renders it probable that other solutions may be found on the same principle.

The equations intended are

$$\cos. y = \sec. x \therefore \cos. x = \sec. y.$$

Equivalent to the squares of the first, we have $1 - \sin.^2 y = 1 + \tan.^2 x$ whence $\sin. y = \tan. x . \sqrt{-1}$. The fluxions of these give $\dot{y} \cos. y$, or its equivalent $\dot{y} \sec. x = \dot{x} \sqrt{-1} . \sec.^2 x$. Whence $\dot{y} = \dot{x} \sqrt{-1} . \sec. x$. Hence again $\dot{x} = -\dot{y} \sqrt{-1} . \cos. x = -\dot{y} \sqrt{-1} \sec. y$. Assuming $y = z \sqrt{-1}$ these last equations become

$$\dot{z} = \dot{x} \sec. x \text{ and } \dot{x} = \dot{z} \sec. \overline{z \sqrt{-1}}$$

which furnishes an evident example of the third case; the only one, in fact, at present known.

If the fluents be taken, we shall find

$$z = \log. \tan. (\tfrac{1}{4}\pi + \tfrac{1}{2}x) = \log. \frac{1 + \tan. \frac{1}{2}x}{1 - \tan. \frac{1}{2}x} = \tfrac{1}{2}\log. \frac{1 + \sin. x}{1 - \sin. x} \text{ \&c. or}$$

$$z = x + \tfrac{1}{6}x^3 + \tfrac{1}{24}x^5 + \tfrac{61}{5040}x^7 + \tfrac{277}{72576}x^9 + \text{\&c.}$$

$$x = z - \tfrac{1}{6}z^3 + \tfrac{1}{24}z^5 - \tfrac{61}{5040}z^7 + \tfrac{277}{72576}z^9 - \text{\&c.}$$

as has been shown by Baron Maseres in the *Scriptores Logarithmici*, by Professor Wallace in the *Math. Repository*, N. S. and others.

To elucidate the mode of generalization, I adhere to the first of these formulæ, as in my former communication. Expressed as a function of $x \sqrt{-1}$, it gives the general values

$$z = \varphi^{-1} \log. \tan. \left\{ \tfrac{1}{4}\pi + \frac{1}{2\sqrt{-1}} \varphi (x \sqrt{-1}) \right\}$$

$$x = \frac{1}{\sqrt{-1}} \varphi^{-1} \log. \tan. \left\{ \tfrac{1}{4}\pi + \frac{1}{2\sqrt{-1}} \varphi (-z) \right\}$$

Ex. 1.—Make $\varphi x = \sqrt{6a} . x$, then are

$$z = x + a x^3 + \tfrac{3}{2} a^2 x^5 + \tfrac{183}{70} a^3 x^7 + \tfrac{277}{56} a^4 x^9 + \text{\&c.}$$

$$x = z - a z^3 + \tfrac{3}{2} a^2 z^5 - \tfrac{183}{70} a^3 z^7 + \tfrac{277}{56} a^4 z^9 - \text{\&c.}$$

and by assigning different values to a, series may be formed at pleasure. If $a = 1$ or $\frac{1}{2}$ or $\frac{1}{3}$, the coefficients will be more simple than in the original series.

Ex. 2.—As a general example of a large class of series, assume $\varphi x = \sqrt{\frac{6ma}{n}} . x^{\frac{m}{n}}$, m and n being any *odd* numbers, and a optional. We shall then have

$$z = \left\{ \sqrt{\frac{n}{6ma}} . \log. \tan. (\tfrac{1}{4}\pi \pm \tfrac{1}{2} x^{\frac{m}{n}} \sqrt{\frac{6ma}{n}}) \right\}^{\frac{n}{m}}$$

$$x = \pm \left\{ \sqrt{\frac{n}{-6ma}} . \log. \tan. (\tfrac{1}{4}\pi + \tfrac{1}{2} z^{\frac{m}{n}} \sqrt{\frac{-6ma}{n}}) \right\}^{\frac{n}{m}}$$

the upper sign obtaining when, m and n being divided by 4, each leaves the same remainder; and the lower sign, when those remainders are different. The reason of which is, that $(\sqrt{-1})^4$ being

$= 1 = (\sqrt{-1})^{\circ}$, the $\frac{4p \pm 1}{4q \pm 1}$ power will be equal to the first simply, or to $\sqrt{-1}$; and the $\frac{4p \pm 1}{4q \mp 1}$ to the $-$ first, or to $-\sqrt{-1}$. Expanded into series, these values are

$$z = \pm \left\{ x + a x^{\frac{2m}{n}+1} + \frac{2m+n}{2n} a^2 x^{\frac{4m}{n}+1} + \frac{304 m^2 + 210 mn + 35 n^2}{210 n^2} a^3 x^{\frac{6m}{n}+1} + \frac{2064 m^3 + 1636 m^2 n + 420 m n^2 + 35 n^3}{840 n^3} . a^4 x^{\frac{8m}{n}+1} + \&c. \right\}$$

$$x = \pm \left\{ z - a z^{\frac{2m}{n}+1} + \frac{2m+n}{2n} a^2 z^{\frac{4m}{n}+1} - \frac{304 m^2 + 210 mn + 35 n^2}{210 n^2} a^3 z^{\frac{6m}{n}+1} + \frac{2064 m^3 + 1636 m^2 n + 420 m n^2 + 35 n^3}{840 n^3} . a^4 z^{\frac{8m}{n}+1} - \&c. \right\}$$

Ex. 3.—For instance, if $m = 3$, $n = 1$, and $a = 1$, then are

$$z = - \{x + x^7 + \tfrac{7}{2} x^{13} + \tfrac{3401}{210} x^{19} + \tfrac{71747}{840} x^{25} + \&c.\}$$

$$x = - \{z - z^7 + \tfrac{7}{2} z^{13} - \tfrac{3401}{210} z^{19} + \tfrac{71747}{840} z^{25} - \&c.\}$$

An endless variety of series endued with the same property may be educed from the general formulæ, by making $\varphi\, x =$ a sine, tangent, cosecant, on their arcs, to log. $\frac{1+x}{1-x}$, or in short to any function containing *only odd powers* of x. Any other would be encumbered with imaginary coefficients.

Article VII.

Biographical Notice of the Rev. W. Gregor.

The Rev. William Gregor, descended from a line of ancestors who have held a distinguished station in the county of Cornwall for a long period of years, was born in the year 1762. He received his school education, at Bristol, under the Rev. Mr. Lee, an able classical scholar; was for a short time under private tuition at Walthamstow, in Essex; and at the usual age entered a pensioner at St. John's College, Cambridge. He proceeded A. B. in 1783, and A. M. in 1786, and was elected Platt Fellow of that Society. His classical and mathematical attainments were of a high order, and procured for him the most distinguished honours of the university.

In 1789 he was collated to the rectory of Deptford, near Totness, upon the presentation of his father; and in the succeeding year he married the daughter of Edward Gwatkin, Esq. In 1793 he was presented by Bishop Ross to the vicarage of Bratton Clovelly, in Devon, which he soon after exchanged for the rectory of Creed, near Grampound, in the county of Cornwall.

Here he finally fixed his residence, performing with exemplary attention his various duties as a christian pastor and a magistrate; holding in difficult and doubtful times the even and conscientious tenor of his way, dispensing to his neighbours both spiritual and temporal benefits, and enlivening the society of his friends by his cheerful and instructive conversation. The latter years of his life, embittered as they were by bodily suffering, only afforded him a more favourable opportunity of practising the precepts which he taught, and of experiencing, personally, the vital and consoling energy of those hopes and of those truths, the enforcement and exposition of which had constituted his most momentous and delightful employment. He died at Creed, on June 11, 1817, carrying with him the regrets of his friends, and the respect of the entire county.

A detail of his professional publications, consisting of sermons preached on particular occasions, and an address to a member of the House of Commons on the subject of the non-residence bill, is omitted in the present brief notice, the object of which is only to exhibit the claims of Mr. Gregor to be remembered as a man of science.

In the year 1791 he communicated to the Journal de Physique an analysis of a black sand found in the parish of Menaccan, about six miles south of Falmouth. This substance he found to contain nearly half its weight of a metallic oxide as yet unknown to chemists, and to which Klaproth, in the elaborate essay which he published some years afterwards on this and other ores of the same metal, gave the name of titanium.

In the Philosophical Transactions for 1805 is a paper by Mr. Gregor, in which he shows that a mineral found at Stenna Gwyn, in Cornwall, and which had been supposed to be a variety of zeolite, is, in reality, a hydrate of alumine, not differing in any essential particular from the wavellite of Barnstaple, which had, just about that time, been analyzed by Sir H. Davy. The same paper also contains an interesting examination of the uranite found in the same mine with the preceding mineral.

In 1809 he communicated to the Royal Society his discovery and analysis of native arseniate of lead, also found in Cornwall.

The Geological Society gladly enrolled him among its honorary members; and in the third volume of the Transactions of that body is a description and analysis of the tremolite, which had been recently found in the serpentine of Clicker-Tor, near Liskeard.

When the establishment of a Geological Society in Cornwall was agitated, Mr. Gregor engaged warmly in support of the measure, and contributed essentially to its success. In return for these and other services, and partaking in the general regret occasioned by the loss of this excellent man, Dr. Paris, then Secretary to the Royal Geological Society of Cornwall, delivered before that body an eulogy on the subject of this short notice, which was ordered to be printed.

For the materials, however, which have been employed in drawing up the preceding sketch, the author is indebted to the liberality of Mr. Gregor's intimate friend, the Rev. J. Trist, of Veryan.

Article VIII.

Some Observations on the Nature of the Vital Powers. Communicated in a Letter to Dr. Thomson, by Dr. W. Philip.

Sir, *Worcester, Jan. 5, 1818.*

As you did me the favour, on a former occasion, to insert in the *Annals of Philosophy* some observations on the effects of Galvanism on living animals with which I troubled you, I hope you will have the goodness to give a place to the following, relating to the same subject.

It appears, as far as I am capable of judging, from many experiments either related or referred to in a treatise which I lately laid before the public, entitled, *An Experimental Inquiry into the Laws of the Vital Functions, &c.* that in the more perfect animals there are three vital powers, each having an existence independent of the others, yet so connected that none can long exist without the others, namely, the sensorial, the nervous, and the muscular powers.

It was long supposed that the muscular fibre derives its power from the nervous system. Haller was the first who maintained that this power resides in the muscular fibre itself. He made many experiments to support his opinion, which have been frequently repeated, and the accuracy of which is now universally admitted. His inferences from these experiments, however, have been opposed upon the ground that, however carefully we dissect away the nervous filaments supplying a muscle, it must still be admitted, that nervous influence may remain in it, either in nerves too small to be removed by the knife, or constituting a necessary part of the muscular fibre itself.

This objection, though frequently urged against the inferences of Haller, he never satisfactorily answered; and it seemed to be countenanced, if not confirmed, by the fact, that when causes of injury affecting the nervous system are of such force as instantly to destroy its power, the power of the muscular fibre is also found to be destroyed. This fact is well illustrated by many of the experiments of Mr. Hunter, and still more fully by those of M. le Gallois, who regards it as wholly invalidating Haller's opinion respecting the power of the muscular fibre.

gravitation. We are acquainted with the cause of lightning, because Franklin proved it to be the same which produces the other phenomena of electricity. Can we show that the phenomena of any or all of the foregoing living powers depend on the same cause which operates in the production of other phenomena?

With regard to the sensorial power, it seems to require but a moment's reflection to answer this question in the negative. There is no real analogy between the effects of this power and the phenomena observed in any other part of nature. Certain fanciful analogies of this description have, indeed, from time to time been suggested; but while they have pleased in the writings of the poet, by the philosopher they have been justly rejected. To a careful observation and judicious arrangement of the phenomena of the sensorial power, therefore, our study of it must be confined.

With regard to the nervous power the case is very different. The principle which operates in many other instances may be the means of exciting the muscles, of conveying impressions to and from the sensorium, of effecting the formation of the secreted fluids, and of causing an evolution of caloric from the blood. The most subtle of known agents, electricity, naturally suggested itself as the cause of the phenomena of the nervous power; and when Voltaic electricity, and its signal influence on the muscular system, were discovered, a material step it was imagined had been made towards ascertaining the nature of this power. On more mature reflection, however, it was admitted, that to ascertain that any power is capable of exciting the muscular fibre, is to go but a very short way towards establishing its identity with the nervous influence, a very large proportion of bodies possessing this property; and of late the opinion appears to have been abandoned; nor can it be maintained on any other grounds than by showing that Voltaic electricity is capable of the more characteristic as well as the more simple functions of the nervous influence.

This I have attempted to do in the above-mentioned treatise. It appears from Experiments 46, 47, 48, 49, that Voltaic electricity is capable of effecting the formation of the secreted fluids when applied to the blood in the same way in which the nervous influence is applied to it; and from Experiments 64, 65, 66, 67, that it is capable of occasioning an evolution of caloric from arterial blood. When the lungs are deprived of the nervous influence, by which their function is impeded and soon destroyed; when digestion is interrupted by withdrawing this influence from the stomach; can we suppose that any thing will renew the functions of these organs but restoring to them the influence of which they have been deprived? Their functions are renewed by exposing them to the influence of a Voltaic trough. Many collateral observations appear to support the inference, which, from these facts alone, seems to be unavoidable. See p. 139

and 149 of the above treatise, and what is said in this treatise respecting asthma, dyspepsia, and apoplexy.

In a paper entitled, "On the Effects of Galvanism in restoring the due Action of the Lungs," which appeared in the Philosophical Transactions of last year, I have observed, that a Voltaic trough of the old construction is more effectual in restoring the due action of the lungs, than the improved trough now in general use. I was at first at a loss to account for this circumstance. From many observations, I have now reason to believe that it arises from such effects of Galvanism, like its other effects on the animal body, being proportioned not to the quantity of electricity supplied by the trough, but to the intensity of its electric and quantity of its chemical power, both of which are proportioned rather to the number of plates, than to the extent of surface.

I have repeatedly tried the effects of a powerful electrical machine in habitual asthma. They are considerable, but inferior to those of the Galvanic trough, which I would ascribe to the former possessing much less chemical power, in proportion to the intensity of its electricity, than the latter. The most powerful electric battery will not readily decompose water without the ingenious arrangement, suggested by Dr. Wollaston, for concentrating as much as possible its electric power, while the power of a few Voltaic plates is, without any precaution, sufficient for this purpose.

It appears from what is said in my treatise on the vital functions, as well as what has just been laid before the reader, that I regard Galvanism as totally distinct from, and having nothing in common with, the vital principle. It is as distinct from this principle as the blood or the muscular fibre; like them, it is only one of the means employed by it in producing the phenomena of life.

In the above treatise I have given at length the reasons which seem to render it probable, that the first rudiment of life exists in the central part of the circulating system, from which it is propagated to every other part. We have reason to believe that it exists not in the muscular fibre of the heart, but in the blood. It is inconsistent with what we observe in the operations of nature that it should exist simultaneously in both, and we never see blood formed from muscular fibre, but we constantly see the latter formed from blood; besides, the great changes of nature take place rather in fluids than in solids.

With regard to the nature of the vital principle, we may say of it what is said above of the sensorial power. As its effects cannot be classed with the phenomena observed in any other part of nature, we have no reason to believe that we shall ever be able to refer them to any more general principle. The view taken of the vital principle by Mr. Hunter, and more fully explained by Mr. Abernethy, is not that it is electricity or magnetism, opinions which some, from want of due attention [illegible]ed to them, but that it is a principle pervading matter in a way analogous to electricity and magnetism; and bestowing on the matter which it pervades certain properties. If it be said that we have reason to believe that the vital power is not the effect of any thing superadded to the matter which is the object of our senses, but the result of a peculiar organization; this I conceive changes but little the view taken of the subject by the above writers, because electricity and magnetism may also, as far as we yet positively know, be merely the result of certain states of organization.

Whether the living principle, electricity and magnetism, be subtle fluids added to bodies, or only a peculiar arrangement of their constituent parts, the fact is, that they bestow on matter certain properties, and all that is essential is, that our expressions should convey this fact, and no more. Till the properties bestowed on matter by these powers are found to be the same, and surely it is impossible to conceive properties more dissimilar than those bestowed by electricity or magnetism, and the living principle, there cannot be a shadow of reason for supposing them the same. The Galvanic experiments above referred to, as far as I am capable of judging, go far to prove that Galvanism has nothing in common with the living principle, because these experiments exhibit them performing functions in the animal economy wholly of a different nature.

I here wish particularly to state, what, although fully expressed in my treatise on the vital functions, has yet been overlooked by some in alluding to my opinions, that the effects observed from Galvanism, in the above experiments, are its effects on parts endowed with the living principle, wholly ceasing, and by no means renewable when this principle is extinct. Galvanism seems capable of performing all the functions of the nervous influence in the animal economy, and if so, must be regarded as identical with this influence; but neither can excite the functions of animal life, except when acting on parts endowed with the living principle. Parts endowed with this principle collect the nervous influence, and apply it where it is wanted, to act on parts also endowed with the same principle; but the nervous influence itself seems to be nothing more than that influence which operates in the production of all Galvanic phenomena.

With regard to the muscular power, I have, in the above-mentioned treatise, had occasion to refer to Mr. Hunter's observations on the analogy which exists between the contraction of the muscular fibre and the coagulation of the blood, and to dwell particularly on one of the most striking of these analogies. In the effects of Galvanism on the blood after it is removed from the body, described in that treatise, and its effects on the muscular fibre also removed from the body, we see another striking instance of this analogy.

When the whole of the facts on this subject are duly considered, the conclusion appears to be unavoidable, that the c ntraction of the muscular fibre, and the coagulation of the blood, depend on the same cause. The close analogy between the coagulation of the blood and that of other coagulable fluids cannot be overlooked; so that it seems a necessary inference, that the muscular fibre contracts by the operation of the same cause, by which certain fluids coagulate; and, therefore, depends on a chemical power. But I would here say of this power what is said above of the Galvanic power,* that it is only in bodies possessing the living principle that it can produce the phenomena of life. It is only before this principle is extinct that it can produce contraction of the muscular fibre, or spontaneous coagulation of the blood.

Article IX.

On the French Varnish for Cabinet Work, &c. By Thomas Gill, Esq.

No. 11, Covent Garden Chambers,
Jan. 14, 1818.

GENTLEMEN,

The improvement of the arts forming an important branch of your *Annals*, I shall make no apology for communicating the following process for varnishing; which, I believe, will be found nearly new in this country, and highly deserves to be made generally known.

This beautiful art, which is an application of a mode of varnishing, hitherto chiefly used in this country for articles turned in the lathe, as flutes, clarionets, and other musical instruments, and in some other minor branches, has been long employed by the French for varnishing their rich cabinet furniture, which is either made of the harder veined woods, or veneered with them; as also for the exquisite *Buhl* works, of inlaid tortoise-shell, brass, silver, &c. which are now become not so rare amongst us as formerly.

It consists in the application of a spirit varnish, mostly composed of shell lac, a very singular substance, consisting of a mixture of resin, wax, and gluten; and which, when dissolved in alcohol, forms the hardest and most durable spirit varnish known, with certain portions of gum mastich and gum sandarach, chiefly for the purpose of rendering its colour paler, which is a desirable circumstance in some of the works to which it is applied; and it differs from other modes of varnishing, more especially in the manner in which it is laid on the articles to be varnished; namely, by rubbing it upon their surfaces (which are first prepared by polish-

* These powers, according to the opinion of one of the greatest chemists which this or any other country has produced, are essentially the same.

ing them), with a fine cloth, and using oil and alcohol during the process, as will now be more particularly described.

And first, the preparation of the varnish, which is composed of the following ingredients, viz.

Shell lac, three parts,
Gum mastich, one part,
Gum Sandarach, one part,
Alcohol, 40 parts.

The mastich and sandarach must first be dissolved in the alcohol, and then the shell lac; and the process may be performed either by putting them into a bottle loosely corked, and placing it in a vessel of water, heated below the boiling point of alcohol, until the solution is effected; or, by putting the ingredients into a clean Florence oil flask, the neck of which is partially closed, by a cork having a narrow slit cut along it, and heating it over a spirit lamp. The alcohol, however, which may escape during the process must be replaced by an equal weight of it after the operation is over, as it is desirable that the varnish should consist of the accurate proportions given, in order to produce a proper effect. The solution may be poured off, for use, from any impurities which may remain; but it must not be filtered, as that operation would deprive the lac of some of its most valuable constituents.

The wood must be prepared for varnishing, by first taking out the marks of the plane with a steel scraper, and bringing it to a smooth and even surface, and afterwards polishing it well with the finest glass paper; as the varnish is laid on so thin that it would expose every defect in it.

The varnish, being put into a phial with a narrow neck, is to be applied upon a fine linen, or cambric muslin cloth, which may be either a slip of about one inch broad and five inches long, or a square of four inches; as a larger piece would only waste the varnish uselessly; and, as it is necessary to be particularly careful not to apply it *too wet* during the process, lest it might dissolve those coats which were first laid on, the cloth should be folded in four thicknesses; then half opened, and its inside slightly wetted with the varnish, by applying it to the mouth of the phial and quickly shaking it up once; it must then be touched on the part wetted with a little oil, again doubled up, and quickly and lightly rubbed upon the surface of the article to be varnished, in a constant succession of small circular strokes; and the operation must be confined to a space of not more than five or six inches square, until such space is finished; when an adjoining one may be commenced and united with the first, and so on, until the whole surface is covered. The varnish is thus enclosed between two double folds of the cloth; which, by absorption, becomes merely *moistened* with it; and the rubbing must be continued until it becomes nearly dry; it must then be again half opened, and the inside again wetted with the varnish without oil; then doubled, and applied as before. A third coat must also be given in the same manner; then one with a little oil, which must be followed, as before, with two others without oil; and thus proceeding until the varnish has acquired some thickness, which will be after a few repetitions of the series; when a little alcohol may be applied to the inside of the cloth before wetting it with the varnish, and then it must be very quickly and uniformly rubbed over every part of the surface, which will tend to make it even, and very much conduce to its polish. The cloth must then be wetted a little with alcohol and oil without varnish; and the surface being rubbed over, with the precautions last mentioned, until it is nearly dry, the effect of the operation will be seen; and if it be found that it is not complete, the process must be continued, with the introduction of alcohol in its turn, as directed, until the surface becomes uniformly smooth, and beautifully polished.

It may, perhaps, seem to some of your readers, that the above process is tedious, and that it is described with an unnecessary degree of minuteness: such on trial, however, will not be found to be the case; especially when it is compared with other modes of varnishing; as the effect is produced without the heat necessary in laying on spirit varnish; and the polish is complete without the trouble of laying on successive coats of an oil varnish with the brush, which must be allowed time to become dry between each, until it becomes sufficiently thick to bear to be reduced to an even surface, with the pumice stone and water, and then to be polished with tripoli. The varnish is also considerably harder and more durable than oil varnish; and, no doubt, will come into general use amongst us when the mode of performing the process is better known.

In applying the varnish, it will be convenient to hold the cloth between the fore-finger and the thumb, with the other fingers resting upon the back of it; and when it has become saturated, clogged up, or stiffened with the varnish, it must be changed for another.

Hoping these directions will prove sufficient for the attainment of this useful art,

I remain, Gentlemen,

Your most obedient servant,

THOMAS GILL.

P. S. In cases where a greater degree of hardness in the varnish is desirable, and its colour is but a secondary consideration, one composed of one part of shell lac and eight of alcohol is to be preferred.

Article X.

Account of Alexander Scott, who spent some Years in the Interior of Africa.

In a note to the Narrative of Robert Adams, p. 140, a letter is inserted from Mr. Brancker, of Liverpool, giving some particulars of the loss of the Montezuma. We are informed that this vessel, "belonging to Messrs. Theodore Koster and Co., and bound to the Brazils, was wrecked on Nov. 2, 1810, between the Capes de Noon and Bajadore, on the coast of Barbary; that the master and crew were made prisoners by a party of Arabs, &c." The letter concludes by the following statement: "It is also said that the crew have obtained their liberty, except one boy." In the course of the last spring this boy most unexpectedly found his way back to Liverpool, after having been, as it seems, for a period of nearly six years detained as a slave among the Arabs, and having been conveyed by them some hundreds of miles into the interior of Africa. From the unaffected simplicity of his manner, and from the little disposition which he manifests to magnify or exaggerate his adventures, there is great reason to place confidence in his narrative. A full account of it is shortly to be published, for the young man's benefit: in the mean time, we have been favoured by a friend in Liverpool with the following outline of his travels, which we hasten to lay before our readers. The names are spelled, as nearly as possible, according to the young man's pronunciation of them, without any attempt to reconcile them to the descriptions of geographers or of former travellers.

"Alexander Scott was born in Liverpool; and when 16 years old sailed from thence in the ship Montezuma, Capt. Kimbley, bound to the Brazils, on Oct. 26, 1810. On Nov. 22 the vessel was wrecked on the coast of Africa, somewhere between Cape Noon and Cape Bajadore. He fell into the hands of Arabs: they sold him to one of a distant tribe, by whom he was taken in a south direction for 15 days, travelling he supposes about 15 miles a day, when they came to a number of tents in the El Gibbla district. Having remained there some months, his master told him that his family, and others of the tribe, were going a long journey to Hez el Hèzh, that he must go with them, and there change his religion or die.

"The part of El Gibbla from whence they set out was about 20 miles from the sea coast, and the party consisted of about 20 families, with a great number of camels, sheep, and goats; the time of the year about the beginning of June. The direction in which they went was to the southward of east, and with little deviation from a direct course during the whole of the journey.

The first four or five days over hard clay, and very barren ground; for 11 days over sandy hills and valleys; then for two months over more hard ground, with some hills, but not high ones, crossing some running waters of brackish quality, and passing a salt-mine and a brimstone-mine; then, after going for two days through a wood, came again to sand. Saw no town, but met occasionally with other parties of Arabs. This sandy district took about a month to pass, and it was terminated by arriving, without any previous distant view, at a large sea or lake. The day was very clear; and mountains were discernible on the opposite shore, but nearly resembling clouds. On the bank of this sea they came to an assemblage of huts called El Sharrag, belonging to the tribe of Orgaeleet. Here all the camels, goats, and sheep, with two persons of each family, were left. The remainder of the party were taken across the sea in a large boat built of a hard red wood, and without any iron in its construction, rowed by six blacks who were slaves, setting out at sun-rise, going the whole of the day; a little before sun-set the anchor, a large stone, was let down, and the boat remained stationary until sun-rise next morning, when they again set off, and proceeded till sun-set on the second day, when they anchored as before. Soon after day-break on the third day went on again, and about two o'clock in the afternoon arrived at the shore, having gone straight across, making for the mountains, at the foot of which they landed, in a district called El Hêzh. The water of this sea was smooth, had a deal of weed upon its surface, was clear under the weed, perfectly fresh, and had no appearance whatever of a current. Scott did not particularly look for a termination of this lake at the higher or lower end as he crossed, but is perfectly satisfied he did not see either end of it. Its length is from N.E. to S.W., and the boatmen called it the Bahar El Tee-eb. They also told him that to the southward there was a large salt sea, which they called the Bahar El Ka-bee-er, to which there was no end, and that the one they were upon run into it, where there were many Saffina el Ka-bee-er, or large ships, and a harbour called Bambarry. On the eastern shore of the Bahar Tee-eb, where the party landed, was a number of huts, built of wood, and covered with rushes. The name of the country was El Hêzh; of the particular place, El Tarsee Mahomet; and of the tribe inhabiting it, El Tarsee del Hêzh. Here were many pilgrims, accompanied by some of whom the party with whom Scott was set out at sun-rise the morning after their arrival to go into the country, taking Scott with them, saying, they were going to Hez el Hezh to Seedna Mahomet, where Scott must change his religion, or if he did not Mahomet would rise up and kill him. They proceeded through a crooked mountain route till about three o'clock, in about a south direction, when they arrived at a valley, in which stood a building about the size and shape of a common barn, the ends being placed to the north and south: at the south end was a door: but there were not any windows in the building, nor any chimney. This place Scott was told was the grave of Seedna Mahomet, meaning of a great man connected with or related to Mahomet, whose name amongst the Arabs is Ur-soell. Here the party prayed, kissed a stone near the door, and told Scott he must now become a Mahometan, or be killed. He, however, steadily refused, and was not again urged, but was not taken any more to the grave, though the party frequently visited it during their stay at El Hean, which was about a month, when they left it in the same boat which took them there, and had also during their stay carried many other parties for the purpose of visiting the grave. On their return there was more wind: a mast was therefore constructed of two oars placed across each other, and a blanket was used for a sail; so that, leaving the shore about the middle of the day, and sailing all night, they arrived at El Sharrag about six o'clock the next morning. The whole party then set out on their return, traversed the sandy district for about a month; then came to the wood, where they had a conflict with some black people, called Bambarras, who were quite naked, tattooed, and armed with bows and arrows. Leaving the wood, they travelled for about a month and a half over hard ground; came to a valley where there was some vegetation; stayed there about six moons; then went three days' journey to another place, where they remained two or three months; then set off again for El Gibbla, and for a week or two went over hard ground; then came to sandy valleys, which took them a little more than a week to cross; and in about a week more they arrived at El Gibbla. They avoided going too far to the northward, being afraid of the Moors. He was detained with the tribe wandering about until the end of July, or beginning of August, 1816, when he escaped and got to the neighbourhood of Wadnoon, from whence he communicated with Mr. Wiltshire, the British Consul at Mogadore who sent for him: he arrived at that place on Aug. 31, left it Nov. 11, and got to London Dec. 9, 1816."

Upon the narrative, we may remark that the number of days which Scott and his party occupied in their journey, was more than 100, which at the rate of only 10 miles a day would make a distance of 1000 miles. In rowing across the lake, they spent about 30 hours, which at the rate of four miles per hour would give a breadth of 120 miles. It may be conjected that the route which they took was somewhat to the northward of the Niger, and probably to the N.W. of the supposed situation of Tombuctoo.

Article XI.

Remarks on Mr. Daniell's Theory respecting the Specific Gravity of Crystals. In a Letter to the Editor of the Annals of Philosophy. By Pat. Addle, Esq.

Sir,

I am one of those who have always derived considerable pleasure from philosophical inquiries; but living in a very retired situation, and having little communication with philosophers, I have no means of becoming acquainted with the progress of scientific discovery except through the medium of the public journals. In Number VII. of the Journal of the Royal Institution, published in October last, I have been surprised and delighted with a very extraordinary, a very ingenious, and, as far as I know, a very novel theory of Mr. Daniell on the specific gravity of crystals. The character of this journal, published under the auspices of so learned a body, and conducted by Professors as eminent for their caution as for their talents, is a sufficient guarantee that nothing trivial or absurd will ever be found in its pages, and I entered upon the examination of the theory with the confidence that such authority must naturally inspire.

The formation of crystals from spherical atoms, as detailed by Dr. Wollaston in the Phil. Trans. had previously attracted my attention; and though I have lived long enough to know that the convulsion of a frog's leg led to the decomposition of the alkalies, I was not prepared to expect, that the theory of Dr. Wollaston (pretty and amusing I admit) should have been but a link in the great chain of discovery, and should have furnished Mr. Daniell with the foundation of a doctrine that bids fair to overturn most of the received opinions in natural philosophy.

The theory of Mr. Daniell possesses the characteristic of all great discoveries—simplicity, and cannot be more concisely or more beautifully stated than in his own words. After referring to figures representing a tetrahedral and octohedral pile of balls, both composed of triangular faces, the bases of which are constituted of four particles, he says, "The tetrahedron is contained by four of these similar and equal planes, and the octohedron by eight; so that the whole superficies of the latter is exactly double that of the former. Now it is obvious that solids so constructed must differ in their specific gravities, unless the number of elementary particles in the octohedron be exactly double the number in the tetrahedron; that is to say, unless the number of atoms in a given space be equal in both arrangements. But it will be found that the tetrahedon is composed of 20 spheres, and the octohedron of 44, the latter containing more than double the number of particles under a double surface. The specific gravity of the latter solid must, therefore, be greater than that of the former."

Here is a mathematical demonstration that requires only the Q. E. D. to give it the air and stile of the early geometricians; it is logical, and, I will venture to say, unanswerable. Adopting the old formula, it may be stated thus: the specific gravities of bodies vary directly as the weights, and inversely as the surfaces. There are many familiar facts (not the less striking on that account) that illustrate and confirm this principle. Gold in its more solid form is one of the heaviest metals; let it be beaten into gold leaf, i. e. increase its surface, and it will swim upon water; nay, upon ether. A dry sponge (which, including all its pores, possesses, perhaps, the greatest quantity of surface of any known body of the same size) will swim upon our lightest fluids. Saturate it with water; i. e. destroy as it were the surface of its pores, and it immediately sinks. Mr. Daniell, however, has adopted a more scientific mode of bringing his theory to the ordeal of experiment. He says, a mass of fluor spar will divide either into octohedrons or into tetrahedrons: "the question, therefore, seems to resolve itself into this: Is the specific gravity of a mass of fluor, split into the form of an octohedron, greater than the specific gravity of the same mass split into the form of a tetrahedron?" To determine this, he proceeded to try the experiment "with all the care and attention which the delicacy of the investigation required;" and the specific gravity of the octohedron he found to be 3·037, while that of the tetrahedron was 2·909:—he adds, "the result of this experiment, *therefore*, was perfectly satisfactory." Most assuredly it was, but perfectly unnecessary, at least for my conviction; for when once I have satisfied myself of the truth of an hypothesis by mathematical demonstration, I never suffer my confidence to be shaken by facts.

There are many men who would cavil at this result, and observe that, according to the theory, the specific gravity of the tetrahedron ought to have been 2·760, for $\frac{44}{2}$: 20 :: 3·037 : 2·760.— An error of two units in the first place of decimals must never be allowed to overturn a theory founded upon a priori mathematical deduction. And after all, notwithstanding his precautions, the difference may have arisen from inaccurate manipulation. I, therefore, determined (for proselytes are generally enthusiasts), by experiments more decisive, and conducted, if possible, with still greater delicacy than those of Mr. Daniell, to place our theory (if he will allow me the use of the plural possessive) beyond the reach of controversy. Unfortunately, Sir, not being a mineralogist, I had no fluor spar to recur to, excepting, indeed, two vases, and an obelisk of Blue John, which graced our drawing-room chimney-piece; and, independently of the difficulty of detaching from them either an octohedral or a tetrahedral portion, it would have been unfeeling to propose such a sacrifice to my wife, who, good soul, has no enthusiasm in these matters. It occurred to me, however, that if true of fluor spar, it must be equally so of every body in nature, fluid as well as solid. If from the same mass of fluor spar I obtain a different specific gravity according as I detach an octohedral or tetrahedral crystal, it follows, that by confining the same fluid in a vessel of an octohedral or a tetrahedral form, I shall so alter the surfaces of the mass of fluid compared with the number of elementary atoms, that its specific gravity must vary with every modification in the form of the vessel which contains it.

By the help of a rough model, an intelligent tinman in the neighbouring market-town, constructed for me an octohedral and a tetrahedral vessel, consisting of equal triangular faces, one of which was left open for the purpose of pouring in the fluid. The octohedron held two gallons, for it would have been absurd to risk the success of the experiment by conducting it on a small scale; and, to say the truth, I abhor (what it has been the fashion of late to call) microscopic chemistry. Besides, the beer can in my servants' hall held exactly two gallons, and to the eye was cylindrical. A large china punch-bowl, in which all my children had been christened, though not perfectly a hemisphere, was so near an approximation that I had no apprehension of error on that score, and a large kitchen funnel furnished me with a cone. The octohedron was laid upon one of its triangular faces, with the open side uppermost, and the tetrahedron was supported upon its apex in a large mass of clay, so that the plane of the open side should be perfectly horizontal. Thus prepared, I had the vessels carefully filled with water, *all taken from the same pump*, and successively plunged a beautiful hydrometer of Nicholson's into the octohedron, tetrahedron, funnel, beer-can, and punch-bowl. Now, Sir, I leave you to judge of my mortification on finding the instrument indicate identically the same specific gravity in all.

I varied the experiments by using distilled, instead of pump water; I tried Atkins's and Sykes's hydrometer, and the areometer of Beaumé, repeatedly, and always with the same result. After recovering from the temporary shock this disappointment occasioned, I soon, upon reflection, discovered that the pressure of the fluids upon the sides of the vessels being exactly equivalent to the pressure of the sides upon the fluid, I had no chance of ascertaining the difference of their specific gravities, unless they could be freely retained in their forms by their own specific attractions, and any attempt to obtain them in this state being hopeless, I abandoned these experiments as anomalies that would be explained when I had time to calculate the necessary allowance for pressure.

Not long after this, on my return one moonlight night from dining with a neighbour after I had been thinking of a mode of discovering the longitude, an experimentum crucis came across my mind.

I procured two cubes of lead precisely equal in weight, and of the same specific gravity; every angle was determined by the reflecting goniometer to be 90° within less than a second; and having placed them on my table, I divided them both into two equal parts, the one, by a vertical section through the diagonal, the other, by a vertical section parallel to one of the sides. The former cube was thus converted into two triangular prisms, the latter into two quadrangular prisms.

Now, without going into the minutiæ of calculation, it is evident that the diagonal of a square being to its side as the $\sqrt{2} : 1$, I obtained a much larger proportion of new surface by the diagonal, than by the parallel division; for the original surface of the cubes being in no wise altered, you will easily see that the surface of the triangular prism is to that of the quadrangular :: 4·414 : 4. Here it is obvious, said I, repeating the words of Mr. Daniell, (which I have by heart) that solids, so constructed, must differ in their specific gravities, unless the number of particles in the one exceed the number of particles in the other, in the same proportion that the surface of the former exceeds that of the latter.

I confess to you, Sir, that I proceeded to ascertain the weights of these demi-cubes with some palpitation of heart, fearing that their new surfaces might have some influence on their weight in air, which would have exceedingly disconcerted my experiment. Luckily, however, this was spared me; they were all precisely of the same weight.

"I then proceeded to take their respective specific gravities," "making use of every precaution to avoid any source of error," when, to my utter astonishment and surprise, there was not the slightest difference whatever. My scales had been made by the late Mr. Coventry, with conical beams, ruby points, and agate planes, and turned easily with the $\frac{1}{100\cdot000}$th of the weight; yet, after innumerable trials, I have never been able to detect a variation as far as the 10th decimal figure, beyond which I have not thought it necessary to proceed.

My faith is not staggered by this untoward result; but I acknowledge myself puzzled, and fly to you for information. I humbly request that either you, Mr. Editor, or some of your readers, or Mr. Daniell, if this should meet his eye, will give me some explanation of these provoking facts.

As this is a question of surface, can an incipient oxidation of the surfaces have given rise to the error? If so, the experiment might be made in a more refined manner with platina cubes. I have turned to the books on the subject; but neither Galileo, nor Boyle, nor Hooke, nor Newton, nor Cotes, nor Huygens, nor the Bernouillis, nor any writer, ancient or modern, that I have consulted, ever once mentions the word *surface* in reference to specific gravities, they constantly make use of the term bulk.

At my time of life, it will never answer to enter into nice metaphysical distinctions between bulk and surface. To all practical purposes they are the same. If the bulk increases, the surface increases, and, *e converso*, if the surface increases, so must the bulk. Nor can I for the soul of me ever understand what these elder mathematicians mean, by solids of greatest bulk under least superficies. These are subtilties with which I will not bewilder my brain. It is quite clear, that if in their deductions they have omitted so essential a consideration as surface, the doctrines of refraction, gravitation, and all subjects connected with density, must undergo a complete revision. It has always been a maxim with me never to suffer authority, in matters of philosophy, to weigh a feather in the scale against my own opinion, though I acknowledge it to be a feather in one's cap when ranged as an auxiliary.

It is a very curious fact, and proves upon what a frail foundation the bubble reputation rests, that Archimedes, when he discovered the imposition in King Hiero's crown, seems to have been totally ignorant of Mr. Daniell's principle, that specific gravity depends upon surface; and yet, by an accidental coincidence, as lucky for him as it was strange, he has actually blundered himself into immortality. But, Sir, I have done; I have stated to you my difficulties freely and candidly, and any notice you may please to take of my request, will confer an obligation on your obliged, and obedient humble servant,

Jan. 12, 1818. PATRICK ADDLE.

ARTICLE XII.

Some Remarks upon Mr. Daniell's Experiments on the Specific Gravity of Crystals. By J. L.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN,

In the Journal of Science and the Arts,* two elaborate essays have lately appeared by Mr. Daniell, on the spherical form of the particles of crystals, in which, after employing many learned arguments in favour of his opinion, he concludes by relating a series of experiments that he performed on the subject, which, he conceives, are of such a nature as absolutely to decide the question. The results of the experiments being all completely favourable to Mr. Daniell's doctrine, he considers himself as

* I. 24, and IV. 20.

having had the good fortune to reduce to a certainty, and to establish as an undoubted matter of fact, what had before been advanced only as a plausible hypothesis. With respect to the truth of the hypothesis, I was very much disposed to coincide with Mr. Daniell, even before I read his experiments; and with respect to the experiments themselves, I consider them in their consequences as, perhaps, even of more importance than the ingenious author is disposed to attach to them. If you will, therefore, allow me to trespass so far on your pages, I shall first abstract an account of the experiments from Mr. Daniell's paper, and then offer some brief remarks upon them.

It is well known that there are certain crystals which, by dissection, are divisible either into the tetrahedral or octohedral form; both these figures are bounded by triangular faces, the tetrahedron being contained by four, and the octohedron by eight. Now if we assume the bases of these triangles to be composed of the same number of particles, as the one solid is bounded by four, and the other by eight of these triangles, the author concludes "that the whole superficies of the latter is exactly double that of the former." He then goes on to state, "that solids so constructed must differ in their specific gravities, unless the number of elementary particles in the octohedron be exactly double the number in the tetrahedron; that is to say, unless the number of atoms in a given space be equal in both arrangements." It is, however, easily perceived, that if we pile up a set of balls into the forms of a tetrahedron and an octohedron, the number of balls in the former will not be half that in the latter; if, for example, we assume four balls as composing the base of each triangle, the tetrahedron will contain only 20, and the octohedron 44; the latter, therefore, contains "more than double the number of particles under a double surface." The conclusion which Mr. Daniell draws from this fact, and in short that which forms the basis of his experiments, is, that "the specific gravity of the latter solid (the octohedron), must be greater than the specific gravity of the former (the tetrahedron)." Now, in fluor spar, we have a method by which the hypothesis can be at once put to the decisive test of experiment; for as we can at pleasure reduce this body to the form either of a tetrahedron or an octohedron, we have it in our power to form two crystals, which should differ in their specific gravity in the same proportion as they differ in the number of their component particles. The author states the question with perfect correctness. "Is the specific gravity of a mass of fluor, split into the form of an octohedron, greater than the specific gravity of the same mass, split into the form of a tetrahedron?" Or, generalizing the question, as I apprehend we may do, in strict conformity with the author's principle, does the shape of a body affect its specific gravity? Singular, and indeed startling as such an assertion may at first view appear, we find that this is stated to be the case, and that not as the deduction from any complicated train of reasoning, or any loose analogy, but as the direct result of experiment. As this may be regarded as the experimentum crucis, upon which the whole argument hinges, I think it will be proper to quote it at full length, in order that I may not, unintentionally, be guilty of any omission or misrepresentation. "I selected," says Mr. Daniell, "a mass of green fluor spar, transparent, and perfectly free from the adhesion of any foreign ingredient. From this I extracted, by mechanical division, the following solids; a tetrahedron, a rhomboid, an octohedron, and a cuneiform or lengthened octohedron. I then proceeded to take their respective specific gravities with a very delicate balance, making use of every precaution to avoid any source of error. They were as follows:

Cuneiform octohedron	3·100
Octohedron	3·037
Tetrahedron	2·909
Rhomboid	2·904

"The result of this experiment was, therefore, perfectly satisfactory; the specific gravity of the octohedral arrangements exceeding that of the tetrahedral in a very sensible degree."

A second experiment, or rather series of experiments, which Mr. Daniell performed, was conceived "to confirm this conclusion in a still more unexceptionable manner." He took a cube of colourless fluor spar, then cut off four of its corners, and afterwards formed it into a regular octohedron; he ascertained its specific gravity in each of these states, and also that of three of the solid angles that were cut off; the results of these six experiments are arranged by the author in a tabular form, as follows:

Specific gravity of the cube	3·180
4 corners cut	3·242
octohedron	3·261
1st corner.	3·115
2d ditto.	3·111
3d ditto.	3·125

Upon this experiment the author remarks: "Here we have the very same solid of perfectly homogeneous composition, varying in its different parts in specific gravity according to the calculations of theory, while nothing could be more unexpected than the fact itself, till the calculations pointed it out as a test whereby the hypothesis must stand or fall." Mr. Daniell concludes by remarking, that "numerous other experiments all agreed in the result, that fluor spar increases in specific gravity according as, in its division, we approach to the perfect octohedral arrangement, and recede from the tetrahedral."

Having thus given you a full account of Mr. Daniell's experiments, and of the deductions which he forms from them, I shall very briefly state the remarks which have occurred to me on the subject. In the first place, it must be admitted that Mr. Daniell proves, in the most satisfactory manner, by the elegant process of counting the balls in the two piles, that different quantities of matter may be contained under the same superficies; but the conclusion which he draws from it, *that the specific gravities must therefore differ*, so far from following as a necessary consequence, is in direct contradiction to every authority that we possess on the subject. It had always been assumed as a fundamental principle, that specific gravity has no connexion with the external form of a body; but that it entirely refers to the weight of the substance in question, compared with that of a body of an equal bulk, assumed as a standard of comparison. The following is the definition which is given of it by the celebrated Cotes: "Bodies are said to be specifically, or in specie, heavier or lighter one than another; when, being equal as to magnitude, the weight of one does exceed or fall short of the weight of the other."* This principle, which, as far as I know, has been universally acquiesced in by all mathematicians and philosophers, must, however, in consequence of the curious discovery of Mr. Daniell, be abandoned.

A second very remarkable fact, which we learn from these experiments, a fact equally at variance with the generally received opinions, is, *that the different parts of homogeneous substances may possess different specific gravities.* This newly established principle must necessarily introduce a new method of experimenting on this subject, and will, indeed, render our former experiments of little value. Provided the substance upon which we operated was homogeneous, and free from impurities, it was never suspected that its specific gravity could be influenced by its relative situation in the mass from which it was derived. But we now find that this is the case, from this "very unexpected" result of Mr. Daniell's experiments. Hence all our accounts of specific gravities must be corrected, or rather ascertained, upon a new principle; we must not rest satisfied, as all chemists and mineralogists have hitherto been, with merely operating upon a certain portion of the substance in question; but we must know exactly what is its shape; whether it was broken off from a larger mass, and whether it formed the central part of that mass, or was merely one of the "corners," and, indeed, it will be necessary that each of these parts be examined separately. This will, no doubt, be a work of great time and labour; but we trust that the ingenious gentleman, who has made this curious discovery, will not decline to undertake a task for which he is so eminently qualified.

A third principle, which seems irresistibly to follow from Mr. Daniell's experiments, is, *that the same substance may have its specific gravity changed according to the volition of the operator.* When he is preparing his crystal for the experiment, he may

* Lectures, p. 3.

leave the octohedron of a greater or less magnitude, or may detach from it a greater or less quantity of fragments; and, according as any portion be left to form part of the octohedron, or be chipped off along with the "corners," it will have its specific gravity increased or diminished. It also follows as a necessary consequence of Mr. Daniell's very "unexpected" discovery, *that the specific gravity of crystals may be changed merely by their apposition to each other*, and that this depends of course upon the volition of the operator. Every one knows that an octohedron may be converted into a rhomb by the addition of two tetrahedrons to two of its opposite faces; we learn, however, from these very curious experiments, that the specific gravity of the rhomb is less than that of the tetrahedron, and this again less than that of the octohedron; so that two crystalline forms, when placed side by side, and thus made to assume a third form, produce a body which has a less specific gravity than either of those which compose it. If I were disposed to enter into any speculations on the subject, I might remark upon the awkward consequences which may arise from this interference of the volition of the operator, with the results of his experiments; we shall in future not only have to guard against false weights and scales, or incorrect observations; but we shall be exposed to false facts and incorrect statements, which although not to be suspected in the present instance, might occur from a less respectable or a less cautious quarter.

The ingenious author has, apparently, left the subject incomplete, in not stating whether this curious property of the specific gravity, changing with the change of form, takes place in other bodies as well as in crystals; whether, for instance, an octohedron of gold is specifically heavier than a tetrahedron of that metal. It would seem to be a necessary consequence of the very curious discovery of Mr. Daniell, that this should be the case; but where the results of the former experiments were so very "unexpected," it would be rash to offer an opinion, until the trial had actually been made. If this should prove to be the case, the same correction of the specific gravities of all solids, and we may presume of all fluids, will be necessary, as has been noticed above with respect to crystals; and we must hope that the learned discoverer will prosecute the plan on which he has so successfully entered, and favour the world with an account of the specific gravities of all bodies arranged in the same form with those of fluor spar.

The consequences which seem necessarily to flow from Mr. Daniell's discovery are so very wonderful, that I at first suspected I must have misunderstood some of the terms employed by him; or that, in this age of innovation, he might have used some new and improved nomenclature; but the clear manner in which he expresses himself seems to preclude this sup[illegible]ition. Nor is it possible to imagine that he can have [illegible] heterogeneous substances, actually possessed of different specific gravities, according to the *old meaning* of the term, in their different parts; because it would be quite contrary to all the calculations of probability, that in so great a number of instances, the accidental errors should all have been exactly of such a nature as to tally precisely with the theory. Nor can I feel any hesitation in absolutely rejecting an idea, which, under other circumstances, would have immediately suggested itself, that the writer, having inadvertently formed an erroneous theory, had endeavoured to prove its truth by a set of fictitious experiments.

I am, Gentlemen, your obedient servant,

Newbold, Jan. 10, 1818. J. L.

Article XIII.

Abstract of a Memoir on the Combinations of Phosphorus and Oxygen. By M. Dulong.*

It is generally supposed that oxygen and phosphorus unite so as to form acids, in two proportions only, and there is still some uncertainty about the proportion of their elements. Lavoisier fixed the proportions of phosphoric acid at 100 phosphorus and 154 oxygen; Sir H. Davy coincides with him in these numbers; but other chemists, as Rose, Berzelius, and Thomson, have obtained different results: Dr. Thomson, from some late experiments, has fixed the proportions at 100 parts of phosphorus to 123·37 of oxygen. M. Thenard is the only chemist who has made a direct analysis of phosphorous acid; and he states its components to be 100 parts of phosphorus to 110 of oxygen: M. Gay-Lussac, and Sir H. Davy, on the contrary, suppose it to consist of only 76 parts of oxygen to 100 parts of phosphorus.

In endeavouring to detect the causes which have led to these various opinions, M. Dulong informs us that he has discovered at least four distinct acids, formed by the union of oxygen and phosphorus. The acid which contains the minimum of oxygen is produced by placing the alkaline phosphurets in contact with water. The phosphurets of strontian and barytes were those

* Abridged from vol. iii. of the Memoirs of the Society of Arcueil. In this abstract will be found the principal facts and opinions which are contained in the elaborate memoir of M. Dulong. It will be perceived that many of his conclusions differ from those of preceding chemists, who have treated upon the same subject, and especially from those of Sir H. Davy. We are informed that this distinguished philosopher has been lately engaged in a series of experiments on phosphorus, the particular object of which is to examine some of the statements which are brought forward by M. Dulong, and which appear to militate against his own. We shall have much satisfaction in taking the earliest opportunity of laying the results before our readers.

generally employed: they were formed by passing the vapour of phosphorus over the heated earth in a narrow tube, and were found to be saturated compounds. When this phosphuret is projected into water, phosphuretted hydrogen gas is disengaged, and after some time a powder subsides to the bottom of the vessel, which is completely insoluble in water and is of a yellow or brown colour. Nitric and muriatic acids dissolve very nearly the whole of it; and it may be precipitated by ammonia, when it is said to exhibit all the properties of a phosphate of the earth employed in the formation of the phosphuret. The water which has been employed in the above experiment contains a considerable quantity of barytes, and it is combined with the new acid in question, which may be obtained in a separate state, by adding sulphuric acid, so as to form the sulphate of barytes, which is precipitated from the fluid. The water may be removed by distillation, and a strong acid is left, which does not precipitate any metallic solution, and possesses a density approaching to that of concentrated sulphuric acid. To this, which M. Dulong regards as a new acid, he gives the name of hypophosphorous, and styles its salts hypophosphites. Iodine, in the solid state, put in contact with this acid, is rapidly dissolved, and the hydriodic acid is produced; it likewise converts chlorine to the state of hydrochloric (muriatic) acid. The hypophosphites are all very soluble, even those of barytes and strontian; they have the property of precipitating gold and silver from their solutions in the metallic state. When heated in glass tubes, we obtain phosphuretted hydrogen gas, phosphorus, and a phosphate coloured by a little of the red oxide of phosphorus. The neutral hypophosphites slowly absorb oxygen, and become acid.

A long, and as it appears very complicated, process was employed to ascertain the composition of the hypophosphorous acid. Four jars were filled with equal quantities of water, in two of which was dissolved a certain quantity of the hypophosphite of soda; a stream of chlorine was then passed through them, until there was no longer any absorption. The pure water in the two vessels served as a standard for measuring the excess of chlorine that was retained in the solutions of the hypophosphite. By means of nitrous vapour, procured from the nitrate of potash, the chlorine was brought to the state of hydrochloric acid; and, by the solution of silver, the proportions of chlorine were ascertained, which had been absorbed by the pure water and the saline solutions respectively. The excess of the latter above the former was what had served to convert the hypophosphite into a phosphate; and by the relation which chlorine bears to oxygen, the quantity of this latter might be calculated which is necessary to complete the saturation of the hypophosphorous acid. The quantity of phosphoric acid was determined by adding a salt, either of barytes or of lime. By forming estimates of the successive steps of this process, we arrive at the conclusion, that this acid consists of phosphorus 72·75 parts, oxygen 27·25 parts: or phosphorus 100 parts, oxygen 37·44 parts. It is, however, admitted, that the acid may contain hydrogen; in which case its name must be changed to hydroxyphosphorous acid.

The next compound of phosphorus and oxygen is the phosphorous acid: this substance has usually been obtained by the slow combustion of phophorus in the atmosphere; but by this process it is not procured in a pure state. The method that is recommended is to form the compound of chlorine and phosphorus, and to decompose it by water: then by evaporating the water, the acid in question is obtained, and hydrochlorio acid is disengaged. To ascertain the proportion of the constituents of this acid, it is sufficient to discover the quantity of chlorine with which the phosphorus is combined in the compound; and this is accomplished by precipitating a given weight of the chloruret, after it has been acted upon by the water, by means of the nitrate of silver. Proceeding upon this datum, we learn that phosphorous acid is composed of phosphorus 57·18 parts, and oxygen 42·82 parts; or phosphorus 100 parts, and oxygen 74·88 parts.

The acid which is generated by the slow combustion of phosphorus in the atmosphere differs from the above acid both in its composition and even in its nature. What have been described by Fourcroy and Vauquelin as phosphites, are either phosphates or mixtures of the phosphates and phosphites. This is illustrated by the products that we obtain from the neutral compounds of this acid, and the alkalies and alkaline earths. We are not, however, to consider the acid as a simple mixture of the phosphoric and the phosphorous acids; because the proportions of the oxygen and the phosphorus seem to be constant, which would scarcely be the case if it were an accidental compound, or one formed of two substances, which have no necessary connexion with each other. Considering it, therefore, as a substance of definite properties, M. Dulong proposes to give it the name of phosphatic acid. In order to ascertain its composition, the same process was employed as with respect to the hypophosphorous acid, the result of which was, that it consists of 100 parts of phosphorus, and 109 of oxygen; but as these numbers do not agree with the relations of oxygen to phosphoric acid, we may take the one which approaches the nearest to it, that of nine to ten, which would give 112·4 parts of oxygen in phosphatic acid. It is indeed admitted that it is the first example of combinations with fixed proportions that differ so little from each other; but, as we extend our researches, we shall probably find the case not a singular one. Professor Berzelius, for example, does not admit the existence of an intermediate oxide of iron, the proportions of which are given by M. Gay-Lussac, merely because it is very near the red oxide, and does not agree with the laws which he had discovered in many other bodies.

Of all the compounds of oxygen and phosphorus, the phosphoric acid is the only one which can be subjected without alteration to an elevated temperature, and which forms salts, that can be obtained in the dry state. It becomes, therefore, essential to reduce all the estimates to the proportions of the phosphoric acid, and, consequently, to ascertain this with the greatest accuracy. Besides, the great differences which there are in the estimates of different chemists, rendered it necessary to examine the subject in detail. When we endeavour to determine the proportions of phosphoric acid by the acidification of phosphorus by means of nitric acid, there are many causes of error which it is not easy to obviate. There is also a great liability to error in the estimates that are made of the weight of the acid from the variableness in the proportions of the insoluble phosphate that is employed in the process. The phosphates of lead, barytes, and lime, which are commonly employed, are not uniform in their composition; besides that the insoluble phosphates often combine with a portion of different soluble salts, which affects the result. On this principle we are to explain the different conclusions at which M. Rose and Dr. Thomson arrived, although they employed the same process.

If we unite the phosphorus to a metal, which is easily acted upon by nitric acid, we may use this substance in estimating the composition of phosphoric acid, without being liable to those sources of error which interfere with the results when we employ the acid in a separate state. The author employed copper for this purpose; having carefully formed a quantity of phosphuret of copper, it was dissolved in nitric acid, by which means all the phosphorus was converted into phosphoric acid. If we precipitate the copper by caustic potash, we may learn by the weight of the oxide whether any phosphoric acid remains attached to it; nitrate of either barytes, lime, or lead, is then added to the fluid, and a phosphate is formed, from which we learn the quantity of phosphoric acid. This method does not appear, however, to admit of very great accuracy; in six experiments that were performed, the quantity of oxygen varied from 117 to 125 parts, to 100 parts of phosphorus. It appears that we can arrive at greater accuracy by dissolving the phosphuret of copper in nitric acid, and evaporating and calcining the residuum in a platina crucible; by this means a phosphate of copper is formed, from which we are able to calculate the quantity of oxide of copper; and the amount of the phosphorus being known, we ascertain that of the oxygen. By this means numbers were obtained much more nearly coinciding than in the former case; the highest was 123·3, and the lowest 122.

Although there seemed every reason to trust to the co[rrect]ness of this estimate, yet it still remained to determine, w phosphorus, placed in other circumstances, would absorb the same quantity of oxygen, or whether in fact there were not other phosphoric acids. The action of chlorine was employed for this purpose; and the result was that, according to the estimate founded upon this process, 100 parts of phosphorus require 123 parts of oxygen, to be converted into phosphoric acid, so that we are justified in concluding that the acid produced by the medium of chlorine, is exactly similar to that produced by nitric acid.

It has already been observed that Sir H. Davy gives a different statement respecting the constituents of phosphoric acid: he conceives that 100 parts of phosphorus require 150 of oxygen, and that the phosphoric requires twice as much oxygen as the phosphorous acid. As his calculation depends upon the idea which he entertains concerning the constitution of the chloruret of phosphorus at the maximum, or the perchloride of phosphorus, it appeared necessary to examine this substance. For this purpose a vessel was filled with chlorine, the weight of which was ascertained; into the same vessel, after removing the chlorine, a minute quantity of phosphorus was introduced, and it was again filled with chlorine, by which means the phosphorus was immediately converted into the perchloride; and by ascertaining the addition of weight acquired by the vessel, it was calculated that 100 parts of phosphorus were united with 549·1 of chlorine; Sir H. Davy's estimate makes the latter number 666. As it had been before found that the chloruret at the minimum, or the protochloride, was composed of 100 parts of phosphorus to 347·7 parts of chlorine, and as 347·7 is to 549·1 very nearly in the ratio of 3 to 5, we may conclude that the oxygen of the phosphorous acid, is to that of the phosphoric in the same ratio, instead of that of 1 to 2. Phosphoric acid must then be composed of phosphorus 44·48 parts, and oxygen 55·52 parts; or phosphorus 100 parts, and oxygen 124·8 parts.

A remarkable phenomenon is mentioned as taking place from the decomposition of the chloruret of phosphorus by water. If a piece of this substance is projected upon water, the violent heat which is evolved reduces the greatest part of the chloruret into vapour. If, on the contrary, the chloruret in powder is thrown upon water, not much heat is excited; but an oleaginous fluid is formed, which soon begins to act upon the water, a great increase of temperature ensues, and the oily body disappears. This oily matter was collected in a separate state, and submitted to a number of experiments, which showed it to be different from either of the chlorurets; but it is conceived to be rather a union of several bodies, than a specific compound. What appears the most probable, is, that it is a hydrate of the chloruret of phosphorus, holding in solution a large quantity of this same chloruret.

When phosphorus is burned in oxygen, or in atmospherical air, with an excess of oxygen, or of air, the acid which results is pure phosphoric acid, without any addition of phosphorous acid. Dr. Thomson adopted this method of analyzing the acid, and obtained results nearly similar to those mentioned above. The properties of the phosphoric acid, which forms a component part of the bones of animals, appeared to possess properties exactly similar, so far as regards the formation of salts, and its capacity for saturation. It is necessary to observe that the phosphoric acid, which is obtained by the calcination of the phosphate of ammonia, is not pure, as it is impossible to remove the whole of the ammonia from it. A quantity of water still adheres to phosphoric acid, although it is kept for a long time in a state of fusion; and this is estimated at 20·6 parts in 100 parts of the acid, which is equivalent to 18·2 parts of oxygen, almost exactly the third part of the whole which is contained in phosphoric acid.

With respect to the composition of the phosphates, M. Dulong's analyses do not agree with either those of Professor Berzelius, or Dr. Thomson: the salts which Berzelius examined are supposed not to have been in the neutral state; and Dr. Thomson has not completed his examination of these bodies, so that the subject may still be regarded as requiring further examination. Three points, however, seem to be ascertained; 1. that the neutral phosphites are changed into phosphates without having their neutrality destroyed; 2. that the hypophosphites, by the same process, yield an acid phosphate; 3. that the metallic phosphurets, obtained by the process mentioned above, are, in reality, merely proto-phosphurets, corresponding to the protoxides which are combined with acids. With respect to the weight of the atom of phosphorus, it is stated to be 20·03, that of oxygen being taken as 10; as phosphoric acid is composed of two atoms of phosphorus and five of oxygen, it will be represented by 90·06.

It appears from the above statement respecting phosphorus, that the analogy which it bears to sulphur is not so great as has been generally conceived. The proportions in which phosphorus and oxygen unite are more analogous to those of azote and oxygen; and the composition of the phosphates and phosphites has also a strong analogy to those of the nitrates and nitrites. On the other hand, it is to be observed that phosphorus and azote differ from each other, as much as possible, with respect to their combustibility.

Article XIV.

Analyses of Books.

Philosophical Transactions for the Year 1817, Part II.

(*Concluded from p. 58.*)

It has been long known that the Island of Java contains a peculiar species of swallow, the nest of which is composed of an animal substance; but naturalists have never been able to ascertain the source from which it is derived, nor the materials of which it is formed. Several circumstances, however, seemed to prove that it proceeded from the stomach of the animal itself; and this induced Sir Everard Home to examine the digestive organs of this peculiar kind of swallow, and to compare them with those of other species of the same genus. The author was informed by Sir Stamford Raffles, late Governor of Java, that the swallows, peculiar to that island, do not migrate; they spend a considerable part of the day in the neighbourhood of extensive swamps, that abound with various kinds of insects, and retire, at the close of the day, to large caverns, which they inhabit in prodigious numbers. The bird is double the size of our common swallow; the male and female lie in separate nests, each adapted to their form, the female nest being wider and deeper, in order to receive the eggs.

By comparing together the gastric glands of the Java swallow, the common swallow, and the black-bird, the peculiar structure of the first was sufficiently obvious. According to the description, "there is a membranous tube surrounding the duct of each of the gastric glands, which, after projecting into the gullet for a little way, splits into separate portions like the petals of a flower." In the examination of the parts, the author received the assistance of Mr. Bauer, who has given us exact representations of what he detected by his microscope. It is reasonable to conclude that these peculiarly formed tubes secrete the animal matter of which the nests are composed, although we have no means of judging how the process is conducted.

This provision, which the Java swallow possesses, of forming a nest from its own secretions, is a remarkable anomaly among the higher order of animals; it is said by the author to prove that this bird was intended by nature to be an inhabitant of the island of Java, "in which nothing is to be met with out of which a nest could be constructed;" but we are not informed in what this deficiency of materials consists, or upon what it depends. Mr. Brande examined the substance, and found it to have "properties intermediate between gelatine and albumen;" the quantity of gelatine, however, appears to be very minute, so as scarcely to account for the difference between this substance and common albumen.

In consequence of the discovery of these peculiarly formed gastric glands in the œsophagus of the Java swallow, Sir Everard Home requested Mr. Bauer to examine the structure of the external membrane of the œsophagus and stomach in the human subject. It was found that the "œsophageal glands, when examined in the microscope, have the appearance of infundibular cells, whose depth does not exceed the thickness of the membrane." The structure of these glands somewhat resembles that of the same parts in birds, and, like them, possesses the exclusive property of coagulating milk. Mr. Bauer found that the structure of the upper arch of the stomach is "made up of cells in the form of a honey-comb, the sides of which are not formed by the doubling of the membrane (for no stretching of the cells alters the form of their orifices), but are regular partitions constructed between the cells." This same structure is found, only in a less distinct form, over the whole of the cardiac portion of the stomach. In the pyloric portion there is also the same kind of cells; but in addition to the former structure, "there are small clusters, the sides of which rise above the surface, giving the appearance of foliated membranes." This foliated structure is still more considerable in the duodenum. From his examinations the author is led to conclude that the gastric glands in the human stomach are, in proportion to its bulk, considerably smaller than in most other animals.

The conclusion that is deduced from these observations is, "that there are three different kinds of organization employed, in adding to the food three different ingredients, which are requisite for its conversion into a material that can be assimilated with living animal matter, and be employed in carrying on the functions of life, also supplying the waste which is constantly taking place. The most important of these is evidently the gastric glands; next in order may be considered the honeycomb structure, and least so, although by no means unnecessary, the foliated membranes, which we know, from what takes place in the Java swallow, form the mucus that is mixed with the other ingredients."

In the conclusion of his paper, Sir Everard Home takes occasion to give an account of a human stomach, which was found after death divided into two portions, by a firm contraction of its substance, which, he conceives, affords an illustration of the healthy state of the stomach while the process of digestion is going forwards.

The species of Sepia inhabiting the shell of the Argonauta Argo has, by all ancient and by most modern naturalists, been considered as the proper animal of the shell. A few eminent naturalists of the present day have, however, supposed that the animal hitherto found in this shell is parasitical. This opinion has derived its strongest support from the absence of those organs on the surface of the body of the animal in question, which are found in all the shelled mollusca, and by which the secretion of the calcareous matter forming the shell is effected. Rafinesque, from his situation on the coast of the Mediterranean, has had peculiar opportunities of studying this animal, and is fully of opinion that it belongs to a genus nearly allied to the sepia of Linnæus, to which he has given the name of ocythöe, and resides, parasitically, in the above-mentioned shell.

Some observations made by the late Mr. Cranch, zoologist to the unfortunate expedition to the Congo, tending strongly to confirm the theory of Rafinesque, are detailed by Dr. Leach in the present paper.

"In the Gulf of Guinea, and afterwards on the voyage, he took (by means of a small net, which was always suspended over the side of the vessel) several specimens of a new species of ocythöe, which were swimming in a small argonauta, on the surface of the sea.

Two living specimens being placed in a vessel of sea-water, the animals very soon protruded their arms, and swam on and below the surface, having all the actions of the common polypus of our seas. By means of their suckers they adhered firmly to any substance with which they came in contact; and when sticking to the sides of the basin, the shells might easily be withdrawn from the animals. They had the power of completely withdrawing within the shell, and of leaving it entirely. One individual quitted its shell, and lived several hours, swimming about, and showing no inclination to return to it; and others left the shells as he was taking them up in the net."

The same species which has furnished Dr. Leach with the materials for this paper, has also afforded to Sir Everard Home the subject of a short communication, tending to confirm the opinion of Rafinesque. In some of the specimens of ocythöe cranchii, the animal had deposited its eggs in the involuted part of the shell which it occupied; these eggs form a cluster, held together by pedicles, one of which belongs to each egg, in this respect resembling the ova of the sepia octopus. But the eggs of all the testaceous aquatic mollusca, as far as they are known, are enveloped in a gelatinous mass, which corrugates by the action of the sea water, and thus encloses each ovum in a cell, in which the young animal passes the interval, usually very short, between its being excluded from the membranes of the ovum, and its acquiring a shell.

Dr. J. R. Johnson, of Bristol, has communicated some observations on the hirudo complanata, and hirudo stagnalis, the object of which is to show that these animals differ from the other known species of leech in such important characters as to justify the arrangement of them in a new genus, to which Dr. J. gives the name of *glossopora*.

It agrees with the genus hirudo, in the body of the animal being furnished with a series of rings; in locomotion being effected by the alternate attachment of the head and of the tail, and in the existence of one stomach divided into several lateral cells or partitions. It differs from the same genus in the mouth being furnished with a projecting tubular tongue, and in having an abdominal pouch, or cavity, for the reception of the young.

Article XV.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

Jan. 8, 1818.—A paper of Dr. Brewster's was commenced, "On the Laws of Polarization in regularly crystallized Bodies;" and on the 15th, the reading of Dr. Brewster's paper was concluded.

In the introduction to this paper, Dr. Brewster gave a short account of the history and present state of the subject of double refraction and polarization. Malus had examined, with great care, the double refraction of calcareous spar, quartz, arragonite, and sulphate of barytes, and maintained that he had demonstrated the perfect identity of their action upon light; whereas it has been shown by Dr. Brewster that the two first have one axis, while the two last have *two* distinct axes of double refraction. The able researches of M. Biot were made with calcareous spar, rock crystal, beryl, phosphate of lime, tourmaline, feldspar, arragonite, topaz, sulphate of lime, sulphate of barytes, sulphate of strontian, and mica; and the result of his experiments in these crystals was, that *all of them* had only *one* axis of double refraction and polarisation, excepting certain specimens of mica which had two axes. Dr. Brewster has, however, shown that no fewer than *six* of these crystals, including sulphate of lime itself, have two axes of double refraction and polarisation.

In order to determine the laws of polarisation and double refraction, Dr. Brewster examined no fewer than *one hundred and eighty crystals*, in 160 of which he found the property of double refraction. Only *twenty-two* of these possess one axis, while about *eighty* possess two separate axes of double refraction; and since the experimental laws of double refraction and polarisation have been investigated only for crystals with one axis, the general laws of the phenomena remained undetermined. In the course of this paper, Dr. Brewster has proved that there is a constant connexion between the primitive forms of crys[tals] and the number of their axes, so that the latter may be pr[edicted] from the former, and that these axes are coincident wi[th] prominent lines in the primitive forms; he has shown that the irregularities observed by M. Biot in sulphate of lime, are the legitimate and calculable results of its having two axes; he has established general laws by which the phenomena of the coloured rings, and the phenomena of double refraction, may be calculated with the utmost facility of accuracy for any given number of axes; he has proved that all the cubical, octahedral, and rhomboido-dodecahedral crystals have three equal and rectangular axes, which, in general, are in a state of equilibrium; and he has shown how all the classes of crystals may be artificially imitated during the passage of heat through glass, the two sets of phenomena being regulated by the same laws. The general laws to which Dr. Brewster has been conducted by this laborious investigation, with which he has been occupied more than three years, are not empirical classifications which merely represent the phenomena. They are laws rigorously physical, and founded on the principles of mechanics. The polarising forces, and the forces of double refraction, are combined and resolved like all other forces, and the phenomena of polarisation and double refraction can thus be computed with as much accuracy as the motions and positions of the heavenly bodies. In the course of this inquiry a number of new and remarkable properties of light were discovered, which the author has promised to communicate to the Royal Society in a series of separate papers.

Jan. 22.—A paper was read by Sir Everard Home, Bart. containing additional facts respecting the fossil remains of an animal, some account of which has already appeared in the Phil. Trans.* showing that the bones of the sternum resemble those of the ornithorhynchus paradoxus.

The reading of a paper, by Capt. Henry Kater, was begun, containing an account of his experiments for determining the length of the pendulum vibrating seconds in the latitude of London.

ROYAL SOCIETY OF EDINBURGH.

Nov. 17.—The Royal Society having resumed their meetings after the summer vacation, the first part of a paper by Dr. Ure of Glasgow was read, containing Experiments and Observations on Muriatic Acid Gas. After giving a condensed view of the present state of the chloridic controversy, he proceeds to detail a series of experiments, which he had recently executed, for the purpose of deciding this fundamental point of chemical doctrine. Considering the composition of dry sal ammoniac to be definitely fixed by the concurrence of his experimental results, published in the Annals of Philosophy last September, with those of M. Gay Lussac, at 32·24 ammonia + 67·76 muriatic acid gas, he exposed thin laminæ of the pure metals, silver, copper, and iron ignited in green glass tubes out of contact of air, to the action of the vapour of the above dry salt, and found in each case the

* For the year 1814.

metal converted into a muriate, whilst a portion of water, nearly equal to one-sixth the weight of the dry sal-ammoniac, made its appearance. To this part of the paper is subjoined the description and drawing of a new, simple, and accurate exploding eudiometer, which the Doctor employed for analyzing the gaseous products of the above experiments.

At the same meeting, a paper by Dr. Fergusson, inspector of hospitals, was read on the Mud Volcanoes of the Island of Trinidad.

In the beginning of the year 1816, this gentleman was employed, along with the deputy quarter-master general of the colonies, and an officer of rank in the engineer department, to make a survey of the military stations in the West Indies, during which their attention was attracted to this extraordinary phenomenon in a district of country that had always been considered, according to their information, as strictly alluvial. It appeared to them to be so highly illustrative of the minor incipient degrees of volcanic agency in the formation of argillaceous hills, that they thought it would be right to mention it in their report, and Dr. Fergusson was deputed to draw up the statement.

This gentleman found that the eruptions of these semi-volcanoes, two in number, which are situated on a narrow tongue of land which points directly into one of the mouths of the Oronoko on the Main, about 12 or 15 miles off, at the southern extremity of Trinidad, and not far from the celebrated Pitch Lake, are at all times quite cold. That the matter ordinarily thrown out consisted of argillaceous earth mixed with salt water, about as salt as the water in the neighbouring Gulph of Paria; but though cold at all times, that pyritic fragments were occasionally ejected along with the argillaceous earth. They also observed, that several mounts in the vicinity possessed the same character in all respects as the semi-volcanoes then in activity, having all the marks, except the actual eruption, of having been raised through a similar process to their existing altitude, of about a hundred feet; and that the trees around them were of the kind that are usually found near lagoons and salt marshes. The nature of the duties on which they were employed did not permit their attempting any analysis of the air, water, or earths, furnished by the eruptions.

Nov. 24.—A general meeting of the Society having been held for the election of office-bearers, the following gentlemen were chosen:

President.—Sir James Hall, Bart.

Vice-Presidents.—Right Hon. Lord Gray and Lord Glenlee.

Secretary.—Professor Playfair.

Treasurer.—Mr. Bonar.

Keeper of the Museum.—Thomas Allan, Esq.

President of the Physical Class.—Sir George Mackenzie, Bart.

Secretary.—Dr. Hope.

Counsellors of the Physical Class.—Lord Webb Seymour, Mr. Leslie, Colonel Imrie, Mr. Jameson, Dr. Brewster, and Mr. James Jardine.

President of the Literary Class.—Henry Mackenzie, Esq.

Secretary.—Thomas Thomson, Esq.

Counsellors of the Literary Class.—Mr. Pillans, Dr. Macknight, Mr. Dunbar, the Rev. Mr. Alison, Lord Reston, and Rev. Dr. Jamieson.

Dec. 1.—A paper, by Dr. Brewster, was read on the Laws of Double Refraction and Polarisation.

This paper was divided into seven sections, of which only the two first were read.

I. On the crystals which produce double refraction, a property which the author has observed in 160 crystals.

II. On crystals with one apparent axis of double refraction. These crystals, which amount to twenty-two, were divided into two classes, positive and negative, and include all those whose primitive form is the hexahedral prism, the rhomboid with an obtuse summit, and the octohedron, in which the pyramids have a square base.

III. On crystals with two axes of double refraction and polarisation. These crystals, which amount to about eighty, include all those whose primitive form is not the hexahedral prism, the obtuse rhomboid, the octohedron with a square base, the cube, the regular octohedron, and the rhomboidal octohedron.

IV. On the resolution and combination of polarising forces, and the reduction of all crystals to crystals with two or more axes.

V. On crystals with three equal and rectangular axes. These crystals amount to twenty, and consist of those whose primitive form is the cube, the regular octohedron, and the rhomboidal dodecahedron.

VI. On the artificial imitation of all the classes of doubly refracting crystals.

VII. On the laws of double refraction, for crystals with any number of axes.

Dec. 15.—A paper was read which had been announced at the first meeting, by Dr. Murray, containing Experiments on Muriatic Acid. He had repeated the experiment performed by Dr. Ure, of subliming muriate of ammonia over ignited metals, with the variation of operating on the salt formed by the combination of muriatic acid and ammoniacal gases, instead of the common sal-ammoniac which, from its mode of preparation, might be supposed to contain water. He obtained a similar result, water appearing when the muriate of ammonia was sublimed over iron at a red heat in a glass tube. His attention having been thus recalled to the subject, he repeated the experiment which he had performed some years ago, of obtaining water from muriate of ammonia by heat, employing an apparatus somewhat on the principle of Dr. Wollaston's cryophorus, and with a successful result. He then submitted muriatic acid gas to experiment in various modes. Iron filings, perfectly dry and clean, having been put into a glass tube surrounded with sand, and placed across a furnace so as to be raised to a red heat, muriatic acid gas, extricated from a mixture of supersulphate of potash and muriate of soda, and conveyed through a tube containing dry muriate of lime, adapted to the other, was transmitted over the ignited iron. Moisture immediately appeared in the tube beyond the ignited space, and soon collected in globules, and hydrogen gas was disengaged. In another experiment the gas was previously kept in contact with muriate of lime for two days, and was then passed by a tube and stop-cock from the jar over the ignited metal with a similar result. And in another form of apparatus, still better adapted to afford a perfect result, and to obviate any fallacy from the presence of aqueous vapour, muriatic acid gas was conveyed from a jar, in which it had been exposed to dry muriate of lime, through a bent tube into a tubulated retort containing dry zinc filings; heat was applied by a lamp to favour the action of the metal on the gas; moisture condensed in the curvature and tube of the retort, and hydrogen gas was collected at the extremity, which terminated under mercury. The heat was renewed at intervals for three or four days, with the requisite addition of fresh quantities of the muriatic acid gas, and the production of moisture increased, until a very sensible quantity of water was obtained at the end of the experiment.

Jan. 5.—The continuation of Dr. Murray's paper on Muriatic Acid Gas was read. In the preceding part of it, it had appeared that from the action of metals on muriatic acid gas, water is deposited. This is a result obviously incompatible with the doctrine in which chlorine is considered as a simple substance, since, according to that doctrine, muriatic gas is the real acid altogether free from water. The opposite doctrine holding the existence of combined water in the gas to the amount of a fourth of its weight, a portion of it may be supposed to be liberated by the action of the metal. A difficulty, however, presents itself even on this view of the subject. The action consists in the acid enabling the metal to decompose the water, and combine with its oxygen. With the oxide thus formed the acid unites, and no water remains to be deposited, since none is liberated from its combination with the acid but what is spent in the oxidation of the metal. The products, therefore, ought to be the same on this hypothesis as on the other, namely, a dry muriate or chloride, and hydrogen gas.

It was shown that the water obtained in the experiments could not be derived from hygrometric vapour; that [illegible] be accounted for from the supposition of a portion of water being combined with the acid in the gas beyond that which is strictly essential to its constitution; and that it could not be ascribed to any lower degree of oxidation of the metal being established. One explanation remained that it might arise from the formation of a super-muriate, the quantity of water combined with the quantity of acid which forms a neutral muriate being sufficient for the oxidation of the metal, so that if an additional portion of acid entered into the combination, the water of this might be liberated. It was accordingly found that the products in all these cases were sensibly acid; and this even when any source of fallacy from a subversion of the combination by the agency of water was obviated. In the sequel, another explanation was suggested on a different view of the subject, if this should not be considered as sufficient.

Dr. Murray considered the result of these experiments as establishing, in addition to what he had before brought forward, the fallacy of the opinion in which chlorine is regarded as a simple substance, which, with hydrogen, forms muriatic acid. The opposite opinion, that it is a compound of muriatic acid with oxygen, and that muriatic gas is a compound of muriatic acid and water, might be held to be established, and it undoubtedly may be maintained. But he has presented a different view of the subject, as being more conformable to the present state of chemical theory.

The progress of chemical discovery has shown that oxygen cannot be regarded as exclusively the principle which communicates acidity. The same property is, in different cases, communicated by hydrogen. And this fact he regards as affording the only argument of any weight in support of the new theory of chlorine.

When water is obtained from muriatic acid gas, it does not necessarily follow that it has pre-existed in the state of water. It is equally possible, *à priori*, that the elements of water may have existed in the gas. On this view oxymuriatic acid will be a binary compound of a radical at present unknown with oxygen, and muriatic acid a ternary compound of the same radical with oxygen and hydrogen. And when muriatic acid gas is formed from the mutual action of oxymuriatic gas and hydrogen, it is simply from the hydrogen entering into the combination. In the processes by which water is obtained from it, the water is formed by its hydrogen and part of its oxygen entering into union. The same view he extends to the other acids which have been supposed to contain combined water. Sulphurous acid is the proper binary compound of sulphur and oxygen; sulphuric acid is a ternary compound of sulphur, oxygen, and hydrogen; and nitric acid is a ternary compound of nitrogen, oxygen, and hydrogen.

While each of these elements, oxygen and hydrogen, communicates acidity, their combined action seems to do so in a still higher degree. Sulphur with hydrogen forms a weak acid; with oxygen, another acid somewhat stronger; with oxygen and hydrogen, one of still greater power. Nitrogen with hydrogen forms a compound having no acidity; with oxygen in two proportions, it forms oxides; with oxygen and hydrogen, a powerful acid. Carbon with hydrogen forms compounds which are not acid; with oxygen, in one proportion, it forms an oxide; in another, a weak acid; with oxygen and hydrogen, the different vegetable acids which are of much superior strength.

This explains the apparent anomaly which appeared in the old doctrine with regard to oxymuriatic acid, that it is a weaker acid than the muriatic, though it has received an additional portion of oxygen. It is so precisely, as sulphurous acid is weaker than sulphuric. The proper points of resemblance are the sulphurous acid with the oxymuriatic, and the sulphuric with the muriatic. It was shown that oxymuriatic acid has a stricter analogy to sulphurous acid than to any other body; and that any deviation from this analogy arises from the large proportion of oxygen which the former contains.

The relations of iodine, the analogy of which, in some respects, to those of chlorine, has chiefly given predominance to the new doctrine with regard to the latter, accords perfectly with these views. The nature of the compounds of inflammable bodies with chlorine accord also better with them than with either of the other doctrines. And they serve to explain a number of other facts connected with the action of acids and their combinations. They afford, for example, a solution of the difficulty which gave rise to the investigation—that of the production of water in the action of metals on muriatic acid gas.

Dr. Murray extended the same view to the constitution of the alkalies. Alkalinity is, as well as acidity, a result of the agency of oxygen; the fixed alkalies, the earths, and metallic oxides, which all contain oxygen as a common element, forming a series in which there is no well defined line of separation. Ammonia stands insulated; it contains no oxygen, yet its alkaline properties are energetic; an anomaly which has led generally to the belief that oxygen must exist in one or other of its constituent principles. It may be explained, however, on a very different principle. As hydrogen, like oxygen, communicates acidity, so it may, like oxygen, give rise to alkalinity. Ammonia, therefore, will be a compound, of which nitrogen is the base, deriving its alkaline quality from hydrogen; and hence stands in the same relation to the other alkalies that sulphuretted hydrogen does to the acids. If the claim of the newly discovered principle in opium to the rank of an alkali be established, it may stand in the same relation to the others that prussic acid, or [illegible] the vegetable acids, do to the acids.

The fixed alkalies, barytes, strontites, and lime, have been supposed to contain combined water, essential to them in their insulated form. It is probable that the elements of water rather exist in direct combination with their metallic base; that potash, for example, is a ternary compound of potassium, oxygen, and hydrogen. And thus the entire class will exhibit the same relations as the class of acids; some being compounds of a base with oxygen; ammonia a compound of a base with hydrogen; and potash, soda, &c. compounds of a base with oxygen and hydrogen. And these last, like the analogous order among the acids, exceed the others in power. When an acid and alkali unite, the hydrogen of both is expended in forming water. The neutral salts, therefore, according to these views, will be either surcompounds of two binary compounds, one of the radical of the acid, the other of the radical of the base with oxygen; or they are ternary compounds of the two radicals with oxygen. The latter is the more probable opinion.

At the same meeting, Dr. Brewster communicated a very interesting paper, consisting of extracts of letters from Mr. Boog to his father, the Rev. Dr. Boog, of Paisley, giving an account of the recent discoveries respecting the sphinx, and the principal pyramid of Egypt, which have been made by Captain C. and Mr. Salt. By very laborious excavations, which were made in vain by the French savans, these gentlemen have discovered, that the sphinx is cut out of the solid rock on which it was supposed merely to rest. They found that the short descending passage at the entrance to the pyramid, which afterwards ascends to the two chambers, was continued in a straight line through the base of the pyramid, into the rock upon which the pyramid stands. This new passage, after joining what was formerly called the well, is continued forward in a horizontal line, and terminates in a well ten feet deep, exactly beneath the apex of the pyramid, and at the depth of 100 feet below its base. Captain C. has likewise discovered an apartment immediately above the King's chamber, and exactly of the same size and the same fine workmanship, but only four feet in height.

Jan. 19.—The second part of Dr. Ure's paper on Muriatic Acid Gas was read. In this part the author showed that the azote of the ammonia has no concern in the production of the water; for the whole azote, competent to the weight of salt employed, is recoverable in a gaseous form. It is then experimentally demonstrated, that the sal-ammoniac, resulting from the union of the two dry constituent gases, yields water in similar circumstances. No water could be obtained, however, by heating dry sal-ammoniac *alone*, or in contact with charcoal, or even by passing its vapour through ignited quartz powder. Hence Dr Ure infers, that the traces of moisture, formerly observed by Dr. Murray, on exposing sal-ammoniac to heat, must have been the hygrometric water of the imperfectly dried salt. In confirmation of this opinion, Dr. Ure finds that both common sal-ammoniac, and that condensed from the component gases, attract moisture from the air to the amount of six or seven per cent. The latter preparation, from its being more finely comminuted than the other, becomes even pasty, when exposed for a day to the humid atmosphere of this country. By the cautious application of heat, this hygrometrical water may be entirely expelled; when the salt resumes exactly its pristine weight and dryness. Dr. Ure's concluding experiment consists in the transmission of dry muriatic acid gas over ignited turnings of pure iron, when a portion of water or liquid acid, corresponding in quantity to the proportion of muriate of iron formed, always makes its appearance. The muriate of iron seems peculiar. It is in small plates, or spangles, of a micaceous lustre, and appears to contain a smaller proportion of iron, and that in a lower state of oxidizement, than the common muriated black oxide. The Doctor infers, from the whole of these researches, that chlorine is oxymuriatic acid; and that the hydro-chloric gas of Sir H. Davy and M. Gay Lussac consists of an atom of dry muriatic acid united to an atom of water, like gaseous sulphuric and nitric acids.

At the same meeting a paper by Dr. Brewster was read, on a singular affection of the eye in the healthy state, in consequence of which it loses the power of seeing objects within the sphere of distinct vision. When the eye is steadily fixed upon any object, this object will never cease to become visible; but if the eye is steadily directed to another object in its vicinity while it sees the first object indirectly, this first object will, after a certain time, entirely disappear, whether it is seen with one or both eyes, whatever be its form or colour, or its position with respect to the axis of vision. When the object is such as to produce its accidental colour before it vanishes, the accidental colour disappears, also, along with the object. The preceding experiments have no connexion whatever with those of Mariotte, Picard, and Le Cat, relative to the entrance of the optic nerve. In the course of this investigation, Dr. Brewster was led to a new theory of accidental colours, which will be read at a future meeting.

In consequence of the very ample account of the proceedings of the Royal Society of Edinburgh, the reports from the Geological and Linnæan Societies are, of necessity, postponed to the next month.

Article XVI.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Lectures.*

Mr. Cooper will commence his next Course of Lectures on Chemistry early in the present month, at his house, 89, Strand.

II, *Graphite in Scotland.*

(To Dr. Thomson.)

SIR,

The discovery of graphite, imbedded in micaceous schistus, at Strathfarran, near Beauly, Inverness-shire, has not, I believe, been publicly noticed. Dr. Davidson, Professor of Natural Philosophy at Aberdeen, had examined the beds a short time previously to my arrival at that city, in September last: he obligingly communicated to me the following account, and gave me specimens:

"There are three beds of compact graphite, varying in thickness from 15 to 18 inches; they are separated by intervening beds of micaceous schistus, about four yards in thickness. The beds dip at an angle of about 25°. The schistose laminæ of the rock dip in the same direction, and at the same angle. The beds of graphite appear to extend from the top of the hill to the bottom, as far as can be discovered. Workings have been commenced in these beds, but have not been continued far enough to discover what may be the quality of the mineral at a distance from the surface." The specimens given me by Dr. Davidson, though greatly inferior in lustre to the best graphite of Borrowdale, yet possess all the characters of true graphite; they are soft and sectile, and leave as distinct a mark on paper as the best specimens from Cumberland. These specimens have the curved laminar structure of many varieties of mica slate, and the surface, which is weathered, has a very close resemblance to that rock. Internally, the mineral appears to be composed of minute laminæ, like mica, which are, however, true graphite.

The circumstance of mica slate impressing its form and structure on the imbedded mineral, so different in composition, may appear at first extraordinary; but it is an effect analogous to what we may observe in other situations. The great unctuosity of the Borrowdale graphite is, as I have reason to believe, derived from that of a soft adjacent bed which accompanies it. The peculiar unctuosity of the Ulverstone iron ore is derived from the same cause; and numerous instances might be mentioned where the quality of metallic ores, and of the metals obtained from them, appear to be affected by the rock through which they pass. To this cause may probably be ascribed the different qualitities of the copper obtained from the Ecton mine, and the mines of Cornwall. I am, Sir,

Your obedient servant,

13, *Tavistock-street, Bedford-square, Dec.* 10. ROBERT BAKEWELL.

III. *Third Volume of the Memoirs of the Society of Arcueil.*

In consequence of the copy of this work, from which the editors took their list of its contents, being accidentally imperfect, they omitted the last article, which is a notice by M. Berthollet on the decomposition of the oxymuriatic acid. It consists of a short paper, in which this celebrated chemist renounces his former hypothesis respecting the composition of this acid, as consisting of muriatic acid and oxygen, and adopts that of its being a simple substance, which forms muriatic acid by being united to hydrogen.

IV. *Civil Engineers.*

A Society has recently been instituted in London by some young men following the profession of civil engineers, for the purpose of mutual communication on the many important topics immediately, or more remotely, connected with their professional pursuits. The principle of their association is the diffusion of useful knowledge among all the members; on which account the Society is restricted to practical engineers, and to such students of general science as have especially directed their attention to those subjects which particularly concern the civil engineer.

The meetings are held once a week during the winter season; business commences with the reading of an original essay, to which succeeds the discussion of a topic previously agreed upon at a former meeting: information relative to projects, inventions, public works in progress, &c. closes the sitting. A Society so constituted, and sustained with spirit, cannot but prove of great advantage, both to the individual members, and to the public at large.

V. *Astronomy.*

M. Biot has been appointed, by the Institute of France, to visit this country, in order to unite with the gentlemen who conduct the Trigonometrical Survey of Great Britain, in making astronomical and other observations, at or near the northern extremity of the British Isles. Dr. Olinthus Gregory, of the Royal Military Academy, was associated with them for the same purpose.

In the months of May and June, M. Biot, assisted by Captain R. Mudge, a son of Colonel Mudge, made experiments at Leith Fort, on the length of the seconds' pendulum. The apparatus employed is of the kind recommended by Borda for that purpose, with slight modifications. When the experiments and connected astronomical observations at Leith were terminated, Colonel Mudge was obliged, by ill health, to relinquish the further prosecution of the summer's operations, and return to England. But Dr. Gregory, Capt. Colby, and Capt. Mudge, accompanied M. Biot to the Zetland Isles, for the purpose of distributing among them, and carrying through, the proposed experiments. The station chosen by these gentlemen in concert, for their common operations, was Balta, a small island, in north latitute 60° 45′. But as this island had no permanent residences upon it, M. Biot removed to the neighbouring island of Unst, where he obtained comfortable accommodations for himself, and a convenient building in which to fix and arrange his pendulum apparatus. Here, therefore, this gentleman, again assisted by Captain Mudge, made experiments and observations analogous to those which had been made at Leith; while Captain Colby and Dr. Gregory employed themselves at Balta; the former, principally, in carrying through a numerous series of observations with the zenith sector, for the determination of the latitude; the latter, principally, in observations with a transit instrument, to determine "the rate" of Pennington's astronomical clock. Other operations, of a subordinate kind, need not be alluded to in this account.

Dr. Gregory afterwards made observations at Marischal College, Aberdeen, to determine the rate of Pennington's clock there; and on trying the clock at Woolwich Common, after its return from the north, he found that its rate was precisely the same as it was last April, before it was taken out on the expedition.

M. Biot and M. Arago have also, it is understood, made, jointly, some pendulum experiments at the Royal Observatory, Greenwich; and it is expected that the several individuals will repeat the experiments and observations, in more southerly stations, during the summer of 1818.

None of the results are yet published; nor does it seem altogether proper that they should be, till the proposed series of operations is terminated. But it is hoped that the deductions which the whole will furnish will be highly useful, in reference to the real length of the seconds' pendulum, the variations of gravity in different latitudes, and the approximate figure of the earth.

VI. *Explosion in a Coal-Mine in the County of Durham.*

The following account of another of these fatal accidents, is taken from the Tyne Mercury, Dec. 23:

"On Thursday, Dec. 18, an explosion of fire-damp occurred in the Plain pit at Rainton colliery, near to Houghton-le-Spring. The total number of lives lost amounts to 26; 10 men, and 16 boys. The explosion took place at three o'clock in the morning, before the hewers had descended the pit; and from this circumstance about 160 lives have been preserved. Every exertion was made to render assistance to those in the mine, and we regret to add that two of the above men fell a sacrifice to their humane endeavours, having been suffocated by the impure air. The viewers and agents were extremely active, and had nearly shared the same fate. A correspondent who visited the pit says—'After particular inquiries, I found that though Dr. Clanny's safety lamps have been generally employed in the collieries of Lady F. Ann Vane Tempest, it so happened that this pit has heretofore been so free from fire-damp, that no safety-lamp had ever been used in it.' All the dead bodies were got out by Sunday; 13 were buried at Houghton, and four at Chester, on Saturday evening; and the remaining nine were interred at the former place on Sunday."

VII. *Dr. Brewster's Experiments on Surfaces.*

We are requested to insert in the *Annals* the following notice, which appeared in the last number of the Journal of Science and the Arts:

We understand that Dr. Brewster has lately completed a series of experiments on the action of the surfaces of crystallized bodies in the polarisation of light; and that he has determined the laws according to which the forces emanating from the surface are modified by the polarising forces which emanate from the axes of crystals. As it had always been taken for granted, in consequence of some incorrect experiments by Malus, that these last forces had no influence whatever upon the first, the results obtained by Dr. Brewster must be considered as very interesting and important, particularly as they lead to new views respecting the ordinary attraction of repulsive forces, by which the phenomena of refraction and reflection are produced.

Article XVII.

Scientific Books in hand, or in the Press.

Part VI. of the Ordnance Survey, including the greater Part of Surry, with Portions of the adjacent Counties of Wilts and Hampshire.

Mr. Mawe is about to publish Familiar Lessons in Mineralogy, in which will be explained the Methods of distinguishing one Mineral from another.

A new Edition of Kitchiner's Practical Observations on Telescopes.

Dr. Armstrong's Practical Illustrations of Scarlet Fever, Measles, Pulmonary Consumption, and of Chronic Nervous Diseases, is just ready; as is a new Edition of his Work on Typhus Fever.

Article XVIII.

Astronomical, Magnetical, and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observation.

Immersion of γ Virginis, Dec. 30, 14h 51′ 15″ M. Time at Bushey.

Magnetical Observations, 1817. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.	
	Hour.		Variation.			Hour.		Variation.			Hour.	Variation.
Dec. 1	8h	35′	24°	30′	50″	—h	—′	—°	—′	—″		Owing to the shortness of the days, evening observation discontinued.
2	8	30	24	31	12	1	35	24	36	34		
3	8	40	24	31	47	1	40	24	34	55		
4	8	45	24	32	02	1	35	24	36	16		
5	8	30	24	30	00	1	20	24	36	06		
6	8	30	24	31	26	1	30	24	36	42		
7	8	30	24	30	42	1	35	24	36	06		
8	8	35	24	32	00	1	35	24	35	07		
9	8	40	24	30	00	1	35	24	35	11		
10	8	40	24	33	57	1	25	24	37	32		
11	8	40	24	34	22	1	30	24	38	13		
12	8	45	24	34	02	1	25	24	42	32		
13	8	45	24	34	37	—	—	—	—	—		
14	—	—	—	—	—	—	—	—	—	—		
15	8	40	24	38	52	1	25	24	38	25		
16	8	35	24	35	39	1	30	24	39	10		
17	8	35	24	35	55	1	30	24	38	46		
18	8	25	24	36	22	—	—	—	—	—		
19	8	45	24	36	21	1	10	24	40	08		
20	8	35	24	33	52	1	30	24	39	00		
21	8	35	24	35	29	1	20	24	39	06		
22	8	45	24	35	53	1	35	24	37	48		
23	8	45	24	35	00	1	30	24	38	25		
24	8	35	24	35	09	—	—	—	—	—		
25	8	45	24	34	15	1	40	24	39	20		
26	8	35	24	35	33	1	25	24	40	40		
27	8	45	24	34	17	1	30	24	37	35		
28	8	50	24	34	26	1	25	24	38	24		
29	8	25	24	34	55	1	25	24	37	54		
30	8	50	24	36	22	—	—	—	—	—		
31	8	50	24	36	35	1	20	24	41	05		
Mean for Month.	8	39	24	34	03	1	29	24	38	02		

A dense fog, accompanied with rain, prevented the observations at noon on the 13th and the following day.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Dec.		Inches.				Feet.		
	Morn....	29·420	54°	90°	SW		Sm. rain	52°
1	Noon....	—	—	—	—		—	55
	Even	—	—	—	—		—	
	Morn....	29·152	46	77	W		Sm. rain	46
2	Noon....	29·054	46	64	NW by N		Cloudy	47
	Even	—	—	—	—		—	
	Morn....	29·060	35	80	NW		Showery	33
3	Noon....	29·043	39	78	NW		Showery	40
	Even	—	—	—	—		—	
	Morn....	29·465	33	84	N by E		Very fine	32
4	Noon....	29·465	39	57	W		Very fine	40
	Even	—	—	—	—		—	
	Morn....	29·270	42	76	S by W		Sm. rain	34
5	Noon....	29·205	44	72	SSW		Cloudy	44
	Even	—	—	—	—		—	
	Morn....	28·955	39	83	W by S		Foggy	
6	Noon....	28·953	42	65	WNW		Very fine	
	Even	—	—	—	—		—	
	Morn....	28·952	34	81	W by S		Cloudy	
7	Noon....	28·910	39	78	W		Fine	
	Even	—	—	—	—		—	
	Morn....	28·245	39	85	SSW		Showery	
8	Noon....	28·146	41	70	W by N		Sm. rain	
	Even	—	—	—	—		—	
	Morn....	28·685	37	80	NW		Cloudy	
9	Noon....	28·728	39	68	NW by W		Very fine	
	Even	—	—	—	—		—	
	Morn....	28·800	32	83	NW		Snow	
10	Noon....	28·857	35	74	NW		Fine	
	Even	—	—	—	—		—	
	Morn....	29·090	28	80	WNW		Very fine	
11	Noon....	29·100	35	64	SW		Very fine	
	Even	—	—	—	—		—	
	Morn....	29·235	29	80	SW		Very fine	
12	Noon....	29·253	34	67	SSE above NW		Very fine	
	Even	—	—	—	—		—	
	Morn....	29·160	36	86	SE by S		Drizzle	
13	Noon....	—	—	—	—		—	
	Even	—	—	—	—		—	
	Morn....	29·165	37	84	SW by W		Very fine	
15	Noon....	29·200	48	67	SSW		Fine	
	Even	—	—	—	—		—	
	Morn....	29·400	40	81	SSW		Rain	
16	Noon....	29·328	43	85	SSW		Showery	
	Even	—	—	—	—		—	
	Morn....	29·140	39	73	W by S		Clear	
17	Noon....	29·216	43	58	W by S		Very fine	
	Even	—	—	—	—		—	
	Morn....	28·500	43	70	W by S		Very fine	
18	Noon....	—	—	—	—		—	
	Even	—	—	—	—		—	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Nov.		Inches.				Feet		
19	Morn....	28·348	40°	81°	WSW		Fine	
	Noon....	28·360	43	58	W		Fine	
	Even	—	—	—	—		—	
20	Morn....	28·927	40	80	NNE		Sm. rain	
	Noon....	29·070	40	67	NE by N		Cloudy	
	Even	—	—	—	—		—	
21	Morn....	29·037	32	60	E		Cloudy	
	Noon....	29·037	34	60	ENE		Cloudy	
	Even	—	—	—	—		—	
22	Morn....	29·079	32	70	NE		Fine	
	Noon....	29·065	34	53	NE by E		Very fine	
	Even	—	—	—	—		—	
23	Morn....	29 086	32	65	N		Cloudy	
	Noon....	29·080	34	50	N by W		Very fine	
	Even	—	—	—	—		—	
24	Morn....	29·205	30	87	N		Foggy	
	Noon....	—	—	—	—		—	
	Even	—	—	—	—		—	
25	Morn....	29·500	29	84	NW		Fine	25°
	Noon....	29·500	30	73	N by W		Very fine	33
	Even	—	—	—	—		—	
26	Morn....	29·649	27	71	NNW		Very fine	26
	Noon....	29·648	32	58	WSW		Very fine	35½
	Even	—	—	—	—		—	
27	Morn....	29·373	34	83	WSW		Showery	26
	Noon....	29·273	37	64	W		Fine	37½
	Even	—	—	—	—		—	
28	Morn....	29·210	34	75	WNW		Fine	33
	Noon....	29·265	35	68	NNW		Snow	37
	Even	—	—	—	—		—	
29	Morn....	29·663	26	70	NW		Clear	25
	Noon....	29·700	32	59	W		Very fine	33
	Even	—	—	—	—		—	
30	Morn....	29·553	35	88	SSW		Foggy	28
	Noon....	—	—	—	—		—	38
	Even	—	—	—	—		—	
31	Morn....	29·585	29	78	ENE		Clear	28
	Noon....	29·574	34	72	NNE		Very fine	35
	Even	—	—	—	—		—	

The quantity of rain that fell between noon, Dec. 2, and noon, Jan. 1, was 2·267 inches. The quantity that fell during the same period on the roof of my observatory, which is flat, covered with lead, and contains 259 superficial feet, was 2·380 inches: this near agreement of quantity implies that the usual conical-shaped pluviometer, one foot in diameter, is sufficiently accurate.

Variation.

Mean	Of 9 months' morning observations....	24°	32′	00″	West.
	Ditto noon	24	41	25	
	Of 6 months' evening..................	24	34	49	

Article XIX.

METEOROLOGICAL TABLE.

1817.	Wind.	Barometer. Max.	Min.	Med.	Thermometer. Max.	Min.	Med.	Hygr. at 9 a. m.	Rain.	
12th Mo.										
Dec. 2	N W	29·45	29·43	29·440	47	29	38·0	71	2	☾
3	N E	29·86	29·40	29·630	41	28	34·5	78	5	
4	E	29·87	29·71	29·790	42	29	35·5	83		
5	S	29·87	29·37	29·620	47	38	42·5	69	27	
6	N W	29·38	29·37	29·375	41	28	34·5	83		
7	S W	29·37	28·61	28·990	42	32	37·0	92	13	
8	Var.	29·07	28·54	28·805	45	36	40·5	85	48	●
9	N W	29·22	29·07	29·145	43	28	35·5	69		
10	N E	29·51	29·22	29·365	35	21	28·0	73	—	
11	Var.	29·67	29·51	29·590	32	18	25·0	80		
12	S E	29·67	29·61	29·640	37	23	30·0	83	—	
13	S E	29·61	29·48	29·545	40	35	37·5	85	40	
14	S E	29·57	29·34	29·455	48	32	40·0	98	24	
15	S W	29·80	29·57	29·685	43	34	38·5	97	72	☽
16	S W	29·53	29·30	29·415	50	35	42·5	96	32	
17	S W	29·53	28·88	29·205	48	35	41·5	74	67	
18	S W	28·88	28·74	28·810		34	—	65	2	
19	Var.	29·30	28·88	29·090	46	39	42·5	76	15	
20	N E	29·56	29·50	29·530	40	27	33·5			
21	N E	29·50	29·44	29·470	33	28	30·5			
22	N	29·53	29·46	29·495	33	29	31·0	74		
23	S E	29·65	29·48	29·565	32	20	26·0	65		○
24	N E	29·90	29·65	29·775	32	24	28·0	80		
25	N E	30·06	29·90	29·980	33	22	27·5	78		
26	Var.	30·08	29·80	29·940	36	22	29·0	77	10	
27	S W	29·62	29·45	29·535	37	32	34·5	92	5	
28	N W	30·10	29·62	29·360	38	21	29·5	72		
29	S W	30·10	29·97	30·035	33	23	28·0	65		
30	Var.	30·00	29·93	29·965	40	22	31·0		6	
31	N E	30·01	30·00	30·005	35	21	28·0	93		☾
		30·08	28·54	29·508	48	18	32·66	78	3·68	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Twelfth Month.—2. Some rain, a.m. 3. Hoar frost: *Cirrostratus:* the sky quickly overcast: some sudden showers followed: evening *Nimbi*, the wind going to NE with force. 4. Hoar frost: fine, with *Cirrostratus:* misty, p.m.: windy night. 5. Very cloudy, a.m.: a gale in the night, followed by rain. 6. Overcast, a.m.: fine and calm mid-day: *Cirrocumulus.* 7. Hoar frost: *Cirrostratus*, with a stormy appearance, a.m.: fine, p.m.: rain, with a gale of wind, in the night. 8. *Cirrostratus* at sun-rise, the wind gone down: wet at intervals: *Nimbi:* much wind again at night. 9. Cloudy, a.m.: about noon *Cirrostratus*, and after it *Cirri* in elevated bars stretching N and S, coloured red at sun-set: starlight, with small meteors. 10. Snowing by nine, a.m.: at eleven the ground was white, when it ceased: clear night. 11. The sun emerged from *Cirrostrati*: rather misty air: the wind gentle at SW, a.m. but easterly in the night. 12, a.m. Vane at SW: calm: much rime, with a misty air till evening: a thaw in the night. 13. Obscure by *Cirrostratus*, a.m.: the hygrometer proceeding towards moisture: rain, gentle in the day: heavier, with wind, in the night. 14. *Cirrostratus* prevailed in a uniform close canopy about the height of the neighbouring hills, on which I found it misty in consequence, while small rain fell below: early in the night came on wind, with showers. A perfect, but colourless *lunar bow*, was observed about ten, p.m. and reported to me by a gentleman whom I accidentally met with at Stamford Hill in the morning. 15. Hoar frost: the sun emerged from a low *Cirrostratus:* very wet, p.m. and night. 16. Wet, a.m.: in the night a heavy gale, ceasing about three. 17. Fair, a.m.: obscure afterwards by *Cirrostratus:* in the night a most violent westerly gale, increasing and decreasing in force by slow intervals, with much rain. 18. Windy: bright moonlight. 19. Wet, p.m. 20. The wind got to NE, a fresh breeze, but at night the clouds came from NW. There was a manifest mutual attraction between the low clouds and the smoke of London. 21. Fair: the clouds tending to *Cumulostratus.* 22. A very slight sprinkling of snow, crystallized in stars. 25. The same, in grains as fine as basket salt. 26. Orange-coloured sun-rise, with red *Cirri:* hoar frost: a lunar corona last night, surrounded by a prismatic halo. 27. After fine dry frost for some days, a thaw early this morning, with rain: in the night a gale, with showers, after which a ground frost. 28. A little snow at mid-day: the temp. 19° on the ground at night. 30. Wet, p.m. 31. A frozen mist came on at eight, a.m. from the southward; and after a clearer interval there was again a very thick fog in the evening.

RESULTS.

Winds Variable.

Barometer:	Greatest height	30·08 inches;
	Least	28·54 inches;
	Mean of the period	29·508 inches.
Thermometer:	Greatest height	48°
	Least	18°
	Mean of the period	32·66°
Mean of the hygrometer		78°
Rain		3·68 inches.
Evaporation		0·38

Tottenham, *First Month*, 10, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

MARCH, 1818.

Article I.

Biographical Notice of M. Duhamel.

In the journals and other records of French science, during the last half century, the name of Duhamel very frequently occurs; and those who have not particularly inquired into the subject would naturally attribute the various memoirs and observations, to which this name is attached, to one and the same person. The celebrity, however, of the name of Duhamel, has been acquired by the meritorious labours of three individuals; namely, M. Duhamel de Monçeau, who particularly devoted himself to the study of botany and vegetable physiology, and to the improvement of French agriculture; the subject of the present article; and his son, the only one of the three who now survives, and who occupies the post of Inspector General of Mines in his native country.

Jean-Pierre-François Guillot Duhamel was born at Nicorps, near Coutances, in the year 1730. After acquiring the usual elements of literature and of science, he was admitted, in his 22d year, *élève des ponts et chaussées*, or, in other words, commenced his studies as a civil engineer.

About this time the French government, sensible of the ignorant and unthrifty manner in which the mines of that country were wrought, and the metallurgical establishments immediately dependant on them were carried on, resolved to make great efforts to reform and improve these very important branches of public industry.

In order to obtain the information required for the due execution of this very important measure, it was resolved to send a deputation to the mining districts of Germany, Sweden, and England. The merit of young Duhamel had attracted the notice of M. de Trudaine, Controller General, who, accordingly, in 1754, appointed him to visit the mining establishments of France, and two years after associated him with M. Jars in the important and delicate commission above-mentioned. In the course of three years the zeal and indefatigable activity of the two associates had carried them through the mining districts of Saxony, Austria, Bohemia, Hungary, the Tyrol, Carinthia, and Styria; they then returned home, bringing with them a vast treasure of useful and interesting observations, particularly with regard to the manufacture of iron and of steel. These were immediately applied to practice, and thus gave the first impulse to the great exertions which have since been made by France in order to perfect the quality of the most intrinsically valuable, and most extensively useful, of all the mineral productions.

M. Duhamel appears not to have accompanied M. Jars in his subsequent journies to England and to the north of Europe, but to have been employed for some years in reducing to practice the information which he had collected The iron works at Ruffec were founded, or at least rendered productive, under his superintendance: the first good cemented steel of French manufacture was made here, the annual quantity of which, even in 1767, had already amounted to about 3000 quintals. Having, by his regulations and personal superintendance placed this important establishment beyond the risk of ordinary casualties, he successively undertook the management of other mining adventures, and thus communicated to a perpetually enlarging circle the information gained by him in foreign countries, modified and adapted, by his own resources and good sense, to the peculiar circumstances of each case.

In 1781 he was nominated Inspector General of Mines; and the periodical journies made by him in the performance of this duty afforded him increased opportunities both of acquiring knowledge and of putting it into practice. Shortly after, he was appointed Professor of Mining and of Metallurgy in the *Ecole Royal des Mines*, a trust for which he was, perhaps, the best qualified of any man in France. He retained this situation for 12 years, in the course of which almost all those able men who now adorn and dignify the *Corps des Mines* came under his instructions.

He published a treatise on subterranean geometry in 1787, and drew up for the Encyclopedie Methodique the whole of the articles relative to practical mining. He was elected a member of the Academy of Sciences, and communicated to that learned body several memoirs, which are inserted in the series of their Transactions.

In his 59th year the French Revolution broke out; but the various chiefs and parties, under whose brief and iron sway the warring elements of the political chaos arranged or seemed to arrange themselves, were all too sensible of the merit and usefulness of Duhamel to offer him much molestation. He accordingly was nominated a member of the first class of the National Institute, retained his situation in the *Corps des Mines*, was employed as commissioner in the survey of many mining districts, both in France and in the annexed provinces of Germany, and contributed many useful papers to the Journal des Mines. In 1801 he published a French and German dictionary of the technical terms employed by the miners of each country. The approaching feebleness of age, though it restrained his personal activity, had no effect on his zeal and on his interest in the improvement of that art to which he had devoted his youthful enthusiasm, his manly energy, and his mature experience. With a temper remarkably calm and placid, added to his other qualifications, he engaged at first sight, and ever after retained the fond attachment of his pupils; as his years advanced, the appellation of "Patriarch of the Miners" evinced the general respect in which he continued to be held. A short illness, unaccompanied by suffering, terminated his life at Paris on Feb. 20, 1816, in the 86th year of his age.

The most important of his contributions to the *Academie des Sciences* are the following: a memoir on the reduction of iron ores, published in 1777, and another on the same subject in 1786. In these the information which he had previously acquired in Bohemia and Styria is skilfully and successfully applied, with certain modifications, to the treatment of the iron ores of France.

The Art of Liquation, published in 1788. This treatise is the most complete account extant of the method of separating silver from copper by means of lead. In this process the lead, being melted with the copper, takes from it the greater part of the silver, and is finally separated from the copper by exposing the mixture to a temperature sufficient for the fusion of the lead, but not of the copper. A multitude of minute particulars require attention, in order that this process may be carried on to the greatest advantage; and these are fully explained in the memoir alluded to. It is true that this method is now becoming obsolete, even in those German establishments where it was carried on to a great extent and with unrivalled skill, having been superseded by the process of amalgamation; and, therefore, M. Duhamel's memoir is now chiefly valuable as a historical document.

In the Journal des Mines his most useful memoirs are, on the best methods of supporting shafts and galleries by timbering and walling; on the cupellation, or rather the refining of silver; and on the separation of the earthy from the metallic parts of ores previous to fusion.

ARTICLE II.

Results of a Meteorological Journal, kept at the Observatory of the Academy, Gosport, in 1817. Lat. 50° 47′ 58″ N. Long. 1° 6′ 4″ W. In Time 4′ 24·3″. By William Burney, LL.D.

The present mean diurnal Variation of the magnetic Needle here is 24° West.

Months.	BAROMETER. Maximum.	Minimum.	Medium.	Range of the Mercury.	No. of changes.	Spaces described.	Greatest variation in 24 hours.	SIX'S THERMOMETER. Maximum.	Minimum.	Medium.	Range.	Greatest variation in 24 hours.	Medium at 8 A.M.	Medium at 2 P.M.	Medium at 8 P.M.
	Inch.	Inch.	Inches	Inch.		Inch.	In.								
January	30·70	28·90	29·979	1·80	31	9·43	0·96	57°	21°	43·11°	36°	22°	39·77°	47·09°	42·45°
February	30·69	29·64	30·120	1·05	28	8·01	0·62	57	35	46·25	22	18	44·03	51·46	45·00
March	30·74	29·06	30·005	1·68	26	6·25	0·44	62	24	44·48	38	24	41·71	52·32	42·87
April	30·74	29·96	30·373	0·78	22	3·98	0·40	66	27	47·30	39	28	45·73	57·06	45·50
May	30·40	29·22	29·856	1·18	19	4·89	0·38	70	35	52·30	35	28	51·61	62·00	49·09
June	30·48	29·39	30·007	1·09	19	6·20	0·62	88	43	60·25	45	29	63·23	71·53	59·80
July	30·22	29·32	29·961	0·90	23	5·58	0·60	73	46	60·84	27	23	61·32	68·84	58·58
August	30·26	28·99	29·881	1·27	25	7·41	0·61	74	44	60·42	30	23	60·09	67·77	57·39
Sept.	30·34	29·43	30·067	0·91	20	4·46	0·45	76	40	59·00	36	22	58·00	66·50	57·00
October	30·42	29·43	30·051	0·99	23	4·44	0·64	58	32	44·60	26	21	42·60	51·41	42·31
Nov.	30·62	29·40	30·100	1·22	17	6·22	0·82	59	31	49·10	28	18	47·07	53·56	47·87
Dec.	30·26	28·68	29·700	1·58	25	8·68	0·82	56	22	38·90	34	21	38·03	43·64	38·90
	30·74	28·68	30·008	1·204	278	75·55	0·96	88	21	50·545	33	29	49·432	57·765	48·896

Months.	WINDS. North to East.	East to South.	South to West.	West to North.	Total No. of days.	WEATHER. A transparent Atmosphere.	Sun with clouds.	Overcast, foggy, &c.	Rain, hail, &c.	Total No. of days.	Evaporation, in inches, &c.	Rain in inches, &c.
January	2	3	14	12	31	3	4	8	16	31	0·30	4·64
February	3	—	10	15	28	2	11	3	12	28	0·91	0·91
March	1	5	12	13	31	4	13	4	10	31	2·00	1·77
April	11	5	2	12	30	9	18	3	—	30	3·80	—
May	4	7	10	10	31	3	13	5	10	31	3·45	3·18
June	2	7	17	4	30	5	15	3	7	30	6·60	2·36
July	2	3	19	7	31	2	13	2	14	31	4·85	3·67
August	2	7	19	3	31	2	13	3	13	31	4·15	4·67
Sept.	12	7	6	5	30	6	15	3	6	30	4·45	2·09
October	20	—	6	5	31	5	12	6	8	31	2·40	1·30
Nov.	1	9	11	9	30	2	10	6	12	30	0·85	2·14
Dec.	7	1	8	15	31	7	10	4	10	31	0·37	3·84
	67	54	134	110	365	50	147	50	118	365	34·13	30·57

ANNUAL RESULTS.

BAROMETER.

	Inches.
Highest observation, March 31, Wind W.	30·74
Lowest ditto, Dec. 8, Wind W.N.W	28·68
Range of the mercury	2·06
Mean annual barometrical pressure	30·008
Greatest range of the mercury, in January	1·80
Least range of ditto, in April.	0·78
Mean annual range of ditto	1·204
Spaces described by ditto	75·55
Greatest variation in 24 hours, in January	0·96
Least ditto in 24 hours, in May.	0·38
Total number of changes in the year	278

SIX'S THERMOMETER.

Greatest observation, June 22 and 23. Wind N. and S.	88° *
Least ditto, January 11, ditto. Wind N.W.	21
Range of the mercury in the thermometer	67
Mean annual temperature of the atmosphere	50·545
Mean ditto of ditto at 8 A.M.	49·432
Mean ditto of ditto at 2 P.M.	57·765
Mean ditto of ditto at 8 P.M.	48·896
Greatest range, in June	45
Least range, in February	22
Mean annual range.	33
Greatest variation in 24 hours	29

WINDS.

	Days.
From North to East	67
From East to South	54
From South to West	134
From West to North	110
	365

WEATHER.

	Days.
A transparent atmosphere	50
Sunshine, with various modifications of cloud.	147
An overcast sky, foggy, &c. without rain.	50
Rain, hail, snow, and sleet.	118
	365

* A tremendous storm of wind, rain, sleet, hailstones (some of them ½ inch in diameter with icy *nuclei*), lightning, and thunder, for several degrees in a S.W. direction, put a period to this excess of heat, at four P.M. on June 23.

EVAPORATION.

	Inches.
Greatest quantity, in June	6·60
Smallest ditto, in January	0·30
Total quantity evaporated in the year	34·13

RAIN.

	Inches.
Greatest quantity, in August	4·67
None in April (see the state of the Winds.)	—
Total quantity that fell here in the year	30·57

N. B. The barometer is hung in the Observatory, about 30 feet above the level of the sea; and the thermometer is placed in a northern aspect, out of the rays of the sun, 10 feet above the garden ground. The pluviameter stands clear of all obstructions on the top of the Observatory, 22 feet above the garden ground; and the evaporation vessel, near the same place, is exposed to the sun and wind in dry weather. For brevity's sake, the four cardinal points only are put down in the table, to show the number of days the winds have blown from each quarter in each month.

With regard to the difference in the state of the weather between 1816 and 1817; this year we find that the quantity of rain is two inches less than that of the preceding, and the quantity of evaporation $11\frac{1}{2}$ inches more. Now, the comparative difference in the two years' rain is not of much consequence; but it must be admitted that the additional quantity of evaporation, which is nearly half as much more as in 1816, is a surprising difference, and will, in some measure, account for the retardation of solar influence that year, perhaps from the spots on the sun, or the cavities in his atmosphere, which were very numerous in the spring and summer months, and in some instances prodigious, as ascertained by our own observations. The number of rainy days is also less this year than the preceding, by 15; but the number of brilliant and cloudless days is nearly on a par.

The annual mean state of the barometer is ·171, or nearly $\frac{2}{10}$ths of an inch higher; and the annual mean height of the thermometer between 2° and 3° more: these favourable indications further corroborate the ungenial weather of that year.

The annual mean barometrical pressure from three observations each day is as follows: at eight o'clock A.M. 30·002 inches; at two P.M. 30·005 inches; and at eight in the evening, 30·017 inches. Thus, from eight in the morning till eight in the evening, a small rise of the mercury has been discovered; but notwithstanding the increase from eight A.M. till two P.M. the mercury, from one hour before till two hours after noon, suffers a simultaneous depression of about $\frac{1}{100}$th of an inch (in summer time more) almost every sunny and fair day: this change we suppose to arise purely from solar influence; but the aggregate diurnal increase does, in all probability, arise from a combination of causes, as caloric downwards, non-electric winds, &c. &c. &c.

The annual mean diurnal temperature of the upper room in the Observatory, where no fire was kept, is about 4° higher than the annual mean *diurnal* temperature without door; and the annual mean *nocturnal* temperature 5° higher. This difference undoubtedly arises from the loss of the calorific or dark rays that steal imperceptibly on, and raise the thermometer placed without door. We make this remark merely to point out to those who keep regular journals of the weather, the real difference that will arise from registering from a thermometer within, and from a Six's placed in the free air in a northern aspect out of the rays of the sun; and we are confident in stating that similar observations made in the same city, town, or village, will ever vary considerably, without regard to placing the instruments for meteorological purposes.

Atmospheric Phenomena.

The following atmospheric phenomena have come within our observation this year, and we have selected them, as a piece of curiosity, from our monthly meteorological journals, published in the 37th and 38th volumes of Naval Chronicle, namely, lightning, 14 different days; thunder, 11; hail, 12; snow, six; and a quiescent barometer, six. 42 gales of wind from different quarters, viz. four from the N., two from the N.E., 17 from the S.W., 10 from the W., and nine from the N.W. 14 rainbows, eight of which were perfect with their proper colours. 16 solar halos; 15 lunar halos; 20 lunar coronas; one lunar iris; and one coloured paraselene, which appeared on July 30, between 11 and 12 P.M. 18 small meteors, commonly called falling or shooting stars, and two large ones, half the apparent size of the moon at her greatest altitude: also two *Auroræ Boreales*, or northern lights. All the modifications of cloud adopted in the nomenclature, appeared here on September 1.

Ocular Appearances.

Solar Halo.—The most beautiful of the solar halos appeared on June 5, from seven till half-past nine, A.M. on the *vesiculæ* of a thin vapour or haze, which was at that time descending slowly into the lower medium; it measured 44° in diameter horizontally, and several of the prismatic colours that formed it were tolerably bright: the atmosphere, from the interior edge of the halo to the light yellow concentric corona immediately around the sun, was, to all appearance, darker and denser than that outside of the coloured circle. At one P.M. on the following day, two semicircular parts of a halo of the same diameter appeared round the sun, formed on thick lofty *Cirri*; but they gradually disappeared as these light clouds moved out of the vicinity of the sun towards the East.

Lunar Halo.—The most beautiful of the lunar halos appeared on November 24, at nine P.M.; it was formed on passing beds of lofty attenuated *Cirrocumulus* from the N.W., and exhibited four lively prismatic colours: its horizontal diameter, measured by a sextant, was 45°, Capella, in the constellation Auriga, being 22° 30′ from the moon's centre, and on the exterior edge of the halo which measurement doubled gives 45°. Its periphery was most perfect at midnight, when the moon's altitude was greatest; for the perpendicular diameter of a lunar or solar halo, when between the horizon and zenith, is always somewhat greater than its horizontal diameter. Both solar and lunar halos are harbingers of falling weather; as rain generally follows in 12 or 24 hours, and sometimes sooner, after their appearance, particularly if the wind come in a westerly direction over the Atlantic Ocean.

To discover a Solar Halo.—Accustom yourself to look closely into the atmosphere, within a few degrees of the sun, when the sunshine is rather faint, and no appearance of cloud near the sun at the time.

A lunar halo is more easily discovered, from the moonlight being feeble, and less brilliant than the solar rays.

Rainbow.—The widest and most perfect rainbow appeared on October 12, at half-past four P.M.; the diameter of its exterior bow along the earth, as measured by the sextant, was rather more than 100°, which is the widest we can possibly see.

The lunar *iris*, or rainbow, appeared on August 25, at half-past eight o'clock in the evening, for about ten minutes, on a large *Nimbus* in the N.W., the moon being nearly at the full, and shining brightly in the S.E.: the prismatic colours of this rare phenomenon were distinctly seen, but they were considerably fainter than those which constitute the solar bow. The lunar iris is nearly of the same extent as the solar, and formed in a similar manner; namely, by the refraction of the moon's rays in the drops of rain in the night.

Aurora Borealis.—The first appearance of the Aurora Borealis was from eight till ten P.M. on February 8; but as that part of the northern hemisphere from the horizon to 70° in altitude was almost overcast with *Cirrostratus*, its appearance here was not very remarkable, except in the instance of a few of the coloured coruscations that extended beyond the zenith southward. The sky being partly clear in the north the following evening, the lights were more distinctly seen; they frequently appeared in perpendicular columns, at other times arched, and varied in colour, on account of the different degrees of rarefaction of the air which they passed through. The last appearance was on September 19, from half-past eight till nine P.M. between the N.W. by N., and N. by E. points: there was only a low *Cirrostratus* cloud near the horizon at the time, above which the Aurora ascended in thick and slender pillars of a whitish light. Eight perpendicular columns appeared at intervals, nearly equidistant from each other; the highest was full 40° above the horizon, under *Stella Polaris*, and the thickest directly under *Benetnasch* in the tail of Ursa Major: they sometimes terminated like the top of a cone, and at others like the long flame of a candle.

Article III.

Register of the Weather kept in the northern Part of the Island of Iceland (Eyafjord), from the Month of June, 1811, *until June,* 1813. *Extracted from the Journal of Captain Van Scheels.*

(*Concluded from* p. 103.)

1812.	Barometer.			Thermometer.			Wind.			Degrees of Wind.	Observations.
	Morning.	Mid-day.	Evening.	Morning.	Mid-day.	Evening.	Morning	Mid-day.	Evening.		
June 1	27 11·4	27 11·9	27 11·2	1·8	3·2	− 0·5	N	N	N	A	Foggy.
2	27 9·8	27 9·3	27 8·7	1·8	2·4	0·0	NE	NE	NE	B	Ditto.
3	27 8·2	27 8·0	27 9·1	3·1	5·2	1·2	NW	NE	NE	A	Cloudy.
4	27 10·0	27 9·9	27 10·4	4·8	6·2	2·2	N	N	N	A	Ditto.
5	27 11·4	27 11·9	28 0·3	3·5	5·8	3·9	—	—	—	A	Ditto.
6	28 8·0	28 1·5	28 2·4	5·5	7·3	4·9	NW	NW	NW	A	Ditto.
Sun. 7	28 2·8	28 3·2	28 4·6	8·2	11·9	8·5	W	W	—	A	Partially clear.
8	28 2·7	28 2·1	28 3·0	7·8	13·5	9·2	W	W	W	B	Ditto, ditto.
9	28 3·5	28 3·1	28 2·0	10·7	15·6	10·2	SW	SW	SW	D	Cloudy.
10	28 1·5	28 0·7	28 0·4	9·0	13·6	7·0	—	—	—	D	Ditto.
11	27 8·0	27 8·2	27 9·4	8·4	12·0	0·0	—	Calm	NW	B	Clear.
12	27 7·6	27 8·3	27 9·2	1·0	2·2	− 0·4	NE	NE	NE	D	Thick.
13	27 11·2	27 11·7	28 0·0	0·0	4·1	2·0	—	E	Calm	B	Ditto.
Sun. 14	28 0·7	28 0·8	28 1·3	3·5	7·1	− 1·2	E	—	NE	A	Clear.
15	28 1·1	28 1·3	28 1·0	4·8	6·2	2·0	N	N	N	A	Ditto.
16	27 11·4	27 10·2	27 9·9	9·2	8·8	2·0	Calm	Calm	E	A	Ditto.
17	27 9·4	27 8·0	27 8·7	9·0	8·5	4·0	N	N	E	A	Ditto.
18	27 9·5	27 10·2	27 10·7	4·0	7·8	3·6	NE	NE	NE	B	Cloudy.
19	27 11·2	27 11·4	27 11·7	5·4	8·8	3·2	N	N	N	A	Ditto.
20	28 0·6	28 0·9	28 1·1	6·6	8·0	2·5	—	—	—	A	Clear.
Sun. 21	27 11·9	28 0·0	28 0·1	8·4	11·3	3·8	—	—	—	A	Ditto.
22	28 0·5	28 1·1	28 1·4	7·6	8·5	2·2	NW	NW	N	C	Ditto.
23	28 1·8	28 2·7	28 2·4	5·3	8·2	4·0	N	Calm	Calm	A	Ditto.
24	28 1·6	28 1·3	28 1·1	9·6	11·4	4·1	—	NE	—	B	Ditto.
25	28 0·8	28 1·5	28 2·8	7·5	9·6	3·9	—	N	S	A	Ditto.
26	28 0·9	28 1·3	28 1·7	8·1	8·6	4·2	N	N	N	D	Thick.
27	28 0·1	28 0·0	27 11·2	7·9	10·1	6·5	N	N	N	A	Ditto.
Sun. 28	27 10·2	27 10·0	27 9·9	6·0	4·7	2·0	N	NE	NE	B	Thick fog.
29	27 11·0	27 11·6	28 0·0	1·5	3·0	3·2	NE	—	—	B	Ditto, rain.
30	28 0·7	28 0·7	27 11·5	3·5	10·0	6·3	N	Calm	N	A	Clear.

1812.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
July 1	27 11·7	28 0·0	28 0·6	3·5	9·7	3·3	N	N	N	A	Clear.
2	27 11·6	27 11·4	27 11·7	6·0	5·5	3·2	Calm	NE	NE	B	Cloudy.
3	28 0·1	27 11·7	27 11·6	3·5	7·9	6·7	—	N	N	A	Rain.
4	28 9·8	27 8·5	27 8·8	6·0	11·7	7·5	Calm	SE	SE	D	Cloudy.
Sun. 5	28 9·3	27 9·4	27 9·4	4·3	10·5	5·3	—	Calm	NE	B	Ditto.
6	28 10·8	27 10·9	27 11·2	6·0	10·0	4·2	—	NE	NE	B	Foggy.
7	28 0·0	28 0·4	28 0·0	4 5	13·0	6·2	—	SE	SE	B	Cloudy.
8	28 0·0	27 11·6	27 11·5	6·5	8·9	4·8	E	Calm	NE	B	Rain.
9	28 0·8	28 2·2	28 3·0	3·5	9·0	6·5	NE	Calm	Calm	B	Ditto.
10	28 3·2	28 3·2	28 3·3	8·6	9·2	5·4	W	W	W	E	Cloudy.
11	28 4·1	28 5·1	28 6·8	5·0	8·5	5·5	NW	N	N	A	Ditto.
Sun. 12	28 6·6	28 6·6	28 5·7	4·6	7·0	5·2	Calm	—	—	A	Clear, frost in night
13	28 4·6	28 3·2	28 3·0	4·8	11·0	5·0	—	—	—	A	Ditto, ditto.
14	28 3·0	28 3·2	28 3·5	4·0	8·6	2·0	NW	—	—	B	Cloudy.
15	28 3·1	28 2·8	28 2·4	0·0	8·0	5·6	Calm	—	Calm	A	Clear, frost in night.
16	28 2·2	28 2·1	28 2·0	2·0	8·5	6·5	—	—	N	A	Ditto.
17	27 11·6	27 11·0	27 11·8	6·0	9·5	5·2	SW	Calm	NE	B	Rain.
18	28 1·9	28 2·2	28 2·4	4·8	4·5	2·0	N	NE	NE	E	Ditto.
Sun. 19	28 2·0	28 1·9	28 1·8	1·0	2·5	1·5	NE	—	—	D	Much snow.
20	28 1·4	28 1·2	28 1·2	1·0	3·0	2·0	—	—	—	E	Ditto, ditto.
21	28 1·0	28 1·2	28 2·0	1·2	5·0	3·0	—	—	—	B	Thick.
22	28 0·7	27 11·6	27 11·5	1·0	7·9	6·5	N	Calm	S	A	Snow.
23	28 0·6	28 0·6	28 0·7	2·4	6·0	4·3	NW	N	N	A	Cloudy.
24	28 0·6	28 0·6	28 0·9	4·0	9·0	6·0	Calm	SE	SE	B	Ditto.
25	28 0·6	27 11·8	27 11·6	4·5	4·0	3·0	E	E	E		Rain.
Sun. 26	28 0·1	28 0·6	28 0·8	3·1	6·0	2·0	NE	NE	NE	B	Foggy.
27	28 0·8	28 0·7	28 1·2	0·5	3·0	1·0	—	—	—	D	Thick snow
28	28 1·4	28 1·5	28 1·6	0·4	2·5	1·5	—	—	—	B	Ditto, ditto.
29	28 1·2	28 0·4	27 11·6	1·0	5·0	2·0	N	N	N	A	Thick.
30	27 11·0	27 0·7	27 10·6	1·5	6·2	3·2	N	N	N	B	Ditto.
31	27 9·9	27 9·4	27 8·9	2·5	7·0	4·0	Calm	Calm	N	A	Ditto.
Aug. 1	27 8·5	27 8·4	27 9·4	7·0	11·9	7·1	SE	S	S	D	Partially clear.
Sun. 2	27 10·4	27 10·8	27 11·9	5·5	10·1	7·0	E	NE	E	B	Rain.
3	28 0·6	28 0·9	28 0·0	3·7	10·2	5·4	Calm	N	—	A	Partially clear.
4	27 9·3	27 9·0	27 8·2	5·1	11·7	8·0	SW	SW	SW	D	Rain.
5	27 9·0	27 9·2	27 9·3	8·7	10·0	4·0	W	W	W	B	Ditto.
6	28 0·6	28 1·0	28 1·1	5·5	12·0	11·0	SW	SW	SW	E	Cloudy.
7	28 2·3	28 2·3	28 2·6	10·9	14·6	7·8	—	—	—	E	Ditto.
8	28 3·1	28 3·0	28 2·0	10·0	14·8	9·0	—	—	—	D	Clear.
Sun. 9	28 2·0	28 2·0	28 2·3	10·0	14·5	10·0	—	—	N	D	Ditto.
10	28 5·0	28 3·3	28 3·1	6·5	13·3	5·0	N	N	—	A	Cloudy.
11	28 2·9	28 2·2	28 1·9	9·5	14·3	6·5	Calm	—	S	A	Ditto.
12	28 0·9	27 11·9	27 11·9	8·0	11·0	10·0	SW	SW	W	B	Ditto.
13	28 0·6	28 0·5	28 0·2	5·1	6·0	5·7	NE	NE	NE	B	Rain.
14	27 10·0	27 8·7	27 8·4	7·0	11·0	6·0	E	E	E	B	Foggy.
15	27 9·0	27 9·1	27 9·6	4·5	4·3	7·5	N	N	NE	B	Rain.
Sun. 16	27 10·0	27 9·8	27 9·5	3·2	5·0	4·5	NE	NE	—	B	Foggy.
17	27 10·8	27 10·8	28 0·0	4·3	7·0	3·4	E	E	N	A	Rain.
18	28 0·7	28 0·6	28 1·2	3·6	7·5	4·0	Calm	N	NE	A	Ditto.
19	28 1·4	28 1·3	28 1·3	4·5	8·0	4·0	—	Calm	N	A	Foggy.
20	27 1·2	28 0·1	28 0·0	3·6	4·0	3·2	N	E	E	B	Rain.
21	28 0·0	28 5·0	28 2·0	7·6	14·2	9·5	SE	Calm	SE	B	Thick.
22	28 2·3	28 1·5	28 1·6	8·2	11·7	6·8	Calm	—	Calm	B	Clear.
Sun. 23	28 2·0	28 2·0	28 2·0	4·2	6·5	4·0	N	N	N	A	Foggy.
24	28 2·0	28 2·0	28 2·2	5·0	6·0	4·0	—	—	—	A	Ditto.
25	28 2·0	28 1·8	28 1·9	3·0	8·1	3·8	—	—	—	A	Ditto.
26	28 2·1	28 2·3	28 2·2	3·0	5·7	8·0	—	—	SW	D	Cloudy.
27	28 0·0	27 11·0	27 11·7	11·0	13·3	12·5	SW	SW	—	D	Ditto.
28	27 6·5	28 1·5	27 11·7	5·0	10·0	5·0	NW	NW	—	B	Rain.
29	27 9·3	27 9·3	27 10·7	11·2	14·5	10·0	SW	SW	—	D	Ditto.
Sun. 30	28 2·4	28 3·4	28 3·4	2·0	4·2	2·0	NE	NE	NE	B	Cloudy.
31	28 4·2	28 3·3	28 3·2	2·2	5·8	2·5	E	Calm	NW	B	Ditto.

1812.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
Sep. 1	28 2·7	28 2·7	28 2·6	5·2	9·3	6·0	W	W	W	A	Cloudy.
2	28 2·6	28 2·6	28 2·5	5·0	9·0	5·5	Calm	Calm	E	A	Ditto.
3	28 1·5	28 1·8	28 1·3	6·0	6·6	5·0	E	E	—	B	Ditto.
4	28 0·7	27 11·0	27 11·1	2·0	8·2	4·0	—	—	Calm	B	Ditto.
5	27 10·2	27 9·4	27 8·3	4·0	9·5	6·0	Calm	Calm	—	—	Ditto.
Sun. 6	27 8·0	27 8·7	27 7·7	6·2	14·0	8·5	S	SE	SE	B	Rain.
7	27 6·5	27 5·1	27 5·0	8·0	15·0	9·3	—	—	SE	D	Cloudy.
8	27 7·5	27 6·3	27 6·3	6·0	10·0	6·5	—	—	S	A	Rain.
9	27 6·3	27 6·3	27 6·8	6·7	10·5	6·0	SE	SE	Calm	B	Ditto.
10	27 5·3	27 5·7	27 6·3	5·8	9·9	4·5	S	W	NW	A	Ditto.
11	27 7·5	27 7·8	27 7·5	2·5	5·0	3·2	N	N	N	A	Ditto.
12	27 5·0	27 4·0	27 0·7	5·5	6·2	5·0	—	—	W	A	Ditto.
Sun. 13	27 0·5	27 3·0	27 6·0	6·5	3·3	0·2	W	NW	NW	D	Thick.
14	27 6·5	27 4·0	27 2·8	— 0·5	3·2	2·9	SE	SE	W	A	Snow, rain.
15	27 4·0	27 4·5	27 6·5	1·0	2·6	— 1·0	—	N	N	D	Ditto, ditto.
16	27 8·4	27 9·4	27 10·7	— 2·4	0·0	— 2·3	N	N	N	D	Snow.
17	28 3·2	28 1·9	28 2·4	— 1·8	0·5	— 3·2	—	NE	—	E	Ditto.
18	28 2·7	28 2·7	28 2·0	— 3·5	3·0	— 2 0	Calm	Calm	Calm	—	Partially clear.
19	28 0·0	27 10·2	27 10·1	— 2·3	2·1	2·0	—	E	E	B	Snow.
Sun. 20	27 9·5	27 9·9	27 9·9	0·5	4·0	2·0	E	—	—	B	Ditto.
21	27 11·9	28 1·7	28 2·9	0·8	0·0	— 2·5	NE	NE	NE	D	Partially clear.
22	28 4·0	28 4·1	28 3·7	— 4·5	— 1·6	— 4·0	Calm	NW	Calm	B	Ditto.
23	—	—	—	—	—	—	SW	SW	SW	B	Ditto.
24	—	—	—	—	—	—	S	S	S	A	Ditto.
25	—	—	—	—	—	—	S	S	S	A	Ditto.
26	27 3·2	27 3·2	27 3·1	5·5	7·0	4·5	SW	SW	SW	B	Cloudy.
Sun. 27	27 0·9	27 0·8	27 3·2	5·0	6·0	2·2	SW	SW	SW	—	Clear.
28	27 6·4	27 7·0	27 6·7	— 3·0	4·0	6·5	W	W	W	—	Ditto.
29	27 5·0	27 4·6	27 3·9	8·0	5·8	6·6	SW	SW	SW	—	Ditto.
30	27 2·8	27 2·5	27 1·9	5·4	6·0	5·6	—	—	—	—	Ditto.
Oct. 1	27 1·2	27 1·5	27 1·9	5·6	4·0	2·5	SW	SW	SW	B	Clear.
2	27 2·0	27 2·0	27 2·0	— 1·5	1·5	— 1·8	S	S	S	A	Ditto.
3	26 8·0	26 8·0	26 6·3	1·3	3·0	4·0	E	E	E	B	Snow.
Sun. 4	26 8·0	26 9·8	26 9·8	2·0	5·6	2·5	E	E	E	A	Cloudy.
5	26 11·9	27 3·7	27 3·7	1·0	4·2	5·0	—	—	—	A	Ditto, rain.
6	27 3·7	27 3·6	27 3·8	1·0	4·6	3·0	—	—	—	A	Rain.
7	27 2·6	27 2·6	27 5·0	5·0	3·5	2·7	—	—	—	A	Ditto.
8	27 9·0	27 9·1	27 9·3	3·5	6 0	3·7	—	—	—	A	Cloudy.
9	27 8·0	27 6·5	27 7·2	4·5	3·6	3·5	—	—	—	A	Rain.
10	27 10·8	27 11·6	28 0·0	3·5	5·0	4·9	—	—	—	A	Ditto.
Su 11	28 0·0	27 11·0	27 9·9	3·7	4·1	1·7	E	E	E	B	Ditto.
12	27 8·4	27 8·4	27 8·2	1·6	3·2	1·9	—	—	—	B	Ditto.
13	27 8·0	27 8·0	27 7·9	2·5	2·7	1·3	—	—	—	B	Ditto.
14	27 11·8	28 0·0	28 1·4	2·0	3·2	2·0	—	—	—	B	Cloudy.
15	28 2·0	28 2·0	28 2·0	1·0	2·6	0·7	NE	NE	NE	B	Thick.
16	28 1·7	28 1·2	28 1·0	— 1·0	— 0·8	— 2·4	E	E	E	B	Snow.
17	28 0·0	27 11·5	27 10·5	— 1·2	— 0·6	— 1·4	N	N	N	A	Ditto.
Sun. 18	27 10·0	27 10·0	27 10·0	— 0·4	— 2·5	1·6	—	E	E	B	Cloudy.
19	27 10·0	27 10·0	27 10·0	— 1·1	— 1·0	— 2·6	E	—	—	B	Ditto.
20	27 10·3	27 10·3	27 11·2	— 2·6	— 2·4	— 3·5	NE	NE	NE	B	Ditto.
21	27 11·0	27 9·9	27 8·0	— 5·0	— 3·0	— 5·0	E	E	E	B	Thick.
22	27 7·4	27 7·8	27 7·5	— 7·1	— 5·2	— 7·6	Calm	Calm	Calm	—	Cloudy.
23	27 8·0	27 8·6	27 9·1	— 4·9	— 2·7	— 4·5	S	S	S	A	Ditto.
24	27 9·0	27 10·0	27 8·8	— 4·1	— 1·4	— 2·0	E	E	E	A	Ditto.
Sun. 25	27 7·4	27 6·7	27 6·7	— 3·2	— 0·2	0·6	E	E	E	B	Snow.
26	27 8·0	27 8·2	27 9·0	— 0·2	0·0	— 2·1	—	—	—	E	Ditto.
27	27 11·0	27 11·0	28 0·5	— 2·4	— 2·5	— 5·0	—	—	N	E	Ditto.
28	28 2·0	28 2·0	28 1·7	— 5·1	— 8·0	—11·0	Calm	Calm	NW	B	Clear.
29	27 11·6	27 11·7	27 10·9	—11·0	— 9·0	—11·0	—	—	Calm	—	Ditto.
30	27 10·0	27 10·0	27 9·3	— 0·2	0·0	0·0	—	—	S	A	Snow.
31	27 8·2	27 7·8	27 7·2	— 0·8	— 0·3	— 1·5	W	W	W	A	Ditto.

1812.	Barometer.			Thermometer.			Wind.			Degrees of Wind.	Observations.
	Morning.	Mid-day.	Evening.	Morning.	Mid-day.	Evening.	Morning.	Mid-day.	Evening.		
Nov. 1	27 5·8	27 4·3	27 3·1	0·0	3·2	0·8	W	W	W	A	Snow.
2	27 3·3	27 4·2	27 4·7	1·0	1·5	1·9	NW	NW	NW	B	Rain.
3	27 9·3	27 10·7	28 0·1	1·0	1·4	0·6	N	Calm	N	A	Ditto.
4	28 2·8	28 3·6	28 4·4	0·0	0·6	−2·0	NE	NE	NE	B	Thick.
5	28 6·5	28 6·5	28 5·8	−4·1	−4·0	−7·0	—	Calm	S	A	Clear.
6	28 4·9	28 4·6	28 4·5	−7·5	−5·2	−6·5	Calm	S	Calm	A	Ditto.
7	28 4·8	28 4·9	28 5·0	−6·5	−4·0	−6·5	—	Calm	S	A	Ditto.
Sun. 8	28 4·9	28 5·0	28 5·0	−6·8	−5·0	−7·0	—	Calm	Calm	A	Clear.
9	28 5·6	28 5·4	28 5·7	−8·0	−6·8	−6·5	—	—	S	A	Ditto.
10	28 5·8	28 5·6	28 5·1	−3·0	−3·2	−5·1	S	E	S	A	Cloudy.
11	28 5·7	28 5·4	28 5·0	−10·0	−9·1	−7·0	S	S	S	A	Snow.
12	28 4·2	28 4·0	28 3·1	−6·5	−5·0	−8·6	N	N	NE	B	Ditto.
13	28 1·8	28 0·5	27 11·7	−10·0	−8·5	−5·1	NE	E	E	A	Cloudy.
14	27 10·3	27 8·8	27 9·5	−1·0	−0·4	2·8	—	NE	Calm	B	Much snow.
Sun. 15	28 1·2	28 2·4	28 3·0	2·0	2·0	−0·5	E	E	E	A	Thick..
16	28 2·8	28 2·6	28 2·0	−1·5	−3·0	−6·1	Calm	Calm	W	A	Partially clear.
17	28 1·8	28 1·5	28 1·0	−1·5	−1·0	−2·8	S	S	S	A	Ditto.
18	28 2·4	28 2·1	28 1·8	−3·4	−5·8	−8·6	W	W	—	A	Ditto.
19	28 0·8	28 0·5	27 11·1	−6·0	−3·8	−4·2	N	N	N	A	Cloudy.
20	27 9·3	27 10·1	27 8·8	−1·5	−0·5	2·8	—	W	W	A	Ditto.
21	27 8·2	27 8·6	27 8·7	−2·8	−3·0	−4·5	—	N	N	A	Snow.
Sun. 22	27 3·9	27 4·3	27 3·9	−5·6	−5·1	−5·0	—	—	—	A	Thick.
23	27 4·1	27 7·4	27 9·3	−5·8	−4·2	−6·1	N	N	N	E	Very thick.
24	28 0·1	28 0·6	28 1·5	−8·0	−7·8	−9·7	NW	NW	NW	B	Ditto.
25	28 2·3	28 2·6	28 1·6	−9·0	−10·5	−5·0	S	S	SW	D	Clear.
26	27 11·4	27 9·2	27 8·9	−2·6	0·0	4·2	SW	SW	—	E	Cloudy.
27	27 11·8	28 0·8	28 0·6	4·0	1·8	0·0	—	—	S	B	Ditto.
28	27 9·6	27 9·0	27 9·4	−0·5	2·3	−1·1	—	—	—	A	Thick.
Sun. 29	27 11·2	28 0·7	28 1·4	−5·5	−4·8	−7·0	S	W	S	A	Snow.
30	28 2·9	28 1·9	28 1·9	−9·0	−8·2	−11·4	S	S	S	A	Clear.
Dec. 1	28 1·7	28 2·4	28 2·8	−11·0	−9·0	−6·2	Calm	Calm	Calm	—	Cloudy.
2	28 3·1	28 3·4	28 3·3	−8·3	−7·8	−8·6	S	S	S	A	Very clear.
3	28 4·1	28 4·2	28 4·4	−9·5	−8·6	−11·0	—	—	—	A	Ditto.
4	28 3·8	28 4·1	28 4·3	−10·0	−10·0	−8·7	W	W	W	A	Ditto.
5	28 4·8	28 5·6	28 6·2	−11·8	−10·3	−12·0	—	—	Calm	A	Ditto.
Sun. 6	28 6·7	28 6·3	28 6·4	−12·4	−12·0	−11·6	Calm	Calm	W	A	Ditto.
7	28 8·2	28 8·2	28 7·6	−3·0	−5·6	−6·0	S	NW	Calm	A	Partially clear.
8	28 6·8	28 6·2	28 5·1	−6·2	−6·0	−9·4	W	W	—	A	Ditto.
9	28 4·8	28 4·3	28 4·0	−8·6	−7·5	−9·5	N	W	—	A	Ditto.
10	28 2·8	28 3·1	28 3·4	−8·6	−5·6	−9·4	W	W	—	A	Ditto.
11	28 2·8	28 2·5	28 2·7	−8·6	−6·2	−7·8	S	S	S	A	Ditto.
12	28 1·6	28 1·0	28 0·7	−7·7	−5·9	−7·6	W	W	W	A	Cloudy.
Sun. 13	27 11·6	27 11·0	27 10·1	−9·7	−9·3	−3·7	—	SW	SW	B	Ditto.
14	27 9·6	27 9·1	27 8·0	−4·0	−3·6	−1·5	SW	SW	SW	A	Ditto.
15	27 7·9	27 8·1	27 8·4	−0·5	0·8	−0·8	S	W	S	A	Ditto.
16	27 8·8	27 9·4	27 9·0	−3·8	−3·3	−3·0	SW	SW	SW	D	Partially clear.
17	27 9·9	27 9·8	27 9·6	−5·0	−3·5	−2·0	S	S	S	A	Thick.
18	27 8·7	27 8·4	27 7·8	0·0	−1·2	0·0	—	—	—	A	Cloudy.
19	27 8·0	27 8·6	27 9·3	2·0	2·2	0·4	W	W	W	A	Very thick.
Sun. 20	27 9·0	27 9·1	27 9·6	0·5	−1·5	−4·0	S	S	S	A	Cloudy.
21	27 10·6	27 11·8	28 1·3	−7·0	−7·6	−4·5	—	—	N	A	Ditto.
22	28 2·6	28 3·3	28 3·1	−3·2	−3·0	−1·5	Calm	Calm	S	A	Ditto.
23	28 3·9	28 4·1	28 4·0	−1·8	−0·5	−3·5	S	S	S	A	Clear.
24	28 4·4	28 4·5	28 4·8	1·5	2·2	3·8	SW	SW	SW	A	Partially clear.
25	28 4·0	28 3·8	28 3·3	4·5	4·1	1·0	—	—	—	A	Ditto.
26	28 0·6	27 9·7	27 8·8	8·0	4·2	3·5	—	—	—	A	Ditto.
Sun. 27	27 9·6	27 8·5	27 7·2	8·6	4·4	4·2	SW	SW	SW	D	Rain and snow.
28	27 0·8	27 1·6	27 9·1	4·0	4·2	−9·3	SW	SW	—	D	Snow.
29	27 4·2	27 7·1	27 7·8	−10·5	−10·0	−10·0	—	—	—	C	Thick.
30	27 8·9	27 8·0	27 7·6	−11·5	−12·0	−10·6	N	W	S	A	Cloudy.
31	27 7·6	27 7·1	27 6·8	−14·0	−15·3	−13·2	Calm	S	W	A	Clear.

1813.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind	Observations.
Jan. 1	27 7·5	27 7·6	27 7·4	− 0·5	− 8·6	− 2·8	W	W	W	A	Snow.
2	27 7·5	27 7·6	27 8·4	−12·0	− 8·8	− 2·3	—	—	S	A	Cloudy.
Sun. 3	27 7·8	27 5·7	27 1·3	− 5·2	− 4·8	4·2	SW	SW	SW	A	Thick.
4	26 10·0	26 8·9	26 5·5	4·0	3·2	1·9	W	SW	SW	D	Ditto, rain.
5	26 9·4	26 10·4	26 10·3	0·0	1·4	0·5	N	N	N	B	Ditto.
6	26 10·0	26 10·9	27 2·8	− 1·5	0·0	− 7·2	N	NW	NW	C	Snow.
7	27 2·7	26 11·9	26 10·0	− 7·0	− 7·0	− 1·8	W	W	W	A	Much snow.
8	26 8·4	26 11·5	27 2·8	− 1·5	0·0	−12·2	—	—	N	E	Ditto, ditto.
9	27 6·2	27 7·2	27 4·9	−11·5	−10·8	−10·0	S	S	S	C	Cloudy.
Sun. 10	26 10·4	26 7·2	26 7·5	4·1	3·6	− 1·1	SW	SW	SW	D	Rain and snow.
11	27 0·6	27 1·2	26 9·8	− 4·0	− 1·5	2·0	—	—	—	F	Thick.
12	26 6·2	26 9·2	26 11·3	4·6	− 0·3	− 0·2	—	—	—	E	Rain and snow.
13	27 2·8	27 3·2	27 4·3	− 1·5	− 2·0	− 2·0	—	—	—	B	Cloudy.
14	27 5·0	27 5·2	27 3·6	− 2·5	− 2·0	− 2·7	S	W	S	A	Ditto.
15	27 1·8	27 0·9	27 1·2	− 2·0	− 2·6	0·8	S	S	S	D	Rain.
16	27 5·3	27 5·7	27 7·7	− 2·6	− 2·9	− 3·7	—	—	S	C	Clear.
Sun. 17	27 7·8	27 5·1	27 1·4	− 3·2	− 3·0	2·1	S	S	S	E	Cloudy.
18	26 10·4	26 11·2	27 1·3	2·0	2·0	1·9	—	—	—	E	Ditto.
19	27 2·1	27 3·4	27 5·7	2·4	2·6	1·1	SW	SW	SW	D	Rain, sn.
20	27 2·4	27 0·6	26 11·3	2·5	3·6	6·2	—	—	—	B	Cloudy.
21	27 8·8	27 8·0	27 9·2	2·1	1·6	6·3	W	W	—	D	Ditto.
22	27 11·4	28 0·1	28 0·0	5·2	6·0	5·0	W	SW	—	D	Ditto.
23	28 1·2	28 2·6	28 4·9	2·0	1·6	0·2	S	W	S	A	Ditto.
Sun. 24	28 2·0	28 6·0	28 5·2	− 2·5	− 2·0	− 3·0	—	—	—	A	Partially clear.
25	28 2·6	28 1·8	28 0·9	− 3·7	− 2·0	− 3·5	Calm	Calm	SW	A	Ditto.
26	27 11·4	27 11·8	28 0·1	− 3·0	− 2·6	3·5	S	S	NW	A	Ditto.
27	27 11·6	27 10·0	27 9·3	3·8	4·1	5·3	SW	SW	SW	E	Cloudy.
28	27 7·2	27 6·1	27 3·2	6·0	6·7	6·8	—	—	—	D	Ditto.
29	27 5·9	27 7·2	27 9·8	5·1	4·0	0·0	W	W	—	C	Ditto.
30	28 2·5	28 4·3	28 6·5	− 3·6	0·7	0·3	NW	—	W	B	Snow.
Sun. 31	28 6·1	28 5·8	28 4·0	− 2·0	− 2·0	− 3·1	W	W	W	A	Partially clear.
Feb. 1	28 2·4	28 2·0	28 0·6	4·0	5·2	4·6	SW	SW	SW	D	Thick.
2	27 9·2	27 8·9	27 7·7	3·1	2·3	1·5	—	—	—	D	Snow.
3	27 6·4	27 6·1	27 5·5	4·2	4·1	5·2	SW	—	—	B	Ditto.
4	27 2·6	27 1·3	27 0·9	4·2	5·0	0·0	—	—	—	E	Cloudy.
5	26 11·7	26 10·4	26 9·9	− 1·5	1·6	− 0·5	—	—	W	A	Ditto.
6	26 8·1	26 8·7	26 9·3	− 2·7	− 1·5	− 4·2	W	W	NW	E	Snow.
Sun. 7	27 2·1	27 1·5	27 0·9	−10·3	− 9·0	− 8·2	—	—	—	A	Ditto.
8	26 10·2	26 9·0	26 10·6	− 6·5	− 5·4	− 7·0	NW	NW	NW	E	Much snow.
9	27 2·1	27 3·3	27 4·8	− 9·0	− 8·2	− 6·2	—	—	—	D	Ditto.
10	27 6·1	27 6·7	27 9·7	− 5·4	− 4·0	− 5·0	—	—	—	B	Thick, snow.
11	27 9·0	27 8·3	27 6·7	− 9·2	− 7·8	−10·0	W	S	W	A	Clear.
12	27 6·1	27 5·8	27 6·3	− 5·0	− 1·2	− 3·1	—	N	W	A	Thick.
13	27 6·7	27 6·6	27 6·9	− 3·0	− 1·5	− 1·1	N	E	E	—	Ditto.
Sun. 14	27 4·0	27 3·8	27 2·2	0·0	− 0·5	− 1·4	W	S	S	A	Ditto.
15	27 2·4	27 2·1	27 2·3	− 3·2	− 1·3	− 2·5	N	W	W	A	Ditto.
16	27 1·0	27 2·1	27 2·5	0·0	− 1·0	5·6	N	N	N	D	Snow.
17	27 3·6	27 4·0	27 4·3	− 7·5	− 7·7	−10·6	N	NW	NW	D	Thick.
18	27 6·2	27 5·6	27 5·1	−13·3	−13·0	−11·9	SE	SW	W	A	Snow.
19	27 5·7	27 6·3	27 6·5	−11·0	− 3·6	− 7·5	S	S	Calm	A	Ditto.
20	27 5·6	27 3·8	27 2·9	−10·5	−12·2	−11·5	NW	NW	NW	D	Ditto.
Sun. 21	27 0·5	27 0·6	27 1·1	−10·0	− 5·6	− 9·6	S	S	Calm	C	Cloudy.
22	27 0·8	27 1·3	27 2·8	− 8·5	− 6·3	− 1·8	NE	NE	NE	D	Snow.
23	27 5·9	27 6·3	27 6·8	− 2·5	− 2·0	− 4·0	—	—	Calm	C	Ditto.
24	27 8·1	27 8·9	27 4·8	− 3·5	− 2·0	− 3·0	N	N	SE	E	Ditto.
25	26 11·3	27 0·0	27 1·1	0·5	3·6	− 1·4	NW	SW	N	D	Cloudy.
26	27 1·5	27 3·3	27 5·6	− 0·2	− 2·0	− 7·8	W	W	W	A	Partially clear.
27	27 7·3	27 5·9	27 8·4	− 4·3	− 3·0	4·7	S	S	SW	F	Ditto.
Sun. 28	27 0·9	27 1·6	27 2·3	3·5	1·9	− 0·4	S	S	SW	E	Ditto.

1813.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
Mar. 1	27 2·8	27 2·7	27 2·2	− 2·5	− 0·5	3·2	S	S	SW	A	Partially clear.
2	27 1·4	27 0·2	27 0·6	− 0·6	− 1·5	− 4·0	SW	SW	—	E	Ditto.
3	27 4·1	27 7·1	27 6·6	− 6·2	− 5·8	− 8·5	N	N	N	A	Snow.
4	27 0·1	27 9·2	27 10·7	− 8·0	− 2·0	− 1·9	W	W	SW	D	Ditto.
5	27 0·3	27 1·8	27 3·1	− 7·5	− 3·0	− 8·2	S	W	S	A	Cloudy.
6	27 10·6	27 8·9	27 4·8	− 6·8	− 4·2	0·5	S	W	S	D	Snow.
Sun. 7	27 9·4	27 10·6	28 1·1	− 6·0	− 4·8	− 5·5	S	S	S	A	Cloudy.
8	28 3·6	28 4·1	28 3·3	− 6·2	− 5·0	− 6·5	W	W	W	A	Snow.
9	28 1·2	28 0·9	28 0·4	− 4·5	2·5	3·0	S	E	S	A	Partially clear.
10	27 11·8	28 1·2	28 2·3	2·5	4·6	− 1·0	—	—	—	A	Ditto.
11	28 1·3	27 10·3	27 9·1	3·7	4·0	3·8	SE	SE	SE	E	Rain.
12	27 10·2	27 8·9	27 5·1	2·4	3·0	0·0	S	E	S	A	Cloudy.
13	27 1·1	27 0·4	26 11·3	0·5	2·0	− 1·4	S	E	SW	D	Ditto.
Sun. 14	27 3·0	27 3·1	27 2·5	− 2·0	0·0	− 1·2	SE	SW	SW	B	Ditto.
15	27 2·5	27 2·3	27 4·0	− 1·0	3·0	− 1·0	SW	—	—	B	Ditto.
16	26 11·4	27 1·3	27 4·8	− 3·5	− 4·4	− 5·0	NE	NE	—	B	Snow.
17	26 9·3	26 8·1	27 2·6	− 3·5	− 0·8	− 5·3	SW	SW	—	B	Ditto.
18	27 2·7	27 4·8	27 6·5	− 9·0	− 3·8	− 9·0	W	W	Calm	A	Partially clear.
19	27 6·2	27 4·8	27 3·0	− 7·2	− 2·3	− 3·8	—	—	W	A	Snow.
20	27 2·6	27 2·5	27 2·4	− 7·0	− 2·3	− 7·5	N	E	NW	A	Thick.
Sun. 21	27 0·6	26 11·2	26 9·4	− 7·5	− 4·8	− 1·5	NE	NE	E	B	Snow.
22	26 9·5	26 9·3	27 3·0	− 0·5	3·9	− 1·8	NW	NW	W	B	Thick.
23	26 11·9	26 9·1	26 11·4	− 4·8	3·8	− 1·0	SE	SW	SW	E	Snow.
24	27 2·9	27 5·1	27 4·8	− 2·0	0·4	1·0	SW	SW	SW	D	Cloudy.
25	27 2·1	27 5·2	27 4·0	2·0	1·1	0·7	—	—	—	D	Ditto.
26	26 8·2	27 0·6	27 3·7	2·5	0·8	− 2·0	—	—	—	F	Ditto.
27	27 6·7	27 5·8	27 6·3	1·2	1·3	0·2	—	—	—	D	Ditto.
Sun. 28	27 6·6	27 7·1	27 4·8	1·0	1·5	− 2·5	—	—	—	B	Ditto.
29	27 4·6	27 4·7	27 6·2	− 1·0	0·1	− 5·5	—	S	N	A	Snow.
30	27 6·8	27 7·2	27 9·0	+ 5·2	− 5·5	− 9·7	E	E	SE	A	Ditto.
31	27 9·5	27 9·3	27 8·9	− 10·0	− 9·2	− 10·1	N	N	NW	C	Cloudy.
Apr. 1	27 9·4	27 10·4	27 10·9	− 10·5	− 8·6	− 11·0	NE	NE	NE	D	Snow.
2	28 0·7	28 1·3	28 1·9	− 10·0	− 7·6	− 13·0	N	N	S	A	Clear.
3	27 11·2	27 9·8	27 6·4	− 7·5	− 2·4	− 1·0	S	S	S	B	Snow.
Sun. 4	27 6·5	27 4·4	27 2·3	− 1·0	0·0	− 3·6	W	W	SW	A	Partially clear.
5	27 3·4	27 4·0	27 5·5	− 7·0	− 7·8	− 9·3	NE	NE	NE	F	Thick.
6	27 6·4	27 7·1	27 9·2	− 7·3	− 4·8	− 4·8	NW	NW	NW	E	Snow.
7	27 10·4	27 10·5	27 9·5	− 2·5	0·8	− 2·0	W	W	W	A	Ditto.
8	27 6·8	27 8·8	27 9·2	− 2·0	− 0·7	− 1·7	NW	NW	NW	A	Cloudy.
9	27 11·2	28 0·3	28 1·4	− 5·6	− 4·2	− 7·0	N	N	—	A	Ditto.
10	28 1·0	28 0·6	27 11·6	0·5	3·0	0·2	W	W	W	A	Ditto.
Sun. 11	27 0·8	27 10·3	27 9·8	8·8	5·0	0·4	S	S	S	A	Foggy.
12	27 7·5	27 7·2	27 4·3	3·0	4·8	5·8	SW	SW	SW	E	Thick.
13	27 3·8	27 4·2	27 5·5	2·7	4·5	1·9	—	—	—	E	Ditto.
14	27 4·8	27 4·1	27 3·3	3·0	4·2	− 2·0	W	SW	SW	B	Ditto.
15	27 3·3	27 2·4	27 5·7	2·5	3·7	− 3·5	E	NE	NE	D	Snow.
16	27 6·0	27 6·3	27 7·8	− 4·0	− 2·8	− 5·0	W	W	W	A	Partially clear.
17	27 11·4	28 0·6	28 1·9	− 4·5	− 3·2	− 6·3	—	—	—	A	Ditto.
Sun. 18	27 8·1	27 8·8	27 9·4	− 4·5	− 3·0	− 4·1	—	—	—	A	Ditto.
19	27 10·6	27 11·2	27 11·8	1·5	0·2	− 5·3	NW	NW	NW	D	Snow.
20	28 3·0	28 5·2	28 6·1	− 6·2	− 5·0	− 8·5	—	—	—	B	Ditto.
21	28 3·8	28 3·1	28 2·6	0·0	3·8	1·3	SE	S	SW	D	Cloudy.
22	28 1·8	28 0·4	28 0·9	4·8	6·7	4·4	SW	SW	SW	F	Ditto.
23	28 1·6	28 1·2	27 11·4	5·0	5·7	4·1	—	—	—	D	Ditto.
24	27 11·0	27 10·6	28 2·3	9·0	10·2	− 0·5	—	W	NW	E	Snow.
Sun. 25	28 9·9	28 9·7	28 7·8	− 4·0	− 1·8	− 2·5	S	W	W	A	Very clear.
26	28 8·2	28 8·4	28 8·9	− 5·8	− 3·0	− 6·6	W	E	E	A	Ditto.
27	28 7·2	28 6·3	28 5·1	− 5·1	− 1·5	− 2·6	—	W	W	A	Ditto.
28	28 4·8	28 3·1	28 1·9	− 1·5	0·8	− 0·5	Calm	S	SE	D	Snow.
29	28 0·8	28 0·6	28 0·7	− 5·0	6·5	− 4·0	SW	SW	NW	C	Ditto.
30	28 1·0	28 0·9	28 0·8	− 1·3	3·5	− 1·5	N	NW	NW	B	Cloudy.

1813.	Barometer. Morning.	Barometer. Mid-day.	Barometer. Evening.	Thermometer. Morning.	Thermometer. Mid-day.	Thermometer. Evening.	Wind. Morning.	Wind. Mid-day.	Wind. Evening.	Degrees of Wind.	Observations.
May 1	28 1·6	28 1·4	28 1·3	1·0	6·0	2·0	S	S	S	A	Cloudy.
Sun. 2	28 1·6	28 1·4	28 1·4	− 1·5	4·5	2·8	S	Calm	Calm	A	Snow.
3	28 2·7	28 2·7	28 3·5	5·0	8·3	6·0	—	S	S	A	Cloudy.
4	28 3·7	28 4·0	28 4·9	7·0	10·2	2·5	—	—	W	A	Clear.
5	28 5·5	28 5·4	28 5·4	2·0	7·5	1·6	W	E	—	B	Ditto.
6	28 5·6	28 5·5	28 5·4	1·8	8·2	2·5	Calm	Calm	N	A	Ditto.
7	28 4·4	28 3·3	28 3·2	1·5	7·9	3·1	—	—	Calm	A	Ditto.
8	28 3·2	28 2·8	28 2·3	3·0	7·0	3·4	S	N	N	A	Ditto.
Sun. 9	28 1·8	28 1·7	28 1·6	3·3	6·7	4·0	N	—	NW	C	Thick.
10	28 3·0	28 3·3	28 3·2	1·5	5·0	1·5	N	N	N	C	Foggy.
11	28 2·3	28 2·0	28 1·9	2·0	3·5	1·0	N	N	N	B	Snow.
12	28 1·8	28 1·8	28 0·9	− 1·2	2·3	− 6·0	NE	NE	NE	B	Ditto.
13	28 1·4	28 1·2	28 1·2	− 7·5	− 3·3	− 4·9	—	—	—	B	Ditto.
14	28 0·3	28 0·2	28 0·2	− 5·6	1·5	− 2·0	NW	NW	NW	B	Cloudy.
15	28 1·5	28 1·6	28 1·2	− 2·2	4·0	− 0·0	Calm	SE	SE	B	Clear.
Sun. 16	28 0·6	28 0·0	27 11·8	− 0·5	5·5	3·0	E	SE	SE	B	Cloudy.
17	27 9·1	27 9·1	27 9·1	3·0	6·2	3·4	SE	SE	SE	B	Rain.
18	27 9·0	27 7·8	27 6·4	1·5	10·2	5·7	S	S	S	A	Cloudy.
19	27 6·5	27 5·8	27 5·5	2·0	9·7	3·2	Calm	E	E	B	Rain.
20	27 5·4	27 6·2	27 8·2	0·0	1·0	− 0·4	NE	NE	NE	E	Ditto, snow.
21	27 11·5	28 0·5	28 1·6	− 1·6	− 1·2	− 2·2	—	—	—	C	Snow.
22	28 1·7	28 1·3	28 0·0	− 1·2	− 0·5	− 2·0	NW	—	Calm	B	Clear.
Sun. 23	27 9·8	27 8·8	27 8·4	0·4	2·0	0·0	Calm	Calm	N	A	Thick, snow.
24	27 8·0	27 8·2	27 8·4	− 2·6	3·2	3·0	N	N	—	A	Ditto, ditto.
25	27 9·2	27 9·6	27 10·3	2·0	6·0	1·9	SE	SE	NE	B	Foggy.
26	27 11·0	27 11·0	28 0·1	1·9	6·1	1·5	N	N	N	A	Ditto.
27	28 0·2	28 0·3	28 0·4	1·6	4·8	2·4	NE	NE	NE	B	Ditto.
28	28 0·6	28 0·4	28 0·0	2·2	3·6	0·4	—	E	E	B	Snow.
29	27 8·4	27 7·1	27 7·2	0·5	9·4	7·6	Calm	S	S	A	Cloudy.
Sun. 30	27 9·2	27 10·4	27 10·1	7·0	11·0	7·5	S	S	S	A	Partially clear.
31	27 9·6	27 8·7	28 0·0	6·9	13·8	7·0	SW	SW	SW	B	Ditto.

(*The Supplementary Register will appear in the next Number.*)

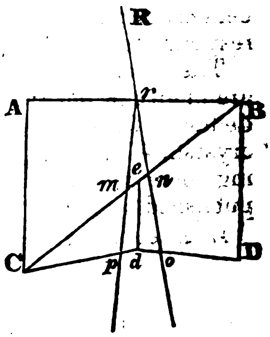
Article IV.

Description of a Method of making Doubly Refracting Prisms perfectly Achromatic. By David Brewster, LL.D. F.R.S. London and Edinburgh.

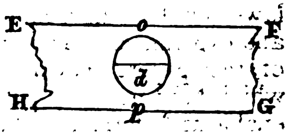
In the course of my experiments on the polarisation of light, I have long been in the habit of making use of perfectly achromatic prisms of calcareous spar; but until I ascertained from M. Biot that the method of constructing such prisms had neither occurred to himself, nor, as far as he knew, to any other person, I did not think of laying it before the public.

When we form a prism of calcareous spar for the purpose of analyzing light that has been submitted to the action of crystallized bodies, and correct the colour of one of the images by the equal and opposite dispersion of a prism of glass, we shall always find that a considerable portion of the colour of the other image remains uncorrected. Even when the refracting angle of the prism is small, this uncorrected colour is very perceptible; but when the refracting angle is great, which it is often required to be when we wish to see at one view the systems of rings produced by crystallized bodies, the spectrum of the uncorrected pencil is extremely large, and alters completely the nature of the light which we are investigating. This is the form of the achromatic prism which I at first employed, and which has been used by M. Biot,* and, I believe, also by Malus.

In order to construct a prism in which the dispersions of both the images shall be simultaneously corrected, let us suppose A B C to be the prism of spar, and let two prisms of glass, B *e d* D, C *e d*, be constructed, so that the first is capable of correcting the colour of the most refracted image, while the second, C *e d*, is capable of correcting the colour of the least refracted image. These prisms must be cut in such a manner that their joining surface, *d e*, bisects the angle, *m r n*, formed by the two pencils when the ray R *r* is incident in the desired direction.



If these two prisms are made of the same kind of glass, C *e d* will generally have a less refracting angle than B *e d* D; and the surfaces C *d*, D *d*, will form at *d* an angle less than 180°. But if it is thought desirable to have C *d* D a straight line, it may be accomplished by selecting crown and flint glass of the proper refractive and dispersive powers, and making B *e d* D of flint glass, and C *e d* of crown glass. The surface C *d* D should be covered with an opaque plate, E F G H, as shown in the annexed figure, having an aperture, *o p*, a little larger than the pupil, and having the line of junction, *d*, of the prisms for one of its diameters.



If calcareous spar were capable of receiving a perfect polish, the achromatic prism would now be complete; but as it appears to be impossible to give its surface a very fine lustre, we must endeavour to produce, by other means, an equivalent effect. When the surfaces of the calcareous spar are as highly polished as possible, the surfaces B *e*, C *e*, of the two prisms must be cemented to the surface C B by a transparent cement, whose refractive power is a mean between the refractive powers by which the pencils *r m*, *r n*, are influenced; and by means of the same cement, plates of well-polished and well-annealed glass

* See Biot's Traité de Physique, tom. iv. p. 268.

must be cemented to the surface A B. By this means we shall have a prism in which the imperfections of the polishing are removed; while the two images are perfectly white, and nearly equally luminous. If we wish one of the two images to be still more perfect, it must be done at the expense of the other image, by using a cement of the same refractive power as that which corresponds to the image which we wish to improve. This compound prism will admit of still farther improvement, by cementing, in every case, the prism of glass C *e d* to the calcareous spar with a cement of the same refractive power with that which corresponds to the ray *r m*, and the other prism *B e d* D, with a cement whose refractive power is equal to that which corresponds to the ray *r n*.

These practical directions respecting the nature of the cement are of greater importance than we are apt to imagine. They are deduced from a series of new experiments on the action of crystallized surfaces, and on the extension of the doubly refracting force beyond the surfaces of bodies, which will soon be published.

Venlaw, *Oct.* 15, 1817.

Article V.

Of Isothermal Lines, and the Distribution of Heat over the Globe. By Alex. de Humboldt.*

The unequal distribution of heat over the globe is one of those phenomena which has been long known as a general fact, but which cannot be exactly ascertained, with respect to its particular laws, until we have more correct data furnished by observation and experiment. To furnish these data is the immediate object of this paper; they are deduced from a great number of facts which have not been published; and if they are not sufficient to enable us to form a correct theory, they may, at least, lay a foundation for it, and will be useful in pointing out to travellers those objects to which they ought especially to direct their attention.

The distribution of vegetables and of organized beings in general depends upon the circumstances that are connected with latitude, longitude, and elevation; and of these one of the most important is atmospherical temperature. The means which the author enjoyed of making observations, during his residence in South America, have enabled him to establish some very valuable data, which could not have been obtained in any other situation, more especially those which require to be made at great heights above

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the level of the ocean. The highest point in Europe where any observations have been made, is the Hospice de St. Gothard, at about 6,400 feet above the sea; but in South America the town of Quito is about 9,000 feet, Huancavelica about 11,670 feet, and the mine of Santa Barbara as much as 14,400 feet above the sea, or more than double that of St. Gothard. In order to compare the results which were obtained in the equinoxial regions with the mean heat of temperate climates, it was necessary to find out different situations, at intervals of 10° of latitude, but on different meridians, the mean temperature of which had been accurately ascertained. These will form so many fixed points, through which the *isothermal lines*, or the lines of equal temperature, may pass. In collecting facts for ascertaining these stations, comparatively few of the numerous thermometrical observations that have been published could be employed. Many of the observations contradict each other; in many cases we do not know under what circumstances they were made; and we are frequently obliged to reject such as, in other respects, appear correct, because we are not acquainted with the absolute height of the place at which they were made. This is remarkably the case with almost the whole of Asia; and it is not a little singular that, while there are more than 500 stations in the equinoxial district of America, many of them mere villages, or even hamlets, the altitude of which has been exactly determined, we are ignorant of the height of Bagdat, Aleppo, Ispahan, Delhi, and many other large and ancient cities in the Old World. In comparing the temperatures of different places, it is, however, quite necessary either that they should be upon the same level, or that a proper allowance should be made for any difference which there may be in this respect.

In the old continent the only good observations which can be employed to form our calculations are limited by the parallels of 30° and 70° of latitude, and by the meridians of 30° east and 20° west longitude; the extreme points of which are, the island of Madeira, Cairo, and Cape North; it comprises about $\frac{1}{7}$ the circumference of the globe from east to west. There are many circumstances connected with Europe, partly depending upon its natural form and situation, and partly upon the state of its civilization, which have given a peculiar character to its climate, different from that of other regions in the same latitude. But as this has been the abode of men of science, they have considered the laws which regulate the temperature of that part of the world as what are applicable to all the others. In this, however, they have fallen into some considerable errors, the causes and the amount of which we must endeavour to discover and appreciate. It is not with the temperature of the atmosphere, and with the magnetism of the globe, as with those phenomena which are determined by a single cause, and may be considered as distinct from all disturbing causes. From their nature, they both depend upon many local circumstances, such as the constitution of the soil, and the disposition of the radiating surface of the globe; and it frequently requires much judgment and discrimination to decide what circumstances are to be taken into account, and what are not connected with the inquiry. The object is to ascertain the quantity of heat which every part of the globe receives annually, and which is of actual use to agriculture and the well-being of the inhabitants; not what depends solely upon the action of the sun, its height above the horizon, or the extent of its semi-diurnal arcs. The temperature of a climate depends both upon the action of the sun, and of various extrinsic causes; among these may be enumerated the mixture of the temperatures of different latitudes, produced by winds, the vicinity of the sea, the nature of the soil, the presence and peculiar form of mountains, and the existence of large tracts of snow or masses of ice.

In distinguishing between the *solar* and the *real* climate, we must remember that the local causes which modify the sun's action are themselves only secondary causes, effects which the motion of this luminary produces in the atmosphere. Many of the local or disturbing causes are necessarily connected with the nature of heat, and are felt over every part of the globe. The ocean tends to equalize the temperature of all the different regions by the mobility which necessarily belongs to it, and the currents of warm air which always flow from the equator to the poles, tend to diminish the rigour of the countries of the north. In estimating the action of the sun alone on the earth, we must have recourse to theory: this will not express the actual height of the thermometer in different situations, but it will show the relations between the mean temperature of different regions. By comparing the results of the calculation, not to the mean deduced from observations made in different longitudes, but to the mean temperature of a single point taken at the surface of the earth, we may proceed in our examination of what depends upon the sun, and upon all the other influences, solar or not solar, local, or such as extend to considerable distances. In this way we shall be able to form an interesting comparison between theory and experience.

For the first philosophical ideas upon the subject of solar heat, we are indebted to Halley. Marian afterwards extended our knowledge of solar action; but he fell into some considerable errors, which were rectified by Lambert, who instituted some important calculations, which, however, do not always accord with actual experience, and which, indeed, depend almost entirely upon mathematical principles. After him, the subject was taken up by Moyer and by Kirwan; and they proceeded more upon observation, at least upon the method of endeavouring to approximate to a true system by collecting observations, and employing them to correct the theory. In speaking of the authors, who have added to our knowledge on the temperature of the different parts of the earth, we must not omit to mention Cotte, who has collected a great number of documents; but they are not reduced into any kind of method, and are not all of equal authority.

These considerations lead us to the conclusion that, in investigating the distribution of temperature, it is important to distinguish between the results which are deduced from observation, and those which are derived from theory. We must collect all the authentic facts that can be obtained; and, after arranging them into regular order, we must submit them to what may be termed empirical laws. After having correctly ascertained the mean temperature of certain places, we may trace on the globe *isothermal lines*, which thus exhibit to the eye the relation of these places to each other. In determining the mean temperature of a particular spot, the old plan was to take the maximum and minimum temperature of the year, and to consider the middle number between them as the mean temperature; but this plan is obviously incorrect. De la Hire seems to have been the first who attempted to pursue a different method, and one founded on more just principles: observing the uniformity of the temperature of the vaults that are attached to the observatory at Paris, he proposed as a general fact, that the temperature of vaults was the mean temperature of the climate.* The other method, that of the maxima and minima, continued, however, to be generally adopted; and, by multiplying the number of the observations, it was rendered more correct, but still liable to inaccuracy. Some of the latest observers have noted the thermometer three times each day, and then taken the mean of these as denoting the mean temperature of the day; others have adopted the plan of observing the thermometer at two periods in the day, which are considered as indicating the maximum and minimum—sun-rise, and two hours after noon; while others, again, have satisfied themselves with observing the temperature at one period only, which has been found, by previous experience, to denote the mean temperature.

By comparing a great number of observations made between 46° and 48° N. latitude, we find that at the hour of sun-set the temperature is very nearly the mean of that at sun-rise and two hours after noon. When, besides noting the maximum and minimum, we take a middle observation, we shall fall into an error, if we simply divide the sum of the observations by three, without attending to the duration of the particular temperatures, and the place which the middle observation occupies between the extreme terms of the series. The middle observation should be at least four or five hours from either of the others; but, upon the whole, the two observations of the extreme temperatures

* Mem. Acad. Sciences, 1719, p. 4.

will give us more correct results. Some very valuable observations have been made by noticing the thermometer from hour to hour, at different seasons of the year, and in different latitudes, until we are able to fix upon a number which may indicate the mean of the day. Serene and calm weather has been chosen on these occasions, and the thermometer has been carefully examined in this way, both in the observatory at Paris, and under the equator. These observations have tended to confirm the opinion that has been mentioned above, that the temperature of the earth corresponds with the mean temperature of the atmosphere, the disturbing causes nearly counteracting each other. In expressing the results of the observations on mean temperatures that have been made in various situations, it is convenient not to employ the numbers that are derived from any particular scale, but to consider the equator as the standard to which all the rest are to be referred, and to denote them all by numbers which have an arithmetical relation to it.

Having now ascertained the method of taking mean temperatures, and of reducing them to a general expression, we may proceed to examine the form of some of the isothermal lines. It has been long known that the temperatures are not the same in the same parallels, especially those in Europe and in America; but, from the facts that will be stated, we shall find that this difference is not so great as has been imagined. By constructing a table, in which we compare the mean temperature and the latitude of different places in the continents of Europe and America, we learn the amount of this difference, and we deduce from this the number of degrees of latitude which we must go northward in Europe in order to arrive at the same annual mean. From this train of observations, we find that the isothermal line, or band, which is considered as 32°,* passes between Ulea, in Lapland, latitude 66° 68′, and Table Bay, in Labrador, latitude 54°. The isothermal line, or band, of 41°, passes near Stockholm, latitude 60°, and St. George's Bay, in Newfoundland, latitude 48°. The isothermal line, or band, of 50°, passes through Belgium, latitude 51°, and near Boston, latitude 42° 30′. The isothermal line, or band, of 59°, passes between Rome and Florence, latitude 43°, and near Raleigh, in South Carolina, latitude 36°. The direction of these lines of equal temperature gives the following differences between the west of Europe and the east of America:

Latitude.	Mean of West of Europe.	Mean of East of America.	Differences.
30°	70·1°	66·8°	3·3
40	63·1	54·5	8·6
50	50·8	37·9	12·9
60	40·0	24·0	16·0

* The thermometrical numbers are all reduced from the centigrade scale to that of Fahrenheit. In the original, the numbers on the centigrade scale are, 0°, 5°, 10°, 15°, respectively.

In advancing from the equator towards the north pole, the mean temperatures become less than that of the equator in the following proportion:

Lat.		Temp.		Temp.
From 0°—20°	in the old contin.	35·6°	in the new	35·6°
20 —30	....	39·2	....	42·8
30 —40	....	39·2	....	44·6
40 —50	....	44·6	....	48·2
50 —60	....	41·8	....	45·1
0 —60	....	72·2	....	88·0

Having traced the isothermal belts from Europe to the provinces of the New World, the next object will be to observe them in North America itself. There are two chains of mountains in this continent—the Alleghanys, and the Rocky Mountains; the first running N.E. and S.W., the latter N.W. and S.E., making nearly equal angles with the meridian, and enclosing the vast plains of Louisiana, Tennesee, and the state of Ohio. This country possesses a milder climate than the parallel latitudes in the Atlantic States, the winters being less severe, and the summers less hot; so that the isothermal lines remain parallel, or nearly parallel, to the equator, from the coast of the Atlantic to the east of the Mississipi, and the Misoury. Beyond the Rocky Mountain the climate is still milder; in New California, and along the northern parts of the western side of the continent, the temperature appears to be very nearly the same with what it is in similar latitudes on the western side of Europe. The isothermal lines will, therefore, be bent upwards in this part.

When we pass from the west of Europe eastward, the isothermal lines are again curved downwards; but the few accurate observations which we possess render it very difficult to fix the exact line; of the general fact, however, there is no doubt. We have hitherto found that, towards the north, the isothermal lines are neither parallel to the equator nor parallel to each other; and as the curve is the greatest in Asia and in America between 80° west and 100° east longitude, it might be supposed that the torrid zone of this part commences to the south of the tropic of Cancer, or that its heat is less intense. This, however, does not appear to be the case; as we approach to the line, below the parallel of 30°, the isothermal lines gradually become parallel to themselves and to the equator. For some time the old continent was thought to be warmer between the tropics than the new; but more correct observations have shown that this is not the case. The mean temperature of the equator may be fixed at 81·2.°

The distribution of the temperature through the different parts of the year differs in the same isothermal line; this is the case with respect both to the old and new continents; in the former a few months are warmer than in the latter; as, for example, the heats in Madras are greater than those in Cumana. In the temperate zone it has been long known that the cold of the winter augments in a more rapid progression than the heat of the summer decreases; it is also known that the climate of islands, and the sea-coast, is milder than the interior of continents; it is, therefore, an important object to compare the mean temperatures of the three winter and the three summer months, at different latitudes, and to observe how the curves of the isothermal lines modify these relations. By comparing together a tract on the west with one on the east side of the Atlantic, extending across the different isothermal lines, we find that the difference between the two seasons increases more in the transatlantic than in the cisatlantic district. But in both the districts the division of the temperature between the winter and summer months is such, that upon the line of 32° the difference is nearly double what it is upon the line of 68°.

In tracing the same isothermal line from west to east, in order to observe the difference between the winters and the summers, we find that the difference is less near the convex summits of the lines than near the concave summits. The same causes which tend to raise up the lines towards the pole also tend to equalize the seasons. Europe may be regarded altogether as the western part of a great continent, and subject to all those influences which make the western sides of all continents warmer than the eastern. The same difference that we observe in the two sides of the Atlantic exists on the two sides of the Pacific; in the north of China the extremes of the seasons are much more felt than in the same latitudes in New California, and at the mouth of the Columbia. On the eastern side of North America we have the same extremes as in China; New York has the summer of Rome and the winter of Copenhagen; Quebec has the summer of Paris and the winter of Petersburgh. And, in the same way in Pekin, which has the mean temperature of Britain, the heats of summer are greater than those at Cairo, and the cold of winter as severe as that at Upsal. This analogy between the eastern coasts of Asia and of America sufficiently proves that the inequalities of the seasons depend upon the prolongation and enlargement of the continents towards the pole, and upon the frequency of the N.W. winds, and not upon the proximity of any elevated tracts of country.

TABLE I.

Places.			March.	April.	May.	June.	Differences of temp. of the four months.			M. temp. of year.
First Group.										
Concave summits in America.										
Natchez, lat.	31°	28′	58·0°	66·2°	72·6°	79·2°	8·2°	6·4°	6·6°	64·8°
Williamsburg	37	18	46·4	61·2	66·6	77·8	14·8	5·4	11·2	58·1
Cincinnati....	39	0	43·7	57·4	61·2	70·8	13·7	3·8	9·4	53·8
Philadelphia .	39	56	44·0	53·6	61·8	72·4	9·6	8·2	10·6	53·6
New York...	40	40	38·6	49·1	65·8	82·2	10·5	16·7	16·4	53·8
Cambridge...	42	25	34·6	45·5	56·8	70·2	10·9	11·3	13·4	50·4
Quebec......	46	47	23·0	39·6	54·6	63·8	16·6	15·0	9·2	41·8
Nain	57	0	6·8	27·5	37·0	43·8	20·7	9·5	6·8	26·4
Second Group.										
Convex summits in Europe.										
(A) Climate of the continent.										
Rome	41°	53′	50 4	55·4	67·0	72·4	5·0	11·6	5·4	60·4
Milan	45	28	47·8	51·0	65·2	70·6	3·2	14·2	5·2	55·8
Geneva	46	12	39·6	45·6	58·1	62·2	6·0	12·5	4·1	49·2
Buda	47	29	38·3	49·1	64·8	68·4	10·3	15·7	3·6	60·0
Paris	48	50	42·2	48·2	60·0	64·4	6·0	11·8	4·4	60·0
Gottingen	51	32	34·2	44·1	57·8	63·2	9·9	13·7	5·4	46·7
Upsal.	59	61	29·4	39·8	48·8	58·0	10·4	9·0	9·2	41·9
Petersburgh..	59	56	27·5	36·9	52·2	59·4	9·4	15·3	7·2	38·8
Umea	63	50	23·0	34·2	43·7	55·0	11·2	9·5	11·3	33·2
Ulea	65	0	14·0	26·0	41·0	55·0	12·0	15·0	14·0	35·0
Enontekies ..	68	30	11 4	26·6	36·5	49·4	15·2	9·9	12·9	27·0
(B) Climate of the coast.										
Nantes	47°	13′	50·0	53·6	60·0	65·6	3·6	13·6	5·6	54·6
London......	51	30	44·2	49·8	56·4	64·2	5·6	6·6	7·8	51·6
Dublin	53	21	41·9	45·8	51·8	55·6	3·9	6·0	3·8	48·4
Edinburgh. ..	57	57	41·4	47·3	50·6	57·2	5·9	3·3	6·6	47·8
Cape North..	71	0	24·8	30·0	34·0	40·1	5·2	4·0	6·1	32·0
Third Group.										
Concave summit of Asia.										
Pekin	39°	54′	41·4	57·0	70·4	84·2	15·6	23·4	13·8	54·8

TABLE II.

Places.	Cisatlantic band, longitude 29° E. 30° W.					Places.	Transatlantic band, longitude 67° E. 97° W.				
	Lat.		Mean temp. of the				Lat.		Mean temp. of the		
			Year.	Winter.	Summer.				Year.	Winter.	Summer.
(Pondicherry)	11°	35′	85·4°	77·0°	90·8°	Cumana.....	10°	27′	81·6°	81·3°	83·3°
Cairo.	30	2	72·6	57·6	84·6	Havannah...	23	10	77·7	80·4	79·9
Funchal......	32	37	68·4	63·8	72·5	Natchez.....	31	28	64·8	48·6	79·0
Rome	41	55	60·1	45·8	75·2	Cincinnati...	39	6	53·6	32·9	73·0
Bourdeaux...	44	50	56·5	42·0	70·9	Philadelphia.	39	56	53·1	32·2	73·8
Paris	48	50	51·8	38·3	66·2	New York ..	40	40	53·9	30·0	79·0
Copenhagen .	55	41	45·6	31·0	62·6	Cambridge...	42	25	50·4	34·0	70·4
Stockholm...	59	20	42·2	26·0	61·8	Quebec	46	47	41·6	15·0	68·0
Drontheim...	63	24	39·7	24·0	61·3	Nain	57	10	26·4	— 0·4	48·4
Umea.	63	50	31·0	13·4	54·4	Fort-Churchill	59	2	25·5	6·8	52·0

The following table shows how the annual heat is divided between the two seasons of winter and summer in all the different parts of the temperate zone. The observations are traced along the isothermal lines from W. to E., and those are preferred which are situated nearest to the most curved parts of the lines; the longitudes are taken from the meridian of Paris:

	Isothermal lines from 32° to 68°.	Mean temperature of Winter.	Mean temperature of Summ.
* Isothermal lines of 68°.	Long. 84° 30′ W.; lat. 29° 30′. (Florida)	53·6	80·6
	Long. 19° 19′ W.; lat. 32° 37′ (Madeira)	63·6	72·0
	Long. 0° 40′ E.; lat. 36° 48′ (N. of Africa)	59·0	80·6
Isoth. line of 63·5°.	Long. 92° W; lat. 32° 30′ (Mississipi)	46·4	77·0
	Long. 11° 51′ E.; lat. 40° 50′ (Italy)	50·0	77·0
Isoth. line of 59°.	Long. 86° 30′ W.; lat. 35° 30′ (Basin of the Ohio)	39·2	78·4
	Long. 1° 2′ E.; lat. 43° 30′ (South of France)	44·6	75·2
Isoth. line of 54·5°.	Long. 87° W.; lat. 38° 30′ (Amer. W. of the Alleghanys)	34·7	75·2
	Long. 76° 30′ W.: lat. 40° (Amer. E. of the Alleghanys)	32·7	77·0
	Long. 3° 52′ W.; lat. 47° 10′ (West of France)	41·0	68·0
	Long. 7° E.; lat. 45° 30′ (Lombardy)	34·7	73·4
	Long. 114° E.; lat. 40° (Eastern Asia)	26·6	82·4
Isoth. line of 50°.	Long. 86° 40′ W.; lat. 41° 20′ (Amer. W. of the Alleghanys	31·1	71·6
	Long. 73° 30′ W.; lat. 40° (Amer. E. of the Alleghanys)	30·2	73·4
	Long. 9° W.; lat. 52° 30′ (Ireland)	39·2	59·8
	Long. 3° W.; lat. 53° 30′ (England)	37·4	62·6
	Long. 0°; lat. 51° (Belgium)	36·5	61·5
	Long. 16° 40′ E.; lat. 47° 30′ (Hungary)	31·1	69·8
	Long. 114° E.; lat. 40° (Eastern Asia)	23·0	78·8
Isoth. line of 45·5°.	Long. 23° 20′ W.; lat. 44° 42′ (Amer. E. of the Alleghanys)	23·9	71·6
	Long. 4° 30′ W.; lat. 57° (Scotland)	36·0	56·4
	Long. 10° 15′ E.; lat. 55° 40′ (Denmark)	31·3	62·6
	Long. 19° E.; lat. 53° 5′ (Poland)	28·0	66·2
Isoth. line of 41°.	Long. 73° 30′ W.; lat. 47° (Canada)	14·0	68·0
	Long. 7° E.; lat. 62° 45′ (Western Norway)	24·8	62·6
	Long. 15° E.; lat. 60° 30′ (Sweden)	24·8	60·8
	Long. 22° E.; lat. 60° (Finland)	23·0	63·5
	Long. 34° E.; lat. 58° 30′ (Centre of Russia)	13·0	68·0
Isoth. line of 36·5°.	Long. 74° W.; lat. 50° (Canada)	6·8	66·8
	Long. 15° 45′ E.; lat. 62° 30′ (W. coast of gulf of Bothnia)	17·6	57·2
	Long. 20° E.; lat. 62° 50′ (E. coast of ditto)	16·7	59·0
Isoth. line of 32°.	Long. 60° W.; lat. 53° (Labrador)	3·2	51·8
	Long. 17° 30′ E.; lat. 65° (Sweden)	11·3	53·6
	Long. 23° E.; lat. 71° (Northern part of Norway)	—	45·7

We may perceive from this table that the inequality of the winters on the same isothermal line increases as the annual heat diminishes, from Algiers to Holland, and from Florida to Pennsylvania. If, instead of observing the most severe winter which is found in every climate, we trace the lines of similar winter temperatures, which we may style *isochcimal lines*; these, so far from coinciding with the isothermal lines, oscillate round them, and connect situations that are placed upon different

* The numbers, expressing the isothermal lines on the centigrade scale, are, 20°, 17½°, 15°, 12½°, 10°, 7½°, 5°, 2½°, 0°.

isothermal lines. For example, in Belgium (geo. lat. 52°, isoth. lat. 51·8°), and even in Scotland (geo. lat. 57°, isoth lat. 45·5°), the winters are more mild than at Milan (geo. lat. 45° 28′, isoth. lat. 57·7°). Ireland presents one of the most remarkable examples of the combination of very mild winters with cold summers; the mean temperature in Hungary for the month of August is 71·6°, while in Dublin it is only 60·8°. These, and many other instances which might be adduced, prove that the isocheimal lines vary much more from the terrestrial parallels than the isothermal lines; in the climates of Europe the latitude of two places, which have the same *annual* temperature, never differs more than 8° or 9°, while there are places that have the same *winter* temperature that differ in latitude 18° or 19°.

The lines of equal summer heat, the *isothermal* curves, as we may style them, follow an exactly contrary direction to the isocheimal. We find the same summer heat at Moscow and at the mouth of the Loire, although the former is 11° further north than the latter; a circumstance which is attributed to the radiation of the earth in an extensive continent, without any considerable mountains. With respect to the relation which subsists between the temperature of winter and spring in different climates, it follows, from what has been stated above, that the increase of vernal temperature is considerable, and likewise much protracted, wherever the distribution of the annual temperature among the different seasons is very unequal, as in the north of Europe, and the more temperate part of the United States; that the vernal increase is great, but short, in the more temperate parts of Europe; that it is small, but protracted, in islands; and that in the different bands of climate enclosed between the same meridians, the vernal increase is smaller, and less protracted, in low than in high latitudes. Many very important conclusions are deduced from these facts respecting the effects of different climates on the cultivation of various kinds of plants, depending partly upon the absolute heat and cold of the summer and winter respectively, partly upon their relation to each other, and partly upon the transition from one season to the other.

The southern hemisphere differs considerably from the northern; it is certainly colder; but the degree of difference between them has been very differently rated. The coldness of the southern hemisphere has generally been ascribed to the sun being a shorter space of time below than above the equator; but it probably depends more upon the greater proportion of ocean, which gives to the southern temperate zone a climate approaching to that of a collection of islands; there is, therefore, a less accumulation of heat during the summer, and a less radiation from the land, in proportion to its less extent; there is, consequently, a less current of warm air from the equator towards the south pole, which permits the ice to accumulate more round it. Near the equator, and indeed through the whole of the torrid zone, the temperature of the two hemispheres appears to be the same; but the difference begins to be felt in the Atlantic about the 22° of latitude; and there is a considerable difference between the mean temperature of Rio Janeiro and Havannah, although they are both equally distant from the equator, the former being 74·5°, the latter 76·4°. The southern climates generally differ from those of the north in respect to the distribution of the temperature through the different parts of the year. In the southern hemisphere, under the isothermal lines of 46° and 50°, we find summers which, in our hemisphere, belong to the lines of 35·5° and 41°. We are not accurately acquainted with the mean temperature of any place above 50° of south latitude; but there is every reason for supposing that it differs considerably from the same degree north.

In estimating the temperature of the ocean there are four circumstances particularly to be attended to; 1. The temperature of the water at the surface, corresponding to the different latitudes, supposing it to be at rest, without either shallows or currents; 2. The decrease of heat in the strata of water which rest upon each other; 3. The effect of shallows, or banks, upon the temperature of the surface water; 4. The temperature of the currents which mix together the waters of different zones. The water of the ocean is said to be the warmest between 5° 45′ N. and 6° 15′ S.; it has been found, by different observers, to be from 82·5° to 84·5°; the temperature of the ocean in this part is from 4° to 6° higher than the temperature of the air which reposes upon it. As we advance towards the poles, the influence of the seasons upon the temperature of the surface of the sea becomes very sensible; but as a great mass of water follows the changes of the temperature of the air very slowly, the means of the months in the ocean and in the air do not correspond.

To complete the subject of temperature, we have still to consider its variations in the different regions of the atmosphere, and in the interior of the earth; but our remarks have been already extended to so great a length, that we shall not, at present, enter upon these topics.

Isothermal Bands, and Distribution of Heat over the Globe.

The temperatures are expressed in degrees of Fahrenheit's thermometer; the longitudes are counted from east to west, from the first meridian of the observatory of Paris. The mean temperature of the seasons have been calculated so that the months of December, January, and February, form the mean temperature of the winter. The mark * is prefixed to those places the mean temperatures of which have been determined with the most precision, generally by a mean of 8000 observations. The isothermal curves having a concave summit in Europe, and two convex summits in Asia and Eastern America, the climate is denoted to which the individual places belong.

Isothermal bands.	Names of the places.	Position in Latitude.		Longitude.			Height in feet.	Mean temp. of the year.	Distribution of Heat in the different Seasons. Mean temp. of winter.	Mean temp. of spring.	Mean temp. of summer.	Mean temp. of autumn.	Maximum and Minimum. Mean temp. of warmest month.	Mean temp. of coldest month.
Isothermal bands from 32° to 41°.	Nain	57°	8′	63°	40′	W	0	26·8°	— 0·4°	23·1°	48·4°	33·4°	51·8°	—11·2° [1]
	* Enontekies	68	30	18	27	E	1356	27·0	0·4	25·0	54·8	27·4	59·6	— 0·6 [2]
	Hospice de St. Gothard	46	30	6	3	E	6390	30·4	18·4	26·4	45·0	31·8	46·2	15·0 [3]
	North Cape	71	0	23	30	E	0	32·0	23·8	29·4	43·2	32·2	50·2	22·1 [4]
	* Ulea	65	3	23	6	E	0	33·0	11·8	27·2	57·8	36·0	61·6	7·7 [5]
	* Umea	63	50	17	56	E	0	33·2	13·0	33·8	54·8	33·4	62·6	11·4 [6]
	* Petersburg	59	56	27	59	E	0	38·8	17·0	38·2	62·0	38·6	65·6	8·6 [7]
	Drontheim	63	24	8	2	E	0	40·0	23·8	35·2	61·4	40·1	65·0	19·8 [8]
	Moscow	55	45	35	12	E	970	40·2	10·8	44·0	67·1	38·3	70·6	6·0 [9]
	Abo	60	27	19	58	E	0	40·4	20·8	38·3	61·8	40·6	—	— [10]
Isothermal bands from 41° to 50°.	* Upsal	59	51	15	18	E	0	42·0	25·0	40·0	60·2	42·8	62·4	22·4 [11]
	* Stockholm	59	20	15	43	E	0	42·2	25·6	38·3	61·8	43·2	64·0	22·8 [12]
	Quebec	46	47	73	30	W	0	41·8	14·2	38·9	68·0	46·0	73·4	13·8 [13]
	Christiana	59	55	8	28	E	0	42·8	28·8	40·1	62·6	41·2	66·8	28·8 [14]
	* Convent of Peyssenburg	47	47	8	14	E	3066	43·0	28·6	42·0	58·4	43·0	59·4	30·2 [15]
	* Copenhagen	55	41	10	15	E	0	45·6	30·8	41·2	62·6	48·4	65·0	27·2 [16]
	* Kendal	54	17	5	6	W	0	46·2	36·8	45·2	56·8	46·2	58·1	34·8 [17]
	Malouin Islands	51	25	62	19	W	0	47·0	39·6	46·6	53·0	48·4	55·8	37·4 [18]
	* Prague	50	5	12	4	E	0	49·4	31·4	47·6	68·9	50·2	—	— [19]
	Gottingen	51	32	7	33	E	456	47·0	30·4	44·2	64·8	48·6	66·4	33·2 [20]
	* Zurich	47	22	6	12	E	1350	47·8	29·6	48·2	64·0	48·8	65·7	26·8 [21]
	* Edinburgh	55	57	5	30	W	0	47·8	38·6	46·4	58·2	48·4	59·4	38·3 [22]
	Warsaw	52	14	18	42	E	0	48·6	27·8	47·4	69·0	49·4	70·4	27·2 [23]
	* Coire	46	50	7	10	E	1876	49·0	32·4	55·4	63·4	50·4	64·6	29·6 [24]
	Dublin	53	21	8	39	W	0	49·2	39·2	47·3	59·6	50·0	61·0	35·4 [25]
	Berne	46	5	5	6	E	1650	49·3	32·0	49·0	66·6	49·8	67·2	30·6 [26]
	* Geneva	46	12	3	48	E	1080	49·3	34·9	47·6	65·0	50·0	66·6	34·2 [27]
	* Manheim	49	29	6	8	E	432	50·2	33·8	49·8	67·1	49·8	68·8	33·4 [28]
	Vienna	48	12	14	2		420	50·6	32·8	51·2	69·2	50·6	70·6	26·6 [29]

Isothermal band from 50° to 59°.	* Clermont	45	46	0	45		1260	50·0	34·7	50·6	64·4	51·2	66·2	28·0	30
	* Buda	47	29	16	41		494	51·0	31·0	51·0	63·2	52·4	71·6	27·6	31
	Cambridge (U.S)	42	25	73	23	W	0	50·4	34·0	47·6	64·4	49·8	72·8	29·8	32
	* Paris	48	50	0	0		222	51·0	38·8	49·2	64·6	51·4	65·3	36·0	33
	* London	51	30	2	23	W	0	50·4	39·6	48·6	63·2	50·2	64·4	37·8	34
	Dunkirk	51	2	0	2	E	0	50·6	38·4	48·6	63·8	50·9	64·8	37·8	35
	Amsterdam	52	22	2	30	E	0	51·6	36·8	51·6	65·8	51·6	67·0	35·4	36
	Brussels	50	50	2	2	E	0	51·8	36·6	53·2	66·2	51·0	67·4	35·6	37
	* Francker	52	36	4	2	E	0	51·8	36·6	51·0	67·2	54·4	69·0	32·9	38
	Philadelphia	39	56	77	36	W	0	53·4	32·2	51·4	74·0	56·6	77·0	32·7	39
	New York	40	40	76	18	W	0	53·8	29·8	51·2	79·2	54·6	80·6	25·4	40
	* Cinninnati	39	6	85	0	W	510	53·8	32·9	54·4	72·8	54·4	74·3	30·2	41
	St. Malo	48	39	4	21	W	0	54·4	42·2	52·2	66·0	55·8	67·0	41·8	42
	Nantes	47	13	3	52	W	0	55·0	40·4	54·5	68·6	55·6	70·6	38·0	43
	Pekin	39	54	114	7	E	0	55·2	26·8	56·3	82·6	54·2	84·4	39·4	44
	* Milan	45	28	6	51	E	390	55·8	36.4	56·1	73·0	56·8	74·6	36·2	45
	Bourdeaux	44	50	2	54	W	0	56·4	42·0	56·8	70·8	56·3	72·8	41·0	46
Isothermal band from 59° to 68°.	Marseilles	43	17	3	2	E	0	59·0	45·5	57·6	72·5	60·0	74·6	44·4	47
	Montpelier	43	36	1	32	E	0	59·4	44·0	57·0	75·8	61·0	78·2	42·0	48
	* Rome	41	53	10	7	E	0	60·4	45·8	57·8	75·2	62·8	77·0	42·2	49
	Toulon	43	7	3	30	E	0	62·0	48·4	60·8	74·8	64·4	77·0	46·4	50
	Nangasachi	32	45	127	35	E	0	60·8	39·4	57·6	83·0	64·2	86·9	37·4	51
	* Natchez	31	28	93	50	W	180	64·8	48·6	65·4	79·2	65·8	79·7	47·0	52
Isothermal band from 68° to 77°.	* Funchal	32	37	19	16	W	0	68·6	64·8	65·8	72·5	72·4	75·6	64·2	53
	Algiers	36	48	0	41	E	0	70·0	61·4	65·6	80·2	72·5	82·8	60·0	54
Isothermal bands above 77°.	* Cairo	30	2	28	58	E	0	72·4	58·4	73·6	85·1	70·5	85·8	55·8	55
	* Veracruz	19	11	98	21	W	0	77·8	72·0	77·9	81·5	78·6	81·5	71·0	56
	* Havannah	23	10	84	33	W	0	78·2	71·2	79·0	83·3	79·0	84·0	70·0	57
	* Cumana	10	27	67	35	W	0	81·8	80·2	83·6	82·0	79·6	84·4	79·2	58

[1] Coast of Labrador. Two years of observations. Floating ice towards the east. A transatlantic climate. Mean temperature of Oct. about 34·6°; Nov. 26·6°.

[2] Centre of Lapland. A European climate. Fine vegetation. June, 49·4°; July, 59·6°; Aug. 56°; Sept. 41·8°; Oct. 27.5°; Nov. 12·4°. Inland situation. Specimen of a continental climate.

[3] Eleven years of observations, calculated afresh in decads by Wahlenberg. Thermometer verified by Saussure. Mean temperature of seven months of the year below 32°. Winds blow from Italy in the winter. Minimum observed in the winter — 0·4°; in Aug. at noon, in the shade, maximum 54·5°; the nights in Aug. frequently from 33·8° to 29·3°; the mean temperature of Oct. 29·3° represents that of the whole year; at the Col de Geant, 10,598 feet high, the mean temperature of July is 36·5°. We find 32° to be the mean temperature in Europe, in 45° of latitude, at 5,400 feet high; at the parallel of the Canaries, at 12,300 feet; in the Andes, under the Equator, at 16,500 feet.

[4] Buch, Voy. en Norw. ii. 416. Specimen of the climate of the islands and coasts in the north of Europe. April, 30°; May, 33·8°; Oct. 32°; Nov. 25·8°. At Alten, lat. 70°; mean temperature of July, 63·5°; a continental climate.

[5] Finland, eastern coast. May, 40·8°; June, 55°; July, 61·6°; Aug. 56·6°; Sept. 46·6°; Oct. 38·6°; Nov. 24·6°. Julin and Buch.

[6] Eastern coast of Western Bothnia. Dr. Nœzen. March, 23·2°; April, 34°; Oct. 38·2°; Nov. 24·6°.

[7] Euler. Mean temperature of the year, 38·2°. Inochodzow. Act. Petr. xii. 519—533.

[8] Two years. Berlin, in the Mem. de l'Acad. de Drontheim, iv. 216. April, 34·4°; May, 50·8°; Oct. 39·2°; Nov. 27·8°. Climate of the west coast of Europe.

[9] Four years. Journal de Phys. xxxix. 40. A continental climate. Winter colder, and summer warmer than at Petersburg. Eastern part of Europe; height as taken from Stritter. Chamounie, lat. 46° 1′; long. 3° 48′ E.; height, 3,168 feet; mean temperature, 39·2°.

[10] Twelve years. Kirwan. Cotte, mean of the year, 41·2°; of the summer, 67·4°, too high. West coast of Finland.

[11] Observations from 1774 to 1804, made by Mallet, Prosperin, Holmquist, and Schleling, calculated by M. De Buch. Voy. de Norw. ii. 309. It is, perhaps, the place the mean temperature of which is the best determined. Winters more serene than at Stockholm; colder on account of the radiation of the ground and the air.

[12] Thirty-nine years of observations, 15 of which are very good. Wargentin. Cotte, mean temperature of the year, 44·2°. Five months below 32°, as at Petersburg.

[13] Four years. A transatlantic climate.

[14] Buch, two years. Mean temperature of the winter scarcely 29·5°. West coast.

[15] Alps of Bavaria. Six years' observations, calculated by M. Wahlenberg. Many fruit trees. Convent of Tegernsée, in Bavaria, height of 2,292 feet; mean temperature of 1785, 42·2°; Peyssenberg, 41°.

[16] Bugge. Three months below 32°. Under the equator, mean temperature of 44·6°, at an elevation of 18,000 feet.

[17] Dalton. West of England. Climate of islands; springs 47·2°. Keswick, lat. 54° 33′, long. 5° 23′ W.; mean temperature, 48°; springs, 48·6°.

[18] Kirwan. Scarcely two years' observations. Southern latitude.

[19] Strnadt. Fifteen years. Climate of the continent of Europe.

[20] Maier.

[21] Six years' observations of M. Escher, calculated by Wahlenberg. The town is situated in a hollow, to which the warm winds cannot penetrate, that render the winters more temperate in the other parts of Switzerland.

[22] The calculation has been made from six years of excellent observations, by Professor Playfair; during this time the thermometer was never seen above 75·8°. Vegetation continues from March 20 to Oct. 20; mean temperature of these seven months is from 55·8° to 50·9°, according as the years are more or less fruitful; wheat does not ripen if the mean temperature descends to 47·6°.

[23] Guittard. Only three years. Mean temperature a little too high. Eastern part of Europe. A continental climate.

[24] Four years of observations, by M. de Salis Sewis, calculated by M. Wahlenberg. Mountains of the Grisons.

[25] Kirwan. Irish Trans. viii. 203, and 269. Specimen of the climate of the islands. Coldest days, 23°; interior of the ground, 49·2°. Hamilton.

[26] The climate of Berne is a continental climate, in comparison with that of Geneva; there is no lake near it.

[27] Seven years of observations. Saussure. Mean temperature, 50·8°. Voy. § 1418. I find the mean temperature from 1796—1815, 50°. Interior of the earth, 52°. Pictet, Bibliotheque Brit. 1817. iv. 109.

[28] Six years.

[29] Austria. Berlin, lat. 52° 31′; mean temperature, probably 46·4° to 47·3°; according to Beguelin, 48·8°; springs, 49·2°. Ratisbon, lat. 49°; height, 1,104 feet; mean temperature, 51·2°. Munich, lat. 48° 8′; height, 1,608 feet; mean temperature, 50·8°.

[30] Ramond. Seven years of excellent observations. The mean of the months, at noon, well ascertained; winter, 40°;

spring, 57°; summer, 70·8°; autumn, 58°. Mem. Inst. 1812. p. 49. Cotte, mean temperature, 51·2°.

[31] Wahlenberg. Flor. Carp. p. 90. Continental climate. Height of the observatory, 474 feet.

[32] Two years, near Boston, in New England. Transatlantic climate. The thermometer sometimes descends to 0°.

[33] Eleven years (1803—1813) of observations made at the observatory. A greater number of years will, perhaps, give the mean temperature a little higher. Vaults, 53°. Kirwan finds for Paris, from seven years of observations of unequal value, 51·6°; he fixes upon 52·7°. Cotte, from 29 years of observations (Journ. de Phys. 1782, July), 53·2°. Cotte, for 33 years, (1763—1781, Mem. Instit. iv. 266), 52·4°. The extraordinary year of 1816 offers the mean temperature of 48·8°; winter, 37·2°; spring, 49°; summer, 59·6°; autumn, 50°: the preceding year, 1815, offers a mean temperature of 50·8°; winter, 37·2°; spring, 52·7°; summer, 62·8°; autumn, 50·8°. Arago. Mean temperature of Montmorency, for 33 years, 50·8°; height, 498 feet. Cotte. Strasburg, lat. 48° 34′; height, 480 feet; mean temperature, 49·2°. Herrenschneider.

[34] Dr. Young. Mean temperature varies from 47·8° to 51·4°, (Lectures, ii. 453). Cavendish (Trans. 1788, p. 61), 48·8°, Roebuck, Hunter, and Kirwan, 51·6°. Horsley, 51·8°. According to Kirwan, the four seasons in London are, 39·6°, 50·9°, 64·8°, 52°; at Paris, 36·2°, 51°, 66°, 52·6°; from which results, London, 51·2°; Paris, 52·4°. Cotte (Journ. de Phys. xxxix. 36) thinks London is 51·2°, and Paris, 52·4°. The difference which we observe in cultivated plants depends less upon mean temperature than upon direct light, and the serenity of the atmosphere.

[35] Seven years. Cotte. Lisle, 48·4°; Rouen, 51·4°; Cambray, 52°; Soissons, 53·4°; Rethel, 53·2°; Metz, 53°; Nancy, 52°; Etampes, 51°; L'Aigle, 49·8°; Brest, 54·2°; Mayenne, 52°.

[36] Mohr, and Van Swinden. Five years.

[37] Thirteen years. Temperature rather too high?

[38] Eleven years. Van Swinden. From 1771—1783. Mean temperature, 51·2°.

[39] Concave transatlantic summit. Seven years of observations give 54·8°; for the four seasons, 34°, 52°, 75·2°, 56·2°. Rush, 52·6 (Drake's View of Cincin. p. 116). Coxe, 54·2°. M. Legaux finds for 17 years, for Springmill on the Schuylkill, lat. 40° 50′; mean temperature, 53·4. Springs, near Philadelphia, 54·8°. Warden.

[40] Two years only. Retif de la Serve. The thermometer sometimes descends to − 4° in the parallel of Naples! Springs, 54·8°. Ipswich, lat. 42° 38′; mean temperature, 50°. Williamsburg, in Virginia, 58·1°. Cotte and Kirwan. Transatlantic climates.

[41] Transatlantic climates west of the Alleghanys. Good observations, from 1806—1813. Col. Mansfield (Drake p. 93). Minimum of the winter, from 5° to 9·4°; Jan. 1797, as low as —16·6°, for 39° latitude. Maximum, 89·6° to 107·6° in the shade, without reflection; $\frac{1}{3}$ of all the winds S.W.; springs near Cincinnati, 54·4°. Little snow falls; but it is abundant between lat. 40° and 42°.

[42] Three years only. Bougourd. Dijon, height, 810 feet; lat. 47° 19′; mean temperature, 50·9°. Besançon, height, 804 feet; lat. 47° 14′; mean temperature, 51° 2′.

[43] Six years. Duplessis, and Boudan. Temperature of the summer too high? Rochelle, 53°. Poitiers, 52·6°.

[44] Amyot. Six years. Concave Asiatic summit. Three months below 32°, as at Copenhagen; the summer like that at Naples.

[45] One of the best determined points. The years 1789—1812 are calculated in decads of days. Observations of the Astronomer Reggio, April, 55·8°; Oct. 58·1°. The two decads which approach the nearest to the mean temperature of the year, are, the first of April, 53·4°; and the last of Oct. 54·6°. The mean temperatures for January have varied in the last 10 years from 25° to 38·4°; those of July, from 71·4° to 78·4°; the mean of the years, from 54·5° to 57·2°. Reggio, taking only 24 maxima and minima in a year for 1763—1798; mean temperature, 55·4° (Ephem. Mil. 1779, p. 82).

[46] Ten years. Guyot. Lyon, 528 feet, 55·8°. Mafra, near Lisbon, lat. 38° 52′; height, 600 feet; mean temperature, 54·3°, too small. Mem. de Lisbonne, ii. 105—158.

[47] Seven years (1777—1782). St. Jaques de Sylvabella. The thermometer descends sometimes to 23°. Cotte (Traité de Met. ii. 420). 34 years (Raymond in Mem. de la Soc. de Med. 1777, p. 86) give 62°. Cotte (Journ. de Phys. xxxix. 21) fixes it at 58·6°. Kirwan, at 61·4°. The observations made at the Royal Observatory of Marseilles can alone decide.

[48] Ten years. Nismes, 60·2°; Perpignan, 59·6; Tarascon, 60°; Arles, 59°; Rieux, 57·2°; Montauban, 55·6°; Tonains, 54·8°; Dax, 54·2°; Rodez, 57°; Aix, 56·6°. Under the equator, 57·8°, at 9,000 feet of elevation.

[49] William Humboldt. Calandrelli, 60°. The thermometer sometimes descends to 36·5°, and rises to 99·5°. Naples, 67·1°; Toaldo, probably 63·5°; Florence, 61·6°; Tartini, too high; Lucca, 60·4°; Genoa, 60·2°; Bologna, 56·3°; Verona, 55·8°; Venice, 56·5°; Padua, 55·6°. Kirwan regards it as an established fact, that in Europe, the mean temperature, in latitude 40°, is 61·8°; in latitude 50°, 52·6°.

[50] Only two years. Barberet, and d'Angos. Sheltered by mountains. Estimate a little too high.

[51] Japan. A single year. Voy. de Thunberg, p. 121. Climate of islands. Under the equator, 64·4°, at a height of 6,000 feet.

[52] West of the Alleghanys, in Louisiana. Four years. Dunbar. Transatlantic climate.

[53] Madeira. Heberden. Climate of islands. St. Croix, of Teneriffe, 71·4°. The remainder of the island of Teneriffe, in the plains, 61·2°. Buch.

[54] Old observations of Tartebout. They appear good. Bagdat, lat. 33° 19′; according to Beauchamps, 73·8°. The four seasons, 50·8°, 74·6°, 92·6°, 77°; but there was reflection from a house. The thermometer falls to 29·8°. Under the equator, at 3,000 feet high; mean temperature, 71·2°.

[55] The calculations are made from the observations of Nouet. (Decade, ii. 213). The following are the mean temperatures of the 12 months: 58·1°, 56·2°, 64·6°, 77·9°, 78·4°, 83·6°, 85·1°, 85·8°, 79·2°, 72·2°, 63°, 68·6°. (Neibuhr, 72·2.) Temperature of Joseph's Well, 72·5°. Catacombs of Thebes, 81·4°. Well of the great pyramid surrounded by sand, 88·2°. Jomard. Bassora, on the Persian Gulf; mean temperature, 77·9°; winter, 64°; summer, 90·8°; July, 93·2°.

[56] Orta. Humboldt. Nouv. Esp. iv. 516. Jamaica, coast 80·6°. Blagden.

[57] Ferrer, 1810—1812. Con. des Tems. 1817, p. 338. Wells of 10 feet deep; air, 76°; water, 74·4°; in 1812, maximum, Aug. 14, 86°; minimum, Feb. 20, 61·6°. Grottos, 81·5°. Humboldt, Observ. Astron. i. 134.

[58] Humboldt. Pondicherry, 85·1°; Madras, 80·4°; Manilla, 78·2°; Isle de France, coast, 80·4°.

Article VI.

Account of some remarkable Minerals recently brought to this Country from the Island of Jean Mayen, *in the* Greenland Seas, North *Latitude* 71°. *Also a Description and Analysis of a Substance called* Petalite, *from* Sweden. By Edward Daniel Clarke, LL.D. Professor of Mineralogy in the University of Cambridge, &c. In a Letter to the Editors.

GENTLEMEN,

Twenty years ago, being engaged in a voyage among the *western* islands of *Scotland*, I had an opportunity of examining the very singular appearances exhibited by the *prismatic* rocks of *Canna*. The shores of that island are covered with a *jet-black* shining *sand*, which, owing to the partial notions I had then formed, and to prejudices imbibed by a residence among the *volcanoes* of the south of *Italy*, I supposed to be *volcanic*. Probably that *arenaceous* appearance had been derived from *basalt*, or *trap*. I have often, however, since regretted, that I did not bring away some of the *sand* for further examination. It was therefore highly satisfactory to me to receive a short time ago, from the Rev. Dr. Satterthwaite, of *Lowther* Rectory, near *Penrith*, a parcel of *sand*, taken from the shore of the remote island of *Jean Mayen*, in the *Greenland Seas*, which immediately reminded me of the *sand* of *Canna*. It was supposed to be *ferruginous*; owing to the partial action of the *magnet* upon some of its particles. *Dr. Satterthwaite*, in his account of it, relates that "a few weeks before he sent it, he had been on board a vessel, just returned from the *Greenland Seas*, and had conversed with a very intelligent ship-captain; who, during his last voyage, had landed on the island of *Jean Mayen*, in 71°. N. L; an island seldom visited by the *English* fishermen; where he found the shores, to an immense extent, and of unknown depth, covered with this kind of *sand*." It has a *jet*-black colour, and a glittering appearance; owing to innumerable particles of minute *crystals*, of the highest transparency, with a splendent adamantine lustre. As these *crystals* differ in lustre from *olivine*, and agree with *olivine* only in their colour and *infusibility* before the *common blow-pipe*, I suspected that they might possibly belong to one of those varieties of *zircon*, which have sometimes been confounded with *olivine*, when mixed with *basalt* in the arenaceous form. This suspicion was further increased by examining them with a lens and perceiving that in some instances a right prism with a square base might be discerned; or with a base so slightly rhomboidal, as not to be thus distinguished from a square. Having therefore selected a *crystal* of this form, but so exceedingly minute as scarcely to be discernible to the naked eye, I fixed it upon the moveable plane of *Dr. Wollaston's* reflecting *goniometer*. A double image was reflected by one of the planes of the crystal, but the image reflected by the contiguous plane was clear and perfectly perceptible, by which I was enabled to measure the angle of inclination; and after repeating the observation several times I found it to equal 92° or $92\frac{1}{2}$°. Hence it is evident that these *crystals* are not *zircons*, although they possess a degree of lustre quite equal to that of *zircon*. In this uncertainty I sent a small portion of the sand to *Dr. Wollaston*, and requested that he would himself measure the *angle* of the particles exhibiting splendent surfaces. Dr. W. pronounced the substance to be *pyroxene;* having an angle, according to his observation, of $92\frac{1}{4}$°. He also informed me that the sand was similar to that of *Bolsenna* in *Italy*.

Dr. Satterthwaite now sent me *three* specimens of different substances which had all received the appellation of *lava*, from the same island of *Jean Mayen;* and in every one of these I had the satisfaction of seeing the same crystals in their matrices; exhibiting the same splendent lustre, but under more visible circumstances of *form* and *cleavage*. In the *first* specimen they are deposited in a dark porous *toadstone* rock, very like what is commonly called *lava* at *Naples*, and which, like the black arenaceous particles found with the crystals of *pyroxene*, is easily *fusible* before the *common blow-pipe*, into a *jet*-black shining glass, externally resembling black sealing-wax. The *second* specimen has the appearance of a substance acted upon by fire; it has a reddish brown appearance, looking like a cinder; being full of innumerable pores, and having the *spongy* aspect of the *scoria* ejected from *Vesuvius*. Besides containing these splendent crystals, it has also a few imbedded crystals of more opaque *pyroxene;* it fuses, like the preceding specimen, into a *jet*-black glass. The *third* specimen is a light grey, friable, earthy, aggregate, in which the crystals of *pyroxene* lie imbedded with dark roundish granular pieces of *basalt* or *trap* in a crumbling mass, that easily separates between the fingers. This last fuses, like the two former varieties, into a *jet*-black glass.

I have now done with the description of the minerals from *Jean Mayen* island; and shall proceed with an account of an interesting mineral from *Sweden* of a very different nature. This substance was sent to *Dr. Ingle* of this University, from *Mr. Swedenstierna* of Stockholm, under the name of *petalite*. Finding it to be altogether new to me, and that its nature was not likely to be made known by the name which had been given to it (no account of its analysis having appeared); I undertook to examine it chemically; requesting *Mr. Holme* to do the same; that by comparing the result of our observations we might be able to state the constituents with all the accuracy in our power. It will be proper, in the first place, to describe the *mineral*, and to point out those characters which induced me to consider it as a new substance.

Externally it resembles common *white quartz*, and to such a degree, that a very eminent mineralogist to whom *Dr. Ingle* exhibited this mineral, considered the specimen shown to him as a piece of *quartz*. Upon a nearer examination, however, it will be found to differ in fracture from *quartz*. It admits of a two-fold cleavage parallel to the sides of a *rhomboidal* prism; two of which parallel to each other are splendent, and the other two are dull. Hence there is an evident appearance of *crystallization;* but I was unable, owing to the want of two contiguous reflecting surfaces, to ascertain the angle of their inclination in a satisfactory manner. Its *specific gravity*, nearly that of *quartz*, equals 2·45. Its colour is *white*, but an almost imperceptible *pinkish* hue may be discerned when it is attentively examined. It is hard enough to scratch glass; although it may be rased by a knife. Exposed to the *common blow-pipe* it is almost *infusible;* but after an intense heat has been for some time continued, it exhibits a glazed superficies, which examined by a lens appears full of minute bubbles. When triturated and reduced to an impalpable powder in a porcelain mortar, it has the white ness of snow. Its most remarkable property remains now to be stated; namely, its partial solution and action in *acids*. Placed in highly concentrated *nitric acid* of spec. gr. 1·45, its loses its white colour and changes to a dingy hue; the *acid*, at the same time, becoming clouded. The same *acid* being boiled upon it, and distilled water, previously boiled, added, there was no appearance of effervescence, but a solution took place. From this solution *prussiated alkali* threw down a *leaf-green* precipitate; the supernatant fluid assuming afterwards a beautiful *amethyst* colour, which by longer exposure to the air changed to *brownish red;* afterwards becoming *reddish brown* and then *brownish black.* These changes of colour leading us to suspect the presence of *manganese*, we undertook the analysis in the following manner:

A. Ten grains of the powder were exposed to a red heat, in a *platinum* crucible, during a quarter of an hour; to expel the water of absorption. The same powder being afterwards weighed, had lost $\frac{1}{10}$ of a grain.

B. Boiled during 20 minutes in *nitric acid* diluted with an equal bulk of distilled water, the insoluble part, washed, and dried in a white heat, weighed $9\frac{1}{4}$ grains.

C. The supernatant fluid collected from B, added to the washings of the insoluble residue, being with moderate heat evaporated to dryness, there remained a pale *lemon-coloured* salt; which, after exposure to a smart red heat for 25 minutes in *platinum foil*, left a *black* powder weighing $\frac{1}{4}$ of a grain; this powder before the blow-pipe gave a fine purple colour to *borax*, and proved to be the *black oxide* of *manganese*.

D. The insoluble substance left by the *nitric acid* in B being mixed with five times its weight of the *bicarbonate of potash*, was placed in a *platinum* crucible, and kept exposed, during three quarters of an hour, nearly to a white heat the whole time. Distilled water was then dropped upon the fused alkaline mass (which appeared slightly tinged with a *rosy* hue), merely in sufficient quantity to soften it; *muriatic acid* being afterwards added, the whole assumed a gelatinous appearance. Upon the addition of more *muriatic acid* a white powder subsided; which, being carefully washed and dried in a white heat, weighed *eight* grains; it proved to be pure *silica*.

E. To the supernatant solution and washings collected from D, a sufficient quantity of *alkali* was added, barely sufficient to neutralize the *acid*. Pure liquid *ammonia* was then poured in, and a white flocculent precipitate slowly subsided, leaving the fluid above it, beautifully transparent. This precipitate, carefully washed and dried as before weighed $1\frac{1}{2}$ grain, and proved to be pure *alumina*.

The constituents therefore of this mineral, according to the preceding analysis, may be stated in the following manner:

Silica	80
Alumina	15
Manganese	2·50
Water	0·75
Loss	1·75
	100·00

This was the result of my own analysis. The analysi[s] of the same substance by *Mr. Holme*, does not materiall[y] from the preceding; and when it is considered how very se[ldom a] *second* analysis, made by the same person, of substances w[here] *silica* and *alumina* are chemically combined, exactly corre[sponds] with the *first*, it would perhaps better answer the purp[oses of] chemical science if the discrepancy were confessed rathe[r than] concealed. At all events this shall be the case in the pres[ent in]stance.

According to *Mr. Holme's* analysis of this mineral the constituents are combined in the following proportions:

Silica	$76\frac{8}{16}$
Alumina	$20\frac{8}{16}$
Manganese	$2\frac{8}{16}$
Water	$0\frac{10}{16}$
	$100\frac{2}{16}$

It has been stated that this mineral came from *Sweden* u[nder] the name of *petalite;* possibly it may not be the substan[ce to] which *Dandrada* gave this name. Should this prove t[o be] true, as it will be necessary to bestow some name upon it[, we] are desirous of calling it *Berzelite,* in honour of the illust[rious] chemist who presides over the analytical researches of [the] country in which it was discovered.

I have the honour to be, Gentlemen, &c.

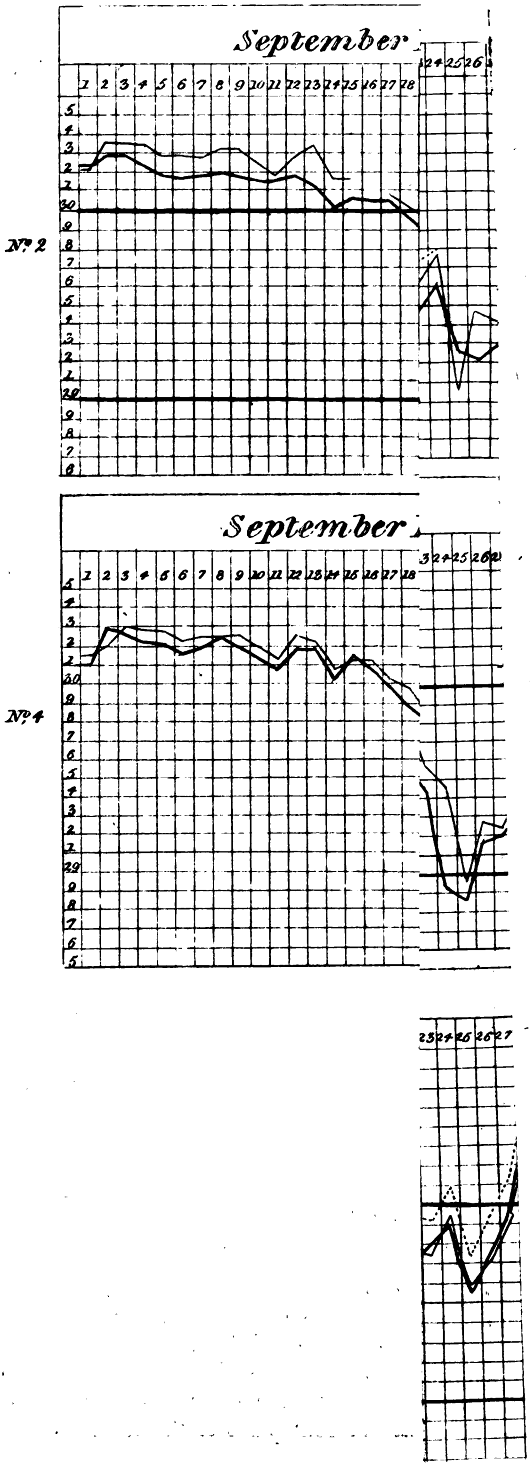
Cambridge, Jan. 21, 1818. EDWARD DANIEL CLARK[E]

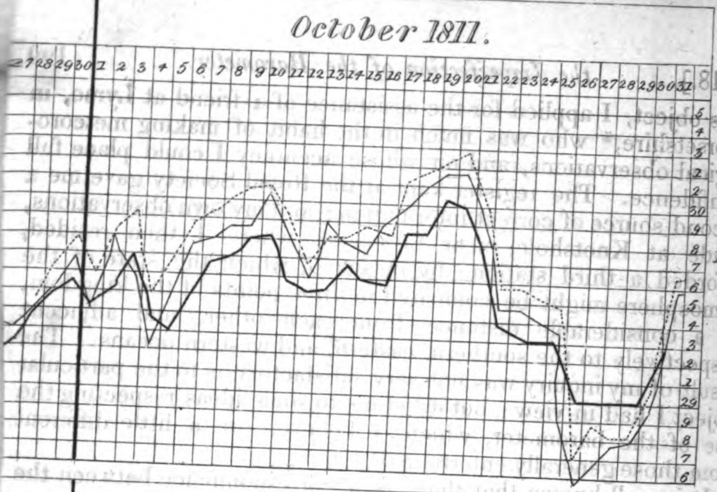
ARTICLE VII.

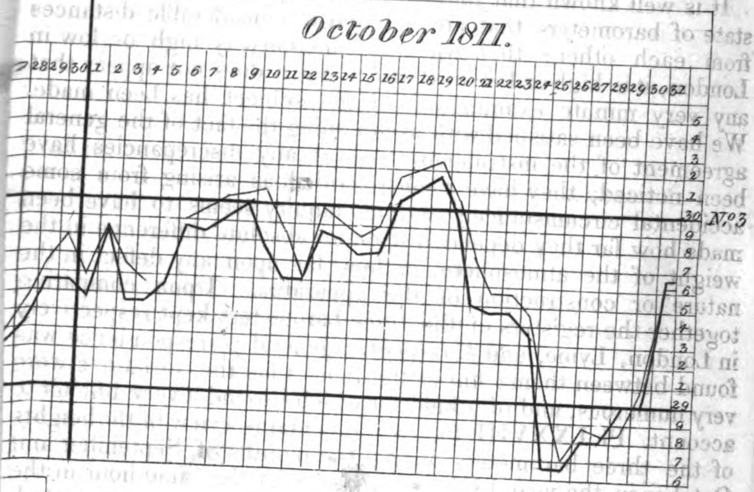
Some Observations on the Imperfection of the Barometer. [By] John Bostock, M.D., &c.

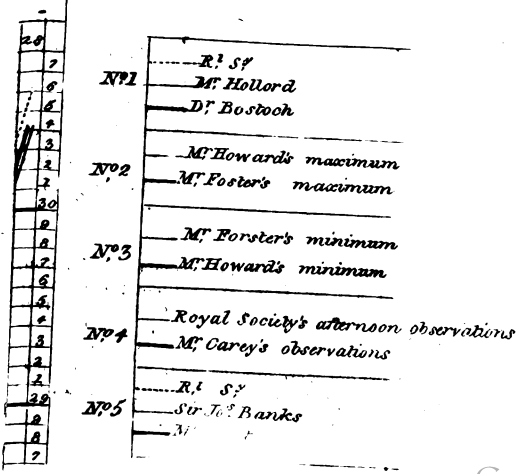
BEING engaged, some years ago, in an inquiry respec[ting] the manner in which the weight of the atmosphere is affec[ted] by the blowing of different winds, and especially by the t[wo] cardinal winds of this climate, the N.E. and S.W., I wished [to] establish an accurate comparison between the height of ba[ro]meters in different parts of the island. In order to accompli[sh]

Plate LXXVIII




October 1811.
27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
No 1


October 1811.
27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
No 3


No 1
Rl. Sy.
Mr. Hollord
Dr. Bostock
No 2
Mr. Howard's maximum
Mr. Foster's maximum
No 3
Mr. Forster's minimum
Mr. Howard's minimum
No 4
Royal Society's afternoon observations
Mr. Carey's observations
No 5
Rl. Sy.
Sir Jos. Banks

this object, I applied for the assistance of a friend at Lyme, in Dorsetshire,* who was much in the habit of making meteorological observations, and on whose accuracy I could place full confidence. The register kept at the Royal Society gave me a second source of correct information; and my own observations, made at Knotshole, near Liverpool, where I then resided, afforded a third station; by means of which the state of the atmosphere might be compared in three points of the kingdom, at a considerable distance from each other, and adjacent respectively to the southern, eastern, and western oceans. The result of my inquiry was not very satisfactory as to the particular object I had in view; but it led me to some ideas respecting the use of the barometer, which, I believe, are a little different from those generally entertained.

It is well known that there is a correspondence between the state of barometers that are situated at considerable distances from each other; that when the mercury is high or low in London, it is high or low in Paris;† but it does not appear that any very minute examination of the subject has been made. We have been satisfied with ascertaining the fact of the general agreement of the instruments; and if any discrepancies have been noticed, they have been regarded as arising from some accidental circumstance; and no inquiry seems to have been made how far they depended upon an absolute difference in the weight of the atmosphere, or how far upon any defect in the nature or construction of the apparatus. Upon comparing together the registers of the three barometers kept respectively in London, Lyme, and Liverpool, a general correspondence was found between them; but at the same time the variations were very numerous, and of a kind for which I found it very difficult to account. Pl. LXXVIII. Fig. No. 1, contains a view of the heights of the three barometers during the months of September and October in the year 1811, taken nearly at the same hour in the morning of each day.‡ These two months were selected, because I was able to procure a greater number of accurate observations for them than for any other period, and, in some degree also, in consequence of the state of the weather, which, during the first part of September, was unusually fine and settled, with steady east winds; while the month of October was equally remarkable for its variable character, with the wind chiefly blowing in the opposite direction. In examining the

* Geo. Holland, Esq.

† An interesting account of the comparative state of the barometer in London, Paris, and Geneva, during the space of a year, from the autumnal equinox in 1806 to the autumnal equinox in 1807, was published by M. Pictet in the Bib. Brit. for Jan. 1811, of which Dr. Thomson has given a translation in vol. ii. of the *Annals*.

‡ The observations at Lyme and Liverpool were always made at nine o'clock; the time of the observations at the apartments of the Royal Society varies a little, but is generally at or between the hours of eight and nine.

three lines traced upon the plan, it will be observed that the Liverpool barometer is generally the lowest, while that in London is the highest; but these heights are not proportional to the actual situation of the instruments; the London and Liverpool barometers being nearly on a level, each about 80 feet above low water in the Thames and Mersey respectively, while that at Lyme was about 100 feet higher. But what is more remarkable, the proportional heights were perpetually varying, so that neither the time nor the degree of the rise and fall correspond. It happens, on more than one occasion, that, upon any considerable rise or fall of the mercury, the maximum or minimum occurred on different days; and in some instances we observe that the mercury was even rising in one of the barometers while it has been falling in another. Upon the whole, the London and Liverpool barometers observed a more uniform course with respect to each other than the one at Lyme, although they differed most in their absolute height.

It is easy to conceive that various local causes may affect the atmosphere, so as to render it heavier in one situation than in another, although not very distant from the former: certain winds blowing over a large extent of the ocean, or even over particular soils, the vicinity of mountains, the position of rivers or deep valleys, perhaps even of large cities, may possibly affect the weight of the air. But before we proceed to any investigations of this nature, it will be necessary to inquire how far the instrument itself, by which these changes are ascertained, is to be implicitly relied on. The principle upon which the barometer acts is so simple, that when the apparatus is in a perfect state, it would be liable to no uncertainty or irregularity; but although the principle of the instrument be correct, its construction is very frequently defective; and indeed its very nature is such as to render it peculiarly liable to become deranged from various causes, even when it had been accurately constructed in the first instance.

Before, therefore, I proceeded any further in the investigation, or attempted to form any theory to account for the diversity of the barometers at the three stations of London, Liverpool, and Lyme, I thought it necessary to institute a comparison between two or more barometers that were placed nearer together, and where the differences, if they existed, must be ascribed to some inaccuracy in the instrument, rather than to any actual variation in the weight of the atmosphere. For this purpose I had recourse to the meteorological diaries that were kept at that time by Mr. Howard and Mr. Forster, the one at Plaistow, and the other at Clapton, at a distance of not more than four or five miles from each other. These gentlemen are well known for the attention which they have paid to all points connected with the weather; and, with respect as well to science as to accuracy, may be regarded as affording us the means of establishing the most satisfactory comparison. Mr. Howard and Mr. Forster fortunately both registered their observations upon the barometer on the same plan; not noticing it at particular hours, but giving the maximum and minimum of each diurnal period. I have arranged their observations in the tabular form. No. 2, contains a view of the maxima of Mr. Howard's and Mr. Forster's barometers, for each day during the months of September and October, 1811, and No. 3, the minima for the same period. The inspection of the tables shows us that the barometers at Plaistow and at Clapton were nearly as different from each other as those at Lyme and at Liverpool; and of course would lead us to conclude, that a considerable part at least of the difference that was observed between them in the former case depended upon the instruments, and not upon the state of the atmosphere.

If we descend to particulars, we shall observe, in the first place, that the absolute height of the Clapton barometer is greater than that of the Plaistow barometer, although Plaistow is on a lower level than Clapton. In the second place, the proportional heights are not the same; the difference between them is perpetually varying, and sometimes the Clapton barometer is even lower than that at Plaistow. In the third place, when any considerable elevation or depression has occurred, the amount of it has been very different in the two instruments; and the greatest elevation or depression has sometimes been a day later at one place than at the other. On Sept. 20, for example, the barometers were both low, the one at Plaistow ·18 lower than that at Clapton: they both rose on that day, but in very different degrees; the Plaistow barometer rose ·27, while the Clapton barometer rose only ·02; so that the barometer at Plaistow became ·07 higher than the one at Clapton. But from the 21st to the 22d, the Plaistow barometer was stationary; while, during the same period, the Clapton barometer rose ·21, so that it became ·14 higher than the other. From Sept. 30, to Oct. 1, one barometer was rising while the other was falling; and the same circumstance occurred from the 2d to the 3d, and from the 7th to the 8th, of the same month; also from the 14th to the 15th; and most remarkably from the 29th to the 30th, when the Plaistow barometer rose ·50, while the one at Clapton fell ·04. But it will be unnecessary to enter into more particulars on this point, as we have, I conceive, the most unequivocal evidence that, even in the hands of those the best qualified to employ the barometer, it is not to be depended upon as an accurate method of ascertaining the weight of the atmosphere.

As the barometer is an instrument which is very liable to be deranged by being moved from place to place, I thought it desirable to institute a comparison between the action of two instruments that had not been subject to any injury from this cause, and which were, at the same time, so near each other, as that it was scarcely possible to conceive there could be any difference in the weight of the atmosphere. We have two registers kept by the makers of instruments, Mr. Cary and Mr. Banks, both residing in the Strand; but unfortunately these can not be compared together with perfect accuracy, because the observations are taken at different periods of the day—Mr. Cary's at one o'clock, and Mr. Banks's at nine. But this difficulty may, in part, be removed by comparing each of these diaries with that kept by the Royal Society in Somerset-house, where it must be supposed that the instrument would be of the most perfect kind, and where any derangement that might have occurred by its removal must have been detected and rectified. The observations at Somerset-house are made twice in the day; the time is not always the same, but it is specified at each observation; the morning observation is generally between eight and nine, and the afternoon observation between three and four. I therefore took the afternoon observation, and compared it with Mr. Cary's, arranging them, as before, in the form of a table. (See No. 4.)

The difference between the lines described by these two barometers is less than any which we have yet examined; but still the same kind of variations will be found to exist. And here we may observe, as in the former examples, that the actual height of the mercury is not in proportion to its elevation above the level of the ocean; for although the two barometers are placed at nearly the same elevation, Mr. Cary's generally indicated a less degree of atmospherical pressure; but, as in the other cases, this difference was not uniform, and occasionally Mr. Carey's barometer became the higher of the two. We also perceive that in any great variations of the mercury the amount of the change was not the same in both instruments; and what is still more singular, they did not always attain their maximum elevation or depression on the same day. We must indeed bear in mind that the observations were not perfectly contemporary; but I believe every one will admit that this circumstance will not account for all the difference between them.

So far as the *time* of the observation is concerned, we are able to obtain more accurate results by comparing the diary of Mr. Banks with that of the Royal Society; and in order to render the comparison quite unexceptionable, I have only selected those days on which the observations at Somerset-house were made precisely at nine, the hour at which Mr. Banks always examined his barometer. As I was on this account obliged to omit several days, when the observations were not taken precisely at the same hour, the comparative heights of the instruments are not marked, as before, by a continued line; but the two registers are placed in parallel columns, to which a third is added stating the amount of the difference between them.

JANUARY, 1811. 9 A.M.

Days.	R. S.	Mr. Banks.	Diff. of R. S.
1	30·26	30·26	·00
2	30·03	30·04	—·01
5	29·84	29·87	—·03
7	29·86	29·88	—·02
8	29·81	29·84	—·03
9	29·81	29·81	·00
10	29·92	29·93	—·01
12	29·61	29·66	—·05
14	29·58	29·63	—·05
15	29·58	29·62	—·04
16	29·85	29·86	—·01
17	29·74	29·77	—·03
18	29·73	29·77	—·04
19	30·31	30·32	—·01
20	30·38	30·40	—·02
21	30·04	30·05	—·01
22	30·29	30·21	+·08
23	30·23	30·23	·00
24	30·42	30·42	·00
25	30·51	30·50	+·01
26	30·23	30·26	—·03
28	29·61	29·61	·00
29	29·62	29·60	+·02
30	29·75	29·73	+·02
31	29·14	29·16	—·02

Here the same general conclusion may be drawn as in the former instances; the absolute heights of the barometers are generally different, and the proportion between them is not uniform. Mr. Banks's barometer is generally the higher of the two; but they occasionally coincide, and sometimes it stands lower than that at Somerset-house. The following is the result of 25 observations:

1	+·08	Diff. of the barometer of the R. S.
2	+·02	
1	+·01	
5	·00	
5	—·01	
3	—·02	
4	—·03	
2	—·04	
2	—·05	
25		

A very accurate meteorological diary is kept in the library of Sir Joseph Banks, which I obtained permission to examine, and from which I transcribed the account of the barometer for the months of January and February, 1807. These I have compared with the observations taken at the Royal Society's apartments during the same period, and likewise with a register of the barometer published by Mr. Bent, of Paternoster-row. The result of this comparison, which is inserted in No. 5, is similar to the former; although the instruments must have been nearly on a level, the absolute heights of the mercury are considerably different, and the proportion between the heights of the different instruments is not uniform.

From the above statements I think we cannot hesitate to admit that the barometer, *as it is commonly constructed*, is not an instrument which can be depended upon for making perfectly accurate observations on the weight of the atmosphere, even when it is in the hands of those the best qualified to judge of its condition, and where it has remained stationary, and has not been exposed to any circumstances likely to injure or derange it. And it is the more objectionable, because the imperfection of the instrument is not visible to the eye, and can in fact only be discovered by comparing it with another instrument which is supposed to be more perfect.

I shall not now attempt to point out all the sources of inaccuracy which may attach to the barometer as it is usually constructed; but the following may be enumerated as among those which are probably of the most frequent occurrence: 1. The barometers being exposed to various degrees of temperature, and no notice being taken of this circumstance, or no correction being made for it. 2. The index not being accurately adapted to the height of the column of mercury: this appears to have been the case in almost every one of the barometers of which the register has been given above; for in no instance does the average height of any of them correspond with the absolute elevation at which it is placed, and in some cases they are in direct opposition to it.* 3. The reservoir in which the tube terminates not being regularly cylindrical, or of the same diameter in its different parts; so that there is not the same ratio preserved between the reservoir and the tube in the different states of the instrument. These two latter imperfections are noticed by the Rev. Mr. Wollaston in his account of the thermometrical barometer, as occurring in the instruments upon which he made his comparative experiments, and being detected in them by means of his newly-invented apparatus.†

* Although the altitude of some of the barometers is given with apparent accuracy, yet it is not always easy to ascertain their exact height. The barometer at Somerset-house is stated to be placed at "81 feet above the level of the low water spring tides." Mr. Banks informs us that his barometer is "104 feet above the level of the sea," and Mr. Bent's is said to be hung "51 feet higher than the bed of the River Thames." I conceive that all these expressions are rather vague, and that it will not be easy to determine the relation which they bear to each other.

† Phil. Trans. 1817.

4. The reservoir being made so small (for the purpose of rendering the instrument as portable as possible), that, in any considerable diminution of the weight of the atmosphere, there is not sufficient space to hold the mercury that ought to leave the tube, so that it is retained in it above its proper elevation. This seems to have been the case with the barometer which I employed near Liverpool, which had not the power of descending much lower than 29 inches, although, in other respects, it was a well-constructed and delicate instrument.

I do not think it necessary to notice some of the more obvious causes of inaccuracy in the barometer, such as the impurity of the mercury, or the presence of air and moisture in the tube, as these are not likely to exist in instruments that are made with a proper degree of care, or, if they did, might be easily detected. There may be other causes, besides those which I have mentioned, which may affect the action of the instrument, without any change being produced in its appearance, which may indicate the imperfection to the observer. In order to avoid the errors that may arise from the different circumstances that have been pointed out, there is a simple expedient which we may adopt, and which will probably be effectual, at least sufficiently so for making meteorological observations. The plan that I would prefer is, that the observer be furnished with two barometers, which may be fixed in the same frame, to which a thermometer should be also attached. Whenever the observer examines the barometer, he must notice the thermometer at the same time; and, by a table ready prepared for the purpose, he must make the necessary corrections for the variations of temperature. If the barometers do not exactly coincide, he must endeavour to ascertain which of them is imperfect, either by referring to some other standard, or by comparing together a number of observations made under different circumstances, by which the particular cause of the imperfection will be probably detected. Until some plan of this kind has been adopted, it would be premature to enter into any speculations concerning the causes which may affect the barometer, or to form any hypotheses respecting the variation in the weight of the atmosphere.

After I had completed the above remarks, I received the number of the Bibliotheque Universelle for October; in which is contained a letter from Dr. M'Culloch to the editors of that journal, with their remarks upon the same, on the subject of the variations of barometers. Dr. M'Culloch had noticed the same differences between them that are stated in the above paper, and had given an account of his observations to the Geological Society, of which an abstract was published in the *Annals of Philosophy*, and afterwards in the Bibliotheque Universelle for September, 1816. In his present communication, Dr. M'Culloch enters into a short detail of his opinions, as well as of the facts upon which they are founded. By comparing the r of barometers in or near London, as well as some that were kept at Edinburgh and at Perth, he perceived that they frequently differed from each other to the amount of several hundredths of an inch; and as Dr. M'Culloch's object in the investigation was to determine how far the barometer could be correctly employed for the measurement of heights, he concludes that it is very imperfectly adapted for this purpose. As to the cause of these differences, Dr. M'Culloch draws an inference, directly the reverse of that which I had formed, that they depend not upon the imperfection of the instrument, but upon actual differences in the weight of the atmosphere in situations very contiguous to each other. Dr. M'Culloch conceives that he has established the four following positions:

1. That the differences between barometers placed at two stations, more or less distant one from the other, are more remarkable at those times when the mercurial column experiences rapid or considerable fluctuations.

2. That the want of contemporary elevation or depression in the two distant stations is the immediate cause of the observed differences.

3. That these differences will in general be as much greater as the instruments on which the observations are made are more remote from each other, supposing the observations to be contemporary.

4. That in all cases the observations which are not contemporary deserve little confidence, although one of the barometers should have remained for a considerable time stationary, since the other may have experienced fluctuations during the same period.

I think it will be difficult to reconcile these positions with the observations that are stated in my paper, or that the difference of atmospherical pressure at Plaistow and at Clapton, or, still more, in different parts of the Strand, can be adequate to produce the variations that were indicated by the barometers in these several stations. And the same conclusion is further confirmed by the experiments that the editors of the Bibliotheque Universelle report as having been performed on this subject by M. Ramond, in the neighbourhood of Clermont. With the same object in view that induced Dr. M'Culloch to examine the subject, in order to ascertain how far the barometer was to be depended upon as a correct instrument for ascertaining comparative heights, M. Ramond placed six barometers in situations not far from each other, used every necessary precaution in making his observations, and applied the necessary corrections. The horizontal distance of the stations varied from about 3,000 yards to 12,000 yards; and some were placed at an elevation of above 2,000 feet above Clermont. Fifty-three observations were then made; by comparing the height of the mercury in the different stations with what the height of these different stations

3

would be as ascertained by other means, the agreement between the heights, as indicated by the two methods, was found so nearly to coincide as to lead M. Ramond to conclude that the barometer might be safely employed as an instrument for measuring heights:

Names of the Stations.	Number of Observ.	Height by Barometer.	Height by levelling.	Difference.	
		Mtres	Mêtres.	Mêtres.	Inches.
The barracks	8	380·36	380·30	+0·06 or	2·34
Crête de Pradelle	5	293·76	294·30	−0·54 —	21.6
(Without a name).....	10	287·78	287·02	+0·76 —	30·4
Shepherd's Bridge	6	493·30	493·75	−0·45 —	18·0
Chevasson	1	420·76	420·80	−0·04 —	1·6
Col des gourdes.	18	597·93	597·84	−0·09 —	3·6

An account is also given of some contemporary observations that were made at Geneva and at Vincy, a place 18 miles northward of this city, and so much elevated above it that the mean height of the barometer at Geneva was 5·332 lines above that at Vincy. The observations were made contemporarily at the Observatory in Geneva and at Vincy, at sun-rise, sun-set, and at two P.M.; they were 66 in number; and, compared together, gave the following results:

14 agreed with the mean difference.
9 differed by $\frac{1}{16}$ of a line or ·005 inch nearly.
10 .... $\frac{2}{16}$ .... ·01 ——
12 .... $\frac{3}{16}$ .... ·0166 ——
8 .... $\frac{4}{16}$ .... ·02 ——
8 .... $\frac{5}{16}$ .... ·03 ——
5 .... $\frac{6}{16}$ .... ·04 ——
66

We learn from this table that, when we observe at the same time two barometers at 18 miles of horizontal, and 444 feet of vertical distance from each other, and without any obstructing body between them, it is about one to three that the difference of the heights of the mercury will be precisely what corresponds to their actual elevation; about one to two that the heights will not differ more than $\frac{1}{16}$ of a line, or even less; and that it is about an equal chance that the difference will not be more than $\frac{3}{16}$ of a line.

It may appear a little remarkable that the barometers that are employed in France and in Geneva should be more perfect than those in England. But we may conceive that the instruments in the above cases were made for the express purpose of the comparative experiments, and would be constructed with peculiar accuracy.

Article VIII.

On the Law of Continuity. By J. Herapath, Esq.

(To Dr. Thomson.)

DEAR SIR,

It was an opinion of Leibnitz, the celebrated contemporary and rival of Newton, that all changes are made gradually and with time. "If," says this philosopher, "a change can be effected without the lapse of time, then the body on which this change is made is in two different states at one and the same instant, which is impossible. If, for instance, it be a change of motion, and the saltus be made at the beginning of the motion, then the body is both at rest and in motion in the same indivisible instant." Hence he infers the impossibility of sudden or instantaneous change, and, therefore, the necessity of continuity as a law. I do not know, having never seen the original work, whether Leibnitz admits any exception to continuity; but, by what I have read in other authors, he appears to rank it with Nature's invariable and unerring laws. But whatever may have been his opinion of its universality, there is little doubt but that it is an idea which has more embarrassed and perplexed both its partisans and opponents than, perhaps, any other that has hitherto been introduced into philosophy. It is now, I believe, almost universally received as an infallible principle. And indeed the merited celebrity of its author, and the specious arguments with which it may be supported, are well calculated to procure it credit with those who receive it merely as a principle, without applying it in investigation; but they that are employed in philosophical researches, and that have, therefore, need of sometimes comparing their deductions with its consequences, must soon become convinced of the impossibility of its being a universal and an immutable law;* though the plausi-

* One of the most singular circumstances that I know of, which the introduction of continuity as a law of nature has occasioned, is the attempt to explode the possibility of absolute hardness; not because any deductions from the idea of perfect hardness are repugnant to phenomena or reason, but because the communication of motion by the collision of hard bodies must be instantaneous, or without the consumption of time; which is contrary to what the principle of continuity requires. It would not, however, I conceive, be a very difficult matter to show, that the primary particles of matter must of necessity be perfectly hard, or that it is impossible for them to be otherwise. The arguments of Sir Isaac Newton appear to me to be pretty conclusive on this subject. This excellent philosopher, in enumerating the principles of nature, says: "It seems probable to me, that God in the beginning formed matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and with such other properties, and in such proportion to space, as most conduced to the end for which he formed them; and that these primitive particles being solids, are incomparably harder than any porous bodies compounded of them; even so hard as never to wear or break in pieces; no ordinary power being able to divide what God himself made one in the first creation. While the particles continue entire they may compose bodies of one and the

bility of the reasoning upon which it is founded, will not, perhaps, readily allow them to perceive where the error lies. This seems to have been the case with Maclaurin and some others; who, notwithstanding they were thoroughly satisfied of the incompatibility of some of the results of continuity with sound philosophy, have not, I believe, pointed out the cause of the errors, or attempted to show wherein the reasoning of Leibnitz is fallacious.

The following ideas respecting this law are what occurred to me at the commencement of my researches on the subject of my paper, published in your number for July, 1816, and which I have now a little extended for the purpose of rendering them more easy to be understood.

Conceive time divided into what I apprehend Leibnitz means by indivisible instants; namely, into such parts as have the same relation to a given portion of time which a mathematical point has to a given line. Then if we admit, with Leibnitz, that a body cannot be in two different states in one of such instants, it must however be acknowledged, that it may be in one state in one of them, and in a different in the next; for if not, it would be no great difficulty to show that a body could never be in different states, and that eternity itself would be insufficient for the production of the slightest change. Now there is no more time between two such moments than there is length between two contiguous points in the same line, and yet in the two instants the states are different. In this manner it is, I conceive, that changes may take place. It is not in the same, but in different contiguous, or successive points of time, that a body is in different states. Thus, with respect to motion, is it not universally allowed that a body may move uniformly throughout one portion of time, a minute for instance, with one degree of motion, and uniformly throughout the subsequent with a different? and, nevertheless, there is no lapse of time between the end of one and the beginning of the other; nor can it be strictly said that the end of one minute is the beginning of the following. For if each minute be divided into infinitely small parts, there is evidently one of these parts to terminate the preceding, and one to begin the subsequent minute. These final and incipient moments are not, however, one and the same moment; they do not coincide, nor have they any interval between them. They are consecutive, contiguous, and, if I may so term them, touching, but not coinciding points in the same line of time. Let, for example, A B and C D be two straight lines, extending towards opposite parts, and touching at their extremes B, C. Now although the two lines thus united

same nature and texture in all ages; but should they wear away, or break in pieces, the nature of things depending on them would be changed. Water and earth, composed of old worn particles and fragments of particles, would not be of the same nature and texture now, with water and earth composed of entire particles in the beginning, &c."

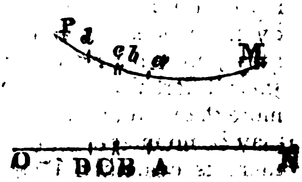
form one straight line precisely equal in length to both together; and the extreme points B, C, have not the least distance between them, these points do not, therefore, coincide. They are still distinct, each the extreme of its own, but not of the other line. For if the two points B, C, coincide, the lines cannot be said to touch, but overlap, and the whole length A D is not the sum of A B and C D, but one point less.*

Some may hence infer, that if there be no lapse of time between the first and second states, and none between the second and third, there will be none between the first and third; and, therefore, none between the first and any other state; and, consequently, that a body may be in any number of different states, or undergo any number of changes, without the smallest lapse of time, which is manifestly absurd. This, however, is by no means a correct inference. A body, according to our ideas, may be in two different states, unlimited with respect to their difference, without the lapse of time; but it cannot be in more than two, unless time intervene. For notwithstanding there may be no interval of time between the first and second moments, there is evidently a lapse of one whole moment between the first and third, of two between the first and fourth, and so on between the first and any other. And since these moments are not absolutely nothing, but supposed to be so small that the body is in one state only in each, it follows, that the number of moments from any given point of time expresses the number of states in which the body has been; and, *vice versâ*, the number of states expresses the number of moments in which the changes have been effected, but not accurately the length of time; it being possible for these moments to be unequal among themselves. If the change of state be uniform, that is, if equal changes be made in equal times, it is probable that these moments are equal; but if the change be not uniform, or unequal changes be made in equal times, it is likely that the moments are unequal.

It was thus I at first endeavoured to establish the possibility

* It will, perhaps, be said, that I here depart from the common idea of a point, and that I am giving extension to that which has ever been admitted to have none. To this I reply that if a point be considered to be absolutely nothing, I am certainly of a different opinion. By a point, I have uniformly understood that which is indefinitely small, or which has no assignable dimensions; and in this sense it is always, I believe, taken by mathematicians, though defined to be that which has neither length, breadth, nor thickness; but *assignable*, *determinate*, or some such word, appears to me to be always implied. If, according to my ideas, a point be indefinitely multiplied, it will make up a line, and a line so multiplied will make up a superficies, and a superficies a solid. Thus a superficies I imagine to be an indefinitely small part of a solid, a line an indefinitely small part of a superficies, and a point an indefinitely small part of a line. And this is the relation I conceive to exist between these four things; but there is no such relation between a point and nothing: for nothing taken an infinitely infinite number of times, will still be nothing; it can never be so multiplied as to amount to what I mean by a point.

of saltatious change, or the saltation of states; but I did not do this with a view to destroy continuity altogether. I was too well convinced of the existence of continuous or gradual change, in most of the great operations of nature, to attempt a refutation of it in toto. My efforts, therefore, at the first consideration, were directed to confute the idea of its being a law, by proving that an opposite principle was equally possible, if not equally probable. But afterwards finding that its universality was acknowledged by some of the most distinguished philosophers of modern times, and considering that, as a principle in philosophy, it was of sufficient importance to merit further attention, and that at present I had only considered it metaphysically, I was induced to take a different view of it, and to see what would be the consequence of a mathematical investigation. The following is part of the result of my reflections.

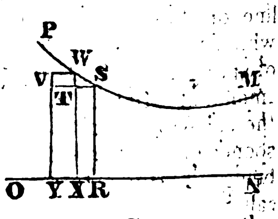


Let the indefinite straight line N O represent any indefinite portion of time, and let the line M P be so related to it, that the perpendicular distances of the parts of the line M P from the right line N O, shall always be as the states of the body corresponding to the intersections of N O by the distances. Any where in the line N O take the contiguous little parts A B, C D; and let *a b*, *c d*, be the corresponding contiguous parts intercepted by the perpendicular distances in the line M P. Then since the extremes B, C, as well as the extremes *b*, *c*, touch, but do not coincide, the distances B *b*, C *c*, touch, but not coincide. And because the extremes *b*, *c*, have no interval between them, nor the extremes B, C, the distances B *b*, C *c*, cannot have any difference, and must, therefore, be equal. But it will not be the same with the distances A *a*, B *b*, or C *c*, and D *d*; for if the state be variable, it may happen that all three shall be different. Moreover, since A B, C D, are of indefinite lengths, the same will hold good under every dimension of them, even if we suppose them to dwindle into mere points. Hence, therefore, if M P be a continuous line, it will be impossible for any change to take place without the intervention of time. A body will be precisely in the same states at the end of one and the beginning of the following instant; but during the lapse of time, however small it may be, a change may easily take place, and the body be in different states. But even this change is not without limits. For no part of M P can be perpendicular to N O, and, therefore, the difference of any two distances A *a*, D *b*, must always be less than *a d*. But with respect to the time A D, the change may have any proportion between 0 and ∞.

This is strictly the law of continuity taken in its utmost extent, from the consideration of which, by assigning cerrelations and properties to the distance, some interesting conclusions may be deduced; but we shall at present only notice one or two well known theorems of motion, and then proceed to the demonstration of the saltation of states.

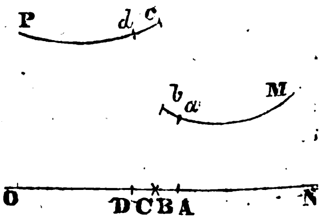
Suppose the perpendicular distance to be always moving parallel to itself, and as the velocity of a moving body, the straight line which it cuts off from a given point being as the time, then will the area described by the distance be as the space or distance described by the moving body. For the increment or fluxion of this area will be equal to the fluxion of the right line drawn into the perpendicular distance, that is, to the fluxion of the time drawn into the velocity. But the product of the velocity into the fluxion of the time is well known to be equal to the fluxion of the space. Therefore the space and this area have always the same rate of increase, and are consequently equal, or in a given ratio. The same conclusion may be as easily obtained by the method of exhaustions.

Again, let the perpendicular R S be drawn any where in the line N O, and let its intersection with the curve be S. Upon R S construct the little rectangle R T, which is the fluxion of the space described by the moving body. Let W be the intersection of the curve and of the side X T, and let S V be taken equal to twice S T; and with T X, T V, and T W, T V, construct the rectangles V X, V W. Then because the time flows equably, the equals R X, X Y, represent the fluxions of the time at the moments R X; and the rectangles S X, W Y, the corresponding fluxions of the spaces. Consequently the rectangle W V ($= \pm$ W T $\times$ R X), is the second fluxion of the space; T W being the fluxion of the velocity. And since $(\dot{v})$ the fluxion of the velocity is equal to the force (f) multiplied by the fluxion $(\dot{t})$ of the time, we shall have $\pm \ddot{x} = f \dot{t}^2$; an equation well known in the higher branches of physical astronomy.



In a similar manner we may proceed to the development of other theorems depending on the principle of continuity in the different branches of pure and mixed mathematics, if we had time and inclination to pursue them, but it is now necessary to resume our original subject.

The construction in other respects remaining the same, let the line M P, instead of being continued, be broken or interrupted at the extremity b, for instance, of the part a b, and suppose c in the other part of the line, which, for convenience, we



assume at a greater distance, to be the interior extremity of the part $c\ d$, corresponding to the part C D subsequent to A B. And because the extremes B, C, touch without coinciding, and the distances B b, C c, are both perpendicular to N O, these distances must touch in every part as far as the extremity b without coinciding. And since the extremity b is contained within the distance B b, or does not extend beyond it, this extremity itself must touch, but cannot intersect, or even penetrate the distance C c. Hence if M P be not a continued line, but composed of parts at various distances from N O, and the state of the body be nevertheless always as the distances of these parts from the right line N O, it is possible for a body to be in one state at the end of one moment and in a different in the beginning of the following; that is, to be in two different states without the lapse of time. And because the distance between the parts is not confined to limits, the difference of the states is likewise not confined to limits, but may be of any magnitude whatever. Nor can the state of the body pass through any of the intermediate degrees between B b and C c. For the state is not, in strictness, though in many cases it may safely be supposed to be, represented by a variable line or distance carried uniformly along the straight line, and which no sooner clears itself from the extremity b, than by a kind of spring it extends itself to the other part M, but by fixed and immutable distances, connecting every part of the one line with the corresponding parts of the other: so that the body is no sooner out of the state B b, than it is in the state C c, the change being, if the expression may be used, a perfect saltatious saltation.

It would be a mere waste of time now to attempt to show wherein we think the reasoning of Leibnitz defective. Our ideas of the subject must be apparent to every one who has attentively read what we have written; but one remark it may not, perhaps, be unnecessary to make, respecting the relation between the state and time; namely, that it appears from what we have said, that, in all cases where continuity takes place, the state is some function of the time; but in other cases the state cannot generally be a function of the time, unless the function be as saltatious as the state. I am, dear Sir, very sincerely,

Your humble servant,

Knowle-hill House, near Bristol, Oct. 30, 1817. J. HERAPATH.

Article IX.

Experiments and Observations upon the State of the Air in the Fever Hospitals of Cork, at a Time when they were crowded with Patients, labouring under Febrile Contagion. By Edmund Davy, Esq. Professor of Chemistry, and Secretary to the Cork Institution.

[The following experiments originally appeared in the Cork Intelligencer, Dec. 9, 1817; their accuracy and importance appeared, however, to the Editors, to render them proper for transcription into the *Annals*.]

From numerous experiments made on air, collected in different countries, by the most enlightened inquirers, it seems to be generally admitted, that the chemical constitution of the atmosphere is nearly the same at all seasons of the year, and in all parts of the globe. Nitrogen and oxygen gases form its principal component parts: it also contains a minute portion of carbonic acid gas, and a variable quantity of aqueous vapour. As oxygen gas is essential to animal and vegetable life, and to the processes of combustion, fermentation, &c.; and as it is constantly entering into new forms, by which its peculiar properties are modified or destroyed, it is considered the most important, and the most active part of the atmosphere. The most general and important change that the oxygenous portion of the air undergoes is its conversion into carbonic acid gas, a substance, which, though obnoxious to animals, is yet made subservient to vegetable life; and this change is invariably connected with the exertion of the vital functions of organic beings, and with the burning of coals, wood, candles, &c. The salubrity and healthy state of the air depend, in a great measure, upon the quantity of oxygen gas it contains; and this quantity (about 21 per cent.) appears to exist in all places exposed to the free atmosphere and the influence of winds. But the same uniformity of composition does not prevail in the air of confined dwelling houses, crowded theatres, and hospitals, that are badly ventilated. At a time when typhus was very prevalent in Cork, and there were in the two Fever Hospitals about 280 patients, labouring, for the most part, under febrile infection, it occurred to my friend Dr. Daly, whose active exertions in the cause of humanity are well known, and likewise to myself, that it would be a desirable object to ascertain the state of the air in the fever wards; and I immediately undertook a series of experiments on the subject. To give in detail all the minutiæ of my experiments, would far exceed the limits of this paper; I shall, therefore, briefly notice my methods and results, and close the communication with a few observations connected with the subject.

ject. I procured air from five large and small wards in the House of Recovery, and from the two wards in Peacock-lane Hospital: I collected it from different parts of the rooms; as, in the middle, at the sides, near the floor, and at different heights from it, and close to the beds of the patients. In every instance the air was obtained by emptying on the spot bottles that had been previously filled with distilled water, and immediately closing them. The bottles were perfectly air tight, being all furnished with well-ground glass stoppers. The air was examined soon after it had been collected. The first and most important object of my inquiry, was to ascertain the quantity of oxygen gas in the several bottles of air. For this purpose, I employed hydrogen gas, and the electric spark; a method that seems to unite more simplicity and elegance than any other; and, with due precaution, is susceptible of great accuracy. As the purity of the hydrogen, used in experiments of this kinds, is of consequence to the accuracy of the results, it may be proper to notice the mode by which it was obtained; especially as it has, I think, some little novelty, and seems to be quite unexceptionable, precluding all source of error, from the presence of common air. I put some small pieces of zinc into a glass, and nearly filled it with water that had been boiling for some time. I then filled a tube with the boiling water, and inverted it in the glass, and after adding sulphuric acid, I shortly after collected the gas.

I made a great number of experiments, using, in every instance, an excess of hydrogen gas. In every trial, I mixed 0·30 of a cubic inch of the air under examination with 0·30 of pure hydrogen gas; and after agitating the mixture in a long, thick, detonating tube, furnished with wires, the charge of a Leyden phial was passed through the tube; and the residual air, on being transferred to the cubic inch measure, occupied about 0·40 of it. I venture to state this as a general result; for though, in a few cases, there was a difference of about one per cent. more or less, yet this difference was rather apparent than real, owing to the difficulty of measuring uniform quantities of air, and it was corrected by a careful repetition of the experiments. Now, as two volumes of hydrogen and one of oxygen gas enter into the composition of water; if the foregoing results are made the basis of a calculation, the apparent quantity of the oxygen gas in the air from the different fever wards will amount to about 22·22 per cent.; but this is not the real quantity; a slight allowance must be made for a minute portion of air disengaged from the water after the detonation of the mixed gases; and when this is taken into account, the oxygen may be fairly estimated at about 21 per cent. And, according to the statements of Sir Humphry Davy, and [illegible] able chemists, 21 per cent. is the actual quantity of [illegible] in the external atmosphere, in different parts of the [illegible] may be remarked, that the variations in the temperature [illegible] the atmosphere, during the preceding experiments, were so small, as not to influence the accuracy of the general results stated.

With a view to confirm the preceding statements, I made comparative trials upon air collected from the open atmosphere, at the top of the observatory belonging to the Cork Institution; a situation, perhaps, not less salubrious than any other in Cork. The experiments were conducted in a manner precisely similar to those I have noticed; part of the same hydrogen was employed, and every precaution used to ensure accuracy. And in every case in which the electric spark was passed through a mixture of the air under examination and hydrogen gas, in the proportion of 0·30 of each, the residual air measured about 0·40. I collected air from Hughes's Lane, a place notorious for the number of cases it had furnished of typhus; but it yielded, on examination, the same uniformity of result.

I have made some trials on the other gaseous constituents of the air, collected from the different fever wards, and compared them with similar experiments on air from the observatory of the Institution; and I have found a very near coincidence in both series of results.

Thus, judging from the absorption that took place in the bottles of air from the fever wards, when placed for some time in water, and when agitated in this fluid; and especially from the effects of lime water on the air; and comparing, by similar trials, air collected from the atmosphere in salubrious situations; I could scarcely, in either case, discover a perceptible difference in the quantity of carbonic acid gas. In one instance, I filled a two quart ground stoppered bottle with the air from a large ward at the House of Recovery; and, on the spot, I put into the bottle a small phial of lime water, and well closed it. After much occasional agitation, and an interval of about two days, I examined the carbonate of lime formed, and compared it with the quantity produced under similar circumstances from the same bottle filled with air from the observatory, and treated with lime water; and I was unable, in this way, to detect any appreciable difference. If this method may be relied on, I think I may venture to state, that the air from the ward did not contain nearly one per cent. more of carbonic acid gas than the air from the observatory.

After I had separated oxygen and carbonic acid gas from the different airs examined, I could not detect the presence of any other gas than nitrogen, which exhibited its characteristic negative properties. The want of leisure prevented me from varying and multiplying my experiments, so as to ascertain the exact proportion of the carbonic acid and nitrogen gases in the airs; and it may be proper to observe, that during the time I was engaged in this inquiry, the variations of temperature, moisture, and pressure of the atmosphere, were very small, and too often connected with accidental circumstances, to be accurately noticed.

Article X.

On a Lamp without Flame. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy*, &c.)

No. 11, *Covent Garden Chambers,*
Feb. 14, 1818.

Gentlemen,

I now communicate for insertion in your *Annals*, the following notice, on a very singular discovery, which has lately come to my knowledge; namely,

Of a Lamp without Flame!

This lamp is one of the results of the new discoveries in chemistry. It had been found by Sir H. Davy, that a fine platina wire, heated red hot, and held in the vapour of ether, would continue ignited for some time; but, I believe, no practical use has been made of this fact.

I have now the satisfaction to inform your readers, that if a cylindrical coil of thin platina wire be placed, part of it round the cotton wick of a spirit lamp, and part of it above the wick, and the lamp be lighted so as to heat the wire to redness; on the flame being blown out, the vapour of the alcohol will keep the upper part of the wire *red hot*, for any length of time, according to the supply of alcohol, and with little expenditure thereof; so as to be in constant readiness to kindle German fungus, or paper prepared with nitre; and by this means, to light a sulphur match, &c. at pleasure.

I might here enlarge upon the peculiar utility of a lamp, which, whilst it affords a sufficient light to show the hour of the night by a watch, and to perform many other useful services, does not hinder the repose of persons unaccustomed to keep a light burning in their bed-room; and which, from its constantly preserving an uniform heat, and not requiring to be snuffed, as other lamps do, may prove a valuable acquisition to the chemist, in performing experiments on a minute scale, where a long continuance of a gentle heat, at an uniform temperature, is desirable. One gentleman has already kept one burning upwards of sixty hours; I have used another several nights, with great convenience; and I have no doubt, that it will soon come into general use.

I am sorry that it is not in my power to communicate the name of the inventor of this lamp. I am indebted to Mr. Garden, a scientific chemist, in Oxford-street, for the first information concerning it, on the 23d day of January last; he had a hint only of its construction from a gentleman, a stranger to him, and took considerable pains himself to ascertain the proper thickness of the wire (which is of considerable importance), and other particulars necessary to its success. I informed my friend Mr. J. J. Hawkins, engineer, of it, the same evening; and he mentioned it at Sir Joseph Banks's *converzatione* on the 25th ult. to many gentlemen of the first intelligence, in point of chemical knowledge; to all of whom it was new.

The proper size of the platina wire is the $\frac{1}{100}$th part of an inch, which may be readily known by wrapping ten turns of the wire round a cylinder, closely together; and, if they measure the $\frac{1}{10}$th part of an inch, it will be right. A larger size will only yield a dull red light; and a smaller one is difficult to use. Mr. Watt Carey, optician, and Mr. J. T. Cooper, chemist, in the Strand, and Mr. Newman, Philosophical Instrument-maker, Lisle-street, have been furnished by me with the accurate particulars; and will supply the platina wire, and the lamps, to any persons who may require them; as will, also, Mr. Garden.

About twelve turns of the wire will be sufficient, coiled round any cylindrical body, suited to the size of the wick of the lamp; and four or five coils should be placed on the wick, and the remainder of the wire above it; and which will be, as aforesaid, the part ignited.

I have found, by experiment, that a wick composed of twelve threads of the ordinary sized lamp cotton yarn, with the platina wire coiled around it, will require about half an ounce of alcohol to keep it alight for eight hours.

A slightly acid smell, rather pleasant than otherwise, is yielded by this lamp during its ignition, arising from the decomposition of the alcohol; as is, also, the case with ether.

I need hardly point out the peculiar safety this lamp will afford, as not a spark of fire can fall from it. And its being totally free from the unpleasant smell and smoke common to oil lamps, will be additional recommendations in its favour.

To persons who are not aware of its nature, the novel appearance of this lamp, in its wick continuing red hot for such a length of time, is very surprising; and it may possibly lead to other contrivances, which may prove of the utmost importance in chemistry, and the arts. I am, Gentlemen,

Your most obedient servant,

Thomas Gill.

P. S. When the wire has become oxided, it will be necessary to uncoil it, and rub it bright again with fine glass-paper; which will cause it to act again with increased effect.

ARTICLE XI.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

Feb. 5.—An abstract was read of Capt. Kater's paper on the length of the pendulum vibrating seconds in the latitude of London.

Those who have attempted the solution of this problem, with the exception of Whitehurst, have proceeded on the assumption that the place of the centre of oscillation might be determined by calculation. But, the truth of this depending on the regular figure and uniform density of the body employed as a pendulum, the difficulties attending this mode of inquiry, may, perhaps, be considered as insurmountable. Capt. Kater having satisfied himself of the inadequacy of this method, endeavoured to discover some property of the pendulum of which he might avail himself, with a better prospect of success; and was so fortunate as to perceive, that the theorem of Huygens, of the reciprocity of the axes of suspension and oscillation, afforded a principle on which to construct a pendulum exempt from all errors resulting from unequal density, or irregular figure.

It is demonstrable that if a pendulum be made to vibrate on its centre of oscillation, its former point of suspension becomes the centre of oscillation; and the number of vibrations on each will be the same in equal times. The pendulum was made of plate brass; two knife edges were passed through it at the distance of about 39·4 inches, and firmly secured. The distance between these was carefully determined in parts of a standard scale, which was the property of the late Sir George Shuckburgh. The pendulum was furnished with three weights, the largest fixed, and the two others moveable.

The moveable weights were shifted, until the number of vibrations in 24 hours, on either knife edge, was equal, when it is evident that the one knife edge being considered as the point of suspension, the other must be in the centre of oscillation, and the distance between the knife edges will be equal to the length of a simple pendulum vibrating in the same time.

It appears from a table, given by the author, of 12 sets of experiments, for ascertaining the number of vibrations made by the pendulum in 24 hours, each set consisting of four experiments, from which the length of the second's pendulum is deduced, that seven of these sets are within one ten thousandth of an inch of the mean result, two within two ten thousandths; and of the remaining sets, the greatest difference is less than three ten thousandths of an inch.

The conclusion deduced by Capt. Kater from his experiments is, that the length of the pendulum vibrating seconds, in vacuo at the level of the sea, is equal to 39·1386 inches of Sir George Shuckburgh's scale, the scale being at 62°, and the latitude of the place of observation, 51° 31′ 8·3″.

An *appendix* to Capt. Kater's paper on the pendulum was also read, containing a demonstration, by Dr. Young, of a theorem discovered by M. Laplace, that if a compound pendulum be made to vibrate on cylinders instead of knife edges, the distance between the surfaces of the cylinders (the vibrations on each being equal) will be the length of the equivalent pendulum.

This was followed by a paper, by the same author, "On the Length of the French Mêtre estimated in Parts of the English Standard;" from which it appears, that the length of the mètre in parts of Sir George Shuckburgh's standard scale, is equal to 39·37079 inches, each standard being brought to its proper temperature.

A paper by Mr. Knight was also read, on the heart wood of trees; the principal object of which was to show, that this portion of the plant bears a more active part in the vegetable economy than is usually assigned to it. The heart wood has been supposed to be chiefly useful as a mechanical support to the other parts, and as retaining only an inconsiderable share of vitality; whereas Mr. Knight endeavours to prove, by a series of experiments, that it serves as a reservoir for the sap, or other juices of the plant, during their torpid state, whence it is again expelled, and sent to the bark at the renewal of vegetation in the spring.

Feb. 12.—A paper, by Sir H. Davy, was read, on the subject of the experiments that have been lately performed at Edinburgh by Dr. Ure, on the nature of chlorine.* The object of these experiments was to prove, that water forms an essential part of muriatic acid gas, by passing the gas through tubes containing portions of iron or other metals, from which process water was procured, and the metal was converted into a muriate. Sir H. Davy, however, brings forward experiments to show, that the water obtained under these circumstances was an accidental product, generated by the hydrogen of the muriatic acid gas meeting with oxygen, which was derived from sources not suspected by Dr. Ure. When tubes of flint glass were employed for the transmission of the gas, the oxide of lead and the alkali in the glass furnished the oxygen; and a portion of it was also furnished by the atmospheric air remaining in the tube. The quantity of water was always found to be diminished in proportion to the care that had been taken to remove all these sources of oxygen.

A paper, by Dr. Marshall Hall, was also read, on the action of water and oxygen on iron. The author endeavours to prove, by experiment, that pure water, below the temperature of 212°, has no action upon pure iron; but that if the water contain any

* *Annals* for Feb. p. 146, *et seq.*

oxygen, an oxidation of the iron takes place, and that the same effect is produced when moistened iron is exposed to the atmosphere. The power of moistened iron in attracting oxygen from the atmosphere appeared to be very complete; and, at the same time, iron was found to be a very delicate test of the presence of oxygen in water.

Feb. 19.—A paper, by Mr. Rennie, jun. was read on the strength of materials. It contained a long detail of experiments and calculations on the mechanical power of different substances, and of the same substance under different forms, of which we hope to give some account in a future number.

On the same evening was also read a paper, by Dr. Brewster, on the same subject with those which had lately been presented to the Society; and two mathematical papers were likewise announced, one by Mr. Knight, the other by Sir Wm. Herschell.

GEOLOGICAL SOCIETY.

Dec. 5.—The reading of a paper, by Mr. W. Phillips, entitled "Remarks on the Chalk-hills, in the Neighbourhood of Dover; and on the green Sand and blue Marl overlying it, near Folkestone," was begun.

Dec. 19.—The reading of Mr. Phillips's paper was continued.

Jan. 2, 1818.—The reading of Mr. Phillips's paper was concluded.

The cliffs extending from Dover towards Deal on the east, and towards Folkestone on the west, have afforded to Mr. Phillips the opportunity of a minute examination of the different strata of the chalk in that part; and the numerous falls on the shore have enabled him to collect various organic remains, which he has transmitted to Mr. Parkinson, who has undertaken to examine them, and to communicate the result of his examination to the Society.

The highest point of the chalk hills here described is near Folkestone, whence they gradually decline in height towards Dover and Walmer, being in the direction of the dip of the strata which is to the N. E. The dip, however, is very small, being less than 1°.

The chalk is distinctly stratified; and the author considers it to consist of the following beds, beginning with the uppermost one:

1. Chalk, with numerous flints. This forms the cliffs of the shore from Walmer Castle to St. Margaret's Bay, whence it begins to rise, gradually, as the lower beds there begin to appear; and it continues to form the upper part of the cliff as far as the citadel. In the Castle hill its thickness may be estimated at more than 100 feet. The strata of flints in this bed occur generally at about two feet distance from each other, and consist for the most part of the detached nodules usual in the chalk with flints.

Beds of plated flint, varying from half an inch to 1½ inch in thickness, also occur, and have been traced for one and two miles in length. Some of the beds of continuous flints are of the thickness of 18 inches. A hard chalk marl, 18 inches thick, is also contained in this bed. Below this bed lies a chalk, consisting chiefly of organic remains; in which numerous flints of peculiar forms are interspersed, and a few strata of flint run along it. This bed is above 100 feet in thickness, is of a yellow colour, and is harder than the upper bed just mentioned; but it probably belongs to the same deposit. Its flints appear, generally, to have been formed on organized bodies. The fossil echini with which it abounds are rarely depressed; and the chalk within them is generally coarser than that of the bed, and of a sandy aspect. This bed is separated from the following by a bed of marl, two or three inches thick; and two other beds of marl are observed to lie in it.

2. Chalk, with few flints. This chalk is soft and white, though not of so pure a colour as that with numerous flints already described. It contains a few thin beds of organic remains, and two beds of soft chalk marl, as well as a few thin beds of flint, which have not the regular disposition of those in the upper strata. In this bed, Mr. Phillips has met with ammonites of a large size.

3. Chalk, without flints. The separation of this bed from the preceding has not been distinctly traced; but there is a considerable difference between them. Mr. Phillips considers it to consist of the two following subdivisions: first, a thick stratum containing numerous beds of organic remains; secondly, a stratum about 50 feet thick, with few organic remains.

The first stratum is of a yellowish colour, and without flints; it is also much harder than the chalk with few flints. Ammonites also occur in this stratum. The second stratum of this deposit rises at the base of Shakspeare's Cliff, on the side nearest to Dover, and is separated from the preceding by a thin bed of soft marl. This stratum is softer and whiter than the one above it, though not so much so as the chalk with few flints. For six feet below the bed of marl it is of a sandy and friable texture, assuming sometimes the appearance and compactness of a sandstone.

4. The grey chalk. This begins to rise on the west of Shakspeare's Cliff, and is softer than the strata reposing on it; but it varies in colour and texture. It is separated from the stratum just described by some very thin beds of a sandy appearance and yellowish colour, and contains, occasionally, beds of sandstone, extremely hard, and from one to five inches in thickness. No flints are visible in this bed: it contains many organic remains not differing considerably from those of the upper beds; but the echini which are found in it are always depressed and broken. Underneath the grey chalk, and near

to Folkestone, a bed of blue marl is seen of considerable thickness; it is soft, and the fossil shells which it contains generally exhibit a pearly lustre. To the action of the sea on this soft bed may be attributed the fall of the large masses of chalk which form the under cliff near Folkestone.

The chalk hills are covered with alluvial sand, of yellow and red colours, and with gravel.

A section of the strata, as shown along the cliffs from Folkestone to Walmer Castle, accompanies this paper.

A letter was read from Capt. Carmichael, accompanying drawings of the Table Mountain at the Cape of Good Hope. The Table Mountain rests on granite, Green Point and the Table Valley on schistus. The upper part of the Table Mountain consists of sandstone in horizontal beds. The junction of the granite with the schistus is visible at Sea Point; and here a very confused mixture of the two rocks occurs. In some parts they form alternate layers of various thickness; in others, fragments of the schistus, of all figures and sizes, lie imbedded in the granite. Between this mixed mass and the pure schistus there is interposed a rampart of granite, apparently differing from that which composes the mass of the mountain, which for about 200 yards is unmixed; but as it approaches the schistus, becomes mingled with it.

Along the shore from Camp Bay to Sea Point are numerous veins of trap in the granite.

Jan. 16.—The reading of a paper, by Mr. Parkinson, entitled "Remarks on the Fossils from the East of Dover to Folkestone," was begun.

Feb. 6.—General Annual Meeting of the Society.

The report of the Council, on the general state of the Society, was read; and the following is the list of officers for the ensuing year:

President.—George Bellas Greenough, Esq. F.R.S. &c.

Vice-Presidents.—William Blake, Esq. F.R.S.; Rev. Wm. Buckland, Prof. Min. Oxford; the Right Hon. Sir John Nicholl, F.R.S.; Sir Henry C. Englefield, Bart. F.R.S. &c.

Secretaries.—Henry James Brooke, Esq. F.L.S.; John Bostock, M.D.; Hen. Heuland, Esq. For. Sec.

Treasurers.—Daniel Moore, Esq. F.R.S. &c.; John Taylor, Esq.

Council.—Arthur Aikin, Esq. Sec. Soc. of Arts; Hon. Henry G. Bennet, F.R.S. &c.; Hen. Thos. Colebrooke, Esq. F.R.S.; Hen. Holland, M.D. F.R.S.; John M'Culloch, M.D. F.L.S.; Ashhurst Majendie, Esq.; Wm. H. Pepys, Esq. F.R.S.; Sam. Solly, Esq. F.R.S.; Charles Stokes, Esq. F.L.S. &c.; Henry Warburton, Esq. F.R.S. &c.; John [illegible]haw, Esq. F.R.S.; Wm. H. Wollaston, M.D. F.R.S. [illegible]

Keeper of the Museum and [illegible] Thomas Webster.

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ROYAL SOCIETY OF EDINBURGH.

Feb. 2.—Mr. Thomas Allan read a very interesting paper on the geology of the country round Nice, a country which, from the circumstances detailed in the paper, appears to be peculiar; or, at least, not to have been hitherto examined with that accuracy which it merits from the interesting facts which it presents. It appears evident that many revolutions have taken place in this quarter; that the rocks have not only been deranged, but that the sea has stood at a much higher level. The fissures in the rocks are often filled with marine shells of the same species that now exist in the Mediterranean; and shells of a similar kind are often found high among the alluvial soil, and down by the sea from the Harmetine countries. Among the fossil shells found in the peninsula of St. Boassure, more than twenty hitherto undiscovered species have been found.

At the same meeting, Mr. Playfair communicated a paper, by General Sir Thomas Brisbane, on the determination of the time by equal altitudes.

ROYAL ACADEMY OF SCIENCES AT PARIS.

Nov. 3.—A paper, by M. Quentin, entitled a statistical table for the department of the Seine; and a memoir, by M. Hachette, on high-pressure steam-engines, were referred to committees.

The reading of a paper, by M. Geoffroy-Saint-Hilaire, on the bones of the thorax, was begun.

M. Huzard delivered in a report on a memoir, by M. Girard, Professor at the *Ecole Vétèrinaire* of Alfort. The object of this memoir is to show, that omnivorous and carnivorous animals vomit naturally, and with ease; and are little, if at all, exhausted by the operation; that monogastric and ruminating animals, on the contrary, vomit only by great efforts, and unnaturally; and that the act is always attended with serious consequences, often with death.

A report was also made on the *Hydro-bascule* of M. Capron, the intention of which is to avoid, in part, the loss of water by the passage of boats through locks.

M. Lacroix delivered in the report of a committee on the manuscripts of the late M. Lagrange. It is recommended that all these papers should be bound in volumes and deposited in the library of the Institute, for the inspection and use of men of science, both natives and foreigners.

Nov. 10.—The whole of this sitting was occupied in matters relating to the internal management of the Society.

Nov. 17.—M. Seber presented a mathematical memoir on the constitution of solid bodies, which was referred to a committee.

A memoir, by M. Fourier, was read, on the temperature of dwelling houses, and on the passage of heat in rectangular prisms.

A dissertation, by M. Lelièvre, on siliciferous alumine, was read. The substance in question was found adhering to the sides of a lead mine in the mountain of Esqueme, one of the Pyrenees; externally, it is white, opaque, and adheres to the tongue; internally, it is translucent, and of a yellowish green colour; it yields readily to the knife; and, from an analysis by M. Berthier, appears to be composed of

Alumina	44·5
Water	40·5
Silex	15·0
	100·

A memoir, by M. Magendie, on prussic acid, was read.

Nov. 24.—A memoir, by M. Fresnel, was read, on the modifications produced on light by reflection.

M. Dupetit-Thouars read a memoir on the growth of bulbous roots.

The class of zoology and anatomy presented the following list of candidates, to fill up the place of corresponding member, vacant by the appointment of M. Scarpa to the place of Associate, viz. Schneider, Rudolfi, Lamoroux, Dutrochet, Poli, Rizzo, Kilby (qu. Kirby), Schreiber, Schweigher, Marcel de Serres, Noel de Lamorinière, and Prévot.

The class of geometry presented the following list, from which to supply the place vacant by the death of M. Jenty; viz. Kramp, Ivory, Plana, and Gergone.

Dec. 1.—M. Fevre presented the third part of his manuscript chemical tables; and M. Doderet, a memoir on several points of astronomy; both of which were referred to committees.

M. Fourier read a report on the memoir of M. Despretz, on the distribution of heat through solid bodies.

The Academy resolved, that the above memoir should be printed in the next volume of *Savans étrangers*.

Ballots took place in order to fill up the vacancies mentioned Nov. 24, when M. Lamoroux was chosen in the class of zoology, and M. Kramp in that of geometry.

Dec. 7.—A memoir, by M. Borguis, was read, on the *Bélier moteur*, which was referred to a committee.

A paper, by M. Adam, on arithmetic, was also referred to a committee.

M. Ivart delivered in a report on Sir J. Sinclair's code of agriculture.

The class of botany presented the following list of candidates for the vacant place of corresponding member; viz. Smith, Kunth, Aug. Saint-Hilaire, Scheygrichon, Desvaux, Persoon, Acharius, Bonpland, Dumas, and Nestler.

Dec. 15.—A letter, by M. Frey, was read, enclosing a memoir on the origin of organized and inorganized bodies: the whole was referred to a committee.

M. Vicat presented experimental researches on the composition of mortars and cements.

A memoir, by MM. Lacroix and Peulvay, on raising water, was presented; and, with the preceding, was referred to a committee.

M. Girard, in the name of a committee, delivered a report on a memoir, by M. Charles Dupin, on the theory of the track of wheels on roads.

M. Percy made a report in favour of the use of caustic in diseases of the urethra, proposed by M. Petit.

M. Bonpland was elected correspondent in the class of botany.

Major Lambton and M. Lindenau were elected correspondents in the class of astronomy.

The class of medicine and surgery presented the following list of candidates for the vacant place of correspondent; viz. Prof. Gregory, of Edinburgh; Baillie, of London; Lauth, of Strasburg; Mannoir, of Geneva; and Foderé, of Strasburg.

Dec. 22.—A memoir, of M. Puguet, on yellow fever, was referred to a committee.

A note, by M. Burckhardt, on the comet of 1816, was read.

M. Percy delivered a report, on a memoir of M. Gondret, on the use of the actual cautery: as a substitute for the cautery, M. Gondret proposes the employment of a pommade, composed of suet and caustic ammonia, in equal proportions.

Prof. Gregory was elected a corresponding member in the class of medicine.

Article XII.

Scientific Intelligence, and Notices of Subjects connected with Science.

I. *Fossil Wood, near Lichfield.* By T. J. Darwin, M.D.

(To Dr. Thomson.)

DEAR SIR, *Lichfield Nov.* 15, 1817.

When I had the pleasure of seeing you at Lichfield, you expressed a desire to learn the nature of the situation where the siliceous fossil wood is found in this neighbourhood; I take the opportunity of informing you, that I visited the spot, in my professional duties, lately.

They are found in gravel, about three feet thick, which lies a foot from the surface of the meadow upon a bed of clay, in a flat country, near Allesley, two miles north of Coventry. The gravel is mixed with a large proportion of argillaceous earth. The specimens of wood are mostly irregular, with acute angles; whilst nearly all the other stones are rounded, or worn by the effect of friction. They differ in the species of trees of which they are the remains. In some there is a material difference in the state of the cortex, although I could not learn that the process of their formation is still going on. The greater part of the specimens are cracked from the centre of the concentric circles; and the fissures are filled with quartz crystals. My friend Mr. Bree, of Allesley (who has a large collection of these interesting fossils) believes, that some few animal remains have been occasionally found at this place in the same state.

Believe me, dear Sir, yours very respectfully,

T. J. DARWIN.

II. *Meteorological Table kept at Derby.* By J. D. Strutt, Esq.

Date 1817.	Barometer.			Thermometer.			Wind.	Rain.		General Observ. taken at 8 A. M.
	8 a.m.	10 p.m.	Med.	8 a. m.	10 p.m.	Med.				
Oct. 12	30·05	30·10	30·075	49	43	46·0	NNE	—		Cirro-cumulus and Stratus.
13	30·25	30·25	30·250	44	46	45·0	NNE	·02		Bright and clear.
14	30·20	30·15	30·175	44	46	45·0	WSW	—		Cirro-cumulus.
15	30·00	29·95	29·975	48	43	45·5	NNE	—		Cloudy.
16	29·95	30·05	30·000	45	42	43·5	NE	·15		Ditto.
17	30·10	30·10	30·100	40	44	42·0	NE	·04	☽	Cumulo-stratus.
18	30·00	29·95	26·975	42	45	43·5	NE	·05		Slight Cirro-stratus.
19	29·95	29·95	29·950	48	45	46·5	NE	·02		Cloudy.
20	29·95	29·95	29·950	46	46	46·0	NE	·01		Ditto.
21	29·85	29·75	29·800	45	45	45·0	NE	·03		Ditto.
22	29·75	29·90	29·825	44	44	44·0	W	·01		Bright, Cirro-cumulus.
23	29·95	29·95	29·950	41	45	43·0	NE	—		Ditto.
24	29·90	29·85	29·875	46	45	45·5	NE	·01		Do., Cirro-stratus.
25	29·80	29·80	29·800	44	44	44·0	E	—	○	Slight Stratus.
26	29·65	29·65	29·650	46	45	45·5	E	—		Cloudy, Stratus.
27	29·56	29·30	29·430	33	37	35·0	SW	—		Ditto, and mist.
28	29·35	29·30	29·325	33	33	33·0	SW	·06		Slight Stratus.
29	29·35	29·40	29·375	34	34	34·0	SW	·08		Clear and bright.
30	29·05	29·30	29·175	52	41	46·5	SW	·04		Bright, Cumulus.
31	29·30	29·70	29·500	45	37	41·0	SSW	·11		Cloudy.
Nov. 1	30·10	30·25	30·175	38	39	38·5	WSW	·03		Clear, bright.
2	30·05	30·05	30·050	47	56	51·5	S	—	☾	Cloudy.
3	30·10	30·05	30·075	56	52	54·0	SW	·02		Ditto, Cumulus.
4	30·00	29·95	29·975	52	52	52·0	SSE	—		Ditto.
5	29·85	29·80	29·825	50	56	53·0	ESE	—		Ditto, drizzle.
6	29·80	29·75	29·775	52	52	52·0	WSW	·03		Ditto.
7	29·60	29·35	29·475	55	56	55·5	S	·15		Cirro-cumulus.
8	29·30	29·20	29·250	50	52	51·0	SSW	·08		Clear, bright.
9	29·55	29·70	29·625	44	42	43·0	SSW	·13	●	Ditto, slight Cirro-cumulus.
10	29·80	29·80	29·800	49	51	50·0	SW	—		Cloudy.
11	29·55	29·60	29·575	50	42	46·0	SE	—		Ditto, Stratus.
12	29·60	29·40	29·500	48	53	50·5	SE	·04		Ditto.
	29·79	29·79	29·79	45·625	45·406	45·515		1·11		

III. *Remarkable Stone found near Derby.* By J. D. Strutt, Esq.

(To Dr. Thomson.)

SIR, *Derby, Nov.* 13, 1817.

I have sent for insertion in your *Annals* an account of a large block of stone, which was discovered, a few months ago, when lowering Chaddesden Hill, about a mile on the eastern side of Derby, and which may, perhaps, be interesting to some of your readers. This block measures about two feet long, 20 inches wide, 14 inches in height, and weighs about four hundred weight and a half. It has the appearance of an irregularly rounded boulder stone, and is composed of greenstone, interspersed with particles of hornblende. It is exceedingly hard, and is not at all similar to any species of stone which is found in this neighbourhood. A number of the bones of some animal were found underneath it. It is supposed that this stone was placed there by the Saxons to mark the boundary between this borough and Chaddesden, and that it was brought by them from some distance; because it is known they always preferred, for this purpose, some kind of stone of which there was none similar in the neighbourhood, in order that no mistake or disputes might arise concerning the boundary. The bones which were found underneath it are supposed to be those of the animal which they sacrificed when the boundary mark was placed there, as was the custom of the Saxons on these occasions. I am, Sir,

Your obedient servant,

J. D. STRUTT.

IV. *Oxides of Manganese.*

We learn, by a letter from Professor Berzelius to M. Gay-Lussac, that M. Arvidson, a young Swedish chemist, has been engaged in a series of experiments upon manganese, from which he concludes that it has three degrees of oxidation. The colour of the protoxide is green, that of the two others is black. The second oxide is formed, either by means of the nitric acid, in heating the nitrate of manganese, until it assumes a reddish brown colour, or by burning the protoxide in the atmosphere. If the second oxide be urged by a continued red heat, a little oxygen gas is disengaged, and a red powder is left, which, by means of acids, may be decomposed into the green oxide and the black oxide. This black oxide, however, is not the peroxide, but the deutoxide. The red powder is composed of 100 parts of manganese and 37·47 parts of oxygen; whilst, in the deutoxide, 100 parts of the metal are combined with 42·16 parts of oxygen. The red oxide of manganese seems, then, to be analogous to the oxide of native magnetic iron. M. Arvidson has also examined the native peroxide. He has found that this oxide, by a powerful calcination, yield 11·3 parts of oxygen, and leaves the red oxide as a residuum; he has not been able to produce this oxide by means of oxymuriatic gas. If the red oxide of manganese should prove to be a specific degree of oxidation, there will be four oxides of manganese, in which 100 parts of the metal will be united with the following quantities of oxygen, respectively: 28·105, 37·47, 42·16, and 56·21: the second of these cannot, however, be reconciled with the doctrine of chemical proportions, unless we consider it as a combination of the first two.

M. Arvidson has analyzed an oxide of manganese, composed of very large and beautiful crystallized needles, that was found at Undenas, in Westrogothia, and has found it to be the hydrate of the deutoxide. Exposed to the action of fire, it yields 10 per cent. of pure water, and 3·07 of hydrogen, and is then reduced to the red oxide. Hence it follows that its composition is such, that the oxygen of the water is $\frac{1}{3}$ that of the deutoxide. The hydrate crystallizes differently from the peroxide; the crystals are generally larger; it does not soil the fingers like the peroxide, and it gives a reddish brown powder. The manganese of Ilefeld has been analyzed by Klaproth, but he does not seem to have been aware of the difference between this and the peroxide. (Ann. de Chim. et Phys. Oct. 1817.)

V. *State of the Weather in Iceland during the Spring of* 1817.*

Reikevig, Aug. 17, 1817.

Last winter was one of the severest we have had for a long while, in particular from the beginning of Feb. to the end of March, with changeable winds and heavy snow, by which even several persons lost their lives. From the beginning of the month of April until the 1st of May, we had often fine and mild weather with thaw, so that we began to flatter ourselves with the hope of a good spring. But on May 2, we had a storm from the north, with much snow; and from that day until St. John's Day (July 7), we had nothing but northerly winds with frost and cold weather; which was the reason that a considerable quantity of sheep, in particular in the district of Skaptefield, as well as a number of lambs, died.

The growth of the grass began very late; so that even about St. John's Day it became necessary in many places to give hay to the cows, which is very uncommon in this country.

The Greenland drifting ice, which had left the northern lands in the beginning of April, returned again in the first days of May, and surrounded the whole of the western, northern, and eastern lands; from the Birdmontain (Lábrabiarg), west of Breidefiord to Easterhorn; from the eastern land it drifted along the coasts of Skaptefield, Rangervalle, and Arnæs districts, even to Rey-

* Translated from the Danish Official Gazette, published at Copenhagen, Oct. 13, 1817.

kenss; yet it has left the southern and eastern coasts of the country for some time; but only very lately the northern land.

From about St. John's Day, the weather has been very dry, and often pretty warm.

The first traders arrived here in the latter part of May, and it is reported, that those destined for the northern and eastern lands were obliged to wait a long time before they could reach the ports of their destination.

[For this communication, the Editors are indebted to Sir Joseph Banks.]

VI. *Meteorological Register kept at New Malton.*

Malton, Jan. 6, 1818.

October.—Mean pressure of barometer, 29·850; max. 30·32; min. 28·70; range, 1·62; spaces described in inches, 6·75; number of changes, 15. Mean temperature, 44·050°; max. 55°; min. 31°; range, 24°. Amount of rain, 1·80. Wet days, 7. Number of brisk winds, 5; boisterous, 3. Prevailing winds, N. and E; N. 9; N.E. 9; E. 5; S. 4; S.W. 2; N.W. 1; Var. 1.

November.—Mean pressure of barometer, 29·713; max. 30·33; min. 28·98; range, 1·45; spaces described in inches, 8·35; number of changes, 16. Mean temperature, 45·500°; max. 57°; min. 32°; range, 25°. Amount of rain, 1·86 inch. Wet days, 7. Number of brisk winds, 3; boisterous, 2. Prevailing winds, S., W., and S.W.; N. 1; S.E. 5; S. 6; S.W. 10; W. 7; N.W. 1.

December.—Mean pressure of barometer, 29·345; max. 29·96; min. 28·34; range, 1·62; spaces described in inches, 9·37; number or changes, 14. Mean temperature, 33·955°; max. 50°; min. 21°; range, 29°. Amount of rain and snow, 4·04 inches, nearly the whole of which fell by night; number of wet and snowy days, 20. Brisk winds, 4; boisterous, 3. Prevailing winds, S.W. and N.W.; N. 1; N.E. 4; S.E. 3; S. 4; S.W. 11; W. 2; N.W. 6. Character of the period: wet, stormy, and changeable.

Meteorological Results for the Year 1817.—Mean pressure of barometer, 29·668; max. 30·61; min. 28·10; range, 2·51; spaces described in inches, 97·69; number of changes, 206. Mean temperature, 47·291°; max. 82°; min. 21°; range, 61°. Amount of rain and snow, 28·02 inches; number of wet and snowy days, 132. Number of brisk winds, 71; boisterous, 37. Prevailing winds, S.W.; N. 44; N.E. 35; E. 10; S.E. 23; S. 63; S.W. 83; W. 60; N.W. 26; Var. 21.

J. S.

VII. *Nightingale of the Ancients.*

Is the ἀηδὼν of the Greek naturalists and poets the same bird as our nightingale?

According to Aristotle (Hist. Anim. v. and ix.), the αηδων disappears during the winter; but in the spring, when the trees begin to be covered with leaves, it sings for a fortnight without intermission; as the year advances, it still continues to sing, but not so incessantly. In the heighth of summer it loses the rapid and various modulation of its song, utters only a simple note, and, at the same time, undergoes a change of plumage; on which account in Italy it passes by two different names, according to the season.

Homer, in his fine simile (Odyss. xix. 518), in which he compares Penelope to this bird, calls it χλωρηις αηδων the green, or more properly *yellowish green* nightingale; and the Scholiast in a note on this passage, quotes from Simonides the expression χλωραυχενες αηδονες, *green-necked* nightingales. Finally, Euripides, (Ελενη, 1117) after calling it αοιδοτατον ορνιθα μελωδον

Αηδονα δακρυοεσσαν

"the mournful nightingale, the most musical and melodious of birds," mentions its *yellow*, or *orange* cheeks ξουθαν γενυων.

But the modern nightingale, as described by the naturalists of England and of France, is of a tawny colour, verging more or less to rusty on the upper parts of the body, and on the belly and breast is of a pale ash colour, nor does it appear to undergo any change of plumage at different seasons of the year; for this circumstance, in itself so remarkable, is not mentioned by any naturalist who has observed the bird in Europe, nor by Sonnini, who saw multitudes of nightingales in the Egyptian Delta, whither they retire from the severity of the European winter.

I have been informed that the nightingales of Moscow, and of the southern provinces of Russia, are larger than the English nightingale, and of a somewhat different appearance. Perhaps Dr. Clarke, who is an occasional contributor to your journal, and who has communicated to the public so much curious and interesting information concerning Russia, Greece, and Egypt, may be able to favour, by a solution of this difficulty, your readers in general, as well as Your humble servant,

R. N.

VIII. *Original Recipe of the Black Drop.*

The following account of the origin and composition of this well known remedy, is extracted from a valuable work on Typhus Fever, lately published by Dr. Armstrong, of Bishop-Wearmouth, in the county of Durham:

"The black drop was originally prepared, upwards of 100 years ago, by Edward Tonstall, a medical practitioner of Bishop's Aukland, in the county of Durham, and one of the Society of Friends. The recipe, passing into the possession of a near relative, John Walton of Shildon, who also prepared that medicine, was found amongst the papers of his brother, the late Edward Walton, of Sunderland; and by the permission of my much respected friend Thomas Richardson, senior, of Bishop's-Wearmouth, one of his executors, it is here inserted.

"Take half a pound of opium sliced, three parts of good verjuice, one and a half ounce of nutmeg, and half an ounce of saffron. Boil them to a proper thickness; then add a quarter of a pound of sugar, and two spoonfuls of yeast. Set the whole in a warm place near the fire for six or eight weeks, then place it in the open air, until it become a syrup; lastly, decant, filter, bottle it up, adding a little sugar to each bottle.

"The above ingredients, agreeably to the experiments of a scientific friend, ought to yield, when properly made, about two pints of the strained liquor; one drop of which he calculated to be equal to three drops of the tincture of opium, prepared according to the London Pharmacopœia; and the effects of its exhibition also tended to show that this was, perhaps, as accurate an estimate as could be made. Probably this compound might be equally well prepared by a simpler process; and, perhaps, some other vegetable acid and aromatic might answer as good a purpose as the verjuice and nutmeg. The black drop is a most excellent preparation of opium, and highly deserving a place in our pharmacopœias. From the quantity of acid in its composition, it will often stay upon the stomach when other preparations will not; and in the hands of a judicious physician, may, therefore, be usefully applied."

IX. *Meteorological Table. Extracted from the Register kept at Kinfauns Castle, N. Britain. Lat.* 56° 23′ 30″. *Above the level of the Sea* 129 *feet.*

1817.	Morning, 8 o'clock. Mean height of		Even., 10 o'clock. Mean height of		Mean temp. by Six's Ther.	Depth of Rain.	No. of days.	
	Barom.	Ther.	Barom.	Ther.		In. 100	Rain or Snow.	Fair
Jan.	29·50	38·41	29·55	38·71	39·580	1·75	12	19
Feb.	29·60	40·37	29·54	39·01	41·070	1·90	17	11
March	29·57	38·00	29·58	37·77	39·700	1·10	11	20
April	30·18	43·86	30·18	42·73	45·600	0·50	7	23
May	29·65	46·19	29·66	44·03	47·774	3·10	13	18
June	29·67	55·03	29·69	52·90	57·600	4·80	15	15
July	29·60	55·74	29·61	53·71	57·480	3·85	20	11
Aug.	29·57	53·87	29·55	52·13	54·900	5·25	20	11
Sept.	29·84	51·30	29·83	51·10	53·833	0·85	9	21
Oct.	29·95	40·06	29·96	39·77	42·130	1·55	9	22
Nov.	29·70	43·50	29·70	45·20	45·800	2·70	16	14
Dec.	29·43	34·09	29·45	34·06	35·548	3·66	11	20
Aver. of year.	29·685	45·035	29·691	44·260	46·751	31·01	160	205

ANNUAL RESULTS.

MORNING.

BAROMETER. Observations.		Wind.		THERMOMETER.	Wind.	
Hig[illegible]	April 6	N E	30·57	June 25	N W	68°
[illegible]	18	S W	28·40	Dec. 12	W	22°

EVENING.

Highest, April 6	S E	30·61	June 25	N W	62°
Lowest, Dec. 18	S W	28·40	Dec. 22	N W	15°

Weather.	*Days.*	*Wind.*	*Times.*
Fair	205	N and N E	25
Rain or Snow	160	E and S E	91
		S and S W	133
	365	W and N W	116
			365

Extreme Cold and Heat, by Six's Thermometer.

Coldest, December 23, Wind N W	15°
Hottest, June 24, Wind S E	76
Mean temperature for 1817	46 75′

Result of three Rain Gauges.	*In.* 100
No. 1. On a conical detached hill above the level of the sea 600 feet	44·40
No. 2. Centre of the garden, 20 feet	31·01
No. 3. Kinfauns Castle, 129 feet	23·56
Mean of the three gauges	32·99

X. *Instrument for distinguishing the precious Stones.*

Dr. Brewster has lately constructed an instrument for distinguishing the precious stones from each other, and from artificial imitations of them, even when they are set in such a manner that no light can be transmitted through any of their surfaces. The same instrument may be employed to distinguish all minerals that have a small portion of their surface polished, either naturally or artificially. The application of the instrument is so simple, that any person, however ignorant, is capable of using it. We expect soon to be able to give an account of it in this journal.

XI. *Mr. Stephenson's Lamps.*

Some experiments were lately performed at the Royal Institution with Mr. Stephenson's lamps, of which we believe the following to be a correct outline.

There were four lamps employed of different forms; those that are designated in the report of Mr. Stephenson's Committee, by the titles of first, second, and third, respectively; and a fourth, which seems to have been considered by them as not materially differing from the third. The first, which is styled the tube and slider lamp, consists, essentially, in a tube, which rises up within a circular wick, to the lower orifice of which is adapted a moveable valve, by which the aperture can be increased or diminished at pleasure, and the rate of combustion of course proportionably reduced. It was found, in several successive experiments, that whenever the orifice of the tube was so far closed as to be barely large enough to support the flame, yet it still always produced explosion when exposed to the mixture of atmospherical air, and hydro-carbonous gas. The instrument employed in these experiments was made by Mr. Hogg, of Newcastle.

The second, or "tube lamp" of Mr. Stephenson, instead of the valve, or slider, and the central passage for the air, has three open tubes on the outside of the flame; their length is stated to be "$3\frac{1}{4}$ inches, and their diameter between $\frac{1}{7}$ and $\frac{1}{8}$ of an inch:" as no lamp on this construction could be procured, Mr. Newman was directed to make one on the model of that described by the Committee; but as it was concluded that the three tubes would be insufficient to maintain the combustion, three additional ones were inserted. Notwithstanding which it was found that the lamp was completely incapable of burning, unless it had a chimney so far approaching to the cylindrical form, that the air could pass down it to feed the flame; a circumstance which, it is obvious, would render it useless as a safety lamp.

The third lamp, instead of the valve, or the tubes, had metallic plates, both at its lower part, and at the upper end of the chimney, in which were apertures of about $\frac{1}{6}$ of an inch in diameter. The identical lamp upon which these experiments were performed, was one that had been made under Mr. Stephenson's inspection, and had been furnished by him to one of the collieries for their use; in every trial to which it was subjected it was insufficient to prevent explosion.

The fourth lamp seems to have been regarded by the Committee as not essentially differing from the third; and it so far resembled it, that it consists of a system of perforated metallic plates. In this, however, the apertures are reduced in size to from $\frac{1}{12}$ to $\frac{1}{22}$ of an inch in diameter; and, by this change, it is rendered incapable of communicating explosion; so that it may be entitled to the appellation of a safety lamp, so far as this part of its construction is concerned. It has, however, one very serious defect, which must, we conceive, in a great measure, render it inapplicable to the purposes of the miner. It has a cylindrical chimney of thick glass, which is nearly in contact, at its lower part, with the small apertures that surround the wick. When the lamp is exposed to an explosive compound, the small jets of flame that rise up through these apertures produce a degree of heat which must almost unavoidably break the glass; and this accordingly occurred with the lamp in question. Mr. Stephenson's friends seem to admit that this fourth lamp was not constructed until after Sir H. Davy's most important experiments were made public, and known at Newcastle.

The results of these experiments must be considered as peculiarly important, because they would appear to be very different from those that were obtained by Mr. Stephenson's committee, of which an account is given in their report.

XII. *Prizes proposed by the Royal Academy of Sciences for the Years* 1818 *and* 1819.

The Academy published in 1815, on the subject of a prize in natural philosophy, the following preamble:

Fruits acquire new properties as they advance to maturity, even where they are removed from the influence of vegetation; they afterwards pass readily to another state, and we do not yet know the changes which take place in their composition, and the causes which produce them.

The subject of the prize was, therefore,

To determine the chemical changes which take place in fruits during their maturation, and beyond this term.

In order to determine this question, it will be necessary to examine, with care, the influence of the atmosphere which surrounds the fruit, and the alterations which the air experiences. The observations may be limited to any kinds of fruit, provided they enable us to draw sufficiently general conclusions from them.

The memoirs which were sent not having fulfilled the conditions of the preamble, the Academy again proposes the same subject for the year 1819.

The prize will be a medal of gold, of the value of 3000 fr.

The period for the reception of memoirs is limited to Jan. 1, 1819.

The Royal Academy of Sciences proposes, as the subject of another prize in natural philosophy, the following preamble:

1. To determine, by accurate experiments, all the effects of the diffraction of the rays of light, direct or reflected, when they pass separately, or simultaneously, near the extremities of one or more bodies, of an extent either limited or indefinite, taking account of the intervals between these bodies, as well as the distance of the luminous focus whence the rays proceed.

2. To conclude from these experiments, by mathematical inductions, the motion of the rays in their passage near the bodies.

The prize will be determined in the public sitting of 1819; but the memoirs will not be received after Aug. 1, 1818, in order that sufficient time may be allowed for verifying the experiments which they contain.

The prize will be a gold medal of the value of 3000 fr.

Errata in the Account of Alex. Scott.

Our correspondent, who favoured us with this communication, has pointed out the two following errors. The Captain's name, with whom Scott sailed from Liverpool, is *Knubley*, not *Kimbley*; and the tribe of Arabs, mentioned in p. 123, line 13, is *Orgaebet*; not *Orgaeleet*.

ARTICLE XIII.

Magnetical and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.	
	Hour.		Variation.			Hour.		Variation.			Hour.	Variation.
Jan. 1	8h	40′	24°	40′	00″	1h	30′	24°	39′	53″		Owing to the shortness of the days, evening observation discontinued.
2	8	40	24	38	01	1	25	24	40	15		
3	—	—	—	—	—	1	25	24	37	50		
4	—	—	—	—	—	1	25	24	40	20		
5	—	—	—	—	—	—	—	—	—	—		
6	8	45	24	33	13	1	30	24	40	13		
7	8	50	24	36	00	1	35	24	43	07		
8	8	45	24	33	22	1	30	24	36	35		
9	8	45	24	35	35	—	—	—	—	—		
10	—	—	—	—	—	1	25	24	39	48		
11	8	45	24	37	38	1	30	24	40	23		
12	8	40	24	35	53	1	25	24	39	25		
13	8	50	24	35	24	1	10	24	40	06		
14	—	—	—	—	—	1	35	24	36	17		
15	8	35	24	32	10	—	—	—	—	—		
16	8	45	24	33	47	1	15	24	39	42		
17	8	45	24	35	00	1	20	24	39	54		
18	8	45	24	33	56	1	45	24	38	42		
19	8	40	24	34	51	1	20	24	40	56		
20	8	45	24	34	21	1	20	24	39	56		
21	—	—	—	—	—	1	20	24	40	27		
22	8	20	24	34	04	—	—	—	—	—		
23	8	40	24	33	38	1	45	24	41	07		
24	—	—	—	—	—	1	15	24	38	35		
25	8	40	24	34	16	1	20	24	40	53		
26	8	45	24	33	35	1	20	24	41	13		
27	8	40	24	35	00	1	15	24	41	13		
28	8	40	24	34	23	1	30	24	40	52		
29	8	10	24	34	25	—	—	—	—	—		
30	8	40	24	34	37	1	40	24	41	02		
31	8	25	24	33	10	—	—	—	—	—		
Mean for Month.	8	40	24	34	01	1	26	24	39	57		

The violence of the wind and rain prevented any observation being made on the 5th.

At noon on the 18th the weather was fine, and the wind blew very fresh from the west by the north; and on the rising of some clouds in the north west, the needle became unsteady, and vibrated at intervals 36′; in the course of half an hour a violent storm of hail and snow came from that quarter.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Jan.		Inches.				Feet.		
	Morn....	29·563	25°	81°	NE		Clear	23°
1	Noon....	29·553	29½	75	NE		Fine	30½
	Even	—	—	—	—		—	
	Morn....	29·543	31	78	ENE		Cloudy	26
2	Noon....	29·530	32	79	ENE		Snow	32½
	Even	—	—	—	—		—	
	Morn....	—	—	—	—		—	29
3	Noon....	29·070	32	80	ESE		Sn. fog	32
	Even	—	—	—	—		—	
	Morn....	—	—	—	—		—	32
4	Noon....	29·023	42	74	SSW		Fine	40½
	Even	—	—	—	—		—	
	Morn....	—	—	—	—		—	31
5	Noon....	—	—	—	—		—	42
	Even	—	—	—	—		—	
	Morn....	29·465	35	81	NW by W		Very fine	31
6	Noon....	29·600	39	73	NW		Very fine	39
	Even	—	—	—	—		—	
	Morn....	29·680	35	87	SW by S		Cloudy	31
7	Noon....	29·600	44	76	WSW		Cloudy	46
	Even	—	—	—	—		—	
	Morn....	29·615	36	65	NW by W		Fine	35
8	Noon....	29·710	40	59	W		Cloudy	41
	Even	—	—	—	—		—	
	Morn....	29·640	37	82	SW by S		Cloudy	32
9	Noon....	—	—	—	—		—	47
	Even	—	—	—	—		—	
	Morn....	—	—	—	—		—	37
10	Noon....	29·358	51	75	WSW		Fine	52
	Even	—	—	—	—		—	
	Morn....	29·350	46	90	SW by S		Cloudy	46
11	Noon....	29·273	47	87	SSW		Fog, rain	48
	Even	—	—	—	—		—	
	Morn....	29·370	38	65	W by N		Clear	36
12	Noon....	29·565	40	57	W		Fine	42
	Even	—	—	—	—		—	
	Morn....	29·368	47	85	SW		Drizzle	38
13	Noon....	29·330	49	77	SW by W		Drizzle	49
	Even	—	—	—	—		—	
	Morn....	—	—	—	—		—	42
14	Noon....	29·320	44	76	WNW		Showery	49
	Even	—	—	—	—		—	
	Morn....	29·210	49	75	WSW		Drizzle	40
15	Noon....	—	—	—	—		—	49
	Even	—	—	—	—		—	
	Morn....	29·410	47	65	W by S		Cloudy	46
16	Noon....	29·402	49	64	W		Cloudy	49
	Even	—	—	—	—		—	
	Morn....	29·345	36	64	W by S		Clear	36
17	Noon....	29·420	40	50	W by S		Very fine	42
	Even	—	—	—	—		—	
	Morn....	29·455	36	67	W by N		Clear	32
18	Noon....	29·543	41	65	W by N		Fine	42
	Even	—	—	—	—		—	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Jan.		Inches.				Feet		
19	Morn....	30·000	31°	67°	W by N		Very fine	30°
	Noon....	30·000	38	56	SW		Very fine	40
	Even	—	—	—	—		—	32
20	Morn....	29·881	33	75	SSW		Fine	
	Noon....	29·790	39	66	SW by S		Fine	41
	Even	—	—	—	—		—	31
21	Morn....	29·420	—	—	SSW		Fog, rain	
	Noon....	29·543	44	56	W by N		Very fine	44
	Even	—	—	—	—		—	30
22	Morn....	29·524	35	79	SSW		Cloudy	
	Noon....	—	—	—	—		—	45
	Even	—	—	—	—		—	31
23	Morn....	29·248	32	79	SW by S		Fine	
	Noon....	29·082	38	80	SW		Rain	40
	Even....	—	—	—	—		—	31
24	Morn....	—	—	—	—		—	
	Noon....	29·000	40	75	WNW		Showery	41
	Even	—	—	—	—		—	32
25	Morn....	29·518	33	80	NW by W		Very fine	
	Noon....	29·535	40	57	W		Cloudy	41
	Even	—	—	—	—		—	40
26	Morn....	29·390	46	84	W		Cloudy	
	Noon....	29·420	49	71	SW		Cloudy	50
	Even ...	—	—	—	—		—	33
27	Morn....	29·470	34	74	WSW		Cloudy	
	Noon....	29·437	40	61	SW		Very fine	41
	Even	—	—	—	—		—	34
28	Morn....	29·080	36	87	SW		Rain	
	Noon....	29·088	41	69	W by S		Very fine	41
	Even	—	—	—	—		—	30
29	Morn....	29·235	31	80	SW		Very fine	
	Noon....	—	—	—	—		—	43
	Even....	—	—	—	—		—	31
30	Morn....	28·552	41	69	SW by S		Hail, rain	
	Noon....	28·490	41	67	SSW		Showery	42
	Even....	—	—	—	—		—	32
31	Morn....	28·830	32	44	NW		Very fine	
	Noon....	—	—	—	—		—	—
	Even....	—	—	—	—		—	

Rain between Jan. 1, and Feb. 1, by the pluviameter, was 1·798 inches. The quantity that fell during the same period on the roof of my observatory, was 2·045 inches. The evaporation between noon Dec. 2, and noon Feb. 1, was 2·04 inches.

Article XIV.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer. Max.	Min.	Med.	Thermometer. Max.	Min.	Med.	Hygr. at 9 a. m.	Rain.	
12th Mo.										
Jan. 1		30·01	29·96	29·985	33	21	27·0	90		
2	S E	29·96	29·58	29·770	33	31	32·0	80		
3	S E	29·58	29·43	29·505	40	32	36·0	75	13	
4	S	29·64	29·48	29·560	44	32	38·0	100	—	
5	Var.	29·90	29·48	29·690	42	28	35·0	80	51	
6	S W	30·15	30·10	30·125	41	29	35·0	85		●
7	S W	30·03	29·82	29·925	47	36	41·5		17	
8	N W	30·18	30·05	30·115	41	29	35·0	58		
9	S W	29·85	29·76	29·805	48	39	43·5	83	11	
10	S W	29·75	29·72	29·735	52	47	49·5	93	3	
11	N W	29·76	29·50	29·630	49	36	42·5	80	9	
12	S W	29·92	29·78	29·850	47	37	42·0	60	3	
13	S W	29·85	29·79	29·820	50	40	45·0	77	—	
14	S W	29·83	29·60	29·715	50	39	44·5	95	24	☽
15	W	29·80	29·56	29·680	53	45	49·0	70	—	
16	W	29·76	29·46	29·610	50	35	42·5	58	16	
17	W	29·88	30·85	29·865	40	32	36·0	60		
18	Var.	30·40	29·85	30·125	42	28	35·0	65	—	
19	S W	30·43	30·30	30·365	38	27	32·5	70		
20	Var.	30·30	29·85	30·075	40	28	34·0	95		
21	Var.	30·12	29·92	30·020	45	26	35·5	89		
22	S W	29·65	29·40	29·525	45	31	38·0	90	12	○
23	Var.	29·60	29·42	29·510	41	28	34·5	72	18	
24	N W	29·93	29·39	29·660	43	29	36·0	93	9	
25	W	28·87	29·79	29·830	47	34	40·5	72	1	
26	S W	29·88	29·60	29·740	52	32	42·0	76	1	
27	S W	29·88	29·50	29·690	46	35	40·5	72	17	
28	N W	29·65	29·50	29·575	43	28	35·5	85	—	
29	S W	29·65	28·98	29·315	43	32	37·5	77	27	☾
		30·43	28·98	29·786	53	21	38·46	78·5	2·32	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first c... A dash denotes, that the result is included in the next following obs...

1

REMARKS.

First Month.—1. Fine. 2. Much wind in the night: snow by morning. 3. After some snow, a thaw, p. m. 4. Small rain, a. m.: fair, p. m.: starlight. 5. Wet stormy day: clear night. 6. Hoar frost: fair. 7. Fair, a. m.: cloudy, p. m.: a gale, with rain, during the night. 9. Wet mid-day: the *Cirrocumulus* has appeared two or three times within a week past. 10. *Cirrus* and *Cirrostratus* at sun-set, rose-coloured, followed by a gale with rain. 11. Gloomy, a. m. with small rain, p. m. and night as yesterday. 12. Fine day: a gale again in the night. 13. The gale continued, with cloudy weather: the night, after a calm evening, was stormy. 14. Wet stormy day: in the evening, *Cumulus*, with *Cirrostratus* and *Cirrus*: the air clearing: much wind in the night. 15. Much cloud and wind, a. m.: small rain, p. m.: night stormy. 16. Fair, with a gloomy sky, a. m.: some rain, p. m.: a heavy gale in the night. 17. The wind is now more moderate, with a tendency to N.W: a very fine day and night. 18. Fair, with a breeze: a squall, with a little rain, p. m.: bright moonlight. 19. Fine. 20. Red *Cirrostrati* at sun-rise, with hoar frost: fine day, with *Cirrostratus* in flocks: *Cirrocumulus*, and *Cirrus*, with a rainy aspect. 21. Gloomy overcast morning: some wind and rain by nine: afterwards fine with *Cumulus*, and a breeze from NW: lunar halo. 22. Fine: windy, p. m.: in the fore part of the night, a heavy southerly gale, with showers. 23. Fine, windy: the barometer fluctuating: lunar corona at night: the wind NW. 24. Rain very early: wet forenoon, p. m. and night fair: windy. 25. Fine, a. m. with *Cirrus* and *Cirrostratus*: windy night. 27. Much wind in the night, followed by rain. 28. Large *Cumuli*, with *Cirri* above; and the rapid development of *Cumulostrati* presented this afternoon a spring-like sky. 29. Hoar frost: fair day: a thickness to the S. and W. p. m. was followed by a nocturnal gale, with rain, as usual of late.

RESULTS.

Winds Westerly, introduced by the South East.

Barometer:	Greatest height	30·43 inches;
	Least	28·98 inches;
	Mean of the period	29·78 inches.
Thermometer:	Greatest height	53°
	Least	21°
	Mean of the period	38·46°
Mean of the hygrometer		78·5°
Rain		2·32 inches.

Character of the period, stormy and changeable: amidst a succession of gales of wind, there were many intervals of fine weather by day; and, as the thermometer shows, of frost by night.

Tottenham, *Second Month*, 20, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

APRIL, 1818.

Article I.

Biographical Account of M. Le Sage.

NOTHING can exhibit a more remarkable example of the effect of certain forms of government, modes of education, and states of society, than the condition in which the little Republic of Geneva has been maintained for the last three centuries. A territory smaller than the smallest county of England, and a population less than $\frac{1}{30}$ of the inhabitants of our metropolis, has produced a succession of men of learning and science, which has greatly exceeded that of some of the most extensive and powerful kingdoms of Europe. In the present number of the *Annals* we propose to give a brief account of one of the natives of that city, who, although less known abroad than many of his countrymen, has considerable claims upon our attention, as well from the extent of his abilities, as from some remarkable peculiarities in his character and turn of mind.

George Louis Le Sage* was born at Geneva, June 13, 1724. His father was a native of Burgundy, but had for some years before retired to Switzerland, where he supported himself by teaching mathematics and natural philosophy. The elder Le Sage appears to have been a man of talents, although not of the

* In the biographical sketch of Lord Stanhope, which was inserted in our number for February, we inadvertently fell into an error, in confounding the works of M. Le Sage, his Lordship's tutor, the subject of our present memoir, with M. B. G. Sage, of Paris, Professor of Chemistry and Mineralogy in "l'Ecole des Mines de la Mounoié." The error was pointed out to us by a friend, and we were induced, from this circumstance, to examine the interesting account of the life of Le Sage, of Geneva, drawn up by Prof. Prevost, from which we have principally extracted the materials of the present memoir.

first order, and at the same time to have possessed a singular disposition and train of sentiments, which had a very marked influence upon the character and pursuits of his son. He was the author of a considerable number of treatises, upon a great diversity of topics, metaphysics, belles lettres, natural philosophy, and economics; but we believe that their reputation has not extended into this country. The subject of our memoir acquired the first rudiments of his education entirely from his father, who appears to have been very anxious to procure for his son every advantage of which his confined resources admitted, and to have spared no pains, or labour, in giving his young mind what he conceived to be the right direction in the pursuit of knowledge. It, however, unfortunately happened, that no two individuals, perhaps, ever possessed a more decided opposition in their natural tastes and intellectual faculties, than the elder and younger Le Sage. The father's sole object was to acquire the knowledge of insulated facts, and to store up individual pieces of information, at the same time that he discarded all system, or attempts at generalization. The son, on the other hand, seems to have been slow in obtaining knowledge, and still more in retaining what he learned, in consequence of a singularly defective memory, while, from a very early period of his life, he was fond of arranging facts and connecting them into a systematic form. This disposition of the son was checked by the father with constant and even harsh perseverance; which, while it had no effect in altering the natural bent of the young man's mind, repressed the warmth and impetuosity of his feelings, and tended most materially to increase and confirm a tendency to shyness and reserve, which he very early manifested. This was still further increased by the behaviour of his mother, and by the general habits of the family, in which parental authority and filial obedience seem each of them to have been carried to an extraordinary extent. In a less tender and complying mind than that of Le Sage, this undue restraint might have been productive of the most unfavourable consequences, both to the intellect and the morals of the individual subjected to it. But although he felt it, and even did not scruple to call it a system of tyranny, his gentle disposition never led him to think of rebelling; but induced him to spend his leisure hours in silent meditation, deprived, as it would seem, of most of the gratifications and amusements of childhood, but without degenerating into spleen or misanthropy. One point, which was a regular part of the discipline of his father's house, was the keeping silence, and never asking what his parents were pleased to consider as idle questions; and this Pythagorean system was adopted with so much strictness, that through life he never acquired a facility of expressing himself; although he afterwards made many useless efforts to counteract this defect of his education.

This cruel restraint had, however, its advantages, although they were of an indirect nature, and very different from what was intended or expected by his parents. As he had no one to whom he could open his heart or unbosom his ideas and emotions, his mind recoiled upon itself; and being of a nature not to be repressed, its energies displayed themselves in a different direction. He spent his solitary and silent hours in musing on the causes of what he saw around him; his reasoning powers became strengthened by this intellectual exercise; and as he was debarred from applying to his parents for the information which he was anxious to obtain on various topics, he very early began to question nature herself. Some of his puerile experiments, which are recorded, are strong indications of his powerful mind; and there is one, made when he was only about 10 years of age, which is so characteristic that it deserves to be selected. The religious system of his parents enjoined a considerable degree of strictness in the observance of Sunday, especially in abstaining from all kinds of occupation; and in order to discover whether the Deity on that day ceased from his labours, in the same way that the human race were commanded to do, he carefully ascertained the daily rate of the growth of some plants, and examined whether there was any difference between the growth of Sunday and of the other days of the week. The chief work on natural philosophy, to which Le Sage had access during this part of his education, was that of Bernard Palissy, a work, in some degree, adapted to inspire him with a turn for inquiry, although not well fitted to give him very accurate ideas: he likewise profited by the lectures that were given in the college of Geneva, and studied under Calandrini and Cramer; the one Professor of Natural Philosophy, the other of Mathematics. But although these circumstances, in some measure turned his attention to experimental science, yet he remained most attached to abstruse and abstract reasoning; and it is remarkable how the natural, or, at least, the early acquired bent of his mind operated upon every thing connected with his education, so as to deduce from it a contrary effect to that which was designed. A remarkable case of this kind occurred when he was about 13 years of age: some one having lent his father the work of Montfauçon, entitled "L'Antiquité Expliquée," he gave it to his son, hoping to excite in his mind a turn for objects of that description. The young man studied the work with attention; but instead of the effect expected by his father, Le Sage was entirely occupied with detecting the fallacy of the author's reasoning respecting the use of certain ancient instruments that are described; and the ideas which he then acquired, after being matured by some years' reflection, gave rise to his ingenious remarks on final causes, entitled, "Teleologie de la Nature et de l'Art."

It would appear that at a very early period of [illegible] our philosopher began to meditate upon that subje[illegible] [illegible]ards engaged so large a portion of his thoughts, the cause of gravity, or physical attraction. Several circumstances of a minute, and apparently trifling nature, led him to this topic; but it seems to have been the perusal of Lucretius's poem which produced the first distinct conception of his future hypothesis; and from this time he carefully abstracted and treasured up every idea which had any bearing upon it, or connexion with it. An instance of this is on record, which deserves to be related, as a remarkable example of the principle which forms so distinguishing a feature in his character, as well as of his youthful sagacity. He commenced about this period the study of geometry, and he informs us that it enabled him to demonstrate the fallacy of a method, which had been proposed by M. Combes, for the quadrature of the circle, and that the reasoning which he employed on this occasion formed the basis of the first solutions that he discovered of a specious objection which had been opposed against every explanation of gravity by mechanical impulse. We learn from this circumstance that he had advanced so far in his hypothesis, while still employed in the elementary part of his studies, as to have formed a distinct notion of the effect of *impulse*. Deluc, who was a contemporary of Le Sage, relates a conversation which took place between them on the same subject, in which the latter attempted to prove to his youthful companion that the horse does not draw a carriage, but pushes it forwards with his chest. The mathematical studies in which he was now chiefly occupied appear to have been congenial to his taste and feelings; that devoted attachment to order and method, which he so early manifested, he had an opportunity of indulging; and he found that he was better able to render himself respectable in the eyes of his schoolfellows, than when he was engaged in those pursuits which more immediately depended upon the exercise of his memory, which, as we have already observed, was so peculiarly defective. Of this deficiency he was himself perfectly aware; and, indeed, one of the great objects of his subsequent exertions was to supply this defect by artificial methods, and by the most scrupulous attention to accuracy, in arranging every fact, and every additional piece of information, which he obtained. He so far succeeded as to be able, on all occasions, to recall at pleasure any ideas which had previously been stored up; but he always found an insuperable difficulty in the acquisition of languages, or in those studies which depend immediately upon the exercise of memory.

The time was now arrived when it became necessary for the young Le Sage to make choice of a profession, a determination which was rendered extremely difficult and painful, both in consequence of the natural indecision and timidity of his disposition, and because on this, as on so many former occasions, his wishes and those of his parents were directly in opposition to each other. He had already acquired so strong a passion for philosophy, that it appeared to him the only object worthy of his attention; and being totally devoid of the ambition of acquiring wealth, he was anxious to devote his whole life to study. But his father, who felt the disadvantages of his own confined circumstances, insisted upon the young man entering on some vocation which might afford a more certain and ample means of subsistence, and these prudential views finally prevailed over the ardent, yet timid spirit of the son. After wavering for some time between theology and medicine, he finally decided in favour of the latter; and for this purpose left his father's roof, and went to pursue his studies at the University of Basle.

Although, by his removal from Geneva, he was freed from the immediate tyranny of his parents, it does not appear that his comfort was much increased by the change. His manner and disposition were totally adverse to his entrance into the world, his shyness and awkwardness were become more conspicuous, and his limited finances did not enable him to profit by the advantages of his situation, although he eked out his scanty income by teaching mathematics. Yet, notwithstanding these obstacles, he enjoyed at Basle a comparatively tranquil existence; and he looked back upon this period of his life with a degree of regret, which would lead us to fear that happiness was, at all times, dealt out to him with a very sparing hand. In this situation he remained little more than a year, and then went to continue his medical studies at Paris. Here he had to contend with the same difficulties as at Basle, his want of personal address, the narrow state of his finances, and the confirmed dislike which he felt for the studies peculiar to the profession which he had chosen. He appears, indeed, to have been sensibly alive to the many unpleasant circumstances which attended his progress through life and clouded his future prospects. In some of his letters, which are still extant, he describes with much force and naiveté the mortifications and privations to which he was daily subjected; yet he submitted with his usual resignation and meekness to what he regarded as his unalterable fate, and never ventured to contradict, or even to expostulate with his father on any of the points on which they had formed such opposite opinions. His residence at Paris was, however, in some respects the most important period of his life; for although his time was chiefly devoted to pursuits that were altogether uninteresting, or even irksome to him, yet his unremitting diligence enabled him to reap some advantage from the situation in which we was now placed, at the fountain-head of learning and science. His genius seized every opportunity which offered of expanding itself, and he made a certain, although not very considerable progress in the path to which his early taste had so decidedly directed him. The smallness of his income induced him at Paris to devote part of his time to instruction, as he had before done at Basle, and he was engaged as a tutor in a private family for the space of a year but it does not appear that he was very well adapted for the office, and he quitted the employment, without either giving or receiving much satisfaction.

When he had spent about two years in Paris, although he had not nearly completed his medical education, his father insisted upon his leaving the university and commencing his professional career. With his usual pertinacity and wrong-headedness, and totally disregarding the feelings of his son, he announced his arrival in Geneva by a public advertisement in the papers; this roused the animosity, or excited the jealousy of the elder practitioners, identifying, probably, the characters of the father and the son, and caused them to enforce a dormant regulation, by which persons who were not freemen of the city were not permitted to practise medicine within its walls. This interdiction, which was absolute and without appeal, blasted all the hopes and projects of the father, and reduced him to a state of apathy and indifference, which caused him at once to resign all authority over his son, and even, apparently, to lose all interest about him. He never more interfered with his plans, but left him to extricate himself, as well as he could, out of the difficulties in which he had involved him.

The health and spirits of the younger Le Sage were much affected by the uncertainty and embarrassment into which he was thus thrown: he formed many projects, which were abandoned almost as quickly as they were formed; but at length he determined to remain at Geneva, and embraced the occupation of his father. It is a little remarkable, that although he had originally entered upon the study of medicine so contrary to his inclination, and had even pursued it, apparently, with so little relish; yet now that an opportunity offered in which he might have indulged the natural bent of his inclination, he made considerable exertions to accomplish the object. These, however, failed; and when no other means offered by which he could be enabled to pursue the profession for which he had been destined, in the 26th year of his age he entered with his accustomed ardour and assiduity upon his new employment, and remained devoted to it for the remainder of his life.

The *narrative* part of this article may be considered as terminating with the establishment of Le Sage at Geneva as a preceptor; for the remaining events which befel him were entirely of a literary nature, consisting of the intercourse, or connexion, which he had with men of science, and the various philosophical topics to which he, from time to time, directed his attention. His constitution was naturally not vigorous; and his literary habits, especially the custom in which he indulged, from an early period, of meditating during the hours of sleep, rendered him liable to many serious infirmities. His temperance and regularity tended, however, to counteract these unfavourable circumstances, so that his life was protracted until his 80th year. During a long period he was afflicted, to a very great degree, with sleeplessness, from which he not only experienced the ordinary unpleasant consequences, but his intellectual faculties were seriously affected, and reduced at times to a state of extreme incapacity. But this unhappy malady was only of temporary duration; and whenever he was freed from it, his mind retained all its vigour, and enabled him to resume his studies with full effect. His exemplary diligence, and his habits of order and regularity, which were extended to all subjects in any way connected with his literary pursuits, enabled him to make a greater degree of proficiency in many abstruse departments of science than even most individuals who had not such obstacles to oppose their progress. We have already alluded, on more than one occasion, to the remarkable deficiency of his memory; this defect remained with him through life; for although by extraordinary method in arranging his ideas and his knowledge, he was able to recal and make use of them at pleasure, it all depended upon the employment of a technical system, which, while it served as a substitute for memory, would tend by its operation to prevent the improvement of the faculty itself.

But although Le Sage was a man of so much diligence and so much method, yet he accomplished less, perhaps, than might have been expected from this combination of qualities. This depended upon two circumstances: the originality and profundity of his views, which prevented him from proceeding rapidly in his course; and the fear which he felt of committing his works before the public tribunal in an imperfect form. What he published were short treatises, comparatively of little importance, often written on particular occasions, as prize essays, or insulated memoirs, inserted in the Transactions of various learned societies. Of these detached productions, perhaps, the most important are, "Essai sur l'Origine des Forces Mortes," which was presented to the French Academy of Sciences, but not published by them; and "Essai de Chimie Méchanique," in which he endeavoured to explain all the phenomena of chemical affinity by the operation of an impulsive fluid, which obtained half the prize that was proposed by the Academy of Rouen. Besides these, and some smaller tracts, which were published during his life, he maintained a very extensive correspondence with many of the most learned men of the age, who appreciated his merit and valued his friendship; and he left behind him a number of works, in a more or less perfect state, which were the unfinished results of his studies and meditations, and which he appears to have regarded as the basis of his future fame, although, by a strange inconsistency, he omitted the essential means of deriving the desired object from them. His most considerable unpublished work, that which contains his matured opinions on his favourite topic, is his "Traité des Corpuscules Ultramondains." The object of this elaborate performance is to account for the ph mena of gravitation by the mechanical principle of impulse, a problem which very early in life occupied his attention, and which it was the great aim of all his exertions, and the height of his ambition to resolve.

Little need be added with respect either to the intellectual or moral character of Le Sage, as they may both be easily appreciated from the above sketch of his life. He possessed some requisites for a genius of the highest order; he had originality of invention, an unusual power of abstraction, and a sufficient command over his mental faculties, when they were in a perfectly vigorous state: but he seems to have wanted that strength of judgment, and that firmness of decision, which might have enabled him to profit by his other talents. Nothing can offer a more remarkable example of this state of character than the circumstance of his passing a long life, continually meditating upon his theory, attaching the utmost importance to it, and most firmly convinced of its truth, yet never venturing to announce it to the world, either because he could not bring it into what he considered a perfect state, or because he conceived that there were few individuals qualified or disposed to comprehend it. The moral qualities of Le Sage stand at least as high as his intellectual; but, like them, they possessed many singular traits. Owing to his defective memory, he was very much in the habit of putting down his thoughts in writing as they occurred, and he has consequently left us many remarks of a singular nature, which he made upon his own character and dispositions. He was a man who scrupulously adhered, on all occasions, to what he thought just and true; he was without guile, without reserve, except that of modesty, and without artifice. He was timid and diffident to an extraordinary degree, and had not a single spark of what can be called ambition, except with respect to the fate of his favourite theory. His feeble constitution, and the cruel restraint by which he was weighed down for nearly 30 years of his life, must have contributed to increase, or, perhaps, almost to produce these defects or peculiarities; and the station which he held in society was not of that kind to enable him to counteract their effect by any external advantages. He was perfectly sensible of his deficiencies, and seems to have been conscious of possessing mental powers and energies which had not the means of properly expanding themselves; yet there was an habitual resignation in all his feelings, which led him to submit with composure, if not with cheerfulness, to what seemed inevitable. His submissive and subdued spirit led him frequently to draw advantages from his misfortunes, and of this he has left us a curious specimen in the supposed benefits which he deduced from his want of memory: of these he pointed out three; 1. That not being able to shine in society, he was secured from vanity; 2. Not being able to impose upon other men, he was secured from falsehood; 3. From absolutely forgetting injuries, he necessarily pardoned them. In summing up the merits of Le Sage, we must not omit to mention that he was a steady and faithful friend; and although so little qualified to engage the notice of the multitude, there were few persons who could boast of the sincere attachment of a larger circle of men of distinguished talents and worth.

Although Le Sage did not publish any connected or complete view of his theory, yet it has been brought forward, in a more or less perfect form, by his friends or pupils. Its great object was to give a mechanical explanation of the cause of gravity, or physical attraction, and to refer all the phenomena to the effect of impulse. When Newton had explained the laws of the system of the world by attraction, he was aware that there might be some mechanical cause for attraction itself; but neither he nor any of his contemporaries or pupils were able to reveal the mystery. Indeed for some time the attempt was entirely abandoned, either as hopeless, or as useless; and no theory that had been offered on the subject was regarded as of any value, when Le Sage undertook to solve the problem, and devoted all his energy, and a large portion of his life, to the attempt. The agents which produce these grand effects are styled by our author gravific corpuscles, or atoms; and it must be admitted that if we once allow of their existence, and conceive them to possess the properties that he assigned to them, the actual phenomena of attraction and gravitation must be the necessary result. These atoms, which are supposed to be indefinitely small, traverse through space in all directions, each atom moving in a straight line in a determined direction, and with a velocity much superior to that of light. The directions of these atoms are various, and their velocity is so great, that although they follow at an immense distance from each other, so that space may be considered almost as a vacuum, yet they abound every where. To comprehend this apparent paradox, we must bear in mind that the atoms pass through every point of space in all directions in an indefinitely short interval of time; so that every point may be regarded as the centre of an innumerable assemblage of atoms, both converging and diverging; or we may conceive that, at every instant, a multitude of atoms arrive at this point from all parts of space, and that, at the same instant, a number of atoms pass from it to all parts, in every possible direction. Having formed to ourselves this idea of a gravific fluid, let us now conceive a solid body immersed in it, bounded by convex surfaces, or by projecting angles, and much larger than an atom of the fluid. This body will remain immoveable, or, at least, it will not be urged by any constant motion; it can only be tossed about by the inequality of the currents, so as to make irregular oscillations. But if we now immerse into the fluid a second body, at some distance from the first, the two bodies will approach each other. For one will now serve as a kind of guard, or skreen to the other; and the opposite currents, having no antagonists, become positive in their operation upon the bodies, and produce a constant motion in them towards each other. And we shall find, by considering the circumstances under which these bodies are placed, and the supposed nature of the fluid, that this motion must be uniformly accelerated, and in the inverse ratio of the square of the distance, as all the forces are which are conceived to depend upon the Newtonian attraction.

If bodies were all equal in the quantity of matter which they contained, or if the quantity of matter was always in proportion to their bulk, their attraction would be in the same proportion. The quantities of matter are, however, unequal in proportion to their bulk; and if we suppose that the gravific fluid can pass through the pores of bodies, and that it is only stopped by the actual particles which they contain, we shall find that a body must always intercept a number of the atoms exactly in proportion to the number of its particles, or that the attraction of bodies must be in proportion to the quantity of matter which they contain. Hence we arrive at the explanation of the great law, that the power with which bodies attract each other, or to use Le Sage's expression, with which they are impelled towards each other, is in the direct ratio of the quantity of matter, and the inverse ratio of the distance. This may be regarded as the essential fact of Le Sage's theory, the base upon which he attempted to erect the grand edifice, and the master key with which he proposed to unlock the secret recesses of nature's operations.

In considering any theory of this description, the first question that we ought to ask is, whether we have any actual evidence of its truth; whether there be any positive fact, or any independent phenomenon, which can really lead us to conclude that this gravific fluid exists? To this question we are obliged to answer in the negative; it is not the object of any of our senses, and, in short, there is nothing which in any way indicates its presence, or announces its existence. We are then to regard it simply as an hypothetical body, called in to explain a set of phenomena; and here, then, two new questions present themselves: Does it explain all the phenomena? and does it in any degree tend to generalize them, or to reduce them to a form which is more consonant to the ordinary operations of nature? If it fail in the first of these respects, it is palpably false; if in the second, it is useless. As far as we are able to judge of the theory, it will be found to be correct in all its applications, and, therefore, is not to be rejected on the first account; but the question of utility is, perhaps, more doubtful. On the subject of generalization there are two main points which Le Sage professes to have accomplished; first, to reduce all the motions of attraction and repulsion to the influence of one agent, or to show that they are exactly reducible to the same laws; and, secondly, to prove that all motion, of whatever kind, is merely a mode of impulse. Of the existence of the communication of motion by impulse, we have innumerable examples always before our eyes; we also see frequent instances of what we call attraction; but it is supposed that this latter is a more incomprehensible operation than the former, and one with which we are less familiar and less able to trace the steps by which it is produced. So far, therefore, Le Sage's theory *may* be useful, and so far it *seems* to advance us a step nearer to the ultimate object of all our researches.

It must, however, be acknowledged, that there are, on the contrary, some considerations which lead us to doubt the utility of all speculations of this kind. And, in the first place, it is a circumstance of no small import to the makers of systems, that no theory which proceeds upon the assumption of any imaginary agent, like the gravific atoms of Le Sage, has ultimately kept its ground, however ingenious they may have appeared, and whatever applause such speculations may have obtained from contemporary writers, they have ultimately fallen into oblivion, or have only been remembered as appendages to the other productions of their respective authors. So far indeed from adding to their celebrity, they generally operate in the directly contrary manner, they are tolerated rather than admired, and we view them with regret, as a melancholy misapplication of labour and genius. And, if we apply these reflections to the subject of our memoir, when we consider what a large portion of his intellectual existence was spent in the construction of this system, when we estimate the number of hours and days which he devoted to it, and inquire what is the result, compared to what might have been accomplished by the same expenditure of time and labour, had he devoted them to the direct advancement of either mathematical or experimental science, we cannot but regret the choice which he made. It may be further observed that the influence of such systems is often very unfavourable on the state of science, at least on the minds of many of those who cultivate it. They are too apt to mistake the nature of the advantage which alone ought to be expected from these speculations: they do not regard them as the means of acquiring knowledge; as affording a commodious nomenclature, which may enable us to express our ideas with greater clearness; or as a species of algebraic notation, by which we may designate these ideas in a precise manner, where, however, there is no natural resemblance or relation between the idea and the mode of expressing it, but they suppose them to be an actual detail of facts; they reason concerning the atoms, and ethers, and subtile fluids, as if they were real existences, and build upon them a thousand whimsical notions, which never entered into the contemplation of their original framers. We are therefore inclined to doubt whether any real benefit would be conferred upon philosophy by any further elucidation, or illustration, of Le Sage's theory of gravity than it has hitherto received from his friends or pupils. It is treading upon a kind of enchanted ground, where we have at all times to maintain a constant struggle between the imagination and the judgment, a contest in which the latter is too apt to be finally vanquished.

Article II.

On the Death of Plants. By Mrs. Ibbetson.

(To the Editors.)

GENTLEMEN,

To comment on the duration of the life of a plant, may be supposed, by the generality of readers, to be a matter purely speculative, and to have little connexion with the more useful sciences of gardening and agriculture. But in my late studies, and the experiments to which they have led me, though I have been anxious to elucidate the more difficult question, in what vegetable life consists, and to show its analogy to animal life; yet my chief aim has been to prove how very tenacious plants are of life, how slowly they quit that beautiful form which nature has bestowed on them, and how long they are in reassuming that state of agglutinated matter to which they are reduced by fermentation and decomposition, and from which they appear originally to proceed. I hope also to be able to show, of what extreme consequence this subject is to agriculture and gardening, how many very important and serious mistakes at present exist, and how much both those arts would be benefitted by a more clear insight into the subject.

It is comparatively easy to ascertain all that happens after the plants are killed and immersed in the earth: we know the commencement of the process and its termination, and hence we too hastily conclude that on this account we must necessarily be acquainted with the whole of the operation. But here we have formed too hasty a conclusion. It is of extreme consequence in agriculture to know, whether burying a plant will kill it? Whether vegetables, when placed in the earth, will make manure at all? That is, whether any process which they pass through when immersed in the soil will bring them back to the substance of mould; and if it will, how long time is requisite for that process? It is also important to be well informed how the earth acts on a dying plant. We know that vegetables require manure, but we are in the habit of employing what has not been clearly proved to be capable of affording them any nutriment. There are many contradictions in our opinions and practice in this respect: when our vegetables are taken out of the ground before they are wanted, we bury them in the earth to save them from the rot, and to preserve them from the frost; and yet we put in the same vegetables, almost in the same manner, to make manure of them, and even expect this change to take place in less time than we suffer them to remain buried for the purpose of preserving them. Now it is certain that they cannot be both preserved and destroyed by the same means; and, upon making the experiment, it soon became evident to me, that we had adopted a false conclusion on the subject. For some years past I have been continually in want of fresh young weeds for my dissections, and I found that I had only to go where the garthistles, bird weed, &c. would in two months, or three at furthest, make excellent garden mould; the very first support and food of plants." But should not Varlo have remembered that cabbages, carrots, turnips, potatoes, &c. are perpetually placed in the ground, on purpose to preserve them from the rot, which the air would undoubtedly produce; and from the cold, which would spoil them; that they remain there from four to six months, with no other disadvantage than the too hasty growth of the roots? That all these plants belong to that part of the vegetable which is soonest destroyed, that having little wood, of a very loose kind, it decays far quicker in the earth than ligneous plants; and that they would certainly be putrified within this time, if the soil did not possess a power of arresting all fermentation, for a certain season, and thus preventing the approach to putrefaction? After seeing how seeds are preserved in the earth, it is astonishing that any agriculturist should suppose that vegetables are easily susceptible of decomposition. That very eminent chemist, Sir H. Davy, has said, that the juices of one plant are of no use in making manure for others, till the plants have passed through the various processes of fermentation, putrefaction, and decomposition. No assertion can be more just; and before all this process can be much more than commenced, death, the most obstinate of all, must be perfected. To kill some vegetables, and prevent their resuscitation in the earth, is no easy matter, especially weeds that are sure to be natural to the soil in which they grow. There is also in every plant a certain part more liable than the rest to throw out radicles, when stimulated by the contact of earth; and if any one of the hearts of the seeds* is retained there (which is often the case), and that the want of air and moisture suspends the fermentation for a long space, so that the plant has time to accumulate *around the hearts of its seeds* that juice which will stimulate it to throw out its *radicles*, the vegetable, instead of fermentation and *death*, *will live* and *send up suckers*.

Now weeds are almost all natural to the soil in which they spring; they are most of them herbaceous or annual plants, of that loose and green kind of wood that is easily destroyed, and as quickly restored; and they have besides little wood, which is also in their favour: they are for all these reasons very liable to spring up anew. In grass the same causes act; but in woody plants life is more easily exterminated, and with greater difficulty renewed. I took up, however, the decayed part of the root of an apple tree; yet was a long and tender shoot almost as thick as my little finger, and half as long, produced from it; it was just formed, though the root to which it was attached was so decayed, as to have lost all its bark, and the greatest part of the wood was perfectly dead, except about an inch or two of the line

* I have shown that that small ball which is the heart of the seed, is that which comes from the root, and has within it that branch which forms the next year's shoot; it is most diminutive, but perceptible in the solar microscope.

of life. It was, therefore, approaching to the last stage of fermentation. On dissecting it three hearts of seeds were discovered, being evidently the source of this shoot, all three having united to form it.

Different plants seem to undergo the process of fermentation in a more or less complete manner; but we may conclude that every plant which has the saccharine fermentation has also the vinous, and that death generally succeeds them. It is often, however, a very long time before each change takes place, and still longer before it can reach putrefaction and decomposition. If the plant be killed by drawing the root out of the ground, the saccharine fermentation takes place directly; and if the whole plant be buried in this state, the fermentation immediately stops, and for a time all effect is suspended, till some accidental air, or moisture, gets access to it and renews it. Thus, by degrees (but at a very slow rate), both the saccharine and vinous fermentations succeed each other; but in ten times the period they would require to pass through the process in the open air, because they are only indebted to accident for the renewal of their fermentation; so that the length of the operation must be most uncertain and irregular.

It is easy to know the different states in which the vegetable is; the saccharine is always attended with a sweetish taste, and a clammy feel; in the next stage the sweetness has passed off, and the plant has less specific gravity. When once these stages are completed, during both of which, and more especially the latter, much caloric escapes; and when all the latent heat is evolved, if just preceding this last operation the heart of the seeds have not time or strength to collect the juices sufficient to excite the vital principle, the plant dies, and the line of life turns black. As soon as putrefaction has appeared in the external parts, the seed also dies, the whole vegetable becomes putrid, loses its form and shape, becomes a mass of fetid matter, and decomposition finishes this part of the process. But it still requires a long time to convert it into mould, and must require much additional matter to bring it to the state of rich garden earth.

The best mould of this kind is a compound of several different earths; it possesses also much animal and vegetable matter. Being of a porous consistence, and therefore exposed for near a foot in depth to the influence of the air, all its component parts are by this means decomposed and reduced. But that part of this earth which is peculiarly beneficial and excellent for the growth of vegetables consists of underground plants, probably of the nature of fungi, which, though they are so extremely diminutive as to require the aid of a microscope to enable us to pick them out, are in such quantities, and are of so tender and delicate a kind, an [illegible] t-lived, as to form a constant succession of nutriment [illegible] to ma to be of exactly the same colour as the earth in which they are found, nearly resembling the bark in their structure, and decaying in the same way; for that substance will seldom bear the contact of the earth, which quickly dissolves and putrefies it. I took up a quantity of these underground plants, and picked them out from the mould; but when placed in a very little earth, in a few days they had all disappeared; the richer the earth is, the more of these plants are discovered in it. The only thing that arrests their growth, is the hard baking of the soil on the surface, which, preventing the air from reaching them, hinders their springing up. I had thorough conviction of this, after trying a baked and gravelly soil; scarce any underground plants could be found; but when I discovered a large crack in the same earth, I examined the soil, and it was full of them, as far as the opening reached.

It is, therefore, to this species of plant the soil is indebted for the greatest part of its richness, and not to the woody plants of the upper ground, which seldom bestow manure worth having, unless it is in an almost uninhabited country, where the woods rot and die away, having, perhaps, a century in which to consume and return to their state of mould: then, indeed, they silently pass through all those various processes, which having for a long space the assistance of air, form *savannas* almost too rich for agriculture. But this requires such a length of time as can only be had in an almost uninhabited region.

I shall now show the effect of the trench in which I put a variety of plants. After an interval of three months, I opened it carefully on June 1; there was no alteration except in the weeds and grasses; the first had thrown out suckers; the grasses, a poor miserable set of roots which ran among the earth; all the branches of trees were alive; the cabbages, carrots, &c. &c. all in a perfect state of preservation. The next opening was in September. Still all was alive and well; but the weeds had again thrown out suckers, though before cut off, and the grasses spread upwards. The branches were in the same state as before, the leaves of the cabbages began to look brown and moist, and a degree of fermentation seemed to have commenced. The third opening was in November: all the leaves had fallen from the branches, but they were still alive: the weeds had not sprung up again, but they were still existing, though if they had been exposed to the open air they would not have been so: the earth, therefore, would certainly appear to possess the power of suspending their decomposition, and rendering the process far more slow and torpid than it would be under ordinary circumstances. The cabbages, which were before in a state of fermentation, were now evidently advancing to putridity; but it was only the leaves that were undergoing this change; for the stalks (though dead) were yet still perfect. The original potatoes were also beginning to decay; but the roots were alive with little fibres growing to them: the carrots were likewise still alive, and perfect. As to the grasses, and more especially the two everlasting peas, they ran through the earth in every direction; and I really believe if put three feet under ground, instead of one and a half, they, as well as the convolvulusses, docks, and many weeds of the kind, would extend themselves through the whole, and arrive at the surface.

This, I think, is proof sufficient that weeds and grass will renew themselves; and that it is filling the ground with their roots to return them to the earth after digging them up at so great an expense of time and money; and that the ground will never be clean as long as this is done. But if, on the contrary, they were brought to a waste place and burned, and their ashes collected, they would not only make excellent manure, but the earth, in a few years, would become perfectly clean from weeds, and all this labour would be spared. The branches have now been in the earth nearly three years; the first winter the walnut and plane died, but the oak and elm lived to the second: they have lost their bark; but with respect to the wood, they are to appearance as far from rot as at first. It may, perhaps, occur to some reflecting minds, that something of this kind passes before our eyes every year even in the air; since almost all the umbelliferous plants may be seen to lose their bark early in the autumn, and stand up in the hedges most conspicuously like frail white wands till the next summer, when the same root shoots again. I have often seen these wands, and marked them with a string, when they have retained their situation not only for one year, but till the second winter has passed, and they have at last given way to weakness rather than to putridity. If, therefore, this wood could support itself in the air for two years without showing any symptoms of decay, it may well be supposed it would require six or seven years to destroy it, if buried in the earth; how then are the roots to be destroyed by merely opening the earth in a fallow? *

Animal matter is said to be decomposed in the ground when lime is with it; but I found that when a piece of meat was placed in a trench, surrounded by lime, it remained six months unaltered, except that it appeared to have surrounded itself with a crust of matter, that prevented the egress, or regress, of any juices whatever, since the flesh grew perfectly hard and dry, and had not the whole time the least bad smell. From these facts we learn that we cannot depend on the decay of the animal and vegetable matter in the earth; and yet I have endeavoured to show, in the most positive manner, in the Philosophical Maga-

* It is useless to mention the turning in green crops, as the same argument holds good for all matters of this kind: not having yet passed through the growing process, they are still more unfit.

zine, that the earth furnishes matter for filling up the seed; and this nutriment probably is derived chiefly from the decay of the underground plants: great patches * of this nutritive matter are often to be found in the root.

I have now several trenches in several different soils, and I hope to give a further account, on a future occasion, which will render the subject more perfect. It appears to me of such consequence to agriculture and gardening, that I cannot help inviting gentlemen interested in this department to repeat my experiments, as they might very likely obtain from them more accurate results. I shall certainly not leave the matter till I ascertain the quantity of mould that may be gained from a given weight of vegetables.

It is admitted that some earths require less lime than others for this process: clay, for example, often contains pools of putrid water, which causes it to decompose vegetable matter much faster than any other earth; while in chalk all vegetables will last longer. In repeating the experiments, great care must be taken that the trough is well covered in, after being opened; for if water can enter it, and the earth is not well pressed together, it spoils the whole experiment; the soil should always be left in its common state of pressure, neither more or less, and not be subject to any rill of water. I have had several different trenches in one soil; but they have all given the same result, except in clay, where putrid water got to the leaves of cabbages and decomposed them in five months; I have now made one which shall remain till the vegetables become converted into mould, if I live so long. I have also made them in different soils, and hope to gain some knowledge from the comparative results in the course of the next two or three years.

It has been objected to me that the small quantity of vegetables in my trough was the cause of their not fermenting; but it was certainly much larger than gardeners, or farmers, ever put in one place to make manure. One of my trenches was as much as three feet deep, and of course held a very large quantity of weeds. It is, however, the principle to which I appeal, that either heat, moisture, or air, is absolutely necessary to fermentation; and that they can be acquired by the plants when buried in the earth only by accidental circumstances. I had a very large hole dug in the earth, and placed there a quantity of hay, that was heating in such a manner it was expected every moment to take fire; it was thoroughly covered, and all air excluded; it totally suspended the fermentation, though that which was spread in the air continued to smoke, and turned

* This powder is so completely to be traced in a tree at the time of seeding, that if the stem is cut every inch from the root, it may be followed all the way up to each separate twig in apertures made on purpose in the pith, and coloured with the powder.

quite black. Why do hay-ricks evaporate every morning and evening for a short time in dry weather? because the dew excites the evaporations, which precede the final extinction of life; nor can it be said that life is extinct, till all this evaporation and consequent fermentation has ceased. I am firmly of opinion that covering of a hay rick with a good thick tarpaulin would be much more likely to stop its firing than putting it abroad, and thus exposing it to fresh air and increased moisture.

I shall now endeavour to inquire, in what vegetable life itself consists, and what are the changes which plants undergo *after* the vital power no longer enables them to resist the common law of chemical affinity.

In animals death has many percussors. It is the total stoppage of the circulation of blood, the cessation of the animal and vital functions consequent thereon, such as sensation and respiration; the smallest fibres grow rigid, the minutest vessels grow into solid fibres, and are no longer pervious to the fluids; the greater vessels grow hard and narrow, and every part becomes contracted, closed, and bound up; and these symptoms increase with the advance to old age. The most subtle fluids in the body are intercepted and lost, the assimilation is weakened, and the means of reparation by the glands prevented. Winslow remarked that all the powers of art can scarcely determine where life ends, and where death begins. The altered colour of the visage, the loss of the animal temperature, and the rigidity of the joints, nay, even the falling jaw, and the fixed eye, are not always sure signs of death. The pulse of the heart may have apparently ceased; the glass applied to the mouth may be sullied by the vapour of the body, and thus deceive; or the person may be living, and recover, though the glass has shown no signs of breathing. The whole process is slow, and almost imperceptible; but it is still not so much so as the extinction of life in a vegetable; for plants, like animals, unless destroyed by casualties or disease, are doomed to die of old age. There may be peculiar circumstances confounding life and death in animals, but the case is not so generally. Vegetables may be said to be more like insects, to exhibit a state of torpidity almost between life and death. Thus flies, to all appearance, are drowned; and yet after two months, or more, being retained in this immoveable condition will return to life, by the application of salt sprinkled on them: and I have shown that a vegetable will suspend its evaporation, when in the earth, and pass through a part of the process of fermentation, and yet still be resuscitated, so as to throw up suckers. The most extraordinary part of the phenomenon of a tree, is, that the longer the plants linger when dying, the harder the wood grows: thus a tree that has [illegible] cut off, and is stripped of its bark, and is then six [illegible] ll this time the wood is hardening. But this [illegible] sensible and evident in the brasicas, and man [illegible] where the wood at the second cutting of the leaves and stem is quite green and soft; but after it has stood a miserable log, exposed to wind and water, and all sorts of weather, the wood increases in strength and hardness till it becomes as hard as the wood of a minor tree, such as the acacia, the oleander, &c. It may, therefore, be truly said that, like the human body, the minute vessels grow into solid fibres, and the vessels are no longer pervious to the juices, which becoming sweet and thickening, the flow of the sap is much impeded; and hence absorption and secretion decrease with old age. The glands which, in the first instance, afforded their assistance to the decayed parts, are no longer able to act with vigour sufficient to remove the vitiated matter; hence the rot settles and increases, the line of life shifts from place to place to avoid it, and grows injured and weakened; and what is of most consequence to the plant is, that the vital and muscular strength lessens, and the vegetable is no more capable of that mechanical power of action on which its health principally depends. It is impossible for any person who has not examined the interior of plants, to conceive what constant motion they possess; we must, therefore, look on them as an apparatus adapted for the performing of a variety of chemical processes, to which they are excited by their irritability, which, therefore, must keep them in constant action, till the sort of torpor which precedes death lessens that exertion. Placing them in the earth greatly contributes to bring on this state by suspending the proper process: with each fermentation they lose a certain portion of latent caloric, which, when the last passes away at the commencement of putrefaction, life itself goes with it. What then is the life which disappears thus slowly, which becomes extinct like a passing sigh? does it pass off with the caloric, or is it caloric itself, thus confined and made latent in the woody part of the vegetable? I am not competent to answer this question; still it is not possible to pass it over, in treating of the nature of vegetables; the exposure to air makes the life evaporate sooner, because it hastens its fermentation; when hay exposed to the dew throws off such a quantity of caloric, it is then disengaging all that it possesses, and which has been concealed in the various parts of the plant, and death ensues: if this passes in the air, it is done so quickly as to fire the vegetable; but if under ground, it merely evaporates as the air or moisture reaches it, and, therefore, requires an immense time: still death is the consequence of both. Darwin, I believe, is incorrect when he says that barley acquires not half its sweetness till after life is extinct, and that this is the process that kills it; but I have repeatedly made barley grow after fermentation has taken place. Every thing which injures the life of the plant brings on the saccharine fermentation: thus pears and apples are gathered to sweeten them.

Many processes will bring on this first step towards putrefaction, when the plant is full of life, though certainly sickening; as this is the cause of the swarm of insects that infect a sick tree. We know that caloric and water contribute to increase the nutriment of mankind, by rendering many vegetable materials innocuous, others digestible in the animal stomach, and it appears particularly efficacious in promoting the saccharine fermentation. Darwin supposes that it could contribute to render manures capable of being absorbed by vegetable roots in a state of less decomposition than by the slow process of putrefaction. But how the process could be shortened I cannot conceive, since the earth suspends every effect. It is certain that the saccharine process, begun in vegetables, will render them more fattening to cattle than when given in their perfect state, especially potatoes; but then great care must be taken that it does not go too far, or they putrefy. And it is not only that the sweetness renders the plants more agreeable to the cattle, who, therefore, eat more of them, but it corrects the acid effects of the rind, and converts it into mucilage. The only deaths which will cut short the process in plants, that I am acquainted with, are those by lightning and frost. In these cases there is no fermentation. The vegetable is killed in a moment, and putrefaction and decomposition immediately succeed; and the curious appearance of plants thus destroyed, clearly exemplifies the dreadful destruction that has ensued. I can perceive no difference in the two; I have often seen potatoes and French beans, when killed by frost, appear in the interior as if stirred with a spoon; the whole is destroyed, the vessels all broken, and the muscles torn to pieces: putrefaction directly succeeds, and the whole is decomposed; and the matter is then drawn by its various affinities to those juices which are of immediate use to the plants which surround the decomposed matter; the water with which it is mixed gives succour to all, and the food is assimilated with the vegetables around. To understand what is the next process (when not directly absorbed by vegetable roots), it would be necessary that the plants be confined, and not mixed with the earth: this would at least show what are the steps which bring them back to mould, to which a part must certainly return. But I have particularly noticed that the vegetables are so far from endeavouring to possess themselves of the putrefied matter, though in great part decomposed, that the roots will often turn from it, till all smell has passed away. Indeed all plants are so susceptible of catching putrefaction, that nature has undoubtedly guarded against this tendency: the plant, therefore, must be completely disorganized before its parts can mix with water, and be absorbed by other roots. How thoroughly then doth this prove that no vegetable can be of use to others till it is completely decomposed; and how plainly does it show the folly of burying young crops, whose crude and watery juices are still more unfit than those of older plants to administer to their wants. I think I have also proved that as weeds will resuscitate, it is the excess of bad management to put them into the ground again; and as to trees and roots, although they may make manure for the next generation, it is too slow a process for us to expect to derive any advantage from it.

The question of what is the life of a plant, is more difficult to answer. Hunter suggested that the life of an animal might be "a subtile and mobile vapour of the electric kind;" and may not this be of the nature of caloric? I have merely shown how the vegetable dies; further I am not competent to judge, especially in so difficult a question. But there appears a great deal of analogy between the death of the more perfect animals, and vegetables, and still more between insects and vegetables; and I still hope that further observations and experiments on the death of plants in my troughs will enable me to penetrate further into this subject. I feel it impossible not to meditate on this topic, and am anxious to obtain the most correct ideas respecting it. An examination into the form of plants has engrossed more than 16 years of my life; and the first cause of their existence must, of course, be a matter of peculiar interest to me.

I am, Gentlemen, your obliged humble servant,

Agnes Ibbetson.

Article III.

An Abstract of an Inquiry into the relative Importance of the Crystalline Form and Chemical Composition in determining the Species of Mineral Bodies. By F. S. Beudant.

(From the Annales des Mines.)

Considerable disputes have subsisted, upwards of thirty years, among mineralogists and chemists, concerning the principle of classification applicable to mineral bodies. Some mineralogists have adopted the results of chemical analysis, others the crystallographical characters, and others again have united both these in their systems.* But in thus combining into one system the crystalline form with the chemical composition, a considerable difficulty has arisen from the attempt to decide which of the two characters ought to be regarded as the most essential in the determination of a mineral species.

It is with a view to solve this difficulty that the author has undertaken the present inquiry.

* The illustrious Professor of Freyberg has not founded his classification on external characters alone. It is obvious that he requires the assistance of chemical analysis in the construction of specific characters.

It appears that the first regular classification of minerals on the principle of chemical analysis, was published by Bergman, in 1782, in his "Manuel du Mineralogiste," in which the superiority of this mode of classification over that which had been previously used, was very conspicuous; and it is true that this principle has been since generally adopted in separating the species into varieties.

Since Bergman's treatise, many other systems have appeared, founded more or less upon his principles, and modified according to the existing state of chemical science.

In all these there were found many species of minerals incapable of being otherwise than vaguely defined by chemical distinctions, and the number is continually increasing. Berzelius, however, has very recently proposed a new and more methodical classification, in which he considers the oxides of aluminum, of silicium, &c. as performing the office of acids in the composition of mineral substances. His treatise is unquestionably the most ingenious and perfect of all that have been founded on chemical analysis, and it will doubtless be improved by a more perfect state of chemical science.

In general, in the proposed classification founded on chemical characters, minerals of the same species are defined *to consist of such substances as are similarly composed.* It cannot be denied, however, that, owing to the irregularity in the proportions of the constituent parts of minerals, this definition becomes uncertain in its application, and the chemical determination of a species will frequently be arbitrary.

About the time that Bergman was employed in constructing his method of classification, Romé Delisle, in comparing together variously formed crystals of the same substance, discovered that they might all be referred to some simple fundamental form, of which they might be considered modifications resulting from the truncation of its edges or angles; but he did not pursue this idea further, so as to apply it to the determination of a species.

M. Haüy at length appeared, and not only multiplied the observations on crystals, but was the first who applied to crystallography the consideration of physical character, combined with the calculations of the geometrician. By a method equally ingenious and exact, he was enabled to demonstrate that all the crystalline forms were related to one single system of geometry, that this system varied in relation to different substances, but was uniform in its application to all the varieties of the same species; and he thence concluded that crystallization was the character on which the greatest reliance might be placed in the determination of a mineral species.

From this has resulted a new classification, in which a mineral species is defined to be *a collection of substances, of which the integrant molecules are similar, and composed of similar elements, and in similar proportions.*

It appears, from this definition, that the results of chemical analyses, and those derived from crystallography, are both jointly regarded. But in its application, it will be seen that the author assigns the greatest degree of importance to crystallography; not from any particular predilection for a science which he, as it were, created, but in consequence of a strict examination of each species, and into the degrees of exactitude and constancy, observable in the results both of chemical analysis and of crystallization. This preference given to crystallographical characters has led M. Haüy to separate bodies which chemistry had placed together, and to unite others which chemistry had separated. The same elements, and frequently in nearly similar proportions, being found connected with incompatible crystallization; and on the other hand, elements dissimilar in number and proportion being discovered in uniformly crystallized bodies.

These facts have been shown by M. Haüy, in his Tableau Comparatif; and he hence concludes, that, to determine the true constituent elements of compound bodies, it is required to separate the accidental mixtures from the result of the analysis. But as he does not discover, in the present state of the science of chemistry, a method of distinguishing the essential elements from the accidental mixtures, he conceives that the crystallographical character may be the most constantly and certainly relied upon for the classification of such bodies as chemistry would leave undecided.

These conclusions, which have received the concurrent sanction of many men of science, have nevertheless not been adopted generally; and particular analyses are frequently adduced to establish new species, in opposition to their crystallographical character.

Chemists agree generally, with M. Haüy, that accidental mixtures enter into the composition of minerals, and that these must be separated before the true component parts can be known; but, they observe, that in many cases it would be necessary to separate one half, or two thirds, of the compound, in order to produce an accordance between the chemical and crystallographical characters, and they have considered this proportion too great to be the result of accident. It is to elucidate this circumstance that the following experiments were undertaken.

It is now generally known that the same compound constantly gives the same crystals; but the inverse of this proposition, which would infer similarity of composition from similarity of form, is true only in theory, or when the compound is perfectly pure. In natural compounds, as well as in those produced in the laboratory, it is frequently contradicted by our experience.

Mineralogists explain these differences of composition by supposing the addition of accidental mixtures to the constituent elements of bodies, although, from our ignorance of the elements themselves, we cannot determine, with precision, the amount of the extraneous matter.

Chemists, on the contrary, do not admit these accidental compounds on so large a scale.

It appeared to the author that the problem might receive some illustration from a series of experiments on such substances as might be compounded and decomposed at pleasure; as these would enable him to determine the proportion of accidental mixture capable of entering into the composition of a body without affecting its crystalline form.

Mixtures of Sulphate of Copper and Sulphate of Iron.

It had been long known that a mixture of equal parts of sulphate of iron and sulphate of copper would afford rhomboidal crystals similar to those given by sulphate of iron, the diagonals of their faces being to each other as $\sqrt{7}$ to $\sqrt{10}$; but this remarkable fact did not determine all the proportions of these two salts capable of producing this rhomboidal crystal. The author's first researches were, therefore, directed to this point.

He mixed sulphates of iron and of copper in various proportions, and produced crystals from the solutions. Equal parts gave, as before, the rhomboidal form; but by increasing the proportion of sulphate of copper, he at length obtained crystals similar in form to those of the sulphate of copper; and by varying the experiments he ascertained the proportions that would give either form.

He at first concluded that the crystals which were produced contained the same proportions of the two salts as the mixture; but by analyzing the crystals * he found the proportions vary according to the degree of concentration of the solution. The sulphate of iron, being the most soluble salt of the two, remained in the greatest proportion in the solution.

Frequently after obtaining crystals of the form of sulphate of iron from some given proportions of the two salts, part of the crystals were re-dissolved, and again crystallized; and by repeating this process, it was found that the proportion of sulphate of iron in the crystals became less and less, and at last was so small that the crystals assumed the form of those of sulphate of copper. Thus crystals which contain 20 parts of sulphate of iron and 80 of sulphate of copper, retained the form of sulphate of iron; then being successively redissolved, and again crystallized, were found to retain the same form, although the sulphate of iron was reduced first to 15, then to about 12, and lastly to only 9 per cent., which appears to be the limit of proportions affording the rhomboidal crystal; for on again redissolving and

* These crystals were analyzed by dissolving in pure water, and precipitating the iron by pure ammonia; and the proportion of sulphate of iron was computed according to the analysis of Kirwan, which gives 28 parts of sulphuric acid to 100 parts of oxide.

crystallizing, the form of the sulphate of copper was produced, containing only 7 per cent. of sulphate of iron.

These crystals are transparent, and of a greenish blue; such as contain only 9 to 12 per cent. of sulphate of iron, are subject to rapid alteration on exposure to the air.*

Mixture of Sulphate of Zinc and Sulphate of Iron.

On repeating the experiments above described, with the sulphate of zinc of commerce, containing about six per cent. of sulphate of iron,† it was found that the crystal of sulphate of iron was produced, with the proportion of 15 per cent. of that salt; and when only 10 per cent. was present, the zinc crystallization prevailed. On successively redissolving the crystals thus obtained, and again crystallizing, the proportion of sulphate of iron in the new crystals continually increased, contrary to the result obtained with sulphate of copper.

Mixture of the Sulphates of Zinc, Copper, and Iron.

It has appeared that the sulphate of copper requires nine per cent., and the sulphate of zinc 15 per cent. of sulphate of iron to produce the rhomboidal crystal: on continuing the series of experiments in order to ascertain the proportion necessary to produce the same crystal, when the sulphates of copper and zinc were both in the solution, it was found that less than three per cent. of sulphate of iron was sufficient; and the crystallization took place more readily than when the sulphate of iron was mixed with either of the other salts singly. It is remarkable that the addition of a small proportion of sulphate of copper added to the sulphates of zinc and iron should occasion this change in the proportion of sulphate of iron necessary to produce its peculiar crystal; and the experiments were varied and repeated, that the correctness of the results might be depended upon: to 80 parts of the crystals of the sulphate of zinc of commerce, containing six per cent. of sulphate of iron, were added 20 parts of sulphate of copper; and from the solution the rhomboidal crystal was obtained. It was also obtained from a mixture of $\frac{4}{5}$ of sulphate of zinc, containing only from two to four per cent. of sulphate of iron, and $\frac{1}{5}$ of sulphate of copper; but on increasing the proportion of this latter salt, its own crystal was produced. Pure sulphates of copper and of zinc were mixed in various proportions; but only the crystals peculiar to these salts

* When the sulphate of iron is in small quantity, it is necessary, in order to obtain the rhomboidal crystals, to concentrate the solution rapidly by heat to the point of crystallization. If left to evaporate slowly, some crystals of the sulphate of copper were found nearly pure, and others containing an indeterminate mixture of both salts.

† To ascertain the proportion of sulphate of iron in this compound, and in the crystals afterwards obtained, a given quantity was dissolved in pure water, the solution was filtered, and the iron precipitated by a solution of potash added gradually.

were obtained; and when the proportions were equal, the form was that of the sulphate of copper; but on adding a very minute quantity of sulphate of iron, the rhomboidal crystal was immediately produced.

On mixing various other salts, equally remarkable results were not obtained; and it was generally necessary to add, at least, one half of any given salt, in order to obtain its peculiar crystal.

In the course of these experiments, it was remarked that compounds of the same acid, with different bases, mixed more readily than compounds of the same base with different acids. Where the bases and acids both differed, the mixture took place in only small quantity.

These results appear to lead to the following important conclusions, relative to the classification of minerals.

In a chemical compound where no indication of mechanical mixture* appears, it has been shown that a foreign ingredient may be present in only indefinite and small proportions, and yet exercise the important function of determining the crystalline form of the compound. The same law may be regarded as applying to mineral compounds also, and will explain the anomalies frequently observed to exist between their chemical analysis and crystallographical character; incompatible crystallizations having been found composed of similar elements, and identical forms of widely differing elements. And it is not extraordinary that this should be the case, considering the variety of substances connected together in the same formation.

But as the chemical products of the experiments already detailed were mere mixtures of the several salts employed, and as the mineral whose analysis is at variance with its crystalline form may also be considered as a mixed compound, how are these to be arranged in our cabinets? Let us first consider the saline crystals already described. These may be regarded as composed of sulphuric acid, and the oxides of copper and iron, or zinc and iron, or copper, zinc, and iron. The chemist may consider these as double or triple salts; but as it is known that the single salts employed may be in solution together without mutual decomposition, and as the sulphuric acid in the mixture is found in the proportion necessary to saturate separately the oxides employed, the compound salts produced must be regarded as simple mixtures only. In classing these chemically, the place assigned to each would be regulated by the salt found in excess; but in the instance of mixtures of equal parts of two or more salts, the chemist would be reduced to the necessity of

* In the term mechanical mixture, that species is not included of which the Fontainbleau sandstone may be considered a type: the grains of quartz there being merely invested, and held together by the carbonate of lime, which has crystallized round them.

classing this compound under each of its component species, and would thus render his classification much confused.

If, on the other hand, we class them crystallographically, they will all be arranged with the sulphates of iron; but hence would result the inconvenience of classing with one substance a crystal containing an accidental mixture of as far as 97 per cent. of other substances, although distinguished from pure sulphate of iron, by adding the terms mixed with such or such other substances.

On comparing the modes of reasoning of the chemist and the crystallographer, a decided advantage appears in favour of the latter. The chemist would be undecided whether to consider the compound as a mixture or as a triple salt, were it not for the conformity observed between the proportion of acid contained in it and that required to saturate the bases separately; which proportion may be merely conjectural. But the crystallographer would decide on its being a sulphate of iron, containing a mixture of other elements. Knowing that similar compounds crystallize in similar forms, and dissimilar compounds in dissimilar forms, he would be led to conclude from identity of form, in the instance under consideration, that the sulphates of copper and zinc were simply mixed, and not chemically combined with the sulphate of iron.

But both these methods of classification possess their inconveniences. In one are ranged, under the sulphates of zinc and copper, salts presenting the form of sulphate of iron; and in the other, the sulphate of iron is made to embrace salts almost wholly composed of sulphates of copper and zinc. It appears, however, that these anomalies may be, in some degree, corrected, by classing with the sulphates of iron all the crystals presenting the form of that salt; and if the proportions of that and the other salts be equal, giving it that place alone; but where the sulphates of either zinc or copper predominate, then placing it also under the class of the predominating salt.

If this principle of classification be admitted in the instances alluded to, there appears no reason why it should not be extended to mineral substances presenting similar discrepancies between their form and composition.

But there is a wide difference between our mixed salts and mineral mixtures. The elements which the chemist finds in the salts, are known to combine in definite proportions, to form compounds which are well understood from repeated analysis and synthesis, and of which the crystalline form may be determined with precision. But mineral bodies do not possess this advantage; for no mineral compound, except some few natural salts, has been produced in our laboratories. We know the composition of minerals only from analysis, which frequently exhibits difference of composition in the same species, and similarity of composition in different species. We do not know the definite proportions in which most of the elements of minerals combine. Of the earths particularly we are ignorant, and yet nearly half the minerals known contain proportions of these. It is impossible, therefore, in the greater number of the minerals, which we are led by analysis to regard as mixtures, to determine the nature of the compounds of which the mixture consists; and we must, consequently, renounce, as respects these, the double classification above proposed.

There are, notwithstanding, some mineral species, to which the foregoing reasonings may be applied. Let us take grey copper as an example; in the analysis of which, Klaproth has obtained the following results:

Components	from St. Wenzel.	Zilla.	Kapnick.
Copper	25·50	31·50	37·75
Sulphur	25·50	21·50	28·
Iron	7·	6·50	3·25
Antimony	27·	29·	22·
Silver	13·25	3·	
Zinc			5·
Silver and manganese			0·25
Loss	1·75	2·50	3·75
	100	100	100

In separating successively from these elements the proportions required to constitute the known compounds, copper pyrites, sulphuret of antimony, &c. we shall distribute the results of these analyses as follows: *

* The proportions here assumed are deduced from the following analyses:

Copper Pyrites, by Guenivean.

Copper	30·85
Iron	32·65
Sulphur	36·00
Loss	1·00
	100

Sulphuret of Copper, by the Same.

Copper	74·5
Sulphur	20·5
Oxide of iron	1·5
Loss	3·5
	100

Sulphuret of Antimony, by Bergman.

Antimony	74·00
Sulphur	26·00
	100

Sulphuret of Silver, by Klaproth.

Silver	85·00
Sulphur	15·00
	100

Antimoniated Sulphuret of Silver, by Thenard.

Silver	58·00
Antimony	23·50
Sulphur	16·00
Loss	2·50
	100

	St. Wenzel.		Zilla.		Kapnik.	
Copper pyrites	21·224	Cop. 6·506 Iron 7·000 Sul. 7·718	19·708	6·042 6·500 7·166	9·854	3·021 3·250 3·583
Sulphuret of copper ..	24·221	Cop. 18·994 Sul. 5·227	17·236	13·506 3·730	44·285	34·729 9·556
Antimoniated sulphuret of silver	22·273	Sil. 13·250 Ant. 5·368 Sul. 3·655	5·042	3·000 1·215 0·827		
Sulphuret of antimony.	29·232	Ant. 21·632 Sul. 7·600	37·562	27·785 9·777	29·743	22·000 7·743
Sulphur?	1·3				5·556	
Metallic copper			17·740			
Sulphuret of zinc.....					6·562	Sul. of z. 5·000 Sul. 1·562
Silver and manganese..					0·250	
Loss.	1·750		2·500		3·750	
	100·		100·		100·	

But as the crystalline form of the mixture is that of the copper pyrites only, we may arrange it first under that species; and as the specimen described in the first column does not contain a notable excess of any other compound, it may stand with the copper pyrites only; the specimen in the second column may, according to the rule proposed, be arranged also under the sulphuret of antimony, from the large proportion of that substance contained in it; and the third specimen, for the same reason, may be placed also with the copper pyrites.

The author has preferred borrowing an illustrative example of the system of classification he has suggested, from the species grey copper, because that substance admitted the closest application of his reasoning: but as the tetrahedral form may apply to many other compounds, it is impossible, at present, to say, decidedly, that it is derived from the copper pyrites in the instance under consideration; and although it was the opinion of Romé Delisle that it was so derived, the author thinks it safer still to continue the grey copper as a separate species.

It would be possible to produce other examples of mineral mixtures capable of the same kind of analysis, but the number is very limited. Of the combinations of the elements of the greater part, and particularly of the earthy substances, we know nothing; and we learn from analysis only the *elements* of compound bodies, and not the different *species* that constitute the compound. Hence, although the results of analysis may lead us to infer a mixture in the body we examine, chemistry, in its present state, cannot discriminate its extraneous from its elementary principles.

The mineralogist will, therefore, proceed with greater certainty by adopting the single classification founded on the crystalline form, until the proportions are ascertained in which the earths combine; and we are thus directed with certainty to the mode of double classification.

An extract of the report of Messrs. Haüy, Vauquelin, and Brochant, on the memoir, is appended to it in the pamphlet. This report approves the deductions of the author in favour of the crystallographical character as a basis of arrangement. It also replies to an objection, which the facts contained in the memoir may be supposed to raise, against the adoption of this basis, by saying that all which crystallography attempts to decide is, that sulphate of iron is present whenever the crystal of sulphate of iron is produced, and that felspar is present whenever the crystal of felspar is formed.

Article IV.

A Plan for a Fire Ship.

(To Dr. Thomson.)

My dear Sir, *Bushey Heath, Feb. 1, 1818.*

The following plan, which I proposed in the year 1804, for the destruction of the enemy's flotilla, being now to a certain degree known, I send it, with your permission, for publication in the *Annals of Philosophy*. It is but fair that we should derive advantage from the invention of our countrymen, and not be doubly annoyed, as in the case of the torpedoes used by the Americans against our men of war, by having our own weapons turned against ourselves, and arming our foes to our own destruction. I have no doubt but that a fire ship steered as described in the following page, might be sent down and fall on board a large vessel laying-to to leeward before she could brace about the sails and gain sufficient way to avoid it.

I remain, my dear Sir, yours very sincerely,

Mark Beaufoy.

It is proposed that a vessel, loaded as a fire ship with combustible materials, should carry at its mast's head a large flag (after the manner of a vane), attached to a spindle passed abaft the mast, through one or more iron rings, and turning in a socket on the deck: near the lower part of the spindle must be affixed the segment of a large cog wheel running into another correspondent with it at the end of the tiller, which is to be constructed of a due length for the purpose. The vessel then under sail being put be[illegible] the wind, with the helm amidship, will continue to proce[illegible] [illegible]direction; because at the instant of its falling off it would be counteracted by the operation of the flag upon the tiller, and restored to its original course.*

By this contrivance the vessel when under sail may be steered, after the helm has been put in a proper position, either before the wind, on a wind, or on any intermediate point, with as much accuracy as by a good helmsman. To preserve the vessel from being sunk by the shot or shells fired at it, the hold should be filled with empty casks tightly bunged; and for the prevention, in the event of a leak, of the deck being blown up by the buoyancy of the casks, place strong pieces of timber on the upper part of the deck, from the stem to the stern post, through which, and some of the beams, have eye bolts driven, the eye part under the deck, and as many iron chains, or straps, hooked into the eyes, and the other ends firmly secured to the kelson.

The mast should not be very taunt, which would render it more liable to be struck by the shot, and the sail should be square if the vessel be designed to go before the wind. The utmost range of a shell is 4,400 yards; if, therefore, the vessel be submitted to the guidance of the flag, and run at the rate of eight miles per hour, it will sail that distance in about 18 minutes. The fusee must be cut accordingly. A flag with a fly ten or twelve feet long will have very sufficient power to steer a vessel of a moderate size. The experiment of steering a model by a flag has been tried, and found to answer with great accuracy.

As soon as the fire vessel is sent down, if the men of war were to fire with powder, an advantage would be obtained in the smoke driving to leeward, and enveloping the object in obscurity.

Two circular segments of wood may be used instead of cog wheels; one fixed to the flag spindle, the other to the extremity of the tiller, the tiller ropes crossing each other, and the ends fastened to the outer parts of the circular segments; the ropes being tangents to the circles, the power on the helm will always be the same. The vessel may be brought to an anchor, if requisite, amidst the enemy's ships, riding under batteries, by having the anchor suspended from the tafrail by means of a stopper fastened to the cable, and immersed equal to the depth of water in which the ships are riding; the moment the anchor touches the ground the stopper will break, and the requisite quantity of cable will run out, and the vessel be brought up by the bitts. A chain should be added to prevent the inner part of the cable from being burned. In case a current sets along the coast under which the enemy's vessels are riding, a proper allowance is easily made for the drift.

If casks were filled with inflated bladders, it would prevent their becoming useless by a shot-hole: should the flotilla to be

* A Dutch dogger, from its light draft of water, is as well adapted for the purpose as any other.

attacked be numerous and occupy a considerable line, several fire ships ought to be employed, divided into three divisions; one division being sent down with the wind on the quarter, another before the wind, and a third on a wind; the last will annoy those which cut and run to leeward. The decks should be loaded with stones, or some heavy materials, that on blowing up more mischief may be done to the foe.

The most advantageous time to send the fire ship among vessels at anchor is at the commencement of the flood, that in case they cut and run on shore, they may continue striking during the rise of the tide; and the most disadvantageous is at the period of half ebb, at which period the tide falls the quickest, and is consequently the most proper time to lay a vessel on shore to save the crew.

Article V.

Account of a Meteor, apparently accompanied by Matter falling from the Atmosphere, as seen at Cambridge by Professor E. D. Clarke, of that University, and other Persons who were Eye Witnesses of the Phenomenon. In a Letter to the Editors.

Gentlemen,

On Friday, Feb. 6, being in company with two other persons who were walking with me in the environs of this University, I had the satisfaction of seeing a large and very luminous *meteor* in the *northern* part of the hemisphere, descending vertically from the zenith towards the horizon. My attention was called towards it by an exclamation from one of our party who called out, "*Look at that Light!*" The atmosphere was perfectly clear and serene, excepting a haziness near the horizon towards the north; and the sun, in a cloudless sky, was shining in great splendour. It was about two o'clock, P.M. The first impression upon my mind in beholding it, was, that a lacerated balloon, owing to some accident, was coming down in ruins; but the intense light with which it shone opposed to the full rays of the sun, almost as instantaneously convinced me of its real nature. Its descent was extremely rapid, and being so perfectly vertical, and the shape of the falling body seeming to indicate the precipitation of matter in combustion, I expected to see it strike the earth; but when it arrived within about fifteen degrees of the horizon, it disappeared; there being as before stated a haziness towards the *north* extendin[illegible]ls from the earth about 12 degrees. Before the *meteo*[illegible]nt path reached this fog-bank, it disappeared.

Probably some other account of this phenomenon will reach you;* in the mean time I send you my brief statement of the fact; having been an eye-witness of it. This is the third great *meteor* which I have seen, in this country; the two former happened many years ago, during the night, and were seen all over *Europe;* that of the year 1783 was one of them; it differed in the direction of its course, which was nearly horizontal; although inclined at a small angle towards the earth. The form of the present *meteor* as seen from *Cambridge* was somewhat like that of a *Florence* flask; it left a train upwards, which was broken into knots of *light;* and the *light* beaming from the body of the *meteor* was so intense that although opposed to the sun's orb it shone almost equal in effulgence to that luminary; and I have no doubt but that if it had happened during the night it would have equalled in its effect either of the *meteors* before mentioned. That a fall of matter has taken place somewhere towards the *north* there can be little doubt; although it be uncertain of what nature it may be, or where it fell, whether in the sea, or upon the land.† Your readers, in their own opinions respecting the cause of this *meteor*, will perhaps differ from mine; but the theory of the phenomenon seems to me to be very simple; namely, that its appearance is entirely due to the *heat* and *light* evolved during the transition of a body from the aeriform to the solid state; a theory at present most happily illustrated by a recent experiment of the ignition of *platinum* wire, coiled around the wick of a spirit-lamp, which exhibits *heat* and *light* for hours after the extinction of the flame of the lamp so long as any of the *alcohol* remain; an experiment of course well known to you because it has attracted such general notice in the metropolis. I am ignorant of its author; but the nature of it is, I understand, thus explained; that "the *hydrogen* of the alcohol combining with the *oxygen* of the atmosphere, forms *water;* consequently heat is evolved."

I remain, Gentlemen, very faithfully yours,

Cambridge, Feb. 6, 1818. E. D. Clarke.

* It was seen at *Swaffham*, exactly at the same hour, where it was visible several seconds. An account of it appears in the "*Norwich Mercury*," published *Saturday, Feb.* 14, in which it is described as "a well defined orb of white light, giving off flame backwards."

† Accounts from *Lincolnshire* have appeared in the public papers, that the inhabitants, at the time of this *meteor*, were alarmed as by the shock of an earthquake; and a hissing noise was heard; the usual sound accompanying the fall of *meteoric* stones.

Article VI.

A Solution of the Equation $\Delta^n(\phi x) = (e^{\frac{d}{dx}} - 1)^n \phi x$: *$n$ being a whole Number, ϕx a Function of x, and e a Number whose Naperian Logarithm is Unity.* By James Adams, Esq.

(To Dr. Thomson.)

Sir, *Nov.* 11, 1817.

From the theory of increments, we have*

$$\Delta^n(\phi x) = (\phi x + n\, d\phi x) - n\{\phi x + (n-1)\, d\phi x\} + \frac{n(n-1)}{1.2}\{\phi x + (n-2)\, d\phi x\} - \&c. \quad \text{(I.)}$$

But by Taylor's theorem, and separating ϕx from its symbol d, we get

$$\phi x + n\, d\phi x = \left\{1 + \frac{nd}{dx} + \frac{n^2 d^2}{1\cdot 2\, dx^2} + \frac{n^3 d^3}{1\cdot 2\cdot 3\, dx^3} + \&c.\right\}\phi x = e^{n\frac{d}{dx}} \times \phi x.$$

$$\phi x + (n-1)\, d\phi x = \left\{1 + \frac{(n-1)d}{dx} + \frac{(n-1)^2 d^2}{1\cdot 2\, dx^2} + \frac{(n-1)^3 d^3}{1\cdot 2\cdot 3\, dx^3} + \&c.\right\}\phi x = e^{(n-1)\frac{d}{dx}} \times \phi x.$$

$$\phi x + (n-2)\, d\phi x = \left\{1 + \frac{(n-2)d}{dx} + \frac{(n-2)^2 d^2}{1\cdot 2\, dx^2} + \frac{(n-2)^3 d^3}{1\cdot 2\cdot 3\, dx^3} + \&c.\right\}\phi x = e^{(n-2)\frac{d}{dx}} \times \phi x.$$

&c. &c.

By substituting in equation (I).

$$\Delta^n(\phi x) = \left\{e^{n\frac{d}{dx}} - n\, e^{(n-1)\frac{d}{dx}} + \frac{n(n-1)}{1.2}\, e^{(n-2)\frac{d}{dx}} - \&c.\right\}\phi x$$

$$= (e^{\frac{d}{dx}} - 1)^n \phi x.$$

* See Translation of Lacroix's Differential and Integral Calculus, p. 488.

I trust, Sir, that the importance of the theorem and the conciseness of the demonstration, will, in some degree, be an apology for my sending them to you.

I am, your most obedient servant,

James Adams.

Article VII.

Memoir on the Geographical Extent of the Strata of the Environs of Paris. By J. J. Omalius D'Halloy.

(*Concluded from* p. 95.)

I shall conclude this memoir with some details on the chalk formation, although, after the excellent description contained in the Mineralogical Geography of the Environs of Paris, nothing more is required on the subject of the common chalk; but the lower beds of this great deposit being in contact with the southern part of the basin of Paris, I think that an account of their modifications may, with propriety, be here introduced.

Beds differing, more or less, from the common chalk in their mineralogical characters, as well as in their chemical nature, and in the presence of particular fossils, separate the strata of the Paris basin from the older horizontal limestone, or lias; but are connected by insensible gradations with the true chalk. Among these shades of gradation the four following modifications may be distinguished: 1. Chalk with pale flints; 2. The *tuffeau*, or coarse chalk, frequently mixed with chlorite; 3. The sands and sandstones of the chalk formation which are generally mixed with calcareous matter; 4. Greyish clay, commonly of a marly character, seldom plastic, and sometimes mixed with chlorite. The passages of these different modifications into each other, and their alternations, prevent the decided determination of their order of superposition. We may, however, remark, that the chalk with pale flints is the most recent, and that it precedes the common chalk with dark coloured flints, from which its separation is not always to be distinguished; that, on the other hand, the clay beds are the oldest of the formation, and that there is even a part of these beds that belongs rather to the lias than to the older chalk.

Fossils abound in these different beds; some, such as the echini, are the same as those of the common chalk; others, as the ammonites, are similar to those of the alpine limestone; some, namely, the belemnites, terebratulæ, &c. are common to them, to the chalk, and to the alpine limestone; those which may be considered as characteristic, as well by their abundance in these beds as by their rarity, or, perhaps, their total absence in other strata, are the orbicular gryphite, and a large shell referable to the genus spondylus.

The large chalk basin which extends like a gulph into the north west of France, presents these modifications of the older chalk throughout its circuit, except on the side of the English channel, where the common chalk reaches to the sea coast. Every where else we may generally recognize the four series just noticed, but with this difference, that frequently one or two of the series acquiring an unusual thickness, give their own character to the district, while the rudiments only of the remaining ones exist, and are hidden by the preponderance of the others. It thus happens that in different districts of this formation the country assumes a calcareous, a sandy, or a clayey character. There is also this difference, that on the east side, from the Oise to the Yonne, these strata form only a narrow band; while to the south, and more particularly to the south west, they occupy a considerable space. The cause of this circumstance appears to be, that the beds, notwithstanding they seem to be horizontal, have on the east side an inclination determined by that of the beds on which they rest. This is considerable, and consequently circumscribes the superficial extent of the strata we are speaking of; while, on the other hand, towards the south west, the lower beds, being more horizontal, allow the edges of the strata which form the older parts of the chalk formation, where they rise to the day, to extend over a greater surface.

The strata of the Paris beds are not placed exactly in the middle of the great chalk basin, as their southern part rests on the older chalk. It is, however, very difficult to say where the common chalk ends, for its passage into the chalk with pale flints takes place by insensible degrees; but I think it may be stated, that on the western side of the basin the country to the south-west of Chartres, Courville, Verneuil, &c. belongs to the chalk with pale flints, which there forms the belt containing the Paris strata, and extends beyond the Loire.

This chalk differs but little from that with dark flints, and sometimes contains subordinate beds agreeing with the common chalk in all respects. It is generally of a coarser grain, less coherent, and contains a greater quantity of sand, and sometimes of clay, and even of chlorite in its lower parts. It is often used as a manure with much advantage. The flints are generally in greater abundance than in the common chalk, and there are some places where their quantity is greater than that of the calcareous matter; their colour is generally bluish white or yellowish brown, sometimes a cinereous grey, rarely blackish. They occasionally lose their mineralogical character, passing by insensible gradations to jasper, to calcareous sandstone, and to breccia, or pudding-stone, which have manifestly an origin analogous to that of the other siliceous nodules.

The alternations of the chalk with pale flints with the coarse chalk and the sands of the chalk, and the passing of each into the others, add also to the difficulties of tracing the limits of these beds. But the predominance which the sandy beds acquire to the west of the band of chalk with pale flints, which I have just pointed out, occasions the existence of a sandy country, which may be considered to be subdivided into two small regions by a point, or cape of the lias near to La Ferte Bernard. One of these regions commonly known by the name of Perche, is a woody country furrowed by numerous valleys which extends from the vicinity of l'Aigle towards Montdoubleau; the other comprehends the dry elevated plains between the Sarthe and the Loire, and extends a little to the north of the first of these rivers.

These sands might, at first sight, be taken for an alluvial deposit, and the rather, because from the want of adherence of their particles, the upper parts have been disturbed by the waters, and are often mixed with rolled pebbles; but on a more careful study, we soon become convinced that they belong to the formation of the older chalk. We observe in fact that the lower parts of the chalk gradually become coarser and contain more sand, and that then the siliceous nodules often pass into the state of calcareous sandstones. We also see that this sandy chalk alternates with regular beds of sand and sandstone, which contain the fossils characteristic of the ancient chalk, and we can distinctly recognize in several places that the principal mass of the sandy strata dips under that of the chalk.

These sands and sandstones generally contain calcareous matter, and sometimes chlorite; but some of them are quite pure: the greater part are of a fine equal grain, others of a coarse irregular texture. Their colour is commonly yellowish, sometimes whitish, rarely blue, reddish, or ferruginous. This last colour belongs principally to some deposits of sandstone passing into pudding-stone, called in the country *roussard*, and which are found buried in the middle of the sands. In general, organized bodies are not found in beds composed of pure quartz; but they are often very abundant in those which contain calcareous matter; the most common are the orbicular gryphœa, and some species of ostreæ. The ammonites here begin to appear, or to speak with more exactness, these strata appear to have been formed at the latest period of the existence of these animals; but we shall probably find, when the species of this genus are better known, that the ammonites of these beds are different from those of the alpine limestone. Remains of fish and impressions of vegetables * are also found in these beds.

The ancient province of Touraine lies to the south of this sandy district, and extends to the lias which is found to the south of Chatellerault and Chatillon sur Indre. The soil is of coarse grained chalk. This substance, known in the western departments under the name of tuffeau, is sometimes tender and friable, and at others is of sufficient hardness for building; its

* This last observation was made by M. Maulay, a naturalist, residing at Mans. I should here remark that I do not consider all the sands which cover the elevated plains between the Sarthe and the Loire, to belong to the chalk formation; for the occasional presence of some thin beds of buhrstones and the existence of a small deposit of freshwater limestone, near Mans, renders it probable that there are some superficial deposits of fresh water sandstone; but I have not had the means of ascertaining this fact.

most common colour is yellowish white, having often a greenish tint occasioned by the presence of chlorite. The flints are always pale, often passing into hornstone, sometimes into jasper or calcareous sandstone. Fossils are abundant in it, and in great variety; the orbicular gryphœa is particularly to be distinguished. From the thickness of these beds, the facility with which they are worked, and the double advantage derived from them for the purposes of building and manure, immense quarries have been formed in them, which are sometimes inhabited by a modern race of troglodytes. These quarries are characteristic of these strata, and are found in the department of the *Meuse-Inferieure*, as well as on the banks of the Loire.

The *tuffeau* of Tourraine is covered by a thick bed of sand, full of pale flints, and sometimes mixed with clay, which is no other than the sandy chalk washed by the waters. The contrast of the agricultural characters in different parts of this country arises from these two systems of soil. When the soil is enough cut through to expose the bed of *tuffeau*, it is very fertile, and deserves the name it has acquired of the garden of France. But the elevated plains covered with sand and flints, present to the eye only barren heaths of great extent.*

The Sologne is a low marshy region, of a sandy nature, and not very fertile, situated to the south of the Loire on the east side of Tourraine; its southern part clearly belongs to the chalk formation. We easily recognize the same sands mixed with entire flints. There is only this difference between them, that the soil has not been opened to so great a depth, consequently the *tuffeau* is less frequently exposed; and, lastly, that the *tuffeau* is not so well characterized, and more resembles the marly chalk.

The part of this country which is to the north of the Sandre, is covered with a sandy deposit, of which it is not easy to determine the origin. This sand is the same as that before spoken of as covering the freshwater limestone of the Gatinais, that is, it is formed of grains of white quartz, generally rounded or globular, often very large, sometimes very small. It is sometimes accompanied with fragments of transparent quartz, commonly white, and rarely greyish, and with brown yellowish flints, all of them more or less rounded, and seemingly found only in the superficial parts.

These sands have often been thought to be alluvial; but on

* The *falun* which is found on some of these plains, and assists to render them fertile, is a separate deposit much more modern than the *tuffeau*. The shells composing it, of which M. de Tristan is preparing a description, have many points of agreement with those of the Paris limestone with cerithia. But the *falun* of Tourraine differs from this last formation in two particulars: it does not occur of a stony consistence, and as Reaumur remarks, it contains only the remains of shells, more or less broken. We find also in this district detached portions of freshwater beds, varying in extent, sometimes in the state of shell-limestone, sometimes in that of siliceous limestone.

this hypothesis we should find among them the debris of the different rocks of which the neighbouring countries are composed, as is the case with the alluvial deposit of the Loire, where we can trace even among the finest sands the mica and felspar of the granite of Auvergne. In no part does a country exist so exclusively composed of quartz that the destruction of its rocks could give rise to the sands we are now considering; and the supposition of such a country being entirely destroyed, or concealed, is much more at variance with what we know of the operations of nature, than the opinion that these sands have been formed as we now see them, in the same manner as the different sandy strata, of which the local formation is actually demonstrated as well by their alternation with other rocks as by the fossils they contain.

The first idea that presents itself on this latter hypothesis is, to consider the sands of the northern part of the Sologne as belonging to the formation of the older chalk, as well as those of the southern part of the same district, of Tourraine, Perche, &c. The existence in these latter of coarse grained beds, resembling the sands between the Loire and the Saudre, adds strength to this opinion. On the other hand, the presence of these sands on the freshwater limestone on the banks of the Loire and in the Gatinais, the occurrence of detached patches of similar sands on the same limestone in other places nearer to Paris, as at Etampes, Rambouillet, &c. and, lastly, certain points of agreement between them and the buhrstone formation, might suggest the idea that they are the latest bed of the second freshwater formation of the Paris basin, as has been already supposed by Messrs. Cuvier and Brongniart in respect to the sands found on the summits of the hills of Longjumeau.*

I confess that I am still at a loss to decide between these two opinions, and that in excluding the country between the Loire and the Saudre from the basin of Paris, I have been determined, in the absence of geological indications, by considering it as a question of physical geography, and on that account think it right not to separate the parts of a region so naturally united as the Sologne. It is, however, proper to remark on this subject, that on the hypothesis that all the sands of this country belong to the older chalk, we may well conceive the possibility of their extension over the freshwater beds; for this deposit of inadherent matter being situated precisely at the part where the waters pass as they descend from the mountains of Auvergne, must have been more disturbed by the waters than those situated differently, and some great catastrophes, such, for instance, as that which has overwhelmed the animals whose remains are found in the alluvial marl and gravel, may have sufficed to throw a part of these sands on the slightly elevated country of the freshwater

* Mineralogical Geography of the Environs of Paris, p. 35.

limestone where they at present occur. To such causes must we attribute also the presence of the rolled pebbles on or near the surface of these sands.

The belt of chalk which surrounds the Paris basin is in a manner interrupted on the east of the Sologne by the point of the freshwater limestone, which extends along the Loire as far as Cosne, where it approaches the lias; but it occurs again beyond this point in a small region covered with trees, hedges, and meadows, known under the name of Puysaie, which extends from the valley of the Loire to that of the Yonne, comprehending the greater part of the country between Cosne, Montargis, and Auxerre.

The soil of this country is not so level as that of Sologne, and shows more frequently the exposure of the different series of beds of the older chalk, such as the chalk with pale flints, the sand, and, above all, the clay, which is the most abundant, and which forms the character of the region. Among these deposits is one which is very remarkable from its utility in an economical point of view; this is the ochre of Pourrain. It lies in the midst of irregular beds more or less mixed with sand, clay, marl, or even calcareous matter, among which we see distinctly the series of imperceptible shades, which unite mineralogically those quartz substances which are known by the names of flints, jaspers, and sandstones.

The beds of clay and sand of Puysaie terminate nearly in a line drawn from Chatillon sur Loing to Joigny; beyond that there is found only the chalk with pale flints, which to the north of Montargis and Joigny, approximates to the chalk, properly so called, which occurs, distinctly characterized, in the plains of Champagne north of the Yonne.

The space occupied by the older chalk becomes after this much contracted, and forms, as I have already remarked, only a narrow band, which skirts the whole length of Champagne from the Yonne to the Oise. This band, which has been already described by M. Desmarest, is remarkable for its regularity throughout so great an extent, and its uniformity of appearance, as a valley of an argillaceous nature, bordered on the one side by elevated plains of chalk, and on the other by those of lias; for it is to be remarked that the land of Champagne, which forms a low plain, where it appears from under the hills of the Paris beds, rises gradually, attains a height at least equal to that of those hills, and terminates on the eastern side in a sort of escarpment, which exposes the marly clay underneath the chalk. This clay is incumbent on the lias, which soon rises to a greater height than the elevated chalk plains, and thus limits the superficial extent of the cla[illegible] it appears that the property of the clay of being easily [illegible] upon by water, is, in a great degree, the cause of the land [illegible] into a valley.

Although then [illegible] the principal character of this side of Champagne, the other beds of the older chalk are not entirely wanting. We find the same *tuffeau* containing chlorite, particularly at Autry, in the department of the Ardennes; and it is a remarkable fact that the older chalk of Champagne differs from that of the other parts of the basin in the very same character which is peculiar to the true chalk of this region.

To the north of Champagne the limits of the chalk extend too far from the Paris basin to be described in this memoir; but near to this basin, and even within a short distance of Paris, is a very small region, in which we see not only the older chalk but also the lias formation, or at least its later members. This canton, commonly called the *pays de Bray*, is situated on the confines of the departments of the Oise, the Lower Seine, and the Eure. It resembles an island, and may be considered as the summit of a mountain buried by the great deposit of chalk.

The parts of this deposit nearest to the *pays de Bray* have the characters of the older chalk. Between Argeuil and St. Sansom we see the substance penetrated by grains of chlorite of a blackish green colour in great quantity, and another modification of a coarse texture, which passes into the state of a sandy marl, and contains, instead of real flints, nodules of greyish calcareous sandstones. It appears that the sands and marly clay which form the particular character of the country come out from underneath this coarse grained chalk. I say only that it appears so, because the disintegrated nature of these deposits, and the labours of agriculture, conceal the order of superposition, and because also the vicinity of the sands and plastic clay of the limestone with cerithia of the Paris basin might offer the supposition that those beds extended to the pays de Bray. The presence of the lias, however, in the central parts of this region, at Meneral, Cuy-Saint-Fiacre, &c. leaves no doubt that at least the greater part of the clays of this canton belong to the formation intermediate between the chalk and the lias.

This last mentioned limestone (the lias), generally of a yellowish white or greyish yellow colour, is remarkable for its hardness, for the abundance of spathose matter it contains, and particularly for the great number of small oysters found in it, although there are some beds of it quite compact, and without any organic remains. It is difficult to decide on the position of the principal mass of this with respect to the clay; but we may see distinctly that there are beds of the two formations which alternate with each other.

These characters are sufficient to point out in this limestone a small formation, very remarkable for the constancy of its mineralogical and geological characters in countries situated at considerable distances from each other, such as Berry, Lorraine, the Boulonais,* the coast of Calvados, &c. This limestone is distin-

* The greater part of the Boulonais is formed of the same beds as those of Bray. It is in the northern portion only that we see the successive appearance

guished throughout by its tenacity, its spathose parts, or by a texture which, though not completely spathose, approaches nearly to the crystalline state, and by the abundance and variety of its fossils, which consist, besides the ostrea of the *pays de Bray*, of other species of considerable size of the families of ostraceæ, of byssiferi, and of trigoniæ, many zoophites, particularly madreporæ, &c. This limestone is every where near to, or accompanied by, the lower clays of the chalk; but in no part can we see its geological position better than in the escarpment called the *Vaches noires*, on the coast between Honfleur and Dives. It there forms some beds of various degrees of thickness, placed in the midst of two deposits of grey marly clay. The upper deposit often contains chlorite in blackish green grains, and passes into the chalk with chlorite which is immediately incumbent on it. The lower clay is characterized by the gryphea latissima, and lies on the oolite limestone, which has a slaty structure in its upper beds, and extends towards Caen.

Article VIII.

Observations on M Beudant's Memoir "Sur la Détermination des Espèces Minerales." By W. H. Wollaston, M.D. F.R.S. &c.

(To the Editors of the Annals of Philosophy.)

Gentlemen,

Understanding that you are about to oblige the readers of the *Annals of Philosophy* with an abstract of M. Beudant's valuable memoir "*Sur la Détermination des Espèces Minerales*," I am in hopes that you will deem a few observations that I have made on the crystalline forms of those metallic sulphates, which were the subjects of M. Beudant's experiments, deserving of publication along with his memoir.

I must own that I felt considerable doubt of the accuracy of his observations with respect to those crystals which he found to resemble sulphate of iron; as it appeared to me that he has not a just conception of the form of that salt, when he speaks of it as crystallizing in rhomboids.

That the form of this salt is an oblique angled parallelepiped cannot be questioned, and that all the acute, or obtuse angles are nearly equal is very obvious; but on examining the modifica-

from underneath these beds, first of the lias, then of the *marbres de marquise*, which I consider to belong to the old alpine limestone, or *zechstein* of the Germans; and, lastly, of the [illegible] strata. The last soon disappear under the chalk, which borders this small region in the form of a semi-circular chain of hills. It is consequently proper to remark that I was incorrect in 1808 (Journal des Mines, tom. xxiv. p. [illegible]) in referring the limestone of the Boulonais, which I had not seen myself, to the transition formation of the north-east of France.

tions it assumes in its less simple state, I have remarked a manifest difference in one direction of the crystal, proving that even if the angular measures were really equal, still the solid could not be regarded as a rhomboid; but must be viewed as a rhombic prism on account of some difference in its linear dimensions. The angles, however, when carefully examined, are not equal; for though two of them have the same measure of 80½°, the third is 82°, or more; and accordingly this angle is to be considered as the measure of a rhombic prism, the terminal face of which is equally inclined to the sides, the direction of its obliquity being from one of the acute edges of the prism.

But though I thus differ from M. Beudant with regard to the primitive form of the common sulphate of iron, I must admit the justness of his remark, that the forms assumed by mixed sulphates of copper and iron, of zinc and iron, or of copper, zinc, and iron, appear the same as that of simple sulphate of iron alone.

I am, however, inclined to think that M. Beudant is not correct in considering all the salts so obtained to be *mixed* crystals, owing their form to the sulphate of iron alone, by which the other metallic sulphates are grouped in the same manner as sand is agglutinated by carbonate of lime in the crystals from Fontainebleau. Some more intimate chemical union may be presumed to occur in those instances at least in which a transparent crystal is obtained; for it is obvious that no *mixture* of bodies which differ so much in refractive power* as the sulphates of copper and of iron can suffer light to pass directly through the mass with the transparency that is observable in some of these salts; and, though I am not aware that any compound salts of the older metals have been hitherto observed, there may, nevertheless, be numberless instances of such union yet to be discovered by inquiry properly directed to that object.

I believe, indeed, that various triple salts of this kind will be found among those sulphates that formed the subjects of M. Beudant's experiments.

If equal parts of sulphate of copper and sulphate of iron be dissolved together and suffered to crystallize, the crystals produced are transparent rhombic prisms, similar to those of mere sulphate of iron.

If two parts of sulphate of copper be dissolved with one of sulphate of iron, the first crystals formed are those of mere sulphate of copper (but of course impure), and then the above triple sulphate of copper and iron, the prismatic form of which is in general so elongated as to show obviously that it is not a rhomboid.

If the sulphates of zinc and iron be dissolved together in equal

* The index of refraction for sulphate of copper is 1·52; while that for sulphate of iron is only 1·45.

quantities, the crystals obtained have also the same form of an oblique rhombic prism, similar to that of mere sulphate of iron; but the colour is a pale greenish white, as observed by M. Beudant.

Since the compounds of each of the foregoing salts with sulphate of iron assume apparently the same form of crystal, it is not surprising that the more compound salt containing all these sulphates together should also present the same rhombic prism; and it must be admitted that the most natural interpretation is that of M. Beudant, namely, that the sulphates of copper and zinc are to be regarded as an intermixture of foreign matter grouped together by sulphate of iron, to which alone the crystalline form may be ascribed.

The transparency of the crystals, however, militates against such an explanation of the forms of the preceding salts, and the doubt thence arising is confirmed by observation of a fourth compound having, to all appearance, the same form, although entirely free from sulphate of iron.

If equal quantities of sulphate of copper and sulphate of zinc (both perfectly free from iron) be dissolved together, and suffered to crystallize, the first crystals formed are those of sulphate of copper, of their usual form and customary intense blue colour (but of course impure). The after crystals are of a paler blue colour, and consist of the two sulphates of copper and zinc combined, presenting, to all appearance, the form of the same rhombic prism before observed, with the same obliquity of its terminal face.

Judging from the apparent quantities of the two salts formed in the preceding experiment, that the sulphate of zinc in the compound salt might exceed the sulphate of copper in the proportion of about four to one, I formed a solution of the two salts in this ratio, which afforded no crystals like sulphate of copper, but presented solely the oblique rhombic prism as before, and so nearly agreeing in the measures with those of sulphate of iron, that I cannot at present undertake to say wherein any difference consists.

But since no geometric reason can be assigned for the prevalence of this peculiar form among several bodies consisting of different chemical ingredients, it may be presumed that some difference will hereafter be found either in the angles or linear measures, and may enable us to distinguish them without having recourse in all instances to chemical analysis.

It is not merely with regard to the triple sulphate of copper and zinc that this hope may be entertained; but even those salts which do contain sulphate of iron, if they be really chemical compounds, as their transparency would lead us to presume, may be expected to exhibit some difference from the simple salt when crystals can be formed with sufficient regularity for accurate measurement.

The existence, however, of mixed crystals, such as these are conceived to be by M. Beudant, cannot be questioned, and must continue to mislead those who think it possible to rely on crystalline forms alone.

In mineralogy the most prominent instance is the crystal of Fontainebleau, without need of referring to other cases of more intimate mixture, but equally indisputable.

Among the salts formed by M. Beudant, it can hardly be questioned that various instances of real mixture occurred such as he represents, though possibly owing their forms in some cases to a more compound base than he has supposed.

There is also one instance observed by myself some years since which I will take the present opportunity of noticing, not merely as adding one to the numerous list that might be quoted, but because it is in itself instructive with regard to the real form of sulphate of nickel.

Having offered to reduce for the late Mr. Tennant some pure nickel, if he would be at the pains of preparing some crystallized sulphate of nickel for that purpose, I received, in the first instance, a quantity of square prisms with pyramidal summits as the first set of crystals formed in his solution.

The next set consisted principally of octohedrons, formed by junction of the summits without any intermediate prism.

A third set was afterwards produced, having the form of an oblique rhombic prism, which I contended could not be real sulphate of nickel, but was probably some triple salt of the same metal.

To this Mr. Tennant replied, that he had recrystallized a part of this salt, and had obtained octohedrons from them as before. We had the satisfaction of being both right; for upon careful examination I found that each crystal contained within it visible octohedrons, of true sulphate of nickel, cemented together by a triple sulphate of nickel with potash, which gave the outward form to the mass.*

It must be owned that the foregoing remarks leave the subject involved in difficulty; but it is to be hoped that they may at least serve to excite the industry of others, and answer the purpose for which they are designed, by suggesting to chemical and crystallographical inquirers a train of curious and useful investigation.

I remain, Gentlemen,

Your obliged and very obedient servant,

Wm. H. Wollaston.

* A friend has suggested to me that the Abbé Haüy was probably misled by some such deceptive appearance, when he assigned the form of an oblique rhombic prism to sulphate of nickel. Traité, tom. iii. 509, fig. 115.

Article IX.

Observations on Mr. Daniell's Theory of Crystallization. By Philo-chemicus Cantabrigiensis.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN, *Cambridge, March 8, 1818.*

Some apology may appear necessary for desiring to occupy a page in the *Annals* by writing on a subject which two of your correspondents have already discussed. The two gentlemen to whom I allude have, through your journal, attacked Mr. Daniell's paper on crystallization, published in the Journal of the Royal Institution for October last; and as this paper (from the mode of its publication) issues forth, under the sanction of the Royal Institution, its influence, if incorrect, may justly be apprehended.

To those who have preceded me I have but to observe, that in their amusing papers they do not appear to have gone to the bottom of the subject, and, therefore, have not detected all the errors of the paper in question.

If, as I trust, Mr. Daniell's object in a scientific investigation is the furtherance of knowledge, he will examine a contrary opinion with candour and attention; if otherwise, he will learn that genuine science will always outshine the ignis fatuus gleam of empirical representation.

With that which I shall not be misunderstood in calling the Wollastonian part of the theory, I do not presume to interfere; but may take the liberty of transcribing a passage from Mr. Daniell's paper,* and making some observations on the mathematical theories there laid down. "The confirmation to which I allude is founded upon the consideration of these circumstances: fig. 11 and 12 represent a tetrahedral and octohedral pile of balls, both composed of triangular faces, the bases of which are constituted of four particles. The tetrahedron is contained by four of these similar and equal planes, and the octohedron by eight; so that the whole superficies of the latter is exactly double that of the former. Now it is obvious that solids so constructed must differ in their specific gravities, unless the number of elementary particles in the octohedron be exactly double the number in the tetrahedron; that is to say, unless the number of atoms in a given space be equal in both arrangements. But it will be found that the tetrahedron, fig. 11, is composed of 20 spheres, and the octohedron, fig. 12, of 44; the latter containing more than double the number of particles under a double surface.

* Jour. Inst. Oct. p. 38.

The specific gravity of the latter solid must, therefore, be greater than the specific gravity of the former."

In the first sentence Mr. Daniell must either suppose that specific gravity depends on surface, or that solid content depends on surface: by proceeding a few lines further, we find "the number of atoms in a given space" mentioned, which proves (as well as the obscurity of the passage allows me to judge) that Mr. D. does not understand specific gravity to depend on surface, but on bulk; and further proves that our author has fallen into the other error of supposing bulk to depend on surface; this is evident from Mr. D.'s asserting that the surface of the octohedron, because it is double of the surface of the tetrahedron will contain a double quantity of matter.

An actual demonstration that solid content does not depend on surface, is surely as unnecessary as to prove that specific gravity does not depend on surface.

We may now, therefore, proceed to examine the mode which Mr. D. uses to find the content of the solids, viz. the summation of the sphericles composing each.

Having an octohedron and a tetrahedron whose linear edges are equal, i. e. composed of the same number of particles, the geometrical mode of measurement would have given the content of the former to be four times as great as the latter; but by Mr. Daniell's "elegant process of counting the balls in the two piles,"*

Content of octohedron : content of tetrahedron :: 44 : 20.

How shall we account for this modern discovery which portends the instant overthrow of all our faith in geometry? the truth is, that this mode of finding the content of a regular body is never correct until the magnitude of the sphericles is diminished, and their number increased sine limite. To make this matter more plain, and to show that the two modes, when properly managed, do not produce different results, let a tetrahedron and an octohedron be taken whose linear edges consist of the same number, viz. of (n) particles, or spheres.

The number in the tetrahedron $= \{1 + 3 + 6 + 10 \ldots\ldots + (2 + \overline{n-1}) \cdot \frac{n}{2}\}$

$$= \frac{n \cdot \overline{n+1} \cdot \overline{n+2}}{1 \cdot 2 \cdot 3}$$

and supposing the octohedron to consist of two pyramids, the number in the first pyramid $= \{1^2 + 2^2 + 3^2 + 4^2 \ldots + n^2\}$

$$= \frac{n \cdot \overline{n+1} \cdot \overline{2n+1}}{1 \cdot 2 \cdot 3}$$

* Annals, Feb. p. 102.

and $\therefore$ the other pyramid $= \frac{n \cdot \overline{n+1} \cdot \overline{2n+1}}{1 \cdot 2 \cdot 3} - n^2$

whence the sum of the particles in the octohedron

$= 2 \cdot \left\{ \frac{n \cdot \overline{n+1} \cdot \overline{2n+1}}{1 \cdot 2 \cdot 3} \right\} - n^2$

$\therefore$ sum of spheres in tetrahedron : sum in octohedron

$$:: \frac{n \cdot \overline{n+1} \cdot \overline{n+2}}{1 \cdot 2 \cdot 3} : 2 \left\{ \frac{n \cdot \overline{n+1} \cdot \overline{2n+1}}{1 \cdot 2 \cdot 3} \right\} - n^2$$

$$:: n \cdot \overline{n+1} \cdot \overline{n+2} : 2n \cdot \overline{n+1} \cdot 2\overline{n+1} - 6n^2$$

which is general for every tetrahedron and octohedron whose linear side consists of (n) finite particles, and is

$$:: n^3 + 3n^2 + 2n : 4n^3 + 6n^2 + 2n - 6n^2$$

$$:: n^3 + 3n^2 + 2n : 4n^3 + 2n$$

which when $n = \infty$, or the body becomes solid :: 1 : 4.

This must, I trust, convince Mr. Daniell that the summation of a finite number of spherical particles is never a correct estimate of the solid content of a body, and may, perhaps, induce him to repeat his experiments on this subject.

With the utmost respect allow me to subscribe myself,

PHILO-CHEMICUS CANTABRIGIENSIS.

ARTICLE X.

On welding Cast Steel and Cast Iron. By T. Gill, Esq.

(To the Editors of the Annals of Philosophy.)

Covent Garden Chambers,
London, March 14, 1818.

GENTLEMEN,

I PRESUME that I need not make any apology for introducing the following remarks, on the above subjects, to the notice of your readers.

It has always been considered a difficult task to weld the higher converted cast steel to iron; and indeed the public are indebted to Sir Thomas Frankland for the first accurate information on the means of performing it; namely, by heating the iron to a welding heat, and the steel as hot as it would safely bear; when, by dexterous management, the union may be effected, and without much injury to the steel.

I was, however, lately very much surprised, by being informed by Mr. Samuel Varley, a scientific mechanic, who was many years employed in assisting the late Earl Stanhope in his philosophical pursuits, that a smith in the neighbourhood of his

Lordship's seat at Chevening, was in the frequent habit of welding pieces of cast steel together without injury to them; and in this way could unite two worn out millwright's picks into a new and serviceable one; and that, in order to prove the value of his process, he had broken a bar of superior cast steel into two parts, and caused the smith to unite them again; and which was done without injuring the quality of the steel in the least degree.

This information of course awakened my curiosity; and I have since made it a point to mention the circumstance to any persons of information who have come in my way, to most of whom it was a new fact: amongst the number, however, I have met with some to whom the process was known, and particularly to Mr. Charles Sylvester, of Derby, who informed me that he had frequently performed it, and even with greater ease than in welding iron, *as the welding heat of cast steel is considerably below that of iron.* And that the chief cause of failure in attempting to do it, was, by persons heating it too much, conceiving that it required to be treated like iron, whereby it had been totally destroyed. That it, however, required a different flux from iron to prevent its oxidation, to which it is extremely liable, the welding sand used for iron being totally unfit for this purpose. He preferred glass of borax, or the greenish-black glass, of which common bottles are made, which consists of sand and alkali only, having no lead in it as in flint glass; and he thought that if it were to be fused with an additional portion of alkali it would be still better.

I have also found that Mr. George Scott, an ingenious mechanic, of the house of Cogger and Co. engineers, of Wardrobe Terrace, Doctors' Commons, has known and employed the process for three years past, and has, only a few days since, thus united four cylindrical rods of cast steel, each four feet long, after being truly turned in the lathe, into one, in order to form a triblet for drawing lead pipes upon of 16 feet in length; and so perfectly is their union effected that the three joinings cannot be perceived!

But what is yet more singular, I have been informed by Mr. Jonathan Dickson, engineer, of Holland-street, Blackfriars, that two bars of *cast iron* may be thus united, their ends being previously enclosed in a wrought iron tube and heated to a proper degree, the tube thus serving as a mould to prevent the fused cast iron from falling asunder during the operation.

In order to promote the success of welding cast steel, I would recommend the employment of a charcoal fire, and the pieces, after being formed of a proper shape for uniting, should have the surfaces intended to be joined filed bright, be coated with borax, and be bound together firmly by bands, hoops, &c. previously to their being put into the fire, and as soon as they are heated sufficiently to fuse the glass of borax, or bottle glass, that they be coated therewith on their outsides, either by dipping them into those substances powdered, or by sprinkling them over with them; and that no more heat than is absolutely necessary to effect their union be employed; and thus the properties of the steel will be as little injured as possible by the process.

I may also add, that it is no unfrequent practice amongst country smiths to unite *cast iron* to wrought iron in place of *steel*, and particularly for the coulters and shares of ploughs, on account of its cheapness; and possibly, for such coarse purposes, it may answer tolerably well. I am, Gentlemen,

Your most obedient servant,

THOMAS GILL.

ARTICLE XI.

Prof. Berzelius on the Discovery of a new Alkali and a new Metal.

(To Dr. Bostock.)

MY DEAR SIR, *Russell-square, March 25, 1818.*

In sending you the abstract of Professor Berzelius's letter which you have asked of me for the *Annals of Philosophy*, I think it right to state, that he has given me no instruction or authority whatever to make such a communication to the public. But as I see no expression in the letter from which I can infer that the Professor would object to this step, and as I have every reason to think that I can depend upon his friendly indulgence, I venture to comply with your request, especially as I feel the same desire as you do, that the interesting discoveries in question should be made known without delay to the British public.

Believe me ever, my dear Sir, very truly yours,

ALEX. MARCET.

A young chemist of great merit, Mr. Arvedson, who works in my laboratory, has just discovered a new fixed alkali. This alkali is found in a mineral from the mine of Uten, in Sweden; the mineral was discovered some time since by M. D'Andrada, and called by him petalite. It is composed, in round numbers, of 80 parts of silex, 17 of alumina, and three of the new alkali. This new alkali is distinguished from the old ones: 1. By the fusibility of its salts; its sulphate and muriate liquify before they arrive at a red heat, the carbonate at the moment when it begins to become red. 2. By its muriate, which is deliquescent, like the muriate of lime. 3. By its carbonate, which does not readily dissolve in water, while it communicates to it precisely the same taste with the other alkalies: the carbonate, when raised to a red heat in a platinum crucible, attacks the platinum as if we had employed the nitrate of potash or of soda. 4. By its great capacity of saturating acids, in which it even surpasses magnesia. We have called it lithion, to indicate that it has been discovered in the mineral kingdom, while the two others are of vegetable origin.

Another discovery no less interesting is, that the information which I gave you in my last letter, respecting the discovery of tellurium in sulphur procured from the mine of Fahlun, which is employed in the manufacture of sulphuric acid at Gripsholm, appears to be incorrect. I have just been making a more accurate examination of it at Stockholm, and I have found that what M. Gahn and I took for tellurium is a new substance possessed of very interesting properties. This substance has the properties of a metal, combined with those of sulphur, to so great a degree, that it might be supposed to be a new species of sulphur. The following are some of its properties. In its metallic state, it has a brilliant metallic lustre on the external surface with a tinge of red; the fracture is vitreous, like that of sulphur, but with a very brilliant lustre, of a grey colour. At the temperature of boiling water it is softened, and at a higher temperature it melts; it may be distilled at a temperature approaching to that of boiling mercury. Its gas, with which the heated part of the vessel may be filled, is yellow, exactly like that of sulphur. If it be sublimed in a large vessel, it is deposited in the form of flowers, of the colour of cinnabar, which are not, however, in the state of an oxide. During its cooling it preserves for some time a certain degree of fluidity, so that it may be moulded between the fingers and be drawn into threads. The threads, when drawn out to a great degree of fineness, if held between the eye and the light, are transparent, and of a ruby colour; while by reflected light they exhibit a brilliant metallic lustre. When this new substance is heated by a candle, it burns with an azure-blue flame, and exhales a strong odour of horseradish, which led us to suppose that it was tellurium. It is not easy to produce this odour from purified tellurium, either because it does not belong to it, except in as much as it contains this new substance, or because it is difficult to make it undergo the change which is necessary to produce this odour. The analogy of tellurium has induced me to give it the name of selenium.

Selenium combines with metals, and generally produces a reddish flame. The alloys have commonly a grey colour and a metallic lustre. The selenuret of potassium dissolves in water without evolving any gas, and produces a fluid of a red colour, which has the taste of the hydrosulphuret of potash. If we pour diluted muriatic acid upon the selenuret of potassium, a selenuretted hydrogen gas is disengaged, which is soluble in water, and precipitates all metallic solutions, even those of zinc and iron. The gas has the odour of sulphuretted hydrogen gas, when it is diluted with air; but if it is breathed less diluted, it produces a painful sensation in the nose and a violent inflammation, ending in a catarrh, which continues for a considerable length of time. I am still suffering from having breathed, some days ago, a bubble of selenuretted hydrogenous gas, no larger than a small pea. Scarcely had I perceived the hepatic taste in the fauces, when I experienced another acute sensation: I was seized with a giddiness, which, however, soon left me, and the sensibility of the schneiderian membrane was so far destroyed that the strongest ammonia produced scarcely any effect upon the nose.

Selenium combines with the alkalies, both in the humid way and by fusion; these combinations are red. The selenurets of barytes and of lime are also red, but they are insoluble. It also dissolves in melted wax and in the fat oils; the solutions are red, but have no hepatic odour. There exist also selenuretted hydroselenurets of the alkalies and of the earths.

Selenium dissolves in nitric acid by the assistance of heat; the solution, evaporated and sublimed, yields a mass crystallized in needles, which is a pretty strong acid; it has a pure acid flavour, and forms specific salts with the alkalies, earths, and metallic oxides. The selenic acid is soluble in water and in alcohol; its combinations with potash and ammonia are deliquescent; the latter is decomposed by fire, water is given out, and the selenium is reduced. The selenates of barytes and of lime are soluble in water. The selenic acid mixed with muriatic acid is decomposed by zinc, and the selenium is precipitated in the form of a red powder; by sulphuretted hydrogen gas an orange-yellow precipitate is formed.

The above contains a concise exposition of the characters of this interesting substance. With respect to its origin, it is evident that it proceeds from the pyrites of Fahlun, where, according to the observation of M. Gahn, its odour may be often perceived when the copper ore is roasted. The pyrites from which the sulphur of Fahlun is extracted is combined with galena, and it is probable that this contains selenium in the form of selenuret of lead.

Article XII.

Analyses of Books.

Transactions of the Horticultural Society, Vol. II. Part VI.

Although many of the papers contained in these Transactions are on topics of mere practical utility, and, therefore, scarcely adapted for our journal; yet there are others of a more scientific nature, or on subjects of more general interest, and as comprising the labours of a very active and intelligent bod of individuals, we presume that our readers will be gratified by receiving from time to time some account of their proceedings. We shall, therefore, transcribe the titles of the papers, and give a few observations on those that we think the most interesting.

Description of the different Plants grown in the Gardens under the Denomination of *Winter Greens*, with an Account of their Qualities, of the Seasons in which they are to be used, and of their Cultivation. By Mr. W. Morgan.—The different kinds of *greens* which Mr. Morgan enumerates, are the green savoy, the dwarf savoy, the yellow savoy, the Brussels sprouts, the green borecole or Scotch kale, the purple borecole, and some other less important varieties. We regret that the author has not given the scientific names of these plants, that they might have been clearly identified, which cannot be done with any certainty by a mere description, such as we have in this paper.

On the Application of Steam and its salutary Effects on forcing, particularly as applied to the Pine Apple. By Mr. James Brown; to this is added some Observations on Mr. Brown's Plan, and Suggestions for its Improvement. By Thomas A. Knight, Esq.—The advantages which steam is said to possess over heat applied in the usual method is, that the degree may be more nicely regulated, and that the moisture which may be introduced in this way into the house is frequently very salutary to the plants. The paper is accompanied by a plate, in which the construction of the apparatus is clearly described.

Observations on the Verdelho Grape. By Thomas A. Knight, Esq. consisting of a recommendation of this variety of grape, as an object of general cultivation; an account of the variety is contained in the Horticultural Transactions for 1814.

Account of a Method practised by Mr. James Mean, Gardener to Sir Ab. Hume, Bart. at Wormleybury, Hertfordshire, for ripening Grapes by Means of Dung-Heat under a common hot-bed Frame. Drawn up by the late George Anderson, Esq.

Account of the Method of growing Mushrooms in Houses. By Isaac Oldaker.—This plan, which is said to have been tried for some years with complete success, consists in forming a building with flues, and with different heights, or tiers of beds, like shelves, in which the compost is deposited, with a walk in the centre. For the minute particulars of the plan we must refer our readers to the engraving, which accompanies the paper. We have accurate directions added for preparing the soil and furnishing it with the spawn.

Description of a Method of numbering Marks, or Tallies, for Plants. By Alex. Seton, Esq.—This is a simple and ingenious method of applying to the tallies a system of notches, made in different directions, and which are supposed to correspond to the Arabic numerals, and thus to supersede the marking of them by ink, or paint, which is very liable to be effaced.

Suggestions for the Improvement of Sir George Stuart Mackenzie's Plan for Forcing-Houses. By Thomas A. Knight, Esq.—In the last part of the Transactions, Sir G. S. Mackenzie had proposed the spherical form as the best adapted for forcing houses, and Mr. Knight, coinciding in the general idea, suggests some modifications in the original design, and endeavours to obviate some objections that had been urged against the employment of the spherical form generally; but for the particulars we must refer our readers to the original paper, as well as the engraving which accompanies Mr. Knight's suggestions.

On the Fences most eligible for Gardens and Orchards. By J. Williams, Esq.—The object of the author is to recommend the planting of evergreen, and especially of holly hedges, in preference to those of hawthorne, or crab. His reasons are, that the former do not afford the same inducement for insects to deposit their young, and that they produce a much greater degree of warmth and shelter. The practical directions that are given by Mr. Williams should be attended to in the raising and management of hollies. The berries do not ripen until March or April of the following year; they are to be gathered at this time, buried in heaps in the ground, and sown in drills the succeeding spring; the proper season for removing the plants is the end of April or beginning of May, when the buds are just expanding into leaf.

Observations on and Account of the Tubers of the Lathyrus Tuberosus, with Instructions for the Cultivation of the Plant in a Garden. By Mr. James Dickson.—The lathyrus tuberosus is a native of many parts of the Continent, where the tubers that are attached to the roots, after being boiled, are served up at desserts like chesnuts in this country. The plant is propagated by means of these tubers.

Account of a Method of forcing Asparagus practised by Mr. Wm. Ross, Gardener to Edward Ellice, Esq. at Wyke House, near Brentford, with some Suggestions for its Improvement. By Joseph Sabine, Esq.—The improvement consists in "placing the roots of the plants over a substratum not in a state of fermentation, and by introducing into the bed the warmth necessary to force them from hot linings to the sides," by which means the plant is less feeble and drawn than when the heat is directly applied to the roots. Mr. Ross employs for raising his asparagus the pits in which the *succession pines* are kept in the summer.

Upon the proper Method of pruning the Peach Tree in cold and late Situations. By T. A. Knight, Esq.—The author observes that the blossom and leaf buds of plants, in their first state of organization, do not materially differ from each other; they then contain leaves only, which are subsequently converted into the component parts of the blossoms. A certain degree of heat and light seems essential to the production of the blossoms, and, accordingly, after a wet and cold season, like [illegible] of 1816, we find the more delicate fruit trees to exhibit lea[illegible] only in the following spring. Mr. Knight remarks that [illegible] are certain buds which expand their leaves earlier than the rest in the spring, and that the blossoms in the axillæ of these buds, are the ones the best calculated to come to perfection. These, as it appears, are situated towards the extremities of the branches, and, therefore, in the ordinary method of pruning, are necessarily destroyed; whereas, in the plan now recommended, they are preserved by merely "pinching off the minute succulent points, generally to the length of one or two inches. Spurs which lie close to the wall are thus made, upon which numerous blossom buds form very early in the ensuing summer; and upon such, after the last most unfavourable season (1816), and in a situation so high and cold that the *peach* tree, in the most favourable seasons, had usually produced only a few feeble blossoms, I observed as strong and vigorous blossoms in the present spring (1817) as I have usually seen in the best seasons and situations."

Observations on the proper Management of Fruit Trees, which are intended to be forced very early in the ensuing Season. By Thomas A. Knight, Esq.—The principle upon which the author chiefly insists in this paper is, that a plant will be in a better state for forcing the wood of which has been very completely ripened in the preceding autumn, and that to promote this effect, the power of vegetation should be put into a state of rest as early as possible, and should remain entirely dormant, until they are permanently excited in the ensuing spring. Some experiments are detailed in which the good effects of this system are made apparent.

Account of the Method of raising Mignionette in Pots, in Succession through the Year, as practised in the Vicinity of London. By Mr. George Rishon.

On the Cultivation of Strawberries in Forcing-Houses, during the winter and spring Months. By Mr. William Morgan.

Account and Description, with a Figure, of a new Strawberry, called the Roseberry, or Rose Strawberry. By Joseph Sabine, Esq. —This seems to be a variety of the scarlet, probably raised accidentally by seed, which was found in a garden near Aberdeen; from its superior size and other properties, it promises to prove a valuable addition to our more hardy English fruits.

Some further Observations on the Method of ringing Fruit Trees, for the Purpose of rendering them more productive. By George Henry Noehden, LL.D. &c.—The object of this paper is to point out, that the practice of ringing fruit trees, that is, cutting off a circular ring of bark from the stem, which the author had recommended in a former paper, has likewise been recommended and practised by the French gardeners.

Account of some Improvements in the Construction of a Stove for Plants, by which bottom Heat is imparted to their Roots, without the Use of Tan. By William Kent, Esq.—An objection arising to the employment of tan for stoves, in some situations, on account of the difficulty of procuring it, and in all cases from its liability to produce worms, Mr. Kent was induced to construct a house in which the flues should pass through a large space, which becomes a chamber of heated air, and which appears to be as effectual as the tan in warming the bodies that are contiguous to it.

On the Cultivation of Strawberries in the open Ground. By Mr. Michael Keens.

Account of a new Method of cultivating the Lobelia fulgens, practised by Mr. William Hedges, Gardener to the Earl of Mansfield. By Joseph Sabine, Esq.

Description of a Stove used for tropical Plants, in the Garden of Sir Abraham Hume, Bart. By Joseph Sabine, Esq.

A short Account of the Works of the Rev. John Volkmar Sickler, an eminent Pomologist in Germany. By George Henry Noehden, LL.D. &c.—We are informed that the subject of this paper was born in 1744 at Güntersleben, near Gotha, and was pastor at Kleinfahnern in the Dutchy of Saxe Gotha. For many years he paid particular attention to the management of orchards; he had three nurseries, one of which alone contained no less than 8000 grafted trees. This nursery was entirely destroyed by Marshal Ney's troops after the battle of Jena, and another of Mr. Sickler's nurseries, in which there were 1,500 grafted trees, shared the same fate from the Cossacks after the battle of Leipzic. The third, containing 1,200 trees, appears to have escaped. He is the author of a great work on pomology, consisting of no less than 48 volumes, containing a very full account of all the fruit trees that are grown in Germany, illustrated by above 1,200 plates. Mr. Sickler has also published a general farming dictionary in 14 volumes, and a botanical dictionary in one volume, besides many smaller tracts.

On a Mode of training Fruit Trees, described by M. Noisette, by George Henry Noehden, LL.D. &c.—M. Noisette's account is published in a French work entitled Bon Jardinier, for the year 1817; it consists in placing a frame-work either on one side or all round the tree, according to circumstances, which is flat at the top, and upon which the branches are trained as on a trellis, in a horizontal position. Another method is, when there are two inclined frames, joined at the top at an angle of about 50 degrees, on which the trees are trained. This latter frame may, if necessary, be covered with a glass case, thus converting it into a small forcing house, and this may be put on or removed at pleasure.

Article XIII.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.*

Feb. 26.—The reading of a paper by the Rev. John Brinkley was commenced, "On the Parallax of the Fixed Stars."

March 5.—The reading of Dr. Brinkley's paper was concluded. The Astronomer Royal having suggested some doubts as to the correctness of the author's former observations on this subject, he was induced to recur to it again, and has devoted much attention to it for the last 16 months. He has again met with apparent motions in the stars, which he can only explain upon the supposition of there being a visible parallax. He thinks that the star which offers the best opportunity for deciding the question is α Aquilæ, and the result of his observations upon it are generally consistent with the theory. Dr. Brinkley doubts whether the mural circle at the Greenwich Observatory be the instrument the best adapted for so delicate an inquiry; and it is on this account, and not from any idea of Mr. Pond's want of accuracy, that the author differs from him in his conclusions.

On the same evening was also read, "Some Additions to the Croonian Lecture, on the Changes the Blood undergoes in the Act of Coagulation," by Sir Everard Home, Bart. V.P.R.S.

The author began with some remarks upon the size of the globules of the blood, which, he informs us, Capt. Kater had ascertained to be the $\frac{1}{5000}$ of an inch in diameter. In order to prove the truth of his hypothesis, that the tubular structure of the coagulum of blood, which afterwards is converted into vessels, depends upon the extrication of bubbles of air, he placed some newly drawn blood under the exhausted receiver of an air-pump, when he found that none of the tubes were produced, while the tubes were formed as usual, in a portion of the same coagulum, which was exposed to the atmosphere. The author succeeded in injecting these tubes, by placing fine size on a piece of coagulum, while it was under the air-pump; if the air was admitted after it had been exhausted, the size was forced into the tubes. He injected the tubes of a piece of coagulum that was formed in the cavity of the abdomen from the small arteries of the peritoneum. Some observations were then made on pus, similar to those on coagulated blood, in which the pus became tubular. This fact is supposed by the author to illustrate the principle on which granulations are formed on the surface of wounds.

* In our last number we inadvertently ascribed the mathematical paper, which was announced on Feb. 19, to Sir Wm. Herschel, instead of J. F. W. Herschel, Esq.; it was entitled "On Circulating Functions, and on the Integration of a Class of Equations of finite Differences, into which they enter as Coefficients."

March 12.—A paper by Dr. Totness Fischer, "On the Anatomy of Spiders," was read; also a paper, by B. Bevan, Esq. "On some Fossils in Leicestershire and Northamptonshire."

ROYAL SOCIETY OF EDINBURGH.

March 2.—Dr. Murray read the first part of a paper "On the Relation in the Law of Definite Proportions in Chemical Combinations, to the Constitution of the Acids, Alkalies, and Earths, and their Compounds." Its object was, to determine if the composition of these substances, according to the theory which he has lately proposed, be conformable to the law of definite proportions. The part of the paper read extended to the acids of which sulphur and carbon are the radicals, the vegetable acids being comprised under the latter. A very strict coincidence is found in the actual proportions, according to the theory, with the law, so as to afford proofs even of the truth of the former; and some of the results display views very different from those which have been hitherto proposed. The remainder of the paper will be read on a succeeding evening.

At the same meeting an abstract of a new paper, by Mr. Lauder Dick, on the Parallel Roads of Lochaber, was read.

After considering the paper which he had prepared on the parallel roads of Lochaber, since his second visit to that district, he was satisfied that it would not be very intelligible if read to the society, owing to the frequent reference to the map and drawings. He therefore contented himself with a very few remarks explanatory of the views he entertained of this interesting subject.

In a former paper he described the general nature of these shelves: he has since ascertained, by several observations, that they are perfectly horizontal. One very remarkable circumstance attending them is, that in one or two instances, they can be traced in a perfect circle, around little isolated hills, on a level with the corresponding line on the sides of the valley.

In his former visit to Glen Roy, he traced the shelves in that valley only; on the late occasion, however, he discovered that they are also to be found in Glen Spean and Glen Gluoy. This last valley contains one range, at an elevation 12 feet higher than that of any of those in the other glens. The two shelves next in altitude are to be found in Glen Roy alone. The uppermost runs through both lower and upper Glen Roy, and loses itself in the flat mossy ground, forming the summit level of the country near the Loch of Spey. Besides these two shelves, which are the particular property of Glen Roy, there is another at a lower level, common to Glen Roy and Glen Spean. Its two extremities are to be traced, one on the mountain of Ben-y-vaan, near Highbridge, and the other on th[illegible] of Aonachmore, one of the Ben Nevis group, nearly o[illegible] This shelf may be followed almost every where, in its [illegible] glens. It

also, that the horizontal shelves of Lochaber, and this vast crack across the island, reflect a mutual light on each other, elucidating the history of both.

March 16.—Mr. Leslie read an account of his new instrument, called the æthrioscope. As a description of it is already in the hands of the public, it is unnecessary to give any abstract of the paper at present.

At the same meeting Dr. Brewster laid before the Society a paper "On a New Theory of Double Refraction."

WERNERIAN SOCIETY.

Dec. 20, 1817.—The Secretary read a communication from Mr. Hood, surgeon, Kilmarnock, on some fossil tusks found in the parish of Kilmaurs, in Ayrshire.

In digging through a bed of alluvial clay to the depth of 17½ feet, four large tusks, resembling those of the elephant, were found; and also the rib of some large animal. The largest tusk measured 40 inches in length and 12½ inches in circumference at the maxillary extremity, and 8½ inches at the end. In the same bed of clay, remains of shells were found.

At the meeting on Jan. 10, 1818, Prof. Jameson read a paper on the geognostical characters of simple minerals. He remarked that the distribution of plants and animals over the earth is determined by distance from the equator, height above the level of the sea, kind of exposure, and other circumstances; but that a different arrangement is observable in mountain rocks, for they are universally distributed, and the same species occurs equally at the equator, and towards the poles, at the level of the sea, as above the line of perpetual snow. Although the distribution of mountain rocks is thus proved to be independent of climatic influence, yet it would appear that the grand series of primitive, transition, and floetz rocks have their peculiarities as to height above the sea, to the spaces occupied by the different formations, and to the general direction, dip, and inclination of the strata. Thus, although the general characters of the formations to the north of the Frith of Forth agree with those of similar groups of rocks on the continent of Europe, and although they exhibit such characters as show that they are members of the same general series, and have been formed at the same time, yet if we contrast them with the collective, primitive, transition, and floetz rocks of other tracts, as of Switzerland, for example, we shall find very striking differences, not only as to the spaces occupied by the rocks, but also to their relative heights above the sea, and the arrangements of their direction, dip, inclination, &c. In short, such a comparison, Professor Jameson remarked, would show that these two masses of land, although exhibiting the same species of rocks and structures, yet are distinguished by particular and individual characters—that both are to be viewed as portions of the earth's surface formed from the same general fluid by a process of crytallization, and that the peculiarities which characterize each of them are to be considered as of a similar description with those local differences observable in crystallizations from the same solution. But the geognostical distributions of simple minerals are very different from those of mountain rocks: we do not find the same species every where; on the contrary, they seem to have many kinds of distributions, in this respect approaching more nearly to what we observe in the physical arrangement of animals and vegetables over the face of the earth. Professor Jameson entered very particularly into this interesting subject. At the same meeting, Professor Jameson read some observations on the natural history of the diamond, and stated it as a conjecture that the remarkable hardness of some woods may be owing to their containing carbonaceous matter, approaching to the adamantine state, and that the diamond itself might occur as a secretion in grain, or even in crystals, in some of the vegetables in the warmer regions of the earth. He also alluded particularly to the natural history of the tabasheer, or *vegetable opal*, found in some oriental vegetables; and from the great tendency observed in some vegetables to secrete silica, he offered, as a conjecture, that some silicified woods met with on the surface of the earth might be trunks, or branches of trees, which had been killed by the over secretion of siliceous matter.

At the same meeting the Secretary read a communication from Mr. Butter, surgeon of the South Devon Militia, giving an account of the change of plumage in the females of several gallinaceous birds, particularly common poultry, to that which resembles the males; and showing that this is a natural result of advanced age only, and not to be accounted a monstrosity.

At the meeting on Jan. 24, Mr. James Wilson communicated some remarks on the eggs of the common frog, and on the tadpole in its early state, tending to prove that the young animal derives its nourishment from the mass of gelatinous matter with which it is encompassed, and that by means of a filament, analogous to an umbilical cord, by which it is attached to the mass. Mr. Wilson also gave an account of the progressive development of the members or extremities of the animal, as observed by him. At the same meeting, Mr. Alexander Adie, optician, exhibited and explained his new instrument called the *sympiesometer*, or measurer of compression; in which the moveable column consists of oil, including in a glass tube a portion of azote, which changes its bulk according to the density of the atmosphere. The barometric scale is made to slide up and down, so that it can be adjusted to a Fahrenheit's thermometer attached to the instrument.

Feb. 7.—The Secretary read the first part of Dr. Traill's account of an African orang-outang, which lately died at Liverpool, the property of Mr. Bullock of the Piccadilly museum. In the introduction to his paper, he gave an account of the manners of the animal, as described by Captain Payne, who purchased it at Isle of Princes, from a native trader who had brought it from the Gaboon river. Captain Payne had it in his custody for more than two months. It showed an inclination to imitate many human actions; but never attempted the imitation of sounds. It disliked the erect posture, and walked on the knuckles, not the palms, of the fore extremities. It was dirty in its habits, and very timid. It associated familiarly with the crew, excepting one boy, to whom it showed a decided and unceasing aversion. It was a faithful attendant of the seamen's mess, ate almost every kind of vegetable offered, was very fond of sweet articles of food; but did not relish any kind of butcher's meat. As the vessel approached the colder latitudes, it became somewhat languid, and carefully wrapped itself in a blanket on retiring to rest. From accounts given to Capt. Payne by negro traders, on whose veracity he placed dependence, it appears, that in its native haunts it is a very formidable animal: they all agreed, too, in affirming, that negro girls had sometimes been carried off and kept in a state of frightful captivity for years; stories which have hitherto been regarded as resting wholly on the authority of Purchas's "Pilgrimes," and other old works.

Feb. 21.—The second part of Dr. Traill's paper on the African orang-outang was read, containing an account of the dissection of the animal. To this dissection both Dr. Traill and Dr. Vose, of Liverpool, dedicated all their leisure hours for several days. They found Tyson's descriptions in many respects accurate; but they also detected several mistakes and omissions. It would here be out of place to attempt to give any account of the appearances on dissection; which, indeed, could scarcely be abridged. It may, however, be mentioned, that they found a flat triangular muscle, inserted near the top of the thigh, which appears to have escaped the notice of Tyson, Camper, and Cuvier. The action of this muscle is to draw the thigh up toward the body; and from its being evidently calculated to facilitate climbing, it has been proposed to name it, *musculus scansorius*. The animal was a female; and the anatomists remark, that the peculiar form of the pelvis shows that the erect posture is not the natural one of the animal; for that in the erect posture it would be extremely liable to abortion in the gravid state.

March 7.—At this meeting the Secretary read a notice of a new quadruped, from the Stoney Mountains in North America. It is described by some American naturalists under the name ovis montana; and other observers are inclined to consider it as a species of antelope. Professor Jameson, from its external appearance, and the circumstance of the genus antelope being foreign to the New World, proposes that it should be introduced into the zoological system, as a new genus between the genera capra and antelope. He also recommends the introduction of this animal into Great Britain on account of the uncommon fineness of its wool, which even excels that of the best merino sheep. Specimens of this highly interesting animal were exhibited, and the Society owe them to an intelligent gentleman, Wm. Auld, Esq. who long commanded in Hudson's Bay.—At the same meeting Professor Jameson read a paper on the formation of valleys. The object of this communication was to propose an opinion which connects the principal phenomena of valleys with the rocks of which they are composed. The subject was treated of under the following heads: 1. Simple minerals are formed with surfaces varying in their direction from the even to the highly waved and angular. 2. Mountain rocks, or those masses of which the crust of the earth is composed, like simple minerals, crystallize with various surfaces from the even to the angular-waved, and thus give rise to considerable inequalities, as single hills and small valleys. 3. Mountain rocks also crystallize in ranges, forming chains of hills or mountains, and hollows between, or greater valleys. 4. Those ranges of mountains and hills occur grouped together in various ways, with numerous principal valleys, depending on the nature of the rock or rocks, and of various other circumstances that prevailed during their crystallization. 5. Those mountain rocks in many tracts on the face of the earth are enormously accumulated, and thus give rise to tracts of alpine lands, such as the Pyrenees. 6. On a more general view we find vast circular accumulations of high land, such as the sea of Europe, including that of Bohemia, Hungary, &c. 7. The opening of the circular and other enclosed valleys give rise to deluges. 8. The various original valleys shown to be formed by the particular mode of crystallizing of the rocks, and other attending circumstances, were afterwards more or less altered by the action of running water, but more particularly by the influence of the atmosphere.

Article XIV.

Scientific Intelligence, and Notices of Subjects connected with Science.

I. *On the Aphlogistic Lamp*. By Dr. Edward Daniel Clarke, Professor of Mineralogy in the University of Cambridge, &c. &c.

(To the Editors of the Annals of Philosophy.)

Gentlemen,

Since I communicated my observations respecting the *meteor* which was seen by day-light in *Cambridge*, an article has appeared in your number for *March*, upon the Lamp *without Flame*, to which I alluded at the close of that communication. The author of this ingenious contrivance, it seems, is yet unknown,* although your readers must be well aware that it is an extension of Sir *Humphry Davy's* experiment with *ether*. An accidental conversation in Mr. *Cary's* shop in the Strand, enabled Mr. *Holme* to bring to *Cambridge* intelligence of the curious, not to say important use, which had been made of Sir *Humphry's* discovery. We succeeded in the first trial we made; and a lamp thus ignited was exhibited in my lecture room, before the gentlemen of the University, where it continued burning during many hours. But I had no idea, at the time, of the degree of light and heat which this *aphlogistic* lamp was capable of exhibiting: and as many of your readers may yet remain as ignorant of its powers as I was in my first experiments with it, I will briefly state the method by which it may be made to evolve a degree of light not only sufficient to enable a person to read the smallest printed or written characters during the night, but which radiates with the intense splendour of substances undergoing combustion in *oxygen* gas, and is attended by heat so powerful that the *alcohol* takes fire, and the lamp becomes spontaneously lighted within a few seconds after being extinguished.

It has been already stated that the *platinum* wire for the *aphlogistic* lamp, ought not to exceed $\frac{1}{100}$ part of an inch in diameter. Twelve coils of this wire (spirally twisted for the purpose round the tube of a tobacco pipe), are to surround, six the wick of the lamp, and six to remain elevated above the wick. But, having this information, nine persons out of ten may fail in their attempt; or produce at best a feeble effect with the lamp; simply from the circumstance, either of their making the diameter of the coils too large, or from twisting also into a spiral form and confining by the pressure of the wire the cotton wick. The wick should be small; and quite loose in the burner of the lamp; and every fibre of the cotton should be placed as perpendicularly as possible. The diameter of the coils should be exactly $\frac{3}{20}$ of an inch; they should be as near to each other as possible without touching, those which lie uppermost being closer together than the first spiral coils which rise from the top of the wick. I succeeded best when there were six coils above the wick and $9\frac{1}{2}$ below, upon the wick. The light then given out was too intense to be endured by the sight. A dark passage was illuminated by it, and the *alcohol* was twice spontaneously kindled in consequence. When the same lamp, after being extinguished, became again ignited, in its *aphlogistic* state, I read paragraphs from newspapers, and manuscript notes written in a very small hand, by the light it afforded.

I remain, &c.

E. D. Clarke.

* According to Mr. *Cary's* subsequent information, the invention of this *lamp* is due to Mr. *Ellis*, of *Bath*.

II. *On a Lamp without Flame.* By Francis Ellis, Esq.

(Addressed to Mr. Cary, of the Strand.)

DEAR SIR, *Bath, Feb. 21, 1818.*

I thank you for the laminated platina. I thank you too for the wire, and the account of the experiment to which it is applicable. Is it not whimsically singular that you should have happened to give me notice of an experiment, which I had devised (and as I thought, the first) more than six months ago? The idea having occurred that platina wire made red hot might conveniently be kept in that state for an unlimited time, without further application of heat, you may recollect I wrote to you for some of the wire in August, which I applied, nearly in the manner you describe, to a small spirit-lamp. By my arrangement light sufficient was produced to enable me to distinguish the time by a watch at the distance of a foot from the wire. You may blow on the coil of wire till it ceases to be luminous, and in two or three seconds it again becomes red. I showed the experiment to several, and among others, to Dr. Wilkinson, who afterwards exhibited it at his lectures. I have some curiosity to learn whether it was known in London prior to the time I have mentioned. With good wishes and esteem,

I remain, dear Sir, your obedient servant,

FRANCIS ELLIS.

III. *Expedition to the Northern Ocean.*

One of the most remarkable natural phenomena that has occurred in modern times, is the disappearance, or breaking up of a large part of the enormous masses of ice, which have for some centuries been accumulating in the different parts of the northern ocean. This accumulation has taken place to the greatest degree, or, at least, its effects have been the most perceptible on the eastern coast of Old Greenland. This territory was originally colonized from Denmark, towards the end of the tenth century; for about four centuries it kept up a regular communication with the mother country, until the ice totally blocked up all access to the shore, so that for the last 400 years all communication with it has been cut off from the other parts of Europe, and there can be little doubt that the inhabitants must have perished. Since that period an immense barrier of ice has extended from near the southern point of Greenland, along the whole eastern coast, stretching across to Spitzbergen, beyond which vessels have seldom been able to penetrate. There appears, however, to be the most decisive evidence that about two or three years ago this barrier of ice was broken in various parts, and that during the summers of 1816 and 1817, large tracts of the northern ocean, that were before completely impassable, became comparatively free from obstruction. We have at the same time equally decisive testimony to the fact, that a similar displacement of the ice has taken place in the part of the northern ocean about Davis's Straits, and that different whale ships have penetrated beyond their usual limits, and found the sea comparatively open. In confirmation of this change in the state of the polar ice, we are further informed that immense masses of it have been met with drifting down the Atlantic; some of them as far as 40° of latitude; and in some parts, where ice is seldom met with, as about Newfoundland, it occurred in such great quantity as to have considerably impeded the navigation.*

To what cause we are to ascribe this extraordinary revolution is a matter of mere conjecture; we are not aware of any occurrence to which it can be traced, unless we imagine that the gradually accumulating mass at length gave way from its own increasing bulk, or that the waters of the northern ocean, being as it were dammed up to an unusual height, at length broke through the mound which confined them. It is certain that a strong current sets in a southerly direction on each side of Old Greenland; and to whatever cause the original dislodgement of the ice may be owing, this current is the agent by which the detached masses of ice have been removed. Many speculations have been formed respecting the effect of this accumulation of ice on the climate of Great Britain and the N.W. of Europe, and on the probable result of its removal. The arguments that have been adduced, to prove that the climate of Great Britain has been gradually deteriorating for the last century or two, appear to us inconclusive; nor, were the fact of the deterioration proved, do we consider the cause assigned as adequate to produce it. But the coldness of the last two seasons is well known; and we think it very possible, and even probable, that the immense fields of ice moving southward, and gradually dissolving as they passed along the Atlantic, may have sensibly affected the temperature both of Europe and America.

A very interesting consequence that is likely to follow from this revolution in the state of the northern ocean, is an addition to our knowledge of the hydrography of the Arctic circle, more especially of the shape of the upper part of Greenland, of the northern termination of the continent of America, and still more the determination of the celebrated question concerning the existence of what has been called the N.W. passage. To ascertain these points, advantage has been taken of the present favourable state of the northern seas, and an expedition is now on the point of sailing for the purpose of exploring these unknown regions. Four vessels of about 300 tuns burden are prepared for the purpose; two of which are to sail N. of Great Britain, to pass between Old Greenland and Spitzbergen, if possible to get to the pole, and then to proceed in nearly a direct course to Behring's Straits; the other two vessels are to go to the W. of Old

* The accumulation of ice about the northern parts of Iceland during the course of the last summer was equally remarkable. See *Annals of Philosophy* for March, p. 229.

Greenland, to pass through Davis's Straits, and to proceed, if possible, in a N.W. direction beyond the supposed northern shore of America. The success of these plans obviously depends upon the suppositions that Old Greenland is an island or a cluster of islands, that Baffin's Bay is a part of the ocean, and that the continents of America and Asia are completely detached. Although these points are all uncertain, yet the evidence that we are able to collect is much in their favour; and there are indeed many circumstances respecting the direction of currents, the drifting of wood, and the course which the whales are observed to pursue, that can scarcely be accounted for upon any other hypothesis. But whatever may be the result of the expedition, it is certainly a most favourable opportunity for instituting the experiment, and we can scarcely fail to derive much valuable information from it, not only with respect to the hydrography of the Arctic circle, but on many other topics of natural philosophy.

The vessels that are to proceed along the eastern side of Greenland are named the Dorothea and the Trent, under the command of Capt. Buchan and Lieut. Franklyn; those that are to pass through Davis's Straits are the Isabella and the Alexander, under the command of Capt. Ross and Lieut. Parry.

IV. *On the Nomenclature of Clouds.* By C. Johnson, Esq.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN, *Lancaster, Feb.* 10, 1818.

Annexed is Mr. Heaton's table of the results of his meteorological register for another year (see *Annals of Philosophy*, vol. ix. p. 215). The rain table is taken, as before, from the Lancaster Gazette. No rain seems to have been collected in the month of April, all that fell on the six showery days having probably passed off by evaporation. The rain which was collected at Kendal, during the year 1817, amounted to 49·74.

Permit me to assure your correspondent Glosterian* that my remarks on the nomenclature of clouds have no reference whatever to the terminology of Mr. Howard.

When drawing up my communication on clouds last year, I wished to acknowledge the information derived from some papers on the same subject, which I had perused with considerable interest many years ago; but I could not then recollect the author. On turning over Nicholson's Journal, vol. xxvi. and xxvii., I have lately found the object of my search, and beg leave to refer your correspondent Glosterian to the observations of Dr. Bostock inserted in those volumes, and to assure him that the clouds I have attempted to describe are always succeeded by much rain in this part of the country.

I am, Gentlemen, your obedient servant,

Christopher Johnson.

* Vol. x. p. 306.

Tabular View of a Meteorological Journal kept at Lancaster. By John Heaton.

1817.	THERMOMETER.				BAROMETER.			WEATHER.		WINDS.								RAIN.
Months.	Highest.	Lowest.	Mean.	Mean diurnal variation.	Highest.	Lowest.	Mean.	Wet days.	Fair days.	South.	South-West.	West.	North-West.	North.	North-East.	East.	South-East.	Inches and sixty-fourths.
					Inches.	Inches.	Inches.											
January	25th 51°	15th 25°	39°	8°	31st 30·52	20th 28·51	29·72	16	15	13	6	6	4	—	—	—	2	1·43
February	20 49	5 31	42	7	1 30·59	20 29·28	29·82	18	10	—	15	9	4	—	—	—	—	3·07
March	29 53	21 22	42	11	31 30·45	3 29·00	29·75	16	15	4	16	6	4	1	—	—	—	2·32
April	22 73	10 30	48	18	6 30·61	29 29·78	30·27	6	24	1	4	7	2	8	3	4	1	0·00
May	7 74	19 38	52	19	6 30·31	12 29·20	29·74	10	21	2	8	7	1	—	8	4	1	1·16
June	21 91	1 42	62	18	16 30·30	13 29·06	29·81	15	15	3	10	10	—	—	1	1	5	1·46
July	3 77	16 49	59	14	24 30·05	1 29·13	29·74	18	13	3	14	9	1	1	2	—	1	2·51
August	5 77	21 45	59	14	22 30·14	26 29·01	29·65	21	10	3	15	4	2	1	2	—	4	6·33
September	17 81	30 49	60	15	5 30·21	26 28·94	29·93	6	24	2	7	4	3	1	3	1	9	0·54
October	8 64	2 38	46	14	5 30·39	30 28·94	30·00	10	21	—	2	—	2	3	15	4	5	1·17
November	5 59	25 35	48	8	20 30·67	8 29·10	29·87	21	9	13	9	5	1	—	—	—	2	3·41
December	1 51	25 24	36	7	25 30·07	19 28·50	29·52	15	16	9	5	3	2	—	7	4	1	5·02
	June, 91	March, 22	49⅓		Nov. 30·67	Dec. 28·50	29·818	172	193	53	111	70	26	15	41	18	31	30·22

V. *Mosaic Pavement.* By N. J. Larkin, Esq.

Mr. Larkin, member of the Geological Society, is about to publish "An Essay on a Species of Mosaic Pavement, formed of right-angled Triangles of different Colours; with the Method of calculating the Number of their Combinations," illustrated by a series of engravings.

VI. *Cobalt and Silver Mine.*

We are informed by Mr. Mawe that the machinery for working the cobalt and silver mine on the west edge of Dartmoor is just completed, and the workings will shortly assume a regular form. The large black masses of arsenical cobalt, contrasted with the white curls of capillary silver and crystallized sulphuret of silver, which fill the cavities of the quartz gangue, form specimens peculiarly interesting, and almost rival those from Mexico.

VII. *Action of the Oxy-hydrogen Blow-pipe on Silica.* By Joshua Mantell, Esq.

(To Dr. Thomson.)

SIR, *Lewes, Dec.* 10, 1817.

The brilliant results obtained by Dr. Clarke, by means of the oxy-hydrogen blow-pipe, induced me and my friend Mr. Robert Ashdowne to embrace the earliest opportunity of repeating his experiments, before the Lewes Philosophical Society; and it is no small gratification to us, to add our humble testimony in corroboration of the accuracy of his statements.

Our first attempts to obtain silicium were unsuccessful; but we have since ascertained, that the failure originated from the substance having been exposed to a temperature so intense as to reduce the metal as soon as it was formed, into a substance of a greyish appearance. We have since obtained it with much facility, by placing pure silex mixed with lamp oil, before the ignited gaseous stream for *a few seconds only*, and have invariably found the metal dissipated, when the fusion has been longer continued. The silicium was as readily produced when the silex was placed on charcoal, as when exposed on a tobacco pipe.

We have taken the liberty of enclosing a few grains of the silicium obtained last evening: its appearance agrees in every respect with Dr. Clarke's description; it has *now* "a greater degree of metallic lustre and whiteness than the purest silver." We hope it will retain its brilliancy till you receive it.

With the greatest respect, I have the honour to remain, Sir,

Your very humble servant,

JOSHUA MANTELL.

The specimen possessed the metallic lustre in great perfection when I received it, and I doubt not will retain it for years. This metallic substance, obtained by my Lewes correspondents, forms a very thin coating upon silica, and the whole is so light that the pieces float upon water. That the metal obtained is not silicon (supposing silicon to be a metal) is obvious from this, that the lustre is neither altered by water, nor nitric acid, nor muriatic acid, nor nitromuriatic, even when in contact with these liquids for 24 hours. Whereas silicon, as we learn from Davy's experiments, cannot be obtained in a separate state, because it decomposes water and every other liquid which he applied to it. I fused a little of the matter sent me with potash, before the blow-pipe, in a platinum forceps. The bead had a greenish shade, and contained a little iron, which was the only metal I could discover in it. But I rather think the metallic lustre is connected with the oil. I have frequently obtained charcoal from animal oil, having a metallic lustre little inferior to that exhibited by the specimens sent me with the preceding communication. The fine silvery colour is probably owing to a very thin coat of this charcoal covering the white silica.—T.

VIII. *Septaria.* By Wm. Davis, Esq.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN,

In the *Annals* for January, page 39, is an interesting paper on the uses of the Septaria; after reading which, I immediately turned to the new edition of Thomson's Chemistry, 1817, for further information, but without success; for I could not find any one of the names, septaria, ludus helmontii, or loam-stone, in the index to that valuable work. You would confer an obligation, therefore, on some of your readers, if you would refer us to the proper article for information, or give in your *Annals* such a description as would enable us to determine whether that valuable substance occurs in our own neighbourhood.

At the same time I beg leave to inquire what is the best means of preventing the oxidizement of steel, or brass wire, when exposed to water? My view in asking this question is the improvement of wire "gig-mills," used for dressing, or facing woollen cloth. The wires act on the cloth something like a brush, or comb, and are constantly wetted. I am, Gentlemen,

Your obliged servant,

WILLIAM DAVIS.

Gloucestershire.

In answer to the first query of our correspondent, we reply that the septaria are balls mostly in the form of an oblate spheroid, which, on being broken, appear to be composed of brownish, or bluish indurated clay, intersected by veins, or partitions (*septa*) of calcareous spar. These veins are widest about the centre of the ball, and generally terminate a little short of the surface. Hence, they have probably been produced not by infiltration, but by a spontaneous separation of the original ingredients composing the mass of which the ball was formed.

The septaria occur either in beds, or casually dispersed through the mass of the great deposit of blue clay which lies above the chalk. The deep cutting for the archway at Highgate Hill, the canal in the Regent's Park, and the clay pits between London and Hackney, exhibit sections of this stratum; as also do the cliffs at the Isle of Sheppy, and at Southend, on the opposite shore of the Thames. The space between the South Downs and the central chalk ridge of the Isle of Wight is chiefly occupied with the same deposit. Septaria also exist in other beds of slaty clay lower in the series than the chalk. They bear a great analogy also with the balls of argillaceous iron ore, deposited in the shale between certain beds of coal; and probably these iron-stone balls would answer many of the purposes of the genuine septaria.

With regard to the latter query of our correspondent, we fear that it will be impossible to prevent either iron or brass wire from being corroded when exposed to a constant alternation of air and of moisture.—Ed.

IX. *New Comet.*

Dr. Olbers, of Bremen, has just discovered a new comet, Nov. 1, at seven p. m. in the west shoulder of Serpentarius, between the stars K and No. 104 of Bode. It was small and very brilliant, particularly in its centre, without a visible nucleus, or tail. It cannot be seen without the telescope. At 7^h 14^m its right ascension was 253° 13′, its northern declination 9° 14′, its course was directed from E. to S. (Quoted from Gazette d'Aix-la-Chapelle, in Journ. Phys. Nov. 1817.)

X. *Chemical Analysis of Pimento.*

M. Braconnot has subjected this substance to an elaborate examination, the result of which is, that it consists of the following ingredients:

1. Fecula	9·0
2. A very acrid oil	1·9
3. Waxy matter united to a red colouring principle.	0·9
4. A peculiar gummy matter	6·0
5. Animalized matter	5·0
6. Citrate of potash	6·0
7. Insoluble residue	67·8
8. Muriate of potash. 9. Phosphate of potash. Loss.	3·4
	100·0

M. Braconnot has performed some experiments on lichens, and particularly on a species of variolaria, probably the faginea, the constituents of which are stated to be the following; the particular details are not given, and the analysis is obviously very imperfect; but it may deserve to be noticed in consequence of the large proportion of lime which was detected in the substance:

1.	Matter analogous to wax	5·0
2.	Bitter and acrid principle	2·0
3.	Green colouring matter	1·0
4.	Undetermined pulverulent substance	3·0
5.	Uncrystallizable saccharine matter	0·5
6.	Jelly	4·4
7.	Vegetable matter analogous to the preceding	31·0
8.	Unknown vegetable matter	34·0
9.	Lime, which was intimately united to the preceding matter	18·0
10.	Ferruginous phosphate of lime, and loss	1·1
		100·0

XI. *Meteorological Establishment at St. Bernard.*

In the number of the Bibliotheque Universelle for October last, Prof. Pictet gives an interesting account of an establishment that has lately been formed for making meteorological observations at the Convent of Great St. Bernard. Every attention appears to have been paid to the accuracy of the instruments, and the method of using them; and we may expect to derive the most important information from a detailed account of the state and variations of the atmosphere at an elevation of above 8,000 feet, where the mean height of the mercurial column is not more than 22 inches. With respect to the construction of the instruments, we are informed that the reservoir of the barometer is exactly ten times the diameter of the tube; the correction for the changes of the height of the mercury in the reservoir, is, therefore, only $\frac{1}{100}$ of the variation in the tube, a quantity which is, in almost all cases, too minute to be noticed. To the barometer is attached a mercurial thermometer furnished with two divisions, one octogesimal, according to the scale of Reaumur, the other so arranged that each degree of the scale corresponds to $\frac{1}{10}$ of a line of variation in the height of the barometrical column. The zero of this latter answers to the tenth degree of the octogesimal scale (54·5° of Fahrenheit), and every observation of the barometer is reduced to this constant temperature, by means of the correction which is obtained by the thermometer. The correction is very easily made, since every degree above or below zero represents so many tenths of a line, which are to be subtracted or added from the barometrical observation. The thermometer is formed with a flattened column of mercury, so as to present to the eye a large and very visible surface, while at the same time the absolute size is very minute. The hair hygrometer of Saussure is employed, but with a little alteration in its mechanical arrangements; in the old construction the index descended towards dryness, and ascended towards moisture; in the present instrument the motions are reversed, so that its action is rendered more conformable to that of the barometer and thermometer.

We have an account of the observations that were made in this meteorological observatory during the latter half of Sept. 1817.

The greatest height of the barometer	22·40
The least height	22·06
The mean height at sun-rise	22·36
Ditto at 2 P.M.	22·42
The greatest height of the thermometer . ..	54·5°
The least height	29·75
Mean height of the thermometer at sun-rise	38·00
Ditto at 2 P.M.	46·6
Mean height of the hygrometer at sun-rise ..	92·0
Ditto at 2 P.M.	84·3

There were four rainy days during this period; the quantity of rain was no more than ·7 inch: the season is represented as having been peculiarly fine.

XII. *Researches on the Cerealia.* By M. Vogel.

M. Vogel read a memoir on this subject to the Royal Academy of Sciences at Munich, in March last; the following are the principal results which he deduces from his experiments; but the processes are not detailed by which they were obtained.

1. The farina of the wheat of triticum hybernum is composed of

Fecula	68·0
Gluten.	24·0
Gummy sugar.	5·0
Vegetable albumen.	1·5
	98·5

That of triticum spelta contains

Fecula	74·0
Gluten, not dried	22·0
Gummy sugar	8·5
Vegetable albumen.	0·5
	105·0

2. The farina of the oat is composed of

Fecula	59·0
Albumen.	4·3
Gum.	3·5
Sugar and bitter principle.	8·25
Fat oil	2·0
Fibrous matter.	—

3. Rice contains

Fecula	96·0
Sugar	1.0
Fat oil	1·5
Albumen	0·2
	98·7

4. Carbonic acid gas will not supply the place of yeast and leaven in fermentation. Hydrogen will make the dough rise, but will not make it ferment.

5. The constituent parts of farina, when they have been once separated, cannot be reunited, so that the farina should become proper for making bread.

6. Wheaten bread is composed of

Sugar	3·6
Torrefied fecula	18·0
Fecula	53·5
Gluten combined with a little fecula	20·75
Carbonic acid	—
Muriate of lime	—
Magnesia	—

XIII. *State of the Magnetic Needle at Paris.*

Feb. 10, 1817, at one p. m. the variation of the magnetic needle was 22° 17′ W. This observation, compared to those of the two preceding years,* seems to leave no doubt of the retrograde motion of the magnet. March 14, 1817, two p. m. the inclination of the needle was 68° 38′. The same instrument in Oct. 1810, was 68° 50′. (Ann. Chim. Dec. 1817.)

XIV. *Mr. Howard's Work on Meteorology.*

Mr. Luke Howard will shortly publish, in two volumes, a work entitled, "The Climate of London, deduced from Meteorological Observations made at different Places in the Neighbourhood of the Metropolis." Vol. I. will contain an introduction relative to the construction and uses of several meteorological instruments; tables of observations for ten years, with notes and results; accounts of collateral phenomena in other parts of the world, and occasional dissertations. Vol. II. will contain a methodical account of the climate of London, under the several heads of the winds, barometer, temperature, rain, evaporation, electricity, &c. deduced from the facts contained in the first volume; with copious general tables, and an index to the whole work. To which will be added, "An Essay on the Modifications of Clouds," by the same Author, several times heretofore printed.

* The variation of the needle at Paris, Oct. 12, 1816, was 22° 25′ W. (Ann. Chim. Dec. 1816.)

Article XV.

Astronomical, Magnetical, and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observations.

Feb. 13. A Tauri	Immersion.... 6h 5′ 41″	Emersion..... 7 28 29	Mean time at Bushey.
Small star about the 6th magnitude.	Immersion.... 6 25 24	Emersion. 7 45 28	Mean time at Bushey.
Small star about the 8th magnitude.	Immersion.... 6 26 06	Emersion not observed.	Mean time at Bushey.

Magnetical Observations, 1818. — *Variation West*.

Month.	Morning Observ. Hour.	Morning Observ. Variation.	Noon Observ. Hour.	Noon Observ. Variation.	Evening Observ. Hour.	Evening Observ. Variation.
Feb. 1	8h 40′	24° 35′ 03″	1h 25′	24° 40′ 46″		Owing to the shortness of the days, evening observation discontinued.
2	8 40	24 35 18	1 25	24 39 29		
3	8 40	24 35 02	1 55	24 40 11		
4	8 45	24 35 32	1 30	24 38 53		
5	8 40	24 34 48	1 25	24 39 55		
6	8 40	24 35 16	1 15	24 41 44		
7	8 45	24 34 12	1 25	24 42 59		
8	8 40	24 34 33	1 40	24 41 26		
9	8 55	24 34 26	1 40	24 39 41		
10	8 45	24 34 18	1 30	24 40 34		
11	8 45	24 34 48	1 25	24 41 53		
12	8 35	24 35 23	1 25	24 41 44		
13	8 35	24 35 19	1 10	24 40 41		
14	8 40	24 34 05	1 30	24 40 27		
15	8 45	24 35 47	1 40	24 41 03		
16	8 40	24 33 52	1 40	24 41 22		
17	8 10	24 35 17	— —	— — —		
18	— —	— — —	1 35	24 40 23		
19	8 10	24 33 43	— —	— — —		
20	8 30	24 33 59	1 15	24 41 27		
21	8 40	24 34 38	— —	— — —		
22	8 35	24 34 08	— —	— — —		
23	8 40	24 33 20	1 30	24 40 20		
24	8 35	24 29 57	1 30	24 42 20		
25	8 55	24 32 57	1 20	24 40 26		
26	8 40	24 34 07	1 30	24 34 51		
27	— —	— — —	1 25	24 40 35		
28	8 30	24 33 49	1 20	24 40 12		
Mean for Month.	8 38	24 34 22	1 28	24 40 51		

Feb. 25 the wind blew hard, with violent gusts from the westward, and the needle vibrated at intervals 57′. In taking the mean of the observations at noon, that on the 26th is rejected, owing to the variation being so unusually small; for which there was no apparent cause

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Feb.		Inches.				Feet.		
1	Morn....	28·665	35°	63°	SW by W		Sleet	30°
	Noon....	28·663	38	54	W by S			39
	Even	—	—	—	—		—	
2	Morn....	28·500	28	75	ENE		Foggy	27
	Noon....	28·468	33	67	NNE		Cloudy	33
	Even	—	—	—	—		—	
3	Morn....	28·660	26	70	SE		Cloudy	25
	Noon....	28·657	34	65	W		Hail showers	36
	Even	—	—	—	—		—	
4	Morn....	28·657	28	77	E by N		Cloudy	25
	Noon....	28·640	29	74	NE		Cloudy	30
	Even	—	—	—	—		—	
5	Morn....	29·060	28	86	SSW		Snow, fog	25
	Noon....	29·123	39	67	WSW		Very fine	40½
	Even	—	—	—	—		—	
6	Morn....	29·483	32	82	NE		Fine	29
	Noon....	29·500	33	72	E by N		Hazy	35
	Even	—	—	—	—		—	
7	Morn....	29·580	27	80	Calm		Foggy	23
	Noon....	29·588	32	74	NNE		Foggy	33
	Even	—	—	—	—		—	
8	Morn....	29·560	24	79	WNW		Foggy	23
	Noon....	29·520	32	72	W		Foggy	33
	Even	—	—	—	—		—	
9	Morn....	29·565	27	78	WNW		Foggy	22½
	Noon....	29·560	31	72	WNW		Foggy	33
	Even	—	—	—	—		—	
10	Morn....	29·520	25	77	SE		Foggy	20
	Noon....	29·553	31	74	E		Foggy	32
	Even	—	—	—	—		—	
11	Morn....	29·733	31	78	ENE		Foggy	28½
	Noon....	29·740	32	67	NE		Cloudy	32½
	Even	—	—	—	—		—	
12	Morn....	29·715	29	76	SW		Cloudy	28
	Noon....	29·700	32	67	SSE		Cloudy	32½
	Even	—	—	—	—		—	
13	Morn....	29·620	31	70	ESE		Cloudy	30
	Noon....	29·550	34	65	SE		Fine	36
	Even	—	—	—	—		—	
14	Morn....	29·370	28	75	SE by E		Fine	27
	Noon....	29·337	35	60	Var.		Cloudy	36
	Even	—	—	—	—		—	
15	Morn....	29·435	30	72	E		Very fine	29
	Noon....	29·438	40	55	ESE		Very fine	40
	Even	—	—	—	—		—	
16	Morn....	29·456	35	83	SE		Foggy	31
	Noon....	29·475	44	73	SSW		Cloudy	45
	Even	—	—	—	—		—	
17	Morn....	29·530	41	74	SE		Cloudy	35
	Noon....	—	—	—	—		—	51
	Even	—	—	—	—		—	
18	Morn....	29·464	45	76	S		Rain	39
	Noon....	29·448	46	79	SSW		Rain	47
	Even	—	—	—	—		—	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Feb.		Inches.				Feet		
19	Morn....	29·555	38°	82°	SSW		Very fine	38°
	Noon....	—	—	—	—		—	48½
	Even	—	—	—	—		—	
20	Morn....	29·600	33	82	SSW		Very fine	31
	Noon....	29·553	41	71	W		Showery	45
	Even	—	—	—	—		—	
21	Morn....	29·217	41	78	SSW		Cloudy	33
	Noon....	—	—	—	—		—	44½
	Even	—	—	—	—		—	
22	Morn....	28·820	36	69	SW		Snow	34
	Noon....	28·677	—	70	ENE		Snow	37
	Even	—	—	—	—		—	
23	Morn....	29·315	31	67	W		Very fine	30
	Noon....	29·364	37	57	WSW		Fine	39
	Even	—	—	—	—		—	
24	Morn....	29·320	34	57	W		Clear	33
	Noon....	29·395	42	49	W by S		Fine	49
	Even	—	—	—	—		—	
25	Morn....	29·120	48	61	W		Cloudy	39
	Noon....	29·088	50	60	W by S		Sm. rain	52
	Even	—	—	—	—		—	
26	Morn....	28·975	38	66	WNW		Snow	37
	Noon....	29·144	40	60	NW by W		Showery	42
	Even ...	—	—	—	—		—	
27	Morn....	29·000	—	86	SW by S		Sleet	32
	Noon....	28·868	47	63	W by N		Showery	47½
	Even	—	—	—	—		—	
28	Morn....	29·200	38	61	W by N		Fine	35½
	Noon....	29·164	44½	60	SW		Cloudy	47
	Even	—	—	—	—		—	

The quantity of rain between noon Feb. 1, and noon March 1, measured by the pluviameter, was 1·45 inches. The evaporation during the same period was 1·05 inches.

Article XVI.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer. Max.	Barometer. Min.	Barometer. Med.	Thermometer. Max.	Thermometer. Min.	Thermometer. Med.	Hygr. at 9 a. m.	Rain.	
1st Mo.										
Jan. 30	W	29·23	28·85	29·040	44	33	38·5	70	7	
31	S W	29·23	29·09	29·160	39	29	34·0	63	18	
2d Mo.										
Feb. 1	Var.	29·09	28·94	28·990	41	24	32·5	74	—	
2	N E	29·10	28·94	29·020	32	20	26·0	90	—	
3	N E	29·17	29·09	29·130	37	24	30·5	88		
4	N	29·50	29·09	29·295	32	26	29·0	82		
5	Var.	29·90	29·50	29·700	—	—		88		●
6	Var.	30·02	29·90	29·960	41	24	32·5			
7	Var.	30·02	30·00	30·010	31	23	27·0	92		
8	N W	30·00	29·93	29·965	33	20	26·5	89		
9	Var.	29·99	29·93	29·960	33	23	28·0	90		
10	E	30·15	29·99	30·070	33	25	29·0			
11	S W	30·16	30·15	30·155	37	29	33·0	75		
12	S E	30·16	30·05	30·105	35	30	32·5	72		
13	N E	30·05	29·81	29·930	38	23	30·5	70		☾
14	S E	29·84	29·72	29·780	36	25	30·5	90		
15	E	29·88	29·80	29·840	40	27	33·5	93		
16	N E	29·93	29·88	29·905	47	34	40·5	97		
17	S	29·93	29·89	29·910	—	—		99		
18	S W	29·93	29·80	29·865	49	34	41·5		23	
19	S E	29·99	29·75	29·870	51	28	39·5	95	19	
20	S	29·96	29·65	29·805	46	29	37·5	95	6	
21	S W	29·65	29·22	29·435	45	34	39·5	72	15	○
22	N E	29·73	28·94	29·335	38	28	33·0	67	—	
23	N W	29·74	29·50	29·620	41	31	36·0	72	1·62	
24	S W	29·80	29·51	29·655	49	36	42·5	61	—	
25	S W	29·51	29·37	29·440	52	35	43·5	62	—	
26	N W	29·72	29·42	29·570	42	29	35·5	72	—	
27		29·60	29·27	29·435		34		82	57	☽
28		29·53	29·29	29·410	47	35	41·0	62	3	
		30·16	28·85	29·975	52	20	34·20	80	3·10	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

First Month.—30. Squally: showers, a. m.: wind and rain in the night.

Second Month.—1. Hoar frost: rain, followed by snow in large flakes: *Cumulostratus* and *Nimbus*. 2. Hoar frost: fine *Cirri*, with *Cirrostratus*, a. m.: the lower modifications with some loose snow, p. m. 3. Fair: hoar frost. 4. Cloudy morning: snow on the waggons from the north, probably of last night: it seems to be the wind blowing over snow that keeps down our temperature to 32°. 5. A few drops of rain about nine, a. m.: after which very fine, with *Cumulus* and inosculation. 6. Hoar frost: misty. 7. Hoar frost: the paths icy: mist increases, with a calm air. 8. Misty: rime to the tops of the trees. 9. Misty: the rime falls partially. 10. Misty till evening, when it cleared up, and the rime fell off. 11—15. Hoar frosts, with fine weather: *Cumuli*, &c: on the 15th a few drops of rain. 16. Very fine, with *Cumuli*, &c.: at seven, p. m. a large faint lunar halo. 17. Fine, with *Cirrocumulus*, &c. 18. Windy: wet, p. m. 19. A slight *Stratus*, a. m.: wet evening: windy night. 20. Hoar frost: somewhat misty: rain before noon: some hail in a shower at half-past one: after this *Cumulus*, with *Cirrus* and *Cirrostratus* above: the latter *imbricated*, or overlapping, like the branches of a pine-tree: then *Nimbi* amidst groups of other clouds, the lofty crowns of which were long coloured with a fine gradation of red tints about sun-set: the sky around the moon showed violet, while the disc was brassy. 21. Much wind, a. m. with clouds driving high and close: wet, p. m.: at evening a lighter sky, with *Cumulus* and *Cirrocumulus*, ending in *Cirrostratus*, with a lunar corona. 22. Morning cloudy and dark, by a large mass of smoke passing near us in the S.: rain, sleet: snow to the depth of several inches, with a very gentle breeze: moonlight evening. 23. Fair: much snow on the trees and shrubs: a strong westerly breeze: the rise of the barometer, like the previous fall, very sudden: at night stormy, with hail and much rain. 24. The snow mostly gone: elevated *Cirri*, with *Cumuli* in a pale blue sky: after *Cirrostratus* and haze at evening, a gale through the night. 25. Much wind, with driving clouds: temperature 48° at nine, a. m. 26. a. m. Rain: snow in very large flakes: sleet: much water out since the late rains: rocky *Cumuli*, followed by *Nimbi* and gusts of wind, p. m.: clouds coloured at sun-set. 27. Wet, a. m.: fine evening after a rainbow. 28. Elevated *Cirri* and *Cirrocumuli* stretching N. W. and S E.: general obscurity followed, with showers and wind.

RESULTS.

Winds variable: in the latter part stormy from the Westward.

Barometer:	Greatest height	30·16 inches;
	Least	28·85 inches;
	Mean of the period	29·975 inches.
Thermometer:	Greatest height	52°
	Least	20°
	Mean of the period	34·20°
Mean of the hygrometer		80·0°
Rain		3·10 inches.

The evaporation for this and the preceding period taken together, is 1·38 inch.

Tottenham, *Third Month*, 26, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

MAY, 1818.

Article I.

Biographical Memoir of Prof. Smith and Mr. Cranch.

If we except the expedition which has just sailed for the purpose of exploring the northern ocean, the public expectation has been seldom raised to a higher pitch than it was by the project that was formed to discover the source of the river Zaire, and to investigate the course of the Niger. In proportion to the degree of expectation which was excited, so was the disappointment at its total failure, and the regret for the melancholy fate which befel those who engaged in it. We shall not, in this place, inquire into the cause of that failure; nor shall we enter upon the question, whether a sufficient degree of prudence and foresight were exercised in forming the plan, and in adapting the means to the object in view. Of the expedition to the Niger we know indeed nothing, but the general fact that it was stopped almost at its outset, and that the commander, Major Peddie, and all the officers and men of science, fell a sacrifice to the climate, or to the hardships to which they were subjected. The result of the expedition to the Zaire was no less disastrous than that to the Niger; it proved equally fatal to those engaged in it, and probably from the same cause—the excessive bodily fatigue which they underwent, in a climate and atmosphere ill adapted for enabling the body to endure any extraordinary exertions. With respect to this latter expedition, much as we must lament the untimely fate of the gallant commander, Capt. Tuckey, and all his officers, as well as the men of science who accompanied him, still it has not been altogether useless; Capt. Tuckey himself, and Prof. Smith, kept, each of them, [illegible] urate narrative of their proceedings, which were fortunately preserved, and have been given to the public in a volume published by permission of the Lords of the Admiralty. Besides other interesting matter which is collected in this volume, it contains biographical notices of the professional and literary men who fell a sacrifice to their ardour in the pursuit of science. Of these Professor Smith and Mr. Cranch, the former at the head of the botanical department, the latter appointed the collector of objects of natural history, were young men of great promise, who had already made considerable advances in their respective pursuits, and whose premature death may be justly regarded a real loss to science. We conceive that we cannot employ the introductory pages of our journal in a more appropriate manner than by giving a brief sketch of the lives of these two individuals.

Chetien Smith was born of respectable parents, in the year 1785, near the town of Drammen, in Norway. He received the first part of his education at Kongsberg, and completed his studies under Prof. Hornemann in the University of Copenhagen. He was destined for the profession of medicine, but he very early in life acquired a decided taste for botany, and especially for that part of it which belongs to the investigation of the cryptogamic plants. In the prosecution of this object, when only in his 22d year, he undertook a journey into the mountains of Tellemarck, where he made so many discoveries of new mosses and lichens as to acquire considerable celebrity for his botanical acumen. He paid a second visit to these mountains in the year 1812, when, besides botany, he extended his observations to various other departments of natural philosophy, so as to prove that his abilities were not exclusively confined to that department which he had selected as his favourite pursuit. The reputation which he acquired by this expedition was such as to point him out to the Patriotic Society of Norway as a proper person to explore a mountainous tract, at that time almost unknown, which separates the valleys of Walders, Guldtransdal, and Romsdal, about the 62d degree of latitude. This object he accomplished in a most satisfactory manner, he made many valuable additions to the knowledge of botany and natural history, and, what places his character before us in a new and very interesting point of view, he devoted his attention in an especial manner to ameliorating the condition of the inhabitants of that sequestered district, and endeavoured to teach them the best means of improving the few advantages which were afforded them by a barren soil and an inclement climate.

By the death of his father, which occurred about this time, Mr. Smith came into possession of a small patrimonial estate, and he determined to devote the independence which he had thus obtained to travelling into foreign countries for the purpose of studying natural history. He had received the appointment of Professor of Botany in the University of Christiania; and one great object of his projected travels was to form a collection of plants, for a new botanical garden which had been established there. He first came to London, visited Kew, and the various gardens in the vicinity of the metropolis; he then went to Edinburgh, explored many of the Scotch mountains, traversed the romantic districts in the north of England and in Wales, and examined their botanical treasures. He visited the botanical establishment at Liverpool, crossed over to Dublin, and, after examining various parts of Ireland, returned to London about the end of 1814. On his return to the metropolis, at the house of Sir Joseph Banks, he met with the distinguished naturalist Von Buch, and they projected a voyage to Madeira and the Canaries, for the purpose of investigating the various objects of scientific inquiry which occur in these islands.

These zealous votaries of natural knowledge arrived at Madeira in April, 1815; they remained there about a fortnight, when they embarked for the Canaries, where they spent between six and seven months, and returned to England in December. The ardour and enthusiasm of Professor Smith were fully excited during this excursion, in which, for the first time, the luxuriance of a tropical climate was presented to him, and where he had an opportunity of examining districts, which, although lying contiguous to each other, differ very much in the nature of their productions. The rapture which he manifested upon his first landing at Funchal is described in a characteristic manner by his fellow-traveller; and from what is known of his general habits and turn of mind, we have no reason to believe that the picture is overcharged. The same sentiments are expressed in the most lively manner by Smith himself, in a letter which he wrote to a friend from Madeira. "How," says he, "shall I be able to describe to you—how declare to you what I have here felt, what I have here seen! How shall I be able to give you an idea of the variety, of the singularity of those forms, of that beauty and that brilliancy of the colours, of all that magnificence of nature which surrounds me! We ascend the sloping ridges of the mountains which embrace the splendid city of Funchal; we rest ourselves on the margin of a brook which falls in numberless cascades across thickets of rosemary, of laurels, and of myrtles; the city at our feet with its forts, its churches, its gardens, and its roadstead; above us forests of the stone pine and of chesnuts, interspersed with the flowers of the spartium and the lavender. A whole legion of canary birds makes the air resound with their sweet song; and nothing here but the snow on the mountain tops, which now and then pierce through the clouds, would recall to my recollection my native country."

As it is not the object of this biographical sketch to give any account of the individual discoveries, or particular observations of Prof. Smith, we must follow him to London. After remaining a short time in this place, for the purpose of arranging his botanical treasures and of profiting by the advantages which it holds out for the acquisition of knowledge of all descriptions, he proposed to return to his native country, when the expedition to the river Zaire was projected; and upon the offer being made to him of the appointment to the botanical department, he immediately embraced it, and devoted himself to it with his accustomed zeal and enthusiasm. In the prosecution of this plan he left London on Feb. 22, and on the following day embarked at Sheerness; after beating about the Channel for nearly a month, in consequence of contrary winds, on March 19 the expedition left Falmouth, and on April 1 came within sight of Madeira. They passed by this island, and proceeded to St. Jago, one of the Cape Verde group, where they remained three days, which were very actively employed by Smith in exploring the botany and natural history of the vicinity of Porto Praya, the harbour of the island. It was nearly two months from the time of their leaving St. Jago before they were able to reach the mouth of the Zaire, from the unfavourable state of the winds and weather; and some time longer was unavoidably spent about the mouth of the river before they entered upon the proper object of their mission. On July 7, Professor Smith, for the first time, was able to make a short excursion on shore, and to set his foot on what he called "the land of promise." He informs us in his journal, that "the vegetation was magnificent and extremely beautiful. Shrubs of a rich verdure, large gramineous plants, and thick groups of palms, met the eye alternately. The country displayed the most beautiful forms—the most charming scenery. I found myself as in a new world, which was before known to me in imagination only, or by drawings."

The subsequent history of the expedition is little else than a narrative of disappointments and disasters. A short time was spent, not far from the mouth of the river, in receiving visits from the neighbouring chiefs, conciliating their good will, and endeavouring to remove any prejudices that might arise respecting the nature and objects of the expedition. Every inquiry was of course made concerning the course of the river, and the best means of prosecuting their journey; when it was soon found that the information which had been obtained in England, and which, indeed, had served as the cause and motive for the undertaking, was extremely defective and considerably erroneous. The first view which they gained of the Zaire sufficiently proved that its magnitude had been much exaggerated; its navigation, almost at the commencement, was found to be difficult and nearly impracticable for the larger vessels, and even the boats were unable to proceed to a greater distance than 130 or 140 miles from its mouth, in consequence of a succession of rapids or low cataracts, which, for a space of about 40 or 50 miles, completely obstruct even the passage of a canoe. Captain Tuckey and his companions were consequently under the necessity of proceeding on foot along the banks of the river, through a rough and precipitous country, without roads, where provisions were procured with great difficulty, and where the natives were perpetually thwarting their progress. To a succession of hardships of this description, rather than to any thing specifically unhealthy in the country or in the climate, we must, perhaps, attribute the fatal fevers which soon began to manifest themselves. The disease was daily making fresh ravages among the troop of adventurers; so that although they appeared to be arrived at a more favourable country, and at a part of the river where there was no further obstruction to water carriage, when they had advanced about 80 or 100 miles beyond the cataracts, or about 260 or 280 from the mouth of the river, it was deemed indispensably necessary to return. On Sept. 9, therefore, to use the words of Capt. Tuckey, "we were under the necessity of turning our back on the river, which we did with great regret, but with the consciousness of having done all that we possibly could." Prof. Smith had until this time preserved his health; and was so much enraptured with the improved appearance of the country, that it was with the utmost difficulty he could be prevailed upon to return; but in four days he was himself attacked with the disease which had proved so fatal to his companions. The following are the only memorials which we possess of the last scene of his life. "He was taken ill before they reached the vessels, and came down with the captain in the last canoe; and was sent with him to the transport, for the sake of greater convience: by this time, however, he was dangerously ill, and refused to take any thing, either in the shape of medicine or nutriment. He had tried bark, but his stomach constantly rejected it; and under an idea that his illness proceeded only from debility, he persisted in taking cold water. On Sept. 21, he became delirious, and died on the following day."

Prof. Smith, who was thus cut off before he had completed his 31st year, was scarcely less remarkable for the ardent zeal with which he prosecuted science, than for the natural gaiety and suavity of his manners. In his travels through the British Islands, every one to whom he was introduced immediately became interested in his welfare, and parted from him with regret. The writer of this sketch saw him during his tour through the north of England in the summer of 1814; and from an acquaintance of a single day felt that attachment to him, which, in ordinary cases, is produced only by long intercourse. Smith spoke in warm terms of the pleasure which he had derived from his tour, and declared his determination, at no very distant period, to revisit this country. At parting, a mutual hope was expressed that the friendship which had commenced under such apparently favourable auspices, might, on some future occasion, be renewed and extended: under the cruel disappointments of this hope, it is still some satisfaction to the survivor to be able to contribute, in however slight a degree, to perpetuate the memory of the talents and virtues of the deceased.*

John Cranch was born at Exeter, in the same year with Prof. Smith, 1785; his parents were in an inferior rank of life, and he had the misfortune to lose his father when only eight years old, so that his mother, being unable to provide for all her family, was obliged to resign her son to the care of an uncle, who lived at Kingsbridge. In this situation he passed six years, during which time his education appears to have been very little attended to, when his uncle, who is described as having been extremely penurious, apprenticed him to a shoemaker. Notwithstanding the extreme disadvantages of his situation, and the very scanty means of improvement which he must have enjoyed, his natural genius soon began to display itself; and in the little leisure which was allowed him, and by the imperfect aid of the few books to which he had access, he drew up correct and classical descriptions of all the insects which he could procure in the neighbourhood of his residence. By his own unaided exertions he even acquired a knowledge of the Latin and French languages, so that he was able to understand the descriptions of the zoological writers which were written in them, and to employ them himself in the description of the objects of natural history. Nor was his attention confined to this study; he seems to have grasped at every kind of knowledge, how much so ever it might appear, at first view, beyond his reach, and was only excited to greater exertions by the difficulties which surrounded him on every side.

At the conclusion of his apprenticeship he went to London, as it appears, with an idea, although probably vague and undefined,

* The herbarium, formed by Prof. Smith, from the banks of the Zaire, upon its arrival in England, was placed at the disposal of Sir Joseph Banks, and arranged under his direction; an interesting and scientific account of its contents is published as an appendix to Capt. Tuckey's narrative, drawn up by Mr. Robert Brown. With respect to the value of the collection, Mr. Brown informs us, that it contains more than 600 species; Adanson, who spent nearly four years on the banks of the river Senegal, does not appear to have collected above this number of plants; Mr. Smeathman, who resided more than two years at Sierra Leone, collected about 450; Mr. William Brass collected 250 species in the neighbourhood of Cape Coast; and Prof. Afzelius, who resided several years at Sierra Leone, formed a collection of 1,200 species. From these facts, and from the coincidence which there is between the proportions of the different kinds of plants in this herbarium and in Smeathman's, Mr. Brown conceives that it may be regarded as exhibiting a fair specimen of the botany of the district which Smith had an opportunity of examining.

Of the species in this herbarium, 250 are absolutely new; nearly an equal number exist also in different parts of the west coast of equinoctial Africa, and not in other countries, of which, however, the greater part are yet unpublished, and about 70 are common to other intra-tropical regions. Of unpublished genera there are 32 in the collection, 12 of which are absolutely new, and three, although observed in other parts of this coast of equinoctial Africa, had not been found before in a state sufficiently perfect to ascertain their structure; 10 belong to different parts of the same line of coast, and 7 are common to other countries. No natural order, absolutely new, exists in the herbarium, nor has any family been found peculiar to equinoctial Africa.

of renouncing his trade and devoting himself to a life of science. He profited by the advantages of the metropolis in the way that might have been expected from the enthusiasm of his disposition, and added very considerably to his stock of knowledge, while, at the same time, he became more devoted to the acquirement of it. He was however compelled, after some time, to leave London, and to resume his mechanical occupation in his native country; but nothing could repress his scientific ardour; and while he worked hard to procure a livelihood, he still devoted his leisure moments to study. Shortly after his return to Devonshire he married, and probably to a person of some property, as we are informed that his domestic circumstances were so much improved by his marriage, as to enable him to consign his business entirely to his journeymen, while he devoted his own time and attention almost exclusively to the pursuit of natural history. The eagerness with which he prosecuted his scientific labours was almost unexampled; we are told, "that no difficulties nor dangers impeded his researches. He climbed the most rugged precipices; he was frequently lowered down by the peasants from the summits of the tallest cliffs; he waded through rapid streams; he explored the beds of the muddiest rivers; he sought the deepest recesses. He frequently wandered for whole weeks from home, and often ventured out to sea for several days together, in the smallest skiffs of the fishermen. No inclemency of weather; no vicissitudes of storms and sunshine ever prevented his fatiguing pursuits; the discovery of a new insect amply repaid the most painful exertions." He commenced his career as an author about this period by some short essays in the "Weekly Examiner;" and gradually acquired a collection of subjects in natural history, the reputation of which extended even to the metropolis.

In 1814, Dr. Leach, of the British Museum, visited Mr. Cranch, in company with some other naturalists, and expressed his admiration at the number of objects which he had assembled. "We were all astonished" says the Doctor, "at the magnitude of his collection of shells, crustacea, insects, birds, &c. collected entirely by himself, and still more so with the accuracy of their classification, and with the remarks made by this self-educated and zealous individual. He conversed on all subjects connected with natural history, with modesty, but at the same time with that confidence which is the result of knowledge." The consequence of this interview was to impress Dr. Leach with so high an idea of the talents of Mr. Cranch, as to engage him to investigate the marine productions of the coast of Devonshire and Cornwall, and to promise his interest to procure him a situation in the British Museum, whenever any suitable vacancy should offer. Immediately upon the receipt of this proposal, Mr. Cranch determined entirely to abandon his trade; he dismissed his workmen, converted his shop and manufactory into apartments for receiving specimens, and laboured in the collection of them with redoubled diligence. His discoveries were very numerous and important, and the remarks with which he accompanied them extremely valuable; many of them have already been laid before the public, and Dr. Leach gives us reason to hope that the rest will appear in due time.

When the expedition to the Zaire was planned, Mr. Cranch was immediately thought of as a person in all respects peculiarly fitted for the undertaking; and when the offer was made to him he immediately accepted it, although, as we are told, "not without some painful struggles to his feelings," in consequence of a presentiment that he should never return. This impression did not, however, cause him to relax his ardour, nor did it render him less active, during the very short period in which he was enabled to devote himself to the objects of his voyage. Indeed to the great exertions which he made upon his arrival at the Zaire, we may, perhaps, ascribe the early date of his disease; his fever commenced on Aug. 23, while the expedition was traversing the banks of the river, in that part where the navigation is intercepted by the rapids. He was carried back to the navigable part of the stream in a hammock, on the shoulders of the natives, and conveyed thence in a canoe to the ships, being altogether ten days in the passage. We are informed that the symptoms of his complaint "were an extreme langour and general exhaustion; a restlessness and anxiety, approaching at times to delirium; but he had no pain, except an uneasy sensation throughout the abdomen; the countenance became of a dirty yellow colour, the pulse was at 108, and very small. The next day he was much worse, and on the third day the whole body became yellow; the countenance assumed a deadly aspect, the pulse at the wrist imperceptible; and in the evening he expired, after uttering a devout prayer for the welfare of his family, and with the name of his wife quivering on his lips."

Cranch exhibits a very remarkable example of the force of original genius, manifesting itself, as it were, spontaneously, at an early period of life, and, in spite of every discouragement, becoming developed in an unusual degree. It is the more singular, because the study of natural history is one which is generally found to require every extrinsic aid for its attainment; not like the pursuit of mere objects of taste, which depends principally on the unassisted efforts of the imagination, and the other intellectual faculties. When we reflect upon the progress which Cranch had made in the various branches of natural knowledge, under the circumstances in which he was placed, and before he had attained his 31st year, we may fairly conclude that had he lived to the usual term of human life, he would have arrived at a very high degree of eminence. In his moral qualities we have much to admire, but at the same time something to regret. He is represented as having been "a sincere Christian, an affectionate parent, and a kind friend," a high eulogium which we have every reason to believe he merited. Unfortunately, however, he had embraced a very gloomy system of religious belief; and this, perhaps aided by a temperament of the melancholic cast, produced occasional lowness of spirits, and an appearance of moroseness, which rendered him less amiable as a companion, and less agreeable as a member of society. The defects of his education, or rather the entire want of it, likewise operated unfavourably upon his manners and deportment, and produced altogether a character which was not calculated to attach those who had only a superficial knowledge of it. Upon the whole, however, his merits very far counterbalanced his defects, and he will always be regarded as an object for our admiration and sincere regret. His memory will be perpetuated by the denomination of various animals which were discovered by him in the Congo expedition, and which derive from him either their generic or specific name.*

Article II.

General Considerations upon Double Flowers, and particularly upon those of the Family of the Ranunculaceæ.† By M. De Candolle. (Abridged from the Third Volume of the Memoirs of the Society of Arcueil.)

Double flowers, independent of their size, possess an excellence which is peculiar to them, and which depends upon the absence of the stamens, that they are much more durable than single flowers. The older naturalists considered the different kinds of double flowers as true species, an idea which we find adopted even by Tournefort; but Linnæus decidedly proved that they are to be regarded as monstrous productions, and of course excluded them from the class of natural beings. Since his time they have been almost totally disregarded by botanists; yet much interesting information, with respect to the nature of plants, may be obtained from them. On the one hand, the study of all the aberrations from ordinary forms may throw light upon the nature of certain organs, upon the value of certain characters, upon the permanence of certain phenomena, and even upon the exact distinction of certain species; while, on the other hand, a knowledge of the natural characters of plants may

* Perdix Cranchii, Pimelodus Cranchii, Ocythoë Cranchii, Cranchia scabra and C. maculata, Cineras Cranchii, and Melalopa Cranchii.

† The ranunculaceæ form the ninth class and the first order of the system of Jussieu; they are characterized as plantæ dicotyledones polypetalæ; stamina hypogyna; they are placed in the class and order polyandria polygynia of Linnæus: the ranunculus, anemone, and trollius, are examples of them.

explain the cause of their monstrosities, as well as their origin, their nature, and their limits.

There are few families of which the flowers are so much disposed to become double as the ranunculaceæ; and their structure explains the cause of this disposition. Since the publication of M. Jussieu's memoir upon this family, botanists have generally been agreed that their flowers are composed, 1. Of a calyx, often coloured like a corolla, and formed of a certain number of segments, which are almost always flat. 2. Within this calyx are generally found one or more ranges of petals, sometimes flat, sometimes with two lips, which give them the form of a horn. The petals are occasionally wanting; for in those plants, such as the clematis, thalictrum, and anemone, where the flower has only one integument, it is rather to be considered as a calyx than as a corolla. 3. Within the petals are to be found many rows of stamens. 4. In the centre of the flower are many ovaries, each furnished with a style, and often defended at their base by a small membranous scale.

All these parts may concur more or less in the formation of double flowers; and in order to explain the nature of the process by which this change is effected, we may take the example of the anemones. A single anemone is composed of a calyx, consisting of five or six large petaloid segments; it is without petals, but has a considerable number of stamens and ovaries. In the double anemone, florists distinguish four kinds of petals; the first consists of parts of the calyx, which experience little or no change in their form; the other three kinds are small accessory petals, which replace the organs of fructification: 1. Those which proceed from the transformation of the pistils; 2. Those which surround the centre, and are formed by the transformation of the stamens; and, 3. Those which are placed in the situation of proper petals, between the calyx and the stamens. The same structure may be observed in other double flowers, and we can always determine what is the origin of the new petals. When the calyx is coloured, it generally produces them; as is the case with the clematis, thalictrum, caltha, &c.; the pistils are more rarely transformed; and when they are so, it is always the parts susceptible of receiving colour. The pistillary petals are of a greenish hue, and they compose the green eyes, or hearts, which are observed in some double ranunculuses, or anemones. It happens not unfrequently that in double flowers, the pistils remain in their natural state in the middle of the transformed stamens; in this case the flower is still capable of being rendered fertile by those in its vicinity, and seeds will be formed from which varieties are produced that will be still more double. When the number of surrounding petals is very considerable, the pistils are, as it were, compressed or stifled, and then the centre of the flower is hollow, as is often the case in the ranunculuses.

The staminal petals, those which are produced by the transformation of the stamens, form the most frequent kind of double flowers, at least among the ranunculaceæ. The stamens may be transformed into petals in two ways; either the filament is enlarged, and the anther totally or partly disappears, or the filament remains in its natural state, and the anther is increased in size. The first of these modes is the most frequent occurrence; and with respect to this variety, we may make the following observations. 1. The facility with which the filament of a stamen is transformed is as much greater as the number of stamens is more considerable; this is exemplified in the rosaceæ, the malvaceæ, the magnoliaceæ, and the ranunculaceæ. 2. The facility with which the filament is transformed is greater in proportion as the thread is flatter; this is observed with respect to the rosaceæ and the liliaceæ, which have filiform threads. 3. When a flower has several rows of stamens, it is the exterior rows which have the most tendency to become transformed, either in their natural state or in consequence of cultivation. Only one exception to this rule has been observed, which is mentioned by Mr. Brown, as existing in a plant from New Holland, to which he has given the name of eupomantia. The transformation of the anthers into petals is a much more rare case than the preceding; and, indeed, there is scarcely any well marked example of it except among the ranunculaceæ; in some of the genera of this family, the filaments remain in their natural state, and the anther is developed into a horn, almost always nectariferous at its base, divided into two lips, producing a very singular form; an example of this is to be observed in the twisted columbine of the florists, the aquilegia resupinata.

These remarks upon the conversion of the stamens into petals of different forms apply to the origin of true petals. These may be regarded as merely exterior stamens, which, in the natural and ordinary course of things, are transformed into plates or horns, as the stamens of the interior rows are in certain accidental cases.* All the ranunculaceæ which become double by the development of the threads into flat petals have their common petals generally flat; all those which become double by the development of the anthers into horns that are more or less labiated, have their natural petals in the form of labiated horns; all those which when they become double have petals of both kinds, have both kinds in the natural state; and it is remarkable that these differences, deduced from the structure of double flowers, perfectly agree with the classification of the ranunculaceæ deduced from the structure of the fruit.

The proper ranunculaceæ, that is, those which have the anthers open on the external side, are divided into three sections:

* This doctrine is maintained and illustrated by M. De Candolle in his "Theorie Elementaire de la Botanique."

1. Those in which the base of the seed touches the summit of the ovary; 2. Those in which the base of the seed touches the base of the ovary; in both these the fruit contains only a single seed; and, 3. Those in which the base of the seed is situated on the side which is nearest the axis of the flower, and where each fruit contains many seeds. All the species of the first section have flat petals, both in the single and in the double flowers; of this description are the clematis, the thalictrum, the anemone, the adonis. Those of the second class have their petals in the form of horns, both in their natural and their monstrous state; such are the ranunculus and the ficaria: while those of the third class present both kinds of petals; such as the hellebore, the nigella, the aconite, and particularly the columbine. All the remarks that have been made respecting the petals apply equally to these flowers, both in their ordinary and in their monstrous state.

From all these facts, deduced from a great number of different families of plants, and under a variety of circumstances, we seem to be still further confirmed in the opinion that the petals are not special organs, but a particular state of the stamens. The petals appear no less entitled to be regarded as stamens, either in an abortive or transformed state, than the scales of buds are to be regarded as leaves, and thorns as abortive branches, opinions which are entertained by almost all naturalists.

Hitherto we have only considered those double flowers the organization of which is the least obscure, those which are produced by the simple transformation of one of the organs of the flower; but a different phenomenon often occurs, which it is much more difficult to explain, where a single organ appears to be multiplied in such a manner as to form a great number of small parts. Thus in the double primrose we find a number of petaloid lobes, which, by their form and position, evidently derive their origin from the corolla, and seem to be the natural lobes of the corolla multiplied indefinitely. Within this first row are found five bundles of staminal petals, composed of a number of petaloid lobes, proceeding from a small pedicle, which represents the base of the filament; and in the centre we often find the ovary carrying a short stile, spread out likewise into a number of petaloid lobes. It may be remarked that this manner of multiplying the parts is common in those plants, the corolla of which, in their natural state, exhibits some traces of doubling; for example, in the primulaceæ and in the narcissus, at the entrance of the tube of the corolla, there is either a little excrescence, or a little corona; and when these flowers become double, it is found that the species which possess these parts are the most disposed to have the lobes of the corolla multiplied.

There is another kind of flowers, which ought to be ranked among double flowers, although they are simple, where the stamens become abortive, and where, in consequence of this circumstance, the corolla, the calyx, and the involucrum, experience a remarkable increase of size, with or without a change of form. This mode of transformation seems to be peculiar to aggregate or compound flowers, such as grow in a corymbus or umbel. The viburnum opulus is an example of this kind of transformation. Compound flowers are transformed in two different modes; in the most common mode the tubular florets, becoming barren, assume the form of a tongue, which is lengthened out, and hangs down on the outside of the head; but at other times the florets only increase in size, without changing their form. Compound flowers appear to follow two rules in this respect: 1. The genera, which have the external florets naturally tongue-shaped, are the only ones which are capable of having the central florets transformed into tongues; 2. When the central flowers are transformed either into tongues or into large tubes, they acquire the colour of the natural tongues of the external florets. This affords the only exception to what is a very general law with respect to the colours of flowers, that yellow flowers may assume all the shades of red and white, but that blue and yellow never change one into the other.

The two following conclusions may be deduced from the facts that have been stated in this paper: 1. The form, the dimensions, the number, the direction, and the colour of all the parts of flowers, are extremely varied, while their position remains constant; from which we may learn, that what is styled the insertion of the organs is the only constant character which determines all their anatomy.

2. Under the title of monstrosities are included double flowers of very different kinds, which have been all confounded together, but which may be systematically arranged, in a manner analogous to that in which Haüy arranges crystals. The following classification and nomenclature are proposed.

Petaloid flowers, flores petaloidei, those which become double, by the simple transformation into petals of a part or the whole of the organs of fructification.

Multiplied flowers, flores multiplicati, those which double by the multiplication or doubling of parts of the corolla, or of the organs of fructification transformed into petals.

Transformed flowers, flores permutati, those in which the abortion of one or both of the organs of fructification produces a considerable alteration in the form or the dimensions of the floral integuments.

These form the three fundamental divisions, or classes, the particular characters of which are deduced from the primitive nature of the transformed organ. Thus in the petaloid and multiplied flowers we may distinguish 13 kinds [illegible] corollary, staminary, and pistillary flowers, the p[illegible] are respectively owing to the transformation of th[illegible] changed into petals; and eopetalary, those in which the corolla is multiplied, and in which the stamens are transformed into simple or multiplied petals, the pistil continuing in its natural state; olopetalary, where the whole, or part of the integuments, of the stamens, and of the pistils, are all transformed into petals or petaloid lobes; agynary, where the integuments and the stamens being multiplied, or transformed, compose all the flower, and in which the pistil is wanting; anandrary, in which the teguments and the pistils being multiplied or transformed, compose all the flower, and where the stamens are wanting.

The transformed flowers may, in the same manner, be distinguished by the epithets bracteary, calycinary, corollary, &c. according as the change occurs in the bractea, the calyx, the corolla, &c. With respect to the compound flowers, they may be stamens, or pistils; perigoniary, those in which the change takes place by the change of both the calyx and corolla at the same time; androgynary, those in which the transformation is produced upon both the organs of fructification without the integuments being altered; corniculated, or antherogenary, those in which the anthers alone are transformed into petals; semi-staminary, where one portion only is changed into petals; hemigoniary, where a part of both the organs of fructification is distinguished into the liguliferous and the tubiferous, according as they are transformed into tongues or into enlarged tubes.

By means of these few technical terms, we may be able to describe with ease and precision all the modifications of double flowers. The florist may have it in his power to describe with accuracy the objects of his cultivation; the physiologist may more easily investigate the causes which produce these changes; and the botanist may at once determine what relation double flowers bear to others of the same genus.

Article III.

On the Geography of Plants. By N. J. Winch, Esq.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN, *Newcastle-upon-Tyne, Jan. 9, 1818.*

Notwithstanding the progress that has been made of late years in the study of the geography of plants on the Continent, I am not aware that any of our own botanists have given the result of their observations on this highly interesting and novel subject to the public. The inaugural thesis of Dr Boué, of Geneva, printed at Edinburgh last year, distributes the Scotch plants in a masterly way; but the flora of England, though thoroughly known and admirably described, has not as yet been subjected to this mode of arrangement. Under this impression I transmit to you some remarks, assigning to several species, indigenous to the parallel included between 54° 30′ and 55° 30′ north latitude, their respective situations as to soil and elevation above the level of the sea. These notes, which must be considered merely as a fragment, I hope will prove interesting to a few of your readers at least, either in an agricultural or philosophical point of view; and, ultimately, may be useful to some writer who shall dedicate his time and abilities in thoroughly developing this branch of English botany.

England in the parallel 55° N. is 70 miles broad. The most elevated mountains here, are Helvellin and Skiddaw, among the greywacke and porphyritic hills of Cumberland; to these succeed Cross Fell, in the encrinal limestone range; next, the syenitic hills of Cheviot and Hedgehope, in the north of Northumberland; then Pontop, in the Newcastle coal field; and Brandon Mount and Warder's Law, in the magnesian limestone near the east coast.* That part of the district bounded on the north side by the Tweed, and on the south by the Tees, by Cross Fell on the west, and by the ocean on the east, possesses a flora of 1,000 phænogamous and 1,130 cryptogamic plants; and about 40 additional species have been detected in Cumberland, unknown to Northumberland and Durham.

Among the Phænogamous plants are comprised,

27 species of Trees.	15 Of the class Monadelphia.
20 Willows.	44 Of the class and order Diadelphia Decandria.
11 Roses.†	33 Of the class and order Didynamia Gymnospermia.
145 Grasses and Carices.	22 Of the order Angiospermia.
14 Liliaceous plants.	19 Of the class and order Tetradynamia Siliculosa.
11 Rough-leaved plants.	26 Of the order Siliquosa.
42 Umbelliferous plants.	
20 Orchideæ.	
81 Syngenesious plants.	

And 221 Annuals, many of which are included in the above number.

The Cryptogamic plants consist of

37 Filices.	300 Lichens.
258 Mosses and Jungermanniæ.	368 Fungi.
164 Fuci and Confervæ.	

To descend from general to particular observations, I shall notice

	Feet.		Feet.
* Helvellin	3,055	Hedgehope	2,347
Skiddaw	3,022	Pontop Pike	1,018
Cross Fell	2,901	Brandon Mount	875
Cheviot	2,658	Warder's Law	632

† Humboldt did not find an indigenous Rose in South America, and only one species in Mexico.

1. Those plants which have reached their northern limits in this part of the kingdom.
2. Such as have reached their southern limits.
3. Those that are found on the sea coast, and again among the mountains.
4. Rare species natives of Switzerland.
5. ——————— of Lapland.
6. ——————— of both those countries.
7. ——————— of neither of those countries.
8. Oleraceous plants found in a natural state.
9. Species which are become indigenous, though originally imported from a distance.

1. *Plants which have reached their northern Limits.*

Bupleurum tenuissimum. On Seaton Moor, near the mouth of Tees.

Juncus maritimus. On the sea shore, near Seaton.

Rumex aquaticus. Near Preston in Skirn, and at Polam.

Schænus Mariscus. At Hell Kettles, near Darlington.

Butomus umbellatus. (See Lightfoot's Flora Scottica, vol. ii. p. 1139.) In the river Skirn, near Darlington. The above mentioned places are all situated in the lower part of the vale of Tees, and at an inconsiderable elevation above the level of the sea.

On the magnesian limestone which skirts the coast of Durham, are to be found

Cypripedium Calceolus.*
Ophrys muscifera.
Serapias ensifolia.
} In the deep and romantic dene at Castle Eden.

Ophrys apifera. Reaches a little further north to the vicinity of Ryehope and Monkwearmouth.

Tamus communis. Terminates its long range from the kingdom of Algiers (see Smith in English Botany) on the north bank of the river Wear, above Sunderland.

Taxus baccata. Is quite at home on the limestone cliffs in Castle Eden, and I greatly doubt if it be indigenous further north.

Hedysarum onobrychis, Saintfoin. Grows wild about Harton Down Hill and Ryehope. A hint the farmers of that neighbourhood do not benefit by, though they cultivate a sterile calcareous soil.

Hippocrepis comosa. On Cronkley Fell, at an elevation of above 2,000 feet.

Statice Limonium occurs sparingly on the muddy shores by the mouth of the Tees, by the Wear above Hilton, and on the coast opposite Holy Island, in Northumberland; but does not reach the east coast of Scotland, though it is found on the Mull of Galloway, on the west coast.

* This locality was noticed above 40 years since in Stephen Robson's British Flora. It still continues to grow in the same place, though by no means abundant.

2. *Plants which have reached their southern Limits.*

Ligusticum scoticum. Flourishes among the stones on the beach, at the north side of Dunstanborough Castle, Northumberland.

Schænus rufus.* By the Wear, near Southwick.

Aira levigata. By the Wear, near Low Pallion.

Sagina maritima. On Hartlepool Pier, and Seaton Moor.

Rare plants on the sea coast:

Thalictrum minus, Astragalus Hypoglottis, and Geranium sanguineum.† On the whole line of coast.

Chironia littoralis. On the Links at Holy Island and Bamborough.

Cerastium tetrandrum. On the Links near South Shields and Wearmouth.

Rosa rubella. On the Links near South Shields, mixed with Rosa spinosissima.

Pulmonaria maritima. Was noticed by Lawson, many years ago, at Scrammerston, near Berwick, and abounds on the Cumberland coast, near Mary Port, and Whitehaven, together with Sisymbrium monense.

3. *Plants which are Natives of the Sea Coast, and are also found on the Mountains.*

Statice Armeria. Cochlearia officinalis. Plantago maritima. Juncus bulbosus.	Do not occur in the intermediate country between the coast and the mountains; but are to be met with on Teesdale and Weardale moors at a height of 2,000 or 2,500 feet above the level of the sea.
Geranium sylvaticum. Chironia Centaurea. Parnassia palustris. Rosa spinosissima. Pyrola minor. Trollius europeus. Vicia sylvatica. Fumaria claviculata. Galium verum. Orchis mascula. Ornithopus perpusillus. Rubus cœsius. With most of the grasses and carices.	May be traced from the coast to the height of 2,000 feet and upwards.

If the soil be calcareous,

Primula farinosa.
Gentiana Amarella.
Gentiana campestris.
Hieracium murorum.
Sesleria cœrulea.
} May be traced from the coast to the height of 2,000 feet and upwards.

Avena pubescens. The downy oat grass is a mere dwarf on the limestone pastures in the vicinity of the sea; but becomes the most valuable of the meadow grasses in Teesdale, Weardale, &c. at a height of 1,500 feet.

4. *Rare Plants Natives of Switzerland.*

Malaxis paludosa, Egleston Moors.

Orchis albida, at Shewing-shields, Winch-bridge, and Borrowdale, 500 to 1,400 feet.

Impatiens Noli-me-tangere. At Scale Hill, Cumberland.

Cistus marifolius. On Cronkley Fell; about 2,400 feet in height.

Arenaria verna. On the Weardale and Teesdale moors, particularly on old lead-mine rubbish, 1,500 to 2,500 feet.

Geum rivale.
Campanula latifolia.
Ribes petræum.
} In woods from 200 to 2,000 feet.

Thlaspi alpestre. Teesdale, and Weardale, and Allendale Moors.

Thalictrum majus. From 200 to 2,000 feet.

Solidago Virga-aurea. From 1,500 to 2,500 feet.

Sedum villosum. Near Rothberry, 600 feet. On Weardale and Allendale Moors.

Ornithogalum luteum. By the Tees at Wycliffe, Barnard Castle, &c.

Epilobium alsinifolium of Villars. On Cheviot and Cronkley Fell, and on the highest ridge of Foal-foot, at the head of Longsledale. This is Epilobium alpinum of Ray and Curtis.

Melica nutans. In woods at no great elevation above the sea.

Sedum Telephium. On rocks and walls about the Cumberland lakes, particularly in the vicinity of Keswick.

Asplenium bryenii. At Fast Castle, Berwickshire.

Pyrola rotundifolia. In Castle Eden Dean, on the coast of Durham.

Pyrola intermedia. In Scots Wood, and East Common Wood, Northumberland; and Cocken and Blackstone Bank Woods, Durham. From 200 to 1,000 feet above the level of the sea.

Kobresia caricina of Willdenow. (Schænus monoicus of Smith.) Teesdale Forest and Cronkley Fell.

Pyrola minor.
Convallaria majalis.
Stellaria nemorum.
} In woods from the coast to Teesdale forest.

5. *Rare Plants Natives of Lapland.*

Epilobium angustifolium. At the foot of Cheviot, Shewing-shields Crags, and on Teesdale Forest, 500 to 1,500 feet.
Salix rosmarinifolia. On the banks of Derwent, near Fryarside.
Draba incana. Teesdale Forest.
Rubus Chamæmorus. Cheviot, Cronkley Fell, Teesdale, and Allendale Moors, 1,500 to near 3,000 feet.
Thalictrum alpinum. Cronkley Fell, in Teesdale.
Rhodiola rosea. Helbeck, Westmorland.
Butomus umbellatus. In the river Skirn, near Darlington.
Sagittaria sagittifolia. In ponds, near Norton.
Andromeda polifolia. On the banks of Prestwick Carr, and on the Muckle Moss, near Shewing-shields.
Utricularia intermedia, English botany. U. Vulgaris β Linnæus. In Prestwick Carr.
The habitats of the last four species are not many feet above the level of the sea, except the Muckle Moss, which may be 500 feet.
Lobelia Dortmanna. In the Westmorland and Cumberland lakes.

6. *Rare Plants Natives both of Lapland and Switzerland.*

Cerastium alpinum.
Serratula alpina.
Caltha radicans. On Helvellin, Cumberland.
Silene acaulis. On Dove Crags Fairfield, Cumberland.
Dryas octopetala. On Cronkley Fell.
Bartsia alpina. By rivulets on Teesdale Forest.
Potentilla aurea. By Winch-bridge, Teesdale, on basaltic rocks.
Aspidium lonchitis. On Cronkley Fell.
Gentiana verna.
Salix arenaria. In Teesdale Forest.
Polygonum viviparum.
Vicia lutea. On high pastures and moors in Teesdale and Allendale.
Vaccinium uliginosum. Near Middleton, and on Melfell, from 1,500 to 2,000 feet.
Juncus triglumis. On Mellfell, Cumberland.
Saxifraga Hirculus. At the junction of the Black Beck with the Balder, near Teesdale.
Saxifraga stellaris. On Cheviot, in Teesdale, and by the Cumberland lakes from 200 to 2,000 feet.
Saxifraga aizoides. By the lakes of Cumberland; on rocks bordering the river Irthing, at Gilsland, and on Teesdale Forest.
Salix herbacea. On Skiddaw, at the height of 3,000 feet.
Galium boreale. Begins to make its appearance, near Bywell, on the Tyne, at a height of 150 feet.

Lathræa Squamaria.
Scandix odorata.
Rubus idœus.
Rubus saxatilis.
Ribes alpinum.
} In woods from the sea coast to the height of 2000 feet.

Trientalis europæa. { Moors, near Harbottle, in Northumberland, and Waskerly, Durham, from 1,400 to 1,600 feet.

Arbutus Urva ursi. Near Hexham, Cronkley Fell, and Blanchland, from 200 to 2,000 feet.

Melampyrum sylvaticum. Near Keswick, and in Teesdale, near Egleston and Winch Bridge, from 150 to 1,500 feet.

Rumex digynus. In Ashness Gill, near Keswick.
Circæa alpina. Near Keswick.
Festuca vivipara. Borrowdale and Teesdale.
Alchemilla alpina. Borrowdale.
Pyrola secunda. Ashness Gill, between Keswick and Lodore, the only English locality.
} At 200 feet and upwards.

Papaver cambricum. Near Windermere.

Juncus filiformis. By Derwentwater Lake.

Juncus triglumis. Meldon Fell, at 2,500 feet.

Carex capillaris. Near Shewingshields, at 500 feet, the only English locality.

{ Myosurus scorpioides β Fl. Brit.
M. versicolor. English botany.
Veronica serpyllifolia.
Nardus stricta.
} From the coast to the summit of Cheviot.

Ophrys cordata. On Egleston Moors, and at the head of the river Derwent.

Salix arenaria. On the Teesdale moors, rare.

7. *Rare Plants which are not Natives of Lapland or Switzerland.*

Potentilla fruticosa. By the Tees, from Barnard Castle to the Muckle Force, 1,000 to 1,500 feet. This is a native of Oeland, and is not indigenous in any other part of Britain.

Saxifraga platipetala. On the west side of Helvellin.

Salix croweana. Blanchland and Teesdale, at 1,000 feet and upwards.

Carex rigida. A Scotch plant. On the summit of Cheviot, and on the highest ground in Teesdale.

Asplenium viride. In Ashness Gill, near Keswick; and on Cronkley Fell, Teesdale.

Cornus suecica. On the summit of Cheviot.

Alisma natans. In Derwentwater Lake.

8. *Oleraceous Plants found in their natural State.*

Pastinaca sativa. On the magnesian limestone.

Daucus Carota. Near the sea coast.

Smyrnium Olusatrum. Crambe maritima, rare. Brassica oleracea.	On rocks on the sea coast.
Apium graveolens. Cochlearia officinalis.	On rocks, and in salt marshes.
Cochlearia Armoracia.	By slow streams.

9. *Plants which have become naturalized.*

Erigeron canadense, rare. On the Ballast Hills, from America.
Œnothera biennis. From America.
Eryngium campestre. On the shores of Tyne, where it has flourished for upwards of a century, probably from Holland.
Anchusa officinalis. On the Links at Hartley, probably from Germany.
Phalaris canariensis. Originally imported from the Canaries.
Datura Stramonium. Originally from Abyssinia.

Centaurea Calcitrapa. Senecio viscosus. Borrago officinalis. Anethum Fœniculum. Isatis tinctoria. Sisymbrium murale. Dipsacus fullonum. Humulus Lupulus. Solanum nigrum. Teucrium Chamædrys.	From the south of England
Avena fatua Lolium temulentum. Lolium arvense. Chrysanthemum segetum. Cichorium Intybus. Agrostis spica venti. Coriandrum sativum. Linum usitatissimum Chelidonium majus. Papaver somniferum	With corn.
Geranium pyrenaicum. Glaucum luteum.	From the north.

Our three species of heath, Erica vulgaris, E. tetralix, and E. cinerea, are met with on moors from the coast to the height of 3,000 feet; but never flourish on a limestone soil. The foxglove is abundant in the county of Durham, but becomes very scarce on the north side of Tyne. Nardus stricta, Scirpus cæspitosus, Eriophorum vaginatum, and E. angustifolium, are met with in lowland moors, and at the same time grow vigorously on the highest of the Cheviots.

Of the mosses which are peculiar to Britain, we have three species:

Bartramia arcuata. On Alpine Moors, and in the recesses of the Cumberland mountains, where it bears fruit.
Daltonia splachnoides. On trees in subalpine woods.
Orthotrichum pulchellum.* On trees in Cawsey Wood, Durham.

Should you think these remarks worthy a place in the *Annals of Philosophy*, an account of the heights at which the different kinds of grain come to maturity, and under what local circumstances various sorts of fruit will ripen, and exotic plants flower, together with some observations on the mean temperature of the air and springs of water, shall be transmitted by,

Gentlemen, your obedient servant,

N. J. Winch.

Article IV.

An Account of a Pseudo-Volcano in the Neighbourhood of Bradely Iron-works, Staffordshire, and of some Mineral Substances found there. By John Finch, Esq.

(To the Editors.)

GENTLEMEN, *Birmingham, Jan. 24, 1818.*

Should you think the following article worthy of a place in your *Annals of Philosophy*, I shall feel obliged by your insertion of it. The above-mentioned tract of ground is situated by the road-side from Birmingham to Wolverhampton, about half way between Wednesbury and Bilston, and close to Bradely lower furnace. It is mentioned by Plott, in his Natural History of Staffordshire, as being on fire in the year 1686, when he wrote. He says, it is not known how long it had been on fire before that time. It then occupied a space of eleven acres; but its ravages have since extended about one mile and a half in extreme length, and one mile in breadth. Whether the fire originated in accident, or from the sulphur contained in the coal and pyrites, cannot at this distance of time be ascertained; but it probably arose from the latter cause, as at other pits the small coal has taken fire on being exposed to the action of the atmosphere; and formerly the accumulation must have been very considerable, as the small coal was not then consumed in the works connected with the smelting of iron.

As the combustible matter is exhausted, the hand of cultivation requires its labour; and, even in parts where the fire is still in activity, by carefully stopping the fissures, and preventing the

* I doubt whether the late Mr. W. Brunton ever found this moss in the north of England, as mentioned at p. 75 of Hooker and Taylor's Muscologia. I sent it to him from this locality in 1805.

access of air, the occupiers are enabled to raise different crops.

A neglect of these precautions sometimes destroys half the produce, whilst the remainder continues flourishing.

On the west, the fire appears to be extending itself by Bradely lower furnace. About two years ago, it began to penetrate through the floors of some houses. It produced great alarm among their tenants by appearing in the night, and four of the houses were taken down. It exhibits a red heat in this situation, and the smoke has forced its way through a bed of cinders 40 feet in height. On the south it is arrested by beds of sand, which cover the coal formation in that part, and on the north and east it is impeded by cultivation.

The above tract of ground presents very interesting appearances in a geological point of view, as exhibiting the action of subterranean fire on the various strata of coal, ironstone, shale, and pyrites, of which the coal formation of Staffordshire is composed. At first view, a stranger might suppose himself in a volcanic region. The exterior view of the strata, exposed to view by the falling in of the ground, presents a surface, blackened by the action of fire, and presenting most of the porphyritic and trappean colours in high perfection. The cindery dust on which you tread, the sulphurous vapours and smoke which arise from various parts of the surface, and the feeling of insecurity which attends most of your footsteps, all combine to give a high degree of interest to the scene.

The space to which I more immediately refer, and from which I procured my specimens, consists of about 14 acres, adjoining a farm house, which is inhabited by a respectable family of the name of Godman. This ground is not yet cultivated, but probably will be in a year or two, when the present appearance will be effaced.

The best views of the ground are obtained at the spot just described, on the bank of cinders at Bradely, and at an excavation to the North West, where a large quantity of the calcined stone has been taken away to repair the roads, and at which place a shaft is now sinking to work the lower beds of coal and ironstone, which are supposed to remain uninjured.

The mineral substances which occur are as follow. Some of them are rare. The description of them may, at least, afford a new locality.

Non-metallic combustible Minerals.

1. *Sulphur.*—This occurs in small brilliant crystals, so minute that the form cannot be determined: also, massy and amorphous, lining in small quantities the cavities of the sandstone and shale, which have been calcined and contain sm[illegible]rtures; or chambers, where the sulphur is sublimed on [illegible]ach to the atmosphere.

2. *Mineral Tar.*—This occurs only in one situation, which appears to be at the cropping out of a thin bed of coal. I only found a small quantity, more or less viscid, and mixed with black earth.

3. *Coal.*—Near the farm-house is a small hollow, caused either by an old shaft, or by the sinking of the ground from the fire beneath. Four feet from the surface is a bed of coal, three feet in thickness. This may be seen without the trouble of descending a shaft for that purpose. It shows the coal most accurately between roof and floor, dipping south. Being so near the surface, it appears in very small lumps, in the state which the miners term *rotten*. Under this bed of coal is a stratum of clay six inches in thickness, which contains vegetable impressions in abundance.

Saline Minerals.

4. *Sulphate of Alumina* occurs as an efflorescence in strata of calcined clay near the surface. It is formed from the burning of the shale, which contains a large portion of alumina, and which is supplied with sulphuric acid from the pyrites.

5. *Muriate of Ammonia, combined with a small Proportion of Sulphate of Ammonia.*—Produced in beautiful crystals of the usual forms; also, a crystallization, which I believe has not been hitherto noticed, at least not by the authors I have consulted. It is a very thin hexagonal table, having two of the opposite sides broader than the others. It occurs in clusters covering the other crystals, which are four-sided pyramids joined base to base.

6. *Sulphate of Zinc.*—This rare substance has hitherto been found only at Holywell, in North Wales. The taste is nauseous-metallic, and it occurs combined with aluminous earth. I should have distrusted my own opinion on this substance; but Mr. Dalton, of Manchester, being in Birmingham for a short time, I submitted it to his judgment, and he allows me to make use of his authority in determining its nature.

Earthy Minerals.

7. *Sulphate of Lime.*—The upper stratum of sandstone is penetrated in several parts by this substance, which has been noticed as occurring in many coal-fields. It here appears remarkable merely from the red base to which it is attached, giving it a porphyritic appearance. It is rather abundant.

8. *Porcelain Jasper.*—Formed by the calcination of almost all the beds of clay which lie over the burning coal, and consequently very abundant. It presents almost every variety of colour, and varies from five to forty feet in thickness.

9. *Newest Floetz Trap, Basalt, or Rowley Rag.*—This substance is well known to geologists, in consequence of the scientific experiments of the late Mr. Gregory Watt, and the

publication of Mr. Keir on the mineralogy of Staffordshire. It was only noticed by them in one situation, viz. in a range of hills, extending from Dudley towards Oldbury, and upon which the village of Rowley is situated. Near Bradely, close to the farmhouse, a bed of this substance occurs, enclosing crystals of hornblende, and having the same tendency to assume the polygonal form, and to decompose into spheroidal masses, with the Rowley rag. It is in fact the same substance, but occupying a very different position. It forms no perceptible elevation, and was originally about 80 yards in length and 30 in width; but one portion of it, being in the way of the farming operations, was entirely cleared from the surface. It formed the uppermost stratum, and was thrown into the holes caused by the fire. A fence to one of the fields, being carried across part of it, exhibits a section of the trap, but not sufficiently deep. At this position I caused a hole to be dug to ascertain the thickness, which appeared to be about four feet. On arriving near that depth, with great difficulty, on account of the nature of the rock, we were obliged to desist; but the smoke from underneath began to ascend, showing that the lower strata were very near. Some expense and time would be necessary to ascertain the junction of this trap with the sandstone, on which I suppose it to rest, and whether, in any part of it, it has a connexion with a fault composed of the same material. The portion of the strata examined was chiefly in small angular pieces, much shattered. The larger blocks were in quadrangular masses. This trap is five miles distant from the Rowley Hills, with which it appears to have no connexion. The collieries in the intervening space are not cut through any corresponding bed of trap. To the west there is a slight declivity of the ground, which it appears to follow, and so far appears conformable.

I beg to apologize for trespassing so much on your time.

I am most respectfully, your obedient servant,

JOHN FINCH.

ARTICLE V.

Biographical Sketch of Adanson.

MICHEL ADANSON, who was no less remarkable for his assiduity in the prosecution of natural science than for the singularity of his habits and character, was born at Aix, in Provence, on April 7, 1727. He was descended from a Scotch family, who followed the fortunes of James II. and afterwards became naturalized in France. He was brought to Paris at the age of three years; and his father being in humble circumstances, his education was conducted under the patronage of the Archbishop of

Aix, who gave him the advantage of a college education. He soon displayed considerable talents; and from his quickness in the performance of his academic exercises, he attracted the attention of the celebrated naturalist Needham, who was attached to the institution in which the young Adanson was placed, and who appears to have determined the future pursuits of his pupil, by presenting him with a microscope. The possession of this instrument awakened in him the most ardent passion for making observations; and he commenced, at a very early age, a train of researches into the various departments of science which he pursued without intermission through a long life of 70 years. Botany very early engaged his particular attention, and he became a zealous student in the "jardin des plantes," so that at the age of 19 he had already written a description of some thousand species of plants, and devoted not merely the whole of the day, but even a portion of the night to his favourite study.

His ardent mind soon engaged him in a much more active and arduous scene; when only 21 years of age he embarked for the coast of Africa, for the purpose of examining the interior of Senegal. The motives which induced him to fix upon this situation are not a little singular and characteristic of his turn of mind. He informs us that he selected it "because it was, of all the European establishments, the most difficult to penetrate, the hottest, the most unhealthy, the most dangerous in all other respects, and, consequently, the least known to naturalists." His constitution and physical powers, no less than his acquired habits, rendered him well adapted for this perilous undertaking; and during five years, which he spent in Africa, it appears that he went through a quantity of mental and corporeal labour, which, perhaps, no other individual could possibly have accomplished. This period he spent entirely deprived of society, and the greatest part of it absolutely in solitude, a circumstance which tended to promote the original peculiarities of his disposition. Naturally of an austere temperament, and little disposed to enjoy the intercourses of social life, he always preferred meditating upon his own ideas to the communication of them to others; and so much was this feeling fostered by his residence in Senegal, that he returned from this country in a state which rendered him almost unable to impart his knowledge to the world, or to profit by the information of his contemporaries.

About the time when Adanson returned from his voyage, Linnæus and Buffon were rapidly advancing to that rank in public estimation to which they were each of them, although very different in their genius and character, so justly entitled. Our young naturalist, however, seems to have paid little attention to either of them, and to have been as little captivated by the scientific accuracy of the one, as by the eloquent descriptions of the other, He determined to pursue a system of his own, at which he laboured with the utmost diligence; but it was of an almost immense extent, and more than any one individual could possibly accomplish. What he called his "universal method" proceeded upon the plan of examining all the functions of every individual object; and by classing each set of functions or operations in separate divisions, he expected to obtain a complete set of distinct parts, which, when united, should combine together to produce the whole. As a kind of specimen of the nature of his "universal method," and the manner of applying it, he published in 1757 an account of the shells of Senegal, a work which acquired for the author a considerable share of reputation, and obtained for him the honour of being elected a member of the Royal Society and of the Academy of Sciences. This volume was intended to form one of a series of eight, which were to include all the natural history of Senegal; but his anxiety to bring before the public the merits of his peculiar system, induced him to relinquish this object, and to publish on the families of plants a work which appeared in the year 1763.

Among the botanists who, before this period, had paid particular attention to the natural relations of plants, the most distinguished was Bernard Jussieu, who had been the preceptor of Adanson. It is probable, therefore, that the pupil imbibed from his master the first impressions upon this subject, but every circumstance proves that, in the detail of the execution, Adanson rested entirely upon his own powers. In the prosecution of his object he secluded himself still more completely from all intercourse with the world, even from that of men of science, who were engaged in the same pursuits; he was without pupils; and almost without friends, and was only known to exist by his publications; and these, although they afforded ample proofs of his knowledge and his industry, were so little attractive in their style and manner, as never to become popular, and to be rather admired than read. Not only his arrangements and his descriptions were original, but his nomenclature, and even his orthography, were often peculiar to himself, and such as might seem almost intended to repel his readers, rather than to allure them to the perusal.

After some years of retirement and unwearied application, he presented to the Academy of Sciences a sketch of his general plan, which afforded one of the most remarkable examples of human industry which we have on record. His labours, as we are informed by Cuvier, consisted of 27 large volumes, in which were explained the general relations of all objects and their arrangement: the history of 40,000 species was placed in alphabetical order in 150 volumes; a universal vocabulary gave the explanation of 200,000 words; there was a great number of separate memoirs and [illegible] together with 40,000 figures, and 30,000 specimens. [illegible] this immense mass must necessarily have been [illegible], and he was strongly urged to separate his original observations, and publish them in a detached form. But he positively refused to follow this advice; and hence the really valuable matter which it contained has become lost to the world, and the celebrity which the author was so anxious to acquire with posterity rather depends upon the supposed extent of his powers than upon any thing which he actually accomplished. He indeed occasionally inserted papers in the Memoirs of the Academy, containing accounts of some of the objects with which he had become acquainted during his residence in Senegal; but these he regarded as of minor importance, and seemed to regret the time which was occupied in preparing them, as so much robbed from his great systematic work. Upon these, however, his reputation rests, and although they are of little importance compared with the store of materials from which they were selected, yet they are most of them valuable, and have contributed to the progress of science.

The latter part of Adanson's life was oppressed with the evils attendant upon poverty, in addition to those of old age. By the Revolution he lost all his property, which principally consisted in a small pension from the government of France and that from the Academy; he seems to have passed some time in absolute penury, and in almost complete oblivion; when, upon the establishment of the Institute, he was called to become one of its members, and, for a short period, enjoyed a degree of comparative comfort and respectability. He died at the age of 70 years, worn out by intense application, and, probably, from the want of those comforts which were necessary to support his declining years. Although so secluded in his habits, and almost misanthropical in his intercourse with literary men, his disposition is said not to have been unamiable, and he had the merit of enduring his misfortunes with exemplary fortitude. His patience may, perhaps, in some measure, be attributed to apathy, and to his mind being so completely absorbed in his scientific pursuits as to render him insensible to those evils which, to the bulk of mankind, are the most intolerable. Even the neglect with which he conceived himself to be treated, probably made little impression upon him; for he seems to have imputed it more to the want of discernment in his contemporaries than to his own deficiencies. He left a direction in his will, which, perhaps, would not have been expected from a person of his turn of mind, but is highly characteristic of his countrymen, that the only decoration of his tomb should be a garland of flowers, taken from the 58 natural families of plants which he had endeavoured to establish.

Article VI.

Solutions of Equations. By James Adams, Esq.

(To Dr. Thomson.)

SIR, *Stonehouse, Dec. 23, 1817.*

Your inserting the following solutions, &c. in your *Annals of Philosophy*, will much oblige Your humble servant,

James Adams.

A solution of the equation $2 \cos. m A = z^m + \frac{1}{z^m}$ on a supposition that $2 \cos. A = z + \frac{1}{z}$. By putting the $\cos. A = c$, and $\frac{1}{z} = x$ we have

$$
\begin{aligned}
2c &= z + x \\
4c^2 &= (z+x)^2 = z^2 + x^2 + 2 \\
8c^3 &= (z+x)^3 = z^3 + x^3 + 3(z+x) \\
16c^4 &= (z+x)^4 = z^4 + x^4 + 4(z^2+x^2) + 6 \\
32c^5 &= (z+x)^5 = z^5 + x^5 + 5(z^3+x^3) + 10(z+x) \\
64c^6 &= (z+x)^6 = z^6 + x^6 + 6(z^4+x^4) + 15(z^2+x^2) + 20
\end{aligned}
$$

&c.

From whence we get

$$
\begin{aligned}
z + x &= 2c \ldots\ldots\ldots\ldots\ldots\ldots = 2 \cos. A \\
z^2 + x^2 &= 4c^2 - 2 \ldots\ldots\ldots\ldots = 2 \cos. 2A \\
z^3 + x^3 &= 8c^3 - 6c \ldots\ldots\ldots\ldots = 2 \cos. 3A \\
z^4 + x^4 &= 16c^4 - 16c^2 + 2 \ldots\ldots = 2 \cos. 4A \\
z^5 + x^5 &= 32c^5 - 40c^3 + 10c \ldots\ldots = 2 \cos. 5A \\
z^6 + x^6 &= 64c^6 - 96c^4 + 36c^2 - 2 = 2 \cos. 6A
\end{aligned}
$$

$$
z^m + x^m = z^m + \frac{1}{z^m} = 2^m . c^m - m\, 2^{m-2} . c^{m-2} + \frac{m(m-3)}{1.2} 2^{m-4} . c^{m-4} - \frac{m(m-4)(m-5)}{1.2.3} 2^{m-6} . c^{m-6} + \frac{m(m-5)(m-6)(m-7)}{1.2.3.4} 2^{m-8} . c^{m-8} - \&c.
$$

A well-known series for twice the cosine of a multiple arc when radius is unity. Therefore $2 \cos. m A = z^m + \frac{1}{z^m}$.

A solution of the equation $(\cos. A \pm \sqrt{-1} \sin. A)^m = \cos. m A \pm \sqrt{-1} \sin. m A$ may now be readily effected.

From the preceding equations we have

$z^2 - 2 \cos. A . z = -1$, and $z^{2m} - 2 \cos. m A . z^m = -1$.

By completing the squares, &c.

$$z = \cos. A \pm \sqrt{\cos.^2 A - 1} = \cos. A \pm \sqrt{-1} \sin. A$$

$z^m = \cos. m A \pm \sqrt{\cos.^2 m A - 1} = \cos. m A \pm \sqrt{-1}$ $\sin. m A$.

Therefore

$$(\cos. A \pm \sqrt{-1} \sin. A)^m = \cos. m A \pm \sqrt{-1} \sin. m A.$$

Hence the following equations

$$(\cos. A + \sqrt{-1} \sin. A)^m = \cos. m A + \sqrt{-1} \sin. m A$$
$$(\cos. A - \sqrt{-1} \sin. A)^m = \cos. m A - \sqrt{-1} \sin. m A.$$

By addition and subtraction,

$$\text{Cos. } m A = \frac{(\cos. A + \sin. A \sqrt{-1})^m + (\cos. A - \sin. A \sqrt{-1})^m}{2}$$

$$\text{Sin. } m A = \frac{(\cos. A + \sin. A \sqrt{-1})^m - (\cos. A - \sin. A \sqrt{-1})^m}{2 \sqrt{-1}}.$$

Article VII.

Solution of a Problem. By James Adams, Esq.

(To Dr. Thomson.)

SIR, *Stonehouse, Jan.* 15, 1818.

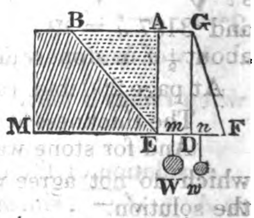
At page 259, vol. iii. Dr. Hutton's Course of Mathematics, we have the following problem:

"To determine the thickness of the wall at the top when the face is not perpendicular, but inclines as the front of a fortification wall usually is."

The solution to which is there given by a *quadratic equation.*

If, in your opinion, the following solution by a *simple equation* be an improvement, your inserting it in the *Annals of Philosophy* will much oblige Your humble servant,

James Adams.



Let A B M E be a vertical section of a bank of earth, and the triangular part A B E that which is supported by means of a wall, the vertical section of which is A E F G. Draw G D perpendicular to F E, and conceive two weights, W and w, to be suspended from the centres of gravity of the rectangle A D, and the triangle G D F, and to be proportional to their areas respectively.

Put A E $= a$, D F $= \frac{a}{c}$, and E F $= x =$ breadth at the *base*.

Then E F $-$ D F $=$ E D $= x - \frac{a}{c} = \frac{c x - a}{c}$ $\therefore \frac{1}{2}$ E D $= \frac{c x - a}{2 c}$

And F D + D m = F m = $\frac{a}{c} + \frac{cx - a}{2c} = \frac{cx + a}{2c}$.

The area A E D G = E D × D G = $\frac{cx - a}{c} \times a = W$,

The area F D G = $\frac{1}{2}$ D F × D G = $\frac{1}{2} \times \frac{a}{c} \times a = \frac{a^2}{2c} = w$.

Hence F $n \times w$ + F $m \times W = \frac{2a}{3c} \times \frac{a^2}{2c} + \frac{cx + a}{2c} \times \frac{cx - a}{c}$ $\times a = \left(\frac{x^2}{2} - \frac{a^2}{6c^2}\right) a$.

Therefore $\left(\frac{x^2}{2} - \frac{a^2}{6c^2}\right) a n$ = "stabilitating force" of the section A E F G, the specific gravity of which being n.

The stability of the supported earth A B E = $\frac{m s^2 a^3}{6}$, m, being the specific gravity of the earth, and s, the nat. sin. (rad. 1) of the angle A E B (page 258, ibid.)

Hence the following equation:

$\left(\frac{x^2}{2} - \frac{a^2}{6c^2}\right) an = \frac{m s^2 a^3}{6}$ $\therefore x = \frac{a}{c} \sqrt{\frac{1}{3n}(m c^2 s^2 + n)}$, a *simple equation*. If the quantity $\frac{m s^2 a^3}{6}$, be reduced on account of friction, as is usual, then $\left(\frac{x^2}{2} - \frac{a^2}{6c^2}\right) a n = \frac{m s^2 a^3}{9}$, and $x = \frac{a}{3c}$ $\sqrt{\frac{2 m s^2 c^2 + 3n}{n}}$.

If the angle A E B = 45°, and $m = n$, the last equation would become $x = \frac{a}{3c} \sqrt{c^2 + 3}$; and when $c = 5$, then $x = \frac{a}{15} \sqrt{28} = \cdot 3527\, a$ = base E F,
and $\cdot 3527\, a - \cdot 2\, a = \cdot 1527\, a$ = top A G,
almost $\frac{1}{6}\, a$ in brick walls.

If $m = 4$, $n = 5$, $c = 5$, and $s^2 = \frac{1}{2}$, we then have $x = \frac{a}{3c} \sqrt{\frac{2 m s^2 c^2 + 3n}{n}} = \frac{a}{15} \sqrt{23} = \cdot 3197\, a$ = E F
and $\cdot 3197\, a - \cdot 2\, a = \cdot 1197\, a$ = top A G,
about $\frac{1}{9}\, a$ in stone walls.

At page 260 ibid. (using the same numbers as above)

The thickness at the top for brick walls is .... $\cdot 189\, a$,
And for stone walls .... $\cdot 159\, a$,

which do not agree with the preceding, owing to a mistake in the solution.

For in completing the square of the equation

$x^2 + \frac{2a}{5} x + \frac{2a^2}{75} = \frac{m}{n} \times \frac{a^2}{9}$, it is printed

$x^2 + \frac{2a}{5} x + \frac{a^2}{25} = \frac{m}{n} \times \frac{a^2}{9} + \frac{a^2}{25}$, instead of

$x^2 + \frac{2a}{5}x + \frac{a^2}{25} = \frac{m}{n} \times \frac{a^2}{9} + \frac{a^2}{75}$; this correction being made, we have $x = \frac{a}{15}\sqrt{\frac{25m + 3n}{n}} - \frac{a}{5} = \frac{a}{3c}\sqrt{\frac{mc^2 + 3n}{n}} - \frac{a}{c}$.
the same as before, $s^2 = \frac{1}{2}$ and $c = 5$.
Here $x =$ A G, the breadth at the *top* of the wall.

Article VIII.

Observations on the Nature of some of the Proximate Principles of the Urine; with a few Remarks upon the Means of preventing those Diseases, connected with a morbid State of that Fluid. By William Prout, M.D.*

The substances to which the author proposes to confine his attention in this paper are, urea, saccharine matter, and lithic acid; the other constituents of the urine are omitted for the present, in consequence of the uncertainty which prevails respecting them.

The urea was obtained in a separate, although in a very impure state, by Rouelle, in 1773, and styled the saponaceous extract of urine. It was made the subject of particular examination by Cruickshanks, and shortly after by Fourcroy and Vauquelin, who first gave it the name of urée; but although they made us acquainted with many of its leading properties, it was not obtained by them in a perfectly pure state. This seems to have been first accomplished by Berzelius, judging from the description which he gives us of its physical and chemical properties; but he does not give us any account of the process which he employed. M. Thenard, in his late work, describes it in such a manner as to show that he had procured it in a somewhat purer state than Cruickshanks; but still it seems not to have been entirely so, as it retained a urinous odour, and deliquesced, on exposure to the atmosphere.

The process which Dr. Prout employs, is as follows. To the extract of urine evaporated to the consistence of a syrup, nitric acid is to be gradually added until the whole is converted to a crystalline mass, which is to be slightly washed with cold water. The nitric acid is then neutralized by a solution of subcarbonate of potash, or soda, and the solution evaporated, in order that the nitrate of potash or soda may crystallize, and be thus separated. The fluid which is left is made into a paste with animal charcoal; cold water separates the urea from this paste in a colourless state; it is to be evaporated to dryness, and the mass digested

* Abridged from the eighth volume of the Med. Chir. Trans.

in alcohol, which takes up the urea alone, leaving the saline bodies, or other extraneous matters; and from the alcoholic solution, the urea may be obtained pure and in the crystallized state, although it is often necessary to repeat the crystallization from the alcohol two or three times.

The properties of pure urea are then detailed by the author. Its crystals assume the form of a four-sided prism; they are transparent and colourless, and have a slight pearly lustre. It has a peculiar, but not urinous odour; it does not affect litmus or turmeric papers; it undergoes no change from the atmosphere, except a slight deliquescence in very damp weather. In a strong heat it melts, and is partly decomposed, and partly sublimed without change; the specific gravity of the crystals is about 1·35. It is very soluble in water; alcohol at the ordinary temperature of the atmosphere dissolves about 20 per cent., when boiling considerably more than its own weight, from which the urea separates, on cooling, in its crystalline form. The fixed alkalies and alkaline earths decompose it; it unites with most of the metallic oxides, and forms crystalline compounds with the nitric and oxalic acids.

In the analysis of organized substances the method generally adopted is to employ some body which may afford a quantity of oxygen, and thus convert their elements into various oxides, the composition of which being known, may enable us to estimate the quantity of the elements. The oxymuriate of potash has been used for this purpose, and serves very well for the analysis of vegetables; but for animal substances it is less useful, because it combines in variable proportions with the azote which enters into their composition. On this account Dr. Prout employed the black oxide of copper, and found it to answer completely, as at a moderate temperature it parts with its oxygen to hydrogen and carbon, but not to azote. The substance under examination was heated with the oxide of copper in an apparatus so contrived, that the amount of water and carbonic acid formed might be accurately ascertained, and the carbon and hydrogen thus estimated, while the azote remained uncombined. When four grains of urea were employed, the product was,

Water	2·45	grains.
Carbonic acid	6·3	cubic inches.
Azote	6·3	ditto.

Hence it was estimated to consist of

Hydrogen	0·266
Carbon	0·799
Azote	1·866
	2·933
Oxygen	1·066
	4·000

Now if we assign to each of these elements the proportional numbers that represent their atoms or combining weight, we shall find that urea consists of

2 atoms or 2 volumes of hydrogen..	2·5	or per ct. of	hydrogen.	6·66
1 atom or 1 volume of carbon....	7·5		carbon...	19·99
1 atom or $\frac{1}{2}$ volume of oxygen...	10·0		oxygen ..	26·66
1 atom or 1 volume of azote....	17·5		azote	46·66
	37·5			100·00

Dr. Prout next examined the composition of the nitrate of urea, which he found to be in 100 parts,

Nitric acid...................	47·37
Urea.......................	52·63
	100·00

or one atom of the former to two of the latter.

He then proceeded to analyze sugar by the same process which he had employed for urea; the result was,

Water...............	2·45	grains,
Carbonic acid.........	12·6	cubic inches:

from which its composition is estimated at

Hydrogen.................	0·266
Carbon..................	1·599
	1·866
Oxygen..................	2·133
	4·000

corresponding to

1 atom or 1 volume of hydrogen ..	1·25	or per ct.	hydrogen	6·66
1 atom or 1 volume of carbon	7·5		carbon..	39·99
1 atom or $\frac{1}{2}$ volume of oxygen....	10·0		oxygen..	53·33
	18·75			100·00

Diabetic sugar and the sugar of milk, when submitted to the same mode of analysis, afforded results so nearly similar to the above that the author regards them all as essentially the same substances affected a little in their external characters by small quantities of some extraneous substance.

Four grains of lithic acid, treated in the same manner, yielded

Water................	1·05	grains.
Carbonic acid..........	11·0	cubic inches.
Azote................	5·5	ditto.

Hence it consisted of

Hydrogen.	0·11
Carbon	1·37
Azote	1·61
	3·09
Oxygen	0·91
	4·00

which correspond with

1 atom or 1 volume of hydrogen	1·25	hydrogen	2·857
2 atoms or 2 volumes of carbon . .	15·00	carbon . .	34·286
1 atom or ½ volume of oxygen .	10·00	oxygen . .	22·857
1 atom or 1 volume of azote . . .	17·5	azote . . .	40·000
	43·75		100·000

Since Dr. Prout completed his experiments, M. Berard has published an analysis of several animal substances, and among others of urea and lithic acid, in which he employed the oxide of copper; his results do not entirely coincide with Dr. Prout's, although they bear a general resemblance to them. Dr. Prout places his own results in the following tabular form:

Elements.	Urea.		Sugar.		Lithic Acid.	
	Per atom.	Per cent.	Per atom.	Per cent.	Per atom.	Per cent.
Hydrogen	2·5	6·66	1·25	6·66	1·25	2·85
Carbon.	7·5	19·99	7·50	39·99	15·00	34·28
Oxygen.	10·0	26·66	10·00	53·33	10·00	22·86
Azote.	17·5	46·66			17·05	40·00
	37·5	100·00	18·75	100·00	43·75	100·00

From these experiments the author draws some general conclusions.

1. The theory of definite proportions holds good in all these instances; and from this circumstance it is probable that it will do so in all bodies that are capable of forming crystalline compounds, either from the animal or vegetable kingdoms.

2. The above compounds appear to be formed by the union of more simple compounds; as urea of carburetted hydrogen and nitrous oxide, lithic acid of cyanogen and water, &c. whence it is inferred that their artificial formation falls within the limits of chemical operations.

3. The relation which exists between urea and sugar seems to explain in a satisfactory manner the phenom[illegible]etes, which may be considered as a depraved sec[illegible]r. The weight of the atom of sugar is just half th[illegible]f the

atom of urea; the absolute quantity of hydrogen in a given weight of both is equal; while the absolute quantities of carbon and oxygen in a given weight of sugar are precisely twice those in urea.

4. Lithic acid is a substance quite distinct from urea in its composition. This fact, the author observes, explains an observation which he has often made, that an excess of urea generally accompanies the phosphoric diathesis, and not the lithic. He informs us that he has several times seen urea so abundant in the urine of a person where the phosphoric diathesis prevailed, as to crystallize spontaneously without being concentrated by evaporation, on the addition of nitric acid.

We shall not extend our analysis to the second part of the paper, as this is entirely confined to the medical treatment of the diseased states of the urine.

Abstract of the Essay on the Analysis of Animal Substances. By M. J. E. Berard. Referred to by Dr. Prout.

M. Berard has lately analyzed a number of animal substances by distilling them with the peroxide of copper, according to the method of M. Gay-Lussac; the following are the results which he obtained:

Name of the substance.	Azote in 100 parts by weight.	Carbon ditto.	Oxygen ditto.	Hydrogen ditto.
Urea	43·40	19·40	26·40	10·80
Uric acid	39·16	33·61	18·89	8·34
Butter		66·34	14·02	19·64
Fat		69·00	9·66	21·34
Mutton suet		62·00	14·00	24·00
Cholesterine		72·01	6·66	21·33
Cetine (spermaceti)		81·00	6·00	13·00
Fish oil		79·65	6·00	14·35

M. Berard has observed that the crystallized uric acid is deprived of water, and that 100 parts of this acid neutralize a quantity of base, the oxygen of which is $\frac{1}{3}$ of that contained in the acid; for the analyses of the urates of barytes and potash have yielded

Uric acid	61·64	100·00
Barytes	38·36	62·23
Uric acid	70·11	100·00
Potash	29·89	42·63

He draws the following conclusions from his analyses:

1. As the uric acid is soluble in a small quantity of potash, we may conceive the possibility of dissolving it in the bladder.

2. As urea and uric acid are the most azotized of all animal substances, the secretion of urine appears to have for its object, the separation of the excess of azote from the blood, as respiration separates from it the excess of carbon.

3. Fats are distinguished from animal and vegetable oils by having a less proportion of carbon.

4. The composition of cetine and cholesterine will lead us to class these bodies rather with wax than with fat.

5. Fish oil has a great analogy with olive oil.

M. Berard relates a remarkable experiment, in which having passed into a red hot porcelain tube a mixture of one volume of carbonic acid, 10 of carburetted hydrogen, and 20 of hydrogen, which nearly represents the same proportion of elements as exists in fat, he obtained a substance under the form of small white crystals, like mother-of-pearl, brilliant, greasy to the touch, lighter than water, fusible by warm water into a fat oil, and soluble in alcohol. M. Berard observes that while he was engaged in his experiments, he was informed by M. Saussure that M. Döbereiner had formed fat by distilling water over incandescent charcoal.—(Bulletin des Sciences, August, 1817; Ann. de Chim. et Phys. v. July, 1817.)

On the Production of Fat. By M. Döbereiner.

The following is the discovery said to have been made by Prof. Döbereiner, on the production of adipose matter from inorganic substances. He was engaged in a series of experiments on the inflammable gas of coal mines, which he was mixing with aqueous vapour in a red-hot tube of iron. He not only thus obtained a large portion of carburetted hydrogen and carbonic acid; but also a considerable quantity of a substance analogous to "gelatine," which, settling in the tube, at length entirely obstructed it. He attempted to analyze this substance, and found it to be a mixture of water and fat. The gas itself contained a considerable quantity of this fat mechanically suspended; for it was only partially transparent, and had a strong smell of heated tallow. It deposited, by cooling, a white adipose matter.

This experiment of the production of artificial fat from water and coal is said to have been repeated with success, and M. Döbereiner expects to be able to produce alcohol by the same substances, and an analogous kind of process. The elements of this combustible liquor exist in water and coal; and the conditions requisite for their combination, it is supposed, are either already present, or may be easily procured. (Bibliotheque Universelle, July, 1807.)

Article IX.

Meteorological Journal for the City of Cork. By T. Holt, Esq.

(To Dr. Thomson.)

Sir, *Cork, Jan.* 31, 1818.

I enclose you a meteorological scale (Pl. LXXXIX) and accompanying Journal for the last three months of 1817. Should you deem it worthy a place in your *Annals of Philosophy*, I shall continue my observations, and can transmit them quarterly, or half yearly. Of the barometer I have enclosed two lines of variation, to explain which it will be necessary for me to observe, that I live on an elevation of about 960 feet above the level of the sea; but as my daily occupation is in the city of Cork, I have an opportunity of regularly observing the variations of both barometer and thermometer every day, and within 20 minutes' difference. The time of observation was on the hill about an hour, and in the town about 40 minutes before sun-rise; and if any material variation occurred in the course of the day, it was noted. The difference in the heights of the thermometer seldom exceeded one degree. I am, Sir, with due respect,

Your very obedient servant,

Thomas Holt.

Remarks.

October.

1. Fine, bright day; light breeze.
2. Hard frost last night; clear day.
3. Ditto, ditto.
4. Fine, dry day; dust very offensive; fresh breeze.
5. Clear, dry day; gale of wind.
6. Ditto.
7. Ditto; brisk gale.
8. Dry, cloudy day; high wind.
9. Clear, dry day.
10. Ditto.
11. Ditto.
12. Ditto.
13. Ditto; frosty evening.
14. Dry, cloudy day: frost last night.
15. Dry, bright day.
16. Ditto, fresh breeze; dust blown very high.
17. Clear morning; frost last night; a light shower about noon.
18. Bright, cold day; frost last night; breeze.
19. Fine, clear day.
20. Ditto.
21. Fine morning; rain, from one P.M.; wet evening.
22. Dry, gloomy day.
23. Frost last night; fine day; wet evening.
24. Foggy morning; fine day.
25. Cloudy day; rainy evening.
26. Fine; but dull day.
27. Rainy morning till 11 A.M.; showery; high wind.
28. Rain last night; showery day; hail and snow this evening.
29. Hard frost last night; fine, clear day; rainy evening, with high wind.
30. Some showers through the day; strong gale.
31. Ditto, ditto.

November.

1. Frost last night; showery day; windy evening.
2. Mild, but cloudy day.
3. Misty morning; high wind.
4. Cloudy, but dry.
5. Rainy morning; fine from noon.
6. Cloudy day; rainy evening.
7. Rain last night, and till noon; showery evening.
8. Rainy morning, and showery day.
9. Showery.
10. Rain last night, and till noon;

showery evening, with violent wind.
11. Showery day; no wind; gale at night, with great rain.
12. Violent rain, and wind.
13. Cloudy day; wind; hard rain from 12.
14. Frost last night; bright day till four P.M.; rainy evening.
15. Violent rain last night; bright day; rainy evening.
16. Clear, bright day; no wind.
17. Hazy morning, and rainy day.
18. Bright day.
19. Misty morning and day.
20. Dry, cloudy day.
21. Ditto.
22. Fine, clear day.
23. Dry, cloudy day.
24. Cloudy, with some showers.
25. Rain last night; cloudy day.
26. Cloudy day.
27. Rain last night; cloudy.
28. Cloudy; rainy evening; wind.
29. Cloudy morning, with thick fog on the hills; rainy evening.
30. Dark, foggy day; rainy evening.

DECEMBER.

1. Rainy morning; cloudy day; fine evening.
2. Bright day.
3. Frost last night; bright day; sleet; breeze.
4. Ditto; bright morning; cloudy day.
5. Rainy morning till noon; fine afternoon; rainy evening.
6. Showery day.
7. Dark, dry day.
8. Rain and wind last night, and through this day.
9, 10, 11. Frosty nights; clear days.
12. Showery day.
13. Dull, misty day; rainy evening; wind.
14, 15. Showery, and wind.
16. Rainy.
17. Bright morning; rainy afternoon.
18. Rain last night; showery day.
19. Showery day; windy evening.
20. Dull day; no rain.
21. Rain last night; dull day.
22. Fine morning, and clear day.
23, 24, 25. Bright, frosty days and nights.
26. Hard frost last night; cloudy, with rain; frosty evening.
27. Showery day; wind.
28. Frost last night; bright day.
29. Ditto, ditto; foggy evening.
30. Dull, dry day.
31. Hard frost last night; bright, frosty day.

Article X.

Mr. W. Smith's Discoveries in Geology.

[The following statement was communicated in the month of March to the Editors, by Mr. Farey, and has since been authenticated by a letter received from Mr. Smith himself. Much discussion has of late arisen concerning the discoveries of Mr. Smith, relative to the mineral structure of England, a great part of which, as appears to us, might have been spared, if Mr. Smith or Mr. Farey, who appears to be the acknowledged expositor of his friend's system, had published, at an earlier period, the present summary. We most gladly insert it in our pages, although it has since appeared in a contemporary journal, having only taken the liberty of compressing the references, and of leaving out a few paragraphs in the notes, and one in the text, which appeared to relate rather to other persons than to Mr. Smith. The references being all of them to papers by Mr. Farey inserted in the Philosophical Magazine, &c. we have not thought it necessary to repeat on every occasion the name of this gentleman.—[illegible]]

Mr. William Smith's claims (according to the opinions of his friends) to merit and originality, in regard to the knowledge of the British strata, may be briefly stated as follows, viz.

1. Having, while employed in the under-ground surveys of collieries, at and near High Littleton, in 1790, and two or three following years, acquired a more intimate acquaintance with the facts of the stratification beneath the surface, and drawn more correct inferences therefrom, as to the necessary connexion of the edges of these strata with the surface * than were then current, or known to the several coal-agents, over-lookers, or working-colliers in the vicinity, or than are even now known or current among a very large proportion of the same class of practical men throughout all the coal districts of Great Britain.†

2. Having, while so engaged, accurately discriminated the regular and undisturbed strata, with the roundish nodules they frequently contain, and strata of sand, from the really worn and heterogeneous alluvial ruins of strata, which are superficially and very variously scattered on the tops and edges of the strata, but are in no case found beneath regular strata; and having practically established means of knowing the alluvia almost at first sight, at the time when almost all observers and writers on the subject were confounding the alluvia with the strata.

3. Having, in the year 1795, applied the aforesaid inferences or deductions to practice, in actually making a map of the strata in the vicinity of Bath and Bristol, and having then freely shown and explained the same to great numbers of persons,‡ particularly to those assembled at several public meetings of the Bath and West of England Society.

4. Having, during the progress of making this first map of the strata, and in beginning very soon after to extend this map to other parts of England, discovered a notable difference between certain English strata, as to the visible boldness with which the edges of certain of them are presented on the surface compared with others, some of them forming almost continued ranges of hills,§ where they basset; and low flat districts, or wide, easy valleys being found, where several of the others come to the surface: and having then fully adopted and practised this new

* Philosophical Magazine for June, 1806, and June, 1811. Mr. Farey's Report to the Board of Agriculture on Derbyshire, vol. i. p. 108, &c.

† Derbyshire Report, i. 163, note.

‡ The late Rev. Joseph Townsend was among these persons; and he so highly valued what Mr. Smith had done, as to request and press Mr. Smith for materials and permission to publish a general account of them, and a list of the shells and strata (mentioned in the 8th and 11th articles), in some work which he then contemplated; on which request a correspondence took place in May to July, 1801, between the Rev. B. Richardson and Mr. Smith, wherein the former persuaded Mr. Smith to publish them himself, and to cause a Latin edition to be prepared, for more readily circulating the important novelties of Mr. S.'s discoveries, throughout Europe. In 1812 Mr. Townsend published the first volume of his "Character of Moses," and in the preface handsomely acknowledges Mr. Smith's assistance in tracing the strata, &c.

§ Phil. Mag. vol. xxxv. p. 138; ditto in June, 1811. Derby Report, i. 112, 113.

principle of selection, for choosing such of the strata out of the great number of others, as should first have colours assigned them, and the tracing and depicting of which on his map should be first attempted.

5. Having made use of certain strata (selected as above), several of which are very unimportant in almost every other point of view, except in their visible edges, and had not even received a name, or been mentioned in previous geological writings, as the subsequent means of mapping or filling in between the ranges of these characteristic strata, as many of the less conspicuous (although, perhaps, more useful) ones * as the scale of the map would admit, a practice at that time quite new amongst the makers of mineral maps, of mine or colliery estates, and even now not adopted, except by those who have expressly followed Mr. Smith in this practice.

6. Having in these early parts of his survey of the strata of England, by that very particular attention to the nature of the surface soil, and its fitness for, and appropriation to, particular kinds of vegetable cultivation or spontaneous growth, which his previous and early habits as a land surveyor and valuer had led and enabled him to pay to these objects, while investigating the strata beneath, succeeded in ascertaining and establishing numerous helps to the mineral surveyor, from the visible appearances of the vegetable productions of a district, towards tracing out the surfaces of its less conspicuous strata beneath.†

7. Having, by the same persevering attention to the surface, in connexion with the strata beneath it, ascertained the true source of the supply of all springs of water to be the superficial water (of rains, or streams, pools, &c.), percolating downwards through porous strata, or alluvia, until intercepted by water-tight strata, or by faults or patches of clayey alluvia, or by water already stagnated in such porous masses; and having deduced, and applied in an extensive practice then commenced, these investigations and conclusions, concerning the strata and springs to the draining of land, wherein Mr. Smith has been employed in most of the improving agricultural districts in the kingdom, since about the beginning of this century.

8. Having, while engaged in the earliest of the investigations above-mentioned, ascertained the important fact of the fossil shells, corals, and other organic remains imbedded in the strata

* In all the numerous and wide-spread opportunities which Mr. Smith, Mr. Farey, and others of his friends have had, in seeing the maps which are in the possession of the mineral owners, and their lessees and agents, and in those of professional coal viewers, &c. throughout Great Britain, not an instance has occurred of any of these maps depicting the thick rocks and strata, whose edges are conspicuous on the surface, as the means of marking out almost parallel strips, within which the coals, ironstones, thin limestones, fire-clay, &c. &c. are to be [illegible] Although in all the minutiæ of surveying mineral estates, these [illegible] ceedings of Mr. S. are equally and even more applicable and [illegible] in kingdom, county, or district surveys.

† Derby Report, p. 168. Phil. Mag. vol. xxxv. p. 189; and [illegible]

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3. Having, in the year 1795, applied the aforesaid inferences or deductions to practice, in actually making a map of the strata in the vicinity of Bath and Bristol, and having then freely shown and explained the same to great numbers of persons,‡ particularly to those assembled at several public meetings of the Bath and West of England Society.

4. Having, during the progress of making this first map of the strata, and in beginning very soon after to extend this map to other parts of England, discovered a notable difference between certain English strata, as to the visible boldness with which the edges of certain of them are presented on the surface compared with others, some of them forming almost continued ranges of hills,§ where they basset; and low flat districts, or wide, easy valleys being found, where several of the others come to the surface: and having then fully adopted and practised this new

* Philosophical Magazine for June, 1806, and June, 1811. Mr. Farey's Report to the Board of Agriculture on Derbyshire, vol. i. p. 108, &c.

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§ Phil. Mag. vol. xxxv. p. 138; ditto in June, 1811. Derby Report, i. 112, 113.

the principal strata, which are enumerated therein in their order, from chalk downwards to coal; which order of the English strata had not previously been ascertained and published by any one; or the fact known that London is situated on almost the highest of the British strata, which, in the following summer, Mr. Smith ascertained.

12. Having in the prospectus which Debrett printed and circulated in 1801 (and of which also great numbers were distributed while Mr. Smith was soliciting the names of subscribers for the publication of his map and memoir) * set forth, very fully, what were the objects and advantages to various classes of the community as well as to science, which would result from the diffusion of the knowledge regarding the strata, which had then recently been acquired.

13. Having from the first commencement of his tracing and mapping the British strata, in the most free and unreserved manner, communicated to all the various mine, colliery, or quarry owners, agents, workmen, &c. with whom he conversed on the spot, throughout nearly the whole of England and Wales, and to scientific men and others in general,† whatever they wished to ask regarding the principles and process on which his investigations had been commenced and carried on to the state in which his maps, sections, and collection were then shown to them; and as to the general conclusions of every kind which he had drawn therefrom; and to Mr. John Farey in particular, the agent at Woburn for the late Duke of Bedford's estates, at his Grace's particular request (made before Mr. Farey had ever heard the name of Mr. Smith mentioned), a full and particular course of instructions was given in mineral surveying by Mr. Smith, at the time of revising his map of the adjacent parts of Bedfordshire and Buckinghamshire.

14. Having, at very considerable trouble and expense, brought together and arranged a numerous collection of specimens of the several English and Welsh strata, from numerous and distant places (all of which were marked), on the range of each stratum, as shown in his maps, and particularly of the organic remains found imbedded in each of these several strata; having rented

Townsend's house in June, 1799; concerning which list, Mr. Farey published a notice, on May 31, 1815, in the Philosophical Magazine, vol. xlv. p. 334; and in August, of the same year, Mr. Smith published a copy of this original list, in the "Memoir" which accompanied his map, facing p. 8. The late William Reynolds, Esq. of Coalbrook Dale; Mr. Thos. Bartley, of Bristol; and others (see Phil. Mag. vol. xxxviii. p. 338, note), received copies of this list, at second hand, soon after 1799.

* Monthly Magazine, July, 1801, vol. xi. p. 525.

† For several years after 1800, Mr. Smith made a point of attending nearly all the public agricultural exhibitions of the Bath Society; of Mr. Coke, at Holkham; of the Duke of Bedford at Woburn; and of Lord Somerville and the Smithfield Club, in London; and there publicly hung up and showed his map of the strata to many hundreds of intelligent persons; which fact has very often been recorded in the newspaper accounts of the proceedings of these meetings. See the Star, June 21, 1804; Phil. Mag. vol. xxxv. p. 114, &c.

and kept rooms for the express purpose of displaying these specimens in the real order and succession in which they occur in the earth, and giving the freest access to them gratis, and to his maps of the strata and sections by all persons who applied, as great numbers did, and occupied much of Mr. Smith's time in thus explaining them.

At first, this collection was shown in Trim Street, Bath, through several years; next in Charing Cross Street, London; and since 1804, for many subsequent years, in Buckingham Street, Strand, at Mr. Smith's present residence; until this collection was, in June, 1816, removed to the British Museum, and there arranged by Mr. Smith, in a similar manner and order, for the free use of the public.

15. Having, in August, 1815, published (at Mr. John Cary's, 181, Strand) his large coloured map of the strata, in 15 sheets, on a scale of five miles to an inch, accompanied by a "Memoir."

16. Having since published (at ditto) "A Geological Table of British Organized Fossils," &c. containing a great many useful and interesting particulars, on a single sheet.

Also (at ditto) "A Geological Section, from London to Snowden," on a long sheet.

And (at Mr. Evan William's, No. 11, in the Strand) one out of the two intended parts of the "Stratigraphical System," in which more than 700 species of shells and other organic remains, which Mr. S. has arranged in the British Museum, are each to be named and scientifically described, with references to the precise places at which the several individuals of each species were dug,* and the particular stratum (with reference to the map and section) which it there occupied.

Also (at Mr. James Sowerby's, No. 2, Mead Place, Lambeth) three out of the seven intended numbers, of "British Strata identified by their imbedded Organic Remains," in which drawings are given, and the names of all the most characteristic shells, corals, &c. of each stratum.

London, Dec. 1, 1817.

* These places, as enumerated in this first part, are 263 in number; and the number of the individual shells, &c. 1155; of which an alphabetical list is given in the Phil. Mag. vol. l. p. 271.

Article XI.

Further Account of Petalite, *together with the Analysis of another new* Swedish *Mineral found at* Gryphytta, *in the Province of* Westmania, *in* Sweden, *&c.* In a Letter to the Editors. By Edward Daniel Clarke, LL. D. Professor of Mineralogy in the University of Cambridge, Member of the Royal Academy of Sciences at Berlin, &c.

GENTLEMEN,

Since I communicated to you the result of my analysis of *Petalite,* I have received intelligence from Mr. *Swedenstierna* of *Stockholm,* to whom I had written upon the subject of this mineral, that the loss which I have stated in the sum of its constituents refers to the presence of a new chemical substance, namely, a new *alkali,* which Mr. *Arvedson,* the pupil of Mr. *Berzelius,* has discovered in *Petalite* in the proportion of three per cent. According to the *Swedish* chemist, *Petalite* consists of 80 parts of *silica,* 17 of *alumina,* and 3 of this new *alkali,* to which Mr. *Berzelius* has given the name of *lithion.* But there is a constituent in *Petalite* which has escaped the notice of the discoverer of *lithion;* namely, *manganese;* and as this metal has been obtained from it in the proportion of $2\frac{1}{2}$ per cent. according to my own analysis and also that of Mr. *Holme,* and, moreover, as the *Swedish* chemist has confirmed my account of the *silica* and *alumina,* I think there can be no doubt, if we have both analyzed the same substance, that the constituents of *Petalite* will be found as follow:

Silica	80·00
Alumina	15·00
Manganese	2·50
Lithion	1·75
Water	0·75
	100·00

As my authority for this statement, I am ready, at any time, to produce the mineral which I have analyzed; trusting in the accounts which I have received for the presence of the new *alkali,* and that the trials, in both countries, were made upon the same substance. There is now more reason than ever for calling this mineral *Berzelite;* because it is evident that the old name of *Petalite* was not applied to the mineral containing *lithion.* Of the importance of Mr. *Arvedson's* discovery, all your chemical readers must be aware: it will be followed by a complete revolution in the analytical part of *mineralogy:* many are the substances which it will be necessary to examine again; and the presence of this new *alkali* will, perhaps, be ascertained in other substances exhibiting the remarkable lustre and somewhat of the fracture of *Petalite.* In the list of these, as a suspicious mineral, to say nothing more of it, I would mention the remarkable variety of *quartz* which is called by the French *quartz gras;* and some of the substances which have received the appellation of *compact feldspar;* a name frequently bestowed in a forlorn conjectural way, when all knowledge of the real nature of a mineral seems to fail. Among the minerals which have received the last appellation, there is a *red siliceous stone,* found at *Gryphytta* in *Westmania;* which being neither the *hornstone* of the *Germans,* nor the *jade* of the *French,* was described by some *Swedish* mineralogists, as a pure *hydrate of silica,* of the same nature as *opal.* The red colour of it, inclining to that *pinkish* hue, which I mentioned as barely discernible in *Petalite,* induced me to suspect that it also contains *manganese;* I therefore undertook its analysis, and found it to correspond exactly with *Petalite* in this respect; probably *lithion* may also be detected in the same substance although it have escaped my notice. Previously to the enumeration of its constituents, I wish to mention that I have ascertained the angles of the mineral which I analyzed under the name of *petalite;* both by the reflecting and by the common *goniometer;* and find them to equal 100° and 80°. Its form, therefore, is that of a four-sided prism, with a rhomboidal base, whose obtuse angle equals 100°.

The red siliceous substance from *Gryphytta,* was first brought to this country by that enterprising traveller *John Fiott Lee,* LL.D. of *St. John's College, Cambridge,* the intimate friend, and often the companion in his travels of the intrepid and lamented *Burckhardt.* Dr. *Lee* had several specimens of this mineral. They were all uniformly of a *red* colour; possessing neither more lustre nor translucency than horn. The fracture is rather splintery than conchoïdal, resembling that of *flint;* it has also the hardness of *flint.* Its specific gravity equals 2·71 when estimated in pump water, at a temperature of 56° of *Fahrenheit.* As this mineral has not yet received any specific appellation, I shall name it *Leelite,* in memory of the friend from whom I received it, and because this appellation will lead no person into error as to the nature of the substance to which I allude. The manner of its analysis was precisely similar to that which I before described when engaged in the examination of *Petalite.*

(A.)—Twenty grains previously triturated in a porcelain mortar were exposed to a strong red heat, during 15 minutes, in a *platinum* crucible, and lost $\frac{1}{10}$ of a grain of water of absorption.

(B.)—Boiled during 15 minutes in *nitric* acid, diluted with an equal bulk of distilled water, the insoluble part being washed and dried weighed $19\frac{1}{10}$ grains.

(C.)—The supernatant fluid collected from B, added to the repeated washings of the insoluble residue, being with moderate heat, evaporated to dryness, there remained a lemon-coloured salt, which after exposure to a smart red heat for half an hour in *platinum* foil left a dark slate-coloured powder weighing $\frac{5}{10}$ of a grain. This powder gave a fine amethyst colour to *borax*, before the blow-pipe, and proved to be the *oxide of manganese*. It had no magnetic property when heated. It dissolved with violent effervescence in warm *muriatic* acid, disengaging the smell of *chlorine* gas.

(D.)—The insoluble residue, mentioned in B, being mixed with four times its weight of *bi-carbonate* of *potash* was exposed, during an hour, in a *platinum* crucible to a heat above redness. The result of this alkaline fusion had then a bright and very beautiful orange colour: its surface upon being cooled exhibited a laminary crystallization. The mass was then moistened with a few drops of distilled water, and *muriatic* acid being added, it yielded gelatinous *silica;* this being washed and dried, weighed 14$\frac{6}{10}$ grains.

(E.)—The supernatant fluid from D, together with all the washings of the *silica*, being collected, *bi-carbonate* of *potash* was added to neutralize the *acid*. The same *alkali* being afterwards added to excess, there fell down a precipitate, leaving the liquid perfectly limpid above it, which when washed and dried weighed 6$\frac{4}{10}$ grains.

(F.)—The precipitate from E being boiled in *muriatic* acid lost only 4$\frac{4}{10}$ of its weight: there remained an insoluble residue, weighing, when washed and dried, two grains which proved to be *silica;* to be added therefore to the *silica* in D.

(G.)—From the solution in F, the acid being first neutralized, *ammonia* threw down a precipitate, which when washed and dried weighed 4$\frac{4}{10}$ grains and proved to be pure *alumina*.

From all the preceding observations, therefore, it appears that the constituents of *Leelite* are as follow:

Silica	73·	75·00
Ditto	2·	
Alumina		22·00
Manganese		2·50
Water of absorption		0·50
		100·00

Specimens of *Leelite* are at present more common than those of *Petalite*, and if persons more experienced in the analysis of minerals shall hereafter find that, like *Petalite*, it is one of the substances containing *lithion*, it is perhaps no more than might be expected. But in the consciousness of having spared no pains in its examination, I have ventured to send you this statement: and I remain, &c. &c.

Cambridge, April 12, 1818. EDWARD DANIEL CLARKE.

P. S. In the accounts published of the alloy used for the *silv* coinage of this country, I do not find any mention made of the presence of *gold*. The old *silver* coinage had a certain proportion of pure *gold;* and every ounce weight of the present new coinage contains about ¼ of a grain of pure *gold;* this I have lately ascertained by a regular analysis. I send you enclosed the exact quantity of pure *gold*, which is contained in every shilling of the new coinage.

Article XII.

*Observations on the Method of printing upon Stone, and on the Composition of the Ink.**

Any calcareous stone, which is compact, with a fine and equal grain, susceptible of being polished with pumice, and capable of absorbing a little moisture, may be employed for lithography. It was supposed, for some time, that the stones used at Munich alone possessed the necessary properties; but suitable materials have now been found in many of the departments of France. Among others, there are strata of calcareous stone in the mountains which separate Ruffec from Angouléme, which are well adapted for this kind of work.

In order to compose the ink, a vessel varnished and luted on the outside is warmed; when it is warm, we introduce one part by weight of white Marseilles soap, and the same quantity of pure mastic. These substances are melted and carefully mixed together; five parts by weight of shell lac is then incorporated with them, by stirring them together until the whole is completely united, and there is then gradually added a solution of one part of caustic soda in five or six parts its bulk of water. This addition must be made cautiously; for if the alkaline ley be poured in all at once, the liquor would froth up, and rise above the sides of the vessel.

When these substances are completely mixed together, by employing a moderate heat and the agitation of a spatula, the necessary quantity of lamp black is added, and immediately after as much water as is sufficient to render the ink fluid and in a proper state for writing. The ink is applied to the stone as it would be to paper, either by a pen, or a pencil. When the design or writing is dry, and we wish to print from it, water, acidulated with nitric acid, is employed, in the proportion of 50 parts of water to one of acid; by means of a sponge the surface of the stone is soaked with this water, taking care not to rub the ink lines; this process is repeated as soon as the stone

* Translated from the Journ. de Pharm. March, 1817.

appears to be dry. An effervescence is produced, and when it ceases, the stone is gently washed with pure water.

While the stone is in this state, and still moist, printers' ink is applied to it, with the common apparatus, which only adheres to the parts that are dry. A sheet of paper, properly prepared to receive the impression, is then laid upon the stone, and the whole is subjected to the action of the press, or the cylinder. To retain the design upon the stone, and to preserve it from dust, when it is not used immediately after being prepared, it is covered with a stratum of a solution of gum arabic, and this varnish is removed by water, when we wish to print from the stone.

Instead of ink, a peculiar kind of pencil is sometimes employed to draw upon the stone, or upon paper, from which a counter-impression is taken on the stone. The pencils are composed of the following ingredients melted together: three parts of soap, two parts of tallow, and one of wax. When the whole is melted and well mixed, we add lamp-black, until the colour be sufficiently intense; the fluid is then run into moulds, where it becomes solid as it cools, and acquires the consistence necessary for the formation of pencils.

Additional Observations on Lithography.

The following particulars are, for the most part, extracted from a report on this interesting art made to the Royal Institute of France, and published in the Journal de Physique for Feb. 1817.

Aloys Sennefelder, a chorus singer at the theatre of Munich, was the first who observed that certain calcareous stones have the property of contracting an intimate adhesion to characters traced on their surface with thick oily ink, and that, if the stone was afterwards moistened, and then dabbed with printers' ink, an impression of the characters might be transferred to paper. In 1800 he obtained from the King of Bavaria a patent for his process, and first applied it to printing music. The history of the further progress of this art is foreign to the object of the present notice.

The only stone hitherto discovered which completely answers the purpose, is a compact, nearly pure carbonate of lime of a greyish white colour. At Solenhofen, near Pappenheim, in Bavaria, are extensive quarries of it; also at Kehlheim, near Ratisbon, at both which places it has for many years been raised, and made into flag-stones for floors and hearths, &c. an application to which it is well fitted by its easily splitting into laminæ of the required thickness and area, and by the facility with which it is brought to a smooth surface. It is supposed to be the same rock, geologically speaking, as the *white lias*, a calcareous flag-stone which is found in England covering the blue or common lias limestone. But I believe that specimens of the requisite hardness and fineness of grain have not hitherto been discovered in this country. The stones are first brought to an even surface by rubbing them against one another, and are then finished with fine sand and pumice stone.

The ink is composed of soap, and of rosin and gum lac dissolved in a solution of caustic soda; to which is to be added a proper quantity of lamp-black: the above ingredients, after being intimately mixed by trituration, are to be diluted with warm distilled water to the consistence of a thick ink, which is then ready for use. The same ingredients being exposed to a gentle warmth, at length dry into a mass, which being put into a wooden case may be used as chalk, or crayon. It is difficult to find a pen which, when charged with this ink, will draw lines sufficiently fine for delicate work, and, therefore, the brushes, &c. of the miniature painter should be had recourse to.

They who are accustomed to the fine handling required in pen and ink drawings, will, with due care, produce the best specimens of lithography. The design being drawn on the stone, either with the fluid ink or with the crayon, the whole surface is to be floated with water acidulated by nitrous acid in order to remove any greasiness, and is then ready for use.

Another variety in the practice of this art is to bring the surface of the stone to a fine polish, and then to cover it with a varnish of gum and lamp-black. The design is etched in by cutting through the varnish by means of a needle and other proper instruments, after which the prepared ink is applied with a brush, and insinuates itself into the places where the varnish has been cut through. The stone is then placed on its edge in warm water, the varnish loosens and falls off, and the traces filled with the prepared ink alone remain. This process has been found useful for maps and other works in which very fine lines are required: the varnish, however, is so much harder than that in common use among engravers that some practice is necessary before the artist can employ the requisite degree of force. It appears probable that by mixing treacle with the gum the consistence of the varnish might be materially improved.

The effect of wood engraving is given very perfectly by covering the entire surface of the stone with the prepared ink, and then scratching it off in the parts intended to be white.

The method practised by M. Engelman of taking off the impressions is as follows:

The press consists of a hollow table terminated at one end by an upright frame supporting a roller, which, by means of a winch, may be made to traverse along the table from one extremity to the other. The stone is laid perfectly horizontally in the hollow of the table, and is secured in its place by means of wedges. It is then moistened with a sponge dipped in pure water till it refuses to absorb any more. A wooden roller covered with leather, and charged with very fine engravers' ink, is then passed two or three times over the surface of the stone, and adheres to all the lines made with the prepared ink, and to those only. A sheet of paper, not so damp as is required in copper-plate printing, is next laid carefully on, a board is placed above it, and then, by turning the winch, the roller, exerting a pressure of more than 1000 lb., passes slowly over the surface of the board, and the process is finished by removing the board and taking out the print thus produced. It is necessary to take about a dozen proofs before the work comes to its full perfection. After a number of impressions have been taken, the more delicate parts will begin to be a little blurred. As soon as this is perceived, remove the stone from the press, and first pass over it a sponge filled with rectified oil of turpentine, and then wash it well with pure water. By this treatment the whole design will be apparently discharged: this, however, is not the case; for on passing the roller charged with ink over the surface of the stone, every line, even the most delicate, which was in the original drawing, will again become visible, and the printing may be proceeded with as at first.

Article XIII.

Further Observations on the French Varnish, or Polish for Cabinet Work, &c. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, *Covent Garden Chambers,*
April 14, 1818.

GENTLEMEN,

Having, since my former communication on this subject, on January 14, inserted in your *Annals* for February, obtained additional information on the process by which larger surfaces may be varnished at once, with as much facility as the smaller ones before recommended, and consequently much time, labour, and expense be saved, I should deem myself unpardonable in withholding it from the public.

The improvement consists in the use of a rubber formed of a flat coil of thick woollen cloth, such as drugget, which must be *torn* off the piece, in order that the face of the rubber, which is made of that edge of the cloth, may be soft and pliant, and not hard and stiff, as would be the case were it to be *cut* off, and thereby be liable to scratch the softened surface of the varnish. This is to be securely bound with thread to prevent it from uncoiling when it is used; and it may vary in its size from one to three inches in diameter, and from one or two inches in thickness, according to the lesser or greater extent of the surface to be varnished.

The varnish is to be applied to the middle of the flat face of the rubber by shaking up the bottle containing it, as in the former described process; but it will absorb a much greater quantity than the linen cloth, before recommended, could safely do; and will continue to supply it equably, and in a due proportion to the surface which is undergoing the process of varnishing, for a considerably longer period.

The rubber must next be enclosed in a soft linen cloth doubled, the remainder of the cloth being gathered together at the back of the rubber to form a handle to hold it by, and the face of the cloth must be moistened with a little raw linseed oil (which may either be coloured with alkanet root, or not), applied upon the finger to the middle of it, and the operation be commenced and proceeded with according to the former directions. The work to be varnished should be placed opposite to the light, in order that the effect of the polishing may be better seen.

In this manner a surface of from one to eight feet square may be varnished at once, and the process, instead of being limited to the varnishing of rich cabinets or other smaller works, can now be applied to tables and other large pieces of furniture with very great advantages over the common way of polishing with wax, oils, &c.

In some cases it is preferable to rub the wood over with a little oil applied on a linen cloth before beginning to varnish. I should, however, prefer the application of the varnish first upon the woollen rubber, and particularly in the angles of framed work, where it is difficult to cause the varnish, applied in the manner above described, to penetrate, and, therefore, should apply it alone without using oil with it for the first coat. At any rate, should the oil be used first, I would certainly recommend that the varnish be next applied alone, previous to commencing the polishing process, with the application of both varnish and oil.

In recesses, or carved work, where the surfaces are not liable to wear, or are difficult to reach with the rubber, a spirit varnish made, without lac, of the usual gum resins, and considerably thicker than that used in the above process, may be applied to those parts with a brush, or hair pencil, as is commonly done in other modes of varnishing.

When works varnished in this manner require to be cleaned, spirit or oil of turpentine should be used, as it is not liable to dissolve the varnish.

The employment of this beautiful process is rapidly extending amongst us; and I shall be glad if, through your channel of information, I can contribute to render the attainment of the art easy to those who may be interested therein.

I cannot here avoid observing, that in the Monthly Magazine for last month is given the process for preparing the varnish, as communicated by me in your *Annals*; but without the directions for applying it. I trust that the editor will, in justice to his readers, supply that defect, or they will derive but little advantage from the communication. I am, Gentlemen,

Your most obedient servant,

THOMAS GILL.

ARTICLE XIV.

Additional Observations on Lithion and Selenium. By Professor Berzelius.

IN the Annales de Chimie et de Physique for Feb. last, we have a letter from Prof. Berzelius to M. Berthollet, announcing the discovery of the two new bodies of which we gave an account in the last number of the *Annals*. This letter contains some particulars which are not stated in the communication to Dr. Marcet, from which our abstract was taken: these we shal l now, therefore, lay before our readers. With respect to the neutral salts formed with the new alkali, we are informed that the sulphate crystallizes with sufficient facility, and that the crystals contain no water of combination; their solution is not precipitated by the muriate of platinum or by the tartaric acid. The nitrate crystallizes in rhomboids, but readily attracts moisture; the carbonate crystallizes in prisms, but the crystals are generally very minute. This alkali was discovered in consequence of its great capacity for saturating acids; for the salt with an alkaline base, which was obtained in the analysis of the petalite, very much exceeded in weight what it ought to have done, had it been composed either of soda or potash. It was natural to conclude that a salt with an alkaline base, which is not precipitated by tartaric acid, must contain soda; this was the opinion which M. Arfredson * first entertained; but after repeating the analysis of the petalite three times, he was led to suspect that it contained something peculiar; and it was in the further prosecution of the inquiry that the new substance was discovered.

With respect to its name, Professor Berzelius remarks that the denomination *lithion*, which they have bestowed upon it in order to designate its origin, has a termination which is according to the analogy of the Swedish language; but that it may require a little modification to adapt it to other languages; as, for example, in French it should probably be called *lithine*. We may suggest that, according to the [illegible] of the other alkalies, in English it will be *lithina*.

* This gentleman's name has been ge[illegible] Afredson; but the correct method seems to be *Arfredson*.

Prof. Berzelius then enters into a description of the selenium. He informs us that in a manufacture of sulphuric acid, belonging to M. Gahn and himself, sulphur is burned which is procured from the mine of Fahlun, and that it deposits on the floor of the great leaden chamber a reddish mass, which is principally composed of sulphur. From the odour which this red mass gave out when it was burned, it was thought to be tellurium, but no tellurium could be obtained from it; and this induced Prof. Berzelius to examine it with more minuteness, when he discovered the selenium. With respect to the odour of this substance, it is stated, that if it sublimed in the air without taking fire, it is evaporated in the form of a red smoke, which has no particular smell. But if the flame of a candle be directed upon it, or it be heated by a blow-pipe, it tinges the flame of an azure blue, and exhales so powerful an odour of the radish, that if $\frac{1}{50}$ of a grain be evaporated, it is sufficient to fill the air of a large apartment. Klaproth has stated that this odour is given out by tellurium; but Berzelius remarks that neither purified tellurium, nor its oxide, nor its combinations with the metals, produces this odour. In order to produce this effect it was necessary to enclose a small portion of tellurium in a little ball of thin glass, and to heat it with the blow-pipe, until the tellurium, being converted into gas, penetrated the ball through a small orifice; in this case the smell was precisely the same with that of the new substance.

If a little muriatic acid be poured into the solution of a selenate, and a bit of zinc be put into it, selenium is precipitated in the metallic state; at first the zinc appears as if it were covered with a pellicle of copper, afterwards the selenium is deposited in flakes of the colour of cinnabar. If instead of muriatic acid we employ sulphuric acid, the precipitate is made with more difficulty, assumes a grey colour, and contains sulphuret of selenium. If a stream of sulphuretted hydrogen gas be passed through a solution of selenic acid, the selenium is precipitated of an orange colour: it becomes red when dried, exposed to heat it melts, sublimes, and yields an orange-coloured transparent mass. It is stated that, although the selenium is extracted from the pyrites which is used to procure sulphur for the manufacture of sulphuric acid, still the acid does not contain the selenium, because the sulphurous acid has the property of reducing the selenic acid to the metallic state.

With respect to the lithion, or lithina, we may add that the discovery of M. Arfredson has been confirmed by Sir H. Davy, who has procured the new alkali, and has found its properties to agree with those stated by the Swedish chemist. Sir Humphry has also succeeded in reducing it to the metallic state; lithium, as it may be called, bears a strong general resemblance to the other alkaline metals, and especially to sodium, to which it seems to be the most nearly allied.

We learn by a letter from M. Gillet de Laumont, inserted in the Journal de Physique for February, that M. Vauquelin has also procured the new alkali, and has recognized in it peculiar properties, distinct from those of potash and soda. In addition to the information which we have obtained concerning it from other quarters, M. Vauquelin states, that when it is united to sulphur it produces a yellow sulphuret, which is very soluble in water, and that it contains 43·5 of oxygen, a greater proportion than is found in the other alkalies. M. Vauquelin has not been able to detect any lithion in the albite of Sweden. M. Haüy has determined the primitive form of the petalite to be a right rhomboidal prism, of which the rhomb is longer than any which have yet been examined.

The petalite was first described by M. Dandrada, in the Journal de Physique;* but the account given of it was so imperfect that it has been little attended to, until M. Swedienstern lately sent some specimens of it both to France and to this country.

Article XV.

On the Kaleidoscope. By P. M. Roget, M.D. F.R.S. &c.

(To the Editors of the *Annals of Philosophy.*)

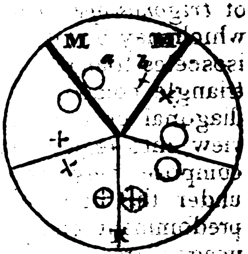
GENTLEMEN, *Bernard-street, Russel-square, April 3, 1818.*

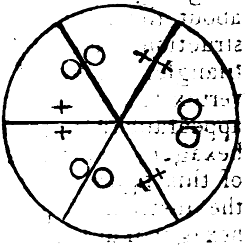
The amusing optical instrument for which Dr. Brewster has lately procured a patent, and to which he has given the very appropriate name of kaleidoscope, admits, as stated in the specification, of various forms of construction. Those composed of more than two mirrors, and which may be denominated *polygonal kaleidoscopes,* have not, however, been so particularly noticed by the inventor, as their superior practical utility when applied to the arts would seem to deserve. Some inquiry into the principles on which they should be constructed may, therefore, be not unworthy of occupying a place in your journal.

The principle of the instrument in its common or simplest form, is the formation of a series of images disposed in the circumference of a circle by the multiplied reflections of a set of objects from two plane mirrors inclined at a certain angle. It is evident that in order to obtain a regular appearance throughout the field of view, this angle must be an equal division of the circumference, otherwise a broken portion of a sector of the circle will present itself at the opposite part of the field from that which the objects themselves occupy. It is not quite so obvious, however, that this angle must not merely be an aliquot part of the circumference, but that it must also [illegible] semicircle equally. If this latter condition be not [illegible]ons

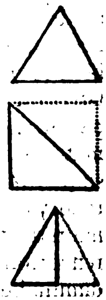
* Vol. li. p. 244.

of the images at the extreme parts will not coalesce, but will overlap and confuse each other. This will be apparent by considering what takes place when the angle is 120°, 72°, 40°, &c. which are the third, fifth, ninth, &c. parts of the whole circumference. The field is, indeed, regularly divided into this number of sectors; but the images of the objects near the edges of the mirrors, occurring in pairs, will not coalesce when followed round the circle. If M M, for example, be the edges of the mirrors seen in the direction of the line of their intersection, the images of *a* and *b*, if the divisions of the circle be an odd number, as five, will occur together on both sides of the radius R opposite to the interval between the mirrors. On the other hand, when this number is even, as six, similar images coalesce, and the optical illusion is perfect.*





In the polygonal kaleidoscopes, or those in which a number of plane mirrors are disposed along the sides of a polygon, so as to form a hollow prism, which repeat the reflections in every direction, and present the appearance of an extended plane instead of a circular field of view, we are restricted by the above condition to a very limited number of arrangements. It excludes, in the first place, all angles above 90°, and, therefore, all polygons having more than four sides. The square and the rectangle are the only four-sided figures which will afford regular appearances. Triangles, therefore, alone remain; and the particular triangles can only be such as are formed with angles of 90°, 60°, 45°, or 30°, which are the quotients of 180° divided by two, three, four, and six; other aliquot parts of the semi-circle being excluded by the necessary condition that the sum of the three angles must be equal to 180°. We are, therefore, limited to the three following species of triangles, which are represented in the margin. The first has all the angles equal to 60°; the second has one of 90°, and the two others of 45° each; and the third has angles of 90°, 60°, and 30°. Let us now inquire into the effects resulting from each of these combinations.



The square kaleidoscope, composed of four mirrors, produces by no means so pleasing an effect as the others; because the regularity of form is in general most apparent in one

* The above-mentioned condition also results from the mathematical formula for calculating the number of images of an object situated between two plane mirrors inclined to each other at a given angle. (See Wood's Elements of Optics, Prop. xiv.)

direction only; and the images arrange themselves in stripes without any extended lateral connexions. Of the triangular kaleidoscopes, the first, having for the base of the prism an equilateral triangle, produces very regular appearances of images, disposed in three lines crossing each other at angles of 60° and 120°, and, therefore, presenting connected triangles. The instrument in this form might be distinguished by the name of *trigonoscope*, or more shortly *triascope*. The second triangle, which may be taken as the base of the prism, is the right-angled isosceles triangle, that is, as may be perceived by the figure, a triangle composed of two contiguous sides, together with the diagonal of a square. This construction divides the field of view into regular squares, which, by their perfect symmetry, compose very beautiful arrangements; and the instrument, under this form, may be denominated a *tetrascope*, since the predominant character of the appearances it exhibits is that of images grouped together by fours, and symmetrically disposed about the sides and angles of squares. The third mode of construction, which takes for its base the half of an equilateral triangle, resulting from its division by a perpendicular from the vertex to the base, as is seen in the third figure, affords also appearances of great beauty. The predominant form is the hexagon, and the images are grouped together in compartments of this figure; a circumstance which may entitle this variety of the instrument to the appellation of *hexascope;* for although hexagonal arrangements also occur in the field of the triascope, they are by no means so striking to the eye, or give so exclusively the character of symmetry, as those which are conspicuous in the construction now described.

As a plane surface of indefinite extent admits of subdivision by regular polygons of the same kind only in three ways, namely, by triangles, by squares, and by hexagons; so each of these modes of division is the result of a separate arrangement of three plane mirrors, namely, by the triascope, the tetrascope, and the hexascope. Of these, the last two appear more especially calculated for affording assistance to artists in suggesting ornamental patterns. All the polygonal kaleidoscopes, indeed, have a material advantage over the common one, in the greater extension they give to the field of view. This field would, in theory, appear to be infinite; but in practice it soon becomes limited, from the great loss of light attendant on repeated reflections. With glass mirrors the light still more rapidly diminishes from the polarisation it receives by being subjected to so many reflections from planes of different relative inclinations. This latter inconvenience might, however, be obviated by employing metallic reflectors. More light being reflected in proportion as the incident rays are more oblique, the instruments above described should be of sufficient length to allow of great obliquity of reflection, and thus afford more numerous repetitions of images before the diminution of light renders them invisible

On this account the mirrors should be at least nine or ten inches long, to a breadth of about one inch, in order to produce a sufficient effect. The illumination is further extended by giving the instrument the form of a truncated pyramid, instead of a prism, with the aperture for the eye at the smaller end.

I am, Gentlemen, your most obedient servant,

P. M. Roget.

Article XVI.

Analyses of Books.

Traité des Charactères Physiques des Pierres Précieuses, pour servir a leur Détermination lorsqu'elles ont été taillées. Par M. L'Abbé Haüy, &c.

To those who are acquainted with the "Traité de Minéralogie" and the "Tableau Comparatif" of M. Haüy, the present volume offers but little information. In the attempt to make a popular book, or rather to lower the subject to the understanding of mere amateurs, the author has, in many instances, abandoned the precise terms of science, and has substituted in their place the vagueness of ordinary language. The narrow bounds within which he has restricted himself, added to the very elementary form that he has chosen to give to his work, have rendered it at once superfluous and defective. The deservedly high esteem, however, in which the writings of M. Haüy are held, demands that a summary of the contents of the volume before us should be laid before our readers.

After some pages, for the most part explanatory of the terms made use of in crystallography, the author proceeds to give a brief description of the species and principal varieties of crystallized gems, as far as relates to their figure and structure, in the following order: topaz, quartz, zircon, corundum, cymophane, spinelle, emerald, dichroïte, garnet, essonite, felspar, tourmaline, peridot, and diamond. The only novelty in this chapter relates to the structure of cinnamon-stone, called by M. Haüy *essonite*. This mineral has hitherto been met with only in amorphous fragments; some of these have afforded indications of structure, from which it may be inferred that the primitive form is a right prism with rhombic bases, the alternate angles of which are 102° 40′, and 77° 20′.

He next proceeds to treat of the physical characters of gems, beginning with their habitudes with regard to light, under which term he includes the colour, properly speaking, of the substances, as well as their power of refracting and reflecting the rays of light. The colours of the gems, with the exception of the spinelle and the emerald, he attributes to oxide of iron; but when he states that each difference in colour is caused by a corresponding variation in the proportion of oxygen, he affirms what is totally contrary to chemical experience. In speaking of refracted light, he shows how, in certain cases, it may be made available as a distinctive character; thus the essonite (cinnamon-stone), and the variety of garnet called *vermeille*, when viewed in the ordinary way, exhibit each the same tinge of poppy red; but if they are successively applied to the eye so as to intercept the reflected rays, the colour of the former will be a pure yellow, while that of the other will be orange.

That play of light, called by the French *chatoiement*, and for which the English language wants a name, which contributes so much to the beauty of the cymophane, and of the star-stone corundum, may also be produced, it appears, in the garnet. For this purpose a dodecahedral crystal of garnet is to be divided by two parallel sections at right angles to any six of its faces; and the hexahedral lamina, thus obtained, on being held between the eye and a candle, will exhibit the flame of the candle with six rays streaming from it, forming angles of 60° with each other, and terminating in the angles of the hexagonal lamina.

The characters of specific gravity and hardness, which are the next in order, present nothing new. Double refraction is then treated of, the precautions necessary in making observations of this kind, and the ambiguities which attend this character in particular species. The electricity of minerals is discussed at some length, and a method is shown of exciting this property by simple pressure. For this purpose a small prism of the mineral (calcareous spar for example) is to be inserted by one end into a quill, and the compound bar thus produced is to be evenly suspended by a silk thread to any convenient support; the projecting end of the spar is then to be compressed for a second or two by the finger and thumb applied to opposite surfaces. As soon afterwards as all oscillation has ceased, a piece of topaz, or of any other transparent mineral, previously excited by friction, is to be brought near the extremity of the spar, and will immediately repel it, as, on the contrary, a piece of amber, or of sealing wax, will attract it.

The last character described is magnetism, which, however, is of no great importance, being perceptible only in the garnet, the peridot, and the essonite.

An appendix follows, giving a very brief description of carnelians, jaspers, agates, and other minerals, which, though not entitled to the rank of gems, are used more or less for ornamental purposes.

The volume terminates with a tabular arrangement of gems and precious stones, according to their colour, of which the following is an abstract.

I. *Colourless.*

Diamond.

White sapphire. Var. of corundum.

White topaz.
Rock crystal. Var. of quartz.

II *Red, mixed occasionally with Violet.*

Oriental ruby. Var. of corundum.
Spinelle ruby. } Var. of spinelle.
Balais ditto. }
Brazilian ruby. Var. of topaz.
Sirian garnet. }
Bohemian ditto. } Var. of garnet.
Ceylon ditto. }
Purple tourmaline, from the United States. }
Rose tourmaline, from Brazil. } Var. of tourmaline.
Violet tourmaline, or siberite, from Siberia. }

III. *Blue.*

Oriental sapphire. } Var. of corundum.
Indigo ditto. }
Beryl. Var. of emerald.
Tourmaline, from the United States.
Saphir d'eau. Var. of dichroïte.

IV. *Green.*

Oriental emerald. Var. of corundum.
Peruvian emerald.
Emerald of Brazil. } Var. of tourmaline.
Ditto of the United States. }

V. *Bluish Green.*

Oriental beryl. Var. of corundum.
Siberian aquamarine. Var. of emerald.

VI. *Yellow.*

Oriental topaz. Var. of corundum.
Brazilian topaz.
Beryl. Var. of emerald.
Jargoon, of Ceylon.

VII. *Yellowish Green.*

Oriental peridot. Var. of corundum.
Chrysoberyl, or } Var. of cymophane.
Oriental chrysolite }
Beryl. Var. of emerald.
Jargoon, of Ceylon.
Peridot.
Peridot, of Ceylon. Var. of tourmaline.

VIII. *Violet.*

Oriental amethyst. Var. of corundum.
Amethyst. Var. of quartz.

IX. *Brownish Red, and Orange.*

Hyacinth. Var. of essonite.
Hyacinth. Var. of jargoon.
Vermeille. Var. of garnet.
Tourmaline.

X. *Gems characterized by particular Plays of Light.*

Starstone ruby.
Ditto sapphire.
Ditto topaz.
Oriental girasol.
} Var. of corundum.
Opal.
Moonstone. Var. of felspar.
Oriental aventurine. Var. of felspar.

XI. *Opaque Gems.*

Turquoise de la vielle roche. Sky blue, greenish blue.
Ditto de la nouvelle roche. Deep blue, pale blue, greenish blue.

Article XVII.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

April 2.—A paper, by Mr. Joseph Swan, was read, giving an account of a new method of making anatomical preparations.

On the same evening a paper, by Dr. John Davy, was read, on the urinary organs and secretions of some of the amphibia. In several species of serpents, which were examined by the author, the kidneys were found of very considerable size, and of a long and narrow form. Ducts proceeded from them to the ureters, which last terminate in what appeared to be a distinct receptacle, communicating with the rectum by a sphincter. A white matter is deposited in the urinary passages, which is occasionally expelled by a kind of extraordinary effort, and which consists of uric acid. The urinary organs and secretions of lizards were found to be nearly similar to those of serpents. The fluid appears to contain no urea.

April 9.—A very important paper, by Sir H. Davy, was read, containing an account of a series of experiments on the combinations of phosphorus with oxygen and chlorine.

The author commences by noticing some late analyses of the phosphoric compounds, which have been made by Professor Berzelius and M. Dulong, which differ both from each other and from Sir Humphry's former results. This circumstance induced him to reconsider the subject, and especially to attempt to discover the composition of phosphoric acid. The best way of accomplishing this he found is to burn the vapour of phosphorus, as it issues from a small tube, in oxygen gas. By adopting this process he determined its composition to be 100 phosphorus to 134·5 oxygen. He then examines the composition of phosphorous acid, which is supposed to contain half as much oxygen as enters into phosphoric acid. Sir H. Davy then enters upon the consideration of the acid which was announced by M. Dulong, under the title of hypophosphoric acid; he is disposed to admit of its existence as a proper chemical compound; but he thinks that the analysis of it given by M. Dulong is not correct. With respect to the phosphatic acid of the French chemist, Sir H. Davy does not think that its existence is substantiated as a proper chemical compound. From a comparison of different experiments, made on various compounds of oxygen and phosphorus, the author assigns 45 as the equivalent number for phosphorus; and proceeding upon the principle that the oxygen and hydrogen in water exist in the proportion of 15 to 2, he gives the following proportions: in the hypophosphoric acid, the proportion will be 45 of phosphorus to 15 oxygen; in phosphorous acid, 45 to 30; and in phosphoric acid, 45 to 60. On some future occasion we hope to give a more complete account of this very valuable and elaborate paper, which we conceive to be one of the most perfect specimens of analytical research that the author has produced.

April 16.—A paper, by Dr. Granville, was read, on a particular malconformation of the uterine system in women, and on some physiological conclusions to be deduced from it.

The case consisted of a female whose uterus was found after death to have been entirely imperfect on one side, and to have had one set only of the lateral appendages; yet she had been the mother of 11 children, some of each sex, and was delivered of a boy and a girl at one birth. This case completely proves the fallacy of a physiological hypothesis, which has been proposed, that the two sexes are formed on separate sides of the uterine system.

On the same evening a paper was also read, by Mr. Pond, on the parallax of *α* Aquilæ, in which the author relates some late observations which he has made, which cause him to doubt the correctness of Dr. Brinkley's conclusions on this subject.

ROYAL ACADEMY OF SCIENCES AT PARIS.

Jan. 5, 1818.—M. Vauquelin was nominated Vice-President.

M. Foucier, in the name of a committee, read a report on a prize to be offered on the subject of statistics.

Dr. Thomas Young, Secretary of the Royal Society of London, was elected a corresponding member in the section of natural philosophy.

Committees were appointed by ballot to examine the memoirs of the several candidates for the prizes offered in natural philosophy, mathematics, and chemistry.

Jan. 12.—Committees were nominated to draw up reports on the subjects and conditions of the prizes for next year, and to adjudge the medal of Lalande.

M. Percy made a report on several works and collections relative to medicine.

Jan. 19.—M. Pons, *Directeur-adjoint* of the Observatory of Marseilles, announced that he had discovered a new comet.

Several memoirs and machines were referred to the consideration of committees.

M. Cauchy gave in a memoir on the integration of a particular class of differential equations.

A paper, by M. Lacoste, M.D. entitled "An Essay on the Means of preventing the Violence of Storms and the Production of Hail," was read, and referred to a committee.

Jan. 26.—The Minister of the Interior requested the Academy to nominate a candidate for the situation of *second Professeur adjoint* in the School of Pharmacy at Montpellier.

M. Devaux gave in a memoir on the glands of vegetables.

M. Vauquelin read a memoir on the influence of the metals in the production of potassium by means of charcoal.

A letter from M. Dupin was read, containing an analysis of a work which he has recently composed, entitled "*Premier Voyage en Angleterre.*" The object of this work is to describe the manufactories and public works of England as far as the author has had an opportunity of examining them.

The docks of the port of London are first treated of. M. Dupin particularly notices the superiority in the construction of these docks over similar works in France, depending on the curvilinear form of the masonry with which the sides of the docks are lined, and on the employment of the same principle in the construction of the locks. He notices also the employment of the steam-engine in hydraulic constructions for all work which requires great and long exertions on one spot, as in pumping, &c.

The habitual use of iron rail-roads, the ease with which they are taken up and laid down, and the great facilities thus afforded for conveying bulky commodities, such as coals, limestone, iron ore, &c. are next described.

The improved dredging machines, worked by steam, for cleaning accumulations of mud in docks and rivers, and for removing banks of gravel, and of other loose materials which impede inland navigation, are noticed by the author with much approbation. He notices also the employment of the diving bell as a substitute for caissons in building under water, and in recovering from the bottom of the sea in harbours, and roadsteds, anchors, cannon, and the contents of sunken vessels. M. Brunel's machines for cutting veneers, for planing and sawing wood, are next noticed; and the report concludes with a description of the improvements lately introduced by Mr. Seppings in the construction of the frame-work of large ships, and which M. Dupin has in vain endeavoured to establish in the naval arsenals of France.

Feb. 2.—M. Percy delivered in the report of a committee on a memoir by M. Roux on the operation for the cataract.

The object of this paper is a comparison of the two methods at present in use of operating for the cataract, namely, by extraction or depression. He observes first, that each method has been long practised; Philoxenus, 270 years before the Christian era, having operated by depression; and Antylus having employed the method by extraction near the end of the first century. M. Roux is an advocate for the method by extraction, and states that out of 660 operations performed by him, for the most part on hospital patients, 400 have been attended with success. The committee, in their report on this paper, state that out of 65 operations performed at the Hotel Dieu by the method of depression, 48 have completely succeeded. Hence they conclude that a rational practitioner will not bigotedly confine himself to either of the two methods, but will be determined in each case by particular circumstances.

M. Lamé read a memoir *on the determination of surfaces of the second degree by descriptive geometry.* This paper, and that of M. Devaux on the glands of vegetables, already noticed, were referred to special committees.

In compliance with the invitation of the Minister of the Interior, the section of chemistry recommended M. Duportal for the office of *Professeur-adjoint* to the School of Pharmacy at Montpellier.

M. Laplace, in the name of a committee, proposed as the subject of a prize for the next year, the construction of lunar tables from theory alone.

Feb. 9.—M. Percy, in the name of a committee, made a report on the medical properties of the preparations of gold.

Dr. Chrestien, of Montpellier, has of late exerted himself to restore to medicine the preparations of gold, which, although highly extolled by the older physicians, have wholly disappeared from modern pharmacopœias; the committee, in order to qualify themselves to form an accurate judgment on the subject, have made experiments, from which they conclude that the salts and other preparations of gold have a decided action on the animal economy, which it is well worth the while of medical practitioners carefully to investigate. They have themselves ascertained that friction of the tongue and gums, with four grains of powder of gold, will (as stated by Dr. C.) produce sometimes a copious ptyalism, sometimes abundant alvine evacuations, and sometimes profuse perspiration.

M. Risso presented a memoir entitled "*Coup d'œil geologique sur les Environs de Nice.*"

M. Girard, in the name of a committee, commenced reading a report on a memoir by M. Vicat on the composition of mortars and cements.

Feb. 16.—M. Daussi read a memoir on the planet Ceres.

M. Chevreul read his seventh memoir *sur les corps gras.*

M. Girard finished his report on M. Vicat's memoir on mortars and cements. The memoir having been approved by the Academy, was ordered to be printed among the Receuil des Savans Etrangers.

A letter from M. Cagniard-Latour was read, on a hydraulic machine for raising water by the explosion of successive portions of vapour.

M. Morichini writes word that his experiments on the magnetic power of the violet rays continue to be attended with success.

M. Cuvier communicated some observations on several sculls of the ourang-outang, from which he concludes that the East Indian animals hitherto described under this name are probably only young specimens of the large species of monkey, called Pongo by Wurmb.

Feb. 23.—M. Dumeril read a report on certain pieces of apparatus, presented by M. Brizé-Fradin, for the purpose of purifying foul air.

M. Dupin read a notice of his *second voyage en Angleterre.*

Article XVIII.

Scientific Intelligence, and Notices of Subjects connected with Science.

I. *On the raising of Olive Trees.**

Trials have been frequently made, but without success, to multiply the olive by sowing the seeds; it has always been found necessary either to employ cuttings, or to procure wild plants from the woods. One of the inhabitants of Marseilles, astonished to find that we cannot obtain by cultivation what nature produces spontaneously, was led to reflect upon the manner in which the wild plants were produced. They proceed from the kernels, which kernels have been carried into the woods, and sown there by birds, who have swallowed the olives. By the act of digestion, these olives have been deprived of their natural oil, and the kernels have become permeable to the moisture of the earth, the dung of the birds has served for manure, and, perhaps, the soda which this dung contains, by combining with a portion of the oil which has escaped digestion, may also favour

* Pharm [illegible] ..h, 1817.

germination. From these considerations the following experiments were made.

A number of turkeys were caused to swallow ripe olives: the dung was collected, containing the kernels of these olives. The whole was placed in a stratum of earth, and was frequently watered. The kernels were found to vegetate, and a number of young plants were procured. In order to produce upon olives an effect similar to that which they experienced from the digestive power of the stomach, a quantity of them was macerated in an alcaline lixivium; they were then sown, and olive plants were produced from them as in the former experiment.

This ingenious process may be regarded as a very important discovery, and may be applied to other seeds besides that of the olive, which are, in the same manner, so oily, as that, except under some rare circumstances, the water cannot penetrate them and cause their development. Of this description is the nutmeg, which will seldom vegetate in our stoves; but which, perhaps, would do so, was it submitted to the action of the stomach, or of the alkaline solution.

II. *On the Gas Blow-Pipe.*

(To Dr. Thomson.)

SIR, *Glasgow, Nov. 20, 1817.*

If you judge the following ideas worth a place in the *Annals of Philosophy*, or otherwise useful, they are at your disposal.

I am, Sir, your obedient servant,

JAMES WATT, M.D.

The powers and facilities of chemical analysis have been of late much improved. Heat and chemical mixture being the great agents in this analysis, whatever augments those powers, or facilitates their application, must also aid in effecting this process. The powers of the solar burning lens, or mirror, had long ago produced effects far beyond the reach of fuel and furnaces. The expensive nature of this apparatus, however, limited its use, and chemists had to regret that the same zeal and munificence which had been employed to extend the powers of the telescope, had not been also employed to furnish a chemical instrument of analogous power in the solar lens and mirror. The powers of galvanism, as an instrument or aid in analysis, left little room for regret in this respect. The alkalies and several of the earths were decomposed, and their metallic bases discovered. This power, however, is both expensive and of limited application. But though galvanism is so expensive, and capable of operating on only small quantities of matter, its successful application to chemical analysis was deservedly hailed as marking an era in science, and celebrated over the civilized world.

So rapid, however, is the progress of improvement, that the late discovery or revival of the use of a mixture of those gases which contain the ingredients of water, applied by the blow-pipe to promote combustion, is likely to supersede the employment of galvanism in chemical operations. The degree of heat thus obtained is sufficient to fuse or resolve substances the most refractory, and the application of a blow-pipe is a simple manipulation.

The great difficulty in the use of this gaseous mixture arises from its very explosive qualities; and the hazard of the ignition passing backward along the tube of the blow-pipe to the magazine. From the combustible nature of the mixture, it should seem wonderful that it could have been used once without explosion. Perhaps it was owing to the rapidity of the gas issuing, exceeding the velocity with which the ignition could pass against the direction of the current backwards to the gasometer. If so, the danger must increase as the gasometer becomes exhausted, and as the issuing current becomes less rapid.

To obviate the danger arising from this tendency of the gaseous mixture to explode, various contrivances have been adopted. Some to secure against danger in case of explosion taking place; some to prevent its occurrence. The latter object is certainly the most important.

This object has been attempted to be gained by interposing a fluid between the lamp and gasometer. A partial explosion, however, might agitate the fluid, or displace a quantity of it, and occasion inconvenience or danger. The addition of the principle of the safety lamp seems the most promising expedient. The wire-gauze lamp prevents explosion, by cooling the gas down below the exploding heat, as it passes the meshes of the gauze. To gain the same end, in the use of the gas blow-pipe, one philosopher has proposed a fagot, or bundle of small tubes, to be enclosed in a larger tube, and the gas to pass through these. Another has proposed to enclose in the tube through which the gas passes, a number of folds of wire gauze. Either of these expedients seems capable of affording the desired security, if the plan be perfectly executed.

But a still more simple and facile apparatus presents itself. It is to make a pretty long portion of the tube through which the gas passes, sufficiently wide, and to enclose in it, instead of a bundle of tubes, or a quantity of wire cloth, a bundle of wires placed longitudinally. The tubes formed by the interstices of these wires are of a much better form, and in proportion to their capacity present a much greater cooling surface, than cylindrical tubes. The apparatus is of the easiest construction. Its powers as a safe-guard may be almost indefinitely augmented. The wires may be used very fine, and, perhaps, may be advantageously twisted; the fagot of wires may be increased at pleasure, both in number of threads and in their length; and in each of these ways, or by them all combined, the powers of this apparatus may be augmented.

The same principle may be applied in various other forms; *e.g.* one of two polished metallic plates might be furrowed with intersecting lines. The plates might then be applied to each other, and their edges soldered or cemented together, except at two points, one for the entrance and another for the exit of the gas. These plates, thus applied, would form a part of the passage between the lamp and gasometer. This too is capable of augmentation at pleasure. Both this and the tube with wires might be easily surrounded, when in use, with cooling or freezing mixtures. By such means the powerful aid of the gas blow-pipe may be obtained with a great degree of safety.

III. *Geological Description of Hutton's Island.**

This island is situated near the western coast of Corea, 36° 10′ north latitude, and 126° 13′ east longitude. The N.E. end is composed of a fine-grained granite, the middle of the island of a brittle micaceous schistus of a deep blue colour, the strata are nearly horizontal, but dip a little to the S.W. This body of strata is cut across by a granite dyke, at some places 40 feet wide, at others not above 10; the strata in the vicinity of the dyke are broken and bent in a remarkable manner; this dislocation and distortion do not extend far from the walls of the dyke; but veins of granite branch out from it at a great distance, varying in width from three feet to the hundredth part of an inch; the dyke is visible from the top of the cliff to the water's edge, but does not reappear on the corresponding cliff of an island opposite to it, though distant only 30 yards. This island is composed of the same schistus, and is cut in a vertical direction by a whin dyke, four feet wide, the planes of whose sides lie N.E. and S.W. being at right angles to those of the great granite dyke in the neighbourhood, which run S.E. and N.W. The strata contiguous to the whin dyke are a good deal twisted and broken, but not in the same degree as at their contact with the granite dyke.

The whin dyke is formed of five layers or sets of prisms laid across in the usual way. Beyond the small island cut by the whin dyke, at the distance of only 40 or 50 feet, we came to an island rising abruptly out of the sea, and presenting a high, rugged cliff of breccia, fronting that on which the granite dyke is so conspicuous: the junction of this rock with the schistus cut by the granite and the whin, would have been interesting; but although we must have been at times within a few yards of it, the actual contact was every where hid by the sea.

The whole of the S.W. end of this island is formed of breccia, being an assemblage of angular and water-worn pieces of schistus, quartz, and some other rocks, the whole having the appearance of a great shingle beach. The fragments of the schistus

* Extracted from Capt. Hall's "Account of a Voyage of Discovery to the West Coast of Corea, and the great Loo-choo Island."

in this rock are similar to that which forms the cliff first spoken of.

The principal island was named by its discoverers after the celebrated Dr. Hutton, from the disposition and relative situation of the strata being, as was supposed, most easily accounted for upon the hypothesis of their igneous origin.

IV. *On Metallic Watering* (*Moiré Metallique*). By M. Baget.*

Metallic watering is a new art, which was discovered by accident; it depends upon the action of acids, either pure, or mixed together, and in different degrees of dilution, on alloys of tin. The variety of the designs resembling mother-of-pearl, and reflecting the light in the form of clouds, and the multiplicity of the objects of art which are executed with the substance, have drawn upon it the attention of the admirers of new discoveries.

The first attempts that I made to obtain this metallic watering have not been altogether unsuccessful, and believing that they may prove of some benefit, I shall describe the different mixtures which I employed; it is, however, necessary to observe at the outset, that the English tinned iron is preferable to the French, as this last is not capable of producing such beautiful forms. First mixture: we must dissolve four ounces of muriate of soda in eight ounces of water, and add two ounces of nitric acid. Second mixture, eight ounces of water, two ounces of nitric acid, and three ounces of muriatic acid. Third mixture, eight ounces of water, two ounces of muriatic acid, and one ounce of sulphuric acid.

Process.—One of these mixtures is to be poured warm upon a sheet of tinned iron placed upon a vessel of stone ware; it is poured on in separate portions, until the sheet be completely watered; it is then plunged into water slightly acidulated, and washed. The watering that I have obtained by the action of these different mixtures upon tinned iron, imitated very closely mother-of-pearl and its reflections; but the designs, although varied, were quite accidental, or rather depended upon the manner in which the tin crystallizes, at the surface of the iron, in coming out of the bath in which it is tinned, and does not present to the eye any thing particularly beautiful. By heating the tinned iron to different degrees in different parts, in order to change the form of the crystallization of the tin, I have attempted to produce designs corresponding to the places where the heat is applied. My trials have been successful; I have obtained stars, fern-leaves, and other figures. I have likewise obtained a beautiful granular appearance by pouring one of the above mixtures cold upon a plate of tinned iron at a red heat.

We may, I think, after some farther experiments, succeed in forming whatever designs we please. The success of the process depends principally upon the alloy of tin which is applied to the

* Journ. de Pharm. for January, 1818.

iron. In many manufactures, bismuth and antimony are added to the tin, and these two metals in proper proportions contribute not a little to the beauty of the results; that of the French manufacture containing zinc is not suitable.

The metallic watering has the property of bearing the blow of a mallet, but not of a hammer; hence it may be used with embossed patterns, but not with those that are punched. The different coloured shades which we see on the watering depend upon coloured or transparent varnishes, which, when properly polished, set off the beauty of the watering.

V. *Test for Arsenic and Corrosive Sublimate.*

The following method has been proposed by Brugnatelli to discover arsenic and corrosive sublimate in their respective solutions, and to distinguish them from each other.

We must take the starch of wheat boiled in water until it is of a proper consistence, and recently prepared; to this is added a sufficient quantity of iodine to make it of a blue colour; it is afterwards to be diluted with pure water, until it becomes of a beautiful azure. If to this azure-coloured solution of starch we add some drops of an aqueous solution of the oxide of arsenic, the colour changes to a reddish hue, and, finally, is quite dissipated. The solution of corrosive sublimate, poured into the iodurretted starch, produces in it almost the same change with the arsenic; but if to the fluid discoloured by the oxide of arsenic we add some drops of sulphuric acid, the original blue colour is restored with more than its original brilliancy, whilst the colour of the fluid that has been discharged by the corrosive sublimate cannot be restored, either by the sulphuric acid or by any other means.

VI. *On the Magnetizing Power of the Violet Rays of the Solar Spectrum.*

The reported discovery of M. Morichini, respecting the magnetizing power of the violet rays, which was scarcely credited in this country, has received the confirmation of Prof. Playfair, as related in one of the late numbers of the Bibliotheque Universelle. He gives the following account of an experiment of which he was a witness, and which was performed by M. Carpa.

After having received into my chamber a solar ray through a circular opening made in the shutter, the ray was made to fall upon a prism, such as those which are usually employed in experiments upon the primitive colours. The spectrum which resulted from the refraction was received upon a skreen; all the rays were intercepted except the violet, in which was placed a needle for the purpose of being magnetized. It was a plate of thin steel, selected from a number of others, and which, upon making the trial, was found to possess no polarity, and not to exhibit any attraction for iron filings. It was fixed horizontally on the support by means of wax, and in such a direction as to but the magnetic meridian nearly at right angles. By a lens of a sufficient size, the whole of the violet ray was collected into a focus, which was carried slowly along the needle, proceeding from the centre towards one of the extremities, and always the same extremity, taking care, as is the case in the common operation of magnetizing, never to go back in the opposite direction. After operating in this manner for half an hour, the needle was examined; but it was not found either to have acquired polarity or a sensible attraction for iron filings. The process was then continued for 25 minutes more, 55 in the whole, when the needle was found to be strongly magnetic; it acted powerfully on the compass, the end of the needle which had received the influence of the violet ray repelling the north pole, and the whole of it attracting and keeping suspended a fringe of iron filings.

It is stated that a clear and bright atmosphere is essential to the success of the experiment, but that the temperature is indifferent. At the time when the above experiment was made, about the end of April, the temperature was rather cool than warm.

VII. *Blue Iron Earth.*

The blue iron earth, or native Prussian blue, as it was formerly called, has been found in many parts of the continent of Europe; as also in Iceland and in Shetland; but it had never been discovered in the island of Great Britain, until it was observed by Dr. Bostock, at Knotshole, near Liverpool. On the north-east bank of the Mersey, about a mile and a half above the town, a small glen, or dingle, is formed, apparently by a fissure in the brown sandstone, which, in this place, rises up to the edge of the water; the sides of the dingle are covered with brush-wood, and at the bottom is a flat swampy pasture. The upper stratum of the soil of the pasture is chiefly sand, mixed with a little vegetable mould; but at the depth of four or five feet, there is a body of stiff white clay, mixed with a considerable quantity of vegetable matter, consisting principally of the roots and stems of different species of rushes, and other aquatic plants. A portion of this clay was procured for examination, principally in order to ascertain how far it was likely to prove useful as a manure, when, after being exposed for some time to the air, the vegetable fibres which it contained were found to be encrusted with a dusky blue substance, the shade of which became gradually more intense, until at length it acquired a deep indigo colour. It exhibited a pulverulent, or feathery appearance, and seemed to be attached to the vegetable matter alone. Its chemical composition was found to agree with that indicated by Klaproth and Laugier, or to consist essentially of oxide of iron and phosphoric acid. With respect to its production, it may be observed, that many circumstances lead to the idea, that the valley formerly occupied a small bay in the river, which was gradually filled up by the accumulation of sand and earth, either deposited by the tide, or washed down from the higher ground, and that a chalybeate spring issues from a rock at the upper part of the valley. If, therefore, we may be permitted to suppose that the remains of marine animals were mixed with the clay and sand by which the bay was filled up, we have on the spot both the constituents of the phosphate of iron.

VIII. *Luminosity of the Ocean.**

After passing Cape Palmas and entering the Gulf of Guinea, the sea appeared of a whitish colour, growing more so until making Prince's Island, and its luminosity also increasing, so that at night the ship seemed to be sailing in a sea of milk. In order to discover the cause of these appearances, a bag of bunting, the mouth extended by a hoop, was kept overboard, and in it were collected vast numbers of animals of various kinds, particularly pellucid *sulpæ*, with innumerable little crustaceous animals of the scyllarus genus attached to them, to which I think the whitish colour of the water may be principally ascribed. Of *cancers*, we reckoned 12 different species, eight having the shape of crabs, and five that of shrimps, and none more than a quarter of an inch in length; among them the *cancer fulgens* was conspicuous. In another species (when put into the microscope by candle light) the luminous property was observed to be in the brain, which, when the animal was at rest, resembled a most brilliant amethyst about the size of a large pin's head, and from which, when it moved, darted flashes of a brilliant silvery light. Beroes, beautiful holothurias, and various gelatinous animals, were also taken up in great numbers. Indeed the Gulf of Guinea appears to be a most prolific region in this sort of animals; and I have no doubt but the marine entomologist would here be able to add immensely to this branch of natural history. As it was found impossible to preserve the far greater part of these animals, by reason of their delicate organization, the spirit of wine dissolving some, and extracting the colours of others, and as most of them require the aid of a microscope to describe them, a great portion was lost upon us, from the want of a person either to describe or draw them from that instrument.

Professor Smith, in describing the same part of the Atlantic, observes, that the number of flying-fish is immense. "Shoals of them constantly surrounded the vessel, and at night they give out a white light resembling that of the moon, when reflected by the sea. It was also chiefly at night that we were enabled to catch with the net the greatest number of mollusca and crustacea. Many different substances contribute to make the surface of the sea light. Some parts of the bodies of most of the crustacea have certain glittering points, and two or three species of crabs were perceived to give out the most brilliant light. The points

* Extracted from Tuckey's Narrative of the Expedition to the Zaire.

which are to be seen on the mollusca are larger, but less bright. But that luminous appearance, which diffuses itself over the whole surface of the sea, arises from a dissolved slimy matter, which spreads its light like that proceeding from phosphorus. The most minute glittering particles, when highly magnified, had the appearance of small and solid spherical bodies."

IX. *Paris Aërolite.*

We are informed in the Journ. de Physique for January, p. 30, that the account of an aërolite, reported to have fallen in Paris, which we noticed in our number of the *Annals* for December last, is entirely without foundation.

X. *On the Fusion of Silica.* By Joshua Mantell, Esq.

(To the Editors of the Annals of Philosophy.)

GENTLEMEN, *Lewes, April* 10, 1818.

If the following account of some experiments on the fusion of silica, by means of the oxyhydrogen blow-pipe, should appear to merit a place in the *Annals of Philosophy*, I shall feel much obliged by its early insertion. With a view to ascertain if the purity of the gases and the intensity of the temperature were sufficient to produce the same metallic appearance in the experiments described in the letter inserted in your last journal, pure silica, mixed with common lamp oil, was exposed to the action of the ignited gases; at the instant of its fusion the mass was removed, and exhibited several globules of a metallic appearance, and of a splendid silvery lustre; the result of this experiment having proved satisfactory, animal oil, intimately blended with finely pulverized charcoal, was submitted to the action of the oxyhydrogen blow-pipe, that it might be determined how far the metallic substance, produced in the preceding experiment, was caused by the charcoal contained in the animal oil, according to the suggestion of Dr. Thomson; the oil was immediately dissipated, but not the least particle of a metallic nature could be discovered on the charcoal that was used as a support. Carbonate of lime, fluate of lime, carbonate of magnesia, &c. mixed with oil, were severally exposed in a similar manner, and afforded similar results. As in every instance the same degree of heat was applied, and the same precautions observed, may we not infer that the metallic lustre, apparent in the first experiment, is not to be attributed to the charcoal contained in the animal oil, but is occasioned by the reduction of the earth to its metallic state. Impressed with this idea, pure silica, placed in a charcoal crucible, was brought to the action of the gaseous stream; but it was instantly scattered by the blast in every direction, and the experiment was necessarily abandoned. To prevent a similar inconvenience, the silica was moistened with water and was instantly fused into a white transparent vitreous substance; but the metallic appearance, invariably produced by the fusion of a mixture of silica with animal oil, was wanting; silica mixed with alcohol, spirits of turpentine, naphtha, &c. was readily fused into a transparent glass, analogous to that obtained in the last experiment. Although the preceding experiments were instituted for the purpose of ascertaining the nature of the metallic substance produced by the fusion of silica combined with oil, we are obliged to confess that they appear to throw but little light on the subject; for if, as Dr. Thomson suggests, the metallic appearance is occasioned by the charcoal contained in the animal oil, why should it not also be obtained by the fusion of other substances when mixed with oil? on the other hand, from the impossibility of producing a metallic appearance from the silica when moistened with other fluids, the origin of this metallic substance is still involved in obscurity. We should, therefore, esteem it a particular favour if Dr. Clarke (through the medium of your work) would favour us with his ideas on the subject; and we beg permission to ask that gentleman, whether the metallic substance he denominates silicium was decomposed when submitted to the action of water, the nitric, muriatic, or nitro-muriatic acids. I have the honour to remain, Gentlemen,

Your very humble servant,

JOSHUA MANTELL.

XI. *Employment of Sir H. Davy's Safety-Lamps in Flanders.*

An interesting pamphlet has lately appeared at Mons, on the explosions that take place in coal-mines, and on the means of preventing them, by the use of Sir H. Davy's safety-lamps; it is published under the direction of the chamber of commerce and manufactures of Mons, accompanied by notes, and by the results of a series of experiments, that were conducted by M. Gossart, President of the Chamber.

The province of Hainault is said to be more rich in coal-mines than any other part of the continent of Europe, and to have no less than 100,000 persons employed in the working them. The same kind of dangerous accidents occurred in them as in the north of England, and various expedients had been employed for their prevention, which were, however, but little effectual in obviating the evil.

"All the precautions," the reporter observes, "which were hitherto known or had been practised, had not been able to preserve, in all cases, the unfortunate workmen from the terrible effects of the explosion of the gas which is extricated in the mines. It is then an inappreciable benefit which we confer, by making known the method of preventing these accidents, equally simple and infallible, which has been discovered by the celebrated Humphry Davy."

M. Gossart gives an ample and accurate detail of the nature and properties of the carburetted hydrogen gas which is extricated in the coal mines, and correctly describes the experiments of Sir H. Davy, by which he ascertained the high temperature necessary for the inflammation of this gas, and the consequent means of preventing the inflammation, when the gas has its temperature lowered by passing through any cooling medium, a circumstance which eventually led to the construction of the safety-lamp in its present form. It appears to have been as useful in the mines of Flanders as in those of England, since no accident of any kind has occurred there since it has been adopted, nor has any inconvenience or difficulty been experienced with respect to it. The pamphlet can scarcely be said to contain any information that is new to us in this country; but it must be regarded a valuable document, in as much as it affords an independent evidence in favour of the value of the instrument, and displays the high sense of obligation to Sir H. Davy which is acknowledged in other countries.

XII. *Infirmary for Diseases of the Eye.*

Sir William Adams having been nominated by his Majesty's government to superintend that part of York Hospital, Chelsea, which has been appropriated to the reception of the blind pensioners belonging to the army, navy, and artillery, feels it a duty to lay open to the profession at large his new modes of treating them. This duty is suggested as well by the pecular confidence which has been reposed in him, as by the high sanction thus conferred upon his improvements in ophthalmic surgery. He, therefore, freely invites all medical practitioners, and students, who are interested in the advancement of this branch of surgery, to attend his operations at York Hospital; which, for their convenience, will be performed in future on Tuesdays and Fridays, between the hours of seven and nine in the morning.

To remove all doubt, or misconception, with regard to Sir William Adams's practice, he proposes, on each of these days, to give a description of the nature of one of the diseases to be operated upon—the general modes of performing the operation—his peculiar mode—and his reasons for deviating from the usual practice, where such deviation has been found necessary.

The records kept of each case, from the patient's admission into the Hospital to his final discharge, will be open at the periods already mentioned, for the inspection of such gentlemen as attend; so that the profession will be enabled fairly to appreciate the character of the *new* as compared with the *old* modes of practice.

Erratum.

In the letter of Philo-chemicus Cantabrigiensis, in our last number, the word *sphericle* is erroneously printed for *spherule*.

Article XIX.

Magnetical and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ. Hour.	Morning Observ. Variation.	Noon Observ. Hour.	Noon Observ. Variation.	Evening Observ. Hour.	Evening Observ. Variation.
March 1	8h 35′	24° 30′ 54″	1h 55′	24° 36′ 25″		
2	8 40	24 33 22	— —	— — —		
3	8 30	24 33 50	1 05	24 41 00		
4	8 35	24 32 53	1 25	24 40 00		
5	8 30	24 33 04	1 30	24 40 17		
6	8 30	24 32 55	1 20	24 42 14		
7	8 45	24 33 26	— —	— — —		
8	8 30	24 33 11	1 30	24 46 15		
9	8 35	24 31 36	1 40	24 39 47		
10	8 30	24 34 43	1 30	24 38 17		
11	8 40	24 31 43	— —	— — —		
12	8 35	24 29 15	1 25	24 39 02		
13	8 30	24 34 17	1 25	24 41 43		
14	8 30	24 31 09	1 35	24 41 37		
15	8 35	24 33 18	1 45	24 41 31		
16	8 35	24 40 18	1 15	24 45 43		
17	8 30	24 32 14	1 25	24 40 26		
18	8 30	24 34 51	1 15	24 43 45		
19	8 35	24 33 56	1 25	24 42 55		
20	8 45	24 31 27	1 40	24 41 32	6h 05′	24° 33′ 40″
21	8 25	24 31 02	1 25	24 41 46	6 05	24 32 53
22	8 30	24 30 16	1 15	24 46 16	— —	— — —
23	— —	— — —	1 30	24 42 30	6 05	24 28 34
24	8 35	24 38 49	1 20	24 42 28	6 05	24 34 01
25	8 30	24 32 33	1 25	24 38 41	6 10	24 34 15
26	— —	— — —	1 10	24 42 32	6 10	24 34 12
27	8 30	24 38 48	1 30	24 41 53	6 10	24 35 06
28	8 35	24 30 48	1 15	24 40 53	6 15	24 35 55
29	8 30	24 29 22	1 35	24 40 42	6 10	24 35 28
30	8 10	24 31 20	— —	— — —	— —	— — —
31	8 30	24 40 00	1 25	24 43 48	— —	— — —
Mean for Month.	8 32	24 33 18	1 26	24 41 37	6 08	24 33 49

This month was remarkable for the violence of the wind and the unsettled state of the magnetic needle, which most days vibrated some minutes; on the 17th the oscillation amounted to 22′ 50″. Rain, by the pluviameter, between noon on March 1, and on April 1, 2·330 inches. Evaporation, during the same period, 2·57 inches.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
March		Inches.				Feet.		
1	Morn....	29·120	37°	60°	W		Very fine	36°
	Noon....	29·137	40	70	WSW		Showery	45½
	Even....	—	—	—				
2	Morn....	29·210	35	70	SW		Very fine	33
	Noon....	—	—	—	—		—	37½
	Even....	—	—	—	—		—	
3	Morn....	29·305	36	70	SSW		Very fine	33
	Noon....	29·220	47	65	SSW		Rain	47½
	Even....	—	—	—	—		—	
4	Morn....	28·915	34	69	SW		Clear	33
	Noon....	28·907	44	49	SSW		Cloudy	46½
	Even....	—	—	—	—		—	
5	Morn....	28·438	42	65	SSW		Cloudy	35
	Noon....	28·460	38	63	W		Snowshowers	43
	Even....	—	—	—	—		—	
6	Morn....	28·843	38	60	SW by S		Clear	34
	Noon....	28·883	43	58	SW by S		Showery	46
	Even....	—	—	—	—		—	
7	Morn....	28·683	42	84	SSW		Rain	32
	Noon....	28·358	—	78	WSW		Rain	48
	Even....	—	—	—	—		—	
8	Morn....	28·480	39	63	WSW		Showery	36
	Noon....	28·584	43	59	WNW		Showery	45½
	Even....	—	—	—	—		—	
9	Morn....	28·923	34	54	WNW		Very fine	32½
	Noon....	28·950	40	42	W		Fine	40
	Even....	—	—	—	—		—	
10	Morn....	28·870	31	64	W by S		Fine	29
	Noon....	28·825	38	45	WNW		Fine	39
	Even....	—	—	—	—		—	
11	Morn....	29·000	35	50	WNW		Very fine	31
	Noon....	—	—	—	—		—	41
	Even....	—	—	—	—		—	
12	Morn....	28·445	31	64	W		Very fine	30
	Noon....	28·440	41	52	W by S		Cloudy	42
	Even....	—	—	—	—		—	
13	Morn....	28·850	34	78	NNE		Cloudy	32
	Noon....	29·085	40	50	NE by N		Fine	43
	Even....	—	—	—	—		—	
14	Morn....	29·400	34	56	WSW		Very fine	31
	Noon....	29·394	42	50	SW by W		Cloudy	43
	Even....	—	—	—	—		—	
15	Morn....	29·037	40	76	SSW		Sm. rain	34½
	Noon....	28·857	43	75	S		Sm. rain	45
	Even....	—	—	—	—		—	
16	Morn....	28·907	37	68	W by S		Fine	33
	Noon....	28·990	41	62	NW		Hail showers	45
	Even....	—	—	—	—		—	
17	Morn....	29·290	43	64	W		Showery	38
	Noon....	29·430	46	47	WNW		Cloudy	48
	Even....	—	—	—	—		—	
18	Morn....	29·630	39	81	WSW		Cloudy	37
	Noon....	29·615	49	61	W by S		Cloudy	50
	Even....	—	—	—	—		—	
19	Morn....	29·558	45	67	SW by W		Cloudy	39
	Noon....	29·500	45	64	SW by W		Showery	50
	Even....	—	—	—	—		—	
20	Morn....	29·265	46	60	WNW		Very fine	45
	Noon....	29·363	50	41	W by N		Very fine	50
	Even....	29·433	43	41	W by N		Very fine	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
March		Inches.				Feet		
21	Morn....	29·484	35°	64°	WSW		Very fine	31°
	Noon....	29·412	47	54	SW		Showery	49
	Even	29·380	42	64	WSW		Showery	36
22	Morn....	29·200	37	72	W		Sleet	
	Noon....	29·185	45	60	W		Showery	49
	Even	—	—	—	—		—	38
23	Morn....	28·805	—	76	W by S		Rain	
	Noon....	29·000	43	58	WNW		Fine	48
	Even	29·100	—	53	WSW		Fine	34
24	Morn....	29·225	37	67	W by S		Cloudy	
	Noon....	29·210	43	57	W		Showery	46
	Even	29·265	37	56	W by N		Showery	33
25	Morn....	29·070	38	76	SW by W		Cloudy	
	Noon....	29·070	45	49	W		Cloudy	45
	Even	29·310	38	55	NW		Showery	32
26	Morn....	29·088	—	—	S		Rain	
	Noon....	28·753	39	77	NNE		Showery	39
	Even	28·967	35	82	NW by N		Showery	32
27	Morn....	29·568	36	70	NNW		Fine	
	Noon....	29·690	42	53	NNW		Very fine	45
	Even	29·780	—	58	N		Showery	33
28	Morn....	29·843	37	56	Var.		Cloudy	
	Noon....	29·841	46	55	SE		Sm. rain	46
	Even	29·820	41	56	S		Sm. rain	36½
29	Morn....	29·743	41	59	SSE		Cloudy	
	Noon....	29·685	48	50	SSW		Cloudy	49
	Even	29·670	41	53	SSW		Very fine	34
30	Morn....	29·612	39	60	S		Fine	
	Noon....	—	—	—	—		—	49
	Even	—	—	—	—			34
31	Morn....	29·895	38	59	NNE		Very fine	
	Noon....	29·855	43	52	NE by N		Cloudy	44
	Even	—	—	—	—		—	

Table containing the Mean Monthly Variation of the Magnetic Needle, from the Beginning of April, 1817, *to the End of March*, 1818.

1817. April.	Morning.......	24°	31′	52″	Oct.	Morning.......	24°	31′	06″
	Noon..........	24	44	43		Noon..........	24	40	46
	Evening.......	24	35	58		Evening.......	—	—	—
May.	Morning.......	24	32	20	Nov.	Morning.......	24	31	49
	Noon..........	24	42	35		Noon..........	24	37	55
	Evening.......	24	34	45		Evening.......	—	—	—
June.	Morning.......	24	31	09	Dec.	Morning.......	24	34	03
	Noon..........	24	42	14		Noon..........	24	38	02
	Evening.......	24	34	05		Evening.......	—	—	—
July.	Morning.......	24	31	14	1818. Jan.	Morning.......	24	34	02
	Noon..........	24	42	06		Noon..........	24	39	57
	Evening.......	24	35	43		Evening.......	—	—	—
Aug.	Morning.......	24	31	16	Feb.	Morning.......	24	34	22
	Noon..........	24	42	51		Noon..........	24	40	51
	Evening.......	24	33	45		Evening.......	—	—	—
Sept.	Morning.......	24	33	02	March.	Morning.......	24	33	18
	Noon..........	24	41	36		Noon..........	24	41	37
	Evening.......	24	34	38		Evening.......	24	33	47

By inspecting the table, it appears that the noon variation (with the exception of the month of August) decreased from April to November, and afterwards increased; which circumstance renders it doubtful if the variation be yet arrived at its maximum.

Article XX.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer. Max.	Barometer. Min.	Barometer. Med.	Thermometer. Max.	Thermometer. Min.	Thermometer. Med.	Hygr. at 9 a. m.	Rain.
3rd Mon.									
March 1	S W	29·64	29·62	29·630	47	33	40·0	59	18
2	S W	29·71	29·52	29·615	48	30	39·0	65	17
3	S W	29·35	29·25	29·300	50	32	41·0	82	14
4	S W	28·83	28·50	28·615	47	36	41·5	72	22
5	S W	29·20	28·83	29·015	44	34	39·0	60	—
6	S	29·39	29·09	29·240	46	30	38·0	64	26
7	S	28·88	28·70	28·790	49	37	43·0	75	37
8	W	29·33	28·88	29·105	47	31	39·0	58	3
9	W	29·36	29·26	29·310	43	28	35·5	55	—
10	W	29·42	29·24	29·330	42	29	35·5	60	
11	N W	28·84	28·80	28·820	44	30	37·0	54	
12	N W	29·26	28·84	29·050	45	32	38·5	62	36
13	N	29·80	29·26	29·530	43	28	35·5	69	—
14	S W	29·80	29·45	29·625	45	35	40·0	68	—
15	W	29·32	29·15	29·235	45	33	39·0	68	
16	N W	29·68	29·32	29·500	48	34	41·0	67	16
17	W	29·98	29·68	29·830	52	37	44·5	58	
18	S W	29·95	29·93	29·940	52	43	47·5	56	
19	S W	29·95	29·58	29·765	52			59	—
20	N W	29·88	29·58	29·730	45	28	36·5		
21	S W	29·88	29·57	29·725	51	35	43·0	66	19
22	S W	29·57	29·22	29·395	50	42	46·0	80	68
23	S W	29·60	29·22	29·410	49	34	41·5	78	9
24	S W	29·70	29·49	29·595	50	31	40·5	65	38
25	N W	29·77	29·45	29·610	48	27	37·5	68	—
26	Var.	29·96	29·15	29·555	39	33	36·0	77	55
27	N E	30·26	29·96	30·110	45	27	36·0	64	1
28	S E	30·26	30·12	30·190	49	35	42·0	63	
29	S	30·13	30·05	30·090	49	27	38·0	53	
		30·26	28·50	29·470	52	27	39·70	65	3·75

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Third Month.—1. *Cirrocumulus* followed by *Cumulus* and *Nimbus*: squalls, with hail and rain: the bow at nine, a.m. and again at three, p.m. 2. Fine, a.m. with clouds, as yesterday: wet, windy, p.m. 3. Hoar frost: fine, a.m.: clouds and wind, p.m.: rain, with large hail in the night. 4. Fine morning: the barometer, which had gone somewhat lower than here noted, rising abruptly: having risen about four-tenths, it took to falling again rapidly: there was a completely overcast sky (with haze in broad streaks, converging in the SW, and scud moving swiftly under it) till dark; when it began to rain, and the wind rose to a greater degree of violence than for some years past, raging thus from SE and SW till past midnight; when it abated, the barometer appears to have turned to rise more abruptly than before, having gone down an inch in 15 hours (the actual lowest point 28·35 inches); there is said so have been much thunder and lightning after midnight; the barometer fell, not uniformly, but by fits, at intervals of about a quarter of a minute, as the more violent gusts of wind came over. 5. Fine, a.m.: squally, with hail and rain, p.m. 6. The same. 7. Wet, stormy: much wind at night, with lightning far to the S and SE. 8. Fair, with *Cirrus* and *Cumulus*; the latter crossed with streaks of *Cirrostratus*: *Nimbi* succeeded with showers: windy night. 9. Fair, with wind and *Cumulus*: the clouds assume a more tranquil aspect: a little snow this evening. 10. Some fine specimens of *Nimbus* to-day, from which a very little snow fell: clear night. 11. Cirrus: windy: in the night some rain, followed by snow from the N. 12. The ground covered with snow: *Cirrus*, followed by *Cumulus* and *Nimbus*: showers. 13. Rain, snow, and sleet, early: various modifications of cloud to-day: at night, a few drops. 14. Hoar frost: some rain, p.m. and evening: lunar halo. 15. Windy: some showers. 16. Various modifications of cloud, a.m. ending in *Nimbus*, and a shower with hail, p.m.: at night, calmer than of late, with a lunar corona. 17. Fair, a.m.: turbid sky above, with *Cirrus*, *Cirrostratus*, &c.: windy. 18. Close *Cumulostratus* most of the day: windy, at night. 19. *Cumulus*, with *Cirrus*: windy, p.m. tending to S: a little rain in the night. 20. The clouds gradually thickened, as for rain; but a brisk wind carried them off to the SE: hygrometer at five, p.m. 36°. 21. Hoar frost: the roads dusty: showers, p.m. 22. Some showers, with hail from NW: fine, p.m.: all night a hard gale from about SW with rain. 23. Morning wet, and stormy: fine, with clouds (among which was the *Cumulus* capped), p.m.: night, pretty calm. 24. Fair, a.m.; then a hail shower: much wind, with rain, in the night. 25. Some hail showers: large *Cumuli*, *Nimbi*, &c. 26. A steady rain from SE, with little wind, a.m.: the rain ceasing, p.m.: the wind went by S. to NW, and so probably by N to NE, where it was on the morning of the 27th, the barometer having risen rapidly with a uniform motion: a shower, p.m. 28. Fair, gloomy. 29. Fair, with *Cumulus* and *Cirrostratus*.

RESULTS.

Winds Westerly.

Barometer:	Greatest height	30·26 inches;
	Least (observed)	28·50 inches;
	Mean of the period	29·47 inches.
Thermometer:	Greatest height	52°
	Least	27°
	Mean of the period	39·70°
Mean of the hygrometer		65°
Evaporation		1·10 inches.
Rain		3·75 inches.

Character of the period for the most part tempestuous, with frequent rains, the barometer running through a series of sharp depressions till near the close, when it suddenly assumed the elevation of fair weather. Almost all the showers, from the first, were more or less mingled with hail.

Tottenham, *Fourth Month*, 21, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

JUNE, 1818.

Article I.

Biographical Sketch of M. Guyton de Morveau.

Louis-Bernard Guyton de Morveau was born at Dijon in the year 1737. His father, who was Professor of Civil Law in the University of that place, superintended with much assiduity the education of his son, who, in consequence, had gone through the general college course in the university of his native town by the time that he had completed his 16th year.

During the next three years he devoted himself to the study of the law, being destined by his father, with his own full concurrence, to the legal profession. These pursuits, however, did not so entirely engross his attention as to preclude him from acquiring some knowledge of natural history, and from cultivating polite literature, a taste for the latter of which was no doubt confirmed by a visit which he paid in 1756 to Voltaire at Ferney. A satirical poem against the Jesuits, published the year after, was probably the fruit of this visit. After completing his professional education at Paris, he settled at Dijon, and had already begun to distinguish himself, when, in his 24th year, a vacancy occurred in the office of *Avocat Général* to the parliament of Dijon. This being one of those situations which, according to the custom of France, were disposed of by public sale, it was purchased by M. de Morveau the elder, for his son, who thus at his very outset in public life appeared pledged and devoted to the exercise of a profession which, in general, more than any other, requires the undivided attention of its followers.

In his 27th year he presented to the parliament of Burgundy a memoir on public instruction and on the influence of education in the formation of moral habits, together with a plan for a college, the liberal and judicious spirit of which obtained for him the friendship of Chalottes, the King's attorney general at the parliament of Bretagne, who had devoted much attention to the same object.

In the same year he was admitted an honorary member of the Academy of Dijon; by far the most celebrated of the provincial philosophical societies of France, and including at that time a number of liberal and active members, among whom was Dr. Chardenon, a chemist of some name. A paper by this gentleman read before the Academy, and which gave occasion to some discussion, is said to have been the immediate cause of the application of M. de Morveau to the study of chemistry. Under the guidance of Macquer's work on the theory and practice of chemistry, and of Beaumé's manual, he rendered himself expert in the common laboratory processes, and in the prevailing theories, so as to become first the antagonist, and afterwards the friend of Dr. Chardenon, who, with the liberal spirit of genuine science, saw with pleasure the accession of a new candidate for fame in his favourite pursuit.

Soon afterwards M. de Morveau made a visit to Paris for the purpose of procuring the necessary books and apparatus for carrying on his further investigations; and in that city made acquaintance with Beaumé, and probably with other chemists, by whom his ardour was duly appreciated and encouraged.

The theory of Stahl, which on its first publication had, by its consistency and appearance of demonstration, seduced the attention of chemists from the facts discovered by Rey, by Hooke, and by Mayow, was now beginning to be called in question: Morveau arranged himself among the defenders of Phlogiston, and in 1768 read before the Academy of Dijon his first memoir, entitled "*Sur les Phénoménes de l'Air dans la Combustion.*" In this, he argues that when combustion takes place in confined air, the resulting diminution of bulk is not owing to the ponderable base of the air uniting with the combustible substance, and, therefore, that the opinion first advanced by Hooke, that a certain quantity of air can support only a certain quantity of combustion, is unfounded.

In 1769 he communicated to the Dijon Academy a short paper entitled "*Sur une Effervescence froide,*" the object of which is to point out a remarkable distinction between the fermentation of vinous liquors and the effervescence or fermentation (for so it was then esteemed) which is excited by pouring an acid on a mild alkali; namely, that in the former case the thermometer rises, whereas in the latter it falls.

In the course of the next three years he communicated a few papers of no great importance to the Academy of Dijon, and published a volume of miscellaneous essays, on subjects of natural philosophy, chemistry, and natural history. He also distinguished himself professionally as a barrister and a magistrate, and at the opening of the session of the parliament of Burgundy pronounced a discourse "*Sur les Mœurs,*" much admired for its eloquence, and truly valuable for the liberal spirit which it breathes.

The year 1773 produced two memoirs on controversial chemistry from the pen of Morveau, entitled "*Defence de la volatilité de Phlogistique,*" and "*Parallèle du Phlogistique et du Causticum,*" in which, however, we perceive no great novelty, either in the facts or arguments. He also laid before the Academy of Dijon an analysis of a mineral water from Mont Cenis.

His two most important communications, however, in this year, remain to be noticed.

The workmen employed in clearing out some of the vaults below the cathedral of Dijon, finding themselves much annoyed by the putrid exhalations, were induced from some vague notions of their own to spread quicklime on the corrupted and half decomposed animal matter in the hope of destroying the effluvium. The consequence, however, of their experiment, was the disengagement of a prodigious quantity of excessively fetid ammoniacal gas, which, penetrating through the pavement into the body of the church, filled the whole cavity of the building, preventing the performance of religious service, and even extending its putrid odour to the adjacent houses. Brasiers, full of burning charcoal, into which were thrown from time to time aromatic resins, vinegar, nitre, &c. were found insufficient to dispel the odour. In this dilemma M. de Morveau offered his services, which were readily accepted. From an examination of the circumstance which occasioned the annoyance, he concluded that it arose from the disengagement of ammoniacal gas holding fetid oil in solution, and that the most effectual way of getting rid of it would be by the use of some very volatile acid which would neutralize the alkali and thus dispose the oil to collect in small drops and fall to the ground. He accordingly arranged some large basins of common salt on the floor of the cathedral, and after pouring into each of them a quantity of sulphuric acid, caused the church doors to be closed for several hours. The muriatic acid gas thus liberated diffused itself through every part of the building, and entirely freed it from the odour by which it had been infested. The public prisons of the town were some time after, it is said, purified by the same means from an infectious fever, which raged among their inhabitants. Of this, indeed, there is no mention in M. Morveau's memoir; but the analogy is so easy from its efficacy on one occasion to its application in the other (especially considering how generally, even by professional and scientific men, putrid exhalations are confounded with infectious miasmata), that we may ascribe to M. Morveau the merit of original discovery on this important subject. Let it be remembered, however, that the late Dr. Johnstone, of Worcester, recommended the use of muriatic acid vapour for this very purpose in the year 1756, and had probably repeatedly made use of it in private practice, and in the prison and hospital of that city, some years before its first application by M. Morveau.

The other paper of M. Morveau, already alluded to, has for its object the relation of experiments made to verify Dr. Brook Taylor's method of measuring the adhesion of surfaces.

James Bernouilli, in his dissertations on the weight of the atmosphere, published in 1682, maintains that the resistance which two pieces of polished marble oppose to their separation is owing to the pressure of the air. This, however, was disproved experimentally in 1713 by Hawksbee; and about the same time Dr. Brook Taylor, having observed the ascent of water between two planes of glass, was induced to make several experiments on the adhesion of surfaces, from which he concluded, that the degree of this force might be measured by the weight required to separate them. Nevertheless, in 1772, MM. Lagrange and Cigna, taking for granted a natural repulsion between water and oily substances, imagined, if there was any adhesion between water and a plate of tallow, that it must be occasioned by a cause different from attraction. The reality of the adhesion being then ascertained, they concluded that it must be occasioned by the pressure of the air, and, therefore, that Dr. Taylor's theory was unfounded.

Such was the state of opinions on the subject when M. Morveau's memoir made its appearance. In this paper, he shows first, that water will ascend between two plates of tallow separated from each other $\frac{1}{4}$ of a line, and in circumstances in which the pressure of the air does not appear to have any influence; secondly, he suspended a small polished disk of glass to one arm of a balance, and brought it in contact with a surface of mercury; then, by adding weights to the other arm till the disk separated from the mercury, he ascertained the adhesive force between these two substances; the same apparatus being transferred within the receiver of an air-pump, and a vacuum being produced, precisely the same results as before took place; hence the truth of Dr. B. Taylor's theory was satisfactorily established. In the subsequent part of the memoir, M. de Morveau appears in the higher character of an original discoverer. He observed that the same disk of glass which, when in contact with pure water, adhered to it with a force equal to 258 gr. required a counterpoise of only 210 gr. in order to separate it from a solution of potash, notwithstanding the superior density of this last. No adequate cause for the difference of these results presenting itself, except the difference of chemical affinity between each fluid and the glass, M. de Morveau was encouraged to undertake some other experiments in the hope of adapting an arithmetical notation to the relative forces of chemical attraction. For this purpose equal plates of the different metals were procured; and being in turn suspended to the arm of an assay balance and counterpoised, were in this state applied to the surface of fluid mercury; and weights were added to the other arm till each disk was separated from its adhesion to the mercury. Each metal was thus found to adhere with a different force; the adhesion of gold equalled 446 gr. and that of iron only 115 gr. the other metals arranging themselves in the following order from gold downwards, viz. silver, tin, lead, bismuth, zinc, copper, antimony. The above order corresponds so nearly with that of the relative affinity of the several metals for mercury, as found by other means, as to render it highly probable that the chief part of the adhesive force thus found by experiment, is owing to chemical affinity, and, therefore, that the numerical series of the weights required to overcome the adhesion is an approximation towards the ratio of the respective affinities for mercury of the metals operated on. The two upper terms, however, of the series are manifestly more incorrect than the others, for mercury will adhere more or less to disks of these two metals, and, therefore, when, in consequence of the counter weight, the separation is effected, it will have taken place not between the gold and the mercury, but between the mercury adhering to the gold and the rest of this fluid.

The above-mentioned investigations had begun to extend the fame of Morveau to England, Germany, Sweden, and Italy, and to procure for him the correspondence of Bergman, Kirwan, and other illustrious foreigners; and the discoveries of Scheele, of Black, and of Priestley, had already begun to attract an unusual share of public attention to the science of chemistry. For these reasons it is not to be wondered at that those pursuits which were at first only the amusement of his leisure, should rapidly acquire in the mind of Morveau the predominance of a ruling passion. Hence in 1776 we find him taking the somewhat unprofessional step of delivering a series of public gratuitous lectures, in illustration of his favourite science, before the Academy of Dijon, the substance of which was printed in four successive volumes in the course of the next two years, and added considerably to the public reputation already enjoyed by their author.

The name of Morveau now stood so high for extensive knowledge and philosophical views on the subject of chemistry, with most of the men of science at Paris, that when the New Encyclopedia was projected, an offer of the chemical department was made by the proprietors to Morveau. The solicitations of the booksellers being warmly seconded by Buffon and others of his scientific friends, M. Morveau was induced to undertake the laborious and important office of drawing up the chemical and mineralogical dictionary, forming part of this great work, having, however, secured a most able coadjutor for the metallurgical articles in M. Duhamel. The variety and extensive research historical, literary, and experimental, required for the execution of an undertaking which should be not unworthy of the reputation of the author, and of the high anticipations formed of the great and almost national work of which it constituted a part; the critical state too of the science of chemistry itself, in the very agony of contest between two fundamental theories, and receiving almost daily accessions of newly discovered and highly important facts, soon convinced M. Morveau that nothing less than his undivided attention would enable him to fulfil the engagements into which he had entered. Accordingly in 1783 he resigned all his professional employments, and wholly devoted himself to the service of science.

In 1782 he published a memoir in the Journal de Physique to show the necessity of establishing a scientific and systematical mode of nomenclature for the various substances, simple and compound, which are the objects of chemical investigation. This memoir is generally considered by his countrymen as the first attempt to emancipate chemistry from the trammels of a barbarous jargon, endurable only while the number of substances was yet small, and while much of mystery still continued to veil from vulgar eyes the higher and more recondite processes of the hermetic philosophy. Without the smallest wish to detract from the real merit and just views of M. Morveau on this occasion, it is only common justice to the memory of the illustrious Bergman, to mention that in his essay *De Analysi Aquarum*, published in 1778, he employs a nomenclature for the compound salts, derived from the sound Linnæan principles of designating every natural substance by a generic and specific appellation, and in more respects than one preferable to that proposed by Morveau. In Bergman's essay, already mentioned, we find *alkali vegetabile äeratum, vitriolatum, nitratum, salitum; calx äerata, vitriolata, salita,* &c.; *ferrum* and *argentum vitriolatum, salitum,* &c.; *hydrargyrus nitratus,* together with many other similar examples, showing that the fundamental principles of correct nomenclature were both understood and applied by Bergman, and were borrowed from him by Morveau, with whom he was in constant and intimate correspondence. In the *tableau* accompanying M. Morveau's paper, we find the following names invented by him, and which are still retained, viz. muriatic and fluoric acids; muriates, phosphates, citrates, &c. as generic terms; barote, potasse, soude, ammoniac, instead of the more circuitous expressions *terra ponderosa, alkali vegetabile, alkali minerale, alkali volatile,* which still continued to be used by Bergman. The merit of M. Morveau, therefore, on this occasion is not the invention of the great principle of scientific nomenclature, for this is due to Linnæus; nor the first application of this general principle to the naming of chemical substances, for this praise is due to Bergman; but the adoption of a few simple, short, and convenient names for some of the supposed simple bodies, and the strenuous and successful exertions which he made to naturalize in France both the principle and the practice.

Two years before the date of the above-mentioned paper, M. Morveau published a translation into French, with notes, of the *Opuscula Chemica*, &c. of Bergman; he also contributed his valuable superintendence of the translation of Scheele's essays by Madame Picardet, and of a number of memoirs by foreign chemists, which, about this time, enriched the pages of the Journal de Physique. He also, with what success we are not informed, established a manufactory of soda from the decomposition of common salt by a process detailed by Scheele in one of his essays.

The publication of the first volume of the chemical part of the Encyclopedie Methodique, which now took place, completely justified the high expectations of the chemical world. The articles *acide*, *adhesion*, *affinité*, contain a vast fund of information, clearly detailed and drawn up in that truly equitable and philosophic spirit which ensures the permanent value of this volume as an historical record, although for practical use it has now become even obsolete. What the reasons were which induced M. Morveau so soon to discontinue his connexion with this work we are not informed; whatever they were, however, their consequences are much to be regretted.

The high character for integrity and abilities which had been acquired by M. Morveau in his practice as a barrister and a magistrate, drew him again into public life on the breaking out of the French revolution. He was first employed in organizing the department of the Côte d'Or, and was subsequently elected a member of the second National Assembly, and was appointed Solicitor General of his department. At this period, his residence in Paris becoming necessary, he resigned the chemical chair in the university of Dijon to his friend Dr. Chaussier, and established himself in the metropolis. In 1794 he was nominated Professor of Chemistry at the Ecole Polytechnique, and in 1795 was appointed member of the National Institute. In the same year he was re-elected a member of the Council of Five Hundred; but, disengaging himself as soon as possible from political employments, he devoted his whole energy, as Director of the Polytechnic School, to perfecting the system of public instruction, and assisting the progress of general science. His indefatigable efforts in the important trust thus confided to him, were rewarded first, by the post of Administrateur General of the Mint, then by the Cross of the Legion of Honour; and, lastly, in 1811, by the rank of Baron of the Empire. His advanced age and meritorious services now obtained for him an honourable retreat from active life, which he enjoyed for about four years; and then, on Dec.

21, 1815, he quietly expired, having just completed his 80th year.

The services rendered by M. Morveau to chemistry were undoubtedly very considerable, though it is not easy specially to point them out. By his extensive foreign correspondence he became the medium through which his countrymen derived much of their knowledge of the discoveries made by foreign chemists. To his zeal and ability, as a lecturer and a director of public instruction, much of the popular favour which attached itself in France to chemical investigations is to be attributed; while the general integrity and disinterestedness of his moral character kept him aloof from petty squabbles and intrigues, and thus enabled him quietly and unostentatiously, but effectually, to contribute in various ways, which were rather felt than acknowledged, to the progress of his favourite science.

Article II.

Memoir upon the Geography of the Plants of France, considered more especially with Regard to their Height above the Level of the Sea. By M. De Candolle. (Abridged from the Third Volume of the Memoirs of the Society of Arcueil.)

The geography of plants is almost a new science; although it had been attended to by Linnæus and some of his successors, yet the first writer, who can be considered as having treated upon it in a regular and systematic manner, is M. De Humboldt.* As the facts that are stated in this paper are deduced from observations made in France, and of course in the temperate zone, while M. de Humboldt's are derived from the torrid zone, there may appear to be some difference in the results; but upon a close examination this difference will be found to be more apparent than real. All the general laws that are laid down as applicable to France may be shown to be conformable to those established by M. de Humboldt; and, indeed, the difference which there is in the facts is itself a verification of the general laws.

One of the most important points in botanical geography is to analyze with accuracy the influence which the absolute height of a place above the level of the sea produces upon vegetation. It is a complicated circumstance, depending upon a variety of causes, which are not necessarily connected together; in order,

* "Essai sur la Geographie des Plantes," 1 vol. 4to. 1807, "avec un Tableau representant les Hauteurs des Plantes des Cordilieres."—(See Ann. of Phil. vii. 373.)

therefore, to understand it in all its relations, it is necessary to examine separately all the external agents of vegetation. Height may act upon vegetables either *mediately* or *immediately*; height influences the temperature of the atmosphere and its humidity, and also the intensity of the solar light; but temperature, moisture, and light, all affect vegetation; therefore, in this way, height will act *mediately* on vegetables. Height has likewise the *immediate* effect of diminishing the density of the atmosphere, and it becomes a curious subject of inquiry, whether this diminished density can affect vegetation. All these different points will be considered in succession; and we shall begin with the effect of absolute height as operating by a change of temperature.

It is well known, that as we ascend into the air, the mean temperature diminishes according to a regular gradation, which is so well ascertained, that if we make the proper allowance for the influence of local and incidental circumstances, we can determine beforehand the mean temperature of a given place, by knowing its latitude and its absolute height. Vegetation, consequently. which depends so much upon temperature, must be much influenced by the latitude and the absolute height; and all the facts of which we are in possession tend to confirm this conclusion.

1. Every one knows that there are many plants which are only found at certain elevations; and it has been proved by M. Humboldt that this limitation of plants to definite heights above the level of the sea is the more constant the nearer we approach to the equator. This fact affords a strong presumption that the effect depends upon the temperature and not upon the rarity of the air.

2. Most of the plants of France which are indifferent to temperature are so likewise to absolute height, and grow from the borders of the sea to the summits of the mountains. In France there are about 700 wild plants, which are found naturally at very different elevations; of these the following may be cited as well known examples. The erica vulgaris and the erica tetralix, which cover many parts of the western coast, grow on the summit of Mount Calm, one of the Pyreneés, about 3,000 mètres high. The statice armeria is found in Holland, in districts that are below the level of the sea, and among the Alps, on the "Col du Bon-Homme," at an elevation of about 2,500 metres. The tussilago farfara and the lotus corniculatus, which are common at the level of the sea in France, are also found on Mount Jovet at an elevation of about 2,400 metres. The same kind of observations have been made with respect to cochliarea officinalis, thymus serpyllum, and vulgaris, digitalis purpurea, nardus stricta, potentilla verna, fritillaria meleagris, asplenium viride, anthoxanthum odoratum, and phleum pratense. Several species of the carices, scirpi, and junci are found in the same diversity of situations; and, in short, the number of plants to

which this remark applies is so considerable, as not to render it necessary to adduce any more particular illustrations. It is to be observed that the above examples are all taken from plants with conspicuous organs of fructification, the identity of which it is more easy to ascertain; if the cryptogamia be taken into account, the observation will apply still more generally.

3. Among those plants which cannot endure a temperature that is either too high or too low, we observe that when they grow in different latitudes, it is at such heights that the effect of the elevation may compensate that of the latitude. Thus many plants of the Alps and the Pyreneés grow in the plains of the north of France; and, on the contrary, the Lapland plants, when they grow in France, are found on the mountains. The saxifraga groenlandica grows on the Pyreneés, at an elevation of from 3,278 to 2,400 metres above the level of the sea; the Linnæa borealis is not found in the Alps at a height less than from 1,800 to 2,000 metres. The chesnut flourishes in the plains of the north of France, on the hills in the south of France, and ascend to a considerable height on the Appennines and on Ætna.

4. Plants which are cultivated on a great scale obey laws entirely corresponding to the above; those which vegetate in all latitudes vegetate also at all heights. M. Humboldt informs us, that the potatoe, which flourishes so well in our northern continents, is cultivated in Chili at a height of 3,600 metres. The same kind of remarks may be made upon the different species of grain, and they may be likewise extended to those plants which are more impatient of cold. The highest point in which maize is regularly cultivated is above the village of Lencans, in the department of the Lower Pyreneés, at a height of about 1,000 metres. Setting out from this point, which is in the 43d degree of latitude, and going 5° north, we come to the neighbourhood of Mans, the most northerly part where maize is cultivated. The same observations may be made upon the vine, the fig, and the olive; and from all the facts, both those that refer to wild, and those that refer to cultivated plants, we arrive at the same conclusion, that such as have limits relative to a mean temperature, have them equally in latitude and in elevation; and that, on the contrary, such as grow almost equally well at all temperatures, are found in all latitudes and at all heights.

Although these facts prove that the influence of temperature is very considerable, yet it has been observed that the mean temperature is by no means a correct guide for us to follow in the appreciation of the effects of climate upon vegetation. But it is to be remarked that the distribution of the heat in the different seasons of the year has a very powerful effect upon the life of vegetables, and, consequently, upon their geography. We know, that absolute elevation produces upon the distribution of the mean heat an effect analogous to distance from the equator; thus the nearer we are to the equator, or to the level of the sea, the less difference there is between the summer and the winter; while the further we are from the equator, or from the level of the sea, the more difference there is between the seasons. Hence we observe an analogy between these two situations with respect to climate, and a similarity in their vegetable productions. Thus the tree which thrives the nearest to the pole is the birch, and this same tree is found on the Alps above the region of the pines. In general, evergreens are rare both in the northern and much elevated regions, or, if they are found there, it is only such as have awl-shaped leaves, on account of the snow, which, accumulating on them, either freezes the young shoots or breaks the branches. In the wild state, perennial plants are more numerous in proportion to those that are annual, whether we recede from the equator or from the level of the ocean. There are certain causes which operate in a different manner upon cultivated plants; but this forms no objection to the general principle which has been laid down, or to the analogy which we observe between a northern latitude and a great elevation.

It is well known that light acts powerfully upon vegetables. It excites their transpiration, determines many of their motions, and seems to produce in them many chemical changes. When they are deprived of light they become white, flaccid, and drawn out; on the contrary, the effect of a bright light is to render them more vigorous, and to increase their colour, firmness, and all their sensible qualities. There are three different ways in which plants are subjected to the increased action of light, according to the situation in which they are found. In the equatorial regions the sun acts upon them, during the whole year, with great power; in the northern countries, during the summer, while the process of vegetation is going forwards, the sun remains a long time above the horizon; and in lofty mountains, the rarity or purity of the air causes the light to be more intense than in the plains. Many of the facts which have generally been ascribed to the operation of temperature upon plants would appear to be rather owing to the action of light. M. Humboldt has particularly attended to this subject, and has attributed to this cause the greater proportion of resinous and aromatic substances, which is found in plants that grow between the tropics, or on high mountains. It is probably owing, in a great degree, to the less intensity of the light, that alpine plants can seldom be made to grow luxuriantly on plains, where they generally acquire a blanched appearance and a delicate texture.

In proportion as we ascend in the air, the hygrometer shows that the degree of moisture continues to diminish. This habitual dryness of the air of mountains tends to increase the insensible perspiration of plants, and consequently the absorption by their roots. The fluid necessary for this purpose is generally supplied by the melting of the snow, with which the summits of the highest mountains are covered; and it is accordingly found that the fertility of the sides of mountains depends very much upon their being furnished with a regular supply of moisture. The frequent rains which occur in all elevated situations, in some measure supply the place of snow in mountains that are not covered by it. Plants that grow at great heights must always necessarily be watered by a fluid which is at a low temperature; and although we are not able exactly to learn the effect which is produced upon plants by the temperature of the water which is applied to them, yet we have many facts which would lead us to conclude that it must have a considerable influence. Gardiners know that tropical plants will not bear very cold water; and, on the contrary, it is observed on the sides of hills, that if we meet with a very cold spring, the plants that grow round it are such as we generally find in a colder climate. An observation the reverse of this has been observed with respect to warm springs, which are found to be surrounded by plants that are natives of a lower situation, or more southern latitude.

With respect to the question, whether the rarity of the air, which is the direct and immediate effect of absolute height, has any influence upon vegetation, we may observe, that as plants act chemically upon the air, especially upon the oxygenous portion of it, it is necessary that the atmosphere be sufficiently dense to supply them with the requisite quantity of oxygen. We have, however, reason to suppose that the air of the highest mountains is sufficiently dense for this purpose; the absolute quantity of oxygen absorbed by plants is not very considerable; it is further stated that they exhale as much oxygen as they absorb, and although M. Theodore de Saussure has observed that the succulent plants absorb the least oxygen, yet it is known that plants of this kind are not those which flourish the best in mountainous situations. M. Humboldt has suggested that a rare atmosphere may act upon plants by augmenting the evaporation, and perhaps the idea may be allowed to be correct; but the effect must be very inconsiderable, and is scarcely, if at all, to be perceived.

From the above remarks it appears that we may lay down six laws or general principles respecting botanical geography.

1. The degree of rarity of the atmospherical air, considered independently of every other circumstance, between the level of the sea and the limit of perpetual snow, does not appear to have any very essential direct action upon the geography of plants. 2. The geography of the plants of different regions is principally determined by the mean temperature, and by its annual phases. 3. As the mean temperature of a given place is determined by the latitude, the absolute height, and the exposure, it follows that the nearer we are to the equator, and consequently the more important the latitude and the exposure are, the more influence the absolute height has upon the habitation of plants,

whilst it loses its importance as we approach the poles. 4. The annual phases of the temperature, as well as the intensity of the light and the dryness, establish a strong relation between the vegetation of very elevated districts and that of the northern countries. 5. Annual and biennial plants, or to speak more correctly, those which fructify only once, become more rare in proportion as we remove from the equator, or from the level of the sea. In our climates there are very few which are elevated above 1,200 metres. 6. If we proceed upon the estimate, that in our climate 180 to 200 metres of absolute height affect the mean temperature almost in the same manner with a degree of latitude, we shall be able to fix the corresponding limits of vegetables in the scale of heights and in that of latitudes.

To the memoir are subjoined four tables, containing lists of the plants that are found in France, arranged according to the heights at which they grow. In the first, we have the plants which are never found in France below 2,000 metres of absolute height; in the second, those which are only found in France between 1,000 and 2,000 metres of absolute height; in the third, those which grow in France indifferently above 1,000 or 2,000 metres of height, but not below; and in the fourth, the plants which grow in France indifferently below and above 1,000 metres, omitting those the difference of which between the minimum and the maximum does not equal 1,000 metres. In all these lists there are no cryptogamian plants admitted. The results that may be collected from these tables are as follows: The first table contains 60 species all perennial; the second, 206 species all perennial; the third, 153 species; the fourth, 517 species. From these tables, besides the cryptogamian plants, which in France amount to 1,500 species, are excluded 700 annual plants, which, for reasons mentioned above, can only grow in places where the snow lies for a considerable length of time; 300 marine plants, which, having a necessity for salt water, cannot grow except on the sea coast, or in salt marshes; about 800 plants, which, requiring a certain degree of warmth, cannot grow in the plains of the north, or in the mountains of France; and, lastly, about 300 species, which are too rare or too little known to enable us to affirm any thing with certainty concerning them. There remains about 1,500 species, which grow in all situations indifferently, making up a total of 5,000 that are indigenous in France.

Article III.

Supplement to the Iceland Meteorology. By Mr. Gladstone and Mr. Park.

(Concluded from p. 175.)

Day of the month.	Hour of the day.	Degrees of therm. of Fahrenheit.	Remarks on weather.
1813.			
May 1	10 a. m.	47	Calm, clear; snow melting.
	8 p.m.	38	
2	9 a. m.	44	Calm, with light clouds and sunshine.
	2 p. m.	51	
3	8 a. m.	50	Clear. Wind E. morning; W. evening, and moderate.
	2 p. m.	54	
	3 p.m.	65 in the sun.	
4	10 a. m.	49	E. Rain in morning; afternoon fine.
	7 p. m.	45	
5	9 a. m.	48	N. E. moderate. Clear.
	1 p.m.	55	
6	10 a. m.	48	N. E. varying to S. E. and W. Fine.
	5 p.m.	50	
	9 p. m.	42	
7	9 a. m.	45	N. E. and N. W. Fine.
	7 p. m.	42	
8	9 a. m.	49	N. E. in the morning, with rain. Evening S. and fair.
	5 p. m.	48	
9	9 a. m.	51	N. W. and W. moderate. Evening, some rain.
	4 p. m.	50	
10	9 a. m.	48	N. Very fine and mild. In the evening, E. The Icelanders predicted to-day a gale of wind which did not take place.
	4 p. m.	50	
	4 p. m.	78 in the sun.	
11	10 a. m.	50	N. moderate. Clear. E. in the evening.
	12	48	
	1 p. m.	76 in the sun.	
	10 p. m.	37	
12	9 a. m.	39	N. E. with rain; evening, blows hard from N.
	3 p. m.	38	
	8 p. m.	30	
13	9 a. m.	30	N. N. E. blows fresh. Ice in the morning the thickness of a crown-piece. In the evening, E.
	4 p. m.	32	
	10 p. m.	22	
14	9 a. m.	35	E. moderate. The hills to the south of Reikiavig again covered with snow.
	8 p. m.	32	
15	10 a. m.	43	S. E. fresh breeze. Partially clear.
	3 p. m.	44	
	9 p. m.	33	
16	11 a. m.	46	S. E. a heavy gale all day. Clear, but hazy out at sea.
	10 p. m.	38	
17	9 a. m.	45	S. E. heavy gale still continues, with rain all day.
	12	50	
18	9 a. m.	46	S. more moderate. Heavy showers in the evening. A gale from the N. predicted by the Icelanders.
	3 p. m.	48	
	11 p. m.	35	
19	9 a. m.	46	N. Cloudy. In the evening a heavy gale from the N. Hills again covered with snow.
	6 p. m.	43	
20	10 a. m.	39	N. gale still continues. Cloudy. In the evening clear.
	6 p. m.	40	
	10 p. m.	35	

Day of the month.	Hour of the day.	Degrees of therm. of Fahrenheit.	Remarks on weather.
1813.			
May 21	9 a.m.	37°	N. Clear. A heavy gale all day.
——	3 p.m.	37	
22	10 a.m.	38	N. E. fresh breeze. Very clear.
	11 p.m.	32	
23	10 a.m.	44	N. E. Very fine. Evening, N. W.
——	2 p.m.	46	
24	9 a.m.	45	N. W. Fine. Evening, N. E.
	7 p.m.	47	
		in the sun.	
25	9 a.m.	49	N. moderate. Rain. Afternoon calm; clear.
	1 p.m.	51	
26	10 a.m.	52	Calm. Afternoon, rain.
	2 p.m.	52	
27	10 a.m.	51	N. W. Cloudy. Evening, E.
	2 p.m.	53	
28	9 a.m.	49	E. Clear, fine. Evening, a heavy squall from N.
	8 p.m.	43	
29	10 a.m.	53	S. E. rain; blows fresh.
	3 p.m.	53	
30	11 a.m.	54	S. E. blows hard. Rain. Evening moderate.
	8 p.m.	47	
31	9 a.m.	52	S. E. moderate. Rain. Afternoon, W.
	3 p.m.	50	
June 1	11 a.m.	47	S. W. blows fresh. Cloudy. Afternoon, a gale from W.
	6 p.m.	42	
2	10 a.m.	45	W. moderate. Evening S. and fine.
	4 p.m.	46	
	7 p.m.	48	
3	10 a.m.	48	S. moderate. Rain all day. Very thick.
	3 p.m.	48	
4	10 a.m.	52	S. W. moderate. Rain all day.
	8 p.m.	48	
5	10 a.m.	58	N. moderate. Fair. Evening, S. E. and rain.
	7 p.m.	55	
6	10 a.m.	53	S. moderate. Fair. Afternoon, continual rain.
	11 a.m.	59	
	3 p.m.	53	
7	10 a.m.	51	N. W. Cloudy. Squalls.
	7 p.m.	46	
8	9 a.m.	45	E. varying to S. E. and N. E. Evening, blows hard.
	2 p.m.	52	
9	11 a.m.	44	N. Clear. Blows fresh.
	5 p.m.	51	
	8 p.m.	52	
10	11 a.m.	56	N. E. Cloudy, but fine.
	6 p.m.	56	
11	10 a.m.	50	N. E. moderate. Fine.

On this day we left Reikiavig for the interior of the island, and did not return until the 15th of this month. During this period I have only the following short notices of the thermometer: at Reikum, hot springs, on the 13th, in the shade, 60°; in the sun, 68°. Wind S. Very fine.

15	4 a.m.	47	S. W. Very fine.
	2 p.m.	54	
	midnight	44	
16	10 a.m.	54	N. E. fresh breeze. Cloudy.
	12 m.	60	

Day of the month.	Hour of the day.	Degrees of therm. of Fahrenheit.	Remarks on weather.
1813.			
June 17	11 a.m.	61°	N. W. nearly calm. Fine.
	8 p.m.	49	
18	10 a.m.	58	N. Very fine.
	11 a.m.	79 in the sun.	
	9 p.m.	52	
19	11 a.m.	62	S. E. Clear. Afternoon, some rain.
	12 m.	65	
	7 p.m.	58	
20	12 m.	57	N. Cloudy. Evening, fine.
	11 p.m.	48	
21	11 a.m.	55	S. E. moderate. Rain.
	5 p.m.	55	
22	10 a.m.	55	N. W. nearly calm. Fine.
	12 m.	70 in the sun.	
		64 in the shade.	
23	11 a.m.	57	S. E. fresh breeze. Rain. Very thick.
	6 p.m.	51	
24	11 a.m.	59	N. W. Clear; very fine: the most pleasant day we have yet had in Iceland.
	2 p.m.	71 in the sun.	
		64 in the shade.	
25	11 a.m.	56	S. E. moderate. Rain.
	12 m.	62	
	12 mid-night	50	
26	10 a.m.	56	E. varying to N. and N. W. Fine.
	11 a.m.	58	
27	11 a.m.	58	N. E. Fine, clear.
July 1	12 a.m.	58	N. W. Clear, fine.
	9 p.m.	54	
2	11 a.m.	54	N. W. moderate. Very fine.
	2 p.m.	54	
3	10 a.m.	58	W. fresh breeze. Cloudy, but fine.
	2 p.m.	59	
4	11 a.m.	61	S. E. ditto, ditto.
	5 p.m.	60	
5	11 a.m.	64	E. moderate. Cloudy.
	4 p.m.	65	

6. Again left Reikiavig for the interior until the 16th inst. On our return we received the following observations on the thermometer from a gentleman there.

7		61	N. Very fine.
		93 in the sun.	
8		57	N. blows hard, but fine.
		68 in the sun.	
9		74 in the sun.	N. moderate. Very fine.
10		58	S. heavy gale and rain all day.
11		56	S. E. moderate. Showers.
12		59	Ditto, ditto.
13		60	S. E. moderate. Fine.
		61	

Day of the month.	Hour of the day.	Degrees of therm. of Fahrenheit.	Remarks on weather.
1818.			
July 14		61°	S. E. Showers. Afternoon fine.
		58	
15		58	S. a gale. Showers. Evening calm, and heavy rain.
		61	
16			

On the 9th of this month the thermometer stood at the foot of Mount Hecla at 2 p. m. 65°; and on the following day, in the afternoon, on the summit of the mountain, at 31°.

17	7 p.m.	55	Calm, rain. Evening N. E.
	11 p.m.	54	
18	11 a. m.	62	S. E. heavy gale, with showers.
	7 p.m.	59	
19	8 a. m.	59	N. W. Clear, fine.
	11 p.m.	55	
20	8 a. m.	58	S. W. moderate. Fine.
	5 p.m.	60	
	11 p.m.	58	
21	9 a. m.	65	Calm, fine. Afternoon S. E. Rain heavy all night.
	4 p.m.	57	
22	10 a. m.	56	S. E. moderate. Cloudy.
	12 m.	63	
	9 p.m.	57	
23	10 a. m.	58	Calm, hazy. Afternoon clear.
	2 p.m.	66½	
24	11 a. m.	62	Calm, clear; the most beautiful day we experienced during our stay in the island.
	2 p.m.	91 in the sun.	
	3 p.m.	64	
26	9 a. m.	67	Calm, clear.
	12 m.	65	
27	10 a. m.	64	N. W. Fine. Blew fresh in the evening.
	10 p.m.	56	
28	10 a. m.	61	N. E. fresh breeze, but fine. Evening S. E. a gale, with heavy rain all night.
	12 m.	63	
	5 p.m.	65	
29	10 a. m.	63	S. E. blows hard, with showers. Evening calm.
	2 p.m.	63	
30	10 a. m.	57	S. E. Rain. Afternoon fine.
	11 p.m.	54	
31	9 a. m.	61	N. W. Very fine.
	10 a. m.	82 in the sun.	
	3 p.m.	62	
Aug. 1	10 a. m.	57	S. E. fresh breeze. Heavy rain all day.
	2 p.m.	56	
	8 p.m.	56	
2	9 a. m.	65	E. Rain all day.
	5 p.m.	57	
3	9 a. m.	63	S. E. Cloudy. Evening N. E.; a gale, with rain all night.
	9 p.m.	57	
4	10 a. m.	55	E. and S. E. blows hard, with rain.
	7 p.m.	56	
5	9 a. m.	58	S. E. blows fresh, with showers.
	3 p.m.	64	
6	12 m.	63	S. E. ditto, ditto.
	6 p.m.	60	
	2 p.m.	59	S. E. ditto, ditto.
			N. W. Very fine.

Day of the month.	Hour of the day.	Degrees of therm. of Fahrenheit.	Remarks on weather.
1813.			
Aug. 9			S. E. a hurricane, with torrents of rain. An old man who to-day crossed the mountains to the S. of Reikevig, says he never before witnessed so heavy rain in Iceland.
10	9 a. m.	55°	S. E. a gale, with rain.
	7 p. m.	49	
11	10 a. m.	56	N. E. moderate. Cloudy. Evening, N. W. Fine.
	7 p. m.	54	
12	11 a. m.	55	N. W. moderate. Fine. A gale predicted by the Icelanders from S. E. which actually took place the following day.

On the 14th inst. left Iceland for England.

Mr. Park's Continuation of the Register.

Day of the month.	Therm.	Wind.	Remarks on weather.
1813.			
Aug. 15	54°	SW	Much rain, and blowing fresh until noon; the afternoon fine.
	58		
	51		
16	53	SW	Showery and thick weather; the evening fine.
	47	N	
17	47	N	Fine weather. Strong wind.
	52		
18	51	NW	Very fine, clear weather.
	48		
19	54	WNW	Remarkably clear until noon; the afternoon, thick weather.
	60	W	
20	53	W	Thick weather. Blows fresh.
	51		
21	55	W.	Thick weather, with rain. Breeze.
	50		
22	59	W	Showery, thick weather. Breeze.
	54	SW	
23	59	E	Nearly calm the former part of day. A fresh breeze, and rain in evening.
	64		
	51	SE	
24	60	E	Fine weather until noon; incessant and heavy rain in the evening. Blowing fresh; a gale with rain in the night.
	64		
25	55	S	A gale, with rain, the whole day; the gale very heavy in the night.
	49		
26	51	W	Fine until noon; in the afternoon much rain.
	49	E	
27	55	SE	Blowing fresh, with rain.
	50		
28	54	S	Thick rain. A breeze.
29	56	SW	Thick weather. A breeze.
	59		
	52		
30	51	SW	A gale, with rain, until noon; the evening calm.
		SE	
31	50	SE	Heavy rain until noon, blowing fresh; the evening fine and calm.
	47		
Sept. 1	49	E	Fine weather. A breeze until noon. Heavy rain in afternoon.
	53		
	49		

Day of the month.	Therm.	Wind.	Remarks on weather.
1813.			
Sept. 2	54°	NW	Very fine weather. A breeze.
	47	N	
3	44	NE	Dark weather, blowing hard.
	50	N	
	44		
4	44	N	Very thick, dark weather, blowing hard: there appears to be a fall of snow in the mountains; the whole of Essian obscured during the day: in afternoon a heavy gale, with rain; and occasionally a sprinkling of snow.
	39		
5	40	N	The gale continues. Weather rather clearer, the mountains covered with snow to their base. The gale tremendous in the night.
6	34	N	The gale has moderated a little. Thick snow, which ceased at five p. m., and weather better; a hard frost in the night.
	33	WNW	
7	32	E	A breeze. Very fine weather; a hard frost in night.
	42	S	
	31	SE	
8	33	E	Remarkably clear, fine weather.
	48	W	
9	38	SW	Very fine, clear weather. A breeze.
	48	NW	
	42	E	
10	48	SE	Showers of rain. A breeze.
	46	S	
11	47	S	Occasionally calm, heavy rain until noon, the afternoon fine.
	50		
12	46	S	Very clear, fine weather. A breeze.
	43	WSW	
13	49	NW	Same as yesterday.
	51		
14	46	SE	Thick rain. A breeze.
	49		
15	46	ENE	Thick, occasional showers, blowing fresh.
	50	S	
16	48	ESE	Showers, blowing hard until noon. A gale, with heavy rain, in afternoon.
	55		
	46		
17	49	ESE	Thick rain, and a gale, which abated in evening.
	52		
18	50	SE	Showers former part of day; the afternoon very fine. A breeze. Northern lights very brilliant.
	57		
	72 in sun.		
	46	NW	
19	47	ENE	Clear, fine weather the fore part of the day; heavy rain in afternoon. A breeze.
	54		
	46		
20	48	SE	Showers, and thick weather the fore part of day; the afternoon fine. A breeze.
	55		
	46	SW	
21	50	SE	Thick showers. A breeze.
	54		
22	48	E	Fine weather. A breeze.
	52	N	
		NW	
	44	W	

Day of the month.	Therm.	Wind.	Remarks on weather.
1813.			
Sept. 23	45°	E	Fine weather. A breeze.
	54		
	46	SE	
24	50	E	Same as yesterday.
	57		
	46		
25	48	SE	A breeze. Rain the whole day.
	57		
	46		
26	49	E	Thick weather; showers. A breeze.
	54		
	47	SE	
27	44	NE	Very fine, clear weather. A breeze.
	52	NW	
	47		
28	49	E	Rain, and blowing hard.
	53		
	46		
29	50	SE	As yesterday.
	52		
	47		
30	44	N	A gale. Very clear. Northern lights very brilliant.
	38		
	56 in sun.		
	35		
	29½		
Oct. 1	35	NE	Blowing fresh. The lake covered with ice half an inch thick.
	42		
	36		
2	42	NE	Blowing hard. Clear.
	48		
	38		
3	40	NE	A gale.
	43		
	37		
4	38	NE	The gale continues.
	42		
	36		
5	36	NE	The gale continues. In the evening heavy rain. The gale ceased in night.
	40		
	37		
6	50	NE	Very fine weather. A breeze.
	56		
	48		
7	46	N	Blowing fresh, former part of the day; in the afternoon a gale.
	48		
	43		
8	28	NE	Remarkably clear, fine weather. A breeze. Northern lights brilliant.
	36		
	63 in sun.		
	26		
9	36	NE	Rain, with breeze; in the afternoon blowing hard.
	42		
	40	SW	
10	34	N	Blowing fresh; a gale in the night.
	38		
	40		

Day of the month.	Therm.	Wind.	Remarks on weather.
1813.			
Oct. 11	31°	N	The gale continues.
	35		
	27		
12	30	N	The gale continues. The lake frozen hard.
	34		
	26		
13	32	N	Breeze. Fine weather.
	37		
	28		
14	21		Remarkably clear, still weather.
	30		
	27½		
15	28		Same as yesterday; skaited on the lake. The Aurora Borealis more brilliant than I have seen them.
	31		
	26		
16	27		As yesterday. A breeze in the evening.
	30		
	26	NE	
17	30	N	Blowing fresh. A sprinkling of snow in the middle of the day.
	31		
	29		
18	29	N	Blowing fresh. Thick in the mountains. A heavy gale in the night.
	31		
	28		
19	27	N	Blowing hard. Thick in the mountains.
	31		
	26		
20	23	N	A breeze; in the afternoon blowing hard.
	31		
21	30	N	Blowing fresh in the Bay; nearly calm at Reikevig. A very severe frost in the night. This is called by the Icelanders the first winter day.
	31½		
	30		
22	31	SE	Thick weather. A breeze the fore part of the day. In the afternoon heavy rain.
	36		
	38		
23	31	SE	Thick rain. Breeze.
	36		
	38		
24	44	SE	Same as yesterday.
	45		
	43		
25	40	W	Fine weather. A breeze.
	41½		
	38		
26	37	W	Occasional showers of hail, though fine for the most part. A breeze.
	40	SW	
27	26	NE	Fine weather. A breeze. A fall of snow in the night.
	25	E	
28	38	SE	Heavy rain, blowing fresh; much snow in the night.
	36	S	
	31	SW	
29	29	N	A gale.
	31		
	26		
30	27½	N	The gale continues; short intervals quite calm.
	26		
31	28	N	The gale continues, with snow; the gale ceased in night.
	29		

Day of the month.	Therm.	Wind.	Remarks on weather.
1813.			
Nov. 1	21°	NE	Fine weather. A breeze.
	26	E	
2	29	N	A breeze, and very fine weather.
	24		
	47 in sun.		
3	44	SE	Rain during the whole day. A breeze.
	45		
4	36	SW	Squalls, though for the most part fine; snow in the night.
	38		
5	30	E	A breeze, with occasional showers, and hail and snow; a heavy gale in the night.
	33		
6	33	SE	Thick snow all the day; very dark.
	34		
7	28	E	Very fine weather. The face of the country covered with snow to a great depth.
	29		
8	29	N	A heavy gale; it ceased in the night.
	30		
9	22	N	Very fine weather. A moderate breeze.
	17		
	16		
10	26	NE	Fresh breeze. Snow in the night.
	30		
11	36	E	Fresh breeze. Thick weather.
	33		
12	21		Calm at Reikevig, but blowing a gale *out* at N.
	19		
13	33	NE	Blowing fresh. Thick snow.
	30		
14	36	W	As yesterday.
	33		
15	21	W	Blowing hard. Much drift snow.
	19		
16	12	ENE	Blowing fresh. The weather clear and fine. The thermometer rose nine degrees in half an hour.
	9		
	18		
17	26	N	Same as yesterday.
	23		
18	29	N	As yesterday.
	27		
19	17	N	As yesterday.
	11		
20	15	N	A gale. Clear weather.
	12		

ARTICLE IV.

Chemical and Physiological Researches on Ipecacuanha. By MM. Magendie and Pelletier.*

THE authors remark that although the natural history of this substance has been accurately examined, yet we are still only

* Abstracted from a paper read to the Royal Academy of Sciences, Feb. 1817.

very imperfectly acquainted with its chemical and physiological properties. They accordingly divide their memoir into two parts, corresponding with these two subjects.

With respect to the chemical composition of ipecacuanha, the last experimentalist who has examined it, before the authors of the present memoir, is M. Masson-Four; and the result of his examination is, that it consists of gallic acid, mucilage, extract, and resin. He conceives that the active principles of this root are the extract and the resin; that alcohol dissolves the resin, the gallic acid, and a portion of the extract; that water takes up the mucilage and the gallic acid, but that it does not dissolve any of the resin. This analysis is so manifestly imperfect, that MM. Magendie and Pelletier resolved to undertake a new examination of it, and they extended their researches to three different articles, which are all employed under the name ipecacuanha, although belonging to different genera of plants. The first is the brown ipecacuanha, derived from the psycotria emetica; second, the grey ipecacuanha, produced by the callicocca ipecacuanha; and third, the white ipecacuanha, the viola emetica.

The brown ipecacuanha, that procured from the psycotria emetica, was the one first examined. The cortical part of the root, being possessed of the most active properties, was separated from the ligneous part, and was made the subject of the following experiments. It was reduced to powder, and then digested with sulphuric ether, first at the temperature of the atmosphere, and afterwards artificially heated. The ethereal tinctures were evaporated, and a fat, oily, odoriferous substance was procured. The ipecacuanha which had been acted upon by ether was then digested in hot alcohol, until nothing more could be extracted from it by this re-agent. Some white flakes, of a matter which resembled wax, separated from the alcoholic tincture; and more of this waxy substance was procured by dissolving in cold water the residue obtained by evaporating the tincture. This residue was of a reddish-saffron colour. The part of the ipecacuanha which is soluble in cold water, was procured by evaporation on the water-bath; it was reddish-brown, very deliquescent, bitter, and nearly without smell; it was powerfully emetic, and slightly reddened blue vegetable colours. The acid which this extract contained was in very small quantity; it was conceived to be the gallic acid from its producing a green colour with acetate of iron.

The extract was precipitated from its solution by acetate of lead; the precipitate was washed, and the lead separated by sulphuretted hydrogen, by which the emetic principle was obtained in a separate state. From the nature of the action of the acetate of lead in this process, it is probable that the substance which it precipitates is homogeneous. When alcohol had no more effect upon the ipecacuanha, it was treated with cold water, the water became mucilaginous, and by evaporation a grey substance was obtained, which, by means of alcohol, became white, at the same time that a quantity of the emetic matter was separated from it. The white substance that was left seemed to be a pure gum; by means of the nitric acid it furnished oxalic and mucous acids. What was then left was the ligneous matter combined with a quantity of starch; these two substances were very closely united together, so that there was some difficulty in separating them. The presence of the starch was indicated by the effect of iodine upon it, which instantly produced a beautiful blue colour when added to the fluid containing it. The mean results of a number of experiments gave the following proportions for the constituents of the cortical part.

Fat oily matter	2
Emetic matter	16
Vegetable wax	6
Gum	10
Starch	42
Woody matter	20
Trace of gallic acid	
Loss	4
	100

The following is the analysis of the internal woody matter:

Emetic matter	1·15
Extract not emetic	2·45
Gum	5·00
Starch	20·00
Woody matter	66·6
Traces of gallic acid and fat	
Loss	4·8
	100·00

The extractive matter, indicated in this last analysis as not being emetic, seems exactly to resemble the common extracts procured from woody substances in general; it may be separated from the emetic extract by the gallic acid, which does not act upon the common extract, while it forms with the emetic extract a very copious precipitate.

The authors then proceed to examine more particularly the properties of the fatty matter and the emetic matter. The fatty matter, which is separated from ipecacuanha by means of ether, is of a beautiful brownish yellow colour, and communicates to alcohol and to ether a bright golden hue; it has the hot and acrid flavour of an essential oil, and contains the substance which gives ipecacuanha its specific odour. By heating or distilling it with water, it may be separated into two parts, one a more volatile odoriferous oil, the other a more fixed oil, which has generally been regarded as a resin.

To obtain the emetic matter in its most pure state, the following process may be employed. The ipecacuanha in powder is to be treated with sulphuric ether, until all the fatty matter is dissolved; then alcohol is to be digested on it, the tincture is to be evaporated on the water-bath, and the residue redissolved in cold water, by which the wax is separated; it is then to be macerated on carbonate of barytes to remove the gallic acid, again dissolved in alcohol, and evaporated. The emetic matter when dried is in the form of transparent scales of a reddish-brown colour; it has scarcely any odour; a bitter taste, slightly acrid, but not nauseous; it is decomposed by a heat greater than that of boiling water; no ammonia is produced from it by distillation, thus proving that it contains no azote; it deliquesces in the atmosphere; it is dissolved by water in all proportions without experiencing any change; it is not capable of being crystallized. It is decomposed by concentrated sulphuric acid; nitric acid dissolves it, and has its colour changed to a deep red, afterwards it becomes yellow, a large quantity of nitrous gas is disengaged, oxalic acid is formed, but none of the bitter yellow matter. The gallic acid precipitates it from its solution either in alcohol or in water; the alkalies when they are concentrated seem to change its nature and properties, but the substance which of all others appears to have the most powerful effect upon it is the sub-acetate of lead; it precipitates it completely from all its solutions. The authors conclude from all their experiments, that the emetic matter is a substance *sui generis*, possessed of peculiar and specific properties; they conceive it to be an immediate principle of vegetables, which is found in plants that belong to different families, and appears to possess the same properties in all cases. From its distinguishing property, they propose to give it the name of emetine.

We have afterwards the analysis of the callicocca ipecacuanha, which is as follows:

Emetine	14
Fatty matter	2
Gum	16
Starch	18
Woody matter	48
Loss	2
	100

The following is given as the analysis of the viola emetica;

Emetine	5
Gum	35
Vegeto-animal matter	1
Woody matter	57
Loss	2
	100

In the second part of the paper, the authors give an account of a number of experiments which were performed, first on brutes, and afterwards on the human subject, in order to ascertain the physiological and medical properties of the fatty matter and the emetine, the only constituents which appeared likely, from their sensible properties, to possess any active virtues. It did not appear that the fatty matter had any particular operation upon the stomach, whereas the emetine was found to act very powerfully. We shall omit the detail of these experiments, and shall conclude this abstract by quoting the three general propositions which the authors lay down as the result of their observations.

1. There exists in the three species of ipecacuanha which are the most used, a peculiar substance which we have called *emetine*, and to which these roots owe their medical properties. 2. This substance is emetic and purgative, and it has a special action upon the lungs and upon the mucous membrane of the intestinal canal; it has besides a well-marked narcotic quality. 3. Emetine may be substituted for ipecacuanha in all cases where we employ this medicine, and with the more advantage as this substance in a determined dose has always constant properties, which is not the case with the different species of ipecacuanha that are met with in commerce, and it has also the further advantage of having very little taste, and scarcely any odour.

Article V.

Analytical Researches on Bitter Almonds. By M. Vogel.*

The almonds were immersed in hot water for a very short time, in order to remove the brown powder and the cuticle with which they are covered. These parts were found to consist of a membranous tissue, containing a portion of tan and fat oil. The almonds were then subjected to strong pressure, so as to extract

* M. Vogel's paper was read to the Munich Academy in July, 1814: an extract from it was printed in the Journ. Pharm. for Aug. 1817, of which the above is an abridgment.

all their oil from them; the oil obtained in this way does not differ from that of the sweet almond. The cake left after the pressure was distilled with water in a large retort; the distilled water reddened litmus, and after being saturated by ammonia forms prussian blue with sulphate of iron; a quantity of a yellowish transparent oil was also obtained, which sunk to the bottom of the vessel. The residue in the retort was found to contain both saccharine matter and gum; and when it was freed from a portion of oil which still adhered to it, and from all soluble matter, it was found to exhibit the properties of animal cheese, being a chemical combination of oil and albumen. When an almond emulsion is made with cold water, a fluid is procured which is almost precisely similar to animal milk; it coagulates by acids, by alcohol, by the electric spark, and by heat; a cream separates from it, which may be converted into a species of butter; and the emulsion, after the separation of its coagulum, resembles the whey of milk. M. Vogel found that the emulsions of a variety of seeds, and also of different kinds of nuts, was of the same nature with that of the almond, and almost exactly resembled animal milk.

The essential oil obtained by distillation possesses some remarkable properties. When the water is taken from it as much as possible it loses its fluidity, assumes a waxy consistence, and finally crystallizes in the form of plates and needles. When the oil is kept in a fluid state under water, after some days it becomes opaque and solid, and after an interval of some weeks it entirely disappears. The oil burns with a very brilliant flame; it is partially dissolved by potash, and also in some degree by ammonia. When it is exposed to the air in small quantities, it is very shortly converted into a crystalline, semi-transparent mass; these crystals are soluble in alcohol and in ether. By this change it nearly loses its inflammability; it melts when sufficiently heated, and again resumes the crystalline form; its sensible properties are likewise much affected. When the oil passes to the crystallized state, it absorbs oxygen. Dr. Sœmmering, son of the Professor of the same name, gave portions of the essential oil, as well as of the distilled water of bitter almonds, to dogs, and it proved fatal in all cases. Where the dose was large, the animals fell down dead instantly, as if they had been struck with lightning; the others perished in a few minutes. The doses are not stated which were employed by Dr. Sœmmering. Notwithstanding this poisonous property of both the oil and the distilled water of bitter almonds, we are informed that Dr. Horn, of Berlin, administered to fever patients in "La Charité" six drams of bitter almonds daily, in the form of an emulsion. In this case it is conjectured that the oil and prussic acid were so modified by the other ingredients as to have had their deleterious quality much diminished or entirely counteracted.

From these and other facts which were ascertained by M. Vogel, he draws the following conclusions.

That 100 parts of bitter almonds contain the following ingredients:

Envelope	8·5
Fat oil	28·0
Caseous matter	30·0
Sugar	6·5
Gum	3·0
Vegetable fibre	5·0
Heavy volatile oil	
Prussic acid	

That the emulsion of bitter almonds has a very great analogy with animal milk; that many seeds and fruits, besides almonds, contain the same caseous matter; that the emulsions are coagulable by acids, alcohol, heat, and electricity; that the bitterness of the almond resides principally in its volatile parts, i. e. the prussic acid and the essential oil; that the essential oil may be obtained separate from the prussic acid, and that it will communicate to water the odour and taste of prussic acid, without giving it the property of forming prussian blue with iron; that the essential oil rectified with barytes, lime, or the red oxide of mercury loses its fluidity by the contact of the air, and gradually assumes the state of white crystals, which are almost without smell, and less volatile than the fluid oil.

We have subjoined M. Boullay's analysis of the sweet almond, both as a confirmation of M. Vogel's very interesting analysis, and in order that the clear priority of discovery, that the emulsive seeds contain not starch but albumen, may remain with M. Vogel.—Ed.

Analysis of the Sweet Almond (Amygdalus Communis). By M. Boullay.*

The almonds were first exposed to a heat of about 120° of Fahrenheit during a space of three days, in order to drive off any water which they might contain. They were then immersed in hot water for the purpose of detaching the cuticle, and afterwards made into an emulsion with water. The emulsion, by standing for some time, threw up a cream to the surface and deposited a residuum; these, as well as the fluid itself, were all separately examined. The cream was a compound of oil and a coagulable matter; the same kind of coagulum was obtained from the fluid part, and principally composed the residuum; these coagula were both mixed with portions of the oil. When

* Abridged from Journ. Pharm. Aug. 1817: the same paper is likewise inserted in Ann. Chim. Dec. 1817.

the coagulum was separated from the emulsion, a fluid was left which seemed very similar to the whey from animal milk; it was saccharine, and after some time acetic acid was developed in it; at a still later period it became alkaline.

One hundred parts of sweet almonds, bruised and strongly squeezed, produced 480 parts of an oil, which was slightly yellow, almost without smell, of a sweet taste, soluble in the cold in 50 parts of alcohol and in two parts of sulphuric ether. By digesting the residue in ether, 60 parts more of the oil were obtained from it. The almond paste, when deprived of its oil, mixed with a sufficient quantity of cold water, and then forcibly squeezed, discharged a fluid which slightly reddened litmus, was coagulated by alcohol, tan, chlorine, the different acids, and the salts of lead and mercury. This fluid was also coagulated by heat. The substance that was left after the pressure, when dried by a gentle heat, became semi-transparent and brittle, and remained for a long time without experiencing any change; it was nearly without taste or odour. This was the same substance which had been separated from the almond cream, and also from the emulsion by heat, and it was found to possess all the properties of albumen. A quantity of this albumen was still retained in the fluid, and it was likewise found to contain a true gum, very similar to gum arabic. Alcohol separated from the mass a quantity of saccharine matter, which, however, could not be made to crystallize. By employing the test of iodine, it appears that there is no starch in the almond. There was a quantity of residuum after removing the oil, the albumen, the sugar, and the gum, which seemed to be of a ligneous or fibrous nature. M. Boullay states the proportion of the constituents of the sweet almond to be as follows:

Water	3·5
Pellicles	5·0
Oil	54·0
Albumen	24·0
Liquid sugar	6·0
Gum	3·0
Fibrous part	4·0
Loss and acetic acid	0·5
	100·0

The following remarks present themselves on the above analysis. 1. The emulsion of almonds is almost precisely similar to the milk of the mammiferæ. 2. The caseous matter, which is separated from the almond emulsion, consists of coagulated albumen and fixed oil, like the cheese of milk. 3. It is to the great quantity of albumen which it contains that almond emulsion possesses the property of clarifying fluids in the same way that milk does. 4. All the emulsive seeds contain albumen in the same state, although in different proportions, both with respect to the whole mass and to the oil. 5. Almond whey may, in many cases, form a mild and pleasant beverage to invalids, where the emulsion could not be digested, in consequence of the quantity of albumen which it contains. 6. Starch, or amylaceous fecula, does not form the base of the emulsive seeds, as was formerly supposed to be the case.

Article VI.

Analysis of the different Varieties of Potatoes. By M. Vauquelin.*

The Society of Agriculture commissioned M. Vauquelin to undertake the analysis for the purpose of ascertaining the relative proportions of starch, parenchyma, and extract, which each species contained. The whole number of varieties which he examined was 47; of these, 11 varieties furnished from $\frac{1}{5}$ to $\frac{1}{4}$ of their weight of starch; two only yielded no more than $\frac{1}{8}$. The 11 varieties, which gave the most starch, lost only $\frac{2}{3}$ of their weight in drying; 10 lost $\frac{3}{4}$, and six nearly $\frac{4}{5}$ by this process. The author observes that the actual quantity of starch is greater than what may appear from his table, as a considerable quantity still remains attached to the parenchyma: so that he concludes that the poorest or least nutritive potatoe contains at least $\frac{1}{5}$ of its weight of starch, and the richest about 28 parts in the 100. The starch was separated from the parenchyma by employing a large quantity of boiling water; but it appears that in this way a portion of gummy matter would also be carried off, which is contained in the potatoe; that this is the case is proved by this circumstance, that mucic acid is formed by the action of nitric acid upon potatoe starch. The proportion of proper parenchyma appears to be very small, generally about 0·15, and often not more than ·01. When totally deprived of its starch and gum, the parenchyma appears to resemble mere woody matter.

The author examined the water in which the pulp of the potatoe had been washed; it was evaporated, and was found to contain a substance that was coagulable by heat, together with some that remained miscible with the water. The coagulable matter was separated, and from its sensible and physical properties seemed to be albumen. The soluble matter was then obtained by evaporation; it consisted of two substances, one soluble in alcohol, which appeared to be of a resinous nature,

* Abridged from Journ. Phys. August, 1817.

and one insoluble in alcohol; a number of small white brilliant crystalline bodies were contained in it, amounting to about 12 parts in 1000 parts of the potatoe, which were found to be the citrate of lime. The part of the extract insoluble in alcohol was then more particularly examined, and was found to contain several different ingredients; 1. A peculiar substance which resembles animal matter in its characters, a minute quantity of the substance that has been called asparagine, together with the phosphates of lime and of potash, and the citrate of potash. It is remarked that the resin and the animalized matter are the only sapid ingredients of the potatoe, and give it the superior flavour which is perceived when the potatoe is eaten roasted, but which is necessarily lost by boiling.

The following directions are given for the analysis of the potatoe. 1. To bruize the potatoe, to squeeze it, and to add a little water and again squeeze it strongly; to collect all the fluids, filter them, and afterwards boil them for some time. 2. To filter this liquor in order to separate the albumen, which has been coagulated by heat, to wash it and to dry it in order to know its weight. 3. To evaporate the liquor to the consistence of an extract, to redissolve this in a small quantity of water, in order to separate the citrate of lime, which must be washed with cold water until it becomes white. 4. To dilute the liquor with water, and to precipitate it by an excess of acetate of lead; to decant the fluid, to wash the precipitate repeatedly with cold water, and to add these washings to the decanted fluid. 5. To add a quantity of water to the precipitate obtained in the last step of the process, and then to decompose this precipitate by a current of sulphuretted hydrogen gas. 6. To filter the liquor and to evaporate it to the consistence of a syrup in order to obtain the citric acid in a crystallized state. 7. To precipitate in the same manner by sulphuretted hydrogen the fluid decanted from the precipitate. To filter the fluid, and evaporate it by a very gentle heat to the consistence of a syrup, or rather of a soft extract; to leave it in this state for some days to enable the asparagine to crystallize; afterwards to mix up this matter with a very small quantity of very cold water; to let it settle, to decant the fluid, and to wash it with small quantities of cold water until the asparagine be rendered white. 8. To concentrate again this fluid to the consistence of an extract, to treat it with alcohol heated to 86°, in order to separate the acetate and nitrate of potash, and to obtain the animalized matter as pure as possible.

M. Vauquelin concludes his paper with the results of his analyses of the 47 varieties of potatoes which were given him for examination, indicating the amount of solid residuum contained in each, and what part of this consisted of starch and of the parenchyma. We have no means of ascertaining which of the varieties that he employed are among those known in England, as, excepting in three cases, the names which he employs are different from those in use with us. These three are the champion, the oxnoble, and the kidney; 500 parts of the recent potatoe were employed in each experiment; in the champion the solid contents were 140 parts, of which 79·5 were starch, and 22 parenchyma; the oxnoble contains 132·5 parts of solid contents, 111·5 of starch, and 23·5 of parenchyma; the kidney contains 112·5 parts of solid matter, of which 82 are starch, and 22 parenchyma.

The greatest proportion of solid contents in any of the species is 165 parts in 500, in the variety which he calls the zelingen; and the least is 110 parts, in a variety called the marbled beaulieu. The largest quantity of starch is 119 parts in 500, in the decrosilles, and the least in the parmentiere, being only 20·5 parts in 500. The parmentiere, on the contrary, contains the largest proportion of parenchyma of any of the varieties, being 94·5 parts in 500, while some of them contain no more than 20 parts. The author does not, however, profess to have arrived at much accuracy in this part of his analysis, his attention having been more particularly directed to the examination of the substances contained in the water in which the pulp of the potatoe had been washed.

Article VII.

Analysis of a Siliciferous Sub-sulphate of Alumine, found in considerable Quantity in a Coal Mine near Oldham. By William Henry, M.D. F.R.S. &c.

Manchester, May 10, 1818.

About a month ago I received from Mr. W. Chippendale, of Oldham, in this county, a specimen of a substance which had been found, the day before, in the old hollows or abandoned works of the celebrated Black Mine, of which that gentleman is one of the proprietors. Above the coal, he informs me, lay a stratum, several feet thick, of a brittle, shivery stone, which, on the removal of the coal, had fallen down and occupied its place. It was on the surface of this fallen stratum that the miners, on breaking into the hollows, discovered a bed, from one inch to three or four inches thick, of a shining white substance, which they represent as having, before it was soiled by rubbish falling upon it, a singular and beautiful appearance. A considerable quantity, mixed with the earth removed in re-opening the works, has already been sent out, amounting to several hundred pounds' weight; and the workmen say that there is still a great deal in sight.

The colour of this substance, when a mass of it is cut into, is intermediate between snow-white and milk-white, except in places where it is streaked with peroxide of iron. It has the consistency of hogs-lard, for which indeed the miners mistook it, is perfectly smooth to the touch, and is, for the most part, moderately translucent, except in small patches where it is opaque and granular. Its taste is sub-acid, and it distinctly reddens paper stained with litmus. When exposed to the air it dries, and in drying splits into lengthened masses like starch, some of which are efflorescent on the surface, while others resemble in translucency the finest pieces of gum arabic. By a temperature of 160° Fahrenheit long continued, 100 parts are reduced to 13. These, by ignition, are further reduced to eight, and the fragments acquire hardness enough to scratch glass. The loss of weight, however, is not constant in different specimens, which evidently vary in their degree of moisture.

Chemical Properties.

1. The substance in its native state (or *hydrate* as it may be called) is miscible with water by trituration; and when a large quantity of water is added, it subsides slowly. Only a small part of it is soluble; for 100 grains digested with four fluid ounces of water, which was afterwards evaporated to half an ounce, gave a solution of the specific gravity 1006. It had the chemical properties of a weak solution of sulphate of alumine, and was very slightly contaminated with iron.

2. The hydrate dissolves readily, and with a scarcely perceptible residuum, in diluted sulphuric, nitric, and muriatic acids. With the first, it gives a solution, which does not yield crystals on evaporation, but a spongy, opaque mass, unless the addition be previously made of sulphate of potash, when it affords crystals of alum. The spongy mass which has been alluded to, if dried at a long continued heat of 160°, does not entirely re-dissolve in water, but a light flocculent substance floats in the liquid. This, when collected from a solution of 100 grains of the hydrate, weighed three grains, after being exposed to a low red heat. Suspecting, from its appearance when treated under the blow-pipe with fluxes, that it still contained alumine, I boiled it with sulphuric acid and a little sulphate of potash; washed, dried, and again ignited it, when it was reduced to 2·4 grains. These had all the properties of silica. The fact furnishes an additional proof that silica, though separately insoluble in certain acids, may accompany alumine into solution.* It shows also that silica, precipitated from a solution of alumine, carries down with it a little of the latter earth. The sulphuric solution of 100 gr. freed from silica, gave, by decomposition with carbonate of ammonia, 6·5 gr. of ignited alumine.

3. One hundred grains of the hydrate dissolved in dilute

* See Stromeyer, Ann. de Chim. lxxxi. 239; and Marcet, Geolog. Trans. i. 245.

muriatic acid gave, with muriate of barytes, a precipitate weighing 8·2 gr. equivalent nearly to 3 gr. of real sulphuric acid, which are capable of saturating 1·2 gr. of alumine, supposing with Berzelius that in alum 10·86 alumine are united with 26·13 sulphuric acid.

4. Solution of caustic potash in considerable excess, boiled in 100 gr. of the hydrate, did not dissolve the whole. There remained, in the form of light flocculi, a substance, which, when collected, washed, and ignited, weighed 2·6 gr. and had the characters of silica.

Alumine, silica, and sulphuric acid, with a large proportion of water, are the only ingredients discoverable in this substance, if we except a mere trace of lime, probably existing in the state of sulphate, which was discovered in its solutions by the agency of oxalate of ammonia. The proportions of its components may be stated as follows:

Water	88·1
Alumine	6·5
Sulphuric acid	3·0
Silica	2·4
	100·0

The quantity of alumine found in the hydrate by analysis being equivalent to the saturation of more than five times the sulphuric acid discovered in it, the principal ingredient may be considered as a *subsulphate of alumine*. To this may be added the epithet *siliciferous*, applied by M. Lelièvre to a somewhat similar mineral, which was discovered by him on the banks of the Oo, in the Pyrenees, and which yielded, on analysis, 44½ alumine, 40½ water, and 15 silex, but no sulphuric acid. To this mineral he has given the name of *siliciferous hydrate of alumine*.*

No water, I was informed, occurs in actual contact with the substance of which I have given an account; but Mr. Chippendale, at my request, has sent me a specimen of the nearest that could be found in the mine. The characteristic ingredient of this water is sulphate of iron, with which it is distinctly impregnated, and which is probably the agent employed by nature in decomposing the argillaceous stratum, that has given origin to the subsulphate of alumine.

* Ann. de Chim. et Phys. vi. 333.

Article VIII.

Anecdotes of the late Richard Kirwan, Esq. Extract from G. B. G.'s Journal of a Tour in Ireland in 1805.

Mr. Kirwan was a man of science at a time when there was scarcely another man of science within his reach. Even at this day he will find among his countrymen but few friends to assist, and few rivals to stimulate him. Notwithstanding this, his whole life has been devoted to the cause of philosophy; he has attempted almost every subject, and though he has not thoroughly succeeded in any, has established a reputation in every country of Europe except his own, where he is little thought of. Owing to some disorder, I believe in the throat, he never eats in company; and whether from an affectation of singularity, from a desire of living out of the world, or from some peculiar notions in regard to health, he makes it a rule to go to bed at eight o'clock, and to rise, if I mistake not, at four. His appearance is calculated to inspire respect; his manners are placid; and being of a communicative turn of mind, and possessed of an amazing deal of miscellaneous information, derived from all authors, ancient and modern, conversation never flags in his presence.

Judgment, a commodity not of Hibernian growth, is that in which he appears most deficient. He takes great pains to refute authors that have never been read, and shows his learning more than his good sense in quoting others that will never be believed. Like Dr. Richardson, for whom we may find an apology in his profession, he refutes the Huttonian theory by the Mosaic dispensation, and the theory of Desmarez by Barruel's Memoirs of Illuminism: he conceives that we are indebted for a large portion of our knowledge, particularly in astronomy, to the antediluvians, and that the first language spoken by man was Greek. This last opinion he calls his youngest child, and says it is no wonder, therefore, that it should be a spoiled child.

Mr. Kirwan calls almost daily at breakfast time. He is very fond of music: some years since he made a tour with Mr. Bunting into the most unfrequented parts of Ireland for the purpose of collecting old Irish airs, particularly those of Caladon and Conadon; he procured very few of them in Donegal, but was more successful in Galway, where a lady who had invited the travellers to her house, on discovering the motive of their journey, sent a messenger 30 miles across the country in search of a fiddler who could play these national tunes.

In the seventh century, when the rest of Europe was involved in ignorance, Ireland is said to have been the seat of refinement and the asylum of learning. Mr. Kirwan, in explanation of this circumstance, observed to me, that the barbarians confined their inroads to the Roman empire, and never found their way to Ireland, a country as yet unconquered and very little known.

Speaking of fashions, he assured me that he had known a man imprisoned for wearing a plaid, and a few years afterwards saw a Lord Lieutenant wear it.

Additional Notice of Mr. Kirwan. Communicated by a Correspondent.

Kirwan was originally intended for a profession (I believe medicine), and sent to be educated by the Jesuits at St. Omers. He used to speak highly of them, of the pains they took, and the ingenuity they exercised, in directing the studies of their pupils; and he told the following anecdote of himself. He had acquired from some ridiculous cause (I believe because a French tailor had disappointed him of a coat) a great dislike to the language, and said he never would learn it; he would read books in other languages, and apply to other objects of study, but he was determined never to learn French. His masters indulged him, they gave him books in English, Latin, German, &c. and some time after, when they found that he had become deeply interested in chemistry, they took away from him all books connected with that science in every other language; and he was obliged to learn French in order to enable him to prosecute his favourite pursuit.

On the death of his brother he succeeded to the family estate; he then left St. Omers, and abandoned all thoughts of a profession. You are, I dare say, aware, that the latter years of his life were devoted almost exclusively to theology, and that his opinions, on points of doctrine, were as varied and as fanciful as can be imagined. He courted the society of divines of various religious opinions, and such boasted of having Kirwan for a convert. It is said, however, that as he lived "Preux Chevalier" he died "Ferme Catholique," adding another instance to the many of the powerful effects of that religion, on minds even of a high order, and accustomed to the investigations of science. You know the variety of his knowledge, and the power he possessed of diversifying his conversation. I heard that Miss Owenson (now Lady M.) visited him very frequently during the latter years of his life, and that even in the midst of his theological pursuits, he was always ready to canvass the merits of a romance, or discuss the chemical composition of a new cosmetic, and that the latter very frequently formed the subject of their conversations.

Article IX.

On a Lamp without Flame. By Francis Ellis, Esq.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Lansdown Crescent, Bath, May* 11, 1818.

An experiment of Sir Humphry Davy's, in his Researches on the Combustion of Gaseous Mixtures, led me, last summer, to the simple mode of keeping a coil of platina wire once heated, in a state of ignition for an indefinite time, without further application of heat, which has been noticed in your *Annals* by the appellations of *the lamp without flame,* and *the aphlogistic lamp.* Subsequently it appeared to me probable that if this lamp were put into imperfect communication with the atmosphere, the accumulation of azote, carbonic acid, and other non-inflammable elastic fluids, might be so regulated as to reduce the temperature of the wire below ignition without interrupting the slow combustion of the alcohol, or the consequent new combinations. With this view, putting the ignited lamp into a hair-sieve of a few inches' diameter, and covering it with a glass funnel nearly closed at top, of rather smaller diameter than the sieve on which it rested, the wire soon became apparently extinct, and afterwards grew black. The continued deposition of moisture on the interior of the funnel showed, however, that the decomposition of the alcohol had not ceased; and when, after some hours, the funnel was removed, the lamp re-ignited with a distinctly perceptible crackling, caused by the inflammation of charcoal which had been deposited on the wire during its apparent extinction.

This experiment, first made in the light, was repeated in a dark room, and extended to ten, twelve, and eighteen hours. When performed in absolute darkness, there were sometimes extremely faint temporary emissions of light, which, I incline to think, may have been occasioned by my breathing, or otherwise agitating the external air, so as to produce irregular influxes of it through my rude apparatus.

The consumption of the alcohol is very trifling. On this and other accounts, whenever not actual light, but the power of producing light is the object, as during night in a bed-room, the lamp may be preferable in its apparently extinct state. Sir Humphry Davy remarks, that "the chemical changes in general produced by slow combustion appear worthy of investigation :" possibly in this investigation the lamp may be of some utility. "When the experiment of the slow combustion of ether is made in the dark, a pale phosphorescent light is perceived about the wire;" and with this appearance, he observes, is connected "the formation of a peculiar acrid, volatile substance possessing acid qualities." At his request, Mr. Faraday endeavoured to obtain it, by causing a mixture of the vapour of ether and common air to traverse a heated glass tube containing pieces of platina wire and foil, and terminating in a bottle placed in a freezing mixture. The quantity thus obtained, even after the process had been continued several hours, was so small as to induce Mr. Faraday to conclude, that "until some other process has been discovered for producing it, there is little hope of its being obtained in its pure state."* With the lamp I found no difficulty in collecting from the slow combustion of sulphuric ether a transparent, perfectly colourless fluid, of a penetrating odour, and peculiarly pungent acid taste. It may be procured in any quantity by placing over an ignited lamp, filled with ether, the head of a small glass alembic with the lip turned up inward, and regulating the admission of air at bottom, so that in the dark there may appear a cone of faint blue light issuing from the coil, while the wire itself seems scarcely ignited. To assist condensation, the upper portion of the alembic-head may be covered with bibulous paper, kept moist by the ends of some soft cotton threads resting on it, whose other extremities are immersed in cold water. Thus circumstanced, the fluid produced by the slow combustion of the ether will, after the process, be found collected in the lip of the alembic-head.

I am, Gentlemen, your very obedient servant,

FRANCIS ELLIS.

ARTICLE X.

On a Spiral Oar. By T. L. Dick, Esq. F.R.S.E.

(To Dr. Thomson.)

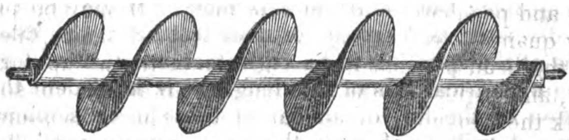
SIR, *Relugas, near Forres, April 8, 1818.*

WHEN I was lately in East Lothian, my friend Mr. Scott, of Ormiston, put some drawings into my hands, illustrative of an old project of his, for applying certain combinations of machinery to vessels of war, in order to enable them to sink the boats forming the flotilla of an invading enemy. These were likewise accompanied by explanatory manuscript observations. Were I to lay his paper before your readers at full length, I am convinced they would be gratified by the ingenuity it displays. But as we are now enjoying the propitious dawn of what we trust will be a long period of peace, and as the detail of such destructive inventions can now have no effect but to awaken harsh and

* Experiments, &c. on a new acid substance.—Journal of Science, No. V.

disagreeable associations, they are, perhaps, better forgotten. There is, however, a fragment connected with this scheme, which I think ought not to be lost, as it seems to promise to be of great utility. The invention to which I allude is the employment of a spiral oar; and as Mr. Scott has kindly permitted me to use every freedom with his communication, I shall venture to offer it to you. I must however, confess, that my limited knowledge of mechanics makes me hazard any remarks as to the variety of its possible applications with very great diffidence.

The figure which accompanies this is not meant as an accu-



rate fac simile of Mr. Scott's drawing, which is of proportions somewhat different, being more particularly adapted to the object he had in view; it is rather intended to convey a notion of the general principle of the spiral oar. It is extremely simple in its construction. It may be made of any given diameter, and the twists of the spiral fin twining around it, may be placed nearer to one another, or more distant, and the fin itself may be more or less expanded, as may be judged most expedient, and the materials also may be suited to the particular purpose the mechanic may have in contemplation.

When it is to be applied, as Mr. Scott intended, to each side of a ship, or boat, for propelling it through the water, he says, it must be made of a size every way corresponding to that of the body it is required to move. In this case there should be a strong iron axis, somewhat longer than the proposed length of the oar; in this, a hollow cylinder of plate copper, made water-tight, should be fixed, in which the spiral fin (made of the same material) may be inserted, running like a screw around it, as represented in the figure. The diameter of the cylinder must of course be proportioned to that of the projection of the fins; and I may remark, that the proportion of the latter, in the figure, would probably be found to be too great, compared to that of the former, if the oar were to be constructed for the purposes of navigation. The greater the diameter of the whole oar, and the greater the distance between each twist of the spiral fin, the greater will be the resistance it will meet with in revolving under water, and the greater will be the effect produced in accelerating the progressive motion of the vessel.

It is unnecessary for me to state Mr. Scott's methods of appending these spiral oars, or of giving motion to them; were I to describe these, several plates would be necessary; and I have no doubt many very effectual plans for doing both will speedily suggest themselves to every well-informed mechanic. It is chiefly the principle of the oar itself to which I wish to call your attention.

The spiral oar possesses many advantages over the common oar, and amongst these, Mr. Scott particularizes the following. The back stroke of the common oar, which is both a loss of time and of labour, is altogether avoided by the constant revolution of the spiral oar, continually tending to give a steady and unremitting progressive motion to the vessel. The ordinary oar cannot be made of large dimensions without becoming altogether unmanageable; but the spiral oars may be made eight or more feet in diameter, and sixteen or more feet long. Supposing the wreaths of the spiral fin to be eight feet apart, it will go twice round a cylindrical axis of this length. It is evident that each revolution of the fin, of an oar of these dimensions and thus constructed, will meet with the same quantum of resistance under water, as a circular plate of eight feet diameter would encounter, if similarly situated, and moving at the rate of eight feet in the time of one revolution of the oar; and that this resistance will increase as the square of the velocity of the oar increases.

The machinery giving motion to these oars might be very easily constructed in such a manner as to be wrought with ease by men, and with this advantage, that any man, whether sailor or not, could lend a useful hand *in giving way* to the vessel. That these oars would be peculiarly applicable to boats is manifest; and there can be no doubt that with proper machinery the progress of the boat would be much more rapid, and the working of it much less of a labour, than if rowed in the ordinary way. Were these spiral oars appended to larger vessels, which might be done in such a way as to admit of their being shipped or unshipped at pleasure, they might be of the utmost importance in calms; and above all, in assisting vessels in distress to work off from a lee shore.

Their application to the steam-boat, and their superiority as to unretarded power over the wheels at present in use, hardly requires any comment.

It appears to me that it is not impossible that a machine of this kind might even be applied with advantage as a water-wheel; and that where a fall of sufficient height for a vertical bucket or cog-wheel could not be commanded, that this spiral wheel might give motion to a corn mill, or any other combination of machinery.

There is yet another purpose for which it may one day be employed, but for which it would, of course, require to be constructed of much lighter materials, I mean that of aerial navigation. This art has been hitherto much neglected, chiefly in consequence of the ignorant and illiberal ridicule so indiscriminately thrown on those whose genius has led them to occupy themselves in the consideration of it. To say that a man devotes himself to experiments on balloons, or wings, is considered to be almost equivalent to asserting that he is deranged. But this ought to be disregarded; for the history of science points out to us that many things once supposed to be impossible, have been since accomplished by talent and perseverance. But a very little time ago, a proposal of *sailing* to the North Pole would have been considered fully as Utopian as if the projector had proposed to *fly* thither; yet we now see a whole rational nation bestowing its energies in an attempt to accomplish the first of these schemes; and we look with at least a hope towards a favourable result.

Nil mortalibus arduum est.

Were we never to attempt things of doubtful issue, the onward march of the arts and sciences would be terminated. It is certainly wisest to believe nothing to be impracticable until it has been fairly and fully proved to be so, by the failure of every feasible means within human reach. Let us, therefore, trust that puerile prejudice may be put to silence, or at least despised, and that those who have chosen so ambitious a career will combine their exertions and concentrate the product of their labours into a focus, which may yet produce something worthy of the ingenuity of man. It appears to me that a spiral wing, somewhat on the principle of the oar invented by my friend Mr. Scott, may be best adapted for giving a forward motion to any vehicle employed in aeronautics. Any wing constructed of the ordinary shape, and calculated for the same vertical stroke that those of birds have, would necessarily lose a great deal of the power of suspension gained by its downward flap during the time occupied in raising the lever to repeat the blow. And although an accurate imitation of the structure of the wings of birds might reduce the upward resistance to comparatively little, yet it would always amount to at least so much as considerably to impede the progress of the body through the air in a horizontal direction. But the spiral wing would produce a steady and unremitting motion onwards without any of those intervals of loss of power.

Having the honour of being acquainted with several scientific individuals who are privately occupied in experiments directed towards the perfection of aeronautics, I feel anxious to make them acquainted with this spiral wing, which I offer to them with deference, leaving them to judge of the propriety as well as the mode of its application. I am, Sir,

Your obedient humble servant,

THOMAS LAUDER DICK.

Article XI.

Some Account of the Appearance and Effects of a singular Storm seen at Bushey Heath, Sunday, April 26, 1818. By Colonel Beaufoy, F.R.S.

(To the Editors of the *Annals of Philosophy.*)

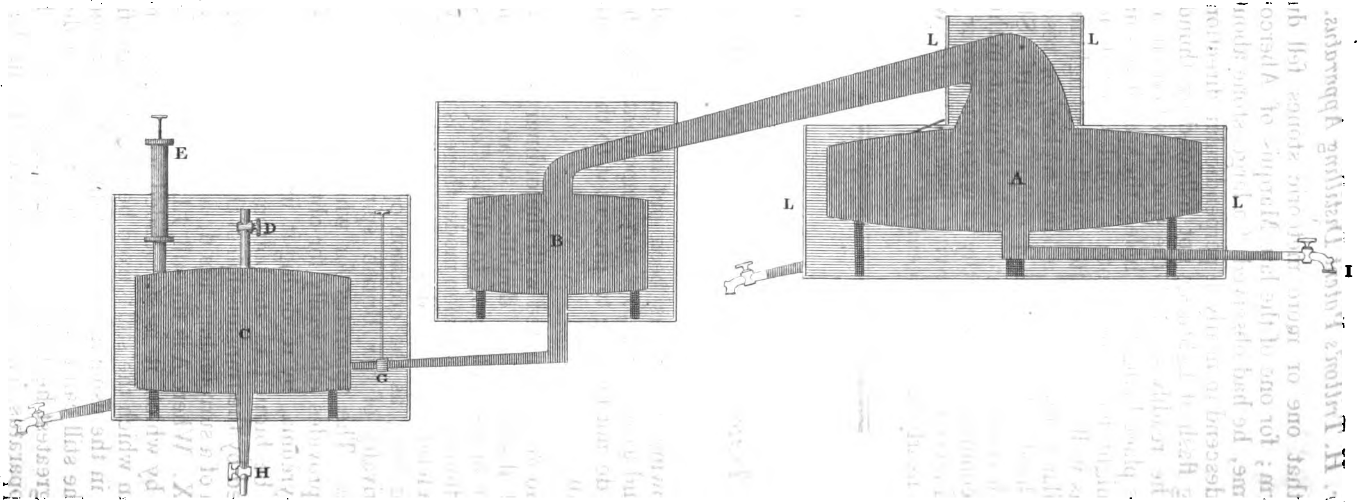
On this day, about half-past 12 o'clock, the neighbourhood of Stanmore was visited by a tremendous storm of hail, wind, and rain, accompanied by some unusual phenomena. The elevated situation of Bushey Heath afforded me peculiar facilities for viewing its progress and effects, which occupied in space about five miles in a direct line, and in time about 20 minutes. The morning had been close and sultry, the heavens sufficiently clear to enable me to observe the transit of the sun over the meridian, the wind variable, the barometer 29·000 inches, the thermometer 61°, the hygrometer 52°, and the variation of the needle 24° 41′ 46″ W. I shortly observed the heavens in the south-east quarter much overcast, and some dense, black clouds forming in that direction, which almost immediately discharged rain in torrents, followed by tremendous hail, lightning, and thunder. In about half an hour the fury of the storm had somewhat abated, when my attention was attracted to the south-east by an amazing commotion among the clouds, which appeared to roll over and into each other with considerable rapidity. Beneath these dark clouds, there appeared a small white one, moving with surprising velocity towards the north-west, at the same time whirling round in a horizontal direction with prodigious quickness, accompanied with a horrid noise, which I can only compare to a stunning and most discordant whistle. The form of this white cloud was in the first instance that of a very obtuse cone with its apex downwards, which, during its rotatory motion, occasionally approached and retired from the earth; the tail of the cone elongating continually as it receded; but on approaching the surface of the ground, expanding like the lower part of an hour glass; when it appeared to collect all the surrounding air into its immediate vortex, as it rebounded with such violence as to root up trees, unroof houses and hayricks, throw down walls, and, in short, every thing that impeded its progress. The effects were, however, exceedingly partial and irregular, depending apparently on the distance of the mouth of the funnel from such objects as chanced to lie in the course of its direction; as also on the area included within the vortex, at the times it exerted its powers of destruction. This whirlwind appears to have commenced near Mr. Dickson's farm, situated about one mile to the west of the village of Kenton in Middlesex; and from thence proceeded in a north by west direction by the compass, over Bellemont, through the orchard adjoining the widow Woodbridge's cottage, over Mr. Robert's field, Mr. Riddock's nursery, Mr. Martin's pleasure grounds, Mr. Utterson's plantations, and the Marquis of Abercorn's gardens, to Mr. Blackwell's premises, where it changed its direction from north by west, to north by east, passing over part of Bushey village, through Mr. Bellas's farm and orchard, and finally exhausting its fury about a mile and a half further. At Mr. Dickson's farm it removed some ridge tiles, and part of the thatch of the outhouses and ricks; and on reaching the widow Woodbridge's orchard it had obtained much greater force, as it levelled the fruit trees, and tore away a great part of the tiling of the cottage, against which it carried a wooden building several feet with great violence. In passing through Mr. Robert's field, it blew down 11 large elms, the breadth of the tornado at this place not exceeding one hundred yards, as was evident from the trifling injury sustained by the other trees to the right and left; crossing the road leading to Stanmore, it entered Mr. Riddock's nursery, where it did considerable injury to the young trees, and almost entirely stripped one side of the house, carrying away the thatch of the hayricks, and unroofing some of the outhouses. In the adjoining premises of Mr. Martin, ten trees were torn up, and his house and buildings much injured. A large may-bush, that stood not 20 yards in front of the green-house, was rooted up; but neither the building or glass received the smallest injury; while a shed at the back, and likewise the low house, which almost adjoined, had many tiles carried away. It next entered Mr. Utterson's plantations, and destroyed 50 trees, appearing to have selected particular ones on which to wreak its fury; for while one was torn up by the roots, those immediately around it were untouched, and some were broken in two places as though they had been twice subjected to the action of the vortex. On approaching Mr. Utterson's beautiful cottage, the storm divided into two parts, one proceeding to the right, the other to the left, as was shown by the thatch remaining perfectly undisturbed, while trees standing both in front and behind of the house were thrown down. At the extremity of the house the storm seems to have again united, as it tore away some wooden paling, though completely sheltered by the building, stripping the tiles of the lower outhouses, and throwing down a considerable portion of the garden wall. At the Marquis of Abercorn's, it passed close by an elm, one of whose branches it carried away, the remainder being untouched; and it then threw down about 75 yards of garden wall, and leaving an interval of the same extent uninjured, destroyed 30 more; this seems to imply that the storm had here a second time divided. Near this spot one of the Marquis's workmen was thrown down by the violence of the wind, and after being rolled over repeatedly, was at length compelled to hold by the grass to prevent his being carried further. In passing over the dove-house, the pidgeons were whirled to the ground, and a quantity of paling was torn up, and blown to a great distance. The current of wind now proceeded across the road to Mr. Blackwell's brick-kiln, tearing from its hinges, and tumbling into a ditch, a field gate, levelling 65 feet of the garden wall in one direction, and also the upper part of another wall running at right angles, in the opposite. The outhouses at this place were much damaged, but the dwelling-house was not touched. A fir which stood among several trees was torn up, while the others received no injury. After leaving the garden, it assailed a large beech, which measured at the base 18 feet in circumference. My eye happened to be fixed upon this tree at the moment; the wind commenced by giving its large head a considerable twist, and instantly afterwards tore it up by the roots. After passing over the gravel pits at Harrow Weald, and a part of the village of Bushey, where it nearly unroofed a house, it continued its course without doing any further mischief until it reached Mr. Bellas's farm. At this place its effects were very destructive among the fruit trees and large elms, besides tearing away the tiles and thatch of the house, buildings and ricks; for here the storm appears to have contracted itself to a width of sixty yards, and its impetuosity to have increased in proportion as its breadth became diminished. After passing in a north by east direction about a mile and a half beyond Mr. Ballas's farm, its fury most probably subsided, as the only further mischief I have been able to trace was the destruction of two small elms in a hedge row, and whose support had been weakened by digging away the earth from their roots. I observed when the cloud or vapour, from which all this storm proceeded, enveloped the upper part of the cone in which Mr. Blackwell burns his tiles and bricks, the cone appeared to be surrounded with a thick mist, and most violently agitated. I also observed that in its passage over the gravel pits it tore up the earth and gravel, not in an uniform manner, but, as it were, by jumps, leaving intervals between the various points of contact, of sometimes 100 yards and upwards; and the dreadful whistling noise continued unabated until the cessation of the storm. This phenomenon was at one time within less than a quarter of a mile of my house; but the trees in the garden were not much affected by it, though I have reason to believe from the testimony of several persons, on whose veracity I can rely, that the violence of the wind was such as to force them to lay hold of the hedges to prevent their being thrown down. Mr. Blackwell, in particular, mentioned, that in returning from church with one of his children, in order to secure himself and boy from being carried away, he was obliged to hold by a large stake. It is further stated, on the most respectable authority, that cattle were seen lifted, or rather irresistibly driven from one end of the field to the other. There is reason to prevent [illegible] passing [illegible] lives house [illegible] property of [illegible] The [illegible]

[illegible]

[illegible] less than [illegible] in the gant [illegible] reason to before [illegible] every I can [illegible] there them [illegible] thrown down [illegible] remain- ing from [illegible] to secure himself and [illegible] obliged to hold to a [illegible] most respect- able authority [illegible] rather irresistibly drive from [illegible] There is reason

PLATE LXXX.

Mr. H. Tritton's Improved apparatus for Distillation



to believe that one or more meteoric stones fell during the thunder storm; for one of the late Marquis of Abercorn's gardeners told me, he had observed "a large stone about the size of his fist descend in nearly a perpendicular direction, after a very dazzling flash of lightning not followed by thunder." At my request he readily showed the spot on where it apparently fell; but the place being full of holes, the search was unsuccessful; or it might have fallen into a pond situated close to the place. I, as well as others, after one flash of lightning, heard a noise similar to the firing of a large rocket, or resembling a number of hard substances shot out of a cart. Should the rarity of such violent commotions of the elements in this country render this communication worthy of insertion in your journal, I shall esteem myself happy in having been enabled to witness its effects from nearly the commencement.

Article XII.

Mr. Henry Tritton's Patent for an improved Apparatus for Distilling.

The following paper has been put into our hands by the patentee; and as it relates to a very important branch of manufacture, we do not hesitate to present it to the attention of our readers.—Ed.

Those who are acquainted with the ordinary procedure in the operation of distilling, are doubtless aware of the unpleasant flavour more or less belonging to all distilled products. In the best distillation in the common mode, there is in a very perceptible degree a fetid smell and flavour; and it is this which entirely prevents, so long as the common operation is continued, the successful rivalry of our British spirits with those of foreign manufacture. The apparatus for which Mr. Tritton has taken his patent, provides effectually for obtaining a produce divested of any empyreuma, by rendering it impossible for the matter in the still to be burned to the bottom, or overheated. This is accomplished by the transmission of the heat to the still through the medium of a surrounding liquid, as will be seen by reference to Pl. LXXX. Where A is the still, LL, LL, outer cases attached to the still by which it is surrounded with water; now if the outer case in which the still is fixed be placed on the fire, as the still itself is in the usual mode of distilling, it is evident that the matter in the still can never be heated to a higher degree than 212°, the greatest heat of the surrounding water. But in the improved apparatus, a much less heat than 212° in the surrounding water suffices to effect distillation. Generally the necessary heat is about 80° less than the common boiling point of 212°; and of course, from the regular application of so low a degree of heat, a still better flavour is secured to the distilled product. To effect distillation at so low a temperature, the pressure of the atmosphere is removed from the surface of the liquid in the still by an air-pump, E, attached to the top of a close receiver, C, which being worked exhausts the still, A, the close condensing vessel, B, and the receiver, C. From the great reduction in the application of the heat, an important saving of fuel is effected; and the vessels, being less exposed to the action of violent heat, will be far more durable. A less quantity of cold water for condensing the vapour in the condensing vessel and receiver is required than in the common distillation, which, in many cases, will be found a material convenience, particularly in some of our West India islands. In the pipe by which the close condensing vessel, B, and the receiver, C, are connected, there is a stop-cock, G, by which that communication may be closed. By this means the contents of the receiver may at any time be drawn off without impeding the operation; for while the stop-cock, G, is turned off, the close condensing vessel acts as the receiver. The receiver is of course to be re-exhausted, if it has been opened while the still is at work, before the cock, G, is again turned on. D, is an air-cock to admit air into the receiver previous to drawing off its contents. H, is the discharge cock of the receiver. I, the discharge cock of the still.

From the distillation being confined throughout the operation to close vessels, the common loss by evaporation at the worm's end is in this apparatus avoided, and an increase of produce is obtained. The produce of the improved apparatus has been repeatedly submitted to the judgment of experienced persons, and has been most highly approved by all. The apparatus itself may be seen at work at the manufactory, No. 63, White-chapel, London.

The subjoined testimonials are, the one from Joseph Benwell, Esq. a gentleman of long experience and of great practical skill in the English malt distillery; and the other from Mr. W. Allen, F.R.S. &c. well known as an excellent chemist.

DEAR SIR, *Henley, Oct. 9, 1817.*

Having attended repeated trials made with your apparatus for producing a vacuum and distilling by the combination of the balneum with the air-pump; and having considered the principle thereof, I feel much satisfaction in communicating my full conviction that it is a mode by which a purer spirit will be extracted, than by any other that has been hitherto practised, that a considerably less proportion of fuel will be requisite, and that the operation may be performed with equal facility.

I remain, dear Sir, yours very sincerely,

To Henry Tritton, Esq. JOSEPH BENWELL.

MY DEAR FRIEND, *Plough-court, Lombard-street, Oct. 7, 1817.*

I consider that the plan for producing a vacuum, or even a partial vacuum, in the vessels destined to receive the products of distillation, is a very great improvement; for in proportion as the vacuum is rendered more perfect, the spirit will be drawn over at a lower temperature, and will be more fragrant and better in every respect; and the still being surrounded with water, the heat can never rise beyond 212°; and consequently that unpleasant smell which the spirit always has when the matter in the still is over heated, or burned to the bottom, is entirely avoided. It is further obvious, that upon this plan distillation may be carried on with a smaller expenditure of fuel than upon the old system.

I remain, thine sincerely,

To Henry Tritton. WILLIAM ALLEN.

ARTICLE XIII.

On Selenium and Lithion. By Professor Berzelius.*

My experiments on this very singular and interesting body have been now for some time completed, and the memoir printed in Swedish contains no less than six sheets. The combinations of selenium with the alkalies and the alkaline hydroselenurets (hydroseleniates according to the nomenclature of Gay-Lussac) elucidate many points of theory. Selenium may be combined with potash without a seleniate and a seleniated hydroselenuret being produced from it when it is dissolved in water. Yet this combination possesses similar properties to the alkaline sulphurets; from which it seems to follow, that the opinion of the dry sulphuret of potash being a mixture of sulphate or hydrosulphate of potash with the sulphuret of potassium, is erroneous.

The hydroselenurets have the same taste and the same general properties with the hydrosulphurets and the hydrotellurets: it appears, therefore, that the hepatic taste, the spontaneous decomposition from the contact of the air, &c. characterize the compounds of those acids into which hydrogen enters in place of oxygen. These characters differ essentially from those of the muriates, the fluates, and the iodates; in my memoir upon selenium, I have endeavoured to give a full explanation of these points.

You have expressed your doubts respecting the metallic nature of selenium; what will you say then when I inform you that this body is a non-conductor of electricity and of caloric.

* Extracted from a letter of Prof. Berzelius to Dr. Marcet.

But, although my vanity might have caused me to wish to consider it as a simple non-metallic substance, as the number of these bodies is so limited, and the discovery of an additional one must, therefore, be the more interesting; yet, in spite of this circumstance, I believe it must be regarded as a metal. Every thing depends upon what is meant by a metal. If you compare them with the simple non-metallic substances, there is only one character which distinguishes them, their brilliant metallic lustre; for the property of conducting electricity is also found in charcoal without one, on this account, considering it as a metal. Now selenium possesses this brilliant metallic lustre in a very remarkable degree. When it is cooled rapidly, it has a vitreous fracture, but one that is entirely metallic; and it possesses a certain, although scarcely perceptible transparency. If, on the contrary, we permit it to become solid gradually, it has a granulated fracture, and is extremely like a piece of cobalt. The slip of green paper, which accompanies this letter, is coated with selenium; I formed it into a pellicule, by reducing it from the selenic acid dissolved in water by sulphureous acid gas. The pellicule is formed on the surface of the fluid, and assumes completely the aspect of a film of gold. Now as selenium must belong to one of these classes, and as there are characters which are common to both of them, I thought it proper to place it in that of which it possesses the most marked character. I divide metals into two classes, those that are capable of forming acids, and those that act as bases; and I place selenium among the acidifiable metals near arsenic.......

Arfvedson has proved that spodumene contains eight per cent. of lithion;* he has also found four per cent. of it in another mineral from Uton, which is called crystallized lepidolite; it contains also boracic acid, silex, and alumine........ Lithion contains 43·9 per cent of oxygen.†......With respect to selenium, I must inform you that I have found a fossil which

* In the number of the Annales de Chimie for March, we have the following letter from M. Gillet de Laumont to the editors.

M. Swedenstierna informed me by a letter of March 17, that M. Arfvedson had not entirely completed his analysis of petalite when he announced that he had obtained *three per cent.* of lithion, and that he now believes he has found *five per cent.* in it; this would bring his analysis more near to that of M. Vauquelin's, who has actually found *seven per cent.* in some very pure pieces which I sent him. M. Swediensterna remarks also that M. Arfvedson has just discovered *eight per cent.* of lithion in triphane (spodumene) undoubtedly from Uton. In consequence of this important discovery, which will probably be extended to other mineral substances, chemists will be able to procure this new alkali very easily, triphane being less rare than petalite; M. Leonhard has just discovered triphane in the Tyrol, and M. Hesinger conceived that he had obtained six per cent. of potash from it, but this will probably prove to be lithion.

† M. Vauquelin concludes from his experiments, that 100 parts of lithion contain 43·5 of oxygen, a quantity which he observes is greater than that of all the other alkalies. The editors of the Annales de Chimie remark, that according to this estimate the equivalent number of the metal is 12·97, of its oxide 22·97, of its dry sulphate 72·97, and of its crystallized sulphate 82·97.—Ann. de Chim. March, 1818.

contains $\frac{1}{4}$ of its weight of it. It had been for a long time considered as an ore of tellurium. I made an analysis of a very small quantity of it some years ago; I could not find any tellurium in it, but the blow-pipe always afterwards retained the odour of this metal. During my researches on selenium, I recollected this circumstance; and the friend who possessed the mineral sent me a sufficient quantity for an exact analysis. I find it to be composed of one atom of selenuret of silver, and two of selenuret of copper. ....

Article XIV.

On a Pumice Stone Table Furnace. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, Covent Garden Chambers,
May 14, 1818.

GENTLEMEN,

It is now upwards of ten years since it occurred to me that *pumice stone*, being a volcanic glass and exceedingly light and porous, might possess *very slow conducting powers for heat and cold*, and consequently form an excellent support for fuel as a table furnace; and on trial I had the pleasure to find my conjectures fully verified. I made hemi-spherical cavities of about an inch and a half only in diameter in two small pieces of pumice stone; and after making side orifices into the hollow cavities thus formed to introduce a blast of air, I filled them with charcoal, putting in also a small piece of copper, and fitted them together. On igniting the furnace and employing a pair of common hand bellows, I soon raised the temperature of the fuel to an extraordinary degree of vehemence, and found the copper was completely fused with that very small quantity of fuel only.

This success induced me to make another furnace of the same material, but of a rather larger diameter; though, possibly, the smallest ever made to be useful, as it was merely a hemi-spherical cavity of two inches and a half in diameter made in a piece of pumice stone about three inches and a half square, and having a channel on one side of it for the blast to enter; and this has continued in use with me nearly ever since as the basis of a most convenient table furnace.

Occasionally, however, I increased its capacity to hold fuel by placing upon its flat top a ring formed of a narrow slip of tinned iron, about one inch broad and 12 inches long, and which could be coiled into a circle of greater or lesser diameter according to the extent of surface I wished to give to the furnace, and upon which I also occasionally laid a flat three-rayed supporter, made of twisted iron wire, or of a metal plate, to hold a vessel to be heated by the furnace.

I next added another piece of pumice stone to the former one, or basis, having a cylindrical hole through it of the same diameter as the cavity in the furnace, which answered still more completely; and in this state it was very frequently seen in use by Capt. Bagnold, who has lately introduced it into the laboratory of the Royal Institution, and given a short account of it in the last number of "The Journal of Science and the Arts;" *but without giving me the credit of the invention!*

It has also been seen and adopted by other persons, as I very much wished to bring it into use, being convinced that it would form a most desirable instrument in chemical pursuits, as well as in the arts.

I have, however, since very materially improved the furnace, having added to it another part in place of the last-mentioned one. This consists of a piece of pumice stone about three inches and a half square, having a conical perforation through it of two inches in diameter in its smallest aperture, and three inches and a quarter in its greatest; this, when placed upon the basis with its narrowest aperture uppermost and filled with charcoal, after being ignited, will continue to burn for half an hour without attendance, the charcoal continually falling down owing to the widening form of the perforation, and will yield an equable heat sufficient to keep a matrass or retort suspended over it, and containing any aqueous liquid, not exceeding a pint measure, constantly boiling during that time, when it may need a fresh supply of fuel.

It may thus be very frequently employed in place of a spirit or Argand lamp; with an expense in fuel too small to deserve estimation.

If, however, the last-mentioned part of the furnace be placed with its widest aperture uppermost, it will be capable of receiving into it and supporting the lower part of a Florence oil flask, or other glass vessel of a similar size, and will keep such a quantity of fluid in it as may be enclosed in the pumice stone, and defended from cooling by the action of the air, constantly boiling with no more fuel than can be contained in the lower part of the furnace; this is no doubt owing *to its slow conducting power for heat*, the vessel being here posited in a similar manner to a boiler set in brick-work.

It will, perhaps, appear singular, *that this furnace has no grate* nor apertures in its bottom to admit air; it will, however, seem more singular to assert, that *it has no occasion for any*; no doubt owing to the air finding its way through the side channel and through the division between the two parts of the furnace; and still more especially to *the very slow conducting powers for heat of the pumice stone itself;* and, indeed, unless the charcoal be quenched after an operation is finished, it will inevitably consume to ashes. I am, Gentlemen, your most obedient servant,

THOMAS GILL.

P.S. It will be necessary, after shaping the pumice stones, and before excavating them, to bind each part round in several places with iron or copper wires let into grooves, in order to prevent their breaking asunder in that operation; or afterwards, by their unequal expansion and contraction, in heating and cooling.

Article XV.

Dr. Brewster's Patent Kaleidoscope. From a Correspondent.

From the great popularity of the kaleidoscope, attempts have been made to discover the principle of the instrument, and even the instrument itself in optical theorems, and in machines long ago exploded and forgotten. The most plausible of these attempts is that which supposes that the idea of the kaleidoscope is taken from Bradley's gardening, which contains the account of an instrument consisting of two plates of mirror glass four inches high and five inches wide. These plates, connected by a hinge, are placed upon a regular kind of drawing, and the observer, looking in in front, sees the lines of the drawing multiplied so as to form garden plats of different forms. A few instruments of this kind, made from Mr. Bradley's description, have been in the possession of the public for more than 100 years; and nobody either saw or heard of any beautiful effects which they produced. The instrument is indeed incapable of producing any effect approaching to the effects of the kaleidoscope; and among all the attempts to evade Dr. Brewster's patent, no person has ever thought of making the instrument described by Mr. Bradley.

To those who are not capable of examining this subject scientifically, it may be sufficient to subjoin the written attestations of one of the most eminent natural philosophers of the present day, who considers the instrument of Mr. Bradley as entirely different in its principle and effects from the kaleidoscope invented by Dr. Brewster. The following is an extract from the opinion of Professor Playfair:

"I have examined the kaleidoscope invented by Dr. Brewster, and compared it with the description of an instrument which it has been said to resemble, constructed by a person of the name of Bradley. I have also compared its effects with a theorem to which it may be thought to have some analogy described by Wood in his Optics. R. M. 13 and 14.* *From*

* Mr. Wood, of Cambridge, has also written a letter, in which he candidly states "*that the effects produced by the kaleidoscope were never in his contemplation*" when he drew up these two propositions, and that they "*contain merely the mathematical calculation of the number, and arrangement of the images.*"

both these contrivances, and from every optical instrument with which I am acquainted, the kaleidoscope appears to differ essentially both in its effect and in the principle of its construction.

"As to the effect, the thing produced by the kaleidoscope is a series of figures presented with the most perfect symmetry, so as always to compose a whole, in which nothing is wanting and nothing redundant. It matters not what the object be to which that instrument is directed; if it only be in its proper place, the effect just described is seen to take place, and with an endless variety. In this respect the kaleidoscope appears to be quite singular among optical instruments. Neither the instrument in Bradley, nor the theorem in Wood's book, have any resemblance to this. Next as to the principle of construction, Dr. Brewster's instrument requires a particular position of the eye of the observer of the object looked at in order to its effect. If either of these is wanting, the symmetry vanishes, and the figures are irregular and disunited.

"For these reasons, Dr. Brewster's invention seems to me quite unlike the other two."

Perhaps we could scarcely have a stronger proof of the novelty of the invention than the effect which it produced when it was first exhibited in London; both the scientific and the unscientific were equally amused and surprised at its effects; and although the principle on which it acts was easily perceived to be one with which we were familiar, yet the mode of its application was what no one had before witnessed.

The Editors have also received the following notice respecting the kaleidoscope, which they subjoin, as tending to complete the history of this curious instrument, and to show what approaches had been made to the invention by the older writers.

On the Kaleidoscope.

In Kircher's Ars Magna Lucis et Umbræ, published at Rome in 1646, there is an account of the experiment, which has of late created so much amusement, under the name of the kaleidoscope. At p. 890 of that work is a description of the appearance of the circle divided into its aliquot parts (which Dr. Brewster's tube so beautifully exhibits), by means of two plane mirrors, which are set at the angles of 120°, 90°, 72°, &c. &c. with one another. He afterwards goes on to describe the multiplication of images by reflections from mirrors, set in different situations with one another, and expressly mentions the variety of combinations which may be produced by changes in the objects which are reflected. Kircher claims the experiment as his own, saying that he had not heard of its having occurred to any one before him. S.

Article XVI.

Analyses of Books.

Transactions of the Geological Society. Vols. III. and IV.

The interest and importance of these volumes demand a far more extensive analysis of their contents than is consistent with the plan of our journal. We trust, therefore, that our readers will consider the following abstracts as intended rather to excite than to satisfy their curiosity.

1. Vol. III.—*A Sketch of the Mineralogy of Sky.* By J. M'Culloch, M.D. F.L.S. &c.

7. Vol. IV.—*Corrections and Additions to the Mineralogy of Sky.* By the Same.

The longitudinal extent of this island is from S.E. to N.W. and its general figure is very irregular, being indented deeply on every side by bays and sea-lochs. The south-eastern extremity (consisting chiefly of the district of Sleat) is composed of gneiss, passing by insensible gradations into chlorite state, and of micaceous schistus. The beds rise to the N.W. at an angle varying from 30° to 50°, or even more. At Loch na Daal they pass into the sea, and may be observed to emerge at Glen Elg, on the main land of Scotland, precisely in the prolongation, to the N.E., of their line of run. To the N.W. of these beds, and extending beyond them in a N.E. direction to the extremity of the island, is a series of beds, which, where they touch the gneiss, are nearly vertical; they then become irregular, and, as their distance from the gneiss increases, rise on the whole towards the S.E. but with various local irregularities. This series consists of red sandstone, of an indurated sandstone, generally blue or grey, but occasionally brown, and sometimes including grains of felspar, of greywacke schist, and, in one place, of pure, compact quartz. The sandstones and schist repeatedly alternate. The red sandstone is the predominant member of this series, and in mineral characters corresponds with the red sandstone, which in Scotland occupies an intermediate place between the primary rocks and those which contain organic remains. Near the Point of Sleat, however, according to Dr. M. this series of slate and of red sandstone passes by degrees into a variety of gneiss, the former of these beds becoming a green, glossy, chlorite slate, and the latter assuming the appearance of a compact quartz containing grains of red felspar.

The newest beds of the sandstone just described, that is, those which lie the furthest to the N.W. rise at an angle of not more than 10°, and are covered by a deposit of limestone rising like them to the S.E. but at an angle not exceeding 5°. The outburst of the limestone may be traced in a direction N.E. and S.W from Broadford to Loch Eishort. This limestone deposit consists of numerous alternations of limestone, shale, and sandstone, and contains gryphites, ammonites, and belemnites; it is, therefore, probably the same as the lias of England, and of the N.E. coast of Ireland. In many places these beds are penetrated, and more or less covered by sienite and other trap rocks. Where this is the case, remarkable changes appear to have taken place in the strata, for which no obvious cause exists except the proximity of the trap. The limestone becomes more crystalline, the organic remains become more rare, and where the utmost change has been effected, a perfect granular marble, without any visible organic remains, is the result, not differing in its external characters from that highly crystalline limestone, or marble, which geologists have been in the habit of considering as one of the primary rocks. The sandstone undergoes analogous changes, being converted into quartz more or less compact; and the shale becoming hard, compact, and brittle, is converted into lydian-stone.

The limestone deposit is covered by calcareous white and grey sandstone, which at Strathaird is intersected by a multitude of vertical dykes of trap without having its stratification materially disturbed.

The northern and western part of the island, as far as it has been examined by Dr. M. consists chiefly of trap, amorphous, tabular, or columnar, and resembling greenstone in composition, except that augite, instead of hornblende, forms one of its constituent parts. In many places it is amygdaloidal, and contains, besides the more common minerals of the zeolite family, magnificent specimens of laumonite and needlestone. On the north-eastern coast it is combined with the lias and other stratified rocks in an infinite variety of ways, the study of which is highly instructive, as it throws much light on many disputed points. "All these irregularities occur in a mass, which, taken in a general view, has the character of a stratified trap, since, notwithstanding these irregularities, it bears a strong parallelism to the already parallel strata with which it is associated. It is abundantly plain that the appearance of stratification in the trap is here the result of the forms of the rocks on which it is placed, or among which it has intruded, in the former case surmounting them, and in the latter appearing to alternate with them. The instances of this apparent alternation are highly interesting, from their great extent, as well as from the perfect conviction which they present of the fallacious nature of this supposed connexion. In many cases the alternations of trap are as regular, as decided, and as evenly parallel as those of the stratified rocks themselves, the sandstone and limestone among which it lies. Yet in no instance does it not happen but that at some point or other the alternating bed of trap will detach an intersecting vein, unite itself to the superincumbent mass, or quitting the interval between two given beds of limestone, or sandstone, make its way across the one immediately above or below, and then proceed with a regularity as great for another long space between some other pair of proximate strata. In one or more instances I have observed this to happen after more than a mile in extent, throughout all which space not the minutest irregularity had appeared to indicate any thing else than a perfectly conformable and alternating stratification."

The middle district of the island lying between the trap and the stratified rocks already mentioned, contains the Cuchullin hills, the most lofty and remarkable in their outline of any of the mountain groups of Sky. The spiry forms of their summits, their hard, serrated outline, the huge, and somewhat curvilinear sheets of rock, that extend from their base to their summit, almost unalterable by time and weather, and absolutely barren, point out, even at a distance, that the rock of which they are composed is very different from the surrounding and adjacent trap and sienite. On a near inspection, it is found to consist of hyperstene, in grains or crystals, mixed in some parts with compact, green felspar, and in others with crystallized, white felspar, somewhat glassy.

3. *On the Geological Features of the North-eastern Counties of Ireland, extracted from the Notes of J. F. Berger, M.D. &c. with an Introduction and Remarks by the Rev. W. Conybeare.—Descriptive Notes, referring to the Outline of Sections presented by a Part of the Coasts of Antrim and Derry, collected by the Rev. W. Conybeare, with Observations by the Rev. W. Buckland, Reader in Mineralogy to the University of Oxford.*

A right line drawn from Dundalk to Londonderry, and the curve of the coast from Londonderry back again to Dundalk, will include somewhat more than the district described in these papers. It may be considered as composed of three systems of mountains. Of these, one occupies the country lying south of the Belfast River and Loch Neagh. The Mourne mountains are its most elevated summits, and consist principally of granite. Hornblende rock and primitive greenstone appear on the skirts of the granite; and at a greater distance from the central nucleus, the greywacke formation is the prevailing rock.

The second system has for its eastern boundary a line drawn nearly N. and S. from the mouth of Loch Foyle to the parallel of the northern extremity of Loch Neagh, and extends westward to Donegal Bay, including the whole line of coast from Loch Foyle to Donegal. This tract consists principally of mica slate.

The third system occupies the whole country lying east of a line drawn from the entrance of Loch Foyle to the southern extremity of Loch Neagh. The prevailing rock in this district is basalt; but other rocks, from mica slate upwards to chalk, make their appearance, especially on the coast; and from their various relations with the basalt, throw much light on the history of this latter rock. The most important of these beds are the lias and the chalk.

The lias here, as in England, consists of beds of slate clay, alternating with thin beds of bluish, argillaceous limestone. Its characteristic fossils are ammonites, gryphites, and the columnar joints of the pentacrinus. In many places it may be clearly be observed emerging from below the green sand, and rests on red marl containing gypsum. At the peninsula of Portrush it comes in contact with tabular and prismatic greenstone, being covered by, and appearing to alternate with, this rock. Under these circumstances it assumes the appearance of a very compact and highly indurated, flinty slate, retaining, however, numerous impressions of ammonites, which sufficiently identify it with the slate clay of the lias, altered by the action of the greenstone.

The beds of oolite and calcareous standstone, &c. which in England intervene between the lias and the green sandstone, have not been observed in this district; the latter rock, therefore, rests immediately on the lias. It is not materially different from the green sandstone of the English series.

The chalk of this district, although perfectly identified, geologically speaking, with the chalk of England, by its relative situation in the series, and by the organic remains which it encloses, differs, in the following particulars, from the usual appearance of this substance. It is harder, and its texture is more compact. It is covered, and often intersected by basalt; in the latter case, and near the plane of contact, the chalk is converted into a dark-brown, crystalline limestone, which, as it recedes from the basalt, becomes more fine grained, then of a sandy aspect, afterwards porcellanous, and at the distance of eight or ten feet from the basalt is not to be distinguished from ordinary chalk. The flints in the altered chalk usually assume a grey, yellowish colour, and the chalk itself, when exposed to heat, is highly phosphorescent.

(*To be continued.*)

Article XVII.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

April 23.—Dr. Wollaston communicated a paper by Dr. Andrew Ure, entitled, New Experimental Researches on some of the leading Doctrines of Caloric, particularly on the Relation between the Elasticity, Temperature, and latent Heat of different Vapours, on thermometrical Admeasurement, and on Capacity.

April 30.—The reading of Dr. Ure's paper was finished. It consists of three parts. The author commences by an historical view of the different experiments performed by Watt, Robison, Dalton, Biot, and others, on the elasticity of the vapours of various substances at different temperatures; and after pointing out some errors into which he conceived these philosophers had fallen, he describes the method which he followed in his own experiments. His method was to confine the vapour under examination in a portion of a barometric tube, to which was applied the flat bulb of a thermometer; it was sufficiently sensible to mark the exact degree of temperature from zero to 200° above the boiling point, where the vapour of water will support a column of mercury of 36 inches; the apparatus is so contrived, that the mercurial column itself is not heated. The author then gives an account of the physical properties of the vapour of water, of alcohol, ether, and spirit of turpentine, from below the freezing point to above that of boiling water.

The second part of Dr. Ure's paper relates to thermometrical admeasurement; he does not think that Mr. Dalton has substantiated his objections against the common thermometric scale, as he thinks the increasing rate of expansion in the mercury is exactly balanced by the circumstance of part of the mercury rising out of the ball, the part to which the heat is always applied, into the stem. In the third section the author attempts to discover by experiment the temperature at which different vapours acquire the same elastic force; the results of his experiments are placed in a table; among others, the latent heat of steam is stated to be 967°; that of alcohol, 442°; of ether, 302°; and of spirit of turpentine, 178°.

May 7.—A paper, by Thomas Smith, Esq. was read, on the peculiarity in the construction of the fangs of poisonous serpents.

A paper, by Mr. Thos. Greatorex, was also read, on the height of the mountains in the north of England, contained in a letter to Dr. Young. His observations were principally directed to Skiddaw, and by employing what appears to have been a very accurate process of geometrical measurement, he found its elevation to be 3,036 feet 3·5 inches.

On the same evening a paper by B. Bevan, Esq. was read, consisting of the results of a registering rain-gauge, kept at Leighton, in Bedfordshire, in 1817. We are informed that there were 614 hours of actual rain, that the average rate at which the rain fell was ·68 of an inch in a day; the heaviest rain was on June 27, which was at the rate of nine inches per day.

May 21.—A paper, by John Pond, Esq. was read on the different methods of constructing a catalogue of the fixed stars.

A paper, by Lieut.-Col. Lambton, was also read, consisting of an abstract of the results deduced from the measurement of an arc on the meridian, extending from 8° 10′ to 18° N. latitude, and in 78° E. longitude, running through Tinnevelly and Bengalore.

GEOLOGICAL SOCIETY.

Feb. 20.—The reading of Mr. Parkinson's paper, on the fossils found from the east of Dover to Folkestone, was concluded.

The author in describing these fossils, adopts Mr. Phillips's division of the beds in which they were found:

Into chalk, with numerous flints.
——————— interspersed flints.
——————— few flints.
——————— without flints.
Grey chalk, without flints.
Blue marl.

Before he enters on his description of the fossils, the author takes occasion to correct an opinion he expressed in a former communication to the Society, that the gravel round London was originally deposited in the spots which it now occupies. Further inquiry has satisfied him that it has been derived from the disintegration of the chalk. It is not the author's intention to enter into an enumeration of the fossils of the chalk generally, but to describe those collected by Mr. Phillips.

In the chalk with numerous flints, were found plagiostoma spinosa, fragments of inoceramus, several species of terebratula, several of echinus, and many cucumerine, clavated and muricated spines.

The fossils, which the author considers more particularly to demand attention, are those flints of spongeous or alcyonic origin, of which this stratum has afforded a numerous variety. In many of these, no traces of organization are to be observed in the flint; but its origin is inferred from its peculiar form; in others the flint is of a brownish colour, and displays the structure of the spunge or of some other body allied to the Polype tribe.

In the bed with interspersed flints, an imperfect nautilus was found, and several species of terebratula, and of echini already noticed, and the remains of alcyonia and of sponges. A specimen of the plagiostoma spinosa was found with the valves expanded and filled with flint.

Some of the chalk exposed to the action of dilute muriatic acid, developed a fine flocculent substance, which fell on the slightest agitation of the vessel.

The chalk of the bed with few flints is heavier than that of the preceding beds, and feels gritty, giving the idea of its being blended with minute particles of sand; it contains the palates of fish in tolerably good preservation. The remains of alcyonia and of sponges are also very abundant, and their structure is more evident than in the preceding occasioned by a strong impregnation of iron. Many shells of the genus terebratula, agreeing with those found in the preceding beds, were collected here, with two varieties of the plagiostoma spinosa, a valve of inoceramus in extremely good preservation, a finely striated asbestiform substance of uncertain origin, several oval and rather flattened bodies, of which some appear to be pedunculated, and several remains of an undescribed shell approaching to the genus teredo.

In the stratum without flints, some traces of a solen were observed.

It is an important fact connected with the history of the beds of chalk, that in the ocean which deposited these beds, the whole race of animals inhabiting the ammonitæ, belemnitæ, and most other multilocular shells, became extinct. The nautilus is the only shell of this class found in the blue clay; and this, with the spirula, are, perhaps, the only multilocular shells (except microscopic ones) found recent.

In and below the grey chalk, the nautili and ammonitæ are found under almost every change of form; these changes seeming to have taken place in the era immediately preceding that in which they totally disappeared. The first departure from the regular form is when the ammonites assumes an oval figure; whence it passes to the hamites, scaphites, &c. In the quarries near Maidstone a multilocular shell has been found of a cycloidal figure, much resembling one found by Dr. Macculloch in Sky, in which the termination of the inner whorl penetrates the whorl which surrounds it. The turrilites has been discovered by Mr. Mantell in the grey chalk of Sussex; and this gentleman has observed traces of organization in the chalk which are distinctly referable to vegetable structure. In the grey chalk, large, transversely striated, excentric nautili occur, and the alcyonium and sponge appear in great numbers and variety.

The fossils of the blue marl beneath the chalk differ from those of the beds above and below it. It contains numerous ammonitæ and hamitæ of peculiar forms, casts of turbinated shells, which the author refers to the genus pleurostoma, and one cast which he refers to solarium. Part of a large undescribed pecten was also found, and some new species of nucula. It contains also great numbers of small fusiform, and frequently transparent belemnites similar to those found at Stutgard.

Many fossil remains were found among the gravel covering the chalk. Of these, a shell is noticed resembling that of the teredo; several flints also occurred apparently derived from animals of the polype tribe, and others that appeared to owe their forms to varieties of sponge.

Mr. Frazer's notes on the Himālā mountains, accompanying a series of specimens, were read.

The plains of Hindostan are bounded on the N. E. by a mountainous tract which runs from the banks of the Burrampooter to the Indus, and, crossing that river, spreads out into a less circumscribed and less lofty highland country, the chains of which are connected with many of the chief ridges of Asia. The belt of hills which thus separates Hindostan from Thibet is perfectly unconnected and unbroken, running in irregular ridges, undivided by any valley of consequence from the one plain to the other. These mountains on the side of Hindostan rise from a level at once into sharp and precipitous cliffs, while the north-western side, according to the best accounts that have been obtained, falls more gradually into green hills, and ends in a gently sloping plain.

The great Himālā mountains form the centre of this ridge, and rear their sharp crests covered by eternal snow, to an almost incredible height, in unapproachable desolate grandeur. Mr. Colebrooke, in the twelfth volume of the Asiatic Researches, estimates the height of the different peaks at 26,862 feet to 22,000 feet. Jumnatra, the source of the Jumna, is estimated at 25,500 feet above the level of the sea. During the tour in which the specimens laid before the Society were collected, the route lay over a shoulder of this mountain within (it was conjectured) 2,000 feet of its summit. The specimens were collected between the rivers Bhagirutta and Sutlej. The general line of the mountains is here nearly N. W. and S. E. A small abrupt ridge rising from 500 to 750 feet in height, and extending from three to six miles in breadth, runs next to the plains from Hurdwar, half way to the Sutlej. This consists of sandstone, indurated clay, and beds of rounded pebbles and gravel. The next range of hills runs from 1,500 to 5,000 feet in height, with sharp narrow crests, and consists of a very decomposable greyish brown indurated clay, containing siliceous matter. Just beyond this range rises a mountain of limestone about 7,000 feet high: a large perennial stream marked the division between this range and a mass of mountains consisting almost entirely of varieties of schist, with much mica, and veined with quartz. Connected with these, were observed a coarse sandstone, and a conglomerate of sand, mica, and gravel, cemented by a white spar easily frangible. As the snowy mountains were approached, rocks of white quartz were observed, and of a hard semi-transparent stone of many colours, grey, red, yellow, and greenish. On reaching the heart of the Snowy Mountains, the distant peaks appeared to be stratified, and to dip to the N. E. at an angle of about 45 degrees. For several thousand feet below their tops, all vegetation ceases, and no living thing is to be seen. The returning route was for a considerable way along the bed of the river Pabur, which rises among the depths of the Himālā: in this bed, blocks of a peculiar kind of rock were found. The neighbouring rocks were schist and limestone. Another opportunity presented itself of viewing the summits of the Himālā from Jumnatree, which rises in two grand peaks, covered on the S. and S. E. by perpetual snow, but showing a precipitous rocky face towards the N. W. The river Jumna was here traced to its source in a number of small rills flowing from the snow, and collected in a pool at the bottom of a steep slope. Nearly every sort of rock observed throughout the tour was found here, particularly the rock before referred to as occurring in the bed of the river Pabur, and white quartz in veins intersected the general stratification. From these veins trickles a stream of hot water impregnated with calcareous matter, which it deposits on the surface of the rocks over which it runs. There are no glacieres in any part of the snowy mountains; but a perpetual frost appears to rest on their summits.

After descending into the bed of the Bhagirutta, that river was also traced nearly to its source: the glen through which it runs is deeper and darker, and the precipices on either side far more lofty than those forming the bed of the Jumna: the rock in the neighbourhood of its source was granitic, and contained black tourmaline.

LINNÆAN SOCIETY.

Owing to particular circumstances, unnecessary here to mention, the Editors have been unable to present to their readers any of the proceedings of the Linnæan Society during the present session. Arrangements, however, have now been made which it is hoped will prevent for the future the recurrence of such an interruption. Of the papers read in the Society prior to April 21, we can only give the following bare list of titles.

Nov. 4, and *Dec.* 2.—A paper was read, by the Rev. W. Kirby, entitled a Century of Insects, including several new Genera, described from the cabinet of the author.

Dec. 16.—A Description of the Island of Tristan da Cunha, by Capt. Carmichael, was read.

Jan. 20, 1818.—The following communications were read:

Conclusion of Capt. Carmichael's paper.

Observations on Solanum Tuberosum, and other plants, by A. B. Lambert, Esq. V. P.

A letter from the Rev. R. Sheppard on the Ardea Major.

A letter from the Rev. J. Skinner, of Cammerton, near Bath, on the Coal Fossils in that neighbourhood.

A letter from his Excellency De Witt Clinton, on a new species of Triticum, found near Rome, in the United States.

Feb. 3.—Observations on Pelecanus Aquila, or Frigate-bird, by Ed. Barton, Esq.

Feb. 17.—The continuation of the Rev. W. Kirby's description of new insects was read.

March 3.—Observations on the Flora of Tristan da Cunha, by Capt. Carmichael.

March 17.—The following papers were read:

A letter from Dr. C. Meryan, on a fish mentioned by Dr. Clarke in his travels, and on two others taken on the coast of Syria.

Remarks on the genera Orbicula and Crania of Lamark, by Mr. G. B. Sowerby.

April 7.—The commencement of a paper, on the poison of fishes, by Dr. D. J. H. Dickson, was read.

April 21.—The communication from Dr. Dickson, on the poison of fishes, was concluded.

By the poison of fishes, Dr. D. does not mean the serious, and sometimes fatal consequences arising from wounds inflicted by the spines of the sting ray and other species of fish; but those which result from eating certain fish, or parts of fish. The journals of many voyages present us with instances of sickness more or less violent, accompanied by intumescence of the body, and irritating eruptions of the skin, being the consequence of eating certain fish. Often the noxious quality appears to reside in a particular part, especially the liver and intestines, as appears from the circumstance of those persons alone, out of a ship's crew, being thus affected who have eaten these particular parts. It is a matter of common observation that all fish are more wholesome and a more agreeable food before than after spawning; the fish, in the former case, being in high health and vigour, but in the latter, being sick, emaciated, and their muscular fibre becoming remarkably flabby. The difference between these two states, which in the temperate European climates seldom amounts to more than a difference in the agreeableness of the fish, considered as an article of food, often, in tropical climates, causes the same species to be in the one case a wholesome, and in the other case a very pernicious food. Again, certain species, especially in the West Indies, are observed at the same season to be wholesome in certain situations, and very much the contrary in others. Thus all the fish on the coast of Barbadoes are said to be safe food, even those which on the coasts of the other islands are deleterious. Examples also have occurred of a ship on one day falling in with a shoal of fish which proved perfectly wholesome, and on the very next day falling in with a second shoal of the same species which were found to be poisonous.

The cause of these differences it is not very easy to ascertain. The common test among seamen of the safety or hazard in feeding on any suspected or unknown kind of fish, is to put a piece of silver into the boiler together with the fish, and if the silver acquires a coppery colour the fish is considered as unwholesome. The coppery, or rather brassy colour thus produced, has probably been the reason why the flavour of fish in this state has been attributed to copper, with which they have been supposed to be infected by feeding on banks of copper ore. But the discoloration of the silver is probably owing to sulphuretted hydrogen, and it is a well-known fact that the drainings of a copper mine are so peculiarly noxious to fish that many lakes, formerly abundantly stocked, have been entirely depopulated by this very circumstance. Vegetable poisons swallowed by the indiscriminate voracity of this class of animals, have been considered as the cause of the occasional unwholesomeness of their flesh; and Dr. Dickson is, upon the whole, inclined to adopt this opinion.

Article XVIII.

Scientific Intelligence, and Notices of Subjects connected with Science.

I. *Meteorological Register kept at New Malton, in Yorkshire.*

January.—Mean pressure of barometer, 29·463; max. 30·25; min. 28·65; range, 1·60; spaces described, 12·50 inches; number of changes, 24. Mean temperature, 34·200°; max. 53°; min. 25°; range, 28°. Amount of rain and snow, 4·36 inches. Wet days, 14; snowy, 5. Prevailing winds, W. and S.W. E. 2; S.E. 1; S. 5; S.W. 12; W. 10; Var. 1. Brisk winds, 8; boisterous, 8. Character of the period: wet, stormy, and changeable, with frequent heavy falls of snow and high winds, particularly by night, and the barometrical column in continual fluctuation.

February.—Mean pressure of barometer, 29·453; max. 30·18; min. 28·67; range, 1·51; spaces described, 7·90 inches; number of changes, 17. Mean temperature, 34·41; max. 50°; min. 23°; range, 27°. Amount of rain and snow, 2·27 inches. Wet days, 7; snowy, 4. Prevailing winds, S. and S.W.; S.E. 2; S. 7; S.W. 15; W. 4. Brisk winds, 4; boisterous, 5. Character of the period: the first fourteen days cold, fair, and calm, with frequent hoar frosts; afterwards wet, stormy, and changeable, with strong gales, and much rain and snow by night.

March.—Mean pressure of barometer, 29·265; max. 30·36; min. 27·85! range, 2·51; spaces described, 12·50 inches; number of changes, 24. Mean temperature, 39·00; max. 57°; min. 29°; range, 28°. Amount of rain and snow, 5·00 inches. Wet days, 13; snowy, 10; Haily, 1. Prevailing winds, W. and S.W.; N. 4; N.E. 1; S.E. 3; S. 3; S.W. 13; W. 6; N.W. 1. Brisk winds, 9; boisterous, 5. Character of the period: tempestuous, with great falls of rain and snow. The tremendous storm of wind, with rain and snow, during the night of the 4th, caused a depression in the barometrical column in the course of nine hours nearly an inch and a half, the minimum being noted at one a.m. on the 5th; nor (with a single exception) did the barometer ever indicate 29·00 until the 13th, when the wind having veered from the S.E. by W. to N. there was a rapid increase of $\frac{8}{10}$ths in a few hours. Abundance of snow fell during the time the column was thus depressed, frequently mixed with rain and hail. At one a.m. on the 25th, there was a loud clap of thunder, which was succeeded by the heaviest fall of snow we have had during the winter; but the weather afterwards became more settled, and the barometer attained its maximum of elevation. It will be seen that the spaces described and the number of changes exactly correspond with those for January; but the mean is less than for many years past.

April.—Mean pressure of barometer, 29·581; max. 30·49; min. 28·89; range, 1·60; spaces described, 7·08 inches; number of changes, 14. Mean temperature, 42·96°; max. 60°; min. 29°; range, 31. Amount of rain and snow, 3·98 inches. Wet days, 6; snowy, 4; total quantity of rain, &c. this year, 15·56 inches. Prevailing winds, N. E. and N.E.; N. 5; N.E. 9; E. 6; S.E. 1; S. 4; S.W. 4; Var. 1. Brisk winds, 5. Character of the period: cold, wet, and changeable, and unfavourable to vegetation. On the 10th and 24th the violence of the snow storms was nearly unparallelled; and on the moors and wolds it lay in drifts several yards thick, and did considerable damage. From 10 p. m. (26th) to two p. m. (27th), we had a heavy fall of rain, attended with incessant, vivid red lightning and loud thunder all the time. The next day another thunder storm passed here to the S. and S.W. where it was visible from six to eight p. m.

When the above periods are compared with those for the last year, either as to the pressure, temperature, or to any other feature, there is no similarity whatever. The first four months last year were fair, dense, and mild; but those now elapsed have presented characters decidedly the reverse. The amount of rain and snow from January 1 to May 1, in 1817, did not exceed 3½ inches; and there were only 34 wet days; but the quantity of rain this year amounts to 15½ inches, and there has been rain or snow in a greater or less degree on 76 days out of the 120.

New Malton, May 4, 1818. J. S.

II. *Analysis of a Specimen of the Diamond Rock.*

Dr. E. D. Clarke, Professor of Mineralogy at Cambridge, has examined a specimen of the *diamond rock*, from the banks of the river *Iigitonhŏnha*, in *Brazil*, which was sent to him for this purpose by *Mr. Mawe*, of the Strand. It contains *diamonds* in their matrices. The rock consists of an aggregate of small *quartz* pebbles firmly set in indurated *iron sand*. The cavities in which the *diamonds* are placed are invested by a yellow ochreous matter which is full of minute pallets of *native gold*, visible to the naked eye.

From the same Professor we have also received an answer to the queries of our *Lewes* correspondent. The *metallic lustre* with which pure *silica* becomes invested when fused before the gas blow-pipe, is sometimes due to the *charcoal* used as a support; the same appearance takes place, under similar circumstances, in the fusion of *corundum*, and other refractory bodies, such as *magnesia*, and *lime*. But Dr. Clarke has observed globules of a metal resembling *silver* when *silica* has been fused with *borax* before the gas blow-pipe, the difficulty of obtaining which is owing to their volatilization almost in the instant of their being formed. A still more remarkable result was obtained in the fusion of *apatite;* when a globule of metal was obtained, which is now in the possession of Mr. *Lunn,* of St. *John's College, Cambridge.* It is not pretended to account for these phenomena, but merely to state the facts, in the hope that others may confirm and explain them.

III. *Comet of* 1811.

During the course of the last year, M. Schröter, of Lilienthal, has published an account of the comet which appeared in 1811; and by comparing his observations on this comet with those which he made upon that which appeared in 1807, he has been led to form some singular conclusions. The nucleus of the comet of 1811, the apparent diameter of which was 1′ 49″, and which, calculating from the distance, must have had a real diameter of 10,900 miles, M. Schröter supposes to be composed of a fluid covering a solid mass. In the centre of this nucleus we distinguish a second, which is smaller and more luminous, the apparent diameter of which being 16·97″, gives a real diameter of 1,697 geographical miles. This central part was surrounded with a particular kind of atmosphere, upon which many of its most remarkable variations depend. Besides this, it was surrounded by a luminous nebulosity, which always exhibited the same brilliancy in every part of its surface, without any appearance of phases; from which circumstance he concludes, that this light being always equable, cannot be the effect of any reflection from the solar light.

Two different parts may be distinguished in the head of this comet: 1. A spherical nebulosity of a whitish coloured light, which surrounded the exterior nucleus, and which is supposed to depend upon the spontaneous luminousness of the body; 2. The posterior part opposite to the sun, beyond which was extended the double tail; this part was separated from the nucleus by a dark interval, equal to half the total diameter of the head of the comet. The apparent diameter of this head was 34′ 12″, which gives it a real diameter of 2,052,000 geographical miles.

The greatest apparent length of the tail is 18°, which gives a real length of 131,852,000 geographical miles. M. Schröter conceives that we cannot explain this prodigious extent without admitting that there exists in space around the sun a subtile matter, susceptible of becoming luminous by the combined influence of the sun and the comet. Independent of the force which comets exercise as masses of matter, he conceives that they are endowed with a repulsive and impulsive force, which has some analogy to the electric fluid, and like it acts in different directions.

IV. *Shower of Red Earth in Italy.*

In the *Annals of Philosophy*, for Jan. 1817, there is a short notice of a shower of red earth which fell at Gerace, in Calabria; a number of the Giornale de Fisica of Brughatelli, which we have just received,* contains a full account of the circumstance, with a description of the substance, by Sig. Sementini, Professor of Chemistry at Naples, of which the following is an extract:

It occurred on March 14, 1813: the wind had been westerly for two days, when at two p.m. it suddenly became calm, the atmosphere grew cloudy, and the darkness gradually became so great as to render it necessary to light candles. The sky assumed the colour of red-hot iron, thunder and lightning continued for a considerable length of time, and the sea was heard to roar, although six miles from the city. Large drops of rain then began to fall, which were of a blood-red colour.

Sig. Sementini collected a quantity of the powder which fell, and describes its physical properties to be as follows: It had a yellow colour, like canella; an earthy, insipid taste; it was unctuous to the touch, and extremely subtile. When the powder was moderately heated, it changed its colour, first to a brown, and afterwards to a black, and became red again as the temperature was raised; after it had been heated, many small shining plates were visible, it no longer effervesced with acids, and had lost about $\frac{1}{10}$ of its weight. Its specific gravity was 2·07.

Sig. Sementini then subjected the powder to chemical analysis, and found its composition to be as follows:

Silex	33
Alumine	$15\frac{1}{2}$
Lime	$11\frac{1}{2}$
Chrome	1
Iron	$14\frac{1}{2}$
Carbonic acid	9
Loss	$15\frac{1}{2}$
	100

So large a proportion of loss was at first ascribed to some inaccuracy in the analysis, or to some body that had accidentally been mixed with the powder; but when he found it always to occur, whatever care was taken in the analysis, he began to suspect that it depended upon some combustible matter essential to the substance. This suspicion was afterwards verified; and by digesting the powder in boiling alcohol for a length of time, he obtained from it a greenish yellow colouring matter, which, when dried, acquired a pitchy consistence, was inflammable, and

* Dec. 2, tom. 1.

left a carbonaceous residuum. The author remarks, that the existence of chrome in this mineral seems to connect it with the aerolites, but the origin of the combustible substance is very obscure; there were no circumstances connected with the phenomenon which would lead us to suppose that it was of volcanic origin.

V. *Redness of the Sea.*

The following account of the red colour of the sea on the coast of Africa, near the mouth of the river Loango, is extracted from Professor Smith's journal.

"Some days ago the sea had a colour as of blood. Some of us supposed it to be owing to the whales, which at this time approach the coasts in order to bring forth their young. It is, however, a phenomenon which is generally known, has often been described, and is owing to myriads of infused animalculæ. I examined some of them taken in this blood-coloured water; when highly magnified, they do not appear larger than the head of a small pin. They were at first in rapid motion, which, however, soon ceased, and at the same instant the whole animal separated into a number of spherical particles."

VI. *Coal Gas employed for the Blow-pipe.*

We are informed that M. Lampadius, on making use of the gas blow-pipe, has found the heat which is produced by the combustion of oxygen with carburetted hydrogen procured from coal, to be more intense than that with pure hydrogen.—(Journ. Phys. for Jan. 1818.)

VII. *Supposed Discovery of a Ship near the Cape of Good Hope.*

A discovery has been lately made of a quantity of wood in a carbonized state, buried at some depth under the sand, about 10 miles from Cape Town. From the appearance and position of pieces of timber, it has been supposed to consist of the framework of a large vessel; and as it is at a considerable distance from the sea, and bears every mark of having been in its present position for a very long period, many speculations have been formed concerning it. The evidence on this point appears, however, to be extremely vague and uncertain; and from the specimens of the wood which have been exhibited in this country, which appear to be in the state of brown coal, as well as from all the circumstances of the case, it is probable that it does not differ from the forests, or collections of trees which have been found buried in different situations, in consequence of some of the great revolutions which have formerly occurred on the surface of our globe.

VIII. *On Cholesterine and the Cholesteric Acid.*

Poulletier de la Salle first distinctly noticed the laminated matter which is frequently found in human biliary calculi;

Fourcroy afterwards described it more minutely, and thought it was similar to adipocire. M. Chevreul has, however, since found that it differs in some respects from adipocire, especially in not forming a soap with the fixed alkalies, and has proposed to give it the name of cholesterine. MM. Pelletier and Caventon have lately observed the action of nitric acid on this substance, and they have found that a new acid is thus generated, to which they have given the name of cholesteric acid. It forms compounds with the alkalies, earths, and metals, the properties of which are all described in a memoir that was presented to the Philomathic Society.

IX. *On the Crystalline Form of the Deutoxide of Lead.* By M. Houton la Billardiere.*

The author informs us, that by boiling massicot in a solution of caustic soda, a portion of the metallic oxide is dissolved; and that after a considerable length of time, the solution deposits white, semi-transparent crystals, of the size of a pin's head, which, by means of a microscope, are easily discovered to be regular dodecahedrons. He performed a series of experiments on these crystals in order to ascertain their nature, and he satisfied himself that they consisted of pure oxide of lead. He styles it the *deutoxide,* because he supposes that there is an oxide with a smaller proportion of oxygen, which may be procured by calcining the oxalate of lead; but it is in fact the *protoxide,* or yellow oxide of the systematic writers.

X. *On the Formation of Coral Reefs.*†

The examination of a coral reef during the different stages of one tide is peculiarly interesting. When the tide has left it for some time it becomes dry, and appears to be a compact rock, exceedingly hard and rugged; but as the tide rises, and the waves begin to wash over it, the coral worms protrude themselves from holes which were before invisible. These animals are of a great variety of shapes and sizes, and in such prodigious numbers, that in a short time the whole surface of the rock appears to be alive and in motion. The most common worm is in the form of a star, with arms from four to six inches long, which are moved about with a rapid motion in all directions, probably to catch food. Others are so sluggish that they may be mistaken for pieces of the rock, and are generally of a dark colour, and from four to five inches long, and two or three round. When the coral is broken, about high water-mark, it is a solid, hard stone; but if any part of it be detached at a spot which the tide reaches every day, it is found to be full of worms of different lengths and colours, some being as fine as a thread, and several

* Abridged from Journ. Pharm. for Aug. 1817.

† Extracted from Capt. Hall's "Account of a Voyage of Discovery to the West Coast of Corea, and the great Loo-choo Island."

feet long, of a bright yellow, and sometimes of a blue colour; some resemble snails, and some are not unlike lobsters in shape, but soft, and not above two inches long.

The growth of coral appears to cease when the worm is no longer exposed to the washing of the sea. Thus, a reef rises in the form of a cauliflower, till its top has gained the level of the highest tides, above which the worm has no power to advance, and the reef of course no longer extends itself upwards. The other parts, in succession, reach the surface, and there stop, forming in time a level field with steep sides all round. The reef, however, continually increases; and being prevented from going higher, extends itself laterally in all directions. But this growth being as rapid at the upper edge as it is lower down, the steepness of the face of the reef is still preserved. These are the circumstances which render coral reefs so dangerous in navigation; for, in the first place, they are seldom seen above the water, and, in the next, their sides are so steep that a ship's bows may strike against the rock before any change of soundings has given warning of the danger.

XI. *Account of a new Mineral called Pargasite.**

A new mineral called pargasite has been sent to this country from Finland. It was found some years ago at the village of Ersby, near Abo.

It is of a green colour, is translucent, and transparent. Its crystals are of various sizes, from an inch downwards. Its form is an octohedron, with a rhomboidal base. It has three cleavages. It is harder than fluor spar, but is scratched by quartz. It also scratches glass. Specific gravity 3·11. It melts before the blow-pipe into a mass of a pearly white lustre. The following are given as the proportions of its constituents:

Silex	42·01
Magnesia	18·27
Lime	14·28
Alumina	14·08
Oxide of iron	3·52
Oxide of manganese	1·02
Oxide of a metal not investigated	0·33
Fluoric acid and water	3·09
Loss	2·59
	100·00

XII. *Lectures.*

Dr. Bostock proposes to give a Course of Lectures on Physiology and Animal Chemistry during the next winter.

* Extracted from the Journal of Science and the Arts, v. 1. 8.

Article XIX.

Astronomical, Magnetical, and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observations.

April 4. Immersion of Jupiter's first satellite.................. { 15h 32′ 20″ Mean Time at Bushey. / 15 33 41 Mean Time at Greenwich.

Beginning: weather cloudy.

April 20. Lunar eclipse end.......... { 13h 28′ 47″ Mean Time at Bushey. / 13 30 08 Mean Time at Greenwich.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.				
	Hour.		Variation.			Hour.		Variation.			Hour.		Variation.		
April 1	8h	35′	24°	33′	09″	1h	30′	24°	43′	03″	6h	15′	24°	35′	02″
2	8	35	24	31	23	1	30	24	41	52	6	15	24	34	29
3	8	30	24	32	04	1	30	24	40	13	6	15	24	35	21
4	8	35	24	31	52	1	20	24	42	38	6	20	24	32	23
5	8	45	24	36	24	1	40	24	42	02	6	20	24	34	33
6	8	30	24	32	30	1	10	24	42	54	—	—	—	—	—
7	—	—	—	—	—	1	50	24	42	08	—	—	—	—	—
8	8	40	24	30	20	—	—	—	—	—	6	20	24	34	34
9	8	30	24	32	38	1	30	24	44	19	6	30	24	37	10
10	8	55	24	34	08	—	—	—	—	—	—	—	—	—	—
11	8	30	24	32	02	1	55	24	45	48	—	—	—	—	—
12	8	35	24	31	27	1	15	24	46	09	6	20	24	32	46
13	8	35	24	32	45	1	40	24	47	37	6	25	24	36	27
14	8	35	24	38	18	1	35	24	48	08	6	30	24	37	12
15	8	35	24	36	06	1	30	24	48	43	6	30	24	35	26
16	8	30	24	33	42	1	25	24	47	00	6	30	24	37	40
17	8	40	24	34	50	1	30	24	45	12	6	30	24	40	13
18	8	35	24	35	09	1	20	24	47	38	6	35	24	36	26
19	8	30	24	31	58	1	35	24	50	30	6	35	24	34	37
20	8	30	24	35	46	1	20	24	44	35	6	40	24	38	29
21	8	40	24	32	19	1	25	24	46	56	6	35	24	38	20
22	8	35	24	36	14	1	10	24	43	18	6	30	24	39	08
23	—	—	—	—	—	1	40	24	46	49	6	25	24	40	47
24	8	35	24	34	07	1	30	24	43	15	6	35	24	36	54
25	8	25	24	35	26	—	—	—	—	—	—	—	—	—	—
26	8	35	24	34	36	1	20	24	41	46	6	40	24	35	14
27	8	35	24	36	40	1	40	24	44	09	6	40	24	37	43
28	8	35	24	35	18	1	15	24	43	10	6	55	24	38	36
29	8	35	24	38	33	1	20	24	45	50	6	55	24	38	16
30	8	35	24	34	57	—	—	—	—	—	—	—	—	—	—
Mean for the Month.	8	35	24	34	06	1	29	24	44	50	6	30	24	36	36

On the 26th, at noon, a furious storm of thunder, lightning, and hail, accompanied with a whirlwind from the S.E. took place, which did considerable damage in the neighbourhood. Rain, by the pluviameter, between noon on April 1, and May 1, 3·750 inches. Evaporation, during the same period, 2·590 inches.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
April		Inches.				Feet.		
1	Morn....	29·803	41°	65°	ENE		Cloudy	53½
	Noon....	29·778	46	51	ENE		Cloudy	48½
	Even....	29·740	41	53	ENE		Very fine	34½
2	Morn....	29·825	37	79	NE by E		Cloudy	48
	Noon....	29·850	46	56	NE by E		Cloudy	
	Even....	29·850	41	60	NE by E		Cloudy	37
3	Morn....	29·905	39	59	NE		Cloudy	46½
	Noon....	29·915	43	50	ENE		Fine	
	Even....	29·925	39	51	ENE		Fine	32
4	Morn....	29·933	39	50	NE		Very fine	47½
	Noon....	29·875	46	44	ENE		Very fine	
	Even....	29·865	42	50	SE by E		Fine	31
5	Morn....	29·630	39	64	Var.		Cloudy	52½
	Noon....	29·480	51	46	SSW		Fine	
	Even....	29·323	46	45	SSW		Cloudy	39
6	Morn....	28·828	47	91	SW by S		Rain	50
	Noon....	28·800	—	80	WSW		Showery	
	Even....	28·945	44	63	WNW		Cloudy	36
7	Morn....	29·260	—	72	ESE		Rain	53
	Noon....	29·140	38	90	E		Rain	
	Even....	—	—	—	—		—	37
8	Morn....	29·035	37	68	SW by S		Fine	60
	Noon....	29·015	52	88	SW by S		Rain	
	Even....	29·948	53	80	SW by S		Cloudy	48
9	Morn....	28·865	52	69	SSW		Rain	55
	Noon....	28·865	53	60	WSW		Showery	
	Even....	28·974	49	65	W by S		Showery	41
10	Morn....	29·128	47	87	SSW		Rain	51½
	Noon....	29·023	—	73	SSW		Rain	
	Even....	—	—	—	—		—	43
11	Morn....	28·760	49	64	SSW		Cloudy	51
	Noon....	28·763	45	71	N		Showery	
	Even....	—	—	—	—		—	31½
12	Morn....	29·520	35	57	NNW		Very fine	46½
	Noon....	29·560	44	46	WNW		Cloudy	
	Even....	29·600	43	57	NW		Hail showers	32
13	Morn....	29·592	39	52	SE		Cloudy	49½
	Noon....	29·487	48	44	SSW		Cloudy	
	Even....	29·382	42	48	SSW		Cloudy	39
14	Morn....	29·245	45	54	S		Fine	54
	Noon....	29·245	53	37	Var.		Cloudy	
	Even....	29·268	46	49	E		Cloudy	36
15	Morn....	29·300	44	49	ESE		Very fine	54
	Noon....	29·258	51	39	E by S		Fine	
	Even....	29·180	46	44	E		Fine	37½
16	Morn....	28·943	47	47	E		Fine	56½
	Noon....	28·886	56	38	ESE		Cloudy	
	Even....	28·847	49	52	E by S		Rain	47
17	Morn....	28·818	48	93	ENE		Rain	53½
	Noon....	28·825	52	65	E		Cloudy	
	Even....	28·825	43	64	ENE		Cloduy	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
April		Inches.				Feet.		
	Morn....	28·900	45°	58°	NE by E		Cloudy	41°
18	Noon....	28·950	51	39	NE by E		Very fine	51
	Even....	29·056	42	46	NE by E		Fine	
	Morn....	29·263	41	47	ENE		Fine	31½
19	Noon....	29·300	48	41	E		Cloudy	50½
	Even....	29·353	41	43	ESE		Cloudy	
	Morn....	29·365	41	43	ENE		Very fine	34½
20	Noon...	29·353	49	37	ENE		Cloudy	51½
	Even....	29·305	44	43	E		Cloudy	
	Morn...	29·244	43	45	E		Fine	33
21	Noon....	29·240	54	41	E by S		Fine	54
	Even....	29·243	46	46	E by N		Fine	
	Morn....	29·235	47	63	E by N		Sm. rain	40
22	Noon....	29·215	56	54	E by S		Cloudy	55½
	Even....	29·105	46	78	E		Rain	
	Morn....	29·032	—	99	NNE		Rain	43
23	Noon....	29·023	42½	80	NNE		Rain	43
	Even....	28·965	41	84	NNE		Rain	
	Morn....	28·846	43	87	NNE		Mizzle	41
24	Noon....	28·862	48	66	NNE		Cloudy	50
	Even....	28·840	44	86	NE		Rain	
	Morn...	28·683	47	78	SE		Mizzle	40
25	Noon....	—	—	—	—		—	55½
	Even....	—	—	—	—		—	
	Morn....	28·983	51	55	ENE		Fine	43
26	Noon....	29·000	61	52	Var.		Hail	62½
	Even....	29·013	57	49	E		Fine	
	Morn....	28·975	55	68	SSW		Cloudy	52
27	Noon....	29·100	62	50	SW by S		Fine	63
	Even....	29·145	58	50	SSW		Fine	
	Morn....	29·385	51	58	SW		Fine	46
28	Noon....	29·453	47	38	W		Fine	58
	Even....	29·515	53	40	SSW		Very fine	
	Morn....	29·550	49	33	SE		Very fine	40½
29	Noon....	29·510	58	30	SSW		Very fine	62½
	Even....	29·465	53	37	ESE		Very fine	
	Morn....	29·285	49	80	ENE		Cloudy	43
30	Noon....	29·138	—	83	NE		Rain	53½
	Even....	—	—	—	—		—	

Article XX.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer. Max.	Min.	Med.	Thermometer. Max.	Min.	Med.	Hygr. at 9 a. m.	Rain.	
3rd Mon.										
March 30	S E	30·30	30·13	30·215	53	35	44·0	71	—	
31	N E	30·25	30·20	30·225	44	35	39·5	64	—	
4th Mon.										
April 1	N E	30·25	30·13	30·190	47	35	41·0	55		
2	N E	30·32	30·23	30·275	47	38	42·5	64		
3	N E	30·37	30·32	30·345	45	32	38·5	52		
4	S E	30·32	30·02	30·170	49	22	35·5	50		
5	S W	30·02	29·22	29·620	54	40	47·0	63	4	●
6	S W	29·67	29·22	29·445	51	34	42·5	73	—	
7	Var.	29·67	29·40	29·535	56	33	44·5	67	65	
8	S	29·40	29·24	29·320	63	48	55·5	61	25	
9	S W	29·50	29·24	29·370	56	40	48·0	61	6	
10	S	29·50	29·16	29·330	55	42	48·5	70	17	
11	N W	29·92	29·16	29·540	56	33	44·5	54	22	
12	W	30·02	30·00	30·010	47	27	37·0	55	2	
13	S E	30·00	29·65	29·825	53	33	43·0	55		☽
14	S E	29·69	29·63	29·660	59	28	43·5	53		
15	S E	29·63	29·34	29·485	60	28	44·0	69		
16	S E	29·34	29·20	29·270	57	47	52·0	52	16	
17	E	29·30	29·20	29·250	54	42	48·0	77	—	
18	N E	29·66	29·30	29·480	50	32	41·0	50		
19	E	29·72	29·66	29·690	53	26	39·5			
20	Var.	29·72	29·63	29·675	54	28	41·0	55		○
21	E	29·66	29·62	29·640	57	40	48·5	48		
22	S E	29·62	29·45	29·535	58	43	50·5	53	—	
23	E	29·45	29·24	29·345	46	42	44·0	80	81	
24	N E	29·24	29·08	29·160	53	42	47·5	75	52	
25	S W	29·35	29·08	29·215	58	42	50·0	65	5	
26	Var.	29·35	29·25	29·300	68	52	60·0	60	14	
27	S W	29·75	29·25	29·500	65	44	54·5	60	—	☾
		30·37	29·08	29·642	68	22	45·36	61	3·09	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Third Month.—30. Hoar frost: a breeze, variable, succeeded by *Cirrus* mingled with *Cumulus*: a few drops, p. m. 31. Fine breeze: large *Cumulostrati*, with a few drops of rain: clear twilight.

Fourth Month.—1. Fine: *Cumulus* passing to *Cumulostratus* in a brisk wind: at sun-set an evaporation of the clouds, followed by dew and an orange twilight. 2. Cloudy morning: *Cumulostratus* carried in a brisk wind through the day. 3. As yesterday, with the addition of red *Cirri* at sun-set. 4. Much sun, with long, faint, linear *Cirri*. 5. Hoar frost: calm: a warm sun, with much dust: *Cirrus* increased to obscurity in the evening, and it rained by night. 6. A gale through the day: calm night. 7. Wet forenoon from the eastward, p. m.: rain from the SW: a gale in the night. 8. Turbid sky: *Cirrocumulus* at nine, a. m. with the temp. 56°, afterwards the wind southing; we had showers at intervals, and a gale by night. 9, 10, 11. Windy, with showers. 12. *Cumulostratus* chiefly, but with rain at intervals: in the evening the wind went to NW, with large *Nimbi*. 13. Fair, with *Cumulostratus*. 14. In the evening a large, faint, lunar halo, on a kind of *Cirrose* obscurity spread from NW towards the zenith. 15. Hoar frost: fine sky, with tendency to *Cirrocumulus*. 16. Hoar frost: *Cirrocumulus* by nine, a. m. in extensive beds: a smart breeze came on, with *Cirrostratus* and fleecy *Cumulus*, and *the first swallow* made its appearance about five, p. m.: rain ensued after dark, with a fragrant smell from the turf. 17. Drizzling morn: fine day. 18. Windy, overcast, bleak morning: fine day. 19. *Cumulostratus*, windy. 20. Hoar frost: fair, with clouds; in the evening a westerly current was evident above, by the motion of elevated *Cirrostrati*: two different beds of this cloud had appeared at sun-set, crossing at an oblique angle in the S: the eclipse of the moon was well seen at intervals through these. 21. Little wind: fair. 22. Wet, p. m. 23. Very wet, a. m. and again, with wind, at night. 24. Overcast day: wet evening and night. 25. Some drizzling rain after inosculation of heavy *Cumuli*, with a stratum of clouds above. 26. Fleecy *Cumuli*, with *Cirri*, and tendency to *Nimbus* in the S: at nine, a. m. an unusual agitation, evidently electrical, was produced in a *Cirrus* by the passage beneath it of fleecy *Cumuli*, which came from S, with the vane at E: thunder clouds soon after formed, and before one p. m. we heard three distinct explosions; two distinct showers of rain mixed with hail followed, but without wind: in the evening, large thunder clouds continuing about, it lightened for some hours in the distance, nearly all the horizon round, the W only being free from it: the wind SE. 27. Cloudy, wet morning: windy at SW: fine afterwards, with large *Cirrus* above *Cumulus*: some lightning at night in the NE.

RESULTS.

Winds Variable, with much South East.

Barometer:	Greatest height	30·37 inches;
	Least	29·08 inches;
	Mean of the period	29·642 inches.
Thermometer:	Greatest height	68°
	Least	22°
	Mean of the period	45·36°
Mean of the hygrometer		61°
Evaporation		1·40 inches.
Rain		3·09 inches.

The excessive rains continuing, have occasioned repeated overflowings of the river Lea into the marshes. Vegetation, which continued nearly dormant at the commencement of this period, was making considerable progress towards the close of it.

Tottenham, *Fifth Month*, 4, 1818. L. HOWARD.

INDEX.

END OF VOL. XI.

ERRATA IN VOL. XI.

Page 122, line 17 from bottom, *for* Kimbley *read* Knubley.
123, line 13, *for* Orgaeleet *read* Orgaebet.
288, lines 19 and 30, *for* sphericles *read* spherules.

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HM