THE

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PHILOSOPHICAL JOURNAL.

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EDINBURGH NEW PHILOSOPHICAL JOURNAL,

EXHIBITING A VIEW OF THE

PROGRESSIVE DISCOVERIES AND IMPROVEMENTS

IN THE

SCIENCES AND THE ARTS.

CONDUCTED BY

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Biographical Memoir of MICHEL ADANSON. Read to the Institute of France. By Baron CUVIER.

WHEN we appear at this tribunal, it is almost always for the purpose of presenting the picture of a life at once happy and useful. The men whom we praise have possessed the twofold advantage of enlightening their fellows, and gaining their esteem and affection. Public opinion loudly dictates to us their eulogy, and the certainty of having only the general sentiment of the friends of learning to express, supports us under the distrust which we entertain of our own powers. But it sometimes also happens, that we have to recal the attention to a man of merit too much neglected during his life, and to plead in favour of his memory against the indifference of his contemporaries. A motive not less powerful, then, animates us. Our functions, having become more difficult, only appear the more honourable and the more touching; they assume, in some measure, in our eyes, the august character of a public magistracy, and we exercise them with all the warmth which a sacred duty inspires.

The most unremittingly pursued labours, and the most fertile conceptions, have but too often received only this tardy justice; and perhaps, by multiplying examples, we should only be increasing discouragements, if these examples did not, along with this unjust neglect, also present a preservative against its influence, and a consolation under its inflictions,—I mean, if we did not see in them, at the same time, both the causes which produce this neglect, and the enjoyments by which it is amply compensated. Both arise from the same principle. The man who is devoted to the discovery of truth, being too much satisfied with the ineffable charm attached to his research, does not sufficiently attend to the opinion of others; and, in reality, it is almost always his own indifference which causes that of his age,—an indifference which is certainly culpable, since it has the effect of defrauding genius of its noble destination.

The historical eulogy of M. Adanson will afford evidence of all these truths, and will derive from them its principal interest. The various qualities of that learned and singular man, their origin and their effects, their agreement and opposition, their influence upon his labours and upon his fortune, will equally concur toward this object. Unbending courage and infinite patience, profound genius and offensive singularity, ardent desire of a speedy reputation, and misconception of the means which afford it; lastly, calmness of mind in the midst of all sorts of privations and sufferings,—every thing during his long life deserves to be pondered, and will, in its turn, become a noble example for emulation, or a salutary admonition for the conduct.

Michel Adanson,* member of the Institute, and of the Legion of Honour, foreign member of the Royal Society of London, *ci-devant* pensionary of the *Academie des Sciences*, and royal censor, was born at Aix, in Provence, on the 7th of April 1727. He was of a Scotch family, which had attached itself to the fate of King James. His father, a servant of M. de Vintimille, archbishop of Aix, followed that prelate, when he was appointed to the archbishoprick of Paris, and took along with him to the capital, the young Michel, then three years of age. M. Adanson, the father, had four other children also, and was not rich; but the protection of the archbishop assisted him in their education. Each of them received a small benefice, and Michel Adanson, in particular, had, at the age of seven years, a canonicate at Champeaux en Brie, which served to defray his expences at the College of Plessis.

* The correct orthography of the name, as the family was from Scotland, will be *Adamson*.—Edit.

He possessed much vivacity of disposition, an imperturbable memory, and an ardent desire to distinguish himself; and nothing more was wanting to ensure his success at college, and make him appear to advantage at public exhibitions. The celebrated English author, Tuberville Needham, then renowned for the numerous and singular facts which his microscopes enabled him to discover, assisted one day at the public exercises of Plessis. Struck with the brilliant manner in which young Adanson executed them, he asked permission to add a microscope to the books which the scholar was to receive as a prize; and in delivering it to him, said, with an air of solemnity, "You, who are so skilled in the works of man, are worthy also of knowing the works of nature."

These words decided the profession of the child. They remained deeply engraven in the memory of M. Adanson, and he even repeated them with interest toward the close of his life. From this moment, his curiosity no longer changed its object. Having his eye attached, so to speak, to that astonishing instrument, he submitted to it all that the narrow limits of his college supplied him with,—all that he could collect in his walks, by stealing away from the paths prescribed to his companions, the smallest parts of mosses, and the minutest insects. He knew those productions which nature seems to have reserved for the curious eye of the philosopher, before those which she abandons to general inspection; and his mind was already filled with those wonders of detail, while his soul had not as yet experienced the impression of the grand spectacle of the universe. Perhaps he never even felt those emotions at once so gentle and animating. He had no youth; labour and meditation seized him from his childhood; and during nearly seventy years, all his days, all his moments, were occupied with the laborious researches of a professed man of science.

On leaving college, he was admitted into the cabinets of Reaumur and Bernard de Jussieu, where a rich harvest opened itself to his activity. He devoured it with a sort of fury. He passed whole days at the Jardin des Plantes. Not content with hearing the professors, he repeated their lessons to the other scholars; and he has been heard to observe, in a jocular way, of the present professors, that they were his pupils of the third generation. We have evidence from his manuscripts, that, at the age of nineteen, he had already methodically described more than 4000 species of the three kingdoms. The mere manual operations which an undertaking like this would require, prove that he employed a part of his nights in it. This, no doubt, contributed much to his own improvement, but it did nothing for the advancement of science: most of these productions were already known and described in books. A climate but little frequented could alone furnish him abundantly with such as had never been seen or examined by naturalists.

M. Adanson, urged by the ambition of placing himself, cost what it might, among those who have extended the limits of natural history, and, like most young students, only knowing for this purpose the easy way of multiplying descriptions of species, determined to travel. He resigned his benefice, and having obtained, by dint of importunities, and through the credit of MM. de Jussieu, a small post in the counting-houses of the African Company, he set out for Senegal on the 20th December 1748.

The motives which determined his choice are curious. "It was," he says in a note that was found among his papers, "because this country was of all the European settlements the most difficult to penetrate, the hottest, the most unhealthy, the most dangerous in all other respects, and consequently the least known by naturalists." The man who could be determined precisely by such reasons as these, would require to have no small degree of zeal. On the other hand, he would be less sensible than any other person to the difference between Paris and a desart. Constantly labouring eighteen hours in the day, he never reflected whether he was near or far from the enjoyments of the world. He appears, besides, to have always had a very strong constitution. In his narrative, we see him, sometimes traversing sands heated to 60° of Reaumur, which converted his shoes into horn, and, by reflecting the light, made the skin of his face peel off; at other times overwhelmed by those terrible hurricanes which occur in the torrid zone, without his activity being ever for one moment diminished.

During the five years which he passed in this country, he described a prodigious number of new plants and animals,—drew a chart of the river, and subjected it to astronomical observations,—compiled grammars and dictionaries of the languages spoken on its banks,—kept a register of meteorological observations, made several times each day,—composed a detailed treatise comprehending all the useful plants of the country,—and collected all the objects of its commerce, together with the arms, dresses, and utensils of its inhabitants We have seen all these works in manuscript, and in his own possession; and we were astonished that a man, single, and destitute of all assistance, could have accomplished them in so short a time. This short space, however, was still further occupied by general reflections of much greater importance, which became the principles of his other works, and which determined the progress of his ideas, and the character of the rest of his life.

Let one represent to himself a man of twenty-one years of age, leaving, so to speak, the benches of the school, still in a great measure a stranger to all the intricacies of our sciences and systems, almost without books, and preserving only by recollection the instructions of his masters; let him imagine this person suddenly transported to a barbarous country, with a handful of fellow-countrymen, having no other connection with him than that of speaking the same language, and who either did not understand, or despised, his researches; let him view this being, abandoned for several years to the most absolute solitariness, in a strange land, where the meteors, the vegetables, the animals, and the human beings, were different from those of ours. His views would necessarily have a peculiar direction, his ideas an original turn; he would not creep along our beaten paths; and if, moreover, nature had given him an assiduous mind, and a strong imagination, his conceptions would bear the impress of genius. But not having to make them pass into the minds of others, without adversaries to combat, or objections to refute, he would not hit upon the delicate art of convincing the understanding without offending the self-love, of insensibly turning the habits into new paths, and counteracting the aversion of sloth by the commencement of a new labour. On the other hand, being always alone with himself, and having no object of comparison, taking every idea that occurred to him for a discovery, never exposed to those little struggles of society which enable a man to ascertain so soon the measure of his strength, he would be inclined to form exaggerated ideas of his talents, and would not scruple to express them with freedom.

What a young man like this would necessarily become, M. Adanson actually realised. Those who have known him must have observed in him whatever of good or of evil there is in the portrait; and from this character once given, the fate of his works and of his person is almost necessarily deduced.

On his return to Europe, which happened on the 18th February 1754, with the rich store of facts and general views which he had amassed, he presently sought to assume the rank among naturalists which he fancied to belong to him. The state of natural history had undergone a remarkable change during his absence. Reaumur was near the close of his life. His ingenious researches found but a feeble and less happily situated continuator in De Gheer. But Linnæus and Buffon began to pave the way to the empire which they divided between them for nearly half a century. The one, a man of a penetrating mind, of indefatigable application, grasping all the productions of nature, forced them, as it were, into arbitrary classification, precise, however, and easy to apprehend; imposed upon them strange names, but invariable, and easily retained in the memory; described them in a dead language, but in brief and expressive words, and having a rigidly determined signification. The other, of an elevated imagination, grave and imposing in his style as in his manners, attaching himself to a smaller number of beings, neglecting those artificial scaffoldings which the study of more numerous productions would have required, exhausted, as it were, each of the subjects which he handled. He traced spirited paintings of them. The pomp and the majesty of nature reigned in their arrangement; her brilliancy and freshness in their colouring. They were connected by new, bold, and sometimes rash views, but always elucidated with an art that carried the mind away captive.

The works of Linnæus, containing in a small bulk an immense series of beings of all classes, were the manual of the learned; those of Buffon, presenting in a suite of enchanting portraits a selection of the most interesting objects, formed the delight of the men of the world. But both of these authors, confining themselves almost exclusively to their own ideas, too much neglected an essential matter,—the study of those multiplied relations of beings whence arises their division into families, founded upon their peculiar nature; and this was precisely what had formed the principal subject of M. Adanson's meditations in his solitude.

He was the first who developed with energy their infinite importance, as well as made extensive application of them. The boldness of his march, and the precision ot his results, astonished naturalists to such a degree that they thought for a moment they saw in him a worthy rival of these two great masters; and perhaps there was only wanting, in order to his reputation approaching theirs, an equally happy employment of accessory means, of which they knew so well to avail themselves. Let us attempt to trace a brief sketch, both of this subject in itself, and of the peculiar manner in which M. Adanson considered it.

An organized being is a unique whole, an assemblage of parts which react upon one another to produce a common effect. None of its parts can therefore be essentially modified, without the others being at the same time sensible of the change. There is, therefore, only a certain number of possible combinations among the great modifications of the principal organs; and under each of the higher combinations there is also only a certain number of subordinate combinations of less important modifications, that can take place.

Consequently, if we had an exact knowledge of all these combinations of different orders, and if each were arranged in the place determined by the organs which constitute it, we would also have a true representation of the whole system of organized beings; all their relations and properties might then be reduced to general propositions; the ultimate and peculiar nature of each could be clearly demonstrated; in a word, natural history would be an exact science.

This is what is meant by the natural method; it is the principal key of the mysteries of organization, the only thread that can guide us with certainty in this inextricable labyrinth of forms of life, and it is only by this method that the naturalist will one day be able to attain a height from which all nature will appear to him, in its aggregate and in its details, as one vast picture. But hitherto we have only been able to catch a glimpse of some portions of this sublime picture; and the point from which we might embrace the whole is still but a sort of ideal object, which we may perhaps never attain at all, although it is our duty unremittingly to tend toward it, and although, by continued labour, we may every day approach nearer to it.

The most direct method would be to determine the functions and influence of each organ, in order to calculate the effect of its modifications; then, forming the great divisions according to the most important organs, and thus descending to the lower divisions, we should have a scale, which, although formed in advance, and almost independently of the observation of species, would nevertheless be the real expression of the order of nature. It is this principle which is named the *subordination of the characters.* It is perfectly rational and philosophical; but its application would suppose a degree of knowledge with regard to the nature, functions, and influence of organs, which, at the period when M. Adanson commenced his labours, was too far from being attained, even in approximation, to admit of being employed; and, perhaps, even the idea of it never presented itself to his mind.

He, therefore, had recourse to a method the reverse of this, which may be called the *empirical method*, or that of experiment, founded upon the actual comparison of species; and, in order to apply it, he devised a plan which is peculiar to himself, and which cannot but be regarded as highly ingenious. Considering each organ separately, he formed of its different modifications a system of division in which he arranged all the beings known. Repeating the same operation with relation to many organs, he thus constructed a number of systems, all artificial, and founded each upon a single organ arbitrarily chosen.

It is evident that the beings which none of these systems would separate, would be very intimately allied, since they would resemble each other in all their organs. The affinity would be somewhat less in those which some systems would not assimilate in the same classes. Lastly, the most distant of all would be those which would not come together in any system.

This method would, therefore, afford a precise estimate of the degree of affinity of beings, independent of the rational and physiological knowledge of the influence of their organs; but it has the defect of supposing another sort of knowledge, which, though merely historical, is not less extensive nor less difficult to acquire, namely, that of all the species, and of all the organs of each species. The neglect of a single organ may lead to the most erroneous results; and M. Adanson himself, notwithstanding the immense number of his observations, furnishes some examples of false relations thus introduced.

This is what he called his *universal method*, and it is also the leading idea which predominates in all his works, printed or in manuscript.

He published in 1757 a sort of trial of it in the *Traité des Coquillages*, which terminates his first volume of his *Voyage au Senegal.* This opened to him, when only thirty years of age, the gates of the Academie des Sciences, and of the Royal Society of London, not because he had gone to seek some shells on the coast of Africa, but because he announced himself as a man of genius, full of new views, of great activity, and capable of doing still higher honour to these illustrious societies by many similar undertakings.

The work, in fact, was such as might rationally enough excite these hopes, and its author deserved these marks of regard, especially from the attention which he had bestowed upon the animals of shells, which before his time had been entirely neglected, and some of which have not even yet been described. His methodical distribution, founded upon a score of those partial systems of which we have already given an idea, was much superior to all those of his predecessors. Nevertheless there still remained some defects in it, for a reason which we have already hinted at, namely, because, from the want of anatomical dissections, he could not have become acquainted with the internal organs, and especially the heart. This omission made him even err in the general description of the class, in which he does not comprehend the mollusca which are destitute of shells.

His project at first was to treat in this manner, in eight volumes, the whole history of Senegal, and, in fact, a great portion of it is completed in his manuscripts; but judging that the utility of his method would be better perceived by a more general application, he soon ceased to publish this first work, in order to glimpse of some portions of this sublime picture; and the point from which we might embrace the whole is still but a sort of ideal object, which we may perhaps never attain at all, although it is our duty unremittingly to tend toward it, and although, by continued labour, we may every day approach nearer to it.

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His project at first was to treat in this manner, in eight volumes, the whole history of Senegal, and, in fact, a great portion of it is completed in his manuscripts; but judging that the utility of his method would be better perceived by a more general application, he soon ceased to publish this first work, in order to devote himself entirely to another, on the Families of Plants, which he had printed in 1763. He also here found the advantage of operating upon more numerous beings, of examining them in more points of view, and for which the empirical method is more excusable, because the functions of their organs are more obscure.

Many botanists had already perceived the importance of distributing plants according to their natural relations. In the latter end of the seventeenth century, Morison, Magnol, and Ray, had, almost at the same time, conceived the idea of such a distribution, but without devising very proper means for accomplishing it. Haller, long had this object in view, but had not the good fortune to be able to make the natural relations entirely agree with an absolute system; and, notwithstanding all his care, that which he adopted still broke through some of those relations. Linnæus voluntarily renounced it in forming his System, and was only sometimes led to it by the force of analogy, which constrained him to break loose from the rules which he had prescribed to himself.

In a word, of all the botanists that preceded M. Adanson, the only one who had never abandoned the inquiry, and who had been most successful in his investigations, and who even deserved to be considered, in this respect, as the master of his contemporaries and successors, was Bernard de Jussieu. That extraordinary man, who combined virtues and a modesty worthy of the first ages, with an extent of knowledge which scarcely any age has surpassed, was occupied with it during the whole of his life; but, always dissatisfied with what he had done, because he saw better than any one what remained for him to do, he did not commit his results to writing; and they were only known by the arrangement which he introduced in 1758, in the garden of Trianon, and by the fragments which his friends or his disciples published. There are strong reasons for thinking that Linnæus had profited by the conversation of Bernard de Jussieu on this subject; for several of the associations indicated in his *Ordines Naturales*, published in 1753, under the form of a mere list without explanations, would with difficulty have arisen from the views which directed that celebrated naturalist in his other works.

It has also been thought that M. Adanson, who was a pupil of Bernard de Jussieu, had gathered from the lessons of his master, the first germs of some of his families. But, were even this conjecture well founded, his fame would lose little by the circumstance. If he profited by these lessons, it was as a man of genius that he did so. The general plan of his book,—the direct principles which he established,—his free and bold march, are all his own, and present no indications of any thing borrowed. The very existence of some errors which Bernard de Jussieu had avoided, proves the originality of M. Adanson's work. These errors always arise from the same cause, namely, the neglect of some important organ; nor yet were they owing to his having established his distributions upon too small a number of partial systems, for he commenced with making sixty-five of these systems, founded upon so many different considerations; but they owed their existence, as we have already insinuated, from want of having rightly comprehended the fecund principle of the subordination of characters. These errors, however, are but few, because a delicate tact often supplied what method alone could not have given him, and the work presents in requital a multitude of happy views, which more recent discoveries have only confirmed.

M. Adanson, for example, pointed out the *perisperm*, and its importance for characterising the families, although he did not give it any name. He formed the family of *Hepaticæ*, and confined that of the *Joubarbes* within proper limits. He was the first who perceived the affinity of the *Campanulaceæ* to the *Compositæ*; the connection of the *Aristolochiæ* with the *Eleagneæ;* of the *Menyanthæ* with the *Gentianæ;* and that of the *Trapa* with the *Onagræ;* of which Bernard de Jussieu was ignorant, and which have since been recognised. His divisions of *Liliaceæ, Dipsaceæ* and *Compositæ* are original and good. His groups of *Fungi* are superior to those of Linnæus. He separated with reason the *Thymelææ* from the *Eleagneæ,* and the *Nyctagineæ* from the *Amaranthaceæ,* which Bernard de Jussieu had confounded. Lastly, a very great number of his genera have been approved of and adopted by the latest botanists.

In his preface, M. Adanson, gives a historical account of the science, which displays an astonishing erudition, when we consider that he had been almost always occupied in observing. He mentions, with accuracy, how many plants, figures, and new ideas each author had added to the general stock. He even gives a sort of scale of the merit of the various systems that had appeared ; but it is only according to their more or less perfect agreement with his natural families, that he assigns to them any precedency. This was putting himself at the head of all the botanists ; and, in fact, he was not far from having such an opinion of himself. He did not conceal in particular the sort of envy inspired in him by the celebrity of the *Sexual System* of Linnæus, one of the most opposite to the natural relations of vegetables. The hope of seeing it quickly fall into disrepute indeed consoled him for a time; but in this he only shewed to what degree he was unacquainted with men, while it was upon his intimate knowledge of them that Linnæus founded almost all his success.

Amiable, benevolent, surrounded by young enthusiasts, whom he trained to become so many scientific missionaries; careful to enrich his successive editions by their discoveries; favoured by the great, connected by an active correspondence with the learned, anxious to make his science appear easy, rather than to render it solid and profound, the Swedish naturalist daily saw his doctrine extend, in defiance of the resistance opposed to it by the pride of individuals, and by national prejudices.

Adanson, on the contrary, retaining his solitary habits, inaccessible in his cabinet, without pupils, almost without friends, holding intercourse with the world only through the medium of his works, seemed to invest these works purposely with repulsive difficulties, as if he dreaded their too general diffusion.

Instead of the simple and convenient nomenclature contrived by Linnæus, he gave arbitrary names to the different beings, which no etymological relation fixed in the memory, and even sometimes disdained to indicate their accordance with the names employed by others. He even invented an orthography of his own, which made his French look like some unknown jargon. This he said was to represent the pronunciation better. But, in order to have the pronunciation represented, it would require first to be fixed; and how could a sound be fixed of which no traces remain? The pronunciation is also perpetually changing; and it is upon the orthography alone that the duration and extent of a language repose. To prove this, let us ask what, for example, would have become of the Latin, had each nation thought proper to write that language in the manner in which it pronounced it?

Thus, notwithstanding the real and acknowledged beauty of the plan which he followed, and the great number of facts which he discovered, notwithstanding the praises which his work received from the most learned naturalists, M. Adanson was far from obtaining that influence over the progress of science to which he was certainly entitled, and the artificial systems still reigned almost exclusively for more than thirty years. But, far from being repelled by this want of success, he scarcely took notice of it. Then, as during the rest of his life, his own opinion sufficed to satisfy him; and always labouring with the same ardour, his families of plants were not entirely printed, when he was already engaged in an infinitely more general work.

The boldest imagination would recoil on reading the plan which he submitted, in 1774, to the judgment of the Academie des Sciences, and still more on seeing the enormous heap of materials which he had actually collected. His object was now no longer to apply his universal method to one class only, to one kingdom, or even to what are commonly called the three kingdoms, but to embrace the whole compass of nature, in the most extended signification of the word. The waters, the meteors, the stars, the objects of chemical science, even the faculties of the mind, and the creations of human ingenuity, all that commonly forms the subject of metaphysics, moral philosophy, and politics, all the arts from agriculture to dancing, were to be treated of in this gigantic undertaking.

The very numbers were frightful. Twenty-seven large volumes exposed the general relations of all these subjects, and the distribution of their various objects. The history of 40,000 species was arranged in alphabetical order in 150 volumes. A universal vocabulary gave the explanation of 200,000 words. The whole was accompanied by a great number of particular treatises and memoirs, by 40,000 figures, and 30,000 fragments of the three kingdoms.

Every one put the question to himself, how a single individual could have even embraced, not to say entered into, the minute investigation, of so many different objects, and what treasures would suffice for their publication.

In fact, the commissioners of the Academy found the execution very unequal. The parts foreign to natural history were reduced to mere indications; two-thirds of the figures were engraved or sketched in works well known; many of the volumes were swelled with materials which still required to be digested. The commissioners, therefore, gave M. Adanson the very wise advice, to detach from this vast mass the objects of his own peculiar discoveries, and to publish them separately, contenting himself with pointing out in a general manner, the new relations which he might perceive between them and other beings.

The sciences will long have to regret that he refused to follow this advice; for various memoirs, independent of his great works, shew that he was possessed of much sagacity in the examination of particular objects. We shall now present a short analysis of his principal writings.

The *Teredo,* the shell which bores vessels and piles, and which has menaced the very existence of Holland, had been examined by several authors. M. Adanson was, however, the first who made known its true nature, and its analogy with the *pholas* and *bivalves.* The description which he gives of it is a model of its kind *: and similar praise is due to his description of the *Baobab* †. This is a tree of Senegal, the largest in the world, for its trunk is sometimes 24 feet in diameter, and its height from 120 to 150. The name of *Adansonia* was given it, after that of the botanist who had so well described it, and Linnæus generously retained this name, notwithstanding all the reasons which he had to complain of the person from whom it was derived.

The history of the gum trees ‡, and the numerous articles which M. Adanson inserted in the Supplement of the first Encyclopædia, unite, along with a great many new facts, much erudition and precision. They shew, by the fact, that our language is capable of expressing with clearness all the forms of

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* Memoires de l'Academie for 1759. † Ibid. 1761.

‡ Memoires de l'Academie, 1773 and 1779.

plants, without having récourse to the barbarous terminology which then began to be introduced, and which is unnecessarily repulsive in so many modern works. Unfortunately these articles were not continued farther than the letter C. It is not known what prevented the printing of the remaining part, which was prepared.

One of the most interesting questions of natural history is that of the origin of the different varieties of our cultivated plants. M. Adanson made many experiments upon those of corn, and saw two arise in the barley species; but they have not been propagated for a long time *. Some naturalists, carrying the consequences of these facts, and others of a like nature, too far, and maintaining that there is nothing constant in the species, alleging even examples which seemed to prove that new species are formed from time to time, he shewed that these pretended species were, for the most part, nothing else than monstrosities, which quickly returned to their original form †.

For a long time, the motions of the leaves of the sensitive plant, and of the stamina of some plants, had been compared to those of certain animals, although the former, for the most part, required to be excited by an external cause. M. Adanson discovered spontaneous movements in a green fibrous substance, living at the bottom of water, and which he supposed to be a plant. He gave a very accurate history of it ‡, and placed it at the head of his system of vegetables. M. Vaucher has since considered it as a zoophyte, and named it *Oscillatoria Adansonii*.

It was M. Adanson who first discovered that the benumbing faculty of certain fishes depends upon electricity. He made his experiments upon the *Silurus electricus* §. It has also been asserted, that he was the author of the letter on the electricity of the tourmaline, which bears the name of the Duke de Noya Caraffa ||. He had, therefore, contributed in two important points to the progress of this branch of natural philosophy. He must, indeed, have been well acquainted with that science, as is

* Memoires de l'Academie, 1769. † Ibid. 1769. ‡ Ibid. 1767.

§ Voyage au Senegal, p. 134.

|| Paris 1759. See Le Joyand Notice sur Adanson, p. 12.

obvious from the details which he has borrowed from it in his Treatise on Vegetable Physiology and Agriculture. He also entered into a long investigation on the unequal expansion of thermometers filled with different fluids.

Nor did he neglect the application of natural history or physics to the useful arts. He first discovered the means of extracting a good blue fecula from the indigo of Senegal. In a memoir addressed to the ministry, he shewed that this colony would be very favourable to all the productions of our islands, and even to those of India, and that it would be easy to have them cultivated there by free negroes, a happy idea, and the only one capable of putting an end to a commerce so disgraceful to humanity. A society of English and Swedes, animated by a religious sentiment, made a trial of this plan some years ago, and we are even assured that the establishment still exists, although part of it has been destroyed by pirates. Should it ever happen that the consequences of the last revolutions, and the present state of the sugar islands, should at length induce the European governments to proscribe a system at once so cruel for the slaves, and so dangerous for the masters, it would be but justice to remember that M. Adanson was one of the first who made known the means of supplanting it, without losing any thing of our enjoyments. Although neither the ministry of France, nor the African Company, paid any attention to this memoir, M. Adanson refused, from patriotic motives, to communicate it to the English, who had offered him a considerable recompence.

These various morsels, all interesting, might have been followed by many others, had M. Adanson been so inclined. His travels, his cabinet, and his continual observations, would have furnished him with sufficient materials for such a purpose.

Buffon made known several African quadrupeds and birds, which were communicated to him by Adanson. M. Geoffroi de St Hilaire, who described the galago, a very extraordinary species of the family of quadrumana, apprises us that M. Adanson had long been in possession of it. We are assured that he had the Ethiopian boar long before Allamand and Pallas described it; and his numerous fortfolios are still full of similar subjects. But all these treasures, and, however melancholy the reflection, M. Adanson himself, were lost to science and society, from the moment that he entirely devoted himself to the execution of the gigantic plan of which we have spoken.

Had M. Adanson been an ordinary man, we should terminate his eulogium here: his errors would have afforded no instruction; but it is precisely because he had a true genius, and because his discoveries place him in the first ranks of those who have benefited science, that it becomes our duty to dwell a little upon this latter and painful part of his history. The principal utility of those honours which we render to men of science is to excite the youthful mind to march in their traces; but the encouragement thus held forth would often prove fatal, if, dispensing praise without discernment, we did not also point out the false routes into which some of these celebrated men have had the misfortune to wander.

From the moment, therefore, that M. Adanson devoted himself to his great work, he reserved whatever particular facts he had, in order to give it more interest, and was no longer willing to publish any thing separately. Dreading to lose the smallest portion of time, he separated himself more than ever from the world, diminished the hours of his sleep, and abridged the time allotted to his repasts. When, by some chance, one was allowed to penetrate to him, he found him buried in the midst of innumerable papers, which covered every part of the room, comparing and arranging them in a thousand ways. The unequivocal marks of impatience which he exhibited, prevented his being interrupted a second time. He even found means of avoiding first visits, by withdrawing himself into a small isolated house in a remote quarter.

Henceforth his ideas were no longer fed or improved by those of any other. His genius now wrought upon its own foundations only, and these foundations underwent no further renovation. All those feelings of self estimation which his solitary habits had engendered in his mind were now fully developed. Calculating the extent of his powers by that of his projects, he placed himself as far above other philosophers, as the work at which he laboured, appeared to him superior to those which they had left. He has been heard to say that Aristotle alone approached him, but still at a great distance, and that all other naturalists remained very far behind. Forgetting that his method essentially rests upon acquired facts only, he attributed to it an innate virtue, which enabled him to foresee them, and to describe unknown species in advance. "I possess," he said, "all the great routes of science; what need have I of bye-roads?" The most profound contempt for the labours of his predecessors, the absolute neglect of modern discoveries, even of objects brought home by travellers, the most obstinate attachment to his old ideas, and complete ignorance of their most decisive refutations; lastly, the utter uselessness of efforts so protracted, so laborious, but so erroneously directed :—Such were the features of his mind, and the character of his labours. For example, although he was writing on mosses, he did not know, in 1800, the existence of Hedwig, nor any of the discoveries published upwards of twenty years before, regarding this singular class.

Those who possessed his confidence were so much the more unwilling to interfere with his peculiar habits, that, while they lamented his eccentricities, they could not but love him. In fact, if a prolonged solitude had given an unfortunate direction to his mind, that fatal suspicion which retirement so often produces, and which has disturbed the repose of so many secluded men, never penetrated to his heart. His manners, always lively, were also uniformly benevolent. He entertained extravagant ideas of himself, but he did not doubt that every body had the same; and in the midst of the most cruel privations of his old age, he was never heard to accuse others.

It must be owned, however, that he had moments when he might with propriety have done so. His principal fortune consisted of two moderate pensions, the reward of his labours in Senegal, and of the objects which he had given up to the Royal Cabinet. The rigorous measures of the Constitutional Assembly deprived him of both, and his seclusion left him no means of recovering them. The pension of the Academy alone remained. That society was still a point of contact with the world. Nor would it have ceased to watch over his fate, had it not soon fallen also amid the general ruin: a decree of the Convention suppressed it, and dispersed its members. Those men, whose illustrious names filled Europe, were happy in having remained unknown to the ferocious tyrants of their country. They fled to seek in the most obscure asylums some shelter from the terrible sword continually suspended over all that had possessed celebrity, and which, perhaps, would have spared none of them, had not the ministers of its fury been as ignorant as they were cruel.

At this period when the most opulent suffered the loss of every thing, it may easily be imagined what must have been the state of an old man of seventy, already infirm, whom twenty years of sedentary labour had left bereft of every relation, and had shut out from all knowledge of men and the world. I have not courage enough to retrace so afflicting a picture. Would that I had the power to paint his admirable patience, and that invincible ardour for study, which survived unimpaired, amid the most calamitous circumstances!

It seemed that he was himself ignorant of his misfortunes. So long as he could meditate and write, he lost nothing of his serenity. It was an affecting spectacle to see this poor old man bent near his fire, sitting in the light of an expiring ember, attempting with a feeble hand still to scrawl a few letters, and forgetting all the difficulties of life, when a new idea, like the visit of a gentle and beneficent spirit, came over his imagination.

Without doubt the love of fortune is not the motive which induces men to devote themselves to science, nor is it worthy of such influence; glory itself presents but an uncertain prospect: but who could resist the intrinsic charm of science itself, and that pure happiness, independent of men and of fortune, of which the history of the learned continually presents such astonishing examples?

A milder day, however, dawned upon France. The Convention, delivered from its oppressors, abjured their barbarities: and one of the last acts of its power was the re-establishment of the Academies, by uniting them into a single body, under the name of the *Institute*.

At the signal of authority, and after four years of dispersion, those illustrious men every where issued from the obscurity of their retreats, and assembled themselves anew. Their first meeting presented a scene never to be effaced from the mind: their tears of joy and congratulation, the eagerness of their mutual inquiries respecting their misfortunes, their retreats, their occupations; the mournful recollections of so many associates who had fallen victims to the rage of their executioners; and the soft emotions of those who, still young, and called for the first time to sit with those whose genius they had long before been taught to revere, learned also, by this melting spectacle, to become acquainted with their heart.

The restless eye of friendship, however, still sought for some whom it had been accustomed to greet, and in this number was Adanson. It was then only that the privations which caused his absence were learned. His retreat at last disclosed itself to the eager search of his companions. He received them with tears of renewed affection. Astonished, perhaps, no less than affected at our interest in his welfare, he no doubt regretted that in renouncing the enjoyments of the world, he had also comprised those of the heart among his sacrifices.

Science, my friends, requires not this: The futile praises of vanity, the deceitful favours of fortune, these are what she imperiously restrains us from pursuing; and, without doubt, you will not find her restrictions in this respect very grievous. Perhaps she also requires us to sacrifice the little praises of the world to true glory, of which society at large is rarely worthy of being judge. But I do not hesitate to declare to you all, that mutual intercourse and esteem only render more agreeable the bonds which unite men of enlightened minds; and that friendship is the only enjoyment which this noble elite of humanity will not renounce, even for the certainty of one day obtaining honours such as these.

A just gratitude obliges us to add that, from the moment when the Government was informed of M. Adanson's condition, every succeeding minister made it a duty to shew, by his example, that the state does not abandon the old age of those who have devoted their life to the public good. Sovereign munificence itself did not disdain to soften his last moments.

But all these benevolent cares were unable to arrest the effects of age, and those aggravated infirmities which pressed so heavily upon him during the four last years of his life; and if we still had the pleasure of seeing M. Adanson occasionally at our meetings, we had not that of seeing him take an active part in our common labours.

He supported his afflictions as he had supported his poverty.

Although several months a prey to the most excruciating pains, his bones softened by disease, and a thighbone fractured in consequence of caries, he was never heard to utter a cry. The fate of his works was the sole object of his solicitude. Death put a period to his painful existence, on the 3d of August 1806.

He directed by his will, that a garland of flowers, made up from the fifty-eight families which he had established, should be the only decoration of his coffin—a frail but affecting image of the more lasting monument which he has himself created. Some friend of science, we trust, will not be wanting, soon to raise him another, by speedily rendering public all that his immense collections still contain of new and useful information.

Notes on the Rattlesnake (Crotalus horridus); *in a Letter addressed to Thomas Stuart Traill, M. D. &c.* By John James Audubon, F. R. S. E. M. W. S. &c *. Communicated by the Author.

THE power of fascination gratuitously ascribed to most snakes by theoretical naturalists, has so long rivetted the attention of all persons inclined to think on the subject, but without the means of judging for themselves, that the following fruits of many years' observation, in countries where snakes abound, will not, I hope, though adverse to the supposed power of fascinating, be looked upon as destitute of interest.

Rattlesnakes in particular, appear to have acquired their chief fame from this supposed charm. I shall, therefore, draw your attention more directly to the habits of that species, and begin by enumerating the many real and extraordinary faculties bestowed upon it. These consist in swiftness; in powers of extension and diminution of almost all their parts; in quickness of sight; in being amphibious; in possessing that wonderful and extraordinary benefit of torpidity during winter; and long continued abstinence at other periods, without, however, in the mean time losing the venomous faculty, the prin-

* Read before the Wernerian Natural History Society, 24th February 1827.

cipal means of their defence. I shall proceed to elucidate, by well authenticated examples, all those different faculties.

Rattlesnakes hunt and secure for their prey with ease grey squirrels that abound in our woods; therefore they must be possessed of swiftness to obtain them. Having enjoyed the pleasure of beholding such a chase in full view in the year 1821, I shall detail its circumstances. Whilst lying on the ground to watch the habits of a bird which was new to me, previous to shooting it, I heard a smart rustling not far from me, and turning my head that way, saw, at the same moment, a grey squirrel full grown, issuing from the thicket, and bouncing off in a straight direction, in leaps of several feet at a time, and, not more than twenty feet behind, a rattlesnake of ordinary size pursuing, drawn apparently out to its full length, and sliding over the ground so rapidly that, as they both moved away from me, I was at no loss to observe the snake gain upon the squirrel. The squirrel made for a tree, and ascended to its topmost branches as nimbly as squirrels are known to do. The snake performed the same task considerably more slowly, yet so fast, that the squirrel never raised its tail nor barked, but eyed the enemy attentively as he mounted and approached. When within a few yards, the squirrel leaped to another branch, and the snake followed by stretching out full two-thirds of its body, whilst the remainder held it securely from falling. Passing thus from branch to branch, with a rapidity that astonished me, the squirrel went in and out of several holes, but remained in none, knowing well that, wherever its head could enter, the body of his antagonist would follow; and, at last, much exhausted and terrified, took a desperate leap, and came to the earth with legs and tail spread to their utmost to ease the fall. That instant the snake dropt also, and was within a few yards of the squirrel before it had begun making off. The chase on land again took place, and ere the squirrel could reach another tree, the snake had seized it by the back near the occiput, and soon rolled itself about it in such a way that, although I heard the cries of the victim, I scarcely saw any portion of its body. So full of its ultimate object was the snake, that it paid no attention to me, and I approached it to see in what manner it would dispose of its prey. A few minutes elapsed, when I saw the reptile loosening gradually and opening its folded coils, until the squirrel was left entirely disengaged, having been killed by suffocation. The snake then raised a few inches of its body from the ground, and passed its head over the dead animal in various ways to assure itself that life had departed; it then took the end of the squirrel's tail, swallowed it gradually, bringing first one, and then the other of the hind legs parallel with it, and sucked with difficulty, and for some time, at them and the rump of the animal, until its jaws became so expanded, that, after this, it swallowed the whole remaining parts with apparent ease.

This mass of food was removed several inches from the head in the stomach of the snake, and gave it the appearance of a rouleau of money brought from both ends of a purse towards its centre; for, immediately after the operation of swallowing was completed, the jaws and neck resumed their former appearance. The snake then attempted to move off, but this was next to impossible; when having cut a twig, I went up to it, and tapped it on the head, which it raised, as well as its tail, and began for the first time to rattle. I was satisfied that for some lapse of time it could not remove far, and that the woods being here rather thin, it would soon become the victim of a vulture. I then killed it, and cut it open to see how the squirrel lay within. I had remarked, that, after the process of swallowing was completed, singular movements of the whole body had taken place,—a kind of going to and fro for a while, not unlike the convulsive motions of a sick animal, as a dog for instance, about to vomit. I concluded that some internal and necessary operation was going on. This was proved when I found the squirrel lying perfectly smooth, even as to its hair, from its nose to the tip of its tail. I noted all this on the spot. This over, I sought my game again, and felt a great satisfaction; but having met my friend Mr James Perry, on whose lands in the State of Louisiana I was then hunting, and having related what had just happened, he laughingly said, "Why, my dear sir, I could have told you this long ago, it being nothing new to me." These facts, I trust, are quite sufficient to exemplify the faculties of swiftness, and the powers of extension and diminution, in the rattlesnake.

In regard to quickness of sight.—I have several times discovered a snake to be near me from a sudden and brisk rustling amongst the dead leaves or grass, as a vulture or forked-tail falcon was passing over the place in search of food, and by close investigation discovered that some snake had made away to hide under a log, root, or stone, from its winged enemy; for, after being satisfied that the noise thus heard was produced by snakes labouring to escape through fear, I have remained snug and silent, and have seen them issue from their covert, when the vulture had gone by. But, further, I have frequently seen them move their heads sidewise, looking up to the trees, and discovered that they were then in search of birds' nests; and so watchful of the parents' motions, that, as if afraid to suffer by the encounter with a bird of size and power, they made choice of the time when both parents were absent, to ascend and rob them either of the young or the eggs if not fully laid and ready for incubation. Should the snake, in such attempts, be perceived by the owners of the nest, their cries of alarm and attack are heard through the woods, and so many other birds assemble and pour in from all sides, that it becomes nearly impossible for the snakes to make good their retreat. I shall merely add that those battles and defeats are corroborated by one of our most eminent naturalists in America.

That almost all snakes can swim, and do swim well, too, and can remain under water a considerable time, is a fact sufficiently ascertained; but that, in this element, they have the power of pursuing fish, and of catching either them or frogs, is a fact which, though equally true, is not so well known. I shall therefore present to you some proofs of this from my own observation. Whilst fishing on the banks of the Schuillkill river, not very far from Philadelphia, about twenty years ago, I saw a snake issue out of the water close to me, and slide up a large stone to receive the benefit of the sun. I perceived it to be swelled about its middle, and shot it to ascertain its contents, when I discovered in the stomach a cat-fish scarcely dead, so fresh indeed that I made it my prize, and felt no ways alarmed at eating it when dressed. Since that time I have had opportunities to see snakes chasing bull-frogs, follow them after they had leaped into the water, and return with them in their mouths. Several other species, indeed, make the water their almost constant place of abode, one of which, the Congo *(C. nigra)*, an extremely venomous snake, is found in great numbers in all the lakes and watery swamps of the Southern States.

Periodical torpidity in snakes, as in almost all animals subject to it, has been wisely ordered, on account of the very slow growth granted to most of them. Snakes, as well as alligators, increase in size very slowly, and are consequently long-lived;—but how transient, if needed, this most wonderful power granted them to live, to die (as it were), and to live again, is, I shall try to describe by the following curious fact. M. Augustine Bourgeat, whose name will be ever dear to me, my younger son, and myself, were hunting one winter-day for ducks, and having halted a while near a lake, we struck up a fire. Being desirous to eat what we were pleased to call our dinner, we began picking and cleaning some of our game. The youngest of our party ran about for wood, and, anxious that a good supply should be at hand, attempted to roll a log, at a short distance, towards the spot pitched on. In doing this, my son discovered so large a rattlesnake closely coiled up, in a torpid state, that he called us to come and look at it. It was stiff as a stone, and, at my request, my son put it into my game-bag, then upon my back, for farther observation. Shortly afterwards, whilst our game was roasting upon the wooden-forks stuck in front of our cheerful fire, I felt something moving behind me, which I thought for a moment was occasioned by the struggles of a dying duck; but presently recollecting the dangerous animal, I begged my friends to see if it was not the snake; and being assured that it was, the time employed in unstrapping and throwing off the bag with the reptile, was, I assure you, of very short duration. The snake was then quite alive, issued from the bag, and began rattling, with its head elevated, and thus ready, while the body was closely coiled, to defend itself from all attacks. The distance at which it then was from our fire, and the consequent cold, would, I thought, soon conquer it; and in this I was not mistaken; for, before our ducks were roasted, the snake had stopped its alarum, and was bent on finding a place of refuge, again to become torpid. Having finished our meal, my son, who had watched all its movements with the eagerness of youth, brought it again, with a smile, saying, "Papa, look at Hercules and the serpent!" We took it home, and it became torpid, or revived, at our pleasure, as often as we removed or brought it near the fire; until having put it in a jar of spirits, it travelled to the Lyceum of New York.—That all their faculties become dormant, and remain virtually dead during torpidity, I have ascertained, by finding snakes, with great quantities of food in the stomach, frozen and undigested, although it had been there for several weeks; when, if the snake was removed to a warm situation, the operation of digestion was daily perceptible, and the whole food in a short time consumed.

Rattlesnakes have the power of laying down their fangs along their jaw-bones when at rest, and of raising them again at will; as sharks also do, and some other fishes. It is only when inflicting a *defensive* wound that their fangs are used. At this time, the snake, either coiled, or in any other position, has the power of darting about two-thirds of its body towards its object, and, with its mouth open to its utmost stretch, all its fangs being erect, it strikes so violent a blow whilst it bites, that I have been assured, by some Osage chiefs, that, on such occasions, they felt, when struck, as if about being thrown off their centre of gravity. The fangs make their way into flesh, or, indeed, tough leather, with perfect ease, and instantaneously. The wound is generally mortal, if proper remedies be not at once resorted to. Among the *native Americans*, cutting out the wounded part, and searing, or, as it is termed in the country, *scaring* it with fire, is considered the most effectual,—but even this requires great promptitude to afford a chance of safety. The quantity of venom infused is more or less, as the animal may have been more or less irritated. If made to bite themselves, their own flesh affords no antidote, for they die in excruciating torments. The venom of a rattlesnake, while the animal is striking against any object, will be sometimes ejected to a considerable distance. I have seen one confined in a wire-cage, when much enraged, strike against the bars so furiously, that the poison was sent several feet towards me.

To give you an idea of the long time this poison retains its property, I shall relate a curious but well authenticated series of facts, which took place in a central district of the State of Pennsylvania, some twelve or fifteen years ago. A farmer was so slightly bit through the boot by a rattlesnake, as he was walking to view his ripening corn fields, that the pain felt was thought by him to have been from the scratch of a thorn, not having seen or heard the reptile: upon his return home, he felt, on a sudden, violently sick at stomach, vomited with great pain, and died in a few hours. Twelve months after this, the eldest son who had taken his father's boots, put them on and went to church at some distance. On his going to bed that night, whilst drawing off his boots, he felt slightly scratched on the leg, but merely mentioned it to his wife, and rubbed the place with his hand. In a few hours, however, he was awakened by violent pains, complained of general giddiness, fainted frequently, and expired before any succour could be applied with success; the cause of his illness also being quite a mystery. In course of time his effects were sold, and a second brother, through filial affection, purchased the boots, and, if I remember rightly, put them on about two years after. As he drew them off, he felt a scratch and complained of it, when the widowed sister being present, recollected that the same pain had been felt by her husband on the like occasion: the youth went to bed, suffered and died in the same way that his father and brother had before him. These repeated and singular deaths being rumoured in the country, a medical gentleman called upon the friends of the deceased to inquire into the particulars, and at once pronounced their deaths to have been occasioned by venom. The boots that had been the cause of complaint were brought to him, when he cut one of them open with care, and discovered the extreme point of the fang of a rattlesnake issuing from the leather, and assured the people that this had done all the mischief. To prove this satisfactorily, he scratched with it the nose of a dog, and the dog died in a few hours from the poisonous effect it was still able to convey.

In confirmation of these facts, I have been told by native Americans, that arrows dipt in rattlesnake venom, would carry death for ages after.

Some European writers of great eminence have asserted, that rattlesnakes are destroyed by hogs in such quantities, that the introduction of the latter into any country, would soon clear it of the former. In the United States, where hogs are very numerous, I never witnessed any one attempt to kill a rattlesnake, and have, on the contrary, remarked that hogs were shy of these reptiles; but if this were not the case, the ease with which rattlesnakes can either make their escape, or defend themselves, is such, that the hog would, in preference, I think, avoid the danger, and without risk, feed on congenial food, which is ever under his nose, and in great abundance throughout all our woods, unless, indeed, the hog were endowed with the power of fascination, a thing not yet communicated by those writers. But why, I would ask those closet naturalists, do not the rattlesnakes fascinate their opponents the hogs as well as birds?

The flesh of rattlesnakes was considered a dainty by the Spaniards, whilst in possession of Louisiana. Mr James Perry, a principal Alcaide in the parish of St Francis at that period, has assured me, that the officers garrisoned on the heights of Fort Adam, were in the habit of giving premiums to the soldiers and Indians who brought them the largest and fattest. The head being cut off, the snake was suspended, so as to become entirely drained of its blood, and the flesh cooked as that of chickens, which it much resembles. Their skins were tanned, and beautiful shoes are still made with them, which retain all the variegated marks exhibited on the scales of the animal when alive.

Perhaps one of the most wonderful faculties possessed by this and many other species of snakes, is that of being able to live without any food whatever for years; and quite as remarkable, that, during the lapse of this astonishing fast, their appearance and condition scarcely exhibit their being in any want. Their movements, the power of rattling, and that of inflicting mortal wounds, are perfectly kept up. One which I confined in a cage for three years had frequently rats, young rabbits and birds of various kinds put in, sometimes alive, and at other times dead, without their ever being touched; not even a movement would be made by the snake to approach them; while, on the contrary, the live quadrupeds and birds shewed great symptoms of fear, and threw themselves violently in all directions about the cage, to effect their escape from an enemy well known to them. The operation of throwing off its skin annually was, however, abandoned, after the first spring of confinement; and as the individual was small, and I did not consider it as arrived at its middle age, I measured its length with accuracy, and discovered, that, during the whole time of its imprisonment, it did not grow in the least. To what extent this power of abstinence is ever used, when the animal is at liberty, I am unable to tell, but I have thought, that the animal possessing it so eminently, went a great way towards proving that it had not that of fascination; as it would be very unnatural for an animal so gifted to lie and suffer, while the single glance of a magnetic eye could bring down a bird at once from the top of any tree into its mouth.

I now and then turned the snake out of its cage, when, with great quickness, it would go about the room, looking in all directions, with a view to effect its escape. As I was armed with a long stick, it never made towards me, but if I put myself in its way, it would stop, prepare for action, and rattle, until I removed, and afforded it a free passage.

Rattlesnakes are easily disabled, and afterwards killed. A single smart blow, even of a slender twig, will disjoint any part of the vertebræ, after which they lie at your mercy.

The mode of copulation used by these reptiles is so disgusting, that I would refrain from any mention of it, were it not my chief purpose to record any facts regarding them that may be uncommon or little known. Early in spring, as soon as the snakes have changed the skin that contained their last year's growth, they issue brightly coloured, glistening with cleanliness, and with eyes full of life and fire. The males and females range about, in open portions of the forest, to enjoy the heat of the sun, and, as they meet, they roll and entwine their bodies together, until twenty, thirty, or more, may be seen twisted into one mass, their heads being all turned out, and in every direction, with their mouths open, hissing and rattling furiously, while, in the mean time, the secret function is performed. In this situation they remain for several days on the same spot, and the danger of approaching such a group would be very great; for, at sight of any enemy to disturb them, they all suddenly disengage, and give chace.

The fact of their rattling, which tends to alarm intruders, and to warn them of their danger, is too well known to call for any observations regarding it.

To conclude: suffer me to call to your recollection a well known fact, that birds, of all kinds, are full of courage; that even the smaller tribes will attack and chase before them the larger kinds, and that those again will even defend themselves from man, and often with success. Have we not all seen the little robin chace a cat? An eagle will keep off a man from her nest, and a cock will attack even a lion. This being the case, why should they suffer their senses to sink in sleep before a reptile, when, with a few mere flaps of their wings, they can so easily escape. After this reflection, can we for a moment imagine, that the Creator has exposed the feathered race to such dangers as the power of fascination would imply? We may rest assured, that, when snakes destroy birds, or any other animals, it is by the quickness of their motion, and the acuteness of their sight, seconded by cunning and strength, but never by fascination.

On the Rein-deer. 1. *Its Naturalization in Scotland.* 2. *Its Food.* 3. *Rein-deer Milk, and preparations made from it.* 4. *Speed of the Rein-deer.* 5. *Rein-deer eats the Lemming.* 6. *On the Furia infernalis* *.

1. *Naturalization of the Rein-deer in Scotland.*

THE question, whether or not it be possible to introduce the rein-deer into this country, will probably be considered as set at rest after the late failure, which has not been the only one. I am still, however, unwilling to believe this; and I cannot but regret, after the activity and perseverance of Mr Bullock had succeeded in bringing alive and well to this country so large a herd of deer, a thing never before attempted, that his labours should not have been seconded by some spirited proprietor, and his views supported in the way that would have been most likely to have crowned them with success,—the immediate removal of the herd, on arriving here, to some remote and favourable part of the Highlands, where the Laplander himself, the most natural person for the purpose, might have undertaken the charge of the herd, and been rewarded according to his care in the increase of it. Had the experiment been tried in this man-

* This account of the Rein-deer is extracted from a very interesting and amusing work just published, which we particularly recommend to our readers,—"Travels in Lapland and Sweden by Captain Brooke," published by Murray.

ner, which it certainly merited, I feel little doubt, that, instead of the herd having been so unfortunately reduced to nothing, its number would now have been trebled, and the success of the undertaking fully established.

Should a future trial ever be made, it would be desirable, as the most likely means of rendering it efficient, to land the deer directly upon the northern part of Scotland, where the country is least inhabited, and possesses a wide, uninterrupted mountain range, in the vicinity of the coast, that, if necessary, the deer might be driven during the summer to the sea side. It is also a circumstance of the greatest importance, though it has never yet, I believe, been attended to, that Laplanders should themselves accompany the deer, and have the personal care of them at all times, instead of this office being entrusted to persons unacquainted with the nature and habits of the animal, as well as its diseases. The experiment should be upon a scale sufficiently large to guard against the casualties that might occur in bringing the deer over, as well as subsequent accidents and contingencies. It has been seen that they will remain healthy in a state of confinement; it would, therefore, be advisable that one-half of the number brought over should be kept up, that they might replace the others from time to time, according to circumstances, and be turned out when their numbers became so strong as to leave no cause for apprehension. It would also be desirable, that the other half, on being turned out on the mountains, should be kept in two separate herds, each under the care of a Laplander, who, without intermixing the deer, might be sufficiently near to assist each other, and have one tent common to both. This farther division would guard against any sudden accident, and the spreading of any contagious disease, that might threaten the safety of the deer; and one part might thus fill up the deficiencies of the other.

Should the experiment fail, after it has been tried in the manner now recommended, it might, with the greatest confidence, be asserted that the rein-deer will not exist in the climate of Scotland: though the trials hitherto made, however decisive they may appear to some, will, I am persuaded, if carefully looked into, be found not sufficiently conclusive to warrant an absolute decision as to the fact.

2. *Food of the Rein-deer.*

The summer food of the rein-deer is not merely moss. The animal in this season strips, with great pleasure, the leaves from the birch, sallow, and aspen, particularly the former, and browses also upon the young herbage, and the tender shoots of the mountain shrubs, which it crops hastily as it passes along. It is affirmed, that where the rein-deer has been feeding, no cattle will graze for a considerable time afterwards.

The food, and almost entire subsistence of the animal, during winter, as is well known, are different lichens, but chiefly the *Lichen rangiferinus*, or rein-deer moss. The properties of this plant, which is thus so providentially strewed over a country destitute almost of other vegetation are very nourishing, and capable of supporting even man himself; though it is not, I believe, ever used for this purpose by the Laplanders. It seems probable, that this, as well as the *Lichen islandicus* (Iceland moss), might be applied with great advantage to the purpose of making a more nutritious and palatable kind of bread, than what is used occasionally in the north of Sweden and Norway by the peasants, in years of extreme scarcity, the chief ingredient of which is the bark of the fir. Cows are said to be very fond of this lichen, when fed upon it; and the quantity of milk then afforded is greater than is produced by any other diet. In those parts of Lapland, where rein-deer are kept by the Swedish or Finland colonists, hay is sometimes given them as food during the winter, should there be a deficiency of their usual subsistence.

As to the question once raised, whether the rein-deer ever ruminate, which was denied by some, it is unnecessary to say more, than that experience no longer permits the fact of their ruminating to be a matter of uncertainty.

3. *Rein-deer Milk, and preparations made from it.*

The Laplander is a wanderer both from nature and necessity. His subsistence depending entirely upon his deer, which are left free and unconstrained, his own movements may be said to be guided by theirs, and by them also his habits of life are in a great measure formed. The number of deer belonging to a herd is from 300 to 500; with these a Laplander can do well, and live in tolerable comfort. He can make in summer a sufficient quantity of cheese for the year's consumption; and, during the winter season, can afford to kill deer enough, to supply him and his family pretty constantly with venison. With 200 deer, a man, if his family be but small, can manage to get on. If he have but 100, his subsistence is very precarious, and he cannot rely entirely upon them for support. Should he have but fifty, he is no longer independent, or able to keep a separate establishment, but generally joins his small herd with that of some richer Laplander, being then considered more in the light of a menial, undertaking the laborious office of attending upon and watching the herd, bringing them home to be milked, and other similar offices, in return for the subsistence afforded him. A Laplander who is the master of a herd of 1000 deer is considered a rich man; though instances are not rare of their possessing 1500 or even 2000.

The food of the Laplander during the period of his summer wanderings is spare and frugal; he no longer indulges himself in his favourite food, rein-deer venison, which forms the luxury of the winter season. In summer he is intent only upon increasing his herd, and providing against his future wants. He contents himself then generally with milk, and the remains of the curd and whey after making his cheese. In the first he indulges himself sparingly, on account of the very small quantity each deer affords, as well as of the great importance it is to him to secure a good quantity of cheese for his winter stock, and to guard against any disaster that might suddenly befall his herd, and reduce him to want. As his herd is milked during the summer season only, when this is drawing to a close, he generally sets by some milk for the purpose of being frozen. This serves not only for his own individual use during the winter, but is prized so much for its exquisite delicacy in this state, that it forms an article of trade; and the merchants with whom he deals, and who repair then to the interior, gladly purchase it at any price.

From the naturally churlish temper of the mountain Laplander, and the value he justly sets upon his milk, it is extremely difficult during summer to prevail upon him to part with even a very small quantity ; and, whenever I visited the tent, I saw with what reluctance these people offered it. By degrees, however, I ingratiated myself so much into their favour, partly from the circumstance of my being an Englishman, and partly by a few well timed presents, that, for some time during their stay near Fuglenæs, I had the luxury of drinking it in a morning for my breakfast ; and I must confess I found it so delicious, that I think the time of any idle epicure would not be ill bestowed in making a trip to Finmark, were it solely for the pleasure of tasting this exquisite beverage. The flavour of the milk is highly aromatic, which, it is probable, is chiefly owing to the kind of herbage the animal browzes upon in summer. In colour and consistency it resembles very rich cream ; and its nature is such, that, however gratifying to the taste, it is difficult and even unwholesome to drink more than a small quantity of it.

Rich as the quality of the rein-deer milk is, it is singular that the cheese which is made from it is extremely bad, being hard, white in colour, of a disagreeable taste, and eatable only by a Laplander. I am ignorant of the cause of it, though inclined to think it arises more from its peculiar nature, than from any defect in the making, this being effected simply by placing the milk in a large iron pot over the fire, which, with the addition of rennet, made from the stomach of the deer, quickly turns it. The curd is then pressed, and the whey being separated from it, is put into small shallow moulds.

The general size of the cheese is that of a small plate, and it is little more than half an inch in thickness. Possibly its being made so thin may have an effect upon the goodness of it, as, when cut, the hard rind composes the larger portion. Bad as it is, it is highly prized by the Laplanders, who eat it both raw and toasted ; in the latter state it appears at the tables of the merchants, and is rather more palatable. Notwithstanding its previous hard and dry appearance, when applied to the fire, a rich pure oil distils from it, which is found extremely serviceable in removing the effects arising from being frost-bitten ; for, being rubbed on the frozen part, it prevents mortification from ensuing. This is used when the common remedy of snow-rubbing has been neglected. I was induced, from curiosity, to bring with me to England several rein-deer cheeses; some of which were till lately in my possession. I did not find that age at all improved their flavour; not having in any degree softened them, or produced any other effect than creating a singular quantity of mites, which accumulate again almost immediately after the former have been removed.

Butter is seldom, if ever, made of the rein-deer milk, by the Laplanders; the reason, no doubt, being the far greater value that cheese is of to them, as an article of support; and bread being at the same time a thing unknown, the making of butter would be of little utility. It is, however, sometimes made by the Finland settlers, who, in many parts of Lapland, keep herds of rein-deer, and is, I have been told, of a peculiarly white colour.

The Laplander sometimes varies his dishes by mixing different kinds of wild berries, such as the whortle or cloud berry, with the whey: the latter being previously boiled till it acquires a thick consistence. This preparation I have seen them eat in astonishing quantity, and with the greatest relish. They are no less fond of the roots of the angelica, the taste of which is certainly very agreeable; and they have, which I believe this root merits, a high opinion of its qualities as an antiscorbutic. They set also much value upon the blood of the rein-deer, from which they prepare a variety of dishes, taking care always to preserve it when the animal is killed. It is probable, that their predilection for it is increased by the antiscorbutic properties which it is said also to possess. An instance of this is to be found in the interesting account of the Dutch navigators, under the command of Hemskirk, who were obliged to pass the winter in Nova Zembla, in the lat. of 76°, and suffered in consequence an intense degree of cold. Several of them died from the effects of the scurvy, and the survivors attributed their escaping this disorder to their constant habit of drinking the warm blood of the rein-deer, which they had killed for their support, a practice which had not been followed by those who fell victims to it.

4. *Speed of the Rein-Deer.*

Various conjectures having been advanced respecting the speed of the rein-deer, I shall state what I know from my own experience, and the information of those on whom I can rely. Taking a general view of my subsequent journey through Lapland, it will be seen, though it may be estimated at about 330 miles, that it was performed with only two deer. The distance between Alten and Koutokeino is about 150 miles, and it was accomplished with one deer in four days. This is unusually slow travelling; but it will be easily accounted for, by the bad weather we experienced, and the state of the snow. This distance, however, has been travelled repeatedly in a far shorter space of time. Mr Aargaard once returned from Koutokeino to Alten, towards the spring, when the sledging is nearly at an end, in twenty-four hours, with only a single deer; and Mr Klerck, who resides at the latter place, performed the same journey twice in thirteen hours, and once in fourteen, employing three deer: which will be considered very fast travelling, particularly by those who are acquainted with his weight.

The distance between Koutokeino and Alten has even been performed in a space of time still shorter than what has been just mentioned, by two other merchants of my acquaintance, who, returning from Tornea to Alten, where they had been on commercial business, on reaching Koutokeino, made the journey across the mountain range in nineteen hours with only one deer, the distance, as before stated, being 150 miles. To have accomplished this, the animal must have kept up an average pace of eight miles an hour the whole way, allowing no time for resting. The greatest instance, however, on record, of the speed of this animal, though it appears little short of an impossibility, is that of the rein-deer, of which a portrait, with that of its driver, is yet preserved in the palace of Drottningholm; though how far it has been authenticated, it would be difficult to ascertain. The case I here allude to occurred in the year 1699, upon the frontiers of Norway. In consequence of the Norwegians making a sudden and unexpected irruption into the Swedish territories, an officer was despatched with a sledge and rein-deer to Stockholm, to convey the intelligence; which he did with such speed, that he performed 124 Swedish miles (about 800 English) in 48 hours: but his faithful animal dropped down lifeless on the Riddarhustorget, just after his arrival in the capital. The bearer of the news, as it is said, was in consequence ennobled, and assumed the name of Rehnstjerna (Rein-deer Star). The second part of our journey from Routokeino to Muonioniska, in Russia, which is rather a greater distance than the preceding, was performed in two days and a half, the weather being good, the snow in better order, and the country over which we passed far more favourable to expedition, from the general flatness of it. Neither of these journeys, however, is a fair specimen of what a rein-deer can really perform in point of speed, though the first may be considered as a proof of its strength and endurance, under very disadvantageous circumstances. It is well known, besides, what delays are necessarily attendant upon a large number of persons travelling together, and with what greater ease and facility a smaller party makes its way, unincumbered with much baggage, and dependent only upon itself. It is difficult, indeed, to state, to what degree a rein-deer, under every favourable circumstance of its own powers, state of snow, weather, nature of ground, or ice, weight it has to draw, &c. can extend its speed.

As the distance, however, between Alten and Koutokeino, which is a continued chain of lofty mountains, and most difficult to pass, has been performed in less than twenty hours, it is certain that, if the powers of the deer had been exerted on different ground, such as the hard surface of a river, a far greater space might have been accomplished in the same time. Ten miles are the utmost I have ever performed in an hour, and it was done at a trot, without putting the deer once into a gallop. I think, however, that a deer, with a light weight and pulk, on the best ground, might be made to perform not far short of double this distance at a gallop, though it would not be able to keep it up at farthest more than an hour. The most accurate account of the speed of the rein-deer is furnished us by Pictet, who, when he visited the northern parts of Lapland, in 1769, for the purpose of observing the transit of Venus, was curious to ascertain the point; and having accordingly measured a certain distance, he started four rein-deer, with their drivers, in very light sledges. The following he states as the results:

"The foremost deer accomplished 5,397 Paris feet in six minutes, passing over thus, in each second, 14 feet 11 inches, and .90 of an inch.

"The second deer performed the same distance in seven minutes and 30 seconds, being 11 feet 11 inches .92 of an inch to each second.

"The two remaining deer were distanced."

In this race, which took place in March, the depth of snow was a great impediment to the deer, and a second trial was accordingly made in the following month, upon more favourable ground, with three deer, the results of which were thus:

"The first deer performed 3,089 feet, 8 inches, and .90, in two minutes, being at the rate of nearly 19 English miles in an hour, and thus accomplishing 25 feet, 8 inches, and .96, in every second.

"The second did the same in three minutes, and the third and last deer in three minutes and 26 seconds. The ground in this race was nearly level." *Nov. Comment. Petropol.*

A traveller, unincumbered with any thing but what he carries on his back, might pass through Lapland, taking its farthest extremities, in an inconceivable short space of time, if proper arrangements were previously made; that is, if he had many deer provided for him, ready at different stations, and was not very unfortunate in the weather. This is supposing what might unquestionably be performed, but yet would be subject to great difficulty and uncertainty; without taking into consideration, whether any one would like to be thus shot like an arrow through a country, unable to form any idea of it beyond the sledge that supported him, or the animal that dragged him along.

5. *Rein-Deer eats the Lemming.*

The curious circumstance of the rein-deer occasionally feeding upon the mountain-rat, or lemming (*Mus Lemmus,*) has been formerly noticed. In addition to the proofs already given of this singular propensity of the animal, I am now enabled to bring forward another, which will be considered even more satisfactory than the former, from its having occurred during the last autumn (1825.) Mr Rickards, who has recently returned from an interesting tour through Sweden and Norway, which he undertook at the instance of a distinguished nobleman, and for the express purpose of bringing over rein-deer, different objects of natural history, and some living specimens of the cock of the woods, has assured me, in the most decided manner, that he is enabled to confirm, from actual observation, the fact of the rein-deer eating the lemming. When passing through Jemptland, in the month of September, before he crossed the frontier mountains into Norway, he met with the lemmings in very great numbers, near Aberg, overspreading the country in their usual manner. He had with him then ten rein-deer, which he had procured; and on two different occasions he had an opportunity of witnessing the fact; at one time with a buck, and the other with a young doe, which had been tied to a stake to render her more tractable to lead, and which, upon one of these animals coming within her reach, sprang forward, seized hold of it, and quickly devoured it.

9. *On the Furia infernalis.*

Whilst noticing the enemies, to the attacks of which the rein-deer is exposed, I am induced to make some observations respecting an animal, the supposed existence of which, for a considerable time, deeply engaged the attention of the Swedish naturalists, and the great Linnæus himself,—the *Furia infernalis.* The account of the singularly fatal ravages of this worm was widely diffused, creating no inconsiderable portion of alarm. Linnæus first noticed the *Furia* in the year 1728, shortly subsequent to his entrance at the University of Lund, in Scania. The young naturalist was then full of ardour in the pursuit in which he became afterwards so celebrated, and his active imagination in this instance probably led him to give credit too easily to what he seemed to have his own experience for believing. While engaged in his botanical researches among some marshes at Fagelsong, in the vicinity of Lund, he was suddenly wounded, as he supposed, by a small slender worm, which, darting upon him, buried itself so instantaneously and deeply in the flesh, as to render all attempts at extracting it of no avail, and causing so great an inflammation, as even to endanger his life. On his recovery, Linnæus, deeply impressed with what had happened, in order to perpetuate the circumstance, gave to the animal by which he had been so grievously wounded, the name of *Furia infernalis;* by which appellation it is introduced into his celebrated " *Systema Naturæ,*" under the class of Worms.*

After Linnæus, many celebrated naturalists eagerly embraced the idea of the existence of the *Furia,* and dissertations on it are to be found in their works, and even in the Transactions of the learned societies at Stockholm and Upsala †, in which several cases were adduced of persons who had been similarly attacked, by a kind of worm of the thickness of a hair, and of a greyish colour, the extremities being black. The animal appeared only to be an inhabitant of marshy spots, whence, by some means or other, it darted forth upon the exposed parts of the bodies of those who happened to be within its reach, burying itself with singular rapidity in the flesh, and occasioning torments so excruciating as to throw its unfortunate victim into a state of madness.

Of those who maintained the existence of the furia was Solander, the pupil of Linnæus; and his dissertation on this subject in the Upsala Transactions shews the little doubt he had with regard to this animal. In this paper he not only adduces several well authenticated instances, when he was in the north of Sweden, of persons who had been wounded, and even fatally, by the *furia,* but even details the nature and appearance of the wound inflicted, the symptoms that ensued, and the remedies to which recourse was had; and asserts his having himself

* " The *Furia infernalis* inhabits the vast marshy plains of Bothnia and Finland, where it crawls up shrubs and sedge-grass, and, being carried forward by the wind, penetrates suddenly into such exposed parts of men and horses as are not perpendicularly situated. It quickly buries itself under the skin, leaving a black point where it had entered; which is soon succeeded by the most excruciating pains, inflammation and gangrene of the part, swooning, and death. This all happens in the course of a day or two, frequently within a few hours, unless the animal be immediately extracted, which is effected with great caution and difficulty, by applying a poultice of curds or cheese; or carefully dissecting between the muscles where it has entered."—*Lin. Syst. Nat.*

† Kongl. Vetenskap's Academiens nya handlingar, vol. xvi. p. 143. Nova Acta Upsal. vol. i. p. 44. Opuscula Zoologica, vol. xvii. art. 7. Miracula Insectorum, in the Amœnitates Academicæ, vol. iii.

examined the worms which he minutely describes. Notwithstanding these high authorities, the accounts of so extraordinary an animal were received with caution, and the default of actual specimens rendered them still more suspicious. More matured experience, however, induced Linnæus to alter the opinion he had first entertained, and led him, many years before his death, to express his conviction of the error into which he had been drawn in respect to this supposed animal; and by the Swedish naturalists of the present day, its existence is regarded as entirely fabulous. It may be observed, meanwhile, that the Academy of Sciences at Stockholm, with an anxious desire to discover the truth, has promised, on several occasions, a considerable reward to whoever should lay before it a specimen of the animal in question; none, however, have been presented to their notice, but what, upon examination, have been proved to be fictitious. With this information I have been favoured by Mr Retzius of Stockholm, son of the late distinguished naturalist. This gentleman has informed me, that he has himself made frequent searches to no purpose on the borders of the Mäler, and other Swedish lakes, in the hopes of discovering this formidable being; and he adds, that, with regard to the *Gordius aquaticus*, or hair-worm, the bite of which has been supposed to be dangerous, his own personal experience has convinced him, that it is perfectly harmless; for, during the space of ten years, when he resided at Carlberg, as physician of the military academy, he was daily accustomed to see the young cadets of the establishment bathing in places where these animals were to be seen in thousands, and yet no accident was ever the result.

Against these reasons for doubt, in respect to the furia, we have, indeed, the conflicting testimony of our own celebrated traveller Dr Clarke, who supposes himself to have been wounded by this very creature, during his progress in Sweden. He had been reading the life of Linnæus, in the open travelling waggon, as he proceeded on his route; and was giving an account to his companion of the marvellous manner in which that celebrated naturalist had nearly lost his life, in consequence of being wounded by a worm, said to have fallen from the air; expressing, at the same time, his incredulity as to the existence of such an animal, and of course his disbelief of the fact. A this moment, he was himself attacked in the same extraordinary manner, and, perhaps, as he says, by the same creature. A sharp pain, preceded by slight irritation, took place in his left wrist. It was confined, at first, to a small dark point, hardly visible, and which, he supposed, to proceed from the sting of a gnat. Presently it became so severe, that the whole of the left arm was affected, quite to the shoulder, which, as well as the joints of the elbow and fingers, became benumbed. The consequences might have been more serious, if he had not resorted to a mode pointed out by the inhabitants, namely, a poultice of curd, to which he added the well known Goulard lotion, prepared from the acetate of lead.

That Dr Clarke suffered acute pain from the sting of some insect, and that his arm was considerably affected by it, may readily be imagined, especially by those who have experienced the venom of the winged inhabitants of the northern forests during the summer, without attributing it to the *Furia infernalis*. Yet that such an animal exists, is doubtless credited by many of the lower classes; and the following reports, which, since my return, I have received from Finmark, show that the idea is still prevalent in Lapland; and though they may be considered in the same light as those related by the learned authors mentioned above, they may serve as amusement for those interested in the question of its existence.

It appears, that the *Furia* does not confine its attacks to the human race, but that cattle, and the rein-deer in particular, are exposed to it. In 1823, the Laplanders are stated to have suffered so greatly in their herds, that 5000 head died from the sting of this creature; and that even the wolves and other animals, that preyed upon the dead carcases, caught the infection, and died with the same symptoms. A Laplander, who possessed 500 deer, on perceiving the destruction among them, thought it best to kill the whole herd; but so quickly did its ravages spread, that, before he could accomplish his purpose, they all died. Great numbers of cattle and sheep were likewise destroyed by its attacks, and it fell, in some degree, upon the human species, a few having become victims to it. A young girl, who was shearing some sheep, that had died from the attack of the *Furia*, felt, while thus employed, a sudden pain in one of her fingers, which rapidly increased, and, on examining the part, she found a small puncture like the prick of a needle; her master, who was by, had the presence of mind to cut the finger off on the spot, and it was the means of saving her life.

The pest is stated to have been confined to Russian and Swedish Lapland, and did not spread higher than Muonioniska. Norwegian Lapland fortunately was not visited with this calamity; and, in order to prevent it from being introduced, all furs, during the year of its prevalence, were forbidden to be purchased *.

As these accounts were unsatisfactory, and I could not hope to obtain better information from such remote quarters, I was induced also, on this occasion, to apply to Mr Retzius, whom I have mentioned before, who, having examined the reports of health of the northern provinces of Sweden, transmitted annually for the information of the government, has forwarded to me the result of his inquiries, by which it appears, that, during the summer of 1823, and the year following, there was a great mortality among the rein-deer in Norbotten and Lapland, which was attributed to some unwholesome quality in the moss; but that he, as well as others of the faculty at Stockholm, had been led to consider the disorder, by which they were attacked, as a particular variety of hydrophobia. It appears, likewise, that the deer are not unfrequently subject to another complaint, an inflammation of the brain; and that, upon opening the part affected, a small vesicular worm † is sometimes found, although in what manner the animal is generated has not yet been explained. The most remarkable symptoms of this disorder, which comes on with great suddenness, are an extraordinary degree of fury, during which the animal attacks and even kills its owners, and frightful convulsions, terminating in death.

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* I have since ascertained, that, in consequence of the alarm excited by the reported ravages of the *Furia*, an edict was actually issued from the Amtmand of Finmark, prohibiting the introduction of all furs into the country during that year.

† The *Tænia cerebralis;* this worm is frequently found also beneath the brain of sheep, and occasions the disease known by the name of rickets.

Account of a simple Apparatus for collecting the Gases evolved from liquids submitted to Galvanic Action. By the Rev. Mr A. Robertson *jun.* Inverkeithing. (Communicated by the Author.)

THIS apparatus consists of a glass-tube, of any size, divided into three parts A, B, C, (Plate I. Fig. 1.) by the two bendings D, E. The upper end is closed, and the lower immersed in the fluid contained in the bottle F. G, H, are platinum-wires inserted through the tube near the bending D.

To use it, it is to be held with the part of the tube marked A, nearly perpendicular, the open end being upwards, and the liquid, through which the galvanic electricity is to be transmitted, is poured in till the tube be filled. A slip of paper, a little broader than the diameter of the tube, is now to be placed over the orifice; and being extended, on both sides, along the tube, is to be held there, so that the whole may be inverted, without spilling, into the bottle F, previously half filled with the same fluid. The wires G, H, are then connected with the galvanic poles; and, when the experiment is finished, the gas evolved at the wire G, will be collected in the part of the tube A, and that from the wire H, at C, in the manner represented in the figure, the displaced fluid descending into the bottle.

The volumes of the gases may be ascertained by graduations on the tube, or they may be separately transferred into small jars, by the aid of a pneumatic trough; the gas at C, ascending into one jar, upon the tube being turned up, while the gas at A occupies the part of it on each side of the bend D; and this, afterwards, upon a proper inclination of the tube, also ascends into another; so that each of them may be examined by itself. Should it be wished to recombine them, it may be done without removing them from the tube, but by holding it so that the gas at C may rise to B, and join that in it, and then transmitting the electric spark between the wires.

The advantages of this apparatus, when water, or any other fluid, not corrosive, is to be decomposed, consist in its simplicity and cheapness, as, by the aid of a blowpipe, it may be made in a few minutes from any piece of glass tube of a proper size; and it possesses also every convenience of those which are more com-

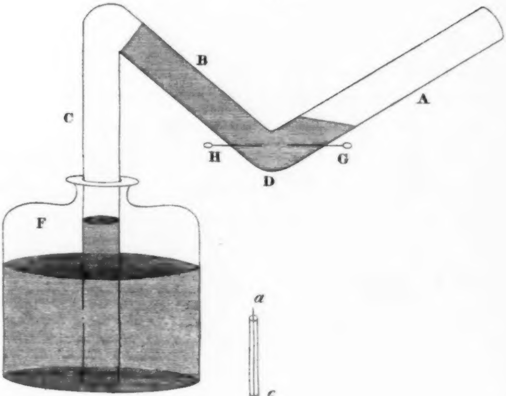

Fig. 1.

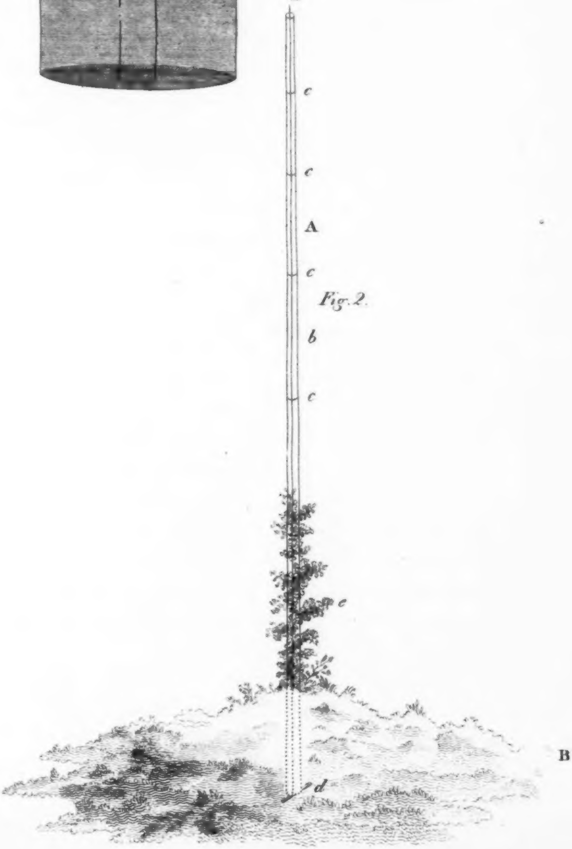

Fig. 2.

Published by A. Black Edin! 1827. E. Mitchell sculp!

plicated and expensive. From the points of the wires within it, being so near each other, the galvanic action is procured in its greatest intensity, and the products from each wire are, nevertheless, separately obtained. But, when corrosive fluids are used, such as the nitric acid (a substance well fitted for illustrating the action of galvanism in effecting decomposition, on account of the rapidity with which the affinity of its elements is thus overcome), it is much more decidedly superior. The quantity of liquid used is comparatively small; there is a greater facility of filling or emptying, without coming in contact with the corrosive matter; and, from there being only one opening, it is more manageable, and there is much less risk of the fluid escaping from the vessels, and being thrown about by the pressure of the gas produced.

Account of an Ascent to the Crater of the Great Volcano of Kirauea. By the Reverend CHARLES STEWART, late Missionary at Hawaii.

THE very striking picture of volcanic phenomena contained in the following " Account," has just appeared in Dr Silliman's excellent Journal. It is delightful to observe the increasing attention of missionary travellers to Natural History. In former times, much of our knowledge in this pleasing and important branch of science was derived from the missionaries;—for a period, they ceased to bestow any attention on it,—but, now, fortunately for their own credit and general utility, they are cultivating it with ardour and effect.

" *July* 2. 1825.—Early on Monday the 27th of June, we commenced our proposed excursion to the volcano. The party from the Blonde, consisted of Lord Byron, Mr Ball first Lieutenant, Lieutenant Malden the Surveyor, Mr Davis the Surgeon, Reverend Mr Bloxam the Chaplain, Mr A. Bloxam the Mineralogist, Mr Dampier the Artist, Mr White a son of the Earl of Bantry, and Mr Powell Midshipman. Maro, a principal chief of the district of Hido, had been appointed by Kaahumanu (favourite Queen of Tamehameha the first), Caterer General, and about 100 natives under his authority, carried our luggage, provisions, &c. &c. Sir Joseph Banks, or, as more familiarly styled, "Joe Banks," was also in attendance in his diversified capacity of interpreter, gentleman in waiting to Lord Byron, &c. &c. The Regent (Kaahumanu), had left nothing indeed undone to render the trip as comfortable as her authority could make it. Neat temporary houses for refreshment and sleeping had been erected, by her command, at intervals of twelve to fifteen miles; and the people of the only inhabited district through which we were to pass, had, the week before, been apprized of the journey of the "British Chief," with strict orders to have an abundance of pigs, fowls, taro, potatoes, &c. &c. in readiness for the supply of his company. When all assembled, we formed quite a numerous body, and from the variety of character and dress, the diversity in the burdens of the natives, bundles, tin-cases, portmanteaus, calabashes, kettles, buckets, pans, baskets, &c. &c. with two hammocks, by way of equipage, slung on long poles, and each borne by four men, made a lively and grotesque appearance, while passing in single file, along the narrow winding-path which formed our only road.

"For the first four miles, the country was uneven and open, and beautifully sprinkled with single trees, clumps and groves of the bread-fruit, the lauala (*pandanus*), and tutui, or candle-tree. We then came to a wood, four miles in width, the outskirts of which exhibited some of the richest and most delightful foliage I have ever seen. It was composed principally of lofty and wide-spreading candle-trees, whose whitish leaves and blossoms afforded a strong contrast with the dark green of the various creepers, which hung in luxurious festoons and pendants, from their very tops to the ground, forming thick and deeply shaded bowers round their trunks. The interior, however, was far less interesting, presenting nothing but an almost impenetrable thicket on both sides of the path. This was excessively rough and fatiguing, consisting entirely of loose and pointed fragments of lava, which, from their irregularity and sharpness, not only tore and cut our shoes, but constantly endangered our feet and ankles also. The high brake, ginger, &c. which border and overhang the path, were filled with the rain of the night, and, from their wetness, added greatly to the unpleasantness of the walk. An hour and a half, however, saw us safely through, and refreshing ourselves in the charming groves with which the wood was here again edged.

The remaining distance, of near thirty miles, was very much of one character. The path consisted solely of a bed of black lava, so smooth in many places, as to endanger falling, and still shewing the configuration of the molten stream, as it had rolled down the gradual descent of the mountain, led midway through a strip of open, uncultivated country, from three to five miles wide, skirted on both sides by a ragged and stinted wood, and covered with grass, fern, and low shrubs, principally a species of the whortle-berry. There were no houses near the path, but the thatch of a cottage, or the rising smoke, seen occasionally, in the edge of the woods, shewed that it was not an uninhabited region. Far on the right and west, the mountains Mouna Kea and Mouna Roa were distinctly visible, and on the left and east, at an equal distance, the ocean, with its horizon, from the height at which we viewed it, mingling with the sky.

We dined thirteen miles from the bay, in the shade of a large candle-tree, where a party of people from the neighbouring settlements, were waiting to see the "arii nui mai Berekania mai," (the great Chief from Britain), as they called Lord Byron. About two miles further, we came to the houses erected for our lodgings the first night: thinking it, however, too early to lie by for the rest of the day, after witnessing a dance performed by a company from the surrounding districts, we hastened on, intending to sleep at the next houses, ten miles distant. But night overtook us before we reached them, and perceiving the ruins of two huts, a few rods from our path, we turned aside to them, just as darkness began to set in. The sticks forming their frames, were all that remained, but the islanders soon covered them with leaves, and spread the ground with fresh fern, before laying the mats which were to be our beds.

"Our arrival and encampment produced a picturesque and lively scene. The natives, who are not fond of such forced marches as we had made during the day, were more anxious for repose than ourselves, and as soon as they heard of the determination to stop, proceeded with great animation and alacrity to make the necessary preparations for the night. Some ran for leaves and grass for the huts, some for wood for a fire—

some for water for our tea, &c. &c. till, in a few minutes, every thing was in as much readiness as if we had expected at an earlier hour to remain there. The darkness, as it gathered round us, rendered more gloomy by a heavily clouded sky, made the novelty of our situation still more striking. Behind the huts, in the distance, an uplifted torch of the blazing tutui nut here and there indistinctly revealed the figures and costume of many of our attendants, spreading their couches under the bushes, or in the open air. A large lamp, suspended from the centre of our rude lodge, which was entirely open in front, presented us, in bolder relief, seated *à la Turque* round Lord Byron, who poured out " the cup that cheers but not inebriates ," the more curious of our dusky companions, both male and female, in the mean time, pressing in numbers about our circle, as if anxious " to catch the manners living as they rose." A large fire of brushwood exhibited the objects of the fore-ground, in still stronger lights and shadows. Groups of both sexes and all ages were seated or standing round, wrapped up, from the chilliness of the mountain air, in their large mantles of white, black, green, yellow and red—some smoking their evening pipe, some throwing into the embers, and others scratching from them, a fish or potato, or other article of food—some giving a loud halloo, in answer to the call of a straggler just arriving—others wholly taken up with the proceedings of the sailors cooking our supper, and all chattering on a hundred different subjects, with the volubility of so many magpies.

" By daylight the next morning we were on the road again. At 9 o'clock we breakfasted at the last houses put up for our accommodation on the way, and, by 11, had arrived within three miles of the object of our curiosity. For the last hour the scenery had become more interesting than it had been during most of the preceding day; our path was occasionally skirted with groves and clusters of trees, and fringed with a greater variety of vegetation. Here, also, the smoke of the volcano was just descried, settling in light fleecy clouds to the south-west. Our resting place, at this time, was a delightful spot, commanding a full view of the wide extent of country over which we had travelled, and around it, the ocean, which, from the vast and almost undistinguished extent of its horizon, seemed literally an 'illimitable sea.' The smooth green sward, under a majestic koa tree (an acacia), nearly encircled by thickets of a younger growth, afforded a refreshing couch on which to take our luncheon. We tarried, however, but for a moment, and then hurried on to the grand object before us.

" The nearer we approached the more heavy the column of smoke appeared, and excited to intenseness our curiosity to behold its origin. Under the influence of this excitement we hastened forward with rapid step, regardless of the heat of a noonday sun, and the fatigue of a walk of thirty-six miles already accomplished. A few minutes before 12 o'clock we came suddenly on the brink of a precipice 150 or 200 feet high, covered with shrubbery and trees. Descending this by a path nearly perpendicular, we crossed a plain half a mile in width, inclosed, except in the direction we were going, by the cliff behind us, and found ourselves a second time on the top of a precipice 400 feet high, also covered with bushes and trees. This, like the former, swept off to the right and left, inclosing, in a semicircular form, a level space, about a quarter of a mile broad, immediately beyond which lay the tremendous abyss of our search, emitting volumes of vapour and smoke, and labouring and groaning as if in irrepressible agony, from the raging of the conflicting elements within its bosom. We stood but a moment to take this first distant gaze, then hastily descended the almost perpendicular height, and crossed the plain to the very brink of the crater.

" There are scenes to which description, and even painting, can do no justice, and in conveying any adequate impression of which, they must ever fail. Of such, an eloquent traveller rightly says, ' The height, the depth, the length, the breadth, the combined aspect, may all be correctly given, but the mind of the reader will remain untouched by the emotions of admiration and sublimity which the eye witness experiences.' That which here burst on our sight, was, emphatically, of this kind, and to behold it without singular and deep emotion, demands a familiarity with the more terrible phenomena of nature, which few have the opportunity of acquiring. Standing at an elevation of 1500 feet, we looked into a horrid gulf, not less than eight miles in circumference, so directly beneath us, that, in appearance we might, by a single leap, have plunged into its lowest depth. The hideous immensity itself, independent of the many frightful images embraced in it, almost caused an involuntary closing of the eyes against it. But when to the sight is added the appalling effect of the various unnatural and fearful noises, the muttering and sighing, the groaning and blowing, the every agonized struggling of the mighty action within—as a whole, it is too horrible!—And, on the first moment, I felt like one of my friends, who, on reaching the brink, recoiled and covered his face, exclaiming, "Call it weakness, or what you please, but I cannot look again!"

It was sufficient employment for the afternoon simply to sit and gaze on the scene, and though some of our party strolled about on the level above, and one or two descended a short distance in the crater, the most of our number deferred all investigation till the next morning.

From what I have already said, you will perceive, that this volcano differs, in one respect, from most others of which we have accounts: the crater, instead of being the truncated top of a mountain, distinguishable at a distance in every direction, is an immense chasm, in an upland country, near the base of the mountain Mouna Roa *, approached, not by ascending a cone, but by descending two vast terraces, and not visible from any point, at a greater distance than half a mile; a circumstance which, no doubt from the suddenness of the arrival at it, adds much to the effect of a first look from its brink. It is probable, that, originally, it was a cone, but assumed its present aspect, it may be centuries ago, from the falling in of the whole summit. Of this the precipices we descended, which entirely encircle the crater in circumferences of fifteen and twenty miles, give strong evidence: they have unquestionably been formed by the sinking of the mountain, whose foundations had been undermined by the devouring flames beneath. One-half of the present depth of the crater has been caused, in the same manner, at no very remote period. About midway from the top, a ledge

* The height of Mouna Roa has never been accurately measured, but variously estimated from 16,000 to 18,000 feet, being thus 1000 or 2000 feet higher than Mont Blanc, and 5000 or 6000 feet higher than the Peak of Teneriffe.

of lava, in some places many rods, and in others only a few feet wide, extends entirely round, (at least so far as an examination has been made) forming a kind of gallery, to which you can descend in two or three places, and walk as far as the smoke, settling at the south end, will permit. This offset leaves incontestible marks of having once been the level of the fiery flood, boiling in the bottom of the crater; a subduction of lava, by some subterranean channel, has since taken place, and sunk the abyss many hundred feet, to its present depth.

The gulf below contains between fifty and sixty smaller conical craters, many of which are in constant action. The tops and sides of two or three of these are covered with sulphur of mingled shades of green and yellow; with the exception of these the ledge, and every thing below it, is of a dismal black. The cliffs above the ledge, forming the outer edge of the crater, are on the northern and western sides perfectly perpendicular, and of a red colour, every where exhibiting the marks of former powerful ignition. Those on the eastern side are less precipitous, and consist of entire banks of sulphur, of a delicate and beautiful yellow. The south end is wholly obscured by the smoke, which fills that part of the crater, and spreads widely over the surrounding horizon.

As the darkness of the night gathered round us, new and powerful effect was given to the scene. Fire after fire, which the glare of mid-day had entirely concealed, began to glimmer on the eye, with the first shades of the evening; and, as the darkness increased, appeared in such rapid succession, as forcibly to remind me of the hasty lighting of the lamps of a city on the sudden approach of a gloomy night. Two or three of the small craters, nearest to the north side, where we lodged, were in full action, every moment casting out stones, ashes and lava, with heavy detonations, while the irritated flames accompanying them glared widely over the surrounding obscurity, against the sides of the ledge and upper cliffs, richly illuminating the volumes of smoke at the south end, and occasionally casting a bright reflection on the bosom of a passing cloud. The great seat of action, however, seemed to be at the southern and western end, where an exhibition of ever-varying fire-works was presented, surpassing in beauty and sublimity, all that the ingenuity of art ever devised. Rivers of fire were seen rolling in splendid coruscation among the labouring craters; and on one side a whole lake, whose surface constantly flashed and sparkled with the agitation of contending currents.

Expressions of admiration and astonishment burst momentarily from our lips, and though greatly fatigued with our walk, it was near midnight before we could yield ourselves to a sleep, often interrupted during the night, to gaze on the light with renewed wonder and surprize. As I laid myself down on my mat, fancying the very ground, which was my pillow, to shake beneath my head, the silent musings of my own mind were, "Great and marvellous are thy works, Lord God Almighty; greatly art thou to be feared, thou King of saints."

On Wednesday, the 29th, after an early breakfast, our party, excepting Lieut. Malden, who was ill, Mr Dampier, who remained to take a sketch, and Mr Ruggles, who chose to satisfy his curiosity above, prepared for a descent into the crater. One of the few places where this is practicable, was within a rod of our hut. For the first 400 feet, the path was steep, and from the looseness of the stones and rocks in and about it, required caution in every movement. A slight touch was sufficient to detach them and send them bounding downwards, with great velocity, to the imminent danger of all in their way. The remaining distance to the ledge, of about the same number of feet, was gradual and safe, the path having turned into the bed of an old channel of lava, which ran off in on inclined plane, till it met the offset, before described, more than a quarter of a mile west of the place where we began the descent. By the time we had all reached this spot, the natives acting as guides, with the Messrs Bloxam and Mr Powel, had preceded the rest of our number too far to be overtaken, and we became two parties for the rest of the morning; the last, into which I fell, consisting of Lord Byron, Mr Ball, Mr Davies, and Mr White, with Lord Byron's servant and my native boy, to carry a canteen of water, and the specimens we might collect. Before descending, we had provided ourselves with long canes and poles, by which we might test the soundness of any spot before stepping on it, and immediately on reaching the ledge, found the wisdom of the precaution.

This offset is formed wholly of scoria and lava, mostly burnt to a cinder, and is every where intersected by deep crevices and chasms, from many of which, light, vapour and smoke, and from others, a scalding steam, are emitted. The general surface is a black glossy incrustation, retaining perfectly the innumerably diversified tortuous configurations of the lava, as it originally cooled, and so brittle as to crack and break under us, like ice, while the hollow reverberations of our footsteps beneath, sufficiently assured us of the unsubstantial character of the whole mass. In some places, by thrusting our sticks down with force, large pieces would give way, disclosing fissures and holes apparently without bottom. These, however, were generally too small to appear dangerous. The width of this ledge is constantly diminished, in a greater or less degree, by the falling of large masses from its edges into the crater; and it is not impossible that in some future convulsion of the mountain, the whole structure may yet be plunged into the abyss below.

Leaving the sulphur banks on the eastern side behind us, we directed our course under the northern to the western cliffs. As we advanced, these became more and more perpendicular, till they presented nothing but the bare and upright face of an immense wall, from 800 to 1000 feet high, on whose surface huge stones and rocks hung, apparently so loosely as to threaten falling at the agitation of a breath. In many places, a white curling vapour issued from the sides and summit of this precipice, and in two or three others, streams of clay-coloured lava, extending almost from the top to the bottom, had cooled in the form of small cascades, evidently at a very recent period. At every step something new attracted our attention, and by stopping sometimes to look up, not without a feeling of apprehension, at the enormous masses over our heads—at others, to gain, by a cautious approach to the brink of the gulf, a nearer glance at the equally fearful depth below—at one time, turning aside to ascertain the heat of a column of steam, and at another, to secure some unique or beautiful specimen, we occupied more than two hours, in proceeding the same number of miles.

We then came to a spot, on the western side, where the ledge widened many hundred feet, and terminated on the side next the crater, not, as in most other places, perpendicularly, but in a vast heap of broken cakes and blocks of lava, loosely piled together as they had been shattered from above in the quakings of the mountain, and jutting off to the bottom in a frightful mass of ruin. Here we had been informed, the descent into the depth of the crater could be most easily made; but without a guide, we were at a loss what course to take, till we unexpectedly descried the gentlemen who had preceded us, reascending. They dissuaded us most strenuously from proceeding further, but their lively representations of the difficulty and dangers of the way, only strengthened the resolution of Lord Byron to go down; and knowing that the crater had been crossed at this end, we hastened on, notwithstanding the refusal of the guide to return with us. The descent was as perilous as it had been represented to be, but by proceeding with great caution, testing well the safety of every step before committing our weight to it, and often stopping to select the course which seemed least hazardous, in the space of twenty minutes we reached the bottom by a zigzag way, without any accident of greater amount than a few scratches on the hands, from the sharpness of the fragments of lava by which we were occasionally obliged to support ourselves. When about half way down, we were encouraged to persevere, by meeting an islander, who had descended on the opposite side and made his way over. It was only, however, from the renewed assurance it gave of the practicability of our attempt, for, besides being greatly fatigued, he was much cut and bruised from a fall,—said the bottom was "ino, ino roa-kawahi o Debelo,"—"very, very bad, the place of the Devil." He could be prevailed on to return with us only by the promise of an ample reward.

It is difficult to say whether sensations of admiration or of terror predominated, on reaching the depth of this tremendous spot. As I looked up at the gigantic wall, which on every side rose to the very sky around me, I felt oppressed, for a moment, by a sense of confinement to a most unpleasant degree. Either from the influence of imagination, or from the actual effect of the intense power of a vertical sun, added to the heated and sulphurous atmosphere of the volcano itself, I experienced an agitation of spirits, and a difficulty of respiration, that made me cast a look of wishful anxiety to our hut, which, at an elevation of 1500 feet, seemed only like a bird's nest on the opposite cliff.

These emotions, however, soon passed off, and we began with great spirit and activity the enterprise before us. I can compare the general aspect of the bottom of the crater to nothing, that will give a livelier image of it to your mind, than to the appearance the Otsego would present, if the ice with which it is covered in the winter, were suddenly broken up by a heavy storm, and as suddenly frozen again, while large fragments were still tossing and dashing and heaping against each other, with the motion of the waves. Just so rough and distorted was the black mass under our feet, only an hundredfold more terrific, independent of the innumerable cracks, fissures, deep holes and chasms, from which sulphurous vapour, steam and smoke, were exhaled, with a degree of heat that testified to the near vicinity of fire.

We had not proceeded far, before our path was intersected by a chasm at least thirty feet wide, and of a greater depth than we could ascertain, at the nearest distance we dared approach it. The only alternative was to return, or follow its course till it terminated, or became narrow enough to be crossed. We chose the latter, but soon met an equally formidable barrier in a current of smoke, so highly impregnated with a suffocating gas, as not to allow of respiration. While hesitating what to do, we perceived this to be swept off, occasionally by an eddy of the air in a direction opposite to that in which it generally settled, and watching an opportunity when our way was thus made clear, we held our breath, and ran as rapidly as the dangerous character of the ground would permit, till we gained a place beyond its ordinary course. We here found ourselves unexpectedly delivered also from the other impediment to our progress —the chasm, which abruptly ran off in a direction far from that we wished to pursue.

We were now at an inconsiderable distance from one of the largest of the conical craters whose laborious action had so greatly impressed our minds during the night, and we hastened to a near examination of it. So prodigious an engine I never expect again to behold. On reaching its base, we judged it to be 150 feet high,—a huge, irregularly shapen inverted funnel of lava, covered with clefts and orifices, from which bodies of steam escaped with deafening explosions, while pale flames, ashes, stones, and lava, were propelled, with equal force and noise, from its ragged and yawning mouth. The whole formed so singular and terrific an object, that, though my drawing book had been accidentally left with my boy, who was unwilling to descend from the ledge with us, in order to secure a hasty sketch of it, I permitted the other gentlemen to go a few yards nearer than I did, while I occupied myself with my pencil on a rough piece of blotting paper, brought by one of the party to wrap round the more delicate specimens we might collect. Lord Byron and his servant ascended the cone several feet, but found the heat too great to remain longer than to detach with their sticks a piece or two of recent lava burning hot.

So highly was our admiration excited by the scene, that we forgot the danger to which we might be exposed, should any change take place in the currents of destructive vapours, which exist in a greater or less degree in every part of the crater, till Mr Davis, after two or three ineffectual intimations of the propriety of an immediate departure, warned us, in a most decided tone, not only as a private friend, but as a professional gentleman, of the peril of our situation,—assuring us that the inspiration of the air, by which we might be surrounded, would prove fatal to every one of us. We felt the truth of the assertion, and, notwithstanding the desire we had of visiting a similar cone covered with a beautiful incrustation of sulphur, at the distance of a few hundred yards only from where we then were, we hastily took the speediest course from so dangerous a spot. The ascent to the ledge was not less difficult than the descent had been, and for the last few yards was almost perpendicular; but we all succeeded in gaining its top in safety, not far from the path where we had in the morning descended the upper cliff.

We reached the hut about two o'clock, nearly exhausted with fatigue, thirst, and hunger, and had immediate reason to congratulate ourselves on a most narrow escape from suffering and extreme danger, if not from death. On turning round, we perceived the whole chasm to be filling with thick sulphurous smoke, and within half an hour, it was so completely choked with it, that not an object below us was visible. Even in the unconfined region above, the air became so oppressive as to make us think seriously of a precipitate retreat. This continued to be the case for the greater part of the afternoon. A dead calm took place both within and without the crater; and, from the diminution of noise, and the various signs of action, the volcano itself seemed to be resting from its labours.

Towards evening the smoke again rolled off to the south, before a fresh breeze, and every thing assumed its ordinary aspect. At this time Lieutenant Malden, notwithstanding his indisposition, succeeded in getting sufficient data to calculate the height of the upper cliff. He made it 900 feet, agreeing with the measurement of some of the missionaries some months before. If this be correct, it is judged that the ledge cannot be less than 600 feet above the bottom, thus making the whole depth of the crater, that which I have stated it in the preceding pages to be, 1500 feet. On similar grounds its circumference at the bottom has been estimated at a distance of from 5 to 7 miles, and at its top from 8 to 10.

Greatly to our regret, we found it would be necessary to set off on our return early the next morning, all the provisions for the natives being entirely expended. We could have passed a week here with undiminished interest, and wished to remain at least one day longer, to visit the sulphur banks on the eastern side, which abound with beautiful crystallizations, and to make some researches on the summit. We would have been glad also, to have added to the variety of specimens we had already collected, especially of the volcanic sponge, and capillary volcanic glass, not found on the side of the crater where we encamped. But it was impossible, and we made preparations for an early departure.

The splendid illuminations of the preceding evening were again lighted up with the closing of the day, and after enjoying their beauty for two or three hours, with renewed delight, we sought a repose, which the fatigue of the morning had rendered highly desirable. The chattering of the islanders around our cabin, and the occasional sound of voices in protracted conversation among our own numbers, had, however, hardly ceased long enough to admit of sound sleep, when the volcano again began roaring and labouring with redoubled activity. The confusion of noises was prodigiously great. In addition to all we had before heard, there was an angry muttering and rumbling from the very bowels of the abyss, accompanied, at intervals, by what appeared the desperate efforts of some gigantic power struggling for deliverance. These sounds were not fixed or confined to one place, but rolled from one end of the crater to the other; sometimes seeming to be immediately under us, when a sensible tremor of the ground on which we lay took place, and then again rushing to the farthest other extremity with incalculable velocity. The whole air was filled with the tumult, and even those most soundly asleep, were quickly roused by it to thorough wakefulness. Every monition momentarily increased, and Lord Byron springing up in his cot, exclaimed, "We shall certainly have an eruption—such power must burst through every thing." He had scarcely ceased speaking, when a dense column of black smoke was seen rising from the crater, directly in front of us,—the subterranean struggle at the same time ceased, and immediately after, flames burst from a large cone, near which we had been in the morning, and which then appeared to have been long inactive. Red-hot stones, cinders, and ashes were also propelled with immense violence, to a great height, and shortly after the molten lava boiled over, and flowed down the sides of the cone, and on the surrounding scoria, in two beautiful curved streams, glittering with indescribable brilliancy.

A whole lake of fire also opened in a more distant part. This could not have been less than two miles in circumference, and its action was more horribly sublime than any thing I ever imagined to exist, even in the idler visions of unearthly things. Its surface had all the agitation of an ocean—billow after billow tossed its monstrous bosom in the air, and, occasionally, those from opposite directions met, with such violence, as to dash the fiery spray, in the concussion, forty or fifty feet high. It was at once the most splendidly beautiful, and dreadfully fearful of spectacles, and irresistibly hurried the thoughts to that lake of fire, from whence the smoke of torment ascendeth for ever and ever! No work of Him who laid the foundations of the earth, ever brought to my mind the awful revelations of his word with such overwhelming impression: Truly "*with God is terrible majesty*,"—"let all the nations say unto God, "*How terrible art thou in thy works!*"

Under the name of *Pele*, (pay-lay,) this volcano, as you may have seen stated in the Missionary Herald, was one of the most distinguished and most feared of the gods of Hawaii *. Its terrific features are well suited to the character and abode of an unpropitious demon, and few works in nature would be more likely to impose thoughts of terror on the ignorant and superstitious, or from their destructive ravages sooner lead to sacrifices of propitiation and peace. It is now rapidly losing its power over the minds of the people. Not one of the large number in our company seemed to be at all apprehensive of it as a supernatural being.

After an almost sleepless night, we early turned our faces homeward, not without many a "lingering look behind," even from the very entrance of our path. It was precisely 6 o'clock, when the last of our party left the brink. Never was there a more delightful morning. The atmosphere was perfectly clear, and the air, with the thermometer at 56° Fahrenheit, pure and bracing. A splendid assemblage of strong and beautifully contrasted colours glowed around us. The bed of the crater, still covered with the broad shadows of the eastern banks, was of jetty blackness. The reflection of the early sun added a deep redness to the western cliffs—the bright yellow of those opposite showed here and there a tinge of vermillion, while the body of smoke, rising between them, hung in light drapery of pearly whiteness against the deep azure of the southern sky. Mouna Roa and Mouna Kea, in full view in the west and north, were richly clothed in purple, while the long line of intervening forests, the level over which we were passing, and the precipice

* *Pele*, is the all-powerful goddess of volcanoes, with the natives, and Kuauea is the habitation of herself and her ministering deities. The conical craters are considered their houses, where they frequently amuse themselves by playing at *koriane;* the roaring of the furnaces, and the crackling of the flames, are the *kani* of the *hura*, the music of their dance; and the red flaming surge is the surface wherein they play sportively on the rolling wave. A spirited account of a singular meeting between Mr Ellis and his party with Oani, the priestess of Pele, is given in the North American.

by which it was encircled, thickly covered with trees and shrubbery, exhibited an equally bright and lively green.

On gaining the top of the first precipice, the distant view of the crater and the surrounding scenery was so strikingly beautiful, that, though most of the gentlemen had preceded me, I stopped long enough to secure the outlines of a drawing. We walked rapidly during the morning, and by 12 o'clock reached the houses built for our accommodation half way between the harbour and volcano. We determined to spend the night at this place. After dinner, a native dance was performed, similar to that witnessed on our way up the mountain on Monday—after which we retired early to rest—set off before day-light the next morning, and reached the Bay in safety, at 1 o'clock on Friday.

ISLAND OF OHAU, SANDWICH ISLANDS,
August 26, 1825.

Observations and Experiments on the different kinds of Coal. By M. KARSTEN. Continued from p. 296. of preceding volume.

2. *Chemical Examination of Mineral Combustibles.*

THE chemical analysis of coal, in the strict sense of the term, can only be guessed with some degree of probability, from the results of the process of carbonization, by comparing the weight and qualities of each of the cokes obtained, with the weight and condition of other cokes coming from coals, whose composition has been already determined by chemical analysis. In such a case as this, the composition of a coal might be ascertained in a pretty satisfactory way from the results of its carbonization.

Such is the principal idea which has directed M. Karsten's researches. On the one hand, the learned author was convinced of this truth, that, in order to judge of the peculiar nature of coals, and to ascertain the cause of the different manners in which, not only brown coals and black coals, but, also, the different varieties of coal, comport themselves, it was necessary to begin with knowing the proportions of carbon, hydrogen, oxygen and azote, which occur in these combustibles. On the other hand, from the extreme difficulty of making such analyses as these in the dry way, M. Karsten considered it as almost impossible to analyse a great number of coals in this manner. He therefore made choice of a certain number of mineral combustibles, which present the most striking differences during distillation in the dry way.

The specimens selected, to the number of eleven, are mineralogically described, and were carefully submitted, on the one hand, to distillation in the dry way, and on the other to chemical analysis. They consisted of fossil wood and brown coal of the countries bordering upon the Rhine, of various black coals of Upper Silesia, the country of Saarbruck, of other parts of Prussia, and of the mines of England. To the results of his eleven chemical analyses, M. Karsten, in order to complete the comparison which he proposed to himself to establish between the different combustibles, has added the result which MM. Gay Lussac and Thenard obtained by their analysis of beech wood.

The author in this manner forms a synoptical table of twelve combustibles, which he takes for general terms of comparison. This table, founded as well upon M. Karsten's analyses, as upon the data admitted by M. Berzelius in the atomic theory, supposes in fact, that, in each of the combustibles essayed, a thousand atoms of carbon are combined with a certain number of atoms of oxygen and of atoms of hydrogen. The author then determines by calculation, how many atoms of hydrogen occur in each of these substances, for a thousand atoms of oxygen.

Before proceeding to the important conclusions which the author draws from his results, it will be proper to point out briefly the manner in which he proceeds.

In the first place, M. Karsten informs us, that in coal he has in vain searched for muriatic acid, iodine, phosphoric acid, and oxide of chrome. The quantity of earths and oxide of iron, which remains after the incineration of coal, that is to say, their contents in ashes, is very variable. One sort of coal leaves only 1 per cent. of ashes, and consequently less than any species of wood. In another kind of coal, the contents in ashes rise to above 20 per cent. The earths which occur in various proportions in the ashes of coals are in general silica, alumina, lime and magnesia. The two latter commonly occur in much smaller quantity than the others.

The author shews by examples, that the determination of the contents in ashes of a coal, even in specimens selected as the purest in a bed of this combustible, cannot, on account of the infinite variety of local circumstances and of position, furnish data which could afford any conclusion as to the whole deposit; but convinced, by more than two hundred and fifty trials of coal, that there exists an essential difference in the contents in earths, of coals of different natural deposits, he admits that the quantity which represents the contents in ashes, especially if it be determined by the examination of several specimens of the same coal, may always be considered as a mean term which approaches the truth.

In respect to this determination, it is of importance to separate from the coal the foreign substances which sometimes occur in its natural fissures. These substances are in general iron pyrites and calcareous spar, sometimes dolomite, galena, blende, sulphate of barytes, carbonate of iron, selenite and siliceous clay. In consequence of this precaution which the author recommends, and because also the trials of coal on a small scale can only be confined to the pure mass, it is evident, that the contents in ashes will always be much less in the small than they would be in the great. M. Karsten concludes from this, that, in order to be enabled to judge of a coal with reference to its employment in the arts, it is not sufficient to know the quantity as well as the circumstances of the coke which it furnishes, and its contents in ashes, but it is also necessary to indicate in detail the usual state of the fissures of the coal, and to mark if the surfaces of these fissures are clean, or if they are filled with foreign substances.

It is in fact in this manner that the author has proceeded in his numerous trials.

After these general remarks and many others, which we are obliged to pass over in silence, M. Karsten describes the apparatus which he employed for his eleven analyses in the dry way, analyses which, as we have already seen, were afterwards to guide him in his researches. It is that which has been employed by chemists for the analysis of vegetable matters. It is known to consist of three glass tubes, connected by two tubes of caoutchouc, which are placed, the one between the first and second tubes, the other between the second and third. The first tube, destined to receive immediately the action of the heat, contained a mixture of the body to be essayed with deutoxide of copper, prepared by means of nitrate of copper. The second tube contained muriate of lime completely dried. The third tube, destined to receive the gases, was very narrow, and graduated by an accurate division into tenths of a cubic inch, Rhine measure. This latter tube conducted the gases into a mercurial apparatus. The quantity of gases developed, was reduced to the temperature of zero, and to the barometrical pressure of 28 inches. Their volume was determined under these conditions. For the absorption of the carbonic acid gas, caustic ammonia was employed. With regard to the residue of gases not absorbed, their volume was subtracted from the total mass of gas, according to the reductions indicated, and it was the difference that made known the real volume of carbonic acid gas. But the author did not enter into the examination of the residuum. Was this pure azote, which did not seem probable to him, or was it rather a mixture of azote with atmospheric air, and carbonic oxide gas, or even carburetted hydrogen gas? With regard to this, the author is not able to pronounce with certainty; he thinks, however, that he avoided the disengagement of carbonic oxide gas, by not filling the first or decomposition tube in the usual manner. The following are the peculiar precautions which he took.

The first tube had a diameter of from 2.5 of a line, to 2.55, and a length of about nine inches. It was shut below, and open above. There was first introduced into it a certain quantity of oxide of copper, which occupied the bottom of the tube; above this, was formed a layer of oxide of copper, mixed with the substance to be decomposed; then a new layer of oxide of copper, without admixture, and so alternately, until there were six layers of mixture in the tube, contained between two layers of oxide of copper, which occupied its two extremities.

This done, at each of the two extremities of the tube, above and below, there was placed a lighted lamp. The tube was thus kept at an ardent heat at the two ends. From this arrangement, there resulted that the decomposition was produced as completely as possible, and that, consequently, there was no reason to dread the disengagement of a considerable quantity of carbonic oxide gas, along with the carbonic acid gas, as happens, when a single lamp only is employed, even with the assistance of a reverbere de tole. The length of the decomposition tube, so far from being an obstacle, on the contrary, allowed a simple support to be adapted to it, suitably disposed for keeping it.

In each of the analyses, there was employed 0.1 gramme, of the substance to be decomposed, after being reduced to an impalpable powder, and dried at the temperature of boiling water. This 0.1 gramme was pounded, and very accurately mixed with four grammes of deutoxide of copper, completely dried. All the other usual precautions were equally taken. In such an analysis, the augmentation of weight which the muriate of lime experiences, makes known the quantity of water that is formed, and from this the quantity of hydrogen disengaged is inferred. The quantity of carbonic acid which is formed, makes known the quantity of carbon. With regard to this, M. Karsten admits, with Berzelius, that water contains 11.06 per cent. of hydrogen, that the cubic foot (Rhine measure) of carbonic acid gas, weighs 0.03543668 of a gramme, and that there are 0.009797952 of a gramme of carbon in it; which is much about the same thing, as saying with M. Thenard, that carbonic acid is composed of 27.68 of carbon, and 72,32 of oxygen by weight, or that, with respect to volume, there are in this acid one volume of vapour of carbon, and one volume of oxygen, condensed into a single volume. (See Thenard's Traité de Chimie, Paris, 1821, tit. 1. p. 644. The same work says, that water is formed of 88.90 of oxygen, and 11.10 of hydrogen in weight, or of one volume of oxyen gas, and two volumes of hydrogen gas, ibid. p. 553.)

On the other hand, by a direct experiment of carbonization, the contents in charcoal of the substance analyzed, are determined, for a perfectly dry state of that substance. The charcoal thus obtained is then burnt, and the quantity of ashes or earthy parts calculated, that occur in the tenth part of a gramme of the substance analyzed. With regard to the quantity of oxygen, it is inferred by the way of difference. For this purpose, from the weight of 0.1 gramme employed, there is subtracted the sum of the three quantities found for the carbon, the hydrogen and the ashes. The remainder indicates the quantity of oxygen.

It is in this manner that M. Karsten has conducted the eleven essays mentioned above. For example, he found that coal of the first quality from the celebrated mines of Newcastle in England, coal with intumesced coke, is composed for 100 parts in weight as follows.

Carbon,	- -	84,263
Hydrogen,	- -	3,207
Oxygen,	- -	11,667
Earthy parts or ashes,	-	0,863
Total,	-	100.

Whence there follows, that proportionally, and abstraction made of the contents in earths, this same coal, considered then as a pure combustible, would be composed of

Carbon,	- -	84.99
Hydrogen,	- -	3.23
Oxygen,	- -	11.78
Total,		100.

If the results of all these analyses be glanced over, it is immediately remarked, that the relation of the quantity of carbon to the quantity of oxygen and hydrogen, which occurs in the different species of mineral combustibles, decides nothing with respect to the nature of the charcoal that is obtained as a residuum of their distillation. The contents in carbon are seen rising from 76 to upwards of 96 per cent.

Thus in the varieties of coal, such of their constituent parts as are not carbon may remain under four per cent., and that without the combustible ceasing to present the regular characters of coal. It might even be said, that the combustible, in its external appearance, approaches so much the more to brown coal, or lignite, that its contents in carbon diminish.

In order to present a more distinct view of the relations in which the oxygen and hydrogen stand to the carbon, in the different species of coal, the author has put together the substances analyzed in a table, indicating, with regard to each of them, how many atoms of oxygen and hydrogen are found for 1000 atoms of carbon. Another table indicates, how many atoms of hydrogen the substances analysed contain, for 1000 atoms of oxygen.

In his calculations, M. Karsten admits, with M. Berzelius, that the weight of an atom of oxygen being represented by the number - - - - - 100

That of an atom of carbon is proportionally expressed by - - - - 75.33

And that of an atom of hydrogen by - 6.217

This being settled, in order to verify M. Karsten's calculations, as we have already done, it is sufficient to recollect that, in the under mentioned results of analysis, for example, with reference to the Newcastle coal, each of the quantities found, whether for the carbon, or for the hydrogen, or for the oxygen, abstraction made of the contents in earthy matters, represents the product of a number of atoms by the weight of an atom of the same substance. Thus, admitting with Berzelius the above relations between the weight of the atoms, we easily find the relations that exist between the number of atoms, whether of carbon, or of hydrogen, or of oxygen, in any one of the combustibles assayed, and consequently the results which M. Karsten has exhibited in several tables.

Here we shall put together into one table the results of the twelve analyses mentioned above, and those of the subsequent calculations of the author, adding, with the view of rendering the whole complete, some details which M. Karsten has merely pointed out; but we shall make no change in the author's numbers, although we sometimes find, on repeating his calculations, slight differences,—which, however, only bear upon the last figures, and have in all probability resulted from the expeditious methods which he may sometimes have employed in the calculation of the decimals.

DESIGNATION of the Combustibles comparatively assayed, by CARBONIZATION.			I. CARBONIZATION OR DISTILLATION IN THE DRY,						
			AFTER DESICCATION AT THE TEMPERATURE OF THE AIR.			AFTER DESICCATION AT TEMPERATURE OF BOILING WATER.			
			Aspect of the Charcoal.	Charcoal obtained for 100 parts in weight.	Ashes coming from the charcoal.	Loss of weight per 100.	Proportional Results of the Carbonization or Contents for 100 parts in weight.		
							Char-coal.	Ashes.	Pure charcoal differenc.
1. Beechwood, (according to the analysis of MM. Gay Lussac and Thenard,	- - - -	-	- - -	0.0	0.0	0.0	0.0	0.0	0.0
2. Fossil wood passing into brown coal or lignite, - - - -	Brühl near Cologne,	-	Pulverulent coke,	49.7	11.40	20.0	62.13	14.25	47.88
3. Common lignite (jet) passing into pitch-coal, - - - -	Uttweiler, to the north of the Siebengebirge on the right bank of the Rhine,	1.2081	Pulverulent coke,	68.2	0.9	5.0	71. 7	0.947	70.753
4. Slate-coal (*Schieferkohle*) of Werner,	Brzenskowitz in Upper Silesia, - - -	1.3098	Pulverulent coke,	53.5	2.5	13.1	61. 5	2.880	58.62
5. Compact slate-coal (*Dichte Schieferkohle*) of Werner,- - - -	Beuthen, in Upper Silesia,	1.2846	Conglutinated coke,	65.3.	0.6	4.0	68.02	0.630	67.39
6. Coal passing from slate-coal to pitch-coal, - - - - - -	Wellesweiler, country of Saarbruck, - -	1.2677	Moderately intumesced, - - -	65.6	1.0	2.2	67.07	1.0	66.05
7. Foliated coal (*Blætterkohle* of Werner), of soft consistence, - - -	Essen and Warden, country of La March, in Westphalia, - - -	1.2757	Intumesced, much swelled, - -	78.6	0.1	1.5	79.79	0.10	79.69
8. Foliated coal, having an almost vitreous lustre, harder than No. 7.,	Ditto, - - -	1.3065	Conglutinated coke,	88.5	1.0	1.2	89.57	1.0	88.56
9. Foliated coal, having an almost vitreous lustre, harder than No. 8.,	Ditto, - - -	1.3376	Pulverulent coke,	92.8	0.6	0.8	93.64	0.60	93.04
10. Compact coal, called Cannel-coal (*Kennelkohle* of Werner), - - -	England, - -	1.1652	Intumesced, much swelled, - -	51.0	0.5	1.6	51.82	0.50	51.32
11. Coal intermediate between foliated coal and pitch-coal, - - -	Newcastle, in England,	1.2563	Vesicular, -	68.5	0.85	1.5	69.54	0.863	68.677
12. Foliated coal, of soft consistence,	Eschweiler, countries of Aix-la-Chapelle,	1.3005	Intumesced, much swelled, - -	81.5	1.17	0.9	82.24	1.18	81.06

DESIGNATION of the Combustibles comparatively assayed, by CHEMICAL ANALYSIS.			II. CHEMICAL ANALYSIS AFTER DESICCATION AT THE TEMPERATURE OF BOILING WATER. Contents for 100 parts in Weight.				Contents for 100 parts in weight. Abstraction made of the Contents in Ashes.			CONCLUSIONS. 1000 atoms of Carbon are united with the under-mentioned number of atoms of		1000 at. of oxyg. in following No. of
			Carbon.	Hydrogen.	Oxygen.	Ashes.	Carbon.	Hydrogen.	Oxygen.	Oxygen.	Hydrog.	Hydrog.
1. Beechwood (according to the analysis of MM. Gay Lussac and Thenard,)	- - - - -	-	-	-	-	-	51.45	5.82	42.73	625	1376	2190
2. Fossil wood passing into brown coal or lignite, - - - - -	Brühl, near Cologne,	-	54.97	4.313	26.487	14.25	64.10	5.03	30.87	363	955	2620
3. Common lignite (jet) passing into pitch-coal, - - - - -	Uttweiler, to the north of the Siebengebirge, on the right bank of the Rhine,	1.2081	17.100	2.546	19.354	1.000	77.879	2.571	19.550	181	402	2114
4. Slate-coal (*Schieferkohle*) of Werner,	Brzenskowitz, in Upper Silesia, - - - -	1.3098	73.880	2.765	20.475	2.880	76.070	2.847	21.083	209	455	2171
5. Compact slate-coal (*Dichte Schieferkohle*) of Werner, - - - -	Beuthen, in Upper Silesia.	1.2846	78.390	3.207	17.773	0.630	78.887	3.227	17.886	171	498	2901
6. Coal passing from slate-coal to pitch-coal, - - - - - -	Wellesweiler, country of Saarbruck, - -	1.2677	81.323	3.207	14.470	1.000	82.144	3.233	14.623	146	479	3554
7. Foliated coal (*Blætterkohle* of Werner), of soft consistence, - - - -	Essen and Warden, country of La March, in Westphalia, - - -	1.2757	88.680	3.207	8.113	0.000	88.680	3.207	8.113	69	441	6356
8. Foliated coal, having an almost vitreous lustre, harder than No. 7.,	Ditto, - - -	1.3065	92.101	1.106	5.793	1.000	93.030	1.117	5.853	47	146	3070
9. Foliated coal, having an almost vitreous lustre, harder than No. 8.,	Ditto, - - -	1.3376	92. 02	0.44	2.94	0.60	96.60	0.44	2.96	23	55	2400
10. Compact coal, called Cannel-coal (*Kennelkohle* of Werner), - - -	England, - - -	1.1652	74. 47	5.42	19.61	0.50	74.83	5.45	19.72	199	886	4444
11. Coal intermediate between foliated coal and pitch-coal, - - -	Newcastle, in England,	1.2563	84.263	3.267	11.667	0.863	84.99	3.23	11.78	104	462	4402
12. Foliated coal, of soft consistence,	Eschweiler, country of Aix-la-Chapelle, -	1.3005	89.1614	3.2070	6.4516	1.18	90.32	3.24	6.54	54	437	7965

On glancing over this table, we observe the preponderating proportion of oxygen and hydrogen to the carbon, in the unaltered vegetable fibres; whereas, in brown coal or lignite and black coal, the proportion of these two gases to the carbon diminishes;—but we also see that this diminution does not take place in a relation which remains the same between the oxygen and hydrogen. We come ultimately to conclude, from the facts detailed, that, in coals, the property of intumescing more or less depends solely upon the relation of the hydrogen to the oxygen, and that the contents in carbon have no influence in this respect.

Thus the appearance and quantity of the charcoal, which is obtained as the residuum of the distillation of coals in the dry way, will enable one to guess with sufficient certainty what must be the composition of these combustibles; but, on the other hand, experience teaches us how much these charcoals or cokes furnished by distillation, vary as to quantity and appearance. Employing the same degree of heat for all, as nearly as possible, we obtain sometimes 50 and sometimes 90 per cent. of charcoal. Sometimes these carbonaceous residuums are in the state of the finest powder. Most commonly gradations without number are observed in them, from the state of a conglutinated matter to the inflation of a vesicular matter, and almost to the appearance of a blackish foam. It may therefore be regarded as certain, that scarcely two carbonaceous residuums will be found the composition of which is exactly the same, and that all, in the mutual relations of their atoms, approach more or less to those which formed the object of the above mentioned analyses, while, at the same time, we can never expect to find a perfect agreement of constituent parts.

From this extreme variation in the composition of coals, it is easy to see that all the charcoals or cokes do not answer equally for all purposes, and that some particular kinds are preferable. If it be asked, what charcoal or coke deserves the preference in general, this question cannot receive a positive answer. But if one wishes to know for what determinate object a particular charcoal or coke is better adapted than another, this may be determined by the proportion of its constituent parts.

The richer the coal is in carbon, the more heat will it develope in burning; for, the more carbon it contains, the more oxygen does it require for its decomposition. On the other hand, the faculty of burning diminishes in the same relation, and coals of this description can only be burnt with the aid of a strong current of air. On account of this inconvenience, and also because a coal which is very poor in oxygen and hydrogen gives little flame, the advantage of being able to develope much heat is, as it were, annihilated in the coals with pulverulent coke, having a large quantity of carbon in their composition. For this reason, in all cases where calefaction is to be operated by means of gases which burn, or, in other words, with flame, the coals with pulverulent coke, having a great proportion of carbon in their composition, must yield to the coals with conglutinated coke, as well as to those with intumesced coke, having a large proportion of carbon.

On the other hand, those coals, with pulverulent coke, answer best in cases in which the combustible is placed in immediate contact with the body to be heated or melted, for example, in the burning of lime and bricks, in the roasting of ores, and for welding iron in a *forge de maréchal*, mixed with coals furnishing a very intumesced or vesicular coke, and having much carbon in their composition: they would also do very well for ordinary fires. Coals, with intumesced coke, or at least those which swell and run in a high degree, do not answer well for such purposes, when employed by themselves, because, from their swelling too much in the grate, they prevent the access of the air, or rather render the disengagement of the decomposed air difficult, and thus oppose the activity of the draught.

In cases where it is required to produce a very intense heat, these coals would not answer, because they would give out a lively melting heat, which, though strong enough while it lasted, would not keep up for any time. An excellent combustible for this latter object is furnished by the coal with conglutinated coke, whether it have much or little carbon in its composition; but it answers still better for the use of a flame-furnace, if it passes into coal with intumesced coke.

For common house fires, for heating steam-engines, for the service of brewhouses and distilleries, the coal with conglutinated coke, having a large proportion of carbon, is that which answers best, because a very strong melting heat is not required for such purposes. It is also employed by preference in several cases, for soldering iron and steel, because this combustible forms a natural vault, under which the proper degree of heat may be given to the metal, without exposing it to the wind of the bellows.

The coal with conglutinated coke, having a smaller proportion of carbon in its composition, is also an excellent combustible for developing a quick, and, at the same time, sustained, heat. If it be less an object to obtain a strong heat, than to profit completely by the flame, the coals with intumesced coke, having a smaller proportion of carbon, may also be very advantageously employed.

The coal with pulverulent coke, having a small proportion of carbon, is not adapted for developing a strong heat. It answers still less for this purpose, if the contents in carbon be very small. It is then the worst sort of coal, for the heat which it produces is neither quick nor sustained.

(*To be continued.*)

On the substance called Fine Linen in the Sacred Writings. By the Rev. DAVID SCOT, M. D., M. W. S., &c. Communicated by the Author.*

WHEN I first turned my attention to the fine linen of the Sacred Writings, I imagined I should soon come to a decided opinion; but, on inquiry, I found it involved in great obscurity, chiefly arising from the vague terms which the ancients had employed in describing it.

The indistinct accounts which they have left us, will be some excuse, it is hoped, for the imperfections of this essay, which was undertaken at the suggestion of a venerable member of this society,—Dr Baird, Principal of the University, and one of the ministers of the city.

Linen, as every one knows, is a manufacture from the fibres of flax, and, in correct language, has the character of fine, when the manufacture is of a superior quality.

Among the Israelites, garments made of linen were worn by

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* Read before the Wernerian Society, 10th Mar. 1827.

the Levites, in contradistinction to those made of fine linen, worn by the priests.

Now, if fine linen be the true translation, we are directly led to suppose, that it was a manufacture from the fibres of flax, but much superior to that of common linen. In Lower Egypt, flax has grown as far back as history reaches; and the art of making linen of the fibres of flax has been cultivated by the Egyptians from time immemorial. Their eminence in this respect has long been acknowledged, though some think that it has been praised beyond its deserts.

As the art of manufacturing linen, whatever may have been its quality, has always been a national pursuit among the Egyptians, there are many, even to this hour, whether they be grave divines, or learned grammarians, who contend, that fine linen is truly and strictly what has that name in the sacred writings.

Convinced, however, that fine linen was not the right rendering of the original term, Calvin, Junius, Tremellius, and others, have rendered it by a term denoting silk; but this rendering must be erroneous, if the product of the vermes bombycina be meant, of which the Chinese, from the remotest antiquity, have formed a delicate and valuable cloth.

When these interpreters, however, come to explain their meaning, we find that it is something resembling silk, growing on trees, soft to the touch, and of which rich and beautiful garments can be made, such as were worn by the Egyptian priests, and those of high rank or in great favour. For instance, we read in Genesis, that one of the Pharaohs clothed the patriarch Joseph in a dress of this kind.

Now, what can this silk be but cotton, which is a downy substance, contained in the pod of a plant, the species of which grow in America, in all the isles of the Archipelago, in Palestine, in Syria, and especially about Thebes in Upper Egypt, through the whole district lying on the east side of the Nile, and west shore of the Red Sea.

Those which produce cotton, are, the Gossipium arboreum, Gossipium herbaceum, and Bombax ceiba. The Gossipium arboreum, in all probability, was the shrub from which the cotton of Egypt was first procured;—about the time of the Ptolemies, it seems to have been gathered from the Gossipium herbaceum. The Bombax ceiba was rather cultivated in Palestine. The cotton of the Gossipium arboreum was of a bright and dazzling whiteness. That of the Gossipium herbaceum was nothing inferior. What the Bombax ceiba yielded, was yellowish; but if the cloth was not so attractive, it must have been owing to the spinner or dyer.

Salmasius, in his Plinian Exercitations, shews that the cotton-plant is abundant in India; and perhaps those are mistaken who think it indigenous in Egypt. Certainly there was a commercial intercourse betwixt Egypt and India from the earliest times; and whether the cotton-plant was brought originally from India to Egypt, or *vice versa,* it can grow in all warm climates.

We agree with Dr Vincent * in thinking, that cotton has had its name from a kind of fruit growing in Crete, called Cotonean by Pliny, though, in the first instance, it may have come into our language through the French.

Pliny tells us, lib. xiii. cap. 14., that "Æthiopia produces some remarkable trees which bear wool, the nature of which has been mentioned in the description of Arabia and India;" and again, lib. xii. cap. 10., the passage referred to by Dr Vincent, "They bear pods as large as the cotonean apples, which burst as soon as ripe, and disclose balls of wool, which are made into linen cloths of great value;" and still more expressly, lib. xix. cap. 1., "the upper part of Egypt, lying towards Arabia, produces a shrub, which some call *Gossipium*, many *Xylon*, and its wool *Xylina*."

By this account, we see that Pliny confounds cotton with linen, for want, no doubt, of a proper term to express it; and Ammianus Marcellinus, lib. 23., confounds it with silk, as some think Virgil does in these two lines of the second Georgic.

> Quid nemora Æthiopum molli canentia lana?
> Velleraque ut foliis depectant tenuia Seres?

though, in general, his natural history is wonderfully correct.

We may therefore, indeed, lay it down as an established fact, that the Greeks and Romans, as well as the later Jews, often call cotton, linen, silk, or wool, as well from imperfect knowledge, as from careless expression; though often they add some circumstance by which it can be distinguished from each of these substances.

The natural colour of cotton is white, and with this whiteness

* Perip. Nearch. Prelim. Disq.

every one is struck as soon as he beholds it. On this ground, several learned men have thought that *shesh*, translated *fine linen* in the English Bible, comes from a Hebrew verb, which signifies to be white.

This whiteness, derived from nature, and not art, cannot be overlooked in any good description of this substance. Thus, Revelations, xix. and 14. "The armies of Heaven followed him on white horses, clothed in fine linen, (the original term is byssos), white and clean." Thus in Isidore's Origines, lib. 22. "White robes of byss, made of a kind of coarser lint;" and again, lib. 27. "Byss is a material excessively white and soft, which the Greeks call Papas."

It cannot be denied, however, that, by bleaching, linen can be made whiter even than cotton; and from comparing Exodus xxvii. and 42. with Exodus xxxix. and 28., we find that *shesh* may denote linen, strictly so called, from this whiteness artificially acquired.

The truth is, if we look to the Hebrew derivation, shesh is capable of expressing any white substance; and accordingly it is sometimes used to express white marble, which, like other kinds of marble, is susceptible of a fine polish.

The Hebrew derivation of shesh, however, does not satisfy every one. Dr Reinhold Forster, in a learned tract *De Bysso Antiquorum*, and an anonymous writer in the Classical Journal, No. xiv., are of opinion, that shesh translated fine linen, was originally an Egyptian term, and this opinion rests on solid ground.

There is the highest probability that the Hebrews borrowed some terms from the Egyptians, and particularly that they borrowed shesh, the name of what is rendered fine linen, as they certainly got the knowledge of the thing, from the Egyptians.

The Hebrews were what are called *Nomades*, or shepherds who tended their herds and flocks, wherever they could find pasture. In these consisted their wealth, and by these chiefly they were fed and clothed. They neither knew nor sought after the luxuries of life.

The Egyptians, on the contrary, were a nation considerably civilized, living under a monarchical government, fixed as it were to the soil, and drawing from its productions whatever could contribute to their convenience or comfort, their use or pleasure. In such a state of society, the elegant, as well as useful, arts are cultivated.

Cotton, which they either got at home, or imported from abroad, was not neglected, and doubtless they had a name for the plant, as well as the contents of the pod, but what either was can now be only matter of conjecture. The language of the Egyptians, spoken in the time of the Patriarchs, is now lost, and we can only judge of it from the Coptic, the state into which the Egyptian passed at the period of the Ptolemies, which, though now a dead language, is preserved in a translation of the Hebrew and Greek Scriptures, and a few tracts, which are of no farther importance than that they are written in this language.

If therefore, *shesh*, the Hebrew term for fine linen, be borrowed from the Egyptians, the Coptic teaches us, that it should be pronounced *sheshe*; *Che* or *cheche*, *chen* or *chenchen*, in that language signifying *wood*; *chens*, *wooden wool*; and *chentoo*, a bit, part or portion of *wood*, often used in the Coptic New Testament, as the proper translation of *sindon*.

Now *sindon* is one of two words in the Greek New Testament, translated linen and fine linen. If we are guided by the Coptic, however, it ought to be translated a cotton cloth or garment. It was in fact a cotton shawl or robe, either manufactured by the Zidonians, sindon being the way in which the Greeks pronounced Zidon, the city famed for this manufacture; or rather according to Reland and Sir William Jones, this shawl or robe was brought to Arabia, Syria, and the shores of the Mediterranean, from the banks of the Indus, this river being called Sind by the natives; and in relation to which the shawl or robe now mentioned was called Sindon by the same people.

In the time of Solomon, *buts*, also translated *fine linen* in the Old Testament, seems to have come into use among the Jews; but that word is not now found in the Coptic, though there is a strong presumption that it was once common. *Bo* or *boo*, signifying *wood* in the saidic or dialect of Upper Egypt, is still preserved; and may not *buts*, wooden wool, be as easily formed from *bo* or *boo*; as *chens*, with the same signification, from *che* or *chen*?

At any rate the Hebrews from the time of Solomon were in possession of this term; and if they did not get it from the Egyptians, they must have gotten it from the Arabians, Persians or Indians. From one or other of these, at least, if not from the Egyptians, the Greeks got this word, and adding their own termination *os*, they were furnished with Byssos, the other term translated fine linen in the English New Testament; and which has passed from Greek into Latin, and even the botanical language of the present day.

Now, that the ideas which we have thrown out about shesh, chens, buts and byssos, are quite correct, will further appear, if we consider that the learned Greeks at least understood that byssos was the woolly product of a shrub or tree, which signified wood. Accordingly, when they had occasion to speak of this shrub or tree, they sometimes gave it the name of *xylon*, which every novice in Greek knows to signify *wood*, and its product, just referred to, *eriozylinon*, or *wooden wool*, which is the literal translation of byssos.

The same phraseology is used by Pliny, who copies servilely from the Greeks. On this subject he uses *xylon*, or *lignum; lana xylina*, or *lignea*.

The Latins, too, have a term, commonly, though erroneously, translated fine linen, of which there are no traces in Greek. This is *carbasus*, which, from a list of Indian plants made by Sir William Jones, we learn to be a Sanscrit term, signifying the cotton-tree, or cotton; and probably was adopted by the Romans, when, in their attempts at universal empire, they first came into contact with the Asiatic nations.

Such are the grounds on which we think the fine linen of the English Bible to be what is now called cotton. To those, indeed, who peruse the English Bible, there is an evident relation betwixt linen and fine linen, but there is no relation whatever betwixt the original terms, by which these substances are expressed. Neither shesh nor buts, neither sindon nor byssos, necessarily imply such an idea. Fine linen is entirely to be considered as a paraphrastic account of that material, whatever it be, denoted by each of these terms.

We are not to be staggered in this persuasion, because this material has the epithet *twined* applied to it in the Old Testament. *Fine twined linen* is a phrase often occurring in the English Bible, but the translation is wrong. If *fine linen* is to be retained, the translation must be *fine linen twined.*

Now we apprehend that twined is an epithet more suitable to what is now called cotton, than linen, however fine, because of the shortness of the filaments of cotton, compared with those of linen. At any rate, all linen, whether fine or not, is twined; and it seems rather singular, why such an epithet should be applied to fine rather than to coarse linen.

The hangings of Ahasuerus' palace Esther i. and 8. are said to be fastened with cords of fine linen. Perhaps cords of linen may be stronger than those of cotton, but the latter would be more flexible when the hangings were drawn, and certainly more agreeable to handle; and these circumstances are presumptions that cotton was the substance of which they were made.

In the reign of James the Sixth, when the common translation of the Bible was printed, the term cotton was unknown, and it was not introduced into the English language till about the beginning of the last century, though the manufacture of cotton, on a small scale, had been attempted during the civil wars, but failed from want of capital or encouragement.

If our translators knew the thing, in all probability they thought they could not better express what is now called cotton, than by using the phrase fine linen, a phrase which all used in their day, and which, as we have seen, had descended to them from the Greeks and Romans, as well as the later Jews.

But though our translators had the authority and example of almost all writers before their time, and in their day, for translating shesh and buts, sindon and byssos, fine linen; yet the phrase must be counted unfortunate, as we believe few persons, even of good understanding, ever dreamt, that any other thing is meant, than an exquisite kind of manufacture from the rind of the flax plant.

From all these details, then, it is plain, that byssos, or whatever term of the same meaning is used, is not to be translated fine linen, which is a manufacture from flax; nor silk, which is the product of a worm; nor wool, which is the covering of a four-footed beast; but cotton, the substance contained in the pod of the cotton plant.

Byssus, in modern botany, denotes a downy powdery substance, connected together by fine filaments, and growing on the surface of water, rotten wood, or old pillars, being a genus comprehending several species, order *Algæ*, and class *Cryptogamia*; but among the ancients, it was the filamentous matter of the plant, at present forming the genus *Gossipium*, order *Polyandria*, class *Monadelphia*.

The manufacture of cotton has arrived at great perfection in this country. Cloths have been made from it of the finest and most beautiful fabric, very agreeable to wear, and most favourble to health.

The same excellence of manufacture has been reached long ago by the natives of India. With instruments the most simple they weave webs of astonishing slenderness and delicacy. These they form into robes, which have been worn from the earliest times. "According to Nearchus," says Arrian in his Indian History, "they use a linen dress of the lint which is from trees." Nay, their knowledge of vegetable lint or wool, is as old as the days of Herodotus. "The Indians likewise possess a kind of plant, which, instead of fruit, produces wool of a finer and better quality than that of sheep. Of this the natives make their cloths." Lib. iii. cap. 106.

Cotton cloths are more suited to warm climates than those of linen. After the finest manufacture of linen, the hardness of the fibre in some sort remains, and, on that account, linen cloths are very disageeable when the body is under perspiration, and even favour the attacks of disease; whereas those of cotton guard the health, and in warm climates are, with great propriety, worn next the skin.

The Egyptians, for this or some other reason, seem to have wrapped cotton cloths about the bodies of the dead, after embalming. "After washing the dead man," says Herodotus, lib. ii. c. 86., "they enclose the whole body in a wrapper of byssos, or cotton, with thongs of leather," &c. In the same manner, Mr Greaves, who witnessed the opening of a mummy, has these words, (Misc. Works, vol. ii. p. 519.) "These pictures with the gorget, were tied on with brownish lengths of cotton. Under these, the whole body had a covering of fine linen; I think of cotton."

I have been informed by some of those who were present at the opening of a mummy, presented to this Society by General Straton, that it was wrapped in folds of cotton, as they understood it; and what struck them very much, the cloth was very coarse, and, in comparison of European manufacture, by no means entitled to the character of fine linen; though it is not improbable that it might be vastly superior to any prepared in early times.

The same account of the cloth wrapped about a mummy, which was carefully examined by Dr Halley, is given in the Philosophical Transactions of 1764. The upper filleting was scarcely equal in fineness to the linens then sold in the shops for 2s. 4d. the yard; the inner filleting was coarser.

While the cotton cloths encircling the mummies were very coarse, those worn by the priests and princes, and favourites of the great, were very fine. These were of the brightest and most dazzling lustre, and well deserved all the praises which they have received from the Jews, as well as from the Greeks and Romans.

We think, therefore, that Hasselquist, Beloe, and others, have been deceived about the coarseness of the cotton cloths of Egypt; and the induction behoved to be more complete than any which they possessed, before they could be justified in drawing so sweeping a conclusion, as they have done, in regard to the coarseness of the Egyptian manufacture of cotton.

Though the cotton plant might grow in Palestine and Syria, the inhabitants had little skill in manufacturing its product. This deficiency might help to increase the admiration which they felt when they beheld what we have thought fit to translate fine linen of Egypt. The courtezan described in the Proverbs, vii. 16. was fully aware of the partiality of her countrymen for this manufacture, when she uttered these words: "I have decked my bed with coverings of tapestry, with carved works, with fine linen of Egypt."

Pausanias, in his Eliacs, observes, that the cotton plant, in his time, grew in Elis, but nowhere else in Greece. Of course, the Greeks knew little about what has been called fine linen, and still less about the art of weaving it. When, therefore, they saw that of Egypt, their surprise was awakened, and, on all occasions, they bestowed upon it the most splendid encomiums.

These were taken for literal truths by the Romans, as in a great measure they deserved to be, and by all those nations that have risen out of the ruins of their empire.

Our belief in these accounts ought not, as I have already said, to be shaken by the coarse cloths which we see to be wrapt about the mummies, for these were intended to be coarse; and even let them be as coarse as the most impartial observer can allow, it must still be granted, that we view them with great disadvantage, after they have been kept about a dead body, it may be, for 4000 years.

The practice of wrapping the dead body in robes of cotton, I have no doubt, was transmitted from the Egyptians to the Jews, and when we read in the Gospels that the crucified body of Christ was wrapped in fine linen (*sindon* is the original word), we will not be thought too rash in asserting that this fine linen was cotton.

For farther satisfaction, however, whenever an opportunity offers, those robes, in which the bodies of the dead were wrapped, ought to be carefully examined by some skilful person, that it may be ascertained whether they were cotton or linen, or cotton and linen intermixed. Julius Pollux, who lived in the second century, was of opinion, that the fine linen of his day was a mixture of cotton and linen; and Forster, in his tract *De Bysso Antiquorum*, is inclined to the same opinion.

Such a mixture has often been tried; for the ingenuity of man is endless. Cotton warp, to speak technically, has not at all times been strong enough for supporting cotton woof, and, therefore, linen warp has been preferred.

In many cases, however, it will not suit, as the cotton yarn does not last so long as the linen; or if, in some cases, it be found to last, its durability must depend on the excellence of the manufacture; and to such perfection has this now been carried by machinery, that cotton warps of sufficient strength can always be got for supporting cotton woofs.

Whether the mixture of cotton and linen was forbidden the Hebrews by their lawgiver, may be questioned; but it is perfectly clear, that the mixture of linen and wool was forbidden, in order to prevent some idolatrous abuse, to which they were inclined, from imitating the customs of their heathen neighbours.

Cotton yarn, however, can be mixed with woollen, especially that kind of it called Worsted; but we do not much admire those specimens of it which we have examined. The mixture of cotton and silk is far better. The substances are more of a kindred quality, and the cloths which result from the mixture, if judiciously dyed, have a fine gloss and magnificent appearance.

Almost every colour can be communicated to cotton cloths; and thus garments are furnished unrivalled for splendour and elegance; such as will suit the highest rank, or please the most improved taste; but we cannot now stop to inquire about blue, purple, and scarlet, with which fine linen, or rather cotton, has been dyed.

The manufacture of cotton cloths, dyed or printed with such colours, has been pushed to an amazing extent, and muslins, dimmities, chintzes, ginghams, jacconets, calicos, &c. are the result. Most of these names are derived from the languages of India; but to give any account of these belongs to the province of Philology, rather than to that of Natural History.

Account of the Capture of a colossal Orang-Outang in the Island of Sumatra, and Description of its Appearance. By Dr Clarke Abel. Concluded from page 375.

Description of the Remains of the Animal.

Head.—The face of this animal, with the exception of the beard, is nearly bare, a few straggling short downy hairs being alone scattered over it, and is of a dark lead colour. The eyes are small in relation to those of man, and are about an inch apart: the eyelids are well fringed with lashes. The ears are one inch and a half in length, and barely an inch in breadth, are closely applied to the head, and resemble those of man, with the exception of wanting the lower lobe. The nose is scarcely raised above the level of the face, and is chiefly distinguished by two nostrils three-fourths of an inch in breadth, placed obliquely side by side. The mouth projects considerably in a mammillary form, and its opening is very large; when closed, the lips appear narrow, but are in reality half an inch in thickness. The hair of the head is of a reddish brown, grows from behind forwards, and is five inches in length. The beard is handsome, and appears to have been curly in the animal's lifetime, and approaches to a chesnut colour; it is about three inches long, springing very gracefully from the upper lip near the angles of the mouth, in the form of mustachios, whence descending, it mixes with that of the chin, the whole having at present a very wavy aspect. The face of the animal is much wrinkled.

HANDS.—The palms of the hands are very long, are quite naked from the wrists, and are of the colour of the face. Their backs, to the last joint of the fingers, are covered with hair, which inclines a little backwards towards the wrists, and then turns directly upwards. All the fingers have nails, which are strong, convex, and of a black colour; the thumb reaches to the first joint of the fore-finger.

FEET.—The feet are covered on the back with long brown hair to the last joint of the toes: the great toe is set on nearly at right angles to the foot, and is relatively very short. The original colour of the palms of the hands and the soles of the feet is somewhat uncertain, in consequence of the effect of the spirit in which they have been preserved.

SKIN.—The skin itself is of a dark leaden colour. The hair is of a brownish red, but when observed at some distance, has a dull, and in some places an almost black appearance; but in a strong light it is of a light red. It is in all parts very long; on the fore-arm it is directed upwards; on the upper arm its general direction is downwards, but from its length it hangs shaggy below the arm; from the shoulders it hangs in large and long massy tufts, which, in continuation with the long hair on the back, seem to form one long mass to the very centre of the body. About the flanks the hair is equally long, and in the living animal must have descended below the thighs and nates. On the limits, however, of the lateral termination of the skin which must have covered the chest and belly, it is scanty, and gives the impression that these parts must have been comparatively bare. Round the upper part of the back it is also much thinner than elsewhere, and small tufts at the junction of the skin with the neck are curled abruptly upwards, corresponding with the direction of the hair at the back of the head.

In the dimensions which I am about to give of the skin, I have stated that it measures from one extremity of the arm to another five feet eight inches; to this is to be added fifteen inches on each side for the hands and wrists, which will render the whole span of the animal equal to eight feet two inches.

The following are the measurements which I have made of the different parts:

Face.

	ft.	*in.*
Length of the forehead from the commencement of the hair to a point between the eyes, ...	0	4½
From between the eyes to the end of the nose, . .	0	1½
From the end of the nose to the mouth, ...	0	3
From the mouth to the setting on of the neck, .	0	4½
Circumference of the mout,	0	6

Skin.

	ft.	*in.*
Greatest breadth about the centre of the skin, .	3	2
Greatest length down the centre of the back, .	3	2
Length from the extremity of one arm, where it is separated from the wrist to the other, ...	5	8
Breadth of the skin from the situation of the os coccygis to the setting on of the thigh, ...	1	4
Across the middle of the thigh, ...	1	0
Greatest length of the hair on the shoulders and back,	1	10

Measurement of Hands and Feet.

Front measurement of hand.

	ft.	*in.*
Length of hand from the end of the middle finger to the wrist in a right line, .	1	0
Circumference of hand over the knuckles, . . .	0	11
Length of palm from the wrist, ...	0	6½
Length of middle finger, .	0	5¼
——— of fore finger, .	0	4¾
Length of little finger, .	0	4¼
——— of ring finger .	0	5
——— of thumb, . .	0	2½

Back measurement of hand.

	ft.	*in.*
Length of ring finger, .	0	6¾
——— of middle finger, .	0	6¾
——— of little finger, .	0	5¾
——— of fore finger, .	0	6
——— of thumb, . .	0	4

Front measurement of feet.

	ft.	*in.*
Length from the end of the heel to the end of the middle toe, ...	1	2
——— of sole of the foot,	0	9¾
——— of middle toe, .	0	4¼
——— of ring toe, .	0	4¼
——— of little toe, . .	0	3½
——— of fore toe, . .	0	3¾
——— of great toe, . .	0	2¾
Circumference over the knuckles of the toes, .	0	9¾

Back measurement.

	ft.	*in.*
Length of middle toe, .	0	6
——— of middle toe, .	0	5¼
——— of ring toe, . .	0	6
——— of little toe, . .	0	5
——— of great toe, .	0	4½

Measurement of the lower jaw.

	ft.	*in.*
Circumference of the jaw round the chin, . .	0	11½
Length of the ramus from the head of the jaw to its base, ...	0	4
Breadth of the ramus or ascending portion of the jaw at a level with the teeth,	0	2¾
Depth of the jaw at the symphysis menti, . .	0	2¼

MEASUREMENT OF THE TEETH.

Number of teeth 32; namely, 2 Canine, 10 Grinders, and 4 Incisive Teeth in each jaw.

Canine Teeth.	*In.*
Whole length of lower canine teeth,	2·7
Greatest length of fang,	.2
Smallest ditto,	1.6
Greatest length of the enamel or exposed part of the teeth,	1.1
Part exceeding the other teeth in length,	·4

	in.
Lateral breadth measured on a level with the jaw,	.6
Breadth from before inwards,	.7

Incisive Teeth.	
Whole length of the lateral,	1.5
Of enamel exposed,	.7
Breadth of cutting surface,	.4
Ditto of central teeth,	.4

The front teeth of the upper jaw greatly resemble those of the lower, with the exception of the middle incisive teeth, which are twice the width of the lateral ones.

Description of the Hindoo Bellows, with Remarks on the occurrence of a similar Bellows in Europe. By W. A. Cadell, Esq. F.R.S. L. & E., M.W.S. &c *. Communicated by the Author.

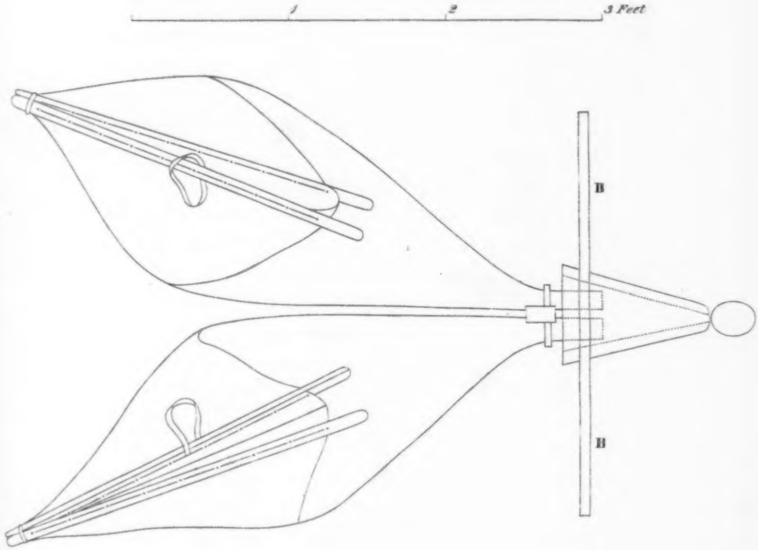
The Museum of the University of Edinburgh possesses a set of models of machines and tools used in the various trades which are practised in India. These models are carefully and neatly executed; and, as they were made in India, they may be considered to be authentic and faithful representations †. Amongst them is the Bhatee or Hindoo bellows, Plate II. It is a very simple machine, consisting of two leather bags. At the mouth of each bag, two long, narrow, flat pieces of wood are sewed to the edge of the leather, so as to give the mouth of the bag the form of a slit, which is closed tight when the flat surfaces of the wooden lips are brought together. Each bag terminates in a nozle; the two nozles are placed in one twere ‡, which conducts the blast to the charcoal fire placed at the mouth of the twere.

* Read before the Wernerian Natural History Society 7th April 1827.

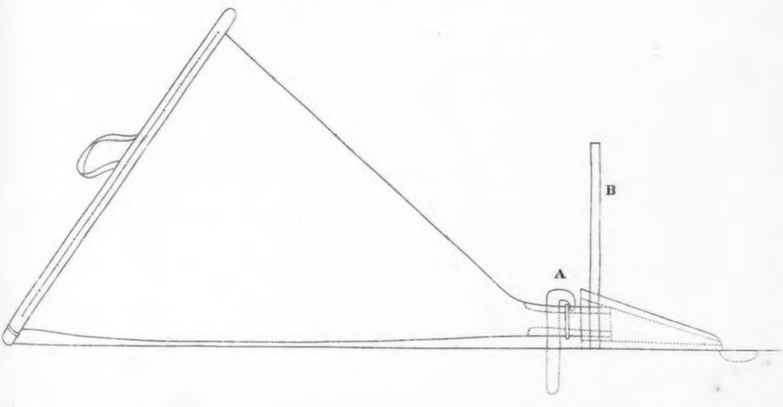
† The merit of having formed this interesting technological collection, is due to the late Miss Margaret Tytler, under whose superintendance the models were made, during her residence at Patna and in the Tirhoot, from the year 1815 to 1821. The models represent the implements used by the different classes of Hindoo and Mahometan labourers and artisans, and were bequeathed by Miss Tytler to the University of Edinburgh.

‡ The word *twere* is from tuyere, French.

The Bhatee or Hindoo bellows seen from above, collapsed.



Side view, the bellows extended.



Published by A. Black Edin. 1827.

E. Mitchell sculp.

To work the bellows, a boy is seated on the ground between the mouths of the two bags, holding in each hand the wooden lips of one of the bags; he holds open the lips of the right hand bag and draws them upwards; when the bag is drawn up to its greatest extent, he shuts the wooden lips, and pushes them down towards the nozle: by this means the air is pressed out of the bag through the nozle, and produces a blast: he has operated in a similar way with the left hand bag, so as to begin to produce a second blast before the first blast is at an end;—and thus working constantly with both his hands, depressing one whilst he raises the other, a continued blast of air through the twere is obtained. This bellows is a less perfect machine, and more is required from the operator, than in the common bellows: for the lips, which act as a valve, require to be opened and shut by the hand; whereas, in the common bellows, the valve is opened by the pressure of the atmosphere, and shuts by its own weight.

Sonnerat * describes the smiths that go about the country in India as making use of this bellows.

This kind of bellows occurs also in the south of France, where it is used by tinkers, and where I met with it in 1826, at Nimes in Languedoc. The bags of the bellows were two goat skins, stripped from the carcase without any longitudinal incision, and with the hair outward; in other essential particulars the machine was like the Indian bellows.

We may conjecture that this bellows was introduced into Europe from India by the Gipsies, who are dispersed over Europe, and are known in each country by a different name †. The

* Sonnerat, Voyage dans l'Inde. He gives a figure of the Hindoo smith's apparatus. In Denham's Travels in Northern and Central Africa 1826, there is a plate representing Negro smiths of the interior of Africa. The bellows which they employ is small, and, from what can be seen of it in the figure, appears to be constructed on the same principle as the Hindoo bellows.

† The gipsies are named Egyptians in an act of Parliament of Henry VIII.; Errones Nubiani in Ludolf's Historia Æthiopica; in Spain Gitanos, which is supposed to be contracted from Egyptianos. Zigeuner in German, Tchinganes in Turkey, Zingari in Italian; these three appellations, Grellmann derives from the Zinganes, a people at the mouth of the Indus mentioned by The-

trade of smith is the principal and most frequent trade of that poor wandering tribe, and they practise it in various parts of Europe*. The Indian origin of the gipsies is indicated by their language. For Grellman and Mr Marsden have shewn, that the language of the gipsies, in its words and inflections, resembles the Hindostanee, of which it may be considered to be a dialect, and the affinity of the two languages has been confirmed by other philologists†. Grellman infers, that the gipsies came from Hindostan; he conjectures, from their manners and occupations, that they were of the lowest cast of Hindoos, and supposes that they left their country when Timour invaded India in 1409; they are first mentioned as making their appearance in Moldavia, Wallachia, Hungary and Germany, in 1417.

Explanation of Plate II.

The uppermost figure is a projection on a horizontal plane, and shews the bellows composed of two leather bags, with their wooden lips. The loop on the inner lip of each pair is for receiving the hand.

The lower figure is a projection on a vertical plane, in which only one of the leather bags is seen; the other being concealed behind it.

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venot. Bohemiens in France, because it is said the first account of them in that country came from Bohemia. Heyden, *i. e.* Heathens, in Holland. Tartars, in Denmark. Sisech, Hindoo, *i. e.* Black Hindoos, by the Persians. Amongst the names they gave their own tribe is Sinte, which is supposed to be from the river Sind or Indus.—*Grellman's Dissertation. Adelung's Mithridates.*

* In Transylvania the gipsies carry on another branch of metallurgy, the art of washing gold from the sand. Von Born briefe über mineralogische gegenstande: Friedwaldsky, Mineralogia Transilvaniae, in cap. de auri loturâ.

† A Dissertation on the Gipsies, by H. M. G. Grellmann, Professor at Göttingen, translated from the German by Mathew Raper, Esq. 1787.

Observations on the Language of the Gipsies, by W. Marsden, Esq.; Collections on the Gipsy Language, by Jacob Bryant, Esq. Both these papers are in the Archaeologia, vol. vii. 1785.

Pallas, in the Neue nordische Beyträge, Th. 3. remarks, that their language resembles the dialect of the Indian traders he saw at Astrakan. These Indians were from Multan, a country situated on the Indus.

Adelung's Mithridates.

In both figures the nozles and twere are seen. The cavity at the end of the twere is for the burning charcoal.

A is a peg driven into the ground between the two nozles. The nozles are bound together by a thong, and the upper part of the peg, which is hooked, holds down this thong, so that the nozles are kept firmly in their place. The top of the peg is seen between the two nozles in the upper figure.

B is a mud-wall, which serves to screen the bellows from the heat of the fire.

Memoir regarding Symington and Bell's pretensions to be considered the original Inventors of Steam Navigation; being an Appendix to a Narrative on the Introduction and Practice of Steam Navigation, &c. published in the Philosophical Journal for July 1825. By P. Miller, Esq.

Having, in justice to the memory of my father, the late Mr Miller of Dalswinton, given a short account of his claim to the adaptation of steam to navigation, which appeared in the Edinburgh Philosophical Journal in July 1825, I now find myself, in consequence of the continued and unwarrantable pretensions of others, reluctantly compelled to obtrude again on the public attention, in order to set these pretensions at rest.

In my former statement I have proved, that, on the recommendation of Mr Taylor, the tutor in my father's family, from whose advice alone my father at any time received the smallest assistance on this important subject, he sent for William Symington, then employed at Wanlockhead mines, in spring 1788, to superintend the construction of a small steam-engine to be used in the experiments he was then carrying on at Dalswinton, for propelling vessels with wheels. In October following, the engine and machinery were completed, and put on board a pleasure-boat on the lake at Dalswinton, and completely answered the expectations of my father, and many other persons who had opportunities of seeing the experiments.

So much was this the case, that, in 1789, my father resolved to extend his experiments; and, in June that year, sent Symington to Carron, with a letter to the Manager of the Carron Company, in order to get a steam-engine constructed for a double vessel, which had been built for him at Leith some years before, for the purpose of ascertaining the power of wheels in propelling ships against wind and tide.

This engine having been accordingly placed on board the vessel at Carron in December of that year, an experiment of its effect was made on the Forth and Clyde Canal. Like that at Dalswinton, it completely satisfied my father of the practicability of his scheme, but the vessel having been too slight for the weight of the engine to attempt a voyage at sea, the apparatus was unshipped and laid up in the store-house of the Carron Company.

Here, as noticed in my former statement, my father's experiments stopt. Symington, who had been employed under him, being thereafter engaged for a considerable period in the construction of machinery at Wanlockhead Mines, was again, after the lapse of 12 years, employed by the late Lord Dundas, the chairman of the Forth and Clyde Canal Company, to superintend a series of experiments his Lordship was then setting on foot, for dragging vessels along the canal, on my father's plan, by steam-boats in place of horses. In 1803, he seems to have completed a steam-boat or tug, called the "Charlotte Dundas," which took in tow two vessels of 70 tons burden each, and dragged them along the summit reach of the canal for 19½ miles in six hours against a strong wind a-head. In 1801, Symington, whom my father always considered in the same light as he did every other labourer or tradesman he employed about his different vessels, took out letters-patent for the invention,—a proceeding of which my father was not aware till a considerable time afterwards, and which excited his warmest indignation.

Such being Symington's pretensions, he comes forward in the year 1824, long after steam-vessels had been erected by others, and successfully used upon the river Clyde, and claims from the Glasgow Steam-Boat Owners, a remuneration for the invasion of his patent-right. "Being unable," as he says in his memorial, "*to extort* any thing from them by the effects of law," he resolved "to put his great confidence for relief in the munificence of his country, the liberality of the proprietors of steam-vessels, and the feelings of others well affected to navigation by the power of steam."

After this declaration, is it possible for Symington to pretend to any privilege or right of invention from his letters-patent? They were surreptitiously obtained many years after my father had made the discovery known to all the world, thereby rendering his letters-patent of no avail.

The other person whose pretensions I find it incumbent on me to refute, is Henry Bell at Helensburgh.

In a late petition to Parliament, praying for some provision in his old age, that person sets forth, "That, in the year 1789, when only 23 years of age, he commenced experiments with the view of propelling vessels by the power of steam; that he pursued these experiments for 10 years, *and was the first person in this country, who brought into practice the power of steam in propelling vessels against wind and tide.* He calls this invention his own, and complains that others with larger capital had adopted the invention, and were bringing ruin on his head." *

It may be true that Bell was the first person in this country who attempted to turn steam navigation to a profitable use, by building the "Comet" steam-vessel, and bringing her to ply upon the river Clyde in the year 1811, for the conveyance of goods and passengers. But while I admit this, and in so far as it can be considered a merit, I have no wish to injure him; common justice, however, to the memory of my late father seems to require that I should state the facts as they really are.

I have already noticed that my father was the first person who introduced the practical use of steam navigation, and that Symington† was the mechanic employed by him in constructing

* —— 1789 was the very year in which the success of my father's experiments were very generally reported by the public press, and from which the young, but INVENTIVE, genius of Henry Bell, derived no doubt much assistance at its origin, and in its growth; and which was likewise much and rapidly improved by frequent inspection of my father's steam-vessel at Carron, in 1789, as Symington states. So much for steam-navigation being his invention, as he is pleased to call it.

† My father often regretted to me having yielded to Mr Taylor's recommendation of Symington, in place of having employed Messrs Watt and Bolton for his engines, and to have availed himself of Messrs Taylor's very competent knowledge in mechanics, to have applied them to the wheels of his vessels.

After the violent disgust he received from Symington's conduct at Carron, he used not unfrequently to reproach Mr Taylor rather smartly, for having ever thought of bringing such a person about him. This circumstance, and putting on board his double boat the first steam-engine ever used for propelling a vessel: that this took place in the year 1788. At that time Henry Bell, who was originally bred a stone-mason, was working with Mr James Inglis, engineer, at Bellshill, and afterwards as an engineer superintending some public works in Glasgow; and having been applied to by Mr Fulton from America, for drawings of some of the machinery used in this country, " that gentleman," as Mr Bell says in a letter signed by himself, and published in the Caledonian Mercury on 28th October 1816, " begged me (Bell) to call on Mr Miller of Dalswinton and see how he had succeeded in his steam-boat plan, and if it answered the end I was to send him a full drawing and description of it, along with my other machinery. This led me to have a conversation with the late Mr Miller, and he gave me every information I could wish for at the time," &c.; and he adds, " Two years thereafter (*i. e.* in 1801), I had a letter from Mr Fulton, letting me know that he had constructed a steam-boat from the different drawings of machinery I had sent him, which was likely to answer the end, but required some improvements on it."

In 1824, Bell gave a further account of his connection with Mr Fulton, in a letter addressed by him to John Macneill, Esq. of Glasgow, of which the following is a literal copy. It will not be overlooked, that, in this account of his scientific correspondence with the American engineer, he makes no allusion to his intercourse with my father.

" Mr John McNeill *Helensburgh* 1*st March* 1924

" Sir—I this morning was fevered with your letter and in ansur to your Inqueres anent the leat Mr Robert Fulton the Amerecan ingenair his ather was from Areshair but what plass or famlay I canut tell but his self

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as much as any thing else, contributed to check the progress of steam-navigation in this country, from its introduction in 1788–9 till 1811, by damping my father's ardour at the time he had resolved to build another vessel sufficiently strong to undertake a sea voyage, and to support the weight of the engine in which he proposed to have embarked at Leith for London; and thus at once to have made it manifest that steam was as applicable to coasting as inland navigation. Such, however, was his bad fortune; and both Mr Taylor and he lived long to repent afterwards, the one for having given, and the other for having attended to, the recommendation; but my father always felt strongly disposed to encourage and support genius, when he found it struggling with poverty; and not unfrequently had he to regret his mistaken kindness.

was born in Amereca He was different times in this contray and staped with me for some time but he published a tritiez on Canal Declining Railroads acctuards I have not his boock but you will finde it in Mr Taylor Stashner London it is 21s He published it in this contray in 1804 I think for in the letter end of the year 1803 he on his way to Frans called on me and in his return in 1804 He was brought up in the line of a painter and was the best hande sceatcher and lickways a good mineter painter He was not brought up as a ingenair,but he was employed to come to this contray to take drayings of our cattin and other meshineray that leaid him in to become en sivel ingenar and was quick in his uptake of any thing When I wrate to the Amerecan goverment the grate yauility that steam navigation wold be to them on their rivers they apointed Mr R Fulton to corspond with me so in that way the Amerecans gatt their first insight from your humbel servent HENERY BELL"

Boats on Mr Fulton's construction were very soon afterwards brought into general use in the United States of America; but it was not till twelve years after my father had employed steam in propelling the two boats erected by him, and after he had given public intimation of the invention to every court in Europe, that any of Mr Fulton's steam-vessels appeared; and not till the year 1811, being ten years after the introduction of them into the United States, that Bell built his vessel called the "Comet" to ply upon the River Clyde, and which was soon afterwards followed by many others.

What I have now stated has been extracted from, and is supported by, the writings and memorials of Messrs Symington and Bell, and seems to me quite sufficient to shew that the merit of the introduction of steam-navigation rests with my late father entirely; and that the only merit of these two persons consists in following out the plan he had adopted, and long before promulgated, of applying wheels or paddles turned by steam in propelling vessels at sea.

Observations on the Glaciers and Climate of Spitzbergen, made during a Visit to that Island; with a Reply to Mr Scoresby's Remarks. By Thomas A. Latta, M.D., M.W.S. Communicated by the Author.

Through the medium of the Philosophical Journal, Oct.—Dec. 1826, I laid before the public a short essay on the condition of the Arctic Sea and Ice, in which, corroborative of statements resulting from personal investigation, I adduced the authority of several voyagers, who have written on the same subject; and it will be seen, that to the valuable treatise on the Arctic Regions, written by Mr Scoresby, I gave my tribute of obligation.

In the course of my essay, having occasion to make a few remarks on the peculiarities of the Arctic climate, I notice the influence which localities may have in giving rise to erroneous impressions; and the mildness of some of the sheltered bays in Spitzbergen, is particularized as tending to mislead the judgment, in estimating the condition of that inhospitable country; and as there appears to be a want of accuracy in Mr Scoresby's remarks on this subject, I have presumed to say so, and have attributed such deviation to the misleading influence of local peculiarities in the following terms:—"The impression formed by such mildness, may have divested the ingenious Mr Scoresby of his accustomed acuteness, whilst treating of the climate of Spitzbergen in his 'Account of the Arctic Regions;' for, biassed by the indications of the thermometer, he reasons himself into the supposition, that the climate, during summer, is more temperate than in Scotland, and gives to the circle of perpetual congelation an altitude of 7791 feet,—a statement contradicted by facts." By this, I have unfortunately incurred that gentleman's displeasure. The following statement will enable the reader to judge for himself:—

The passage in Mr Scoresby's Treatise on the Arctic Regions, which induced me to make the assertion which has offended him, is the following, vol. i. page 123:—"It may appear a little remarkable, that an effect of cold, amounting to perpetual frost, that is observed in elevated situations, in temperate, and even in hot climates, does not occur on the tops of considerable mountains in Spitzbergen; and it is really extraordinary, that inferior mountains, such as Ben Nevis in Scotland, the elevation of which is only about 4380 feet, should sometimes exhibit a crest of snow throughout the year, while in Spitzbergen, where the mean annual temperature is about 30° lower than in Scotland, and the mountains little inferior in elevation, the snow should sometimes be wholly dissolved at the most considerable heights." And, biassed by the indications of the thermometer, which, as observed by Captain Phipps, stood in Spitzbergen so high as 58¼°; and allowing the usual complement of 90 yards of altitude for every degree of decrease, he says,—"It will require an elevation of 7791 feet for reducing that temperature to the freezing point; and hence we may reckon this about the altitude of the *upper* line of congelation when frost perpetually prevails." Now, certainly in this statement it is distinctly stated that the *warmth of the climate* during summer is so great, *as is sufficient for the solution of the snow, even on the tops of the mountains*, which circumstance is rendered remarkable, when contrasted with the condition of mountains in lower latitudes; and Ben Nevis in Scotland is exemplified as *retaining its crest of snow* throughout the year, though nearly of the same elevation as the hills in Spitzbergen. Now, what other conclusion could we draw from such a statement, than that our author meant to convey the notion, that at the one place the warmth of the climate in summer is somehow so great, that *all the snow of winter, even on the tops of the mountains*, is dissolved by it, whilst, at the other place, hills of equal elevation retain their crest of snow, *the warmth of the climate not being sufficient for its solution.* No doubt it is well known that the presence of snow in summer on Ben Nevis, like that on Lebanon, Mount Jura, and various sequestered nooks in the Apennines, with other alpine situations below the circle of perpetual frost, depends not on the frigidity of the atmosphere, but almost entirely on local peculiarities, and is nearly as little under the influence of climate, as the frozen stores in our ice-houses; but Mr Scoresby here does not seem to reckon on the effects of local situation, but mentions the appearance as *a matter of contrast between the summer heat of the two countries*; and if he says the snow in Spitzbergen is not only entirely dissolved, but if he also places the circle of congelation at a much greater height than we find it over Scotland, is it not distinctly implied that the climate of the former is considered warmer during summer than that of the latter?

Such, I think, is the only construction we can put on this portion of Mr Scoresby's narrative. It now remains that we adduce those *facts* which are hostile to his allegations. They result from personal investigation; and what I consider of no mean importance, are supported by Mr Scoresby's own evidence.

During the warmest portion of the very hot summer of 1818, I passed several days on the shores of Spitzbergen. My time, otherwise unoccupied, was spent in ranging through the country, in the course of which I traversed one of the principal glaciers, or wonderful valleys of ice, for which this strange land is famed. I made a short excursion inland. And whilst the ship's crew were occupied in securing the *blubber* of a very large whale, found dead on the strand, I explored a considerable portion of the shore, and climbed a mountain, from the summit of which I had a view of the interior. These various excursions afforded me ample opportunity of making observations, the result of which, under the varied positions, always furnished, in so far as climate was connected, the same uniform result. And the impression, formed on my mind, was the reverse of that which Mr Scoresby's account is calculated to produce, for so far from the snow being wholly dissolved on the mountain tops, every mountain and valley, excepting tracts along the shore, was buried in eternal snow.

My *first* landing on Spitzbergen was in the neighbourhood of the Seven

Icebergs, which lie a little to the north of the channel which separates Fair. Foreland from the main, in the 79th degree of north latitude. There, excepting where the snow had been wreathed, the beach was entirely bare. My chief commission being to collect specimens of the various animals which might come in my way; and meeting with few on the shore, but such as had been our constant attendants at sea; I was induced, notwithstanding the dense mist which enveloped the interior, to follow the course of a valley leading inland, and had not gone a great way ere the snow became general. And when the mist lightened for a moment, it disclosed one vast solitary wild of monotonous whiteness, and, as it bore not the smallest traces of any living thing, I retraced my steps. Such appearances were certainly indicative of a low inland temperature, since the snow, even on the lower grounds, remained undissolved.

I next directed my steps towards one of the chief icebergs, and prompted by curiosity, having ordered the boat to meet me at the other side, I resolved to traverse this stupendous mass on foot. During this very hazardous excursion, I had an opportunity of witnessing such phenomena as went to prove, not only the lowness of the inland temperature, and the little elevation of the circle of freezing in Spitzbergen, but also the occurrence of a warmer air over the beach and the neighbouring ocean.

The seaward extremity of the iceberg terminated in a perpendicular precipice, estimated at 200 feet high, which rested on the strand, and was washed by the breakers. From thence it extended inland along the valley, which, to a certain altitude, it completely filled. The surface rose with a gentle slope of from 10° to 20°. On the seaward extremity, a thawing temperature, exerting its influence, had not only dissolved all the snow, but also a portion of the ice, and thus rendered the slope more abrupt. The interior extremity, along with the adjoining mountains, was buried under a common covering of never melting snow. The mass was cleft throughout, with many a yawning gulph, through which the tinkling of the subglacial rill, the produce of the melting snow and ice was heard far beneath, pursuing its course to the sea. These rills, indicating the action of a thawing temperature, occurred towards the lower extremity of the berg; it being probable that the upland country is subjected to perpetual frost.

The recollection of these facts is impressed on my mind by an event never to be forgotten. The rents, with which the iceberg was every where traversed, descend, perhaps, to its very bottom. Their width, which sometimes exceeded a fathom or two, was greatest towards the lower extremity; and being impassible, I was forced to take a circuitous route along the higher regions of the iceberg, where the rents could be leaped across, although sometimes not without danger. I had not ascended far, ere patches of snow became common, but so long as it was partial, the position of the rent beneath was generally well defined, there being a marked difference of hue between the snow which filled them, and the layer which was spread over the deeper coloured firm ice. These crevices were not only widest towards the seaward extremity of the mass, but they enlarged all along its centre, so that before I had reached midway across, I was obliged to deviate still farther, and found no passage till I had ascended to the vicinity of the snow line: there it became necessary to proceed with the greatest possible caution, for the snow having become deeper and more general, hid under the almost uniform surface the site of danger. Where the snow completely filled the rents, as was very often the case, the danger was diminished; and though sometimes plunged to the haunches, yet I easily extricated myself, but it sometimes happened, that only a thin covering was drifted across the mouth, incapable of sustaining any weight; one of these had well nigh proved fatal to me, for whilst, with cautious steps, I moved forward, on a sudden my support gave way, my extended arms, and the resistance afforded by my gun, suspended me for some seconds between the opposing brinks, over a fearful chasm. After a few dangerous struggles, I was enabled to extricate myself. It is impossible to depict the feelings of this awful moment, which were in nowise lessened, when, having gained the firm brink, I viewed the dark abyss which had, but a moment before, threatened me with destruction. My fears magnified my dangers tenfold; and, for a while, deprived me of the resolution to move, till somewhat recovered from my panic. I hesitated whether I should proceed or return. At length, considering that half the mass and many dangers were behind me, and the boat waiting on the beach before me, to which there was no other passage but across the iceberg, I moved on, and almost crept out the rest of my way, and happily reached the beach in safety, where the boat had been waiting for a length of time for my arrival.

These particulars I have been induced to detail, with a view to corroborate what I have stated regarding the position of the snow. It will appear, that a thawing process was in operation chiefly in the vicinity of the sea: That, there, the snow was dissolved, and the ice in a melting state, furnishing water to the streamlets flowing underneath: That, as I ascended inland, the snow was first met with in patches, and at length became the uniform covering of all the upland country. Mr Scoresby says, vol. i. p. 103., "The upper surfaces of icebergs are generally concave, the higher parts are always covered with snow, but the lower parts (meaning the seaward extremity) in the latter end of every summer present a bare surface of ice." Now, if such was the aspect which this country presented during the warmest month of a milder season than is common in Greenland, when more ice had disappeared from the Arctic Sea than the oldest fisherman remembered, how is Mr Scoresby's statement to be reconciled with it?

But the actual condition of Spitzbergen not only contradicts Mr Scoresby's statement, by demonstrating unequivocally, the permanency of the snow, and consequent lowness of temperature; it also points out the insufficiency of the means, the conjoint operation of which, he thinks, produces this fancied warmth. A statement of these is found, Arctic Regions, vol. i. p. 125., in the following terms: "The weather, in the months of June, July and August, is much clearer at Spitzbergen than it is near the neighbouring ice, where most of my observations on temperature were made; and, as such, the temperature of these months on shore must be warmer than at sea, and so much higher, indeed, as is requisite for occasioning the dissolution of the snow, even on the tops of the mountains, and this is no doubt the fact; for, besides the increase of temperature produced by the prevalent clearness of the atmosphere, we may bring into the account the circumstance, that, from the steepness of the hills, the sun is always actually vertical, to one surface or other of the mountainous coast, throughout its daily course." But it must be evident, that, if such were actually the case, if serenity prevailed over the land where the temperature was higher than at sea, it would follow, that, as the interior exposed the broader surface for the sunbeams to impinge on, and as it is removed from the colder atmosphere of the ocean, the heat there would more readily accumulate, and, instead of valleys filled up, and mountains buried under perpetual snow, we would see the whole which had accumulated during the storms of the long dark winter night, speedily dissolved, and thus give rise to torrents and rivers. But, so far as we could discover, the land was riverless, and eternal frost prevailed. During a very great part of the year, the atmosphere is intensely cold, the temperature of the winter months being commonly 60° or 70° below the freezing point *; during summer it is only on the sea-beach that it ranges a little above 40°: even this is of rare occurrence; for the air is for the most part obscured with impenetrable fogs, (for the production of which sharp peaks are peculiarly adapted), so that the warmth of the sun's rays is absorbed long ere it has penetrated the gloom; and even during the short intervals of serenity, but a small proportion of heat can reach the surface of the earth, on account of the great body of air the oblique sunbeam has to traverse, and the additional resistance opposed to its progress, by the density of the cold atmosphere, which not only intercepts part of its caloric, but counteracts the influence of the small portion which reaches the surface, by the frigorific emanations sent from the superjacent regions of frigidity. Captain Weddell, in his interesting narrative of a voyage to the Antarctic Ocean, so far from considering the temperature of the islands there elevated, attributes the cold of the neighbouring sea to the frigid influence of the soil; and were Spitzbergen not too insignificant to produce such consequences in the north, I doubt not but the same conjecture might be applicable. It is an island of no great magnitude, and is mostly bristled into lofty peaked mountains; the soil is refrigerated by the terrible severity of an almost perpetual winter, and excepting adjoining the sea, is at all seasons covered with snow; consequently the sunbeam has very little effect on it. The influence of these peculiarities is not diminished by the condition of the adjoining sea, which is either covered with ice loaded with snow, or open; in which state it constantly absorbs the little heat left in the impoverished sun-beams, without having its temperature elevated, this being prevented not only by the permanency of the currents, but by the sluggishness of the sea-water at a low temperature. Its freezing point is about 4° lower than that of fresh water, and its mobility, in that condition, being much impaired, the revolution produced among its particles goes on but slowly, and consequently much time may be spent ere the temperature of the upper strata of the sea can be elevated, even to the freezing point of fresh water; nor can they attain even that by 2°, if the surface is strewed with ice. Under these circumstances much caloric may be abstracted from the warmer air, as it flows on to the land, and there its temperature will soon be reduced to

* How has this been ascertained?—Edit.

that of the frozen territory; not only from the great affinity which melting snow has for caloric, but from the gelid state of the soil itself.

Thus, it may be easily conceived, that the general temperature of Spitzbergen is always low, and that the sun does not elevate the thermometer much above the freezing point. I do not say that his power is inconsiderable; for his presence in the firmament constitutes the difference between summer and winter, producing a range of temperature of probably 70° or 80°. In winter it falls to 40° or 50° below zero, but in summer it may be above freezing; indeed, on the snowless grounds in the vicinity of the sea, the temperature is sometimes elevated to between 40° and 50°: this, however, I do not consider as general, but as confined to the skirts of the land, where the warmer sea breeze has dissolved the snow, furnishing an earthy sheltered soil, for the suns rays to impinge on; and this seems the more probable, as, towards the interior, where the sun acts exclusively, the snow is perpetual, it is also supported by atmospheric phenomena, such as I witnessed during my visit. The wind blew from the ocean, and though serenity prevailed there, so that our ship lying about a couple of leagues in the offing, was always in view, yet a very dense mist enveloped the land. The cause of such appearances, though it might be partly looked for, in the intermixture of strata of air of different temperatures, and in different states of humidity, might chiefly originate in the difference between the temperature of the warmer air coming from the sea, and frigid surface of the soil. As the wind from southern latitudes, such as prevails in June, July, and August, passes over a sea, the temperature of which during summer, when free from ice, is elevated a few degrees above freezing, it becomes loaded with moisture. In its course towards the coast it is neither interrupted by land; nor, does it encounter a colder body than that from which it imbibed its humidity; consequently, though saturated, it continues serene, but as soon as interrupted by frozen mountains, or lands, or seas, covered with snow and ice, its temperature is reduced, and being no longer able to hold its moisture in solution, gives birth to mist, and hoarfrost, shrouding the atmosphere with obscurity. These phenomena are well illustrated by the climate of Spitzbergen. That the adjoining sea is more temperate than elsewhere in the Arctic ocean, is not only established by observation, but is proved by the more scanty production of ice all along the western shores of the island, and is probably caused by the warmth of the feeble remnant of the Gulf Stream, which having skirted the coasts of Scotland and Norway, passes on to Spitzbergen, and is lost among the currents in the frozen ocean. The Sea freezes more tardily in consequence of this, and a remarkable gulf, or open sea, extending even to the 80° of northern latitude, lying in the direction of this current, and called the Whale Fishers' Bight, is thereby produced. And what strongly points out the fact is the circumscribed limits of the icebergs on the western shores at Spitzbergen. They all terminate at the beach; whereas in Baffin's Bay, and on the east coast of Old Greenland, where the temperature of the water is low, icebergs generated in the valleys, stretch out into the sea, and, in the process of time, furnish repeated crops of those mountainous masses, found afloat on the ocean. In the sea of Spitzbergen, however, these are never met with, for the higher temperature of the water limits the glacier which produces them at the beach.

The moist air retains its humidity as it passes over this warmer sea, but as soon as it reaches the icefield, its caloric is abstracted, and its vapour discharged in the form of mist or snow; or, if wafted to the land, it dissolves the snow on the shore: but ere it reaches the interior, it is refrigerated by the gelid surface over which it has passed; producing, as in the former case, much hoarfrost and snow, by which the air is almost constantly obscured; hence it is evident the sun's heat can produce but little influence on the soil.

On account of such a state, I could obtain but a very partial glance of the interior; yet shortly after I obtained a very satisfactory view from the summit of a hill of considerable elevation. During this excursion, I had the pleasure to be accompanied by Mr Scoresby himself. We landed some leagues farther south than the scene of my investigation on the preceding visit, and whilst the crew were flensing a whale found on the beach, we directed our steps towards the most accessible mountain in the neighbourhood, from the summit of which we enjoyed a sight of one of the wildest scenes the imagination can fancy. The sea breeze, which had formerly filled the atmosphere with mist, had now died away, and all was cloudless and calm. The sea was destitute of ice, as far as the eye could reach; and, though the flats on the shore and even the higher lands on the beach had lost their covering of snow, still the interior was every where clothed with it. Such are incontrovertible facts, and clearly indicate, I think, that the warmth of the climate, as well as the means by which that warmth is produced, are not in concordance with Mr Scoresby's statement, since the summer heat seems insufficient for the solution of the snow, even in the valleys. That such is the case seems to be implied even in our author's own words. Arctic Regions, vol. i. page 94, he says, " The valleys of Spitzbergen opening towards the coast, and terminating in the back ground with a transverse chain of mountains, are chiefly filled with everlasting ice. *The inland valleys at all seasons present a smooth and continued bed of snow*; in some places divided by considerable rivulets, but in others *exhibiting a pure unbroken surface for many leagues in extent.*" Now, if such a statement is correct, and doubtless it is, it is surely at variance with the notion that there the circle of perpetual frost is 7791 feet high, or that the air is so temperate, that all the snow is dissolved, *even on the tops of the mountains.* Indeed, if such were the case, Mr Scoresby's theory of the formation of icebergs would be reduced to a mere chimera. Thus, vol. i. p. 107, he says, " The time of the foundation, or first stratum of icebergs, being frozen, is probably nearly coeval with the land on which they are lodged; their subsequent increase seems to have been produced by the congelation of the sleet of summer or autumn, and of the bed of snow annually accumulated in winter, *which, being partly dissolved by the summer sun, becomes consolidated,* and on the decline of the summer heat, frozen into a new stratum of transparent ice. Snow, subjected by a gentle heat to a thawing process, is first converted into large grains of ice, and these are united, and afterwards consolidated, under particular circumstances, by the water which filters through among them. If, when this imperfectly congealed mass has got cooled down below the freezing temperature, by an interval of cold weather, the sun break out and operate on the upper surface, so as to dissolve it; the water which results, runs into the porous mass, progressively fills the cavities, and being then exposed to an internal temperature sufficiently low, freezes the whole into a solid body."

The largest icebergs are situated on the west side of the island; which, as in all Arctic countries, is always the warmest: they occupy valleys sheltered by the adjacent heights, opening towards the sea. Now, how is it possible that, in such situations, the snow flake could accommodate itself *to a partial thawing and freezing again*, if, on the adjoining mountain tops, 3000 or 4000 feet high, *the snow is wholly dissolved?* Mr Scoresby, however, alleges, that such really happens, and thinks that these icebergs, by a continuation of this thawing and freezing of snow, are able,—notwithstanding the elevated tempera. ture, " the dismemberment from the lower edge, producing these mountainous masses found floating on the ocean, and the avalanches from the mountain summit," are able,—not only " to prevent diminution of the parent glacier," but to produce a " perpetual increase."

Mr Scoresby finishes his remarks on my observations with the following: " What facts Dr Latta can bring forward to shew that a thawing temperature never occurs so high as 7791 feet I know not, especially when, by observation of the thermometer, I found the temperature in Spitzbergen so high as 37. at midnight at an elevation of 3000 feet." The few facts which have been already produced are, in our humble opinion, sufficient for the end they have to serve. However, as our author seems to lay some stress on the above observation, and adduces it for our notice, we will surely not be deemed forward if we make free with it.

We have already noticed, that Mr Scoresby reared his estimate of the altitude of perpetual frost over Spitzbergen, on the most elevated temperature recorded there, as observed by Commodore Phipps during a voyage towards the North Pole. That commander, while he tarried in Vogel Sang, near the rendezvous of the present expedition under Captain Parry, pitched his tent on a low flat island in the sound. The position was highly favourable to the accumulation of the heat of the sun; accordingly the thermometer rose, on one occasion in July, to 58½°. Guided by which observation, Mr Scoresby, allowing 90 yards of altitude for every degree of decrease, estimates the height of perpetual frost at 7791 feet. " Hence," says he, " we may reckon this about the altitude of the upper line of congelation, where frost perpetually prevails." But, even at the time when Commodore Phipps noted this temperature, the mountains were covered with snow, nor did he ever see any rivulets which the liquefaction of snow, had the high temperature been general, would have produced. The low ice skirting the northern shores of the island was covered with snow. And though it was July, the little pools on the ice in the neighbourhood of the Sound were sometimes frozen over. These straggling circumstances certainly shew that the high temperature was local, and if local, afforded no grounds for Mr Scoresby's calculations; but he thinks otherwise, and endeavours to give stability to an untenable allegation, by adducing an observation of his own: " I found," says he, " the temperature in Spitzbergen so high as 37° at midnight, at an elevation of 3000 feet." On this occasion I had again the pleasure of accompanying him.

The thermometer, placed *among stones in the shade on the brow of the hill,* indicated a temperature of 37°; on the plain it was 44°; the difference then was 7°, which, even allowing that there was a decrease of only one degree for every 90 yards of ascent, reduces the altitudes from 3000 feet to 1890 feet. Nor can this observation of Mr Scoresby's prove any thing else than that the circle of perpetual frost is *not* so high as 7791 feet; for there is a strong presumption that it was about its greatest altitude during our visit; for, not only was the season much more temperate than is common in Greenland, but the observation was made during the warmest portion of that season, and yet the temperature of the plain was 44°; the difference between that and freezing is 12°; and though we allow the full complement to every degree of difference, perpetual freezing should be encountered not higher than 3240 feet. No doubt the observation was made at midnight, but the temperature at midnight and mid-day is nearly the same; and if the warmth near the shore is a good deal dependent on the breeze, the hour of observation is of less importance; and farther, the hill was situated near the sea, where the temperature is evidently higher than inland. The thermometer also was placed among stones on the brow of the hill; these stones were small fragments of limestone, lying on a slope perpendicular to the sun's rays, and which, when they imbibe heat, can retain it long. Hence, the thermometer was probably higher than the temperature at such an elevation should have been. I may also notice, the top and shoulders of this hill were deeply clad with snow, the lower margin of which was in a state of rapid solution; but, on the hill top it was frozen so hard as to resist impression though leaped upon, which indicated, that, though a thawing temperature had been there, it was not permanent; and if so on a hill so low, and so exposed to the sea breeze, we may conceive the condition of the mountainous regions in the interior, particularly as the temperature evidently sinks as we recede from the shore.

Indeed, the solitary evidence of the thermometer can afford no satisfactory indication of the amount of altitude, as the lower regions of our atmosphere are very much under the influence of localities, which, particularly in insular situations, is much circumscribed. Accordingly, though the thermometer usually accompanies the scientific traveller, its movements are seldom adduced in testimony of elevation. And we cannot help being a little astonished at Mr Scoresby's faith in it, and the conclusions at which, biassed by its indications, he has arrived, when we reflect on the peculiarities of a Greenland atmosphere; and more especially, since these conclusions are most positively contradicted by every other phenomenon presented to the sense in the dreary scenery of Spitzbergen. Indeed, his calculations are more at variance with the enlightened views of modern science than the unphilosophical notions of our forefathers, who fancied, that, as the ground became heated by the sun's rays, it imparted caloric to the stratum of air in contact, which, in its turn, warmed the air above, and the temperature of each superjacent stratum thus depended on the proximity to the source of warmth; but, since it is now established, that the decrement of caloric depends on the increase of capacity which air acquires by the diminution of density, it is evident, that, until beyond the reach of the influence of the peculiarities of local situation, the evidence of the thermometer is inadmissible, and even then its movements are rendered irregular by numerous circumstances, which no allowance can rectify, nor caution prevent *.

If we diverge from the equator, descend in the ocean, or mount into the atmosphere, we *generally* encounter a decrease of temperature. If such were regular and uniform, the thermometer would afford a good criterion to determine *height*, *depth*, or *difference of latitude*; but this method, from numerous circumstances, is quite inapplicable. The irregularity is greatest in the air, and in no country is that irregularity greater than in Greenland during the summer months; for the atmosphere there is subject to greater vicissitudes than, perhaps, in any quarter of the globe. Mr Scoresby states, vol. i. p. 397, "In the Polar Regions forcible winds blow in one place, when at the distance of a few leagues gentle breezes prevail. A storm from the south, on one hand, exhausts its impetuosity upon the gentle breeze blowing off the ice on the other, without prevailing in the least. Ships within the circle of the horizon may be seen enduring every variety of wind and weather, at the same moment; some under close reefed top-sails labouring under the force of a storm; some becalmed, and tossing about, by the violence of the waves; and others plying under gentle breezes from quarters as diverse as the cardinal points." The temperature is as variable as the winds, and is entirely under their influence. It has been observed to undergo a change of many degrees within the small compass of an hour or so. On shore the vicissitudes are still greater, on account of the greater variety of circumstances calculated to produce it. On the sheltered hill side exposed to the sun, the general warmth of summer may be felt, whilst on the opposite side we may be chilled by the cold of winter. By the sea-side, a few vegetables spring up and flourish for a while, but towards the interior, neither plant nor animal is seen. Now, it must appear evident, that if we were to calculate on the height of continual frost by observations of temperature made on such a surface, the boundaries would be more irregular even than the surface of the soil, *a physical impossibility*. Rome differs but little from Naples in latitude, and the longitude is nearly the same; but the temperature of the former in summer is sometimes 12° or 14° higher than that of the latter; but we are not to infer from that, that the circle of perpetual freezing over these differs 2000 or 3000 feet in altitude.

* Dr Latta seems to be mistaken in supposing, that the decrease of temperature in the atmosphere would be regulated by the capacities of the different strata for heat, were it not for the contiguity of the earth's surface; because the temperature observed during ascents in balloons deviates farther from this law than temperatures on mountains usually do. The law of decrease depending on capacity, was first advanced by M. Dalton, afterwards by Professor Leslie, and still more lately adopted, for a time, by Mr Ivory, who was at length convinced of its insufficiency, and abandoned it. The atmosphere, it is true, has only been explored, and that imperfectly, to the height of about four miles. But this partial research leaves no doubt, that the same weight of air in the upper regions contains much more heat than below; or, that the decrease of temperature is much slower than the law of capacity requires. Various reasons may be given for this, and, among others, that heat radiates copiously from the lower warmer strata to the dilated colder regions, which, from their coldness, will, besides, absorb heat with avidity from the fresh solar rays by which they are penetrated; for these rays are well known to have lost much of their strength by the time they reach the lower strata. Add to this, that, when currents occur in the upper regions, they usually come from a warmer climate, and the lower currents from a colder. So that, upon the whole, very good reason may be given why the higher atmosphere should be much warmer than the law of capacity requires.—EDIT.

Travellers in climbing mountains, generally observe a slower diminution of temperature towards the base, on account of the accumulating warmth of the plain. Saussure noticed but little difference between the temperature of Geneva and the elevated valley of Chamouni. On ascending Mount Ætna, the traveller finds the thermometer standing as high at Nicolosi as at Catania, though the difference of altitude is 3000 feet. Winds modify the temperature of the air very much, as they carry along with them the heat of the soil over which they pass, and as they curl up the mountain side, they bring the temperature of the most elevated situation nearer to that of the plain. Humboldt observed the temperature of the Peak of Teneriffe fall to within 3° or 4° of freezing, which differed from that of the plain 36°. But Labillardier found the thermometer on the same spot much higher, whilst the difference amounted only to 17°: when the latter traveller made his observation, the wind blew from the arid wastes of Africa, whereas, it came from the wide ocean during Humboldt's experiment. On the volcano of Antisana in the kingdom of Quito, the latter enterprizing philosopher saw the thermometer stand so high as 60°, at an elevation of 18,000 feet. I myself carried this instrument three times during three successive days to the summit of Arthur Seat, elevated scarcely 700 feet above the plain. During the first ascent, the decrement of heat gave it an altitude of about 135 feet, and during the second of 1755 feet, and during the third of 1350 feet, which discrepancy was chiefly produced by the wind. In Scoresby Sound, on the east coast of Old Greenland, our author observed the temperature on shore so high as 70°, and more oppressive than in the West Indies, whereas it was at the same time in the offing so low as 40°. If, under such circumstances, a change of wind should happen, and a breeze blow briskly from the ocean, whilst the observer was marking the descent of the thermometer, in climbing an elevation, the consequence would be, that, as the temperature of the *sound* was elevated by the local accumulation of heat, it would be speedily cooled down to the more general temperature of the air of the ocean, which, as it came off fields of ice, might make a difference at 30° or 40°, and this, if rigidly calculated on, would make an error of upwards of 10,000 feet! Or even if no change of wind occurred, he would soon emerge from among the heated atmosphere of the bay, and so be subjected to the same error, and this is precisely the case with the little island of Spitzbergen. There, through the conjoint operation of the sun and the sea-breeze, the snow on the beach is dissolved, and the air of the earthy, sheltered bay, is more elevated in temperature than the surrounding atmosphere; and it seems that this has been the circumstance which has misled Mr Scoresby, for he has hastily set down this local accumulation of heat as the general feature of the atmosphere throughout the island; so he says the temperature over Spitzbergen is warmer than on the neighbouring ocean, "so much so indeed as is requisite for dissolving the snow even on the tops of the mountains." But Spitzbergen is not an island of great magnitude, and its surface is much lessened by very considerable arms of the sea, and large sinuses and bays which are formed in it; so that if, whilst the snow on the ice field on the adjoining sea is scarcely dissolved, solution is effected on the tops of the mountains, and the circle of perpetual freezing elevated to 7791 feet, the body of warmer air must be collected into a strange pyramidal form, which one would think the cold circumambient air would soon pull down.

Leith,
21st April 1827.

On the Paragrele or Protector from Hail. By John Murray, Esq. F. L. S., M. W. S., &c. Communicated by the Author.

Dear Sir,

Permit me to submit to your notice a few remarks on the subject of *paragreles*, as I have witnessed them extensively used in some districts abroad.

The term implies that they are safeguards from hail, as *paratonneres* signify protectors from the thunder-storm; they both depend on similar principles, and must stand or fall together. Conductors of lightning, if constructed on scientific principles, have been found an efficient guard from meteoric fire; and *hail*, being a meteorological phenomenon dependent on, and modified by, the electricity of the atmosphere, it follows, that paragreles are founded on the true principles of inductive science, and must form a shield of protection to the property of those enlightened individuals whose intelligence may lead them to their adoption. Superstition, pale and terrified, may regard their erection as opposed to the providence of Heaven, and ignorance erect its crest of feeble opposition; but Truth defies their combined attack, and triumphs in the light she diffuses. If an insulated thunder-rod can discharge the cloud of its forked and fiery elements, and scatter its parts to the four winds of heaven, *a fortiori* paragreles, or pointed metallic wires, infinitely multiplied, and extending over a vast surface, must exercise a power infinitely greater.

I consider it quite absurd to circumscribe the influence of a conducting rod within a given radius, as some have done; and have confined it to about 300 feet, because all this must depend on a variety of combining circumstances,—as the comparative degree of the conducting character of the metallic rod, the meteorological feature of the air, as to its barometric or hygrometric state: the intensity and altitude of the cloud, and the electrical relation between the earth and the heavens. When I consider the electric phenomena of the fires of *St Elmo*, *St Barbe*, *Castor and Pollux*, &c., I must conclude that the distance at which points act on the source of the thunder-storm must be very great.

The light that tips the spire, or gilds the mast of ships at sea, are familiar examples, as well as the electric fires that occasionally gleam on the umbrella at night during a thunder storm, or those that are seen to fret the horse's mane. The altitude of the storm cloud has been variously estimated, say ordinarily from 8000 to 10,000 perpendicular feet. The fact remains certain and incontrovertible, that conductors do control the power of the lightning at this distance, and no doubt at distances still more remote. Our aērial electroscopes, as those of Kinnersley and others, become charged with electric matter at no great height, and I have found that, in the case of the electric kite, an elevation of 100 perpendicular feet has always yielded me as much electricity as I could safely manage. Prior to this happy application of scientific truth, the only method of warding off the effects of hail consisted in dispersing the coming cloud by the discharge of cannon from the alpine acclivity. In Italy and Switzerland, at least, these destructive discharges of fragments of ice, are the offspring and accompaniments of the thunder-storm; and this being the case, we have powerful and presumptive evidence in favour of paragreles; that meteorological phenomena are electrical admits of no doubt, and Beccaria, Saussure, De Luc, Volta, &c. have incontestibly established the fact.

It appears that paragreles were attempted in America, on the principles of Dr Franklin, in the year 1819, and with boasted success. They have passed from the New into the Old World, and now prevail in France, Switzerland and Italy. The paragrele in its first form, consisted of a pole crowned with a point of brass. From this extremity proceeded a straw rope, with a small cord composed of linen thread, passed through its centre, Baccaria and Volta having proved their conducting character. The description accompanying these remarks exhibits the paragrele in its most improved form, and as it is now used in the Canton de Vaud, the Bolagnaise and Milanaise territories, &c., and recommended by Sig. Arioli, Professor of Natural Philosophy in the University of Bologna.

Pinnazzi of Mantua proposed, as early as 1788, the erection of numerous metallic points in the fields, for the purpose of depriving the clouds of their electricity, and thus preventing their resolution into hail. Many sçavans entertained the proposal as exceedingly plausible, especially those of the academies of Dijon and Arras, and called to recollection what had been previously stated by Guinard, Buissant, Morveau, Berthollet, and more recently by Bosc and Le Normand. A few years ago, Mons. L'Apostolle of Geneva endeavoured to modify the erection of Pinazzi by the substitution of straw ropes, but experience proved them inefficient. The paragreles of L'Apostolle had fallen into discredit and oblivion, when, in 1821, Mons. Thollard, Professor of Natural Philosophy in the College of Tarbes in France, in the department of the High Pyrenees, revived them with some modifications. His proposal was to erect poles of willow, poplar, pine, chesnut, or other trees, armed with sharpened brass points, attached to a rope formed of ripe barley or rye-straw, and raw-thread twisted throughout its extent. He contended that he had thus succeeded in securing a territory of ten *communes*. This assurance had considerable effect, and excited general attention. The French journals took the lead in the discussion; some spoke favourably, and others unfavourably, of the project. The Italians, on their side, did not keep silent on a subject so important to their interests; and the theory of the paragreles has been attacked and defended in France, Italy and Switzerland.

Such is a succinct account of the history of the paragreles, so far as I was able to obtain it. The inferences deduced theoretically from conducting rods are all in favour of them. The formation of hail is a well known electric phenomenon, and conductors of electricity are influential in changing the electric character, or modifying the quantity of electricity. By paragreles the hail or fragments of ice are softened into snow or melted into rain. The results obtained all demonstrate their value and importance. From the moment I witnessed them I unhesitatingly pronounced a verdict in their favour. Mons. Crud has the merit of having established them in the Bolognaise territory; Professor Chavannes in the Canton de Vaud (who met with considerable opposition and hostility); and Beltrami in Lombardy.

The curious and remarkable facts and proofs which have been detailed in Mons. Crud's letter to Mons. Chavannes, dated 29th July 1824; and those by Dr Joseph Astolfi, in his communication to Professor Onoli, give the most decided and indisputable proofs of their efficacy and successful application. They should be planted from one to two thousand feet apart, and the higher elevations similarly supplied.

During my stay at Lausanne in the summer of 1825, I had a good deal of conversation with Professor Chavannes on the subject of the paragreles; he complained bitterly of the opposition he had met with, and the attempted ridicule that had been cast upon him by the journals of the day, and was glad to receive an opinion from me decidedly favourable. It may suffice to say, that a great part of the vineyards of the Canton de Vaud are now guarded by paragreles. My inquiries as to their utility throughout Switzerland have been extensive, and the voice in their favour unanimous; and, on the other hand, in districts that were not guarded, the mischief was considerable. In one case, in a field immediately adjoining the boundary of the paragreles, the ruin occasioned by a hail storm was complete, but it ceased at this limit; as if science had stood by the paragreles, and had been commissioned by Providence to say to the destructive meteor, "Hitherto and no further:" "Here shall thy proud force be stayed." I am respectfully, dear sir, yours, &c.

3d May 1827.

Explanation of Plate II.

A, A pole of wood, which may be from 35 to 50 feet long.

B, The earth in which the pole is fixed to the depth of about 3 feet.

a, The termination of the brass-wire; it is 3 or 4 inches higher than the summit of the pole, and sharpened at the point.

b, The brass-wire attached to the pole in all its extent, resting in a shallow groove channelled in the wood. This brass-wire should be at least the 20th part of an inch in diameter.

c, Small rings which fasten the wire to the pole, and prevent it being displaced.

d, A small transverse pin, which secures the conducting wire at the bottom of the pole.

e, **Thorns, brambles, or furze, surrounding the pole, to secure it from injury.**

Note.—**That part of the wood which enters the earth should be *charred*, to preserve it from moisture; while the remainder of the pole may be varnished, the better to secure its non-conducting character. The varnish of *Lampadius*, composed of a mixture of *linseed oil, sulphate of copper, and lead*, will be found remarkably good for this purpose.**

Observations on the Structure and Nature of Flustræ *. By R. E. Grant, M.D., F.R.S.E., F.L.S., W.M.S., formerly Lecturer on Comparative Anatomy in Edinburgh. Communicated by the Author.

THE regular forms of the cells of Flustræ, their close and exact arrangement, and the elegant foliage which they form by their union, early attracted the notice of naturalists; and the great flexibility, transparency, and ramified appearance of these substances, caused them to be universally regarded as marine plants, till Jussieu, by his discovery of the polypi of the *Flustra foliacea* (*Mem. de l'Acad.* 1742), assigned them a place in the animal kingdom. The interesting observations of Jussieu on that species, of Læfling on the polypi and formation of the new cells of the *F. pilosa*, Ellis on the structure and forms of the cells of many British species, Basterus on the spontaneous motions of the small bodies which escape from the apertures of the cells, Pallas on the mode of formation of the cells and on the nature of the bullæ at their summits, and of Spallanzani on the structure and appearance of the polypi, have shewn that these animals possess a highly complicated organization, and have some of the characters of compound animals or zoophytes. Ellis has shewn that the forms of the cells vary remarkably in different species, presenting an obvious and useful character for their discrimination; and nearly forty species of these animals, recent and fossil, are described by authors. No writer, however, has yet examined the minute structure, the mode of growth, and the

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*** Read before the Wernerian Natural History Society of Edinburgh on 24th March 1827.**

mode of generation of Flustræ, with sufficient detail, either to comprehend the history of a single species, or to determine the true nature of the genus. The most accurate observers have unfortunately confined their observations to the skeleton, while those who had opportunities of examining the soft parts, in the living state, have been blinded by preconceived hypotheses, and their observations are neither minute nor correct. The accurate and minute observations of Ellis and Pallas relate solely to the axis. Basterus examined these animals frequently alive on the coasts of Holland, and often saw the ova moving to and fro spontaneously on escaping from the cells; but, as he maintained that the polypi of all zoophytes are merely species of vermin infesting the surface of aquatic plants, he naturally considered these moving bodies, both in flustræ and in other zoophytes in which he likewise observed them, as polypi which had left their habitations, to swim about for a time in search of prey, and again returned to their cells. Spallanzani observed the polypi bent like a bow in their cells, and supposed them connected to the cells by their lower extremity; he remarked the bell-shaped arrangement of the tentacula around the mouth, and the constant currents towards that orifice,—but he did not perceive the ciliæ placed on the two lateral margins of the tentacula, and imagined the currents to be produced "by the constant agitation of the arms." The same function has been erroneously ascribed to the tentacula by most authors, and the number of these organs in any species has not been accurately ascertained. A very slight observation is sufficient to shew that the cells of flustræ are more isolated than they are in most zoophytes, and that the lower part of the polypus is not continuous with a central fleshy axis, as it is in Sertulariæ, Plumulariæ, Campanulariæ, and many other keratophytes. This circumstance early led to an opinion that the polypi of flustræ have no connection with each other, and that the whole substance consists only of a congeries of independent cells. This opinion was strengthened by the statement of Læfling, that, when one polypus of the *F. pilosa* is touched, the neighbouring polypi are not affected, and that, in advancing from their cells, they advance without order or regularity. It is likewise stated by the same observer, that the new cells, placed around the margins of the branches, are formed by the developement of bodies which are protruded from the old cells contiguous to them; and that, in the middle space, between the margins of the branches, we find the old polypi, for the most part, dead, or entirely removed from the cells. These views regarding the nature of Flustræ, seemed to be confirmed by the statement of Basterus, that the polypi have no connection with the cells, and occasionally leave them entirely to seek for nourishment; and by the remarkable fact stated by Jussieu, that, after having retained a living flustra for a few days in a vessel of sea-water, he observed that all the *polypi* had left their cells, and lay motionless at the bottom of the vessel. There can be little doubt, from what I shall state hereafter, that this appearance, observed by Jussieu, consisted of the escape of the *ova* from their cells, and probably their fixing themselves on the bottom of the vessel. I have found them often fix themselves permanently on watch-glasses in less than six hours after their escape from the cells. Basterus quotes Rœsel as having likewise observed the polypi to swim to and fro after leaving the cells, (Bast. Opusc. sub. p. 61., and Rœsel. Supp. p. 605.) The same sentiments are still entertained by the most distinguished naturalists, both regarding the independent nature of the cells of Flustræ, and their mode of formation by the successive developement of small vesicles or gemmules which have fallen from the mouths of the old cells. Lamouroux states (*Hist. des Polyp.* p. 99), that, when the polypus of a flustra has attained its full size, it discharges through the opening of its cell a small globular body which attaches itself near that aperture, increases in bulk, and soon assumes the form of a new cell. Lamarck maintains (tom. ii. p. 154.), that the polypi of these animals have no communication with each other, no common connecting substance, and "do not form compound animals;" that the gemmutes, or reproductive vesicles, after detaching themselves, fall into a determinate position beside the other cells; that each polypus probably perishes after producing a single vesicle, and that the polypi are hence likely to be found alive only near the outer margins of the branches. As the branches of Flustræ almost always expand in breadth from their base to their free extremity, by the successive interposition of new rows of cells, which continually disturb the parallelism of the older rows, and cause them to diverge outwards, Pallas imagined (*Elench. Zooph.* p. 34.) that sometimes the same cell discharges two reproductive gemmules. And as we always observe the first cell of a new row small and deformed, he imagined that the two gemmules were discharged at different times, and that the second never arrived at a perfect state. We are still far from being sufficiently acquainted with the intimate structure and economy of animals thus low in the scale, to predict, from the appearance of their dried axis, what may be the real nature, the mode of growth, or the mode of generation of Flustræ; but it is very obvious, that if the generally received opinion, that they are not compound animals, prove correct, they ought no longer to be placed among zoophytes, whose polypi are always connected together by a common axis, so as to form compound animals, the whole of whose parts are animated by one common principle of life and growth.

The chief difficulties in examining the living phenomena of Flustræ, and which have probably retarded our knowledge of the structure and economy of these beautiful marine productions, are the extreme minuteness, the shyness, and the complicated structure of the polypi; the quantity of earthy matter in the parietes of the cells, rendering them somewhat opaque; the circumstance of the most common branched species, as the *Flustra foliacea*, *F. truncata*, &c. having the cells disposed in two opposite planes, which are closely connected to each other, back to back, and which prevents the accurate examination of these branched species under the microscope by transmitted light; and the circumstance of the sessile species being fixed immoveably on the surface of solid bodies, whose opacity likewise prevents their minute examination by transmitted light. The numerous species of Flustræ in the Frith of Forth, and their great abundance, both in deep water and near the shore, present a very favourable opportunity of examining the recent structure, and watching the living phenomena, of these animals at all seasons of the year; and a careful examination of a single species, would not only illustrate the history of this numerous and obscure genus, but would likewise throw much light on the equally unknown nature of *Cellepores*, *Discopores*, *Tubulipores*, *Escharæ*, and some other nearly allied calcareous zoophytes. The species of Flustræ most abundant in the Frith of Forth, and from which the following observations have been chiefly taken, are the *F. foliacea*, a branched species with a double plane of cells and two projecting spines at each side of the apertures of the cell; *F. truncata* a very delicate branched species, with a double plane of cells disposed in longitudinal straight lines, the sides of the cells are nearly straight and parallel, and have no projecting spines; *F. carbasea*, a delicate, broad leaved, branched species, with a single plane of large transparent cells, without projecting spines; *F. dentata*, a sessile species, with a single plane of cells, generally incrusting the leaves of large fuci, the margins of the cells are surrounded with numerous short projecting sharp calcareous spines; the *F. pilosa*, a delicate sessile species, the apertures of whose cells are defended only by a single long curved spine, it generally encrusts the stems of the smaller fuci or the branches of zoophytes; and the *F. telacea*, a sessile species, with long quadrangular cells covering the leaves of large fuci, the cells having two short spines at their summit.

When we look through a branch of the *F. foliacea* or other species of Flustra, which has a double plane of cells, we find that the boundaries of the cells on one side, do not coincide with the boundaries of those on the opposite plane; the position of the cells on one side of the Flustra has no relation to those on the opposite side, and the appearances, presented by the contiguous cells on the opposite sides, are often totally different, the cell on one plane presenting a polypus in full activity, while the contiguous cell on the opposite plane presents an ovum arrived at maturity, with the remains of a decayed polypus nearly absorbed. This not only produces a confused appearance in the cells, but likewise diminishes their transparency; and although, in such species, we can tear the two planes of cells separate from each other, this is generally attended with injury both to the cells and their contents. Such species, therefore, though the largest, the most abundant on our coasts, and those which have been most frequently examined, are ill adapted for the commencement of an inquiry of this kind, and the sessile species, which spread as a crust on the surface of opaque bodies, are still more unsuitable. The *F. carbasea* of Ellis, Lamouroux, Lamarck, &c. is a branched species, which not only has the advantage of being very common on our coasts, and of having the cells arranged in a single plane, but likewise of having the cells of a large size, and very transparent, from the small quantity of lime in their parietes. This species is not found near the shore like the *F. dentata*, *F. pilosa*, and *F. telacea*, but is brought up in great quantities during the dredging season, from almost all the oyster-beds of the Frith of Forth, where it is found in ramified tufts, from two to four inches high, adhering by a very narrow base to the surface of shells, stones, fuci, and even of the smallest zoophytes. Its branches are broad, thin, semitransparent, studded with small reddish-brown spots, generally dichotomous, often trichotomous; the trunks of the branches have thick, yellow, opaque margins, and their free extremities are very thin, membranous, transparent, and rounded or lobed. In the dried state the branches have a glistening membranous surface, they produce distinct effervescence, and coil up when touched with nitric acid, indicating the presence of carbonate of lime in the horny texture of their cells. They are so delicate that we rarely find a specimen in which the branches are not broken at their extremities, or perforated with ragged holes, and they are very often studded on both sides with small patches of the *Flustra dentata*, in the same manner as the *Flustra foliacea* is very much infested in the Frith of Forth with creeping branches of the *Cellaria reptans*. There are no tubular roots in this species as there are in the *F. truncata*; the compact base is formed of condensed cells, which originally contained polypi. The polypi are deficient near the base, as in other flexible branched zoophytes, from the constant bending and pressure at that part, which gradually extend and approximate the sides of the cells, and thus render the stems more compact, flexible, and strong, to sustain the increasing weight of the branches, and consequent increased influence of the waves. This takes place likewise in the stems of branched zoophytes without polypi, and may be compared to the condensation of cellular substance into membrane and ligament in higher animals. It is by rearing the ova of this species on the surface of watch-glasses, that I have found its first formed parts to consist of polypiferous cells, and not of tubular roots, as in many other zoophytes, although the same may be ascertained by a careful examination of these hard parts. The cells are arranged with remarkable exactness, in perpendicular straight lines, and in curved rows diverging on each side to the margin. It appears much more important in the economy of a flustra to preserve this exact arrangement, than to perfect the forms of the individual cells, as we often observe the cells at the commencement of the new rows assume a small and distorted form, in order to adjust them to the precise line of arrangement of the neighbouring cells. The cells are all nearly of the same size, in whatever part of the branches we observe them, and whether on young or old, large or small specimens. The cells are about a third of a line in length, and half as much in breadth. They are widest in the middle, slightly tapering and arched at the summit, and contracted to about a third of their breadth at the base. They open by an arched and folding aperture near their wider extremity, and all the apertures are placed on the same side of the branch, which is probably the most pendent in the natural state. As the cells have only one aperture, and are arranged in a single plane, we find one side of the branches in this species entirely free from apertures; this shut side of the branches is the most frequent seat of the *Flustra dentata*, but the side containing the apertures is likewise often attacked by this parasitic species. The anterior part of the cell consists of a thin transparent membrane. The margins of this membrane are supported and protected by several fasciculi of straight slender calcareous *spicula*, which are attached to the solid sides of the cell, and extend inwards along the surface of the membrane. These spicula are all of the same size and form; they are less than the tenth part of a line in length, of equal thickness throughout, round at their free extremities, and dissolve with effervescence in diluted nitric acid. They are not perceptible without the aid of a microscope. The spicula are arranged along the whole of each side of the cell; they are placed in nearly parallel groups, of three or four, at short distances from each other, and are most numerous at the middle of the cell where the principal part of the polypus is usually coiled up in a spiral turn.

In the newly formed cells at the extremities of the branches, we at first observe the spicula only at the part of the cell where the body of the young polypus is still entirely shut up in a sac. The cell is usually shut, or nearly shut, at the top, in the retracted state of the polypus, but opens by a kind of semilunar valve, with firm margins, when the polypus is advancing out from the aperture. The back of the cell is formed by a transparent tough membrane, which contains some opaque spots of calcareous matter, and exhibits numerous transparent branched lines, like vessels or fibres, running chiefly in a longitudinal direction. When the polypus is dead, and nearly absorbed, many of these vessels are seen radiating from the last remains of the polypus, which appear as a small red or brown spot in the centre of the posterior wall of the cell. The lateral walls of the cell appear to consist of a thin calcareous lamina, lying perpendicularly to the general plane of the cells, it is white, and very tough; and, when highly magnified, it exhibits fibres or vessels, running longitudinally on its surface. Mr Ellis supposed the lateral walls of the cells of *Flustræ* to be formed by a tube. When we look perpendicularly on this part, it appears as a white filament; but when viewed laterally, we observe it to consist of a regular thin plate, surrounding the whole margin of the cell. By examining carefully with the microscope the margins and corners of the cells, we observe, that there is a thin transparent membranous lining within the walls of the cell. In the young cells, this internal lining forms a small shut sac at the bottom of the cell, in which the infant polypus is inclosed and matured: this sac gradually extends to the aperture of the cell through which the polypus at length protrudes its tentacula; and, at last, it is found nearly applied to the walls of the cell. The particles of sand and other matter, which sometimes appear to be within the cells, are generally on the outside, adhering to the posterior wall.

The polypus of the *F. carbasea* is nearly twice as long as the cell which contains it, and when retracted within the cell, it is found coiled up in a spiral turn, extending from the aperture to the base of the cell. The polypus consists of the tentacula, the head, the body, and a large globular appendix, attached to the posterior part of the body. The tentacula are usually twenty-two in number, sometimes we observe only twenty-one; they are long, slender, cylindrical, of equal thickness throughout, and have each a single row of *ciliæ*, extending along both the lateral margins from their base to their free extremity. The tentacula are nearly a third of the length of the body of the polypus, and there appear to be about 50 ciliæ on each side of a tentaculum, making 2200 ciliæ on each polypus. In this species there are more than 18 cells in a square line, or 1800 in a square inch of surface, and the branches of an ordinary specimen present about 10 square inches of surface; so that a common specimen of the *F. carbasea* presents more than 18,000 polypi, 396,000 tentacula, and 39,600,000 ciliæ. From the smallness of the cells of the *F. foliacea*, the immense number and size of the branches, and the cells being disposed on both sides of the branches, the above calculations are often ten times greater in that species. When the polypus is stretched out from its cell the tentacula remain stiffly expanded in a bell-shaped form, their free extremities being all equally reflected outwards; and it is somewhat remarkable, that when the polypi are torn from their cells and examined, quite dead, in fresh water, the tentacula remain in the same stiff expanded form. The tentacula are exquisitely sensible, and we frequently observe them, either singly or all at once, striking in their free extremities to the centre of the bell-shaped cavity, when any minute floating body comes into contact with them. When the polypus is expanded, there is a constant current of water towards its mouth, produced by the rapid vibrations of the ciliæ of the tentacula. The ciliæ move by far too rapidly to be followed by the quickest eye, aided by the most powerful microscope, and their motions are quite regular, ascending along one side of the tentaculum, and descending along the other, like a current. These regular motions appear more like some physical phenomenon than any movements depending on volition, as I have just shown, that an ordinary sized specimen of this animal can vibrate nearly 40,000,000 of ciliæ at the same instant with this incalculable velocity,—an exertion of volition altogether inconceivable in an animal which exhibits no trace of a nervous system. All the ciliæ of a polypus appear to commence and cease their motions at the same time. The bases of the tentacula are inserted into the outer margin of a broad prominent lip surrounding the mouth of the polypus. When the polypus is withdrawn into its cell, the tentacula form a close straight fasciculus quite distinguishable, like every other part of the polypus, through the transparent sides of the cell. The head of the polypus into which the tentacula are inserted, is a little more dilated than the rest of the body, and rounded; and from the incessant revolution of particles observed within it, this part seems to be ciliated internally, like the sides of the tentacula. The head has the power of dilating itself by a sudden stroke, which is probably produced by the sudden retraction of the prominent sides of the mouth, when they have seized an animalcule. The tentacula and the head are of a white colour, and the rest of the body is generally of a yellow, or sometimes of a blood-red colour. We observe a fibrous capsule descending from the whole margin of the aperture of the cell, to be inserted around the body of the polypus a little below the head. This part is probably destined to aid the polypus in advancing from the cell, or to protect the interior of the cell from foreign matter. From the same part of the polypus numerous distinct fasciculi of soft fibres descend, to be inserted into the base of the cell; these appear destined to retract the polypus into the cell. These fibres appear very much corrugated and interwoven at the bottom of the cell, when the polypus is entirely withdrawn into its cavity. The body of the polypus is a long cylindrical fleshy tube of equal thickness throughout, to near its extremity, where it tapers a little. The body, after extending to the bottom of the cell, makes a curve backwards, and again upwards to the centre of the cell, where the posterior extremity is bent forward, and to one side. From the part of the body which ascends to the centre of the cell, about a sixth from the posterior end of the polypus, a fleshy tubular process is sent off, which terminates in a large oblong fleshy sac, generally filled with some opaque matter. As this process is nearly as thick as the part of the body from which it comes, the polypus appears bifurcated at its shut extremity. At the point of the bifurcation, the polypus appears to be somehow connected with the centre of the posterior wall of the cell; and every other part of the polypus, excepting this, moves freely in the cavity of the cell. The last remains of the dead polypi are found at this point of the cell, with vessels radiating from them. From the point of the bifurcation to the entrance of the round sac, we perceive a kind of circulation continually going on within the fleshy tube; it consists in the constant revolution of the particles of some fluid, probably caused by ciliæ disposed on the internal surface of the canal. The tapering or posterior part of the body of the polypus sometimes exhibits small portions of digested matter passing to and fro within it. The round shut sac containing the opaque yellow matter moves often, and quite freely, within the cell; and it appears to belong rather to the digestion than to the generation of this animal, as it communicates directly with the digestive canal of the polypus, and it will be seen that the polypus of this animal has as little to do with the formation and growth of the ova, as it has in other zoophytes.

In place of finding the polypi alive only near the margins of the branches, as Lœfling, Lamark, and others have maintained, we find them almost equally abundant and healthy in every part, from the base to the apex, and from the centre to the margins of the branches. The cells along the sides of the branches are generally imperfectly formed, and contain no polypi; their outer calcareous margin is for the most part wanting. The last two or three rows of cells, at the extremities of the branches, are thin, soft, gelatinous, and transparent; and contain young polypi so imperfectly formed, that it is quite obvious that the extreme row could not have been generated by the polypi of the second row, after their arriving at maturity. The extreme margin of the branches always presents a smooth and even outline from the equal growth of every point of the axis, and never exhibits the notched or serrated line, which would be produced by the unequal developement of a terminal row of gemmules. The cells newly formed in the soft gelatinous terminations of the branches, have the same size and form as the oldest cells, so that we find at the extremities of the branches a row of imperfect cells in every stage of their formation. Some of these imperfect cells do not yet exhibit the rudiments of a polypus; some a little further advanced exhibit an opaque spot at the base, from which tentacula at length shoot out like buds; other cells, more nearly completed, present the young polypus inclosed in a long shut sac, tapering upwards to the point where the aperture of the cell is afterwards formed; and others, which only want their upper arched wall, contain perfectly formed polypi, capable of projecting their tentacula and head through the opening of the cell; their parts are very transparent and colourless, and their globular appendix appears empty. The sides of the cells form continuous, ramified, and waved lines, from the base to the apex of the branches; and the growth of the axis in this, as in every other zoophyte, precedes the growth and formation of the polypi. The *axis* of this zoophyte consists in the parietes of the cells, and it presents, in every stage of its growth, a regular form, and exact proportions in all its parts; it is composed of a continuous fleshy and calcareous substance, like the outer part of the axis of the gorgonia, which the beautiful experiments of Cavolini have shewn to be by far the most highly organised part of that zoophyte, possessing distinct irritability, and secreting the horny layers of the central part of the axis. The polypi are most intimately and inseparably connected with the axis by three parts of their body, and are only digestive sacs or mouths developed by the axis, as in all other zoophytes, for the nourishment of the general mass. By the *axis* of a zoophyte, I understand every part of the body excepting the polypi, whether of a calcareous, horny, or fleshy nature. The exact mathematical arrangement and forms of the cells of *Flustræ*, is incompatible with their existence, as separate and independent beings, but is quite analogous to what we are accustomed to observe in *Cellariæ*, *Sertulariæ*, *Plumulariæ*, and many other well known compound animals.

Although the *ova* of Flustræ have been often observed, no one appears to have hitherto examined either their mode of formation within the cells, or their mode of developement after expulsion, so as to determine the real nature of these globular bodies, and the erroneous conjectures of naturalists respecting them have greatly perplexed the history of this genus. The ova of the *F. carbasea* make their first appearance as a small yellow point, a little below the aperture of the cell, and behind the body of the polypus; they are unconnected with the polypus, and appear to be produced by the posterior wall of the cell, in the same manner as the axis, or common connecting substance of the polypi, produces them in other zoophytes. In this rudimentary state they are found in the same cells with the healthy polypi, but, before they arrive at maturity, the polypi of such cells perish and disappear, leaving the entire cavity for the developement of the ovum. There are never more than one ovum in a cell, and it occupies about a third of the cavity, when full grown and ready to escape. When first visible it has a round or slightly oblong and regular form; when mature, it is ovate with the small end next the aperture of the cell. The ova do not appear in all the cells at one time, nor is there any discernible order as to the particular cells which produce ova, or the part of the branch which contains them. Cells containing ova are found alike on every part of the branches, from the base to within two or three rows from the apex, occupied only by young polypi. Sometimes we find half a dozen or a dozen of contiguous cells all containing ova, sometimes two or three only; and often such cells occur singly, at short and irregular distances from each other. We find the ova, in all stages of maturity, on the same branch at the same time; and we seldom observe a specimen of the *F. carbasea*, during the months of February, March and April, which does not contain numerous ova. The ova have a lively yellow colour; and when they occur abundantly on a specimen or a part of a branch, they cause it to exhibit the same lively hue, which is very different from the dull spotted brown appearance which the branches present at other seasons. Cells are often observed on different parts of the branches, containing neither polypi nor ova; but the fewness of these, and the great number of cells still containing only polypi at the season of generation, render it probable that polypi are regenerated in the empty cells after the escape of the ova. In the empty cells from which the ova have escaped, we frequently observe a few remains of the former polypus lying at the place where the body of the polypus bifurcated, and where the principal connection seems to exist between the polypus and the axis; we likewise perceive numerous monades and other animalcules busily employed in consuming the remains of the dead polypus. The ovum, even before arriving at maturity, exhibits very obvious signs of irritability, frequently contracting different parts of its surface, and shrinking backwards in its cell; the ciliæ on its surface are likewise observed in rapid motion within the cell, as in the ciliated ova of other zoophytes. The mature ova are often found with their small end projecting from the opening of the cells, and their final escape is aided by the incessant vibrations of the ciliæ covering their surface, by the ova contracting themselves in their lateral direction, by the waves agitating the branches of the flustra, and by the same incomprehensible laws which regulate the formation and growth of the ova, and the whole economy of this zoophyte.

When the ova of the *F. carbasea* have escaped from the cells, and are observed swimming to and fro in a watch-glass with sea-water under the microscope, we perceive that the small end which first escaped from the cell is carried foremost, and the broad posterior end has now expanded into a broad circular zone, giving a flatness to that extremity. The ciliæ are longest in the centre of the broad extremity as in other ova *, and become gradually smaller towards the narrow end. When torn and examined on a plate of glass under the microscope, the whole ovum appears composed of very minute gelatinous granules or monade-like bodies, without any external capsule or internal calcareous matter. They are very irritable, and are frequently observed to contract the circular margin of their broad extremity, and to stop suddenly in their course when swimming; they swim with a gentle gliding motion, often appear stationary, revolving rapidly round their long axis, with their broad end uppermost; and they bound straight forward, or in circles, without any other apparent object, than to keep themselves afloat till they find themselves in a favourable situation for fixing and assuming the perfect state. The time of their remaining in this free and moving state varies from a few hours to about three days, according to circumstances. When placed in a watch-glass, immersed in a vessel of pure sea-water recent from the sea, and kept in the cavity of the glass, by a careful management, they generally fix within the space of six hours from the time of their escape from the cells. The slightest agitation when they are about to fix, causes them to recommence, and continue for some time, their gliding motions; and if again separated from the surface of the glass when they have begun to fix, they generally remain free, and perish. During the process of fixing, they exhibit no peculiar appearance or change of form; they appear simply to lie on their side, and the ciliæ continue to vibrate over the whole surface, producing a constant current in the water, and clearing the space immediately surrounding the ovum; on agitating gently the water, however, we now find that it can no longer move from its place. I have found the ova of the *F. carbasea* remain three days in this fixed recumbent position without undergoing any perceptible change of form,

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and without relenting the motions of the ciliæ on their surface. About this time from their fixing, the ciliæ cease to move, and disappear, first at a particular part of the surface, and in the space of twenty-four hours longer they cease their motions over the whole surface of the ova. In about two days after the ciliæ have ceased to move, the ovum appears more swelled, the surrounding margin becomes more transparent and colourless, and the yellow matter, which appeared to compose the whole ovum, is now confined to the central part. As the ovum enlarges and loses its bright yellow colour, it assumes a form more nearly resembling that of a cell, and acquires a light grey or whitish colour, with increased transparency in every part, excepting the yellow central spot, which gradually diminishes in size. A delicate white opaque line makes its appearance near the outer margin of the transparent ovum, and passing round its whole circumference; this white line has the form and nearly the size of a full-grown cell, and is the rudiment of the lateral calcareous wall of the cell. Towards the base of this rudimentary cell, we perceive the gelatinous interior become more consistent and opaque at a particular point; from this dull spot within the cell we soon perceive short straight tentacula begin to bud out, extending upwards in the direction of the future aperture. The gelatinous spot from which the tentacula originated, assumes the vermiform appearance of the body of a polypus, and we distinctly perceive the bundles of fibres which connect its head with the base of the cell. The aperture of the cell, in form of a crescentic valve, is perceptible before the infant polypus extends so high in the cell, and is not a mere perforation made by the polypus, as Lamouroux and some others have supposed. The structure of the polypus is perfected within a distinct shut capsule, and when we first detect it protruding from the cell, it possesses all the parts of an adult polypus, and vibrates the ciliæ of its tentacula with as much regularity and velocity as at any future period. Before the polypus is capable of protruding from the aperture of the first cell, we perceive the upper part of that cell extending outward to form the rudiment of a second, in the same manner as we observe at the tips of the branches in adult specimens,

(To be concluded in next Number.)

Some Remarks on the Temperature and Climate of Shetland. By WILLIAM SCOTT, A. M., of the Royal Military College at Sandhurst.—Communicated by the Author.

AT the request of Professor Jameson, I drew up a set of Tables, exhibiting the temperature, wind, and weather, during part of the years 1824 and 1825, as observed by myself at Belmont, in the island of Unst, Shetland, in Long. 0° 51′ West, Lat. 60° 42′ North, the thermometer being elevated 66.2 feet above the level of the sea, and 300 yards distant from it. These tables, however, prove too bulky for insertion in the Philosophical Journal, and therefore the following only are submitted to the public attention :—

Table of the Mean Morning and Evening Observations for twelve Months, from June 1824.

Times of Registration.	1824.							1825.					Mean of the Morning and Evening Observations.
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	
7½ A. M.	52°3′	54°5′	56°0′	51°2′	43°3′	39°0′	36°7′	40°2′	38°7′	40°7′	43°8′	47°3′	45°3
8½ P. M.	49 3	51 0	53 0	50 2	43 4	39 0	37 3	40 4	38 8	40 1	41 4	45 1	44 1
Mean temperature of the twelve months, commencing June 1824,													44°7

It appears almost unnecessary to explain how this result has been obtained. It may be done, however, in very few words: The temperature was registered at half-past seven o'clock every morning, and half-past eight every evening. At the end of a month, the morning observations were collected into one sum, the evening into another, and each divided by the corresponding number of observations. Thus the monthly mean temperature, at these hours, was obtained; while that of the year was, by a similar process, deduced from the mean observations of twelve months.

The times of registration were those proposed in 1823, by a committee of the Royal Society of Edinburgh, who considered the temperature of 7½ A.M., and 8½ P.M., as affording, severally, a near approximation to the mean temperature of the day. From the present observations, it appears, that, in the months of June, July, and August, the morning mean exceeds the evening by about 3°; in September by 1°; that in October and November they are equal; while in December the evening exceeds the morning by 6′; in January by 2′; in February by 1′; after which the morning means again exceed the evening, the difference increasing as the season advances. The point at which the morning and evening mean temperatures become equal, seems to be about 39° or 40°; and if the general winter range fell as much below this point as the summer rises above it, we should probably find the morning mean as much less than the evening in winter, as it exceeds it in summer, and the annual mean temperature of the morning not greater than that of the evening. In the instance before us, the former exceeds the latter by 1° 2′.

The midday mean forms no element of the above table. It is given here to shew the range only of the thermometer; and this, it will be observed, is, in steady weather, very limited. In 1824, the thermometer reached its highest point, 65° 8′, on the 2d of September; and the lowest, (at least the lowest I observed), 24° 8′ at 8½ P.M. of the 16th December. At 9½ A.M., 16th June 1825, it stood at 67°; by noon it had sunk to 66°; and the wind, which was at this time southerly, having changed to the north, it fell, before 8½ P.M. of the 17th, to 44° 6′; and at noon of the 18th and 19th, rose no higher than 47°; 67° was the highest point I observed it reach during my stay of 15 months.

The proximity of the sea to every part of the country, has doubtless a considerable effect in modifying the temperature; and to this it is unquestionably owing that Shetland, near the extremity of the north temperate zone, has warmer winters than regions situated 10° nearer the Equator. To this cause, also, are to be attributed the moisture of the atmosphere, the almost perpetual obscuration of the heavens with clouds, and the frequent fogs which prevail in the country.

From the observations of a single year, it would be impossible to form a correct estimate of the average number of fair and rainy days, or of the quantity of rain, snow, &c. that falls annually; and as this register contains all the facts I possess, I think it better to leave those who may see it to form their own conclusions, than to hazard any of mine on the subject.*

Thunder is of rare occurrence, and is heard more frequently during the storms of winter than in the summer months. I happened to hear it but once while in the country.

The aurora borealis, I was told, is not now so frequently seen as it was fifteen or twenty years ago; the brightness of its colours, the light it gives out, and the rapidity of its corruscations, are also said to have diminished. Being desirous of observing this beautiful phenomenon, I looked for it generally in nights that were favourable to its appearance. I, however, saw it only

* We hope to be able to find room for the Register in our next Number.

a few times, when it always appeared very faint, and had little sensible motion.

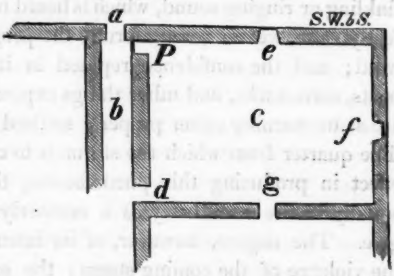
Connected with the subject of meteorology, I may mention a remarkable phenomenon which fell under my observation when in Shetland, and of which I now regret I did not keep a register. In a room on the ground-floor of the house of Belmont, is a wall-press, or cupboard, on a shelf of which wine-glasses and tumblers, are usually placed, in an inverted position. These glasses are at times heard to emit a sound similar to what might be produced by striking their outsides gently with a piece of metal (as the edge of a knife), or by raising their edges a little, and suffering them again to fall sharply on the shelf. This tinkling or ringing sound, which is heard in moderate, also in perfectly calm, weather, is uniformly the prognosticator of a gale of wind; and the confidence reposed in its fidelity is such, that boats, corn-stacks, and other things exposed to injury from wind, are at its warning either properly secured or placed under cover. The quarter from which the storm is to come seems to have no effect in producing this phenomenon, the sound being heard equally before a southerly as a northerly, easterly, or westerly gale. The degree, however, of its intensity is proportioned to the violence of the coming storm; the sound being louder and more frequently repeated before very violent than before less violent gales. It is heard sometimes a longer, sometimes a shorter, time before the commencement of a storm, but generally several hours; and the tinkling is repeated at irregular intervals till the storm begin, and also sometimes during its continuance.

Notwithstanding of patient investigation, I discovered nothing peculiar about the press, which is formed in the wall, and lined with planed fir plank, nor any agitation of the air near it, nor could I ever observe the glasses in motion, though I often watched them closely while ringing. I observed only that their tinkling was louder, and also more frequent, when the door of the room was shut than when it was open.

The sound, I am satisfied, was not produced by any agitation of the shelf supporting the glasses, nor by a current of air shaking the glasses themselves; the only alternative, then, appears to be that it proceeded from sudden contraction or expansion of the glass, producing vibration, and thence sound,—the cause of which expansion or contraction may perhaps be (I hazard the hypothesis as merely probable) a particular state of the electric fluid before a storm. This, however, is left for the consideration of those more conversant with natural phenomena than myself.

The house of Belmont stands about 55 feet above the level of the sea, on the top of a gentle eminence, having the sea on the south and south-west; a small fresh-water lake on the west, another on the north, and on the east and north-east a brook, in winter forming a small marsh, with pretty high ground rising from it. The site of the house is dry.

The annexed is a ground-plan of that part of the house containing the room in which this phenomenon is observed. *a* is the front door; *b* the lobby; *c* the room; *d* the entrance into it; *P* the press; *e* a window; *f* the fire-place; and *g* a door leading to another room behind *c*. The shell of the house is built of gneiss; the partition *P*, *d*, of brick; the walls of room *c* are plastered, painted in oil, and pannelled below the surbase.



On the History and Constitution of Benefit or Friendly Societies. By Mr W. Fraser, Edinburgh.

[This communication we consider of great importance at this time, when the distressed state of the working classes, and the accompanying increase of disease, so much and so justly engage the attention of the public. It is also a subject which cannot fail to interest the political economist.—Edit.]

Benefit or Friendly Societies are associations for the purposes of Health and Life Assurance. Health Assurance provides for pecuniary benefits during professional incapacity, arising from sickness, accidents, or other bodily infirmity; and Life Assurance makes provision for old age, sums payable at death, and annuities to widows or other nominees. Such at least comprise all the usual transactions of Friendly Societies.

These institutions are of great antiquity, and those in Britain are ascertained to have originated with the Saxon *Gilds* or Corporations, whose objects were chiefly to supply funds for relief to their members in times of pecuniary or bodily distress, for protection from personal injury, and convivial enjoyments. Sir Frederick Eden, in his work on the Poor, has given the Rules of two of these Gilds or Societies established at Cambridge and Exeter, previous to the Norman Conquest, and which, so far as relates to benefits during sickness and at death, run almost in the same terms as the Regulations of Friendly Societies now in use. The first institution, however, under this appellation, of which any record appears to have been obtained, was the Friendly Society of Newcastle-upon-Tyne, founded only in 1719. Towards the commencement of the late King's reign, such societies began to multiply rapidly in number. At this period Friendly Societies were merely connected with incorporated or such other trades as were chiefly confined to towns, and for the benefit of their decayed members only. Sickness or infirmity did not alone entitle to benefit, unless when coupled with extreme indigence, and even this limited relief was restricted and regulated, according to the amount of the funds at the time, and the opinion the society or its managers might form of the wants of the applicants. The advantages, however, derived from them, even upon this limited scale, were soon observed and duly appreciated by other classes of the community; and numerous societies of all ranks and occupations were, in a short time, formed in almost every town and considerable village in the kingdom. From being charitable associations, too, they have now assumed the more respectable character of mutual assurance societies, where every individual is entitled to claim as his right the stipulated allowances; and hence the idea of charity, so repugnant to every independent mind, can no longer be associated with these copartneries.

Institutions for Life and Health Assurance, have been for some time divided into two great classes,—the one, resorted to in the higher ranks, termed Life Assurance Companies, but not affording benefits during sickness; the other hitherto confined to the working classes, chiefly for these benefits, and still known by the name of Benefit or Friendly Societies *. But the former class, although their capital and transactions are to a very great amount, embrace a small proportion of the population, when compared with the latter. It is impossible to ascertain exactly the number of either Friendly Societies or their members; but from 1793 to 1820, the regulations of upwards of 200 societies had been confirmed by the Justices of the Peace for Aberdeenshire alone. According to the Parliamentary returns in 1802, the Friendly Societies established in England and Wales were no fewer than 9,672 in number; and in the Returns to Parliament in 1815, the members of Friendly Societies were enumerated at 925,429, or about one-thirteenth part of the population. But even this must have been far below the actual numbers, because of the difficulty of obtaining accurate returns, owing to the reluctance which has hitherto existed among these institutions to give publicity to their transactions: And as in neither of these returns was Scotland included, where Friendly Societies are considered to be proportionately still more numerous than in England, the total number of their members may be supposed to be pretty accurately given in the Edinburgh Review for January 1820, in which they are estimated to include one-eighth part of the whole population of the Empire, or about 1,610,571 members.

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* *The Medical Provident Institution of Scotland*, formed last year, and now in full operation, is the first association in this quarter of the island, which has extended the benefits to the middle ranks of society. The most distinguishing feature of their scheme is HEALTH ASSURANCE, by which they are to pay certain sums to their members while labouring under professional disability, arising from sickness or accidents, in middle age; combined with a life-annuity after 60. They also grant annuities for old age, and to the widows or nominees of members, unconnected with assurance on Health. As there is no proprietary, the whole funds are of course available to the members themselves, under deduction of the charges of the most economical management. The association is at present confined to the Medical Profession, but without making this an essential article of their constitution. It is, we understand, likely to become very popular with this numerous and highly respectable body, which is almost the only one in the country that has no annuity institution peculiarly appropriated to its members.—EDIT.

Of the immense benefits afforded by Friendly Societies, some idea may be formed from the returns given in to the Highland Society of Scotland in 1822, from 79 societies in various parts of Scotland. By those returns, it appears, that these few societies, comprising not above 10,000 members annually, had alone actually paid for no less than 132,964 weeks of sickness and infirmity, in a medium period of 13 years only, or at the rate of 10,228 weeks yearly. The total sum, therefore, paid by them, during these 13 years, at the low calculation of 5s. per week, would amount to L. 33,241, or L. 2,557 annually; and if the same rate be taken for the whole societies in Britain, it will be found that their distribution will amount to L. 411,823 annually for sickness benefit alone.

No returns of the mortality among Friendly Society members have been obtained; but as these societies pay sums upon the death both of members and their wives, and supposing only two-thirds of the members to be married, the number of members and their wives insured for this benefit will be 2,684,285 yearly. Taking their average age at 40 (40.3 being that of the male members of the 79 Scotch societies above referred to), and their annual mortality at 76 in 3635, which is that given by the Northampton tables, the number of deaths occurring yearly will be 56,123; the payments for which, at the rate of L. 5 for each, will be L. 280,615 annually.*

Hence it will be seen, that the distributions for sickness and deaths alone amount to L. 692,438 in the year; but, as there are several other benefits granted by many Friendly Societies, such as widows' annuities, allowances to orphans, &c., their total annual payments may be estimated at nearly *a million Sterling!*

When, therefore, the very great relief thus afforded both to parishes and individuals is considered, Friendly Societies are

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* As each society has hitherto limited its benefits to a certain uniform sum for all the members, it frequently became necessary for a person to be in more societies than one. Hence the actual number of *different* individuals and deaths occurring yearly in Friendly Societies, would not be so great as that stated in the text; but this circumstance does not of course diminish the estimated amount of distributions.

surely well entitled to be ranked among the most beneficial institutions of the country, and deservedly to claim the attention both of philanthropists and statesmen.

It will scarcely be credited, however, that of late years much hostility has been shewn to Friendly Societies, and by none more strongly than by the patrons of Savings Banks. These latter institutions are certainly well calculated for many useful purposes; but it must still be evident that they can bear no comparison with the former, or supersede the use of them. On this subject it has been justly remarked by a late writer, "Will the advocates for Savings Banks be easily persuaded to save their annual premiums, instead of insuring their houses against fire? Certainly not; yet they recommend the mechanic to place his money in the bank, to provide against sickness and old age, whilst they know that sickness, like fire, though somewhat slower in its operations, may in a short time exhaust the savings of fifty years, and like fire, too, may come suddenly before the first year expires. The best friends of the working classes will always entreat them to provide against the manifold wants of sickness and old age, by means of respectable and well conducted Benefit Societies, the payments to which ought to form a part of their current and positive expences. To those who have any thing to spare after this, a savings bank may be useful; the necessities of sickness and old age being first secured by these societies, the mechanic and labourer, through the medium of the bank, may add to their comfort; but no individual either befriends his neighbour or his country, by enjoining a reliance upon individual savings, as a security against casualties which may overtake a man in an hour, and in a few months sweep away the savings of a whole life.*" In short, the best and indeed the only safe way of providing against any contingency is by uniting with others; and hence institutions, such as Friendly Societies, when properly conducted, can alone afford the means of providing for the vicissitudes of infirmity and disease, at the same time that they, in conjunction with Savings Banks, en-

* "Considerations on the necessity of appointing a Board of Commissioners for the Encouragement and Protection of Friendly Societies."—London, 1824.

courage those habits of industry and economy, which are the only sure sources of happiness and independence.

Friendly Societies of France.

From several interesting Reports in the Transactions of the Philanthropic Society of Paris, it appears that Friendly Societies are comparatively but recent institutions in France. They are stated to have there originated with religious bodies, upon whose dissolution the box and funds for the support of the sick and aged, were preserved and supported by such of the members as continued to reside near to each other. When these societies became thus independent of the church, entrants of various occupations were afterwards admitted, and several new societies were formed for the same purposes. Their progress, however, seems to have been for a long time extremely slow; the first of which there is any account having been instituted in 1694, and but other three from that date till 1789, when three more were established at Paris. In 1805 they only amounted to twenty-six, but, in the beginning of that year, the Philanthropic Society of Paris directed its attention to them. This body appointed a Committee to inquire into the origin, number, and regulations of those then in that city, as also to ascertain what measures should be adopted for their more general encouragement. Upon their Report, 100 francs were awarded to one of the societies established in 1789; and premiums of from 100 to 200 francs were offered to every society which should be afterwards instituted, so soon as they had obtained sixty members. It was at the same time intimated in all the public journals, that copies of rules considered well adapted for Friendly Societies in general, would be furnished gratis to all those who might choose to apply for them. This laudable example of the Philanthropic Society was soon followed by a similar society in Marseilles, and through their exertions no less than forty Friendly Societies were, in the course of three years, established in that city. To such societies Government afterwards also extended its encouragement; and in May 1821, on the occasion of the christening of the Duke of Bordeaux, the

King announced that premiums would be given to the Friendly Societies in Paris, in proportion to the sums which they themselves had deposited; and 50,000 francs were distributed accordingly, through the medium of the Philanthropic Society. In June 1824, there were 164 Friendly Societies in Paris, but they are all upon a very limited scale, the whole comprising only 14,700 members, with a total capital of 821,198 francs, (L.34,216 Sterling, or about L. 2 : 6 : 9 per member)—To the Philanthropic Society, then, as well as to the indefatigable exertions of M. Everat, printer in Paris, one of their Committee, is chiefly to be ascribed the establishment of Friendly Societies in France.

Legislative Enactments, and Inquiries.

In 1772, Friendly Societies attracted the attention of the British Legislature; but although they were frequently under the consideration of Parliament in the course of the twenty years following, no statutory regulation of them took place until the year 1793, when a bill was introduced by the late George Rose, Esq. and passed into a law. During the subsequent twenty-five years, the subject of Friendly Societies came also frequently before Parliament; and the provisions of the original act were greatly extended, by no less than seven different statutes. These acts, after reciting that "the protection and encouragement of Friendly Societies, for securing, by voluntary subscription of the members thereof, separate funds for the mutual relief and maintenance of the said members, in sickness, old age, and infirmity, is likely to be attended with very beneficial effects, by promoting the happiness of individuals, and, at the same time, diminishing the public burdens," enact, that it shall be lawful for any number of persons to form themselves into such societies; and, upon their rules being exhibited to the Justices of the Peace, and confirmed by them at a Quarter Sessions as lawful, they shall become entitled to many important privileges. The principal of these are as follows:

No stamp-duty is exigible for any bonds required from their Treasurers, and upon these bonds being lodged with the Clerk of the Peace, he may, in case of forfeiture, proceed against such office-bearers in his own name, for the use of the Society;—if any office-bearer, or other person entrusted with their funds, dying or becoming bankrupt, the claim of the society is preferable to all other debts; all disputes between their members or representatives, and the society, are determinable by the Justices without appeal; but if their regulations appoint these matters to be settled by arbitration, the decision of the arbiters is declared to be final; no fees whatever are exigible by the officers of the Justices for the enrolment of their regulations; and their cases are to be decided in a summary manner.

By these acts it is also declared, that the usual committee of management must not consist of less than eleven in number, and that the books shall be at all times open for the inspection of members,—that no rule or regulation once confirmed can be afterwards altered, nor any new regulation adopted, but by a general meeting of the members of such society, or by a committee specially appointed for that purpose, convened by public notice in writing by the Secretary—that the proposed alterations or additions shall have been read at the two usual meetings of the society or committee previous to calling said general or committee meetings,—that three-fourths of the members then present shall have agreed to the measure, and that such alterations or additions be finally submitted to the Justices for their approval as before. Lastly, it is declared, that no society can be dissolved, or its funds diverted from their original purposes, without the concurrence of *five-sixths* of its whole members, as well as with the consent of all those receiving, or entitled to receive, aid from its funds at the time.

Such are the more important enactments previous to the year 1819, when Mr Courtenay introduced a bill for supplying a most material defect in all the previous statutes. This was the want of sufficient security against error in the original constitution of their schemes, in adapting the contributions and benefits to each other. Previously the rules of every society, which merely professed to provide for sickness or old age, and were directed to no unlawful purposes, fell necessarily to be sanctioned; but by this latter statute it was also required, that the "tables and rules are such as have been approved by two persons at the least, known to be professional actuaries, or persons skilled in calculation, as fit and proper according to the most correct calculation of which the case will admit." This act also greatly enlarges the provisions of former acts, by extending the privileges of mutual assurance to " any natural state of contingency, whereof the occurrence is susceptible of calculation by way of average," and allows societies to invest their funds in the Bank of England at 4½ per cent. interest, under the regulations applicable to Savings Banks. This statute, however, did not extend to Scotland.

But notwithstanding all these salutary enactments, their operation, both in England and Scotland, has been but partial and imperfect. Till very lately no data existed by which the necessary payments for particular rates of benefit during sickness could be satisfactorily ascertained, and those for other benefits were seldom attended to. The Justices, too, with very few exceptions, usually sanctioned the rules in whatever shape they were presented, and decided Friendly Societies' causes with little or no regard to their regulations. Hence all the labours and enactments of the Legislature remained either unknown or unheeded, and these institutions were consequently led into error, litigation, and ruin.

These evils, however, and the very great utility of such societies, tended to excite a keen interest in their favour. Several patriotic individuals endeavoured to procure data for establishing their schemes upon a more secure basis; but nothing effectual was accomplished, until, upon the motion of Mr Charles Oliphant, the Highland Society, in 1820, instituted their inquiry into the rate of sickness among Friendly Societies in Scotland, and published the result in a most valuable Report in 1824 *. Mr Courtenay also brought the subject again before Parliament in 1825, when a Select Committee of the House of Commons was appointed to take into consideration the present statutes, and to make such investigations into the rate of sickness, mortality, and other matters, as might be deemed expedient. Many highly respectable and intelligent witnesses were accordingly examined, much valuable information obtained, and the result of the whole embodied in a Report, which has not perhaps been exceeded in interest and utility, by any Parliamentary paper of late years. This report

* Report on Friendly or Benefit Societies, drawn up by a Committee of the Highland Society of Scotland. A. Constable & Co. Edin. 1824. Price 6s.

has not yet been followed up by any alteration of the existing acts, but the Committee having been this session of Parliament (1827) reappointed, it is to be presumed that they will speedily undergo a revision and amendment.

It may here be observed, however, that Friendly Societies have always regarded legislative interference with the utmost jealousy and alarm; but that this arose from misapprehension, and from the benevolent objects being misunderstood, the following extract from the Parliamentary Report above alluded to, will sufficiently demonstrate: "Your Committee take this opportunity of observing, that it is in their opinion, only in consideration of the advantages conferred by the law, that any restrictive interference can be justified with voluntary associations, established for lawful and innocent purposes. They wish this principle to be kept in view, in considering as well the history of the law, as the suggestions which they shall make for amending it. It is true that the restrictions which the act (1793) imposes are, without exception, calculated for the benefit and security of individuals; nevertheless it is for the individuals themselves to determine whether to adopt the provisions of the statute which offers at the same time regulation and privilege, or to remain perfectly unfettered by any thing but their own will, or the common and more ancient law against fraud and embezzlement. For your Committee apprehend, that although the act of 1793 appears to begin by rendering lawful the institution of Friendly Societies, there neither was at that time, nor is now, any law or statute which deprives the King's subjects of the right of associating themselves for mutual support." This Report, and that of the Highland Society of Scotland, will be more particularly referred to in the sequel.

There are no legislative enactments regarding Friendly Societies in France; but their rules must be at first submitted to, and approved of by, the Prefect of Police, and notice thereafter given to him some days previous to each meeting.

Such a detail of the Parliamentary proceedings and enactments has been deemed necessary, with the view of directing to them the special attention both of Justices of the Peace and of Friendly Societies. As already mentioned, the rules of almost every society bear evidence, that, in the first place, the statutes are either almost wholly useless, or at all events seldom attended to; and, in the next place, according to Mr Gavin Burns, in his able pamphlet on the Principles and Management of Friendly Societies in Scotland, "it is a known fact, that many decisions have been given, in cases of society disputes, in our inferior courts of justice, in which, from motives of lenity or humanity to a complaining member, this principle (of adhering to the rules) has been departed from; and although he may have failed in performing his part of the stipulations mutually agreed on, in many cases has been adjudged to receive the benefit of the funds the same as if he had fulfilled them;" but such "lenity or humanity, however well meant, when shewn to one member at the expence of strict justice, may, by injuring the general interests of the society, become *cruelty* to numbers, who may be thereby deprived of that relief in sickness and old age to which they had a just claim." Thus are societies deprived of the many benefits and protection which these acts are intended to afford; whereas were their provisions duly acted on, the interests both of societies collectively, and of their members individually, would be more effectually preserved.

It is true, indeed, that, in Scotland, the Justices have no power, by the existing statutes, to alter or impose upon societies any law whatever, provided their rules be merely consistent with the common law of the land; but still a great deal of good might be done, were societies merely made aware of their errors before their regulations were passed into a law. In this respect, great praise is certainly due to the Justices of Forfarshire, who have lately drawn up and printed a statement explanatory of the principles on which societies can alone be conducted with safety and advantage, and copies of which are issued to all societies applying for sanction. It is understood that the Justices of Peace for the county of Edinburgh are now also in the habit of recommending a similar publication* to their attention. By these and similar measures, a very beneficial change cannot fail to be soon effected in the principles and management of Friendly Societies; for it cannot be doubted, that to irregularity hitherto in the proceedings of societies themselves, must certainly

* Remarks on the Constitution and Errors of Friendly Societies, with the Laws of the Edinburgh Compositors' Society, instituted upon the principles recommended by the Highland Society of Scotland. Oliver and Boyd, Edinburgh, &c. Price 1s. 6d.

be ascribed much of the litigation, and the apparently inconsistent decisions, which have so frequently occurred.

Imperfections in the Schemes of Friendly Societies.

As the funds of Friendly Societies principally arise from a certain sum paid by members at entry, and an annual contribution so long as they remain in the society; while the disbursements consist of allowances for sickness or inability to work, and for the funerals of members, their wives or widows, it is evident that no society can be permanent, unless the contributions with the accruing interest, be in just proportion to the allowances. But it is much to be regretted that institutions so numerous and useful, should have been so very generally founded on miscalculation, which formed the chief operating cause of their own dissolution. This is the less surprising, however, when it is recollected, that it is only of late years that the system of Life Assurance has been brought to maturity, even in the higher, and consequently better educated, part of the community. Dr Price has shewn that, in his time, Life Assurance schemes went to ruin, in consequence of having been founded on erroneous computations; and the Scotch Ministers' Widows' Fund, established about the middle of last century, appears to have been one of the first institutions founded upon just principles. Besides, an accurate knowledge of *the rate of mortality* was all that was wanted for properly conducting Life Assurance Schemes, but for those of Friendly Societies, *the rate of sickness* was also required. Of this latter requisite, however, no accurate information, till lately, had ever been obtained, or indeed thought of; and hence their contributions and allowances were necessarily fixed at random, and left to be raised or lowered as circumstances might require.

But to some even of the best informed, this mode of management seemed to be sufficient, and the only one capable of being adopted; for, in the article on Benefit Societies, in the Supplement to the Encyclopædia Britannica, it is stated, "that it is a great advantage of benefit clubs not to require much in the way of funds. If the *calculations* are correct, the outgoings within an average period will balance the incomings; and all that is requisite in the way of fund, is a small sum to meet accidental inequalities. When this fund is lost, it is not much that is lost; if a small additional sum is subscribed by each member, or, instead of this, if the allowances are suspended, or only reduced, the society is placed in its former situation." Not the least hint, however, is given by this writer, of the way by which correct calculations may be obtained; and how he could suppose that, even were such calculations once procured, a society could afterwards act upon them without accumulating a capital, it is certainly very difficult to conceive,—for, as the rate of the yearly contribution continues the same for life, while the rate of sickness (or disability) increases yearly from youth to age, a society must either always be possessed of a capital in proportion to the number and ages of its members, or be unable to meet the heavy demands of old age; the sickness between 60 and 70 years of age being at least tenfold what it is between 20 and 30. Mr Finlayson, however, the actuary for the National Debt Office, when first examined, in 1825, before the Committee of the House of Commons, gave it as his opinion, that " there is a constant and given mortality operating upon life, but no such law exists as to sickness." He therefore, likewise, " when applied to by the members of Friendly Societies, advised that which appeared to be quite sufficient, without any such calculations. I have advised them to separate their project into two parts, the one embracing that which was susceptible of calculation, the other that which was not; it so happens, that sickness, and the other events to which I have alluded, are of immediate and temporary occurrence, and may be provided for by immediate means. Not so the other benefits, which usually require a long period of time before they be realized; and therefore a simple mode of attaining the objects of those societies occurred to me, which was, that they should have two chests, as it were, one for the temporary purpose of sickness, to be supplied by a trifling contribution, and augmented as occasion might require; the other to be entirely distinct, and kept as their permanent capital." That this opinion, however, with regard to the rate of sickness, was erroneous, will be afterwards fully shewn, by the most unquestionable evidence; and that the system of management recommended, and hitherto almost universally acted upon, is the most ruinous that could have been suggested, has been already sufficiently demonstrated by the numerous failures of Friendly Societies' schemes. But as these opinions are from so high authority, and as the failures of Friendly Societies are attended with the most serious consequences both to their members and to the public, we trust to be indulged in entering somewhat fully into a detail of the more obvious errors which have been committed.

As already stated, Friendly Societies were originally charitable institutions. Hence the expenditure was extremely limited, and, consequently, a small contribution would be adequate to defray it. In the progress of time, however, when every one became entitled to claim the allowances as his right, the same contribution could not suffice; but, as might have been expected, a long time necessarily elapsed before this was perceived, as no society, which continues to acquire new members, can come to its maximum expenditure for the first 30 years; and, therefore, the improvement in the principle of benefits, without a corresponding increase of the payments, has certainly been one main cause of the failure of their schemes.

Societies at their commencement, generally admit members at all ages, for the same rate of entry money, and even afterwards seldom make any difference for those under 36 or 40. A uniform sick allowance is likewise granted to the whole for the same annual payment, upon the supposition, that the aged of one generation will be provided for by the youth of the next. But, while the demands of youth are no doubt greatly less than those of old age, still the surplus contributions of the young members will be alone very inadequate to defray the allowances of the old; for, supposing the annual rate of sickness of an individual at 21 years of age to be represented by *one*, the rate of sickness from 60 to 70, on an average, will be represented by *ten*, and at 70 it will be represented by *eighteen*. Hence, if members do not enter in youth, and accumulate a sufficient capital, or if it be prematurely expended in defraying the larger demands of those who entered at higher ages, then, when a number of years has passed, the expenditure will come to exceed the income, and a small capital must soon be exhausted. Still, however, if young members can be found, if the contributions be increased, and the allowances reduced, a long period may elapse before the growing evil is fully known, until by the greatly increased claims of the now more numerous and aged members, the society suddenly go to ruin.

Another important error which societies have committed, is in enlarging their distributions, when their capital has continued progressively to accumulate for a long series of years. This circumstance, however, until its reasons are fully understood, is apt to create a dangerous illusion. Although the annual contributions for a number of years at the commencement may be greatly less than is necessary to support the society to the end, yet the capital may for many years continue rapidly to increase. In the early and healthy period of life, the members, even with a very low contribution, will pay more than they receive, but in advanced life they will receive much more than they pay. A society, therefore, for money received, undertakes to pay afterwards a far greater amount; and hence, although possessing a large capital, it may still, in fact, be far below the requisite sum. As has already been remarked, however, an idea has very generally prevailed, that Friendly Societies have no need of funds, and that to accumulate capital is merely providing for posterity, since societies have it always in their power either to raise their contributions or lower their allowances, as circumstances may require. But, as was long ago justly remarked by Dr Price, all that is given too much to present claimants is so much taken away from future ones; and if a scheme is very deficient at the beginning, the first claimants may, from the greater part of the members being young and healthy, receive for a number of years so much more than they ought to have done, as to leave little or nothing for those who come after them. Erroneous schemes are therefore attended with peculiar injustice; and this injustice will be the same, if, instead of reducing the allowances, the annual payments should be increased, for the only difference consists in causing the injustice to fall on future contributors instead of future claimants, In general, however, deficiencies will only be perceived when it is so late that no other alternative remains to save societies from instant destruction, but either to raise the contributions, or reduce the allowances far below what was originally promised. Members, therefore, entering twenty or thirty years after the commencement, will be called upon to pay larger yearly contributions than are required to secure their own proportion of benefit, on account of being obliged to support the original surviving members, who, when they were young, perhaps never either gave to others half the present allowances, or paid much above half the annual contributions. Their best and youngest members will then perceive that they have gone upon erroneous calculations, and will desert them, the inevitable consequences of which must be, a still greater deficiency in their annual income, and a more rapid desertion and decline, until a total bankruptcy and dissolution take place.

But the accumulation of capital which necessarily occurs in societies for a number of years at the commencement, has also led into the very erroneous opinion, that as the capital increases, so ought also the terms of admission in the same proportion even for young members; while the fact is, that as the funds increase, so also do the first members increase in years and infirmities; and though members enter subsequently to a larger capital than the first members did, they at the same time enter among a larger class of aged and infirm people, who, from their payments being now inadequate to defray their allowances, must themselves either require all the capital that they had accumulated in early life, or be supported from the surplus contributions of the young members. The usual practice, therefore, of raising the rates of entry-money, and otherwise limiting the terms of admission, when a society has been some time established, and has accumulated a capital, is doing a manifest injury to *young* entrants, who can never derive any benefit from that capital.

So much with regard to the errors in the sickness department, but the same erroneous system of management is still more obvious in that for funerals, or sums payable at death.

A member entering at 40 years of age, becomes entitled to the same allowance at death, as if he had entered twenty years before, while the society has been deprived of just so many years' contributions. It has been asserted, however, that a man at 40 is likely to continue as long healthy as one at 20, and, therefore, that a society runs just as much risk with the one as with the other. That such is not the case will be afterwards made apparent; but although this were to hold true with regard to sickness, still the case is different with regard to death. An entrant at 40 *is then alive*, and no possible claim could have been previously made for his funeral money. He, therefore, to all intents and purposes, has pocketed twenty years' contributions, deprived the society of that amount, and thus placed himself in a vastly better situation than those members who entered in early youth.

But besides the great loss thence arising from the admission of aged men, the usual method of only contributing for funerals as they occur, is attended with the most destructive consequences. While the members, or a great proportion of them, are young, the deaths will be few, but, with the advance of age, these will necessarily increase. Hence the demands will then also increase; and thus, in old age, when least able to afford it, the surviving members will find the contributions perhaps double what they were in youth. At the commencement of a society, too, the members are generally few in number, and where a small sum only, or perhaps nothing, is levied from each member, the balance, if not the whole, must be taken from the sick-fund. Should the members increase, so will also the deaths, and consequently the contributions and disbursements; so that the accounts for funerals will ultimately equal, if not exceed, those for sickness, while the sums received by the relations will bear no proportion to the payments, or the period which the member may have been in the society.

The most pernicious, however, and certainly the most unjust, of all the evils of the old system, is the giving funeral allowances for wives, and annuities to widows, without the payment of adequate contributions. Now that the principle of charity is abandoned, why should the married possess advantages over the unmarried? Where all contribute alike, all should receive alike; and if double or treble allowances are required, they ought to be paid for in proportion. This is surely but equitable; for as well might a married member claim sick-money for his wife, without contributing for it, as demand funeral-money, or a widow's allowance, under similar circumstances. It has been said, however, let all marry, and then every one will be on an equal footing; but if all were to marry, then the same contribution would not suffice; and those who are now married, are just as much bound to contribute for their additional allowances as if all the members were married. But the evil does not even stop here. Upon the entry of a member, the society has seldom the means of knowing any thing relative to the health or age of his wife. Should she be old or in a bad state of health, her funeral-money will probably be very soon required. The member may again marry, pay a small sum, and in a short time claim a second—nay even a third—wife's funeral allowance;—and all this chiefly at the expence either of the young and the unmarried members, or of the funds of a poor bankrupt society.

But, heavy as this burden certainly is, it is nothing in comparison with widows' allowances. It should be particularly observed, that a widow's provision is not the light burden generally supposed, or one which may be added to a scheme without an adequate contribution; on the contrary, it will of itself inevitably soon bring a society to ruin. The same, if not stronger, objections are therefore applicable to those allowances as to funerals; but as such benefits are now seldom promised by these societies, it seems here unnecessary to do more than allude to them. It is still to be regretted, however, that many institutions, under the denomination of *Widows' Schemes*, are still in existence, upon the most erroneous principles, and which will therefore be productive of nothing but loss, disappointment, and misery.

Such, then, being the opinions by which Friendly Societies have been guided, and the system of management which they have very generally adopted, it is not surprising that they should have so frequently failed; "their errors, however, are matter of no reproach, for the spirit is to be admired, which, revolting at the humiliation of depending upon charity, led their founders, seeking for the means of independent support in sickness and in old age, to endeavour to attain the desired end, regardless of the dangers of miscarriage*,"—but their experience having now laid the foundation of a more correct system, by affording data for computation, which could not otherwise have been obtained, every means should be used to found them on a more secure basis in future.

(*To be continued.*)

* Highland Society's Report, p. 9.

On the Comparative Nutritive Properties of Different Kinds of Food.

A very interesting report on this subject was formerly presented to the French Minister of the Interior, by MM. Percy and Vauquelin, two members of the Institute, the accuracy of which may be depended on. It may, at this period of public distress, be valuable in those families where the best mode of supporting nature should be adopted at the least expence.

The result of their experiments is as follows:—In bread, every hundred pounds weight are found to contain eighty pounds of nutritious matter. Butcher's meat, averaging the various sorts, contains only thirty-five pounds in one hundred. Broad beans eighty-nine. Pease, ninety-three. Lentils (a kind of half pea, but little known in England), ninety-four pounds in one hundred. Greens and turnips, which are the most aqueous of all the vegetables used for domestic purposes, furnish only eight pounds of solid nutritious substance in one hundred. Carrots, fourteen pounds. And, what is remarkable, as being in opposition to the hitherto acknowledged theory, one hundred pounds of potatoes only yield twenty-five pounds of substance, valuable as nutrition.

One pound of good bread is equal to two pounds and a half, or three pounds, of the best potatoes; and seventy-five pounds of bread, and thirty pounds of meat, are equal to three hundred pounds of potatoes. Or, to go more into detail, three quarters of a pound of bread, and five ounces of meat, are equal to three pounds of potatoes; one pound of potatoes is equal to four pounds of cabbage, and three of turnips; but one pound of rice, broad beans, or French beans, is equal to three pounds of potatoes.

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*On an Excellent Mode of Coating Small Articles of Metal with Tin.** By Thomas Gill, Esq.

Mr Gill once witnessed the following superior mode of tinning small articles, such as tacks, nails, &c., for instance, with great economy and convenience.

The workman having previously made the surfaces of the ar-

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* From Gill's Technical Repository.

ticles clean from rust or other oxide, by pickling them, or putting them into sulphuric, muriatic, or nitric acid, diluted with water, as usual, and washing them well afterwards in water, he put them into a stoneware gallon bottle, having an oval body, a narrow neck, and a handle to lift it by, together with a proportionate quantity of bar or grain tin, and of sal ammoniac. He then placed the vessel, lying upon its side, over a charcoal fire, made upon a forge-hearth, and heated it; continually turning it round all the while, and frequently shaking it, to distribute the tin uniformly over the surfaces of the articles to be tinned. They were then thrown into water, to wash away all remains of the sal-ammoniac, and finally dried in saw-dust made warm.

The great merit of this process consists in the employment of the *stoneware vessel*, which not only prevents the dissipation of the sal-ammoniac in fumes; but also gives up the whole of the tin to the articles to be tinned, which would not be the case were a metallic vessel to be used.

On polishing Ivory, Bone, Horn and Tortoise-shell. By Dr Thomas P. Jones.

Ivory and Bone, either plain or ornamented.

Ivory or bone articles admit of being turned very smooth, or, when filed, may afterwards be scraped in the manner to be presently described, so as to present a good surface. They may be polished by rubbing them first with fine glass paper, and then with a piece of wet linen cloth dipped in powdered pumice-stone; this will give a very fine surface, and the final polish may be produced by washed chalk or fine whiting, applied upon another piece of cloth wetted with soap suds.

Care must be taken in this, and in every instance where articles of different fineness are successively used, that, previous to applying a finer, every particle of a coarser material be removed, and that the cloths be clean, and free from grittiness.

Ornamental work must be polished with the same materials as plain work, only using brushes instead of linen or woollen rags, and rubbing as little as possible, otherwise the most prominent parts will be injured. The polishing materials should be washed off with clean water, and, when dry, the articles may be rubbed with a clean brush, to finish them off.

Horn and Tortoise-shell.

These substances are so similar in their nature and texture, that they may be classed together, as far as regards the general mode of working and polishing them. A very perfect surface is given by scraping them ; the scraper may be made of a razor-blade, the edge of which should be rubbed upon an oil-stone, holding the blade nearly upright all the while, so as to form an edge like that of a currier's knife ; and which, like it, may be sharpened and improved by burnishing, at least so far as its hardness will permit.

To prepare the work, when properly scraped, for polishing, it is first to be rubbed with *buff*, made of woollen cloth, *perfectly free from grease* ; the cloth may be affixed upon a flat stick, to be used by hand, but what workman call a *bob*, which is a wheel running in the lathe, and covered with the cloth, either upon its edge or periphery, or flat face, as may be required, is much to be preferred, on account of the rapidity of its operation. This buff or bob is to be covered either with powdered charcoal and water, or fine brick dust and water. After the work has been made as smooth as possible by this means, it must be followed by another buff or bob, on which washed chalk or dry whiting is rubbed ; the comb, or other article, is to be slightly moistened with vinegar, and the buff and whiting will produce a fine gloss, which may be completed by rubbing it with the palm of the hand, and a small portion of dry whiting or rotten stone.—*Franklin Journal.*

Abstracts and Remarks relative to Captain Sabine's Experiments on the Dip and Intensity of the Magnetic Needle, in different parts of the Northern Hemisphere. By Peter Barlow, F. R. S., Mem. Imp. Ac. Petrop. Communicated by the Author.

In my former paper relative to the magnetic experiments made during the late Northern Expedition *, I endeavoured to

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* I wish here to correct an omission in the title of my former paper. It was intended that the experiments should have been stated to have been " By Captain Parry, Lieutenant Foster, and the other Officers of the Expedition."

shew that the hypothesis suggested by Lieutenant Foster, viz. " of the magnetic pole having a daily motion about its mean point in an orbit of about 2¼′ or 3′ in radius," would serve to explain all the general phenomena of the observed daily changes in direction and in intensity of the magnetic needle in different parts of the globe. I also stated that there were other changes, or rather other sources of change, which served to modify the observed results, and would require farther illustrations. These illustrations will form the subject of the following pages, particularly with reference to Captain Sabine's experiments. First, then, let us observe, that it is shewn in the former paper, that if the phenomena alluded to may be generally represented by a daily rotation of the magnetic pole about its mean point, it must be by supposing the pole to be always inflected towards the sun. It is on this supposition the former explanation as to time, &c. has been founded, and the first question beyond this is, " Does this inflection arise from the solar influence increasing or diminishing the magnetism of that part of the globe on which it is the greatest? A very little consideration will suffice to shew, that, if that hemisphere of the earth on which the sun shines at any time has its magnetic power more strongly developed in consequence of the increased heat, the resultant of all the forces will approximate towards that part of the sphere, and will cause an apparent approach of the pole towards that side. Now, we have seen that this apparent approach of the magnetic pole has been actually observed during the time the sun is advancing towards the meridian of any place; and hence we conclude that this approach is caused by an increased magnetic action in those parts of the earth immediately exposed to the solar influence.

That this would be the case in the magnetism of an iron-ball thus partially heated, is unquestionable,—*Phil. Trans.* 1821, *Part I.*; and as, in all other known cases, the laws of iron, magnetised by induction, and those of terrestrial magnetism, so closely resemble each other, it may serve to condense our remarks, if we first confine them to the case of an iron-ball under different temperatures resembling the actual state of the earth.

With this view, it may be observed, that, according to the hypothesis of iron receiving its magnetism by induction, it is supposed, both in my investigation and in that of M. Poisson, that each particle of the magnetic fluid has the same intensity of action at the same distance; and, on this supposition, all the conditions of its action are deduced. But if, instead of this uniform action, we suppose the equatorial parts of a sphere of iron to act with greater intensity, as would actually be the case if the temperature of the iron were increased in those parts, let us inquire in what manner, and in what degree, this would influence the laws deduced from assuming an uniform intensity at equal distances. And if it result from this inquiry, that an increased intensity, and a diminution of the natural dip about the equatorial regions, would be the necessary consequence of such a supposition, and an increase of the natural dip, with a corresponding decrease of intensity in those parts towards the poles of the iron shell; and if, moreover, referring to actual observations and experiments on the terrestrial globe, it should be found that corresponding phenomena have been observed in the frigid and torrid zones, we shall, I think, have strong reasons for assuming that the phenomena in both cases are due to the same cause, viz. an unequal temperature and a corresponding inequality of magnetic intensity; but still not such as can be explained by assuming a pole of intensity distinct from that of direction.

Here, then, at once will be seen the principle on which I propose to explain, first, the apparent anomalies which Captain Sabine detected in his experimental results between the intensity and dip in the frigid, temperate, and torrid zones; and, secondly, some of the modifications in the daily changes of magnetic intensity, &c. which seem to be dependent on causes not embraced by the general hypothesis of the daily rotation of the magnetic pole of the earth about its mean point.

It is, I believe, to Dr Young we are indebted for the first analytical formulæ for expressing the intensity of terrestrial magnetism, as depending on the dip of the needle, viz.

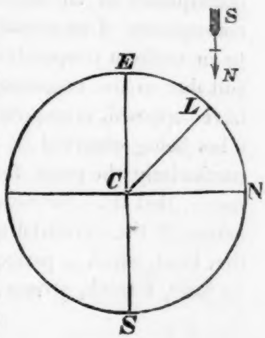
$$\text{Intensity of dipping needle } I = A\sqrt{\frac{1}{4-3\sin^2\delta}}$$

$$\text{Intensity of horizontal needle } I = A\sqrt{\frac{1}{3+\sec^2\delta}}.$$

Where δ is the dip, and I the magnetic latitude of the place of observation; and although more exact observations have shewn that these laws are not strictly true, in places where the dip differs considerably, yet the agreement is too close to admit of a doubt that they are on general principles correct, and that the discrepances are due to some cause which it would be satisfactory to be able to explain. Let us see, therefore, how far the supposition of an effect, due to unequal temperature, may be calculated to furnish such an explanation.

In the first place, it may be proper to remark, that whatever might be the temperature of the entire sphere, so that it were uniform, the laws would remain the same; the intensity would, indeed, be different, but the formulæ having reference only to the relative intensities, dip, &c. in different latitudes, would, of course, remain the same under all uniform temperatures.

I propose to examine this question only on broad principles, without attempting any thing like an analytical investigation of it; because, to investigate this problem, in all its generality, would require, in the first place, a more perfect knowledge than we yet possess, of the proportional magnetic developement under different temperatures; and, secondly, if this were known, it is perhaps doubtful whether the modern analysis, even in its present high state, would be competent to contend successfully with all the conditions of such a problem. At the same time, it will be easy to shew, that the circumstances alluded to, viz. an increased heat about the equator, would alter the laws which are applicable to an uniform temperature, and that this change would tend to results very strongly resembling the known conditions of terrestrial magnetism.



Let us conceive the uniform temperatures, to which the laws apply, to be that belonging to the magnetical latitude, in which the needle is at right angles to the terrestrial magnetic axis, so that the dip is equal to the magnetic colat., then $2 \tan. l = \tan. \text{colat.}\ l$, or $2 \tan. l = \cot. \text{lat.}$, which gives $\text{lat} = 35°.44$.

We may then, according to the broad view we are taking of the subject, consider the needle as placed in equilibrio in this position by two forces, one directed towards the polar parts N, and the other towards the equatorial parts C. Now, conceive the actual temperature of the several regions to be restored, then all the parts between L and C will be increased in temperature; and, therefore, according to our supposition in magnetic intensity, while the intensity of all the parts between L and N will decrease, and the needle will, in consequence, be more inflected towards the centre C; that is, the dip will be increased: but the actual intensity, independent of the dip, will be greater or less, according as the mean temperature shall be now greater or less than the uniform temperature first supposed; however this may be, in this particular latitude, there is, at least, some part in which the mean temperature shall be less than the uniform temperature, and beyond that point, towards the pole, the intensity of the needle will be less, from considerations of temperature only, than that given by the formula $I = \sqrt{\frac{1}{4-3 \sin^2 \delta}}$; it will also be less, because the dip will itself be greater than that which results from the principle upon which the formula is obtained. It follows, therefore, that, in every magnetic meridian, there is a point beyond which, towards the pole, the actual observed intensity of the needle will be considerably less than ought to result from the formula given by Dr Young, and employed by Captain Sabine; and, in a similar way it may be shewn, that there is another point in each meridian towards the Equator, in which the intensity is considerably greater than that given by the formula; first, in consequence of an increased temperature; and, secondly, in consequence of an actual diminution of the dip below that due to an uniform temperature. That this would be the actual result due to the magnetic action of an iron ball, heated as we have supposed, is unquestionable; and the circumstance of such a law being observed in the different zones of the earth, and particularly the proof furnished by Lieutenant Foster's experiments, that the solar rays have a positive influence on the magnetism of the terrestrial sphere, and an influence, moreover, of that kind, which is perfectly consistent with these suppositions; we have, I think, strong reasons for concluding, that the partial intensity of magnetism, in different parts of the globe, is dependent on the partial temperature; and, that the formula deduced from a supposition of a uniform temperature, will give a less intensity towards the equator, and a greater intensity towards the poles, than is consistent with the actual state of terrestrial magnetism; or, which is the same, the observed intensity in the torrid zone will be found to exceed, and that in the frigid zone to fall short of, the intensity which ought to result from the formula generally employed. And this is consistent with the observations of Captain Sabine, as will appear from the abstract we have made in a subsequent page. In the above reasoning we have supposed an uniform temperature in each parallel of latitude, but this, of course, is by no means the case on the terrestrial globe; consequently, although the hypothesis advanced above may explain, on general principles, many of the apparent anomalies observed by Captain Sabine, it cannot be expected to meet them entirely; because, if temperature has the general influence we have supposed, it must also have that partial influence, which is due to localities, and other causes of partial temperature, and hence, perhaps, we may account for that extraordinary intensity which Captain Sabine observed at New York, and along the coast of America generally; the land and ocean furnishing not only different degrees of temperature in the same parallel, but also different conducting powers, and it is probable that much depends upon the latter condition; and hence, again, perhaps considering the land of the terrestrial globe, as divided into two great continents, we may see some reason why the laws of magnetism, as actually observed on the earth, should be rather consistent with the hypothesis of two north and two south poles, (as first advanced by Dr Halley, and supported by so many authorities by Professor Hansteen), than with that which supposes only one pole in each hemisphere.

Unfortunately, Professor Hansteen has mixed up, with many valuable records, collected with great labour, a great deal of mystical matter relating to numbers and periods, which have thrown some discredit upon the performance; but, rejecting the latter, it is extraordinary how very nearly his calculations approach to observations not only as relate to the dip and variation, but also to the intensities in different parts of the world, as will be seen by comparing them with the results obtained by Captain Sabine in various parts of the northern hemisphere, and with those of Captain Parry and Lieutenant Foster, at Port Bowen, and other stations; and, as the general results in Hansteen's table of intensities, as well as those from observation, appear to be all consistent with the above explanation, we are justified, I think, in concluding, that the discrepance between the intensities, as observed, and as computed from the formula $I = A\sqrt{\frac{1}{4-3\sin\delta}}$, arises from the unequal temperature of the different regions; and, consequently, that the hypothesis of a pole of intensity, distinct from that of direction, is unsatisfactory and untenable.

The following are the dips and intensities, as observed by Captain Sabine, and as computed by the formula $I = A\sqrt{\frac{1}{4-3\sin\delta}}$.

Places.	Latitude.	Longitude.	Date.	Dip.	Intensity.	
					Comp.	Observ.
St Thomas,	0°0.5 N.	6.75 E.	May 1822.	00° 0′.4 S.	1.00	0.99
Ascension,	8.0 S.	14.5 W.	June ...	5 10. S.	1.005	
Bahia,	13.0 S.	38.5 W.	July ...	4 1.2 N.	1.00	
Sierra Leone,	8.5 N.	13.5 W.	March ...	31 2.25 N.	1.12	1.115
Marranham,	2.5 S.	44.0 W.	Aug. ...	23 7.75 N.	1.06	1.09
Gambia,	13.5 N.	16.75 W.	Feb. ...			
Port Praya,	1.5 N.	23.5 W	Jan. ...	45 26.1 N.	1.27	
Teneriffe,	28.5 N.	16.25 W.	Jan. ...	59 50. N.	1.57	
Trinidad,	10.5 N.	61.5 W.	Sept. ...	39 2.5 N.	1.19	1.33
Madeira,	32.5 N.	17. W.	Jan. ...	62 12.3 N.	1.55	
London,	5.15 N.	0. W.	Aug. ...	70 3.5 N.	1.72	1.54
Jamaica,	18. N.	77. W.	Oct. ...	46 58.25 N.	1.29	1.52
Cayman,	19.25 N.	81.5 W.	Oct. ...	48 48.3 N.	1.32	1.53
Drontheim,	63.5 N.	10. E.	Oct. 1823.	74 43. N.	1.82	1.52
Hammerfest,	70.5 N.	24. E.	June ...	77 15.7 N.	1.87	1.57
Havannah,	23. N.	82.5 W.	Nov. 1822.	51 55.3 N.	1.37	1.62
Spitzbergen,	80. N.	11.5 E.	July 1823.	81 11. N.	1.93	1.66
Greenland,	74.5 N.	19.5 W.	Aug. ...	80 11. N.	1.92	1.62
New York,	40.5 N.	74. W.	Dec. 1822.	73 0.5 N.	1.79	1.88

With respect to the intensity of the horizontal needle, it will be obviously subject to different laws, because it will be less as the dip is greater, and greater as the general intensity is greater. It follows, therefore, that the intensity of the horizontal needle may be at its maximum, when the general intensity is at its minimum, and *vice versa*, particularly in places where the dip is very great, because there a very few minutes' change in the dip will very sensibly affect the horizontal needle, while that of the dipping-needle will scarcely have suffered any perceptible alteration. Irregularities in the horizontal needle will therefore be much more common, and more appreciable, in northern latitudes, than in places near the Equator; while changes in the state of the dipping-needle will be more common in the latter situations than in the former; all which I believe is sufficiently consistent with observations; at least Professor Hansteen has recently shewn, that the change of intensity in the horizontal needle, between its annual maximum and minimum, is much greater as the dip is greater; and I think it highly probable, if his observations had extended to places nearer the Equator, he would have found it a minimum in one place, when it was at its minimum in the other.

It would, however, be endless to trace out all the circumstances that might result in different places, by supposing that a higher temperature developed a higher degree of magnetic intensity. I shall therefore content myself with what is above stated, hoping that it will be sufficient to attract the attention of observers to this probable cause of magnetic irregularities in different parts of this terrestrial globe.

WOOLWICH,
19*th May* 1827.

ERRATUM IN THE FORMER PAPER.

For Professor Leibech *read* Professor Seebeck.

Refutation of Mr Ivory's New Law of the Heat extricated from Air by Condensation. By Mr HENRY MEIKLE.—Communicated by the Author.

WHEN writing the articles on the relations of air and heat, inserted in the last Number of this Journal, I was not aware that my previous labours on the same subject in No. II., had already set a-working the great powers of Mr Ivory. But, on perusing the numbers for February and March, of that valuable united journal *The Philosophical Magazine* and *Annals of Philosophy*, I found an attempt to bear down, not by rational argument, but purely by force of his own authority, all that I had formerly proved on this subject. I say *proved;* for, although Mr Ivory, throughout his recent papers, is at great pains to state, in the most pointed terms, the very reverse of what I had inculcated; yet he not only does not combat my reasoning, but admits, in the strongest terms, nay, eulogizes, in one place or other of his paper, all the data I have employed; and every one who has but a moderate acquaintance with the mathematics, will see that the conclusions I have drawn follow as necessarily from the data, as those of any proposition in Euclid. A still more elementary investigation of the law of temperature in air, is given at page 336. of the last Number of this Journal; and the same conclusions may be legitimately drawn from the premises in various other ways.

I did not expect that on this subject I was to be opposed by first rate mathematicians; because such ought to see at once the truth of my conclusions, even although they may not admit my investigations to be altogether free from imperfections. Others are at liberty to withhold their assent, but men of science must give way, because it is not a mere matter of opinion. There is no alternative, if the data be admitted.

Mr Ivory's paper is entitled, "Investigation of the Heat extricated from Air, when it undergoes a given Condensation." In the *Philosophical Magazine* for July 1825, the same author has given us what he calls "The Laws of the Condensation and Dilatation of Air," &c. and which are intended to serve the very same purpose. They had been published two years prior to this, by that distinguished mathematician M. Poisson. But, in the present article, no mention is made of the old laws, far less whether they are now repealed to make room for the new. When an author presents the public with a view of any subject, different from, or directly opposed to, what he had formerly given them, he is not only expected, but bound, in good faith, to state his reasons for such a change. Our author, as we shall hereafter see, is blamable in this respect.

After some introductory remarks which had been repeatedly given in his former papers, the pretended investigation of the new law proceeds thus:—" We must next inquire according to what law the latent heat accumulates when air expands. When a mass of air, under a constant pressure, varies by the application of heat, I *assume* it as an acknowledged principle, that equal quantities of absolute heat produce equal increments of volume." Now, on this I need only observe, that *assumed* principles and *acknowledged* principles are too often *erroneous* principles; and it is the business of science to challenge the legitimacy of all such random and gratuitous assumptions.

In assuming this acknowledged principle, Mr Ivory has been forced to transgress the much more sound and safe principle of Newton,—*That no more principles are to be admitted than are necessary to solve the problem.* Now, Mr Ivory knows very well, that I have repeatedly shewn that the problem can be solved in a most satisfactory manner, without this assumed and acknowledged principle. Nay more, I have shewn that it is a false and unfounded principle, as will farther appear by the perusal of this essay, which I hope will have the salutary effect of finally settling the true scale of the air-thermometer.

Having thus noticed the loose hypothetical foundation of Mr Ivory's investigation, I shall now advert to its remarkable inconsistency with his previously avowed doctrines. Thus, his laws or formulæ given in *Phil. Mag.*, July 1824, page 9., set no limit to the heat extricated from air by compression; but, as we shall shortly see, he has now confined that rise of temperature within a very narrow compass, and without assigning a sufficient reason for effecting such an extraordinary revolution in the unalterable laws of nature! In 1825, the greatest cold produced by the dilatation of air, could never descend below—448° Fahr.; but, under the new law, it is bottomless and unfathomable.*

* By looking into page 338, No. II. of this Journal, it will be found, that though I had anticipated the scanty production of heat by the new law of condensation, yet I did not then foresee, but doubted, its enormous frigorific powers.

In July 1825, Mr Ivory was pretty sure that the value of the fraction, which he now calls $\frac{a}{\beta}$, was $\frac{1}{3}$, and assigned a most absurd reason for it, as noticed in the last Number of this Journal. He also maintained, that it agreed sufficiently with the experiments on sound. In February last, he makes this fraction $\frac{3}{8}$; in March $\frac{2}{5}$; and, by this time, it is hard to say what may have been its fate. But, at all events, he avers and insists, over and over again, that it must be a *constant* quantity; and he contends, with equal zeal, for the accuracy of the law of Boyle.

On these two points, viz. the *constancy* of the ratio of the specific heats and the law of Boyle, Mr Ivory and I are perfectly agreed. They are the only data required for investigating the true law of temperature in air, and from which it follows as a necessary consequence *. However, when we reflect a little on the unstable nature of Mr Ivory's creed, it would be nothing remarkable, that, ere long, he renounce them both, and, as usual, without wasting time in assigning a reason.

The fraction of which we were just speaking, is the excess of the specific heat of air under a constant pressure, over its specific heat, reckoned unit, under a constant volume. From the many experiments made with the apparatus formerly described, I have found that fraction always so close on $\frac{1}{3}$, that I expect this will ultimately turn out to be the true quantity; and I think, the circumstance of this value pointing at the existence of a repulsive force, between the particles of air, inversely as the square of their distance, adds greatly to the probability †. It scarcely deserves notice, that the value of this fraction, as computed by Mr Ivory, from the experiments of Desormes and Clement, was always .3492, till I gave the correct Number .354, which he has now got hold of.

In the Second Number of this Journal, I instanced the para-

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* This law, it will be recollected, is, that, when the variations of the quantity of heat in a mass of air are uniform, those of its volume, under a constant pressure, form a geometrical progression; as do likewise the variations of pressure under a constant volume.

† See last Number of this Journal, p. 391.

doxical circumstance, that a correct result may sometimes be obtained from erroneous premises; but fortune has not here favoured Mr Ivory with any such conclusion, nor saved him from announcing, as the result of his investigation, a proposition which, he says, "solves the problem," although it may not only be condemned on its own evidence, but it obviously involves the consequence, that air, having the temperature of 32° F., can never by compression be brought to 212°,—a result notoriously at variance with observation, which has never yet discovered a limit to the rise of temperature,—but a result, let us recollect, which supposes the absolute zero at — 448° F. When would tinder kindle under the boiling point *! Had the same air been rarified only eight times, it would have been cooled down to — 1228° F., or 780° below the absolute zero above mentioned. A more extravagant inconsistency cannot well be conceived, if we except the still greater cold attending a greater rarefaction; and yet, according to the laws of 1825, the greatest cold could never reach — 448°.

The proposition alluded to, and which announces Mr Ivory's new law, is this: "*The heat extricated from air when it undergoes a given condensation, is equal to $\frac{3}{8}$ths of the diminution of temperature required to produce the same condensation, the pressure being constant.*

But since *ignorantia legis nemini excusat*, I shall, for the reader's edification, present him with a comparison of the laws. Let a be the expansion in the volume of air at zero, for one degree of the thermometer; τ the temperature by the common scale, for the initial density; and i the change of temperature on the same scale, produced by changing the density of the air in the ratio of ϱ to unit; or, ϱ is the quotient of the density at the end of the operation, when divided by that at the beginning. Then the old law of condensation given in 1825 is

$$i = \frac{1 + a\tau}{a}\left(\varrho^{\frac{1}{3}} - 1\right);$$

* According to the experiments of M. Gay Lussac, tinder or amadou becomes ignited in air condensed into one-fifth of its bulk. But this, by the new law, only produces a temperature of 32° + 144° = 176° F., or 36° *under the boiling point!*

and the new law announced above is

$$i = \frac{1 + a\tau}{a} \times \frac{3}{8} \times \frac{\varrho - 1}{\varrho}.$$

Two very different laws to be sure. If $\tau = 32°$ F., and consequently $a = \frac{1}{448}$ for Fahrenheit's scale, we have,

$$\text{For 1825,} \qquad i = 480° \left(\varrho^{\frac{1}{3}} - 1\right).$$

$$\text{For 1827,} \qquad i = 180° \times \frac{\varrho - 1}{\varrho}.$$

The truth of all I have alleged against the new law will now be manifest; particularly, that the quantity i can never amount to 180°; that is, the temperature can never, by condensation, be raised 180°, or to the boiling point of water. So that, under the new law, we need never attempt to kindle tinder in a condensing syringe.

If we compute the increase of temperature for a quadruple condensation, by means of the formula given in 1825, viz.

$$i = \frac{1 + a\tau}{a} \left(\varrho^{\frac{1}{3}} - 1\right),$$

we shall find, that the rise of temperature on the common scale, or the value of i, obtained by putting $\varrho = 4$, is exactly equal to the sum of the rises obtained at two operations, taking an intermediate density. Thus, put $\varrho = 2$, and find the value of i; then add this to τ, and find a second value to i; it will be found, that the whole rise of temperature is precisely the same in both ways. The character of the formula, therefore, remains unsullied by this test, though I do not mean to say that this is a complete and positive proof of its correctness. On first seeing that formula in M. Poisson's memoir, I tried it by this test, and the result did not lower its value in my estimation.

It is plain, that any formula which will not bear to be so handled, must be a mere visionary shadow, self-condemned, and good for nothing. I therefore proceed to apply the same simple test to the trial of the new law.

The new law of condensation is, of course, meant to be quite general in its application,—answering alike for all moderate temperatures and densities. Let us see how it stands the foregoing test, of computing the rise of temperature due to a quadruple condensation, by a single operation, and by two separate operations. At one operation, we have, putting $\varrho = 4$, and $\tau = 32°$ F., and $a = \frac{1}{448}$

$$i = \frac{1 + a\tau}{a} \times \frac{3}{8} \times \frac{\varrho - 1}{\varrho} = 135°.$$

Again, with $\varrho = 2$, we obtain $i = 90°$. Adding this to 32° makes the initial temperature $\tau = 122°$, and the formula, with ϱ again $= 2$, becomes 106°.875 for the second value of i. Hence the whole rise, computed at two operations, is $90° + 106°.875 = 196°.875$, which exceeds 135°, the rise at one operation, by the *enormous quantity* of 61°.875.

A similar inconsistency will come out in whatever way we vary the trial, and whether we use rarefactions or condensations. But I shall now apply a more obvious test.

In the case just considered, air at the freezing point, or 32° F., had that temperature raised 90°, or to 122°, by having its density doubled. Now it is clear, that, if the new law were correct, the same air, by having its acquired density halved, should just have its temperature lowered 90°, or from 122° to 32° F., being in every respect restored to its original condition. But if, in the above formula, representing the new law of condensation, we put $\tau = 122°$, $a = \frac{1}{448}$, and $\varrho = \frac{1}{2}$, the depression of temperature is no less than 213°.75; and, consequently, the resulting temperature, in place of 32°, is $122° - 213°.75 = -91°.75$ F.; giving the *monstrous error* of 123°.75, just double of that in the former example.

On the other hand, when the formula representing the old law of condensation is tried by the same test, not the slightest inconsistency can be detected; because this is founded in fact, but the new law in fancy.

It would be no difficult matter to apply both of these tests in a general way, by means of symbols; but the above proof, I presume, will be deemed quite conclusive, and will be more obvious to a greater proportion of readers.

The absurdity of the new law of condensation is therefore rendered evident to demonstration; and, indeed, if we reflect for a moment on its illegitimate origin, we shall cease to wonder at its untimely fate.

The result clearly proves what I formerly stated, *that it is impossible, in the very nature of things,* for the change of the quantity of heat in air to follow the change of volume under a constant pressure, if we admit the law of Boyle, and that the specific heat of air under a constant pressure, has to its specific heat under a constant volume an *invariable* ratio. So that, in spite of all Mr Ivory's analytical skill, he has allowed his prejudices to run him into a most untenable delusion; but having virtually renounced his former tenets, it is not very obvious what he can next embrace.

Postscript.—It will be found on examining Mr Ivory's papers in *Phil. Mag.* for February and March last, which treat expressly on his new law, that no intelligible reason is given for such a radical reform. This excited in me, and probably in many others, no small degree of surprise. For every one would have naturally expected, that a most satisfactory reason for the change should have prefaced his first paper; and since his article on Sound, in the Number for April, did not profess to treat of the new law, but is styled an "application" of it, I never thought of searching there for what ought to have appeared so long before, and was foreign to the title. But since my paper on Mr Ivory's articles was sent away, I happened to look into his article on sound, and found a very brief and obscure hint that something of his in *Phil. Mag.* for June 1825 was liable to objection. At first, I thought it should be June 1824, but afterwards saw that it must mean July 1825, and then perceived that such was all the explanation or admission of incorrectness we were to expect on this mysterious transaction. But this, after all, was an admission of error in a point where he was most correct; and therefore really worse than no admission. Before, however, making this tardy and useless confession, our author tries to have MM. Laplace and Poisson first in the scrape, and prefers a charge against them, which, I have no doubt, he will discover to be without foundation, when once his notions get right about the scale of temperature, and the laws of condensation.

It will now be seen, that my not looking sooner into the *Phil. Mag.* for April was a matter of no moment; and every one will be able to judge whether Mr Ivory has there redeemed his pledge of "clearing away all the clouds of obscurity," of which perhaps he had the best share himself.

A Tour to the South of France and the Pyrenees, in the year 1825. By G. A. Walker Arnott, Esq. M. W. S. (Continued from a former Number).

Having provided ourselves with all that was necessary for our journey, we left Montpellier in the diligence on the 17th May, in company with our two friends MM. Requien and Audibert, and arrived very late the same evening at Narbonne. On our route, we picked up very few plants, partly owing to our observing scarcely any of interest, and partly to the difficulty of getting out of a public coach when we did discover any. About Beziers, we first saw *Paronychia hispanica,* DC. (*Illicebrum argenteum*, Lin.), and *Echium violaceum* and *plantagineum* of French authors; but I have very great doubts if the latter be the true *E. plantagineum* of Linnæus; for, if I recollect well, Sir James Smith, in the Flora Græca, describes the leaves of the *E. plantagineum* as having strong lateral nerves, and covered with a soft pubescence. In the above two French species, however, which I consider as mere varieties of one species, the lateral ribs are by no means conspicuous, and the hairs are always more or les rigid. The description given by De Candolle in the "Flore Française" answers well to the plant of Linnæus; but it is only indicated at Nice upon the authority of Allioni, who may have confounded it with the *E. violaceum* *.

* That which is indicated at Narbonne in the Supplement to the "Flore Française", is certainly the same with ours. Mr Bentham (Catalogue des Plantes indigénes des Pyrénées et du Bas Languedoc, p. 76.), also considers, what we found as mere varieties of each other, but that each is the true Linnean plant: he further observes, that "when the plants grow close together

On the afternoon of the 18th, we made a short excursion to a small hill called the Pech de l'Agnelle (la Nielle of some, and la Nivian of others), on which, and in the plain betwixt it and Narbonne, we found a few rare species: some of these were in a good state, though many, on account of the extreme drought, which in a great measure had destroyed the crops, were too much advanced. Among those we secured, were *Plantago albicans*, two or three *Medicagos*, *Paronychia hispanica*, *Sisymbrium columnæ*, *Sonchus tenerrimus*, *Lonicera balearica*, Dum. (with which *L. implexa*, Ait. *, appears identical), *Melica pyramidalis*, of which *M. minuta* is merely a starved state; *Cachrys Morisoni*, *Leuzia conifera*, *Trifolium hispidum*, and *Lachenalia serotina*, which form no bad specimen of what we commenced our excursion with. *Silene quinquevulnera*, and *S. cerastoides*, were here so intermingled, that one feels astonished that they had ever been separated as species: the petals emarginate or entire, the pubescence, and the absence or presence of spots on the petals, were marks evidently set at nought by nature, and of no use to any but a mere herbarium botanist or horticulturist. In addition to the above, we met with an *Anthemis*, perhaps *A. incrassata*, Loisl., though in some points it does not well agree with his description.

On the 19th, we traversed the Montagne de la Clape, which is calcareous, exceedingly arid and dry, and destitute of any kind of covering higher than a *Cistus*. On our route to it, we

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in a poor and arid soil, the radical leaves are early destroyed, and the stem becomes straight, and simple, especially at the base, forming then the *E. violaceum* of authors. When, on the contrary, it occurs in a rich soil, though dry, with abundance of lateral room to grow, especially when on the road-sides, where it has been trampled under foot, its radical leaves grow to a great size, and its stem is branched from the base: it is then the *E. plantagineum*. The stiffness of the hairs varies much in both cases." To the above-mentioned "Catalogue," Mr Bentham has prefixed an account of our Tour to the Pyrenees. As a translation of it will contain nearly all that I was about to say, I feel assured that my readers will excuse me for giving one, instead of telling the same thing in different words. Much, therefore, I will translate, and where I have any thing to add, that he may have omitted, I shall do so: I shall also extend the botanical notices.

* This must not be confounded with *L. implexa*, Willd. which is evidently the same as *L. etrusca*, Savi.

met with *Frankenia intermedia*, DC. the leaves of which were covered with a *Puccinia*, which may be *P. Frankeniæ*, Link *. On ascending the hill, we found in the clefts of some extremely rugged rocks some interesting plants, but some of them too far advanced:—*Buffonia perennis*, *Melica pyramidalis*, *Piptatherum cærulescens*, *Alyssum spinosum*, *Dianthus pungens*, and *Lavatera maritima*, were among the number; and in the dry grassy turf near the summit, we discovered for the first time *Medicago leiocarpa*, nob. † This beautiful species is suffruticose, smooth and prostrate, and may have been long passed over for *Trifolium cæspitosum*; the legumes are perfectly smooth, which, with other characters, will at once distinguish it from the closely allied *M. suffruticosa*. From the point we found the above to the Redoute Montolieu, was a pretty long and tiresome walk: the ground was extremely rough with stones, and we saw scarcely a single plant that could recompense us. At the redoute we found the *Viola arborescens*, but so far advanced that the capsules had already burst open, and scattered the seeds. From thence we kept along the sea-shore to the Isle St Lucie, walking for three or four hours of the hottest of the day on the broad sandy beach, without a single trace of vegetation, scarcely even were there any *algæ* thrown on shore; but we saw some shells of the *Argonautæ*. On all this long track we did not meet one human being, except what constituted a large group employed in drawing their nets: they consisted of two or three men, and about twenty stout sun-burnt women, but all so dressed alike, *en culottes*, that it was by their voices alone we could recognise the fair sex. Little serves to amuse us, when we have nothing else, and the above circumstance contributed in no small degree, until a multitude of *Statices*, and other maritime plants, presented themselves to us in the island of St Lucie. Had a botanist been the first to discover this spot, he certainly must

* Dr Greville informs me it is *Puccinia Lychnidearum*, Link; but I do not know where that is described: it is certainly not *P. lychnidis*, DC.

† Although the legumes are smooth, or free from pubescence, they are nevertheless strongly reticulated; so that I have to regret that our provisional specific name *leiocarpa* has been adopted by Mr Bentham in his "Catalogue."

have named it the Island of Statices:—*St. aristata, auriculæfolia, diffusa, ferulacea, monopetala, oleifolia*, and *reticulata*, are mentioned as natives of it, and indeed we found all of these. Several *Euphorbias, Astragalus massiliensis, Scorzonera parviflora*, and *Juncus Gerardi* (*J. cœnosus*, Bich. and Sm.), were among the others we gathered. In the evening, we descended along the east side of the canal, and slept at La Nouvelle, a dirty village, where we could scarcely get any thing to eat (not even fish), and dared not complain, the lady of the house using her tongue so nimbly as to keep us all in order. A bad supper and a scolding hostess were not sufficient inducements for us to remain here another day; so the next morning at daybreak we began our return to Narbonne. We examined all on the west side of the canal, and obtained better specimens of many species we collected yesterday. *Passerina dioica* here formed thickets, and in the intervals we observed some poor specimens of *Evax pygmæus, Læflingia hispanica, Bupleurum glaucum*: of *Tamarix africana, Reseda alba*, and *Donax mauritanicus*, we found a few specimens, besides several others of less note, that it is unnecessary to mention. Although we had every reason to be satisfied with our excursion to this island, there is no doubt but one would more successfully visit it, either somewhat earlier or later: the small plants, as the *Evax* and *Læflingia*, had suffered much from the heat; and the larger ones, as the *Statices*, are scarcely enough advanced until the beginning of June. The Isle St Lucie was lately an island separated by the sea from a long narrow neck of land. Whilst they brought the canal, a branch of the Grand Canal of Languedoc, down this part, it was no difficult matter to complete the isthmus, and consequently make St Lucie a peninsula: this was done, so that it is at present no island, though still retaining its old appellation. We finished this excursion by returning by Capitoul, a small village on the side of the Montange de la Clape, where we expected to find the *Atractylis humilis*: we were, however, disappointed, as we got merely one or two of last year's stems, and some new ones scarcely emerged from the earth. Let those who can, visit this hill about the very commencement of May, and, above all, carefully avoid the seabeach.

Betwixt Narbonne and Perpignan, to which we now bent our course, is an excursion of two days. The greater part of the first we spent in the neighbourhood of the old abbey of Fontfroide, once a fine building, though now the upper storey is converted into a miserable auberge, and the lower into a stable. Passing the village of St. André, we reached Donos, where, instead of spending the night at the village, we were most hospitably received at the chateau, the house of the proprietor of the estate. The first part of this excursion was very rich. Besides many species of small plants (among which may be mentioned *Piptatherum paradoxum*, *Melica ciliata*, *Lœflingia hispanica*, *Briza maxima*, *Cytinus hypocistus*, *Trifolium Cherleri*, and *Tolpis barbata*) which we met with on the hills about Fontlaurier, we found, in the wood of Fontfroide, a great variety of *Cisti*, all of them in flower: here were *Cistus albus*, *populifolius β*, *monspeliensis*, *crispus* (both with red and rose coloured flowers), *longifolius*, and several states of *salvifolius*, or perhaps hybrids between that species and *C. monspeliensis*. The rarest of all no doubt was *C. longifolius*: of this seldom more than a single plant is found at a time, which alone would lead to a suspicion of its hybridity; it may have sprung from the *C. monspeliensis* and *C. populifolius*. *C. corbariensis*, though indicated here, we did not meet with. This is perhaps another hybrid between *C. salvifolius* and *C. populifolius*. De Candolle has made it, in his "Flore Françoise," a variety of *C. salvifolius*, and Dunal, in the "Prodromus," though he retains it as a species, places it close to that species. Its appearance is that of a small-leaved variety of *C. populifolius* *; but the peduncles having no bracteæ at their base, point out the propriety of Dunal's arrangement, unless, indeed, it, as well as many other of the *Cistineæ*, were to be turned out as hybrids, and left to the care of the florists. In addition to those mentioned as found at Fontlaurier, I ought to notice the *Helianthemum guttatum*, which here puts on so many appearances, that one at first would

* Mr Bentham thinks that *C. corbariensis* arises from the young autumnal shoots of *C. populifolius* beginning to flower, and that it is identical with this latter species (Cat. p. 72.)

imagine they had found as many distinct species. The three principal variations were, however, that of *H. guttatum* Dun., in which, though the stems be hirsute, the pedicels are generally glabrous; of *H. eriocaulon* Dun., in which the whole plant, the pedicels not excepted, is rough with white patent, bristly hairs; and, lastly, *H. punctatum* Dun., of which the leaves are covered with a very short, thick, starry pubescence: these three states I believe to arise from the seed of the same plant. There is also little doubt but *H. plantagineum* and *H. inconspicuum* are only varieties of *H. guttatum*.

Early the next morning we quitted Donos, and traversed the Low Corbières to Cascastel, where we turned, and took a retrograde direction by Durban and Villeseque to Séjean. In all parts of this route, we were so fortunate as find our lately discovered *Medicaga leiocarpa;* and at Cascastel we even found another new species, *M. reticulata*, nob., approaching *M. tornata*, but differing by the legume reticulated, and furnished with a thick, bisulcated, tuberculose margin. *Astragalus pentaglottis* and *sesameus*, and *Euphorbia lucida*, presented themselves, but in small quantities. *Malcomia africana* was also rare, but the same could not be said of *Convolvulus althæoides*, which covered the side of a hill near Durban. In all the excursions we have made since our arrival at Narbonne, we have occasionally found specimens of *Hippocrepis scorpioides*, Req. a new species, not uncommon throughout the south of France, closely allied to *H. comosa*, but distinguished by the legume being more cylindrical, and nearly straight, as in *Ornithopus*.

We arrived at Séjean about nine o'clock, and intended to set off by the night diligence for Perpignan; but when it arrived about an hour after, there were only two vacant places. Two of the party set off, while the other two (of whom I was one) remained, resolved to wait for another vehicle expected about eleven. It arrived, and we were fortunate, if I can apply that word to the being squeezed nearly to death between two fat Spaniards, who alone seemed fitter for filling the whole *interieur* than for occupying two of the three seats on one side. Notwithstanding, the whole cargo arrived at Perpignan about four in the morning, not ten minutes after our friends, who had fared no better than ourselves.

On the 25th, we made an excursion to the banks of the Testa, where we found in very good state most of the plants indicated there, as *Andryala lyrata*, *Lachenalia serotina*, and *Melilotus gracilis*. *Cistus laurifolius* was scarcely yet in flower. A handsome blue flowering *Orobanche* (*O. comosa*, Wallr.?) about the size of *O. major*, was here far from rare, growing on the roots of *Artemisia campestris*.

The botanic garden is of little consequence; but there are nevertheless several scarce plants in it, habituated to the open air. *Solanum bonariense* and *Schinus molle*, were in the utmost luxuriance: there was also a fine tree of *Stillingia sebifera*. The lecturer here has 200 fr. (about £18 Sterling) *per annum*, with 200 more to pay the incidental expenses of the establishment, as utensils, flower-pots, new plants, &c. The head-gardener is better off: he has 400 fr. for the garden, and 700 for taking care of the pepinière or nursery, with which, however, he has to pay his assistants.

The 26th, 27th, and 28th, we devoted to an excursion to Collioure. On our way there, we gathered *Vicia perennis*, DC. *Hypecoum grandiflorum*, nob., and several other good plants, during the time that the diligence ascended the steep places of the road. Where the regular road was under repair in one place, we were obliged to take another; and near the village of Corneille del Vercol, we observed a blue *Iris* on the right side of the road, which we supposed to be *I. spuria*. The whole summit of the hill above Collioure, between the road and the fort, is covered with *Scolymus grandiflorus*, regarding which De Candolle and La Peyrouse have had some discussion. Although De Candolle, when there, had not seen it, it nevertheless appears to be the true plant, and a very distinct species from the other two found in France.

The next morning we took the road to Bagnols, and ere long found *Asphodelus microcarpus* and *Orobanche crinita*, Vir. both lately discovered in Corsica. Near Portvendres we observed in abundance *Euphorbia biumbellata*, *Corynephorus articulatus*, *Anthyllus Gerardi*, and *Orobanche fœtida*; and at Paullilas *Lavatera olbia*. From Bagnols we ascended the banks of the river to Cancompa; nor could our time be said to be lost, when we procured *Briza minor* and *Trifolium ligusticum*. *Vitex* *agnus-castus* grew every where about Bagnols; but the most interesting plant in the whole valley was *Gymnogramma leptophylla*, Desv. The mosses were few in number, and not in very good condition. I was, however, enabled to recognize *Bartramia stricta*, Schw. by its single peristome. We ought to have found *Nonea lutea* on the rocks about Collioure, and *Arenaria peploides* *, La Peyr. about Paullilas, but returned to Collioure without seeing either.

On the 28th, having previously ascended the Montagne Verte by N. D. de Consolation, and procured *Malva Tournefortii*, *Allium triquetrum*, *Medicago suffruticosa* (a new and distinct variety) *Cytisus triflorus* and *candicans*, we returned to Perpignan. Thus finished this rich excursion: all the best plants were in good condition, and instead of three, there would have been sufficient employment for eight days. The whole chain of the Albères must be stored with species of great rarity, and the northern must be even far inferior to the south or Spanish side, which we had not time to visit.

29th May.—This day was Charles X. crowned, and consequently kept as a day of festivity. It is almost worth while to go to Perpignan to see their national dances; and I regret exceedingly I can give no idea of them by description. I shall never forget when, as if by the touch of a magician, all the females were, at a particular part of the tune, seated on the shoulders of the men, and then put down again on *terra firma*, the evolutions in the dance being uninterrupted. In the afternoon, a few halfpence and sugar-plums were scattered among the peasantry. The town of Perpignan is not handsome, but the promenades are fine. The features of the common people, as may be expected from the greater heat, are much more swarthy than at Montpellier: several females were almost black, and had even the thick nose and lips of the African negro.

(To be continued.)

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* This, so far from being the *Ar. peploides* of Linnæus, does not even belong to the same natural order: it is a *Hagea* or *Polycarpon*, for these genera are certainly not distinct. M. Gay of Paris, who has given me a specimen from the rocks at Portvendres, named it *Polycarpon pentandrum*: it is closely allied to *Hagea polycarpoides*.

Account of the interesting Works of Art lately discovered in the Ruins of Selinus, by two English Architects, Messrs Harris and Angell. Communicated by Dr Traill of Liverpool.*

Two young English architects, Messrs Harris and Angell, having come to Sicily to study its celebrated antiquities, after long occupying themselves with those of Agrigentum, of Syracuse and Catania, turned their attention, in the winter of 1823, to the remains of Selinus.

In excavating amid the ruins of two great temples in that place, they discovered, on the steps of their façades, several metopes broken into a thousand fragments, on which might be traced portions of figures in high relief, which inspired these gentlemen with a strong desire to search for the remainder.

They applied themselves immediately to new researches, and, with great labour, collected many other fragments, which they sent, with the first, to Palermo, where they proposed to unite them; and, if possible, to restore to the arts works of such inestimable value. But poor Harris, infected by the mephitic exhalations of Jalico (the ancient marsh of Gonusa, against which, according to Laertius, the genius of Empedocles successfully combated, but, unfortunately for the Selinuntines, without lasting success), died, lamented by all who knew his virtues and his talents. The task of uniting the fragments then devolved on his sorrowing companion, who, for that purpose, came to the capital of Sicily, where he found the author of the present memoir appointed by the government to assist him. †

The learned gentleman, before giving an account of the labours of that ingenious youth, and expressing his own opinion on the works which they succeeded in restoring, conceived himself called on to offer some observations on the origin and vicissitudes of the city to which they had belonged. Contrary to the

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* Read before the Wernerian Natural History Society, 21st April 1827.

† Signior Pietro Pisani, who has published the learned memoir reviewed in the present article. It was printed at Palermo, in 1814, in a small octavo volume, entitled, "*Memoria delle opere di Scultura ultimamente scoperte in Selinunte.*"

opinion of some, who suppose Selinus to have been founded by the Phœnicians, he inclines to believe that it was founded by the Sicani: supporting his opinion by the remarks of Diodorus, that Dedalus, having come from Crete to Sicily, (long before the Phœnicians, as is well known), built, in this city, a bath, in which was collected hot vapour issuing from the earth, and inducing a soothing pleasure in the human frame. In Selinus, among other very ancient edifices, was a celebrated temple of Jupiter Agoræus, before the altar of which, according to Herodotus, Eurleon was slain, who unhappily aspired to become a tyrant, after having earned the divine title of Liberator. But every vestige of this temple had disappeared for many ages; and it would seem, perhaps, a hopeless task to discover it. Three very ancient temples, of moderate size, have been discovered on the spot now occupied by the citadel; and three others of a posterior age, but of more ample dimensions, at the place called *The Pillars of the Giants*, about a mile from the citadel. None of the second group could be the temple of Jupiter Agoræus; none of the first had been conjectured to be so.

The six temples are all built of a shell-limestone of the tertiary formation, like those of Syracuse, of Agrigentum, or of Segesta, and have ornaments of a granular limestone of the secondary formation. The fragments of the metopes, composed of this last material, almost all formed part of a sculptured frieze in the middlemost temple of the first group; and some of them belonged to the central one of *The Giants' Pillars.* The cramps (*Tessersi*), found in considerable number between the respective triglyphs, much facilitated a knowledge of the consecutive disposition of the metopes; and, consequently, (thanks to the drawings which the two English artists made on the spot) to their recomposition.

The work was commenced by the reunion of the metopes of the temple of the citadel. Of the ten which originally existed, they have succeeded in joining three nearly entire, viz. the 6th, the 7th, and the 8th, each 4 feet 9¼ inches (English measure) in altitude, and 3 feet 6½ inches broad.

In each are *three figures*, representing a mythological subject, " a circumstance worthy of notice," says the author of the memoir, " since no more than two figures have ever been observed on the metopes of any temple hitherto discovered." In the sixth, (which he describes with its companions), he believes that he has recognised the education of the Sicilian Bacchus, the son of Jupiter and Ceres, more ancient than the Theban offspring of Jupiter and Semele. This he eruditely deduces from many circumstances, and especially from its affinity with another group ascribed to Polycletes; which, according to Pausanias, was to be seen in the temple of Ceres at Athens. In both, the young Bacchus is placed between two goddesses, his mother, and his sister Proserpine. The only peculiarity in our sculpture is, that, assisted by his mother, he stands in the act of curbing four horses yoked to a rustic car; an unequivocal symbol of agricultural operations. The seventh metope appears to the author still more easily explained. He does not hesitate to find here delineated the moment of time in which *Perseus*, sustained by Minerva, under a human form, cuts off the head of *Medusa* (guilty of having profaned the temple of the goddess by the seduction of Neptune), while from the blood of the wound, Pegasus is produced, whom the dying female presses to her bosom as part of herself. And, lest it may be objected to him, that the *Gorgon* is not recognisable, as she wants the characteristic of snaky locks; he answers, that the first who gave her this attribute was Æschylus, who was several ages posterior to the sculpture of which he treats; so that this characteristic may be considered in some degree as modern and arbitrary. Indeed, he remarks, that the beautiful and unfortunate young woman is also represented with the long and natural tresses on an ancient Etruscan monument, made known by his countryman Micale in his history *; as likewise on a valuable coin, which Eckel attributes to Populonia; Castello to Camarina; and which he believes to have belonged to Selinus †.

In the eighth metope, which is better preserved than the last, he recognises *Hercules Melampyges*, either from his black bullocks, or because he carries on his shoulder, appended to each extremity of the spear, the two brothers Passalus and Archemon; who were induced to betray him whilst he slept. This

* "Italia avanti il Dominio dei Romani."

† Ossia delle Neitiche nere che porta in ispalla," &c.

accords with the mythology of the statue erected by them near Thermopylæ, in grateful acknowledgment of his having spared their lives justly forfeited by their crime; and with the pictures on two Greco-Sicilian vases of great antiquity, one seen by the author in Palermo, the other at Girgenti.

To find on three consecutive metopes the actions of three sons of Jove engraven; and to know that the ancient Selinus, where there was a temple to Jupiter Argoræus, occupied the site of the citadel of Selinunte, gives probability to the idea, that the metopes belonged to that temple. In like manner, says the author, we find the war of the giants sculptured on the façade of the temple of Olympian Jove at Agrigentum. In one of the tympans of the Parthenon at Athens, we behold the representation of the birth of Minerva; and in the other, her contest with Neptune. Thus, in the façades of the most celebrated temples of antiquity, were represented deeds relating to the divinity worshipped within.

With respect to the middle temple of the group of *the Pillars of the Giants*, (to which none can compare in size, except that of the Agrigentine Jupiter,) not having succeeded in piecing any of its metopes, it becomes difficult to decide what subjects they represented. Each of them contained no more than two figures, seemingly of warriors and women intermixed. Hence the author, after an examination of numerous fragments, is of opinion that they represented *Amazons*, and has proposed as a question, whether the subject might not be the invasion of Attica by those heroines?

The metopes of the temple of the citadel evince, from the rudeness of the back ground, and of the most elevated parts of the sculpture, no less than by the hardness of the figures themselves, an extreme antiquity. The *Hercules Melampyges* alone is somewhat less rude; and one can perceive that it unfolds the germs of the successful efforts at perfection which the art of sculpture was then making. Certainly the horses (a phenomenon which each may explain in his own manner) are most beautiful, not only relatively to the human figures, but absolutely; and on seeing them, we are inclined to refer them to the perfection of the art.

In reflecting on the very remote origin of Selinus, and the resemblances in the above mentioned sculptures, to those of the early *Etruscan style*, we could believe them, says the author, also the production of an *Etruscan chisel.*

This opinion, he adds, will appear less improbable, if we reflect, that the *Siculi*, from Italy, came to take possession of the island, to which they gave their name, about 300 years before the Greeks, and might have brought with them the arts which then flourished in Etruria. Yet, still it would not be erroneous to attribute a Grecian origin to the sculptures, if it be true, as celebrated scholars have maintained, that the Etruscans learned the arts from the Pelasgi or the Tyrrhenians. Hence Winckleman recommended monuments of the most ancient Etruscan style, as the only remains which could give an idea of the earliest specimens of Grecian sculpture *.

Of the Phœnicians, the author thinks it unnecessary to say a word; because they did not found a single town in Sicily; because they had no connection with it, but for a short period; because they had no intercourse with the Siculi, but as traders; because, when they came as allies to the Segestans, Selinus had already existed for ages; because they did not cultivate the fine arts; and because we possess nothing of their works, but a few rude coins.

With regard to the sculptures of the temple of *The Pillars*, the author remarks, "There can be no doubt that they are the productions of a Grecian chisel." From their style being quite similar to the marbles of Ægina, sculptured about sixty years before the time of Pericles, we not only discern (in comparison to the above mentioned sculpture) a great progress in the art, but a high degree of perfection. The drawing of the figures is correct and elegant, the heads beautiful and attractive, the forms rounded, the action simple and natural, the drapery disposed in compressed and parallel folds, with much gracefulness, the shadows as well as the lights, distributed in soft gradation. Another characteristic excellence of these figures, ob-

* The justice of this remark has since been confirmed by the discovery of the Ægina marbles, in which the style is exactly what has been hitherto called Etruscan, forming the long lost link which connects the stiff outline of Egyptian art with the perfection of Grecian sculpture.—Tr.

serves the author, is their being in such bold relief, that the greatest number touch the ground only in a few isolated points. From this it is evident, he adds, that, when they were executed, already long experience had taught, that, in *relievos* exposed to the open air *, the detaching of the figures contributes much to the distinctness of the groups, and to the harmony of the general effect. Their execution, he adds, is in every respect worthy of the school which preceded that of Phidias.

We have before us a letter of Sig. Hittorff, written from Selinunte, 30th December 1823, to the editor of the Journal of Arts in Stuttgard, which seems to confirm the above remarks. It is to be regretted, that the theatres of Taormina and Catania, and the temples of Girgenti, had not left leisure to the German artist to enjoy his visit to Palermo, and to follow, as discoverer and illustrator of the metopes of Selinus, the unfortunate Harris, on whose memory he bestows a tear, which we have pleasure in recording.

On the Magnetic Influence of the Heat produced by the Solar Rays, &c. By Mark Watt, Esq. Member of the Wernerian Society. Communicated by the Author.

As the curious and diversified phenomena disclosed by recent investigations into the laws of magnetism, and the delicate impressions of which they are susceptible, have become objects of general interest; perhaps a short statement of a few experiments made on the magnetic needle last spring and summer, in the Isle of Wight, may not be unacceptable.

A magnetic needle of about three inches long was used, and was suspended by a hair, which hung from a stand, and, surrounded by a sheet of pasteboard, to protect it from any slight current of air that might pass through the room. The needle gave similar indications to another, which was boxed in the usual way.

It is generally supposed, that when a magnetic bar is placed

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* Che ne rilievi da esporsi in campo aperto il distacco delle figure.

free to move, it is not easily prevented from evincing the influence of that law which obliges it to rest parallel with the magnetic meridian; although the intermediate body should be applied close to the bar,—no body interposed at any distance (if not attractive) having any influence on it whatever. I found, that, by coating the needle with bees-wax, or putty, the directive power might be variously modified; and that, by making the coating sufficiently thick, the polarity of the needle might be so far counteracted, as to produce for the time a total cessation of its action. The magnetic bar, however, which was suspended and balanced from the centre, gave some indications of its polarity, though immersed in the midst of about a pound of putty,—a proof, amongst many, of the subtilty of the magnetic fluid.

A needle traversing on a pivot is of course unfit for such trials; but when the needle is suspended horizontally by a human hair, and the other end of the hair fixed to the top of a glass-bell by a little wax, or suspended in any other way, it indicates much slighter influence than in any other situation; and a human hair doubled will support nearly $\frac{6}{12}$ths of a pound, a horse-hair one pound avoirdupois with ease, and, if loaded, by degrees considerably more.

I gradually increased the thickness of a layer of bees-wax around the suspended needle, covering both the poles; and I perceived, that, as the thickness of the coating was augmented, the north pole of the needle seemed to shew greater tendency to move westward; and, with a coating of wax of about $1\frac{1}{2}$ inch diameter, the needle pointed N. W. for several hours, and in the course of some days went back to N. N. W., where it remained almost stationary. I repeated this experiment several times, with nearly the same results.

I also repeated the experiment with another small magnetic bar of about 2 inches long, and $\frac{1}{8}$th of an inch in breadth and thickness, making the needle and bees-wax swim in a large basin of water. I incased the needle in a pound of bees-wax, making it into a cylindrical shape, of half a foot long and $2\frac{1}{2}$ inches in diameter. If the south pole of the bar was placed towards the north, it turned round the pound of wax with ease; and when it became steady, it pointed several degrees more to the westward than the common compass needle. As the tendency of the north poles of these magnets was to verge towards the west, in the direction of the variation, when placed under these circumstances, it seems to favour the idea that the cause of the variation is distinct from the law which gives to the magnetic needle its polarity.

It appears that, when the magnetic needle finds itself in what may be termed a new situation in respect to the influence that may affect it, a considerable time is often necessary before it can adjust itself to those alterations, making sufficient allowance for the time it would take to settle, when any way set in motion.

This is exemplified by fixing two magnetic bars on the circumference of a circle, at the distance of 90° from each other, the circle being suspended by a hair from the centre horizontally, and balanced so as to move round easily; and the two north poles of the bars placed outwards, and the south poles pointing to the centre of the circle, in the direction of the radii. If the north pole of a powerful magnet is placed between the north poles of the bars, at the distance of two inches on a separate stand, they commence to vibrate, and the alternate repulsion of the magnetic bars by the third magnet, causes the circle to oscillate for nearly half an hour; and, when it ceases, the repelling magnet, if the needles are equal in power, will be exactly between them. If one is stronger than the other, the strongest will be farthest off. The same phenomenon would take place in an inverse ratio, if an attracting magnet was introduced between the bars; the strongest resting nearest the attractor. This is too refined an experiment to be shewn by a common magnet, but is exhibited by considering the north pole a large magnet. If we place two magnetic bars across each other at right angles upon a piece of cork, swimming in water, the strongest needle will rest nearest the north, if alike equidistant from it.

Though the pointing of the needle was altered by its being surrounded by wax, it did not lessen its sensibility to the power of other attracting bodies; but seemed, on the contrary, rather to increase it, by leaving it more free from the influence of the polar attraction. One object I had in view, by diminishing the polarity of the needle, without interposing any other attracting body, was to observe what influence the solar rays might exert on it.

I exposed pieces of tin, zinc, copper, and sealing-wax, to the rays of the sun for two hours, and, being considerably heated by this means, they sensibly attracted the magnetic needle, producing a variation of a few degrees. When heated by the fire, they had no effect on it. The copper and sealing-wax appeared to possess the greatest power of attraction. The rays of the sun, as far as I could judge, when passed through a lens, caused a variation of two or three degrees. And it also appeared to me, that, when the focal rays were passed through different coloured glasses, and made to impinge on the side of the wax surrounding the needles, that they had different effects on the opposite poles. The blue rays formed in this manner, seemed to attract the south pole, and repel the north. The blue and violet ray produced a variation of several degrees, when directed to the south pole.

The rays of the sun, whether undivided or separated by the prism, do not appear to exert their influence long on the magnet, in producing a variation not above a minute; and this arises, I suppose, from their coming into close contact with it; and from their being so suddenly generally diffused over the whole needle. It requires favourable circumstances to observe the effect of these delicate influences; and I should feel indebted to any one who would try these experiments with powerful lenses, to attempt a farther illustration of them.

When the magnetic needle is surrounded with wax, or glass, and made to swim on the surface of water, it moves to much gentler impressions than when placed on a pivot. The wax also prevents the rays of light from coming into such full contact as when the needle is uncovered. A shade should be thrown over one pole, when the other is made the subject of experiment. And the vessel ought to be large in which the magnet swims, else it will not rest in the centre, being attracted to the edges; and it should be marked at the bottom, to enable the observer to detect the motions of the needle.

List of Rare Plants which have Flowered in the Royal Botanic Garden, Edinburgh, during the last three months; with a Description of several new species. Communicated by Dr Graham.

10*th June* 1827.

Acacia lunata.

Loddig. Bot. Cab. t. 384.

A. *lunata;* phyllodiis falcatis, basi vix attenuatis, oblique mucronatis, uninerviis, margine antico uniglandulosis; pedunculis racemosis, axillaribus, phyllodios æquantibus; capitulis numerosioribus, paucifloris; floribus 5-fidis.

Description.—*Shrub* free growing. *Branches* scattered, spreading, slender, smooth, angular. *Phyllodia* falcate, mucronate, glaucous, $1\frac{1}{2}$ inch long, $\frac{1}{4}$ of an inch broad, having a distinct single rib not quite in the centre, veins very obscure; as the branches spread out nearly at right angles, the phyllodia on the lateral branches turn towards the upper side, but on the upright shoots they spread on all sides. *Peduncles* axillary, about the length of the phyllodia, sometimes a little longer, often rather shorter; *pedicels* simple. *Flowers* capitate, capitula numerous on each peduncle, generally four flowers in each head. *Calyx* 5-phyllous, phyllæ ovate, pointed, adpressed, corolla 5-cleft; tube campanulate, limb spreading, segments lanceolate. *Stamens* very numerous, filaments very slender, anthers rounded. *Style* longer than the filaments; *germen* lateral; the whole capitulum of a delicate and beautiful yellow colour.

Seeds of this very elegant species were received from Mr Fraser from New Holland, under the name of *Acacia acinacifolia*, in 1821. We have remarked, as stated by Messrs Loddiges, that it never produces fruit in our greenhouses.

Acacia mucronata.

Banksia integrifolia.

Br. Trans. Linn. Soc. vol. x. p. 206. ?

Description.—*Trunk* erect. *Bark* dark and cracked. *Branches* at first erect, ultimately spreading, covered with soft, yellowish pubescence when young. *Buds* in whorls, but generally all, excepting one or two, abortive. *Leaves* petiolated, subverticelled or scattered, ligulate, coriaceous, dry, stiff, undulated, green and naked above, below covered with white tomentum, through which many small reticulated veins appear, when young covered with yellow tomentum on both sides, sinuato-serrated, occasionally entire, serratures mucronate, middle rib prominent behind. *Flowers* terminal, head 2–3 inches long, less than half the length of the leaves, which are generally crowded at its base. *Calyx* silky.

We have a plant which has not yet flowered, but which I can consider only a variety, which is more vigorous in its growth, the trunk swollen into joints, the branches more erect, the leaves more decidedly verticelled, more of them entire, and many of them lanceolate, having evident nearly transverse primary veins, the pubescence on the young shoots being red-brown.

Raised from seeds sent by Mr Fraser from New Holland in 1819.

Cactus heptagonus.

Cycas circinalis, mas.

This plant, whose stem is $4\frac{1}{2}$ feet high, nearly cylindrical, and 6 inches diameter at the base, has flowered for the first time with us this spring. Its appearance differs from the figure given by Achille Richard, in the catkin being sessile, cylindrical, less compact, the scales much shorter, more dilated at their outer extremities, so as to give them a deltoid or almost halberd shape, and their beaks are nearly equal to their own length. The anthers are crowded on the lower side of the scales, and are generally connected in threes or fours.

Dracæna obtecta.

D. *obtecta;* arborea, foliis lanceolatis, acutis muticis, basi dilatatis, confertis, planis, panicula terminali composita, folia superiora æquanti, congesta, ramis elongatis ascendentis, floribus sparsis, bracteis integerrimis, superioribus minoribus.

Description.—*Stem* round, scarred by the separation of the leaves, 12 feet high. *Leaves* crowded at the top, and would probably have remained on a great part of the stem, had they not been cut off for want of room, lanceolate, acuminate, but without mucro, attenuated towards the base, but then dilated, and stem clasping, thickened along the middle, nerves numerous, slender, parallel; a large *bud* is formed in the axil of each leaf, but proves abortive, excepting near the top, and at the period of flowering, when several offsets split the leaves, in the axils of which they spring, and pushing through, appear on the lower side. *Panicle* terminal, large, crowded, compound, scarcely exceeding in height the tip of the upper leaves. *Bracteæ* situated at the origin of each branch of the panicle, resembling miniature leaves, quite entire, becoming smaller and smaller upwards in the panicle: at the lower branches of the panicle there are two, one large and below the branch, the other much smaller and above it. *Flowers* sessile, numerous, scattered, and highly perfumed. *Corolla* 6-parted, revolute, afterwards approximating at the apex, and withering. *Filaments* subulate, revolute; *anthers* small, green; *pollen* yellow. *Germen* ovate, green, trilocular; *style* somewhat tapering upwards to the 3-cleft stigma. Every part of the flower except the germen and anthers pure white.

This plant was raised from seeds sent by Mr Fraser in 1820 from New Holland, without name, or any statement of the particular district from whence it was obtained. It grows vigorously when placed in a large tub with rich soil. The specimen which has flowered was at first kept in the stove, but for two years has been in the greenhouse. A specimen planted in the open border is scarcely alive.

Dryas integrifolia.

Liparia sphærica.

——— villosa.

Lomatia longifolia.

Magnolia cordata.

Flowered in May on the open wall, in a sheltered situation.

Omalanthus populifolius.

O. *pupulifolius;* frutex erectus; caule deliquescenti; foliis sparsis, deltoideo-rhomboideis, acuminatis, integerrimis, subtus albidis, margine callosis; stylo bifido, segmentis revolutis, stigmatibus terminalibus obliquis, germine lenticulari.

Description.—*Stem* erect, round, red on the side next to the light, green and spotted with red on the other, about seven feet to the first branches. *Branches* proceeding from a point, equal in size, and leaving no leading shoot, every subdivision taking place in the same way; number of branches proceeding from one point various, but very commonly three. *Leaves* soft, pendulous, deltoideo-rhomboid, with a red callous edge, acuminate, upper surface bright green and dull, lower white; while decaying the whole becomes beautifully red; middle rib red and strong, with many oblique straight veins proceeding from it to the edge of the leaf, and united by many small transverse, somewhat reticulated secondary veins. *Petiole* red, somewhat channelled, nearly as long as the leaf, having a concave gland projecting forwards from its point of union with the leaf. *Buds* inclosed in large, pointed, convolute sheaths. *Racemes* terminal, nodding. *Flowers* monœcious; female flowers at the base, male flowers towards the apex of the racemes, and much more numerous; female flowers solitary, male generally three together, both pedicelled, but the pedicel of the female rather the longer, and lengthening still farther as the fruit ripens. *Bracteæ* at the base of both, rounded, biglandular. *Calyx* in both flowers diphyllous, kidney-shaped, especially in the male, entire, glandular, caducous in the female flowers. *Stigmata* two, terminal, oblique, round, slightly bordered, green. *Style* divided to about two-thirds of its length, segments revolute, green, their upper surface covered with a reddish, glandular excrescence, which is continuous from the one segment to the other, and broader than they are. *Germen* lenticular, more rounded as the fruit advances to ripeness, bivalvular, bilocular, loculaments with one seed in each, dissepiment contrary to the valves. *Seeds* oblong, flattened towards the dissepiment, from the upper part of which they are suspended: outer coat hard and dark, white and shining on its inner surface; embryo straight. *Male flowers* compressed; *stamens* six; *anthers* geminate; *filaments* united at the base.

This plant is a native of New Holland, from whence we received it by the kindness of Mr Fraser in 1824. It sprung from seeds sown among earth in which growing plants were imported. It has been always kept in the stove, though it will probably thrive in the greenhouse. I am indebted to Dr Hooker for pointing out to me the description of the genus by Adrien de Jussieu, in his account of the *Euphorbiaceæ*, a work I had not before seen. The form of the stigma and the germen are different from the account and figures given by that author; the leaves are scattered, not alternate, and I have not observed that in our plants the male and female flowers are ever on distinct racemes; yet I cannot at all doubt that the present species belongs to the genus *Omalanthus*.

Oxalis bipunctata.

O. *bipunctata*; scapo multifloro, petiolis vix longiori, compresso, petiolisque pubescenti; foliis ternatis, foliolis rotundato-obcordatis, subtus pubescentibus, supra subnudis, petiolis cylindraceis; sepalis obtusiusculis, apice bimaculatis; staminibus 5, stylos superantibus.

Description.—*Leaves* bright green above, paler (occasionally purple when young) below, very slightly acid, all radical, ternate, leafets broadly obcordate (1¾ inch from base to apex, 2¼ inches across), pubescent on the lower side, very sparingly so on the upper, ciliated, middle rib prominent below, and giving off two strong arching veins on each side, those nearest the base being generally branched on their outer side. *Petioles* round, 5 inches long, pubescent, hairs spreading and lax. *Scapes* numerous, pubescent like the petioles, and rather longer than them, slightly compressed, somewhat irregularly divided at the top, but generally into three branches, which are sometimes again divided, though most frequently the flowers proceed directly from their extremities, on long, round, spreading pedicels. *Pedicels* of the bud nodding, of the fruit reflected. *Bractea* at the primary division of the scape a short entire sheath, at the secondary divided into small leafets, placed one on the outside of each pedicel. *Calyx* green, with a few adpressed hairs, leafets lanceolato-elliptic, with narrow membranous edges, each having two oblong, approximating orange callosities on the outside of the apex. *Petals* lilac and veined, subspathulate, truncate, unequally crenate at the apex, spreading. *Stamens* 10, 5 shorter and 5 as much longer than the styles; *filaments* colourless, united at the base, and above the union hairy; *anthers* yellow, cordate, attached by their backs to the filaments. *Germen* nearly smooth, green, divided into 5 oblong lobes, each containing several seeds; *styles* 5, stout, nearly colourless, hairy; *stigmata* lobular, deep green, projecting between the longer filaments.

The plant flowered abundantly in the stove of the Royal Botanic Garden, Edinburgh, in April and May 1827, but has not produced seed. Roots were received in 1823 from Mr Harris at Rio de Janeiro, by Captain

Graham of his Majesty's Packet Service; but other specimens, which are extremely similar, were in the collection before, though it is not known from whence obtained. These differ from the plant described, only in having the back of the leaf more reticulated, the anthers paler, and the shorter stamens equal in length to the styles.

Passiflora alata, var. pedunculata.

I have already noticed three varieties of this beautiful species cultivated in the Botanic Garden at Edinburgh. The present was raised from seed brought by Captain Graham of his Majesty's Packet Service from Rio de Janeiro in 1823. It is as handsome as the finest of these, and in foliage very much resembles the var. *insignis.* It is, however, easily distinguished from all the others, by the peduncle being equal in length to the petiole; by the bracteæ being very large; by the stipulæ having one or two teeth on one side; by the nectaries being rather shorter, and opening wider.

Penæa imbricata.

P. *imbricata;* foliis rhombeo-ovatis, acutis, integerrimis, quadrifariam imbricatis vel patulis; ramis tetragonis, decussatis, floribus terminalibus; bracteis paucis, nudis, coloratis, sagittatis, folio minoribus; laciniis corollæ obtusis, medio plicatis.

Description.—*Shrub* erect, bark brown and cracked; *branches* numerous, decussating, ascending, four-sided. *Leaves* sessile, rhomboid-ovate, coriaceous, somewhat pointed, decussating, generally spreading on the branches, imbricated towards the flowers, naked on the back, middle rib distinct, with a few obscure lateral veins. *Bracteæ* few, sagittate, without ciliæ, coloured. *Calyx* diphyllous, segments linear, coloured, alternating with two hastate bracteæ nearly on the same plane. *Corolla* rose coloured, tubular, tube furrowed, inflated at its base, tapering somewhat to the throat, less than double the length of the calyx; *limb* 4-parted, segments rounded, with a slight point in the centre, folded back in the middle, about half the length of the tube, and slightly contorted. *Stamens* 4, alternating with the segments of the corolla, and attached to the throat; *filaments* subulate, coloured; *anthers* large, cordate, as long as the filaments; *pollen* yellow. *Germen* 4-lobed, 4-celled, pointed; *style* terminal, 4-sided; *stigma* capitate, 4-cornered.

Raised from Cape of Good Hope seeds, kindly communicated to the Royal Botanic Garden, Edinburgh, by Mr Aiton, in 1823, and kept in the greenhouse.

Primula longiflora.

Psidium chinense.

Sterculia Balanghas.

Strophanthus divergens.

S. *divergens;* frutex erectus; ramis oppositis, patentissimis, foliis oppositis, lanceolato-oblongis, nitidis, stipulis parvulis, acuminatis, intra axillaribus, pedunculis terminalibus, dichotomis, segmentis calycinis bracteisque erectis, subulatis.

S. dichotomus; β chinensis, Bot. Reg. t. 469.

Description.—With us a *shrub* of nearly 2 feet high, and probably never free growing, erect, and certainly in no degree sarmentose or climbing. *Branches* numerous, and spreading at right angles. *Bark* brown, and thickly sprinkled with light coloured warts. *Leaves* crowded on the extremities of the branches, suberect, on short petioles, opposite, lanceolato-oblong, or sometimes inclining to ovate, shining, having a strong middle rib, and strong nearly transverse veins uniting in arches near the edges of the leaf, mucro very small. *Stipulæ* very small, pointed, one at each side of the axils of the leaves. *Peduncles* terminal, once, twice, or rarely oftener dichotomous: often three buds form at the end of the peduncle; the central one first expands, and afterwards the others in succession, but not very frequently two at a time, unless the peduncle is more frequently divided. *Bractea* subulate, one on the outside of each pedicel, and about half its length, deciduous; two similar but smaller bracteæ are placed opposite to each other, about the middle of each pedicel, and from the axils of these, other flowers push, or prove abortive. *Calyx* 5-parted, segments green, subulate, erect, and very similar to the bracteæ. *Corolla* funnel-shaped; *tube* cylindrical, and nearly twice as long as the calyx; *faux* campanulate, crowned; *corona* of 5 biparted blunt white teeth; *limb* cut into 5 linear segments (about 2 inches long): in the bud, these segments form a long twisted beak, but afterwards spread wide; *colour* of the corolla yellow, streaked and sprinkled with red on the inside of the throat and base of the laciniæ. *Filaments* gibbous, adhering by their backs to the tube of the corolla, and, as well as the inside of the campanulate portion of the corolla, hairy; *anthers* sagittate, adhering to each other and to the stigma, each terminated by a long awn. *Germen* round, lobular, green; *style* stout, cylindrical, white; *stigma* angular.

Seedling plants were received several years ago from Valleyfield, the seat of Sir Robert Preston, but their history could not be ascertained. Have been kept in the stove, and flower freely. There is a specimen in the Banksian herbarium, which, from my own recollection, I would have said is not named, but marked from China; but, according to the Botanical Register, it is there considered a variety of *S. dichotomus;* and as I took no notes when I saw the specimen above two years ago, it is probable I am wrong. It must, I think, be considered specifically distinct.

Trixis auriculata.

T. *auriculata;* fruticosa; foliis sessilibus, auriculatis, pubescentibus, subtus tomentosis, sparse denticulatis, paniculis axillaribus terminalibusque, divaricatis, paucifloris.

Description.—*Stem* woody, round. *Bark* brown, cracked. *Branches* green, woolly, flexuose. *Leaves* scattered, at length revolute from the apex, sessile, winged, lanceolate, ciliato-denticulate, pale green, densely pubescent above, covered with yellowish short tomentum below, glutinous; *wings* rounded, quite entire, stem clasping, at first spreading, flat, afterwards revolute in their edges. *Peduncle* axillary, generally supporting three flowers, round, about half the length of the leaves, spreading, and afterwards divaricated. *Pedicels* spreading, at length divaricate, as well as the peduncles pubescent, and one of the pedicels generally provided about its middle with a small ovate leaf. Peduncles, pedicels, and reflected calyx, become brown, and long remain attached to the plant. *Flowers* nodding; calyx persisting, calycled, cylindrical, green, of 8 equal, linear-lanceolate keeled phylla; calycle persisting, of 5 or 6 unequal, lanceolate leafets, spreading at the apex, one often approaching in size to the calyx. *Corolla* white, pubescent on the outside, bilabiate; *outer lip* much the largest, reflected, its edges involute, apex 3-toothed; *inner lip* revolute, cleft to its base; *faux* inflated; *tube* curved outwards. *Anthers* brownish-yellow, extending from the throat to the stigma; *spurs*, two from the base of each anther, somewhat waved, nearly as long as the filaments, nearly colourless; *filaments* inserted into the upper part of the tube. *Stigma* cleft, revolute, yellow; *style* tumid at the base, and slightly swelling towards the stigma, nearly as long as the outer lip of the corolla, white. *Seed* long, pubescent, surmounted with a little spreading saucer, the edges of which support the pappus, and the style is inserted into a little elevation in the centre; *pubescence* tubular, and yielding from its extremity a transparent fluid. *Pappus* sessile, yellow, hair-like, rough, reaching to the limb of the corolla. *Receptacle* subpilose, pitted.

This plant was received in 1824 at the Royal Botanic Garden, Edinburgh, from M. Otto, Berlin, under the name of *Perdicium brasiliense;* but I entirely agree with Dr Hooker that it is a new species, and I adopt the specific name which he suggested. Has been kept in the stove.

In the last Number of this Journal, I described, under the name of *Euonymus scandens*, a species which I believed to be new. Its close resemblance to *E. echinata* of the Flora Indica was apparent; but I was led to suppose our plant different, from having received it from the Botanic Garden at Calcutta under the name which I adopted, and from Dr Wallich having stated as a character of his *E. echinata*, the transverse veins of the leaves. Dr Hooker, however, has since then obligingly compared specimens which I gave him of our plant with specimens of *E. echinata* sent to him by Dr Wallich, and he assures me they are precisely the same, the veins of the leaves being oblique in both. The specific name of *echinata* must therefore supersede that which I had adopted. A figure of the plant will presently appear in the Botanical Magazine.

Celestial Phenomena from July 1. *to October* 1. 1827, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Aberdeen.

The times are inserted according to the Civil reckoning, the day beginning at midnight. —The Conjunctions of the Moon with the Stars are given in *Right Ascension*.

JULY.

D.	H.	′	″		D.	H.	′	″	
1.	0	37	5	☌ ☽ υ ♌	16.				☿ greatest elong.
2.	0	12	53	☌ ☽ ♃	17.	0	37	5	☌ ♀ μ ♊
2.	6	55	54	☽ First Quarter.	19.	11	18	9	☌ ☽ ε ♉
2.	11	26	1	☌ ☉ ♄	19.	18	7	2	☍ ☉ ♅
2.	22	15	50	☿ near η ♋	20.	20	16	35	☌ ζ ♉
3.	4	6	45	☌ ☽ α ♍	21.	20	40	55	☌ ☽ ν ♊
4.	3	2	48	☌ ☽ λ ♍	22.	3	52	30	☌ ☽ ♀
4.	16	42	43	☌ ☽ 2 α ♎	22.	12	46	32	☌ ☽ ♄
5.	3	59	45	☌ ☿ δ ♋	23.	17	6	0	☉ enters ♌
5.	13	33	28	☌ ☽ κ ♎	23.	17	17	19	☌ ☽ ♂
5.	17	59	47	☌ ☽ λ ♎	24.	0	37	26	● New Moon.
5.	22	8	19	Em. I. sat. ♃	24.	21	5	43	☌ ☽ 1 α ♋
5.	22	31	15	☌ ☽ 1 β ♏	24.	22	8	53	☌ ☽ 2 α ♋
5.	22	33	31	☌ ☽ 2 β ♏	25.	18	51	53	☌ ☽ ο ♌
6.	0	57	12	☌ ☽ ν ♏	26.	3	4	41	☌ ☽ ☿
7.	2	57	18	☌ ☽ ρ Oph.	26.	4	0	46	☌ ♀ ♄
7.	23	1	39	☌ ☽ 2 μ ♐	26.	4	38	27	☌ ☽ π ♌
8.	22	22	22	○ Full Moon.	28.	5	31	48	☌ ☽ υ ♌
9.	3	9	5	☌ ☽ ♅	28.	21	40	27	☌ ♀ δ ♊
9.	23	21	53	☌ ☽ β ♑	29.	11	46	25	☌ ☽ ♃
13.	0	30	46	☌ ☉ ♂	30.	10	13	50	☌ ☽ α ♍
15.	6	34	14	☌ ☽ ε ♓	31.	9	44	26	☌ ☽ λ ♍
15.	20	27	38	☾ Last Quarter.	31.	14	52	2	☽ First Quarter.
16.	11	50	49	☌ ♀ η ♊	31.	23	48	30	☌ ☽ 2 α ♎

AUGUST.

D.	H.	′	″	
1.	17	1	58	☌ ☽ 4 ζ ♎
2.	6	35	3	☌ ☽ 1 β ♏
2.	6	36	22	☌ ☽ 2 β ♏
2.	9	7	0	☌ ☽ ν ♏
3.	11	58	57	☌ ☽ ρ Oph.
4.	8	38	0	☌ ☽ μ ♐
5.	23	59	55	☌ ☽ ♅
6.	9	45	52	☌ ☽ β ♑
7.	5	23	12	○ Full Moon.
11.	15	2	13	☌ ☽ ε ♓
13.	0	53	46	☌ ☉ ☿
14.	9	10	23	☌ ♀ δ ♊
14.	11	40	17	☾ Last Quarter.
15.	18	14	28	☌ ☽ ε ♉
18.	3	33	24	☌ ☽ ν ♊
19.	2	15	45	☌ ☽ ♄
21.	3	47	28	☌ ☽ 1 α ♋
21.	4	50	22	☌ ☽ 2 α ♋
21.	11	27	25	☌ ☽ ☿
21.	12	16	33	☌ ☽ ♀
21.	12	21	43	☌ ☽ ♂
21.	12	29	56	♀ near ♂
22.	14	21	26	● New Moon.
23.	14	36	0	☌ ♄ δ ♊
23.	23	31	42	☉ enters ♍
24.	11	19	34	☌ ☽ υ ♌
26.	1	25	38	☌ ☽ ♃
26.	15	34	4	☌ ☽ α ♍
27.	15	6	40	☌ ☽ λ ♏
28.	5	16	14	☌ ☽ 2 α ♎
28.	22	44	48	☌ ☽ 4 ζ ♎
29.	12	33	36	☌ ☽ 1 β ♏
29.	12	34	56	☌ ☽ 2 β ♏
29.	15	8	47	☌ ☽ ν ♏
29.	21	8	33	☽ First Quarter.
31.	1	22	39	☌ ♀ α ♌
31.				☿ greatest elong.

SEPTEMBER.

D.	H.	′	″	
2.	7	6	31	☌ ☽ ♅
2.	18	37	32	☌ ☽ β ♑
3.	22	22	52	☌ ☿ ♂
5.	14	22	5	○ Full Moon.
6.	9	50	37	☌ ♂ α ♌
6.	13	12	7	Im. III. sat. ♃
8.	0	25	0	☌ ☽ ε ♓
9.	22	32	38	☌ ♂ α ♌
12.	2	7	20	☌ ☽ ε ♉
13.	5	27	22	☾ Last Quarter.
13.	17	11	11	Im. III. sat. ♃
15.	15	22	47	☌ ☽ ♄
16.	21	20	34	☿ very near σ ♌
17.	11	41	15	☌ ☽ 1 α ♋
17.	12	44	24	☌ ☽ 2 α ♋
19.	5	20	39	☌ ☿ ♀
19.	7	0	36	☌ ☽ ♂
19.	18	54	31	☌ ☽ π ♌
20.	18	34	9	☌ ☽ ♀
20.	20	30	53	☌ ☽ ☿
20.	21	9	57	Im. III. sat. ♃
21.	3	11	35	● New Moon.
22.	5	33	24	☌ ♀ β ♍
22.	18	1	23	☌ ☽ ♃
22.	21	57	29	☌ ☽ α ♍
23.	20	3	16	☉ enters ♎
23.	21	3	50	☌ ☽ λ ♍
24.	10	59	50	☌ ☽ 2 α ♎
24.	21	24	17	Sup. ☌ ☉ ☿
25.	4	14	0	☌ ☽ 4 ζ ♎
25.	17	55	44	☌ ☽ 1 β ♏
25.	17	57	4	☌ ☽ 2 β ♏
25.	18	6	51	☿ very near η ♍
25.	20	30	11	☌ ☽ ν ♏
28.	2	52	32	☽ First Quarter.
28.	14	4	31	♀ very near η ♏
29.	12	48	44	☌ ☽ ♅
30.	1	16	26	☌ ☽ β ♑

Times of the Planets passing the Meridian.

JULY.						
	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	13 38	10 11	12 18	17 47	12 6	1 23
5	13 47	10 16	12 14	17 33	11 55	1 6
10	13 43	10 22	12 9	17 15	11 37	0 42
15	13 53	10 29	12 1	16 57	11 19	0 21
20	13 49	10 36	11 56	16 41	11 3	0 1
25	13 39	10 42	11 50	16 23	10 46	23 40
AUGUST.						
	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	13 12	10 52	11 42	15 59	10 22	23 12
5	12 50	10 57	11 37	15 46	10 9	22 56
10	12 17	11 2	11 31	15 29	9 50	22 36
15	11 43	11 8	11 24	15 12	9 33	22 15
20	11 13	11 14	11 17	14 55	9 16	21 55
25	10 56	11 19	11 10	14 39	8 59	21 35
SEPTEMBER.						
	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	10 52	11 25	11 0	14 17	8 34	21 6
5	10 59	11 29	10 54	14 4	8 21	20 50
10	11 13	11 32	10 47	13 47	8 3	20 30
15	11 27	11 36	10 38	13 31	7 45	20 10
20	11 43	11 40	10 32	13 16	7 27	19 50
25	11 57	11 43	10 24	13 0	7 9	19 31

Proceedings of the Wernerian Natural History Society.

(Continued from the preceding vol. p. 391.)

1827, *Feb.* 24.—Professor JAMESON, P. in the chair.—The Secretary read a communication from Mr David Don, on the species of Rheum which affords the rhubarb of commerce. This has been ascertained to be the Rheum Emodi of Dr Roxburgh, —the R. australe of the Flora Napalensis. (See preceding volume of this Journal, p. 304.)

Mr John James Audubon of Louisiana, being present, read an account of the natural history of the Rattlesnake, (Crotalus horridus), illustrated by a very beautiful drawing of the animal suffering the attacks of mocking-birds.—[This interesting paper is printed in the present Number of this Journal, p. 21, *et seq.*]

At this meeting, a series of models of sailing vessels of different descriptions, employed in the Chinese seas, was exhibited and explained by Professor Jameson. These models were wholly the workmanship of native artists, and regarded as very faithful representations.

The first part of Sir William Jardine and Mr Selby's work on ornithology, large paper copy, coloured, was presented by the authors, and thanks voted for the same.

March 10.—Professor Graham, V. P. in the chair.—Dr R. E. Grant read an account of the Paca of Brazil, Coelogenus of M. Frederick Cuvier, and shewed preparations of the most remarkable parts.

The Rev. Dr Scott of Corstorphine then read an essay on the substance called *fine linen* in the Sacred Writings, proving that it must have been cotton cloth.—[This learned essay will be found in the present Number of this Journal, p. 71, *et seq.*]

The Secretary then read a communication from the Rev. William Scoresby of Liverpool, F.R.S. L. and E., and foreign member of the French Institute, containing some strictures on Dr Latta's observations on the Arctic Sea and Ice.—[This paper will be found in the preceding Volume of this Journal, p. 382.]

Professor Jameson then read the following communications: 1. A notice by Mr Trevelyan regarding the *cockles* said to exist in a living state, at a great distance from the sea, in Yorkshire, and which he considered as probably only the Tellina cornea. 2. A short paper by Colonel Silvertop, on the effects likely to be produced on the lead trade of Britain, by the great importation of Spanish lead, and proposing to interdict the importation of lead-mine machinery into Gibraltar, from whence it uniformly finds its way into Spain.

The Professor then exhibited and described specimens of fossil fishes collected from quarries in Caithness, by Mr Sinclair; and likewise some specimens of the fossil fishes of Yorkshire, collected by Mr Witham of Lartington.

March 24.—David Falconar, Esq. of Carlourie, V. P. in the chair.—Dr R. E. Grant read a memoir regarding the anatomy and mode of generation of Flustrae, illustrated by preparations and drawings.—[The first part of this curious and interesting paper is printed in the present Number of this Journal, p. 109, *et seq.*]

The Doctor likewise read a notice on the existence of ciliae in the young of the Buccinum undatum, Purpura Lapillus, and some other molluscous animals; and also on the mode of generation of the Pontobdella muricata of Lamarck.

A beautiful model of the tigress and cubs at present exhibiting in Edinburgh, was exhibited to the meeting.

SCIENTIFIC INTELLIGENCE.

CHEMISTRY.

1. *Brome in Salt Springs.*—Professor Stromeyer has detected Brome in the mother-water of the Springs of Luneburg, Pyrmont, Helden, and Sulbeck. He also detected it in the water of the North Sea.

2. *On the Taste of Arsenic.*—At the trial of Mrs Smith for poisoning her servant, held in the Justiciary Court here in February last, the professional gentlemen, who were examined, differed as to the taste of arsenic. It is singular, that a difference of opinion should exist on a fact of so much importance and apparently so easy to settle; yet this is not the first occasion on which scientific men have differed regarding it. On referring to systematic authors in chemistry and medical jurisprudence, it will be found, that arsenic is invariably said to have an acrid taste. But it is well known that systematic writers are too apt, especially on points apparently so simple and trivial, to quote from one another, without personal experiment. And, accordingly, when a reference is made to such medico-legal authors as have written specially on arsenic, or to the evidence of persons who have taken it when administered with articles of food, we find that some say the taste is sweetish, others that it is first sweetish and then acrid, others that it is sweetish and acid, others *that it has no taste at all.* The natural inference is, that the taste, whatever it actually is, must be weak; so that, in fact, the poison may be swallowed without

any taste being perceived. We have been informed by Dr Christison, Professor of Medical Jurisprudence in this University, that, in reference to the evidence of Mrs Smith's trial, he has recently made some experiments on the subject, and that others have been made, at his request, by Dr Duncan *jun.*, and Dr Turner and other two gentlemen; and the following is the general reeult:—The quantity of the solid poison tasted, varied from two to four grains; and the duration of the tasting from half a minute to a minute and a half. Two only *thought* they perceived, towards the close, a very faint sweetish taste; the rest declared the powder to be tasteless. As to the solution, its taste appeared to most to be very faintly sweetish. What may be its taste, when allowed to pass to the root of the tongue, it is not easy to determine, as the experiment, made with a sufficient quantity, would be unsafe. But it has certainly been swallowed without the person remarking any particular taste at the time; and the most common account has been that it tasted sweetish. The particulars may be seen in a paper in the Edinburgh Medical and Surgical Journal for this quarter.

3. *On the Preservative Power of Arsenic over the bodies of persons poisoned with it.*—This property has been introduced for the first time to public notice in Britain by the evidence on the trial of Mrs Smith. It appears from the reports of the medical gentlemen employed on that occasion, that, in the body of the person poisoned, although it had been three weeks buried, and the external parts were a good deal decayed, the stomach and intestines were in a state of very high, if not perfect, preservation; so that the diseased appearances, caused by the inflammation which the arsenic excited, were quite distinct. It farther appears, that very little difference took place for three weeks afterward. This property has been for some time known in Germany. On several occasions, the bodies of persons poisoned with arsenic have been found after three, five, six, seven months, two years, two years and a half, converted externally into a species of adipocirous matter, and the stomach and intestines firm, flexible, reddish, or as if they had been pickled; and the appearances of disease, caused by the arsenic, were often as distinct as in a recent body. Dr Christison has collected several of these remarkable facts, in the paper already referred to. The following are

the most valuable, because they are the result of express experiments; and, in one set of them, comparative experiments were made on animals not poisoned with arsenic. In dogs poisoned with arsenic, and buried for *two months*, the flesh and alimentary canal were found red and fresh, as if pickled; and, though the cellar in which they were buried again was flooded for *eight* months after, the intestines were eventually found entire and red, while all the soft parts of dogs killed by blows, by corrosive sublimate, or by opium, and buried in the same place, were converted into a greasy mass *. Another experimentalist, Dr Kelch of Königsberg, buried, in February, the internal organs of a man, who had died of arsenic, and whose body had remained, without burial, till the external parts had begun to decay; and, on examining the stomach and intestines, *five months* afterwards, he found that the hamper which contained them was very rotten; but, "that they had a peculiar smell, very different from that of putrid bowels,"—"were not yet acted on by putrefaction,"—"and were still as fresh as when they were taken from the body, and might have served to make instructive preparations." Nay, "they had lost nothing of their colour, glimmer, or firmness,"—"In the stomach, the inflamed spots, seen originally, had not disappeared; and the small intestines showed, in some places, spots of inflammation, with the redness unaltered †." In consequence of the preservation of the body, arsenic has been detected in Germany *fourteen months after interment.* It is proper to add, that arsenic does not always act as an antiseptic upon the bodies of those poisoned with it. The circumstances under which it does act have not been determined.

4. *Observations on Iron by M. Ant. Muller.*—(1.) *Cast Iron.* 1*st*, Iron is capable of forming two distinct combinations with carbon; one, in which there is little carbon and much iron, the carburet of iron (protocarburet); another, in which there is much carbon and little iron, graphite (percarburet). 2*d*, Cast-iron is

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* Neue Entdeckungen betreffend die Kennzeichen der Arsenic-vergiftung. Augustin's Repertorium für die öffentliche und gerichtliche Medizin I. i. 26.

† Hufeland's Journal der praktischen Heilkunde, XIX. iv. iii, and XXII. i. 166.

nothing else than a combination of pure iron and carburet. The grey kinds contain also graphite. 3. In our high furnaces, the iron-ores commence with being deoxydised; the regulus of iron presently combines with carbon, and continues to do so, as long as circumstances permit it. This operation of reduction is accompanied with the formation of enamel, which has a particular influence over the quantity of carbon which the cast-iron may contain, according as it is produced more or less rapidly, is in greater or smaller quantity, more or less vitrified, liquid or thick, and, lastly, according to the nature of its component principles. 4. In the cast-irons which have but little carbon, the affinity of the iron for that substance is too strong to allow it to separate and form graphite; such irons, therefore, remain white, even after a slow refrigeration. In those cast-irons which are rich in carbon, on the contrary, that substance separates during the solidification of the iron, and forms graphite, the particles of which, in intimate mixture with the rest of the mass, give the iron a grey fracture. A sudden refrigeration not allowing this successive formation of graphite, always occasions a white fracture. 5. There are substances which, united with iron, prevent this separation of carbon under the form of graphite, such as phosphorus, sulphur, the metallic bases, the earthy oxides, and other metals, especially manganese. In this case, the cast-iron, which contains as much carbon as the greyest iron, and even more, preserves the fracture white, even after the slowest and best conducted refrigeration possible.

(2.) *Pure Iron.—Forged Iron.* Forged iron is considered as pure iron containing foreign substances, especially carbon, in too small quantities to alter its properties. It is the properties more or less noxious which these substances communicate to it which form so many varieties.

(3.) *Steel.*—Its chemical composition appears to be identical with that of white cast-iron; that is to say, it is formed of pure iron, carbon, and a third body, such as aluminium, silicium, manganese, &c., which renders stable the union of the carbon and iron. The difference between the white cast-iron and steel, appears, according to Mr Muller, to reside only in the mechanical arrangement of the molecules.—*Annales des Mines* 1826.

MINERALOGY.

5. *Optical Property of Dichroite.*—This mineral, which is interesting, not only on account of the different colours it exhibits in common light, but also in polarised light, has been found, by Professor Marx, to possess, like tourmaline, the property of polarising light itself.

6. *Ilmenite of Siberia is Polygmite.*—Among the minerals brought from the Urals, Professor Kupfer of Kasan observed one which he at first took for tantalite, but afterwards ascertained to be a particular species, to which he gave the name *Ilmenite*, from the Ilmen mountains in the Urals, where it occurs. The following are its characters :—Colour black, streak brownish. Occurs massive, rarely crystallised, in variously modified, oblique four-sided prisms ; therefore belongs to the prismatic series of Mohs. Lustre on the fracture shining and resinous ; fracture conchoidal ; no cleavage visible ; fragments sharp-edged ; opaque ; hardness = 4.0 ; specific gravity = 4.75 — 4.78. Kupfer is now disposed to consider this mineral as identical with the polygmite of Berzelius.

7. *Scheererite, a new Mineral Species.*—This mineral, which belongs to the inflammable class, occurs near to St Gallen, in Switzerland, in a bed of brown coal. It was sent to Professor Stromeyer, by Captain Scheerer of St Gallen. It is found in loosely aggregated, whitish, feebly shining, pearly crystalline grains and folia, that generally occur in nests in brown coal. It is rather heavier than water ; does not feel greasy, is very friable, has no sensible taste ; in the cold, and even by friction, exhales no particular smell, but by heating gives out a feeble aromatic empyreumatic smell. It melts very readily into a colourless liquid. It becomes fluid at 36° R. In this state it resembles a fatty oil, penetrates paper in the same manner, but the spots or stains thus produced, disappear on the paper being heated. The melted mineral, on cooling, crystallises into four-sided acicular crystals. It inflames in a platina spoon, held over a spirit of wine lamp, and burns with a feeble aromatic-empyreumatic smell, without leaving any residuum. The preceding, and other properties, as given by Stromeyer, go to prove, that Scheererite, like the Naphtaline, is a binary compound of hydrogen with carbon.

GEOLOGY.

8. *On the Coal-field of Brora in Sutherland.*—Our active and intelligent friend, Mr Murchison, Secretary to the Geological Society, in a paper lately read before the Geological Society, gave an interesting account of the Coal-field of Brora, in Sutherland. Having, several years ago, examined the Brora district, we can bear testimony to the accuracy of the following details of Mr Murchison :—" The Brora coal-field forms a part of the deposits, which on the south-east coast of Sutherlandshire occupy a tract of about twenty miles in length, from Golspie to the Ord of Caithness; and three miles in its greatest breadth;—divided into the valleys of Brora, Loth, and Navidale, by the successive advance to the coast of portions of the adjoining mountain range which bounds them on the W. and N.W. The first of these valleys is flanked on the S.W. by hills of red conglomerate; which pass inland on the N.E. of Loch Brora, and give place to an unstratified granitic rock, that forms the remainder of the mountainous boundary. With a view to the comparison of the strata at Brora with those of England, the author had previously examined the N.E. coast of Yorkshire, from Filey-Bridge to Whitby, comprising the coal-field of the Eastern Moorlands above the lias. The highest beds at Brora consist of a white quartzose sandstone, partially overlaid by a fissile limestone, containing many fossils,—the greater number of which have been identified with those of the calcareous grit beneath the coral rag;—and along with these Mr Sowerby has discovered several new species. The next beds, in a descending order, are obscured, in the interior, by the diluvium which is generally spread over the surface of these valleys, but are exposed on other places on the coast; and they consist of shale, with the fossils of the Oxford clay, overlying a limestone resembling cornbrash and forest-marble, the latter associated with calciferous grit. To these succeed other sandstones, and shales containing belemnites and ammonites, through which the shaft of the present coal-pit is sunk, to the depth of near eighty yards below the level of the river Brora. The principal bed of coal is three feet five inches in thickness, and the roof is a sandy calcareous mixture of fossil shells, and a compressed assemblage of leaves and stems of plants, passing into the coal it-

self. The fossils of this and the superior beds are identical for the greater part, with those which occur in the strata above the coal in the east of Yorkshire; and, of the whole number of species collected by the author, amounting nearly to fifty, two-thirds are well-known fossils of the oolite; the remainder belonging to new species represented in the last numbers of the Mineral Conchology. The plant, of which the Brora coal appears to have been formed, is identical with one of the most characteristic vegetables of the Yorkshire coast, but differs essentially from any of the plants found in the coal measures beneath the new red-sandstone: It has been formed into a new genus by Mr König, and is described by him in the present memoir, under the name of *Oncylogonatum*. The author, therefore, considers the Brora coal, from its associated shells and plants, as the equivalent of that of the Eastern Moorlands of Yorkshire. At Loth, Helmsdale, and Navidale, shale and sandstone overlie calcareous strata resembling cornbrash and forest-marble, and these are, in many cases, dislocated, where they are in contact with the granitic rock, and distorted where they approach it. The base of the entire series above mentioned is seen at low water on the coast near the north and south Sutors of Cromarty, where the lias, with some of its characteristic fossils, is observable resting upon the sandstone of the red conglomerate,—the latter in contact with granitic rock. On the north-west coast of Scotland, several members of the oolitic series, with their peculiar organic remains, were recognized by the author in the Isles of Skye, Pabba, Scalpa, Mull, &c. A short sketch is given of the geognostic relations of the schists and sandstones of Caithness, some of which are probably referrible to the new red sandstone;—some of these beds resembling the copper slate of Thuringia, and its associates; whilst the fossil fish recently discovered at Banniskirk, though the species is new, appear to belong to the same family with those of Mansfeldt, in Germany. The paper concludes by adverting to the support given by the preceding facts to the great importance of zoological evidence in the identification of distant deposits:—since the existence in the north of Scotland, of a large portion of the oolitic series of England, has been demonstrated from the agreement of organic remains, although the mineralogical characters of the beds containing these fossils are perfectly distinct at the extremes of the tract through which the strata are distributed.

9. *On the Distribution of Living and Fossil Plants.*—Count Sternberg lately read a memoir before the Bohemian Society on some peculiarities of the Bohemian Flora, and on the climatic distribution of the plants of the former and the present world. No remarkable variety would be expected in a country like Bohemia, whose highest mountains are more than 100 fathoms below the snow line of its degree of latitude, whose low lands do not descend to the sea coast, and whose Flora contains little more than 1800 species of vegetable productions; yet Bohemia, which is environed by primitive mountains, exhibits many peculiarities both in the mineral and vegetable kingdoms. In the deep valleys in the vicinity of Prague, the Podbaba and the Scharka; on the limetone walls of the transition mountains which intersect the Berauner circle, particularly at Karlstein; and on the conical mountains of the circle of Leitmeriz, there are plants which must be considered as ornaments of the European Flora, and these phenomena correspond with what has been frequently witnessed and expressed, that is, that the forms of plants depend, partly on the chemical nature of the soil in which they grow, and, in a more general view, on the climatic relations, arising from the operation of light and heat. When we compare the individual genera and species discovered by Humboldt and Bonpland on the chain of the Andes,—by Wahlenberg in Lapland,—by R. Brown among the plants gathered on Melville Island, &c.,—the result of the comparison is, that, in the furthest north, where the snow region is lowest, the same plants occur as are met with towards the south, high up on mountains, where the snow region also is much elevated above the sea; and that, at both extremities, the highest, as well as the lowest, there are found particular genera and species, wanting in the middle region, and which have yet a mutual affinity. These observations respecting the plants of the present world, may, with the same result, be extended to those of the former world. The greatest number of impressions of plants found in the secondary series of rocks nearest the older coal formation may, with probability, be traced back to the families of *Lycopodia*, of ferns *(Filices)*, of

Equiseta, of palms, *Eucadäea*, and *Najadea*. According to the genus and species, they have a much closer resemblance to the plants between the Tropics than to those of our zone; and what is particularly deserving of observation, the same genera and species are found in the most remote regions where the plants now in existence are entirely different. The external forms of the greatest number of fossil trees are very similar to the arborescent ferns found between the Tropics. In England, the Netherlands, Germany, North America and Greenland, the *Lepidodendra* are met with abundantly in greywacke, in sandstone of the coal formation, and in the slate-clay of the black coal formations. Impressions of the genus Knorria appear in the greywacke of Magdeburg, in the slate-clay of Saarbrüchen, and as perpendicular petrified trees in the province of Orenburg, on the confines of Asia. We obtained *Pecopteris lanceolata*, a fern, and *Rotularia marsiliæfolia*, a *Najadea*, from the black bituminous coal of Swina in Bohemia,—of Wettin in Germany,—and of Huntington in Pennsylvania. Ferns, scaly trees, and their attendant *calamites*, are to be found wherever black bituminous coal of the older formation is discovered. The species, however, are frequently different, and they therefore follow, in their climatic and geographical distribution, the same laws observed by the plants of the present world, and according to the relations of a higher and more uniform temperature, which must be supposed to have existed at some former period. An affinity depending entirely on the same laws is observed in the more recent vegetation of the quader-sandstone formation, and upwards, through all the coal formations. The family of trees with scaly bark has disappeared; dicotyledonous trees and shrubs have supplanted the ferns, which now appear seldomer, and under different forms. Palms and cycadæa have increased. The leaves as well as the fruit of dicotyledonous plants are like the genera called willows, maples, nut-trees, which are found abundantly in brown coal. These likewise make their appearance in England and Germany, at Hoer in Schonen, and probably in Surturbrand in Greenland; at which places we may conclude the temperature was formerly more uniform. If the facts here briefly stated are compared, the consequent conviction must be, that vegetation, in its climatic and geographical distribution, has been continually influenced by the same laws of light and heat; and that it experienced many modifications at the different periods of formation and vegetation, before it was disposed into those zones which now exist.

BOTANY.

10. *Note on the Native Country of the Potato.* By Aylmer Bourke Lambert, Esq. F. R. S., A. S. G. S., H. S., and M. R. A. S., Vice-President of the Linnean Society, &c. &c.—In Nos. 19. and 28. of Brande's Journal of Science, and in a separate article on the native country of the potato, inserted in an appendix to the *second* volume of my work on the *Coniferæ*, I have, already, I trust, satisfactorily shewn, that the potato is truly indigenous to South America, and that the wild plant, which is found in various parts of Peru, Chili, and in the vicinity of Monte Video, is identical with the *Solanum tuberosum*; but, as additional facts are always important in a question of this nature, I beg to subjoin the following extract of a letter, which I have just received from my friend, Alexander Caldcleugh, Esq., who is at present resident in Chili. The letter is dated Santiago de Chili, 14th October 1826. He says, "I have completely satisfied myself about the wild potato. I am now quite convinced that this potato is really nothing more than the *Solanum tuberosum*. I dug up several, and found the tubers few; some were as large as a pullet's egg, and deep in the ground. I traced some quite to their origin. They appeared to be all nearly of a size, and I therefore infer, that they do not now grow bigger in the wild state. I ate two of the tubers, and found no bad effects from them, neither did I find them bitter; but they left a slightly warm sensation in my mouth."

11. *Double Cocoa-nut.*—For a long time the palm which yields the double cocoa-nut was altogether unknown: the fruit was found either at sea, or cast ashore on the Isle of France, and generally in a state of decay, or perforated by insects, and its origin was considered to be mysterious. It has, however, been completely ascertained that it grows on the Seychelles, a group of islands to the north east of Madagascar; and it is perhaps the most *local* plant in the world, being confined to

three small islands, called Praslin, Curieuse and Ronde, within half a mile of each other, mountainous and rocky, and the soil poor. The trunk of this splendid palm rises straight to the height of 60 or even 90 feet, and is crowned at top with a tuft of from twelve to twenty magnificent leaves, each leaf nearly 20 feet long, and 10 feet wide. The male and female flowers are produced on different trees. The structure of these and of the nuts have lately been fully described and illustrated by our distinguished countryman, Dr Hooker, in the Botanical Magazine. Through the zeal and attention of Mr Telfair of the Mauritius, and Mr Harrison of the Seychelles, germinating nuts of the double cocoa are shortly expected in this country; and this palm will, we hope, ere long be seen flourishing in the stoves of our Botanic Gardens.

ZOOLOGY.

12. *The Cock of the Woods* (Tetrao urogallus).—The capercailzie, or cock of the woods, existed formerly both in Ireland and Scotland; and, according to Shaw, one was killed in the latter country, about fifty years ago, at Loch Lomond. It is much to be regretted, that so magnificent a bird should have been lost; and it would be well worth any attempt to recover the breed. In the latter country there would be little doubt of its succeeding, if it could but be procured in sufficient numbers to make the attempt. The cock of the woods is by no means a difficult bird to rear, even in a state of captivity. There are several instances of its being kept alive in Sweden; and but very recently Captain Brooke was informed of two, where the female was sitting on several eggs, the result of which he was not acquainted with. All that it requires in its natural state, is a considerable tract of wild country, well wooded with the fir, which may be considered necessary to the bird, as on its shoots it principally subsists during winter. If there be also a wide extent of mountains and high lands, it will be the more favourable; and should the cranberry, the whortle or blaeberry, and the other wild fruits which these situations produce, be found in abundance, the trial would, in all probability, be attended with success. In every part of Sweden they are found in abundance, as also in the southern parts of Norway. The soil, generally speaking, in both countries, is

of a light and sandy nature; the forests almost wholly composed of fir, generally with little underwood; and the earth covered with the different kinds of berries just noticed. What brushwood there is, is frequently the juniper and low birch, the berries of the former being also a favourite food of this bird. No attempt, Captain Brooke thinks, would ever succeed to rear them in this country by bringing their eggs over. Without speaking of other objections and impediments, the difficulty of meeting with the eggs would be sufficient. The peasants even seem to consider this as in a manner proverbial; and Captain Brooke never met with any one of them who had either seen the eggs or discovered a nest. The way in which they take the birds, is principally by means of the gun, though sometimes snares are used. The offer of a good price is all that would be necessary; and with this temptation, there would be little fear of any insuperable difficulty. The old ones alone should be brought over, or birds of sufficient age to cause no apprehension in this respect. All the attempts that have been made by transporting young birds, have uniformly failed from their dying shortly afterwards, whereas the old ones have lived. The female bird, during the period of incubation, is extremely shy, readily forsaking her nest when disturbed. In general, she lays as many as ten and twelve eggs, which are nearly equal in size to those of a hen. The ground of them is tawny white, but thickly covered with small blotches of a reddish brown, a few specks being some shades deeper, and approaching to black. When the young birds are hatched they resemble the mother, and remain so till autumn, when the black plumage of the male begins to appear.—*Vide Captain Brooke's Travels in Lapland.*

13. *Walking Match.*—Robert Skepper, the pedestrian, has finished his arduous task of walking from Winchester to Farnham, and back, fifty-six miles for twenty successive days. This feat is, we believe, the greatest of its kind ever performed in this or in any other country.

14. *Trotting Match.*—Mr Bullock, on Friday, accomplished the task of forty miles, in four hours (harness), at the trot. It was done on the Huntingdon road, over a ten mile piece of ground, ten minutes under the time. The match was for 200 sovereigns.

15. *Coccus Cacti.*—This little insect, so valuable for yielding the cochineal dye and carmine, has of late years been introduced not only into the East Indies, but likewise into some of our West India islands. In St Vincent's, the Reverend Lansdown Guilding, a distinguished naturalist, has established a nopalery (or cochineal nursery) in his own garden; and it is believed he has already sent specimens of the dried insect to the Society of Arts in London. The species of cactus or nopal, planted by Mr Guilding for the insects to feed and breed upon, is the C. cochinillifer of Linnæus, but not of Decandolle; which last is C. Tuna of Linnæus. In Mexico two varieties, or perhaps species, of the insect are bred; a superior kind called *fina*, and a common kind called *silvestre*. It is the latter only which we have yet acquired; but the East India Company having offered a large reward for the introduction into Bengal of the former, we may hope that this will soon be accomplished. The importance of the object will appear, when it is mentioned, that the annual consumption of cochineal in Great Britain alone, is estimated at 150,000 lb., which is worth L. 275,000 Sterling. For about twelve years past, a few of the insects have been kept on cacti, in one of the hot-houses in the King's garden at Kew. Like the common coccus of our pine-stoves, the male is winged, and flies about; while the female is destitute of wings, and scarcely ever changes her place. A good representation of the cochineal cactus, with some of the insects upon it, has just been published by Professor Hooker of Glasgow, in the Botanical Magazine,—a work now conducted in a style of the first excellence under that gentleman's management.

16. *Notice of the Habits and Characters of the Lemur tardigradus* of Linnæus; *Le Loris paresseux, ou, le Paresseux du Bengale* of Cuvier. By W. Baird, Esq.—This very interesting little animal, from being seldom brought to this country, and, perhaps from his being a nocturnal animal, seldom to be met with even in India, has never been described, as far as I am aware, with the minuteness he deserves; and though a very interesting account of some of his habits and manners has been given by Vosmaer and Sir W. Jones, there are still several particulars connected with his organization that have never even been mentioned by any author who has attempted his descrip-

tion. Nay, though a specimen of this animal was dissected by that very celebrated anatomist Sir Anthony Carlisle, a good many years ago, and though at this time he made a most important discovery, that the arteries of the superior and inferior extremities of this animal divided into numerous small branches, as is the case in the sloths,—his tongue and his eyes were apparently never examined by him, and the peculiarities which occur in these organs, and which are interesting in themselves, have never been pointed out. A short description, therefore, of these peculiarities, and some of his habits, may not be uninteresting.—The genus Lemur of Linnæus (the Makis of Cuvier), including animals with long tails and great swiftness, as the *L. catta* and *L. macaco*, and animals without tails and remarkable slowness of motion, as the *L. tardigradus*, has been split by Cuvier, after M. Geoffroy, into several divisions. Two of this singular genus are remarkable for their slowness of motion, and have been formed by that naturalist into a distinct genus, the Loris. This species, the *Loris paresseux*, is a native of India, the specimen from which this description is taken, and which is still alive, having been procured at Penang, or Prince of Wales' Island. His body is of a dusky-brownish colour, it is particularly well marked by a line of dark-brown running along the back, and is covered with a very thick short fur. This sort of covering, which is seldom to be met with in animals belonging to a tropical climate, would appear to be necessary for this animal; for, being exceedingly slothful in his motions, and apparently incapable of taking much exercise, it becomes necessary to defend him in this manner from the cold of winter, to which he is very sensible. His eyes are large and very prominent, almost perfect hemispheres in shape, and very much approximated. They shine very brilliantly in the dark, especially when animated, when they glow like balls of fire. The manner in which he closes his eyelids is very peculiar. All the animals we know belonging to the class Mammalia, like man, close their eyelids in a direction upwards and downwards, and, in general, at least, the upper eyelid is the one which possesses the greater degree of motion. In this animal, however, the eyelids are brought together in a diagonal direction, or outwards and inwards, which gives him, at the moment of shutting his eyes, a most peculiar look; and it is the under or outer eyelid that is possessed of the greatest degree of motion, the upper or inner one being almost fixed. At first sight, it would appear that, in order to possess this lateral motion, the muscular apparatus of the external eye must deviate from that of the other animals of the class Mammalia, and that a separate muscle must be in existence, attached to the outer or lower eyelid. Upon looking more attentively, however, we observe the inner canthus of the eye situate very low down on the face,—and this circumstance, perhaps, may account for the manner in which he shuts his eyes. The orbicularis oculi muscle must be very powerful; and from this position of the inner canthus of the eye, and the insertion of the muscle being in consequence of this also low down in the face, it will act chiefly on the outer or lower eyelid, and, drawing it towards the inner or upper one, which is only partially moveable, thus close the eye in a diagonal direction. It is to be lamented, however, that Sir Anthony Carlisle's attention had not been directed to this peculiar appearance before he dissected the specimen he had possession of, as the existence of a separate muscle attached to the lower eyelid in this animal, would form a remarkable exception to the other mammalia. —Another very remarkable appearance is presented by his tongue. Beneath the tongue proper, if I may so call it, which is somewhat like that of the cat, but not rough, is another tongue, white coloured, narrow, and very sharp-pointed, which he projects along with the former one when he eats or drinks, though he has apparently the power of retaining it within his mouth when he chooses. I have not seen any particular use to which he applies it; but from its sharpness it would appear as if it was formed for puncturing soft fruits, which he is very fond of, and which, no doubt, form part of his food in his native woods. Perhaps it may be calculated for catching insects, as he eats grasshoppers, spiders, &c. I have never seen it projected alone, however, but always in company with the other. It is somewhat singular that this double tongue has escaped the notice of naturalists, and even of Sir A. Carlisle. The index finger of the posterior extremity is furnished with a sickle-shaped claw; all the other fingers have flat nails.—Small birds, and soft fruits, such as the plantain, are his favourite food. Rice, sugar and oranges, he is also very fond of. When an orange given to him has been at all hard, I have seen him much puzzled how to extract the juice. On such an occasion I have observed him lie all his length on his back in the bottom of his cage, and grasping the piece of orange with both hands, squeeze the juice into his mouth. Mr Vosmaer mentions the animal he had in his possession as being fond of dry biscuit; that, when moistened with water, he would not touch it; and that, when water was presented to him, he smelled it, but would not taste it. This is all at variance with the specimen in my possession. Dry bread or biscuit he will not touch; but when moistened with water, and dipped in sugar, he eats it very readily; and water he also takes greedily, lapping it as the cat does. —His fæces are rather peculiar in their form. They are very hard oval pellets—very much tapered at the extremity last discharged, and sometimes tapered off to a long thread, an inch or two in length. He is very slothful, and extremely slow in his motions. During the day he sits on his hinder parts, close to the bars of his cage, rolled up in the form of a ball; his head in his breast, and grasping the bars of his cage with his posterior extremities, which are brought up close to his belly. In this position he will sit and sleep during the whole day almost, if not disturbed. When he climbs, it is in a most methodical manner. He first lays hold of the branch with one of his fore paws, then with the other. When he has obtained a firm hold with both fore paws, he then moves one of his hinder ones, and, after grasping firmly the branch with it, moves the other, never quitting his hold with his hind paws, till he has obtained a secure grasp with his fore hands. When irritated, he makes a shrill plaintive cry, expressive of much annoyance, and bites severely if he can reach the offending substance. When irritated much, I have seen him dart his body forwards, in order to seize with his teeth the finger or hand of the person annoying him; upon such an occasion, however, it was only his trunk that moved—his posterior extremities were all the time firmly grasping the substance on which he stood, and he seemed to make use of them as levers, by which to increase the force and celerity of his motions.

NEW PUBLICATIONS.

***Illustrations of Zoology, being representations of New, Rare, or otherwise remarkable subjects of the Animal Kingdom, drawn and coloured after Nature, with Descriptive Letter-Press.* By James Wilson, Esq. F. R. S. E., Member of the Wernerian Society. Blackwood, Edinburgh,—Cadell, London. No. I. Atlas 4to.**

A general taste for the pursuits of Natural History has been very rapidly developed within these last few years. Enterprizing and intelligent naturalists have arisen in almost every quarter of the world, by whose observations a great advance has been made towards an exact knowledge of nature. The splendid writings of Buffon were perhaps the first to excite a general interest in this delightful study—while the order and harmony which the classification of Linnæus bestowed upon the apparently confused and almost endless variety of subjects, greatly contributed to augment the number of zealous amateurs. These two men may be looked upon as the great lights of the science of nature in modern times. The first, by bringing a greater portion of that emphatic and original power of mind, called Genius, than had ever before been applied, in aid of Zoology, relieved the science from the undeserved opprobrium of being regarded as the pursuit of inferior capacities; and, by embodying his thoughts in language as attractive and brilliant as had ever been employed to give utterance to the workings of the human intellect, he gained many proselytes among those who had hitherto viewed the science, and all its barren technicalities, with coldness, if not disgust. The second, by his close and cautious observations, and that peculiar and instinctive tact, by which, in the darkness which then pervaded the science of comparative anatomy, he may be said to have predicted many of those most beautiful analogies of the animal kingdom which later observers have demonstrated, bestowed a clearness and precision of outline on the views of the naturalist, which can never more be effaced from the picture of nature.

The deservedly popular system of Linnæus, though it does not profess to be a natural method of classification, actually is so in many of its parts; for it must be admitted, that the greater proportion of his groups are exceedingly natural, and well composed. He always had natural affinities in view; his aim being constantly to place genera together in a certain allied progression, as far as their relationship could be ascertained *. In regard to the excellence of the genera themselves, their consonance with nature is rendered still more evident, by the large proportion of these which Cuvier and Latreille, have retained as leading generic divisions in their recent works, certainly the most skilful approaches which have been made towards the establishment of a natural system. Linnæus was probably aware of the extreme difficulty, or rather, we should say, the utter impossibility of a perfectly natural arrangement, for he confesses, in his *Philosophia Botanica*, his inability to define the great divisions called *orders*, on account of their being so connected with each other, by several points of affinity, as to form a map, rather than a linear series. The observation may be applied with equal truth to the subjects of the animal kingdom. Certain species are grouped together by such analogies of form and structure, as render their mutual resemblances apparent, even to an ordinary observer. To these groups, the name of Natural Families has been applied—but, that no general system of arrangement exists in nature, by which the various genera may be made to follow each other, like the series of links in a linear chain, is evident, from the discordant, ever varying, and very arbitrary methods employed, even by the most accomplished naturalists of the day. We must therefore rest satisfied with such a system as presents the objects of Natural History in conveniently arranged groups, the component parts of each of which bear a considerable resemblance to each other; without seeking after what is unattainable, namely, the establishment among these groups of a perfectly natural and well graduated sequence.

Some time after the death of the great Swedish Naturalist, his *Systema Naturæ* was revised and republished by Dr Gmelin. A vast addition was made to the number of species, but as many

* See Sir J. E. Smith's observations in the Supplement to the Encyclopædia Britannica, vol. ii. p. 391.

of these were repeated under three or four denominations, according to the discrepancies which they exhibited as the results of a difference in age, sex, season, or locality, this addition to the kingdom of nature was, in many instances, rather *nominal* than real. As, however, the disciples of the Linnean school were numerous, wherever the science of Zoology was successfully cultivated, and as the 13th edition of the *Systema Naturæ* (that of Gmelin), was, if not the most complete, at least the most comprehensive, which then existed, it was almost universally adopted as a standard work, by the knowledge of which the subjects of Natural History were to be ascertained and arranged. This general adoption of the Gmelinian system, has been productive of the greatest disadvantages, and its abiding influence continues to propagate error, and pervert the truth. His ignorance in Ornithology was remarkable, and the confusion which resulted from it has not yet been dispelled *. His chief blunders arose from the want of attention to the sexual characters of the species, and the peculiar marks which distinguish the young, the adolescent, and the mature of both sexes, and from his entire ignorance of that double moulting which takes place so extensively, especially among the shore and water birds. In short, every thing which fell in his way, which differed in any respect from the descriptions contained in the 12th edition, was inserted as a new species; and he thus undeservedly gained the reputation of having more widely extended the field of observation, than any of his cotemporaries. The term *Systema Naturæ*, associated as it was in the minds of all with the wonderful accuracy of Linnæus, served of itself as a kind of passport to his blunders.

The chief inconvenience which has sprung from the system of Gmelin, is this; his specific names having been adopted both in numerous systematic works, and in such books of Voyages and Travels as related, either directly or indirectly, to the pursuits of Natural History, they have become so associated with almost all the older species, that it is impossible to illustrate clear-

* We regret to observe, that, in the recent republication of Dr Latham's Synopsis, under the title of a General History of Birds, though some additions have been made to the original text, scarcely any alterations or corrections have been attempted, so as to place the work upon a level with the improved and extended condition of the science.

ly the history of any of these, without collecting together his double and triple synonyms; and thus that space which might otherwise be devoted to a more extended description of species, or to general observations on their habits and economy, is necessarily occupied by an uninteresting, and, in itself, useless list of erroneous specific appellations. It would therefore be advisable, now that the true distinguishing characteristics of the species are so much better known, to cease referring to his unnecessary multiplication of names, unless when the detection of further error renders such reference necessary. By this means systematic works might either be presented in a more portable form, or space would be afforded for a more extended description of such variations, as form the links of those consecutive changes of character, which sometimes so beautifully distinguish, while they connect, the young and adults of innumerable species. At all events, it appears to be quite unnecessary to perpetuate the record of palpable error, on the part of any one observer, when the truth has not only been ascertained, and demonstrated, but universally admitted.

The inconveniences arising from a too rigid adherence to a defective nomenclature, have been increased rather than counterbalanced, by the misdirected activity of those, who, mistaking alteration for amendment, have pursued an opposite extreme, and fallen into a more glaring error. Led on by the prevailing spirit of innovation, many modern writers on zoology seem to have imagined, that, because numerous errors existed in the older systems, " all that they inherit should dissolve ;" and that, to remedy the evil, nothing short of a radical change, both in name and nature, would suffice. In several instances, however, the object has certainly been very ingeniously attained by a more simple process, for, by a careful adoption of new terms, and a strict adherence to well known and long established principles, an air of novelty has been thrown over many a fair fabric, the substantial materials of which are indeed of sufficiently ancient origin. All this would be amusing enough, if there was no malice mingled with their weakness, but it is rather too much to be told by those who owe every thing to his *past* existence, (for had he been alive now, it is scarcely to be supposed that their names would ever have been bruited in the ears of men), that

"Linnæus was entirely ignorant of the philosophy of nature!" It would be well for nature, by which, we presume, the *soi-disant* philosophers mean to express the works of their Creator, and the admirable laws by which these are kept sustained and co-ordinate, if such another observer were alive at this time.

So great, however, has been the impulse given to Natural History since the commencement of the present century, chiefly in consequence of the progress of geographical discovery, that its field has been most wonderfully extended. To take, as an example, the subjects of Entomology, which, in the time of Linnæus, that is to say, about the year 1766, amounted to 3060, (among which were included many animals not correctly defineable as true insects,) are now calculated to exceed *one hundred thousand.* As the increase in the other classes has also been great, though not proportionate, it will readily be conceived that the system of Linnæus required, as it certainly admitted of, such a modification as would fit it for the reception of a more extended dominion. In Entomology, consequently, we find that his orders have been preserved almost entire by the first naturalists of the present day; while, in regard to the propriety of retaining as much of the Linnæan system as possible, in every branch of the science, we have the following testimony from the pen of the Baron Cuvier. "Je conseille neanmoins, quand on nommera les espèces, de n'employer que le substantif du grand genre, et le nom trivial. Les noms de sous-genres ne sont destinés qu'à soulager la memoire, quand on voudra indiquer ces subdivisions en particulier. Autrement, comme les sous-genres, dejà tres-multipliés, se multiplieront beaucoup plus par la suite, à force d'avoir de substantifs à retenir continuellement, on sera exposé à perdre les avantages de cette nomenclature binaire, si heureusement imaginée par Linnæus. C'est pour la mieux consacrer que j'ai démembré le moins qu'il m'a été possible, les grands genres de cet illustre reformateur de la science. C'etait non seulement un égard que je devais à la memoire de Linnæus, mais c'etait aussi une attention nécessaire pour conserver la tradition et l'intelligence mutuelle des naturalistes des differens pays." We conceive it to be chiefly owing to the frequent and unnecessary changes now alluded to, that so many obstacles have as yet opposed themselves to the formation of an elementary introduction to Natural History upon a permanent basis, in which the facts of the science shall be presented in a popular, and, at the same time, philosophical manner. That no such introduction exists, is to be regretted as detrimental to the progress of science.

In the absence, however, of such a work, we hail with pleasure the appearance of the publication, the title of which is prefixed to our present observations. Its object, as the author states in his preface, is "to combine the precision of a scientific treatise, with the more excursive and agreeable character of a popular miscellany, and by avoiding alike the vagueness and inaccuracy of the one, and the repulsive dryness of the other, to gain the favour of both classes of readers, by a faithful and consequently an interesting exposition of one of the most beautiful and certainly not the least important of the natural sciences." He further remarks; "By a judicious and varied selection of subjects from the different classes of the animal kingdom, accompanied by a history of their habits and modes of life, it is hoped that, in the course of not many years, such a representative assemblage may be brought together, as will serve to exemplify, in a novel and interesting manner, the numerous tribes of living creatures, of which the great family of nature is composed." The work has been established, as the vignette on its title page implies, in immediate connection with the museum of our University, and chiefly for the purpose of illustrating the rare and beautiful objects which it contains. We have no doubt, however, that, from the superior style in which it has been brought out, and which, we are happy to say, reflects the highest credit on all concerned, Mr Wilson's "Illustrations of Zoology" will be welcomed by the naturalists of these kingdoms as a highly valuable medium, through which to communicate coloured representations of whatever objects may henceforward occur in any department of Natural History, of peculiar interest from their novelty or beauty. Although the collection of drawings already in the author's portefolio, is of great value from its accuracy and elegance, we understand it to be his intention to leave the work open for the reception of whatever communications may be made to him, accompanied by faithful portraits of the animals described. In the furtherance of his determination to illustrate the animal kingdom, in a more efficient manner than has ever before been attempted in this country; he has secured, in addition to his own skill as a draftsman, the aid of several of the first animal painters in Great Britain; and he has also been fortunate in gaining the co-operation of many distinguished amateurs of science, whose collections of drawings especially, have been long known, and duly prized.

The first number of this elegant work, contains, 1*st*, a representation drawn from life, of the Puma, or American Lion (*Felis concolor*), now in the menagerie of the Museum; 2*d*, two views of that beautiful little hawk, the Finch Falcon of Bengal (*Falco cœrulescens*), the smallest of all the accipitrine birds of prey, from the specimen in the Museum; 3*d*, the only adequate likeness which has yet been given of that rare and recently discovered and very beautiful Gull, the *Larus Sabini*, likewise from the Museum; and, 4*th*, the upper and under sides of that most magnificent production of the insect world, the Great Owl Moth of Brazil (*Noctua erebus strix*), from Mr Wilson's own collection. The letter-press presents the generic characters and specific description of these creatures, and is rendered more valuable, by many general observations, written with much elegance, on the manners and modes of life, which distinguish the orders and tribes to which they respectively belong.

List of Patents granted in England from February 8. *to May* 19. 1827.

1827,

Feb. 8. To Sir WILLIAM CONGREVE, of Cecil Street, Strand, for a new Motive Power.

12. To WILLIAM STRATTON, of Limehouse, engineer, for an improved apparatus for heating air by means of steam.

14. To GEORGE PRIST, of the Old City Chambers, Bishopsgate, for certain improvements, communicated from abroad, in Copper and other Plate Printing.

20. To PHILIP JACOB HEISCH, of America Square, for Improved Machinery for Spinning Cotton, communicated from abroad.

To WILLIAM BENECKE, of Deptford, in behalf of M. W. PESCATORE of Luxemburgh, for a Machine for Crushing Seeds, and other oleaginous substances, for the purpose of extracting oil therefrom.

To CHARLES BARWELL COLES, late of Duke Street, Manchester Square, Esq. and WILLIAM NICOLSON, of Manchester, civil engineer, for a new method of Constructing Gasometers, communicated from abroad.

1827,

Feb. 20. To **William Jefferies**, of London Street, Radcliffe, brass manufacturer, for Improvements in Calcining or Roasting and Smelting or Extracting Metals from Ores, &c.

To **Pierre Erard**, of Great Marlborough Street, musical instrument maker, for improvements in the construction of Pianofortes, communicated from abroad.

To **Augustus**, Count de la Garde, of St James's Square, for a method of making Paper from the ligneous parts produced from certain textile plants, in the process of preparing them by the patent rural mechanical brake, and which substances are to be employed alone, or mixed with other suitable materials, in the manufacture of paper.

To **William Smith**, of Sheffield, for an improved method of manufacturing Cutlery, and other articles of Hardware, by means of Rollers.

Mar. 2. To **Joseph F. Ledsam**, of Birmingham, for purifying Coal-gas by means not hitherto used.

10. To **Jonathan Lucas** and **Henry Ewbank**, both of Mincing Lane, for an improved process for dressing of Paddy or rough Rice.

17. To **Samuel Wellman Wright**, of Upper Kennington Lane, Surrey, engineer, for improvements in Machinery for making Metal Screws.

22. To **Benjamin Rotch**, of Furnival's Inn, Esq. for his Diagonal Prop, for transferring perpendicular to lateral pressure.

To **James Stewart**, of Store Street, Bedford Square, pianoforte-maker, for improvements on Pianofortes, and in the mode of stringing the same.

To **James Woodman**, of Piccadilly, perfumer, for his improvements on shaving and other brushes.

To **James Perkins**, of Fleet Street, engineer, for improvements in the construction of Steam-engines.

27. To **Aristides Franklin Mornay**, of Ashburton House, Putney Heath, Surrey, Esq. who, in consequence of a communication made to him by a foreigner residing abroad, and of discoveries by himself, is in possession of certain improvements in preparing for Smelting, and in Smelting Ores, and other substances, containing certain metals, or in extracting such metals from such ores and substances.

To **Matthew Bush**, of Dalmonach Printfield, near Bonhill, near Dunbarton, North Britain, calico printer, for certain improvements in Machinery, or Apparatus for Printing Calico, and other fabrics.

31. To **Bennett Wodcroft**, of Manchester, Lancashire, manufacturer, for certain Processes and Apparatus for printing and preparing for manufacture yarns of linen, cotton, silk, woollen, or any other fibrous materials.

April 4. To **Henry Aspray Stothert**, of the city of Bath, founder, for certain improvements on or additions to Ploughs.

April 4. To John Paterson Reid, merchant and manufacturer in Glasgow, for an improvement or improvements on Power-Looms, for weaving cloth of various kinds.

To Joseph Tilt, of Prospect Place, Parish of St George, Southwark, Surrey, merchant, for improvements in the Boilers used for making Salt, commonly called Salt-pans, and in the mode of applying heat to the brine, communicated from abroad.

5. To Edward Cowper, of Clapham-road Place, Parish of St Mary, Lambeth, Surrey, gentleman, for improvements in Printing Music.

9. To James Shudi Broadwood, of Great Pulteney Street, Golden Square, parish of St James's, Westminster, Middlesex, pianofortemaker, for certain improvements in Grand Pianofortes.

24. To James Whitaker, of Wardale, near Roachdale, for improvements in Machinery for Pressing Cardings from woollen or carding engines, and for drawing, stubbing, and spinning wool and cotton.

To George Glugo, of Lyons, now residing in Fenchurch Street, loom, &c. manufacturer, for improvements in Weaving Machinery.

28. To M. W. Lawrence, of Leman Street, Goodman's Fields, for improvement in Refining Sugar.

To J. A. Berollas, of Great Waterloo Street, Lambeth, for a Detached Alarum Watch.

To R. Daws, of Margaret Street, Cavendish Square, for improvements on Chairs, or machines calculated to increase ease and comfort.

To T. Bradenback, of Birmingham, for improvements in Bedsteads.

To B. Somers, of Langford, Somerset, M. D. for his improvements in Furnaces for smelting.

T. W. Lockyer, of Bath, for his improvement in the manufacture of Brushes, and materials applicable thereto.

To H. Knight, of Birmingham, for a machine for ascertaining the attendance to duty of any Watchman, Workman; or other person, also applicable to other purposes.

To John Maccurdy, Esq. of Cecil Street, Strand, for improvements communicated from abroad, in the Rectification of Spirits.

May 5. To J. Brown and W. D. Champion, of Bridgewater, Somerset, for a Composition or substance which may be moulded into bricks or blocks for building, and also made applicable for ornamental architecture.

8. To D. Bentley, of Eccles, Lancashire, for an improved Carriage-Wheel.

19. To T. P. Coggin, of Wardworth, near Doncaster, for a new or improved machine for the Dibbling of Grain.

List of Patents granted in Scotland from 21st March to 8th June 1827.

1827,

Mar. 21. To Matthew Bush, of Dalmonach Printfield, near Bonhill, in the neighbourhood of Dunbarton, North Britain, calico printer, for "certain improvements in machinery or apparatus for Printing Calicoes, and other fabrics."

30. To Morton William Lawrence, Lemon Street, Goodman's Fields, county of Middlesex, sugar refiner, "for an improvement in the process of Refining Sugar."

To William Wilmot Hall, of the city of Baltimore, United States of America, at present residing in the city of Westminster, county of Middlesex, attorney-at-law, for a communication made to him by a foreigner residing abroad, "of a new invention of an Engine for moving and propelling ships, boats, carriages, mills, and machinery of every kind."

April 2. To John Oldham, of the city of Dublin, gentleman, for "certain improvements in the construction of Wheels, designed for driving machinery which are to be impelled by water or by wind, and which said improvements are also applicable to propelling boats and other vessels."

3. To Thomas Howard, of New Broad Street, in the city of London, merchant, for "the construction of a new Engine for giving motion, by the expansive power of the vapour of liquids (particularly such as evaporate at a lower temperature than water), comprising a new method of condensation of vapour or elastic fluids, and which engine the petitioner intends to denominate a Vapour Engine; which invention he believes will be of general benefit and advantage, by affording very important improvements in giving motion to various kinds of machinery."

May 7. To John Paterson Reid, merchant and manufacturer in Glasgow, for "an improvement or improvements on Power Looms for weaving cloth of different kinds."

To Joseph Tilt, of Prospect Place, in the parish of St George, Southwark, in the county of Surrey, merchant, for a communication made to him by a foreigner residing abroad, for "an invention of certain improvements in the Boilers used for making salt, commonly called salt-pans, and in the mode of applying heat to the brine."

21. To Charles Barwell Coles, late of Duke Street, Manchester Square, in the county of Middlesex, presently residing in the city of Paris, France, Esq. and William Nicholson, of Manchester, in the county of Lancaster, civil engineer, for a communication made to them by a foreigner residing abroad, "of a certain invention of a new method of constructing gasometers, or machines or apparatus for holding and distributing gas for the purpose of illumination."

June 8. To Thomas Clarke, of Market Harborough, in the county of Leicester, carpet and worsted manufacturer, for an invention of "certain improvements in manufacturing Carpets."

THE

EDINBURGH NEW

PHILOSOPHICAL JOURNAL.

Biographical Memoir of Dr JOSEPH PRIESTLEY. Read to the Institute of France. By Baron CUVIER.

GENTLEMEN, I have to-day to present you with an account of the life and writings of Dr Joseph Priestley, an English clergyman, who was born at Fieldhead, near Bristol, in 1728, and died at Philadelphia in 1804. His great discoveries in physics procured him the distinction of being named a foreign associate of the Academy of Sciences of Paris; and the Institute hastened to confer upon him the same honour. He was also connected with most of the learned societies of Europe; and the homage which I now render to him, has perhaps already been rendered in more than one of its great cities.

This honourable unanimity will appear so much the more encouraging to the lovers of science, and will so much the more prove to them the irresistible influence of real merit, that the person who in this case was the object of it, used no address, and employed no management, to procure it; that his life was entirely polemical; that he always seemed to delight in combating the most predominant opinions, and that he attacked the interests dearest to certain classes of men. It is true that this excessive ardour in maintaining his opinions exposed him to implacable hatreds. He was long the object of every kind of calumny, and more than once the victim of atrocious persecutions. A populace, enraged by the false reports of his enemies, destroyed in a single day the fruit of the whole labour of his life; and it was only by banishing himself from his native country, that he escaped the fury of his persecutors. But when his fellow-citizens seemed to abandon him, several nations hastened to offer him an honourable asylum; and, at this very moment, when, in a country at war with his, the principal literary institution of France pays through me the last and melancholy tribute which it owes to all its members, I see in this assembly several of those whom he has combated, joining as it were their voice to mine, and, by their generous concurrence, completing his triumph.

Science and philosophy have nothing to fear from their blind enemies, so long as such a reward awaits the man who may have enlarged the noble edifice of human knowledge; so long as in thus serving humanity in general, genius may burst the shackles of local relations; so long, in fine, as the developement of new truths may induce us to pardon in their discoverer whatever there may otherwise be in his opinions that is whimsical, extraordinary, or perhaps even dangerous; for I ought not to conceal from you, that there are of all these kinds among the opinions of Priestley.

In fact, his history will disclose to you, as it were, two different, I might almost say opposite, characters. The one, a circumspect natural philosopher, examines only the objects that come under the empire of experience, employs in his progress a cautious and rigorous logic,—allows himself to cherish neither theories nor prejudices,—seeks only after the truth, whatever it may be, and almost always discovers and establishes it in the most solid and brilliant manner. The other, a rash theologian, handles with audacious boldness the most mysterious questions,—contemns the belief of ages,—rejects the most revered authorities,—comes into the lists with preconceived opinions,—seeks to maintain rather than examine them,—and, in order to support them, plunges himself into the most contradictory hypotheses.

The first tranquilly delivers over his discoveries to the examination of the learned. They are established without difficulty, and procure for him an unchallenged reputation. The latter surrounds himself with warlike apparatus, arms himself with learning and metaphysics, attacks every sect, shakes every dogma, and shocks the consciences of all by the keenness with which he seems to aim at their subjection.

It is against the man of heaven, the minister of peace, that earthly weapons are employed: it is he who is accused of exciting hatred, of provoking vengeance, of disturbing society. The profane philosopher, on the contrary, is respected by all: every one admits that he only professes to defend truth by reason; that he only employs his discoveries for the good of society; that he uses only mildness and modesty in his writings.

Obliged as I am to describe to you Priestley as he was, it is necessary for me to trace him in his two characters,—to speak of the theologian, the metaphysician, and politician, as well as of the natural philosopher. I shall not, however, mistake what my office more particularly requires, nor forget that it was the natural philosopher who was associated with the National Institute, and that you ought principally to expect here the exposition of his scientific discoveries.

It is, besides, probable, that this is that part of his character which will most interest Europe and posterity. He has somewhere said, that, for a lasting reputation, scientific labours are as much superior to all others, as the laws of nature are superior to the organization of societies, and that none of the statesmen who have held the reins of government in Great Britain can bear to be compared with the names of Bacon, Newton, and Boyle;—an exaggerated maxim, perhaps, yet one which it would have been well had he always kept before his mind; but he is not the first celebrated man whose judgment has been unable to subdue his propensities.

It is here, however, of importance to remark, that his paradoxical opinions had no influence upon his conduct, and that, if we except the misfortunes which overwhelmed him in his old age, and of which he was the innocent victim, the events of his life were uniform and simple. The catalogue of his works alone would indicate as much; and when it is known that he produced more than a hundred volumes, it will not be expected to find in him a man of much general intercourse with society, or that his history can be any thing more than an analysis of his writings.

In early life he had the misfortune to lose his father, who was a tradesman, and who left him in great poverty; but a rich and pious aunt took him under her charge, and afforded him the means of studying languages and theology. After being for some time a pastor of the Presbyterians of some small districts, he obtained a situation in a school at Warton, connected with the same sect. He afterwards resumed the pastoral functions among the dissenters of Leeds, a city in the neighbourhood of the place of his birth. His writings in natural philosophy, and his first researches into the nature of the gases, having brought him into notice, Lord Shelburne, secretary of state, afterwards Marquis of Lansdowne, appointed him as his librarian, and took him as a travelling companion into France, and several other countries. At the end of seven years, he left the house of this nobleman, to settle at Birmingham as a minister, and instructor of youth. In this situation he remained during eleven years, until the time of the persecutions which constrained him to leave that city, and which immediately after determined him to retire to the United States. Such is the brief, and yet complete record of the events of his private life. The account of his works is of more importance, and must be given at greater length.

Those which he first published were devoted to instruction. His earliest production was an English grammar *, which is still used in many schools in Great Britain. His historical and biographical maps, presenting to the eye, in a convenient form, the rise and fall of each state, with the age of those celebrated men who flourished in it, deserve to be generally introduced †. His lectures on history indicate all the views, all the varied knowledge which it is requisite to possess, in order to study with advantage the revolutions of nations. Those on oratory and criticism are considered as excellently adapted to be put into the hands of the young ‡. It was also in the same didactic manner that he wrote his first works in natural philosophy, his His-

* Printed in 1762 and 1768. He added to it in 1772, Observations for the use of those who are advancing in the language, and Lectures on the Theory of Language and Universal Grammar.

† New Map of History; and Map of Biography, 1765.

‡ Course of Lectures on Oratory and Criticism, 1777; 4to.

tory of Electricity, that of Optics, and his Elements of Perspective *.

The History of Electricity had the merit of making its appearance at an interesting period, when Franklin had just thrown a most brilliant light upon this beautiful branch of natural philosophy, and made the boldest application of it. It presented a clear and accurate account of all that had been done in that department of science; and being translated into several languages, began to extend its author's reputation abroad.

But abandoning the irksome labour of unfolding the discoveries of others, he lost no time to place himself among the original discoverers in physics. It is by his inquiries into the different kinds of gases, that he has especially merited this title, and erected the most durable monument to his fame †.

It had long been known, that several bodies allow air to escape from them, and that others absorb it under certain circumstances. It had been remarked, that the air of sinks, at the bottom of wells, and that which rises from liquids in a state of fermentation, extinguishes light, and destroys organic beings. It was also known, that a light gas exists in mines, rising most commonly towards the roofs of subterranean vaults, and sometimes taking fire and producing great explosions. The former received the name of *fixed air;* the latter that of *inflammable air.* They are the same as those which we now call *carbonic acid gas*, and *hydrogen gas.* Cavendish determined their specific gravities: Black discovered that it is the fixed air which renders lime and the alkalies effervescent; and Bergmann was not long in detecting its acid quality. Such was the extent of know-

* The History and present state of Electricity, London, 1767 and 1775, 4to: it has been translated into French by Brisson, Paris, 1771, 2 vols. 12mo. —The history and present state of the discoveries relative to Vision and Colours, London, 1772, 2 vols. 4to.—Familiar Introduction to the Theory and Practice of Perspective, 1771, 8vo.—He also published a Familiar Introduction to the Study of Electricity, 1768, 8vo.

† Experiments and observations on the different kinds of Gases. The first volume appeared in 1774, the third and last in 1779. This work was continued, under the title of Experiments and Observations respecting various branches of Natural Philosophy, 3 vols. 8vo, the last published in 1786 at Birmingham. The whole were translated into French by Gibelin, in 6 vols. 12mo, Paris 1775 to 1780.

ledge in this department of science, when Priestley took up the subject, and treated it with great success.

Happening to lodge at Leeds near a brewery, he had the curiosity to examine the fixed air which exhales from beer in fermentation, and the deleterious power with which that air operates upon animals, as well as its effect upon the flame of candles. His investigations having afforded him striking results, he submitted inflammable air to similar experiments. Wishing afterwards to determine all the circumstances in which these two gases manifest themselves, he soon remarked, that, in a great number of combustions, especially in the calcinations of metals, the air in which these operations are performed is altered in its nature, without either fixed or inflammable air being produced. Whence his discovery of a third kind of noxious air, which he called *phlogisticated air*, and which was afterwards named *azotic gas*.

He made use of small animals for trying the pernicious action of these different gases, and found himself obliged to inflict tortures on sensible beings. His character is well illustrated in the joy which he experienced on the discovery of a fourth kind, which freed him from the necessity of having recourse to these cruel means. This was *nitrous gas*, which possesses the property of suddenly diminishing the volume of any other gas with which it is mixed, nearly in the proportion in which that other gas is respirable, and consequently the property also of measuring, to a certain extent, the degree of salubrity of different airs.

This discovery gave origin to that branch of natural philosophy named *Eudiometry*, and was of primary importance. All the natural sciences were interested in possessing such a measure, and medicine in particular might have been highly benefited by it, were it not so difficult to introduce scientific processes into the practice of even the most scientific arts.

Combustion, fermentation, respiration, and putrefaction, produced sometimes fixed air, at other times inflammable air, and sometimes phlogisticated air. There were therefore a multitude of causes capable of vitiating the air ; and yet its purity not being sensibly altered during the long period that these causes have been in action, it was necessary that there should be in nature some constant means of keeping up this purity.

Priestley found this means in the property which he discovered in vegetables of purifying the atmospheric air during the day, by decomposing the fixed air,—a property which is moreover the principal key to the whole vegetable economy, and which, joined to the property that animals have of vitiating the air by respiring it, led to the fact, which has been subsequently more clearly developed, that the spring of life principally consists in a perpetual transformation of elastic fluids.

Thus, his discoveries respecting the gases opened quite a new field to the inquiries into living bodies: physiology and medicine were enlightened from a source hitherto unknown. New rays, still brighter, presently issued from the same focus. Having applied the heat of a burning-glass to salts of mercury, Priestley had the good fortune to obtain, pure and isolated, that respirable portion of the atmospheric air which animals consume, which vegetables restore, and combustion alters. He named it *dephlogisticated air*. The other gases different from common air, extinguished lights; this made them burn with a clear flame, and with prodigious rapidity: the others destroyed animals immersed in them; in this they lived even longer than in common air, without requiring its renewal; their faculties seemed to acquire more energy in it. It was for a moment imagined that this discovery afforded a new means of exciting and perhaps of prolonging life, or at least an infallible remedy against most of the diseases of the lungs. This hope was fallacious. Nevertheless the dephlogisticated air remains one of the most brilliant discoveries of the eighteenth century; it is the same which, under the name of *oxygen*, the modern chemist regards as the most universal agent of nature. By it are produced combustion and calcination of every kind; it enters into the composition of most of the acids; it is one of the elements of water, and the grand reservoir of fire; it is to it that we owe almost all the artificial colours which we make use of in common life, and in the arts; it is that which, in respiration, gives to our bodies, as well as to those of animals, their natural heat, and the material principle of their motions; the energy of the various species of animals is in proportion to the power of its action upon them; vegetables pass through no period of their growth, without its being combined or disengaged in them in various ways:—in a word, natural philosophy, chemistry, vegetable and animal physiology, have scarcely a single phenomenon in their range that they can completely explain without it.

It is but a slight sketch that I have here presented of the most remarkable discoveries of Priestley; want of time forces me to pass over a multitude which might of themselves furnish ample materials for the eulogy of any other man. Each of his experiments henceforth became, whether in his own hands, or in those of other philosophers, fertile in luminous consequences; and there are still some in the number that have not received sufficient attention, and which will perhaps one day become the germ of quite a new order of important truths.

His works were received with general interest: they were translated into all languages; the most illustrious natural philosophers repeated his experiments, varied them, and commented upon them. The Royal Society, on the appearance of his first volume, decreed to him the Copley Medal, which is given for the best work in natural philosophy, published in the course of the year; a medal of little value in itself, but which England considers as the most noble prize that can be gained in science. The Academy of Paris conferred on him an honour not less noble, and still more difficult to be obtained, because rarer, one of its eight places of foreign associates, for which all the learned men of Europe strive, and of which the list, commencing with the names of Newton, Leibnitz, and Peter the Great, has at no time degenerated from its first splendour.

Priestley, loaded with honours, was, from his characteristic modesty, astonished at his good fortune, and at the multitude of beautiful facts which nature seemed to have been unwilling to reveal to any but himself. He forgot that her favours were gratuitous, and that if she had been so successfully interpreted, it was because he had discovered the method of constraining her to divulge her secrets, by the indefatigable perseverance with which he interrogated her, and by the innumerable ingenious contrivances to which he had recourse, to extort from her the responses which he gave to the world.

Others carefully conceal what they owe to chance; Priestley seems anxious to attribute to this all the facts he discovered. He remarks, with a candour peculiar to himself, how many times he had made use of them without perceiving them, how often he possessed new substances without distinguishing them; and never does he conceal the erroneous views which sometimes directed him, and the fallacy of which he discovered only by experiment. These avowals did honour to his modesty, without disarming jealousy. Those whose views and modes of procedure had never furnished them with any discovery, called him a mere maker of experiments, without method and without object. There is no wonder, said they, that, among so many trials and combinations, there should be some productive of fortunate results.

But those who possessed the true spirit of philosophy were far from being the dupes of these interested criticisms. They knew by how many efforts those happy ideas are always elicited, which lead to and regulate all the others; and the men who, after having had the good fortune to make great discoveries, have taken pleasure in increasing our admiration by the beautiful light in which they have placed them, entertain no hostile feelings towards those who, like Priestley, have preferred accelerating our enjoyment, by presenting their discoveries as rapidly as they have made them, and by ingenuously tracing all the windings by which they were led to them. This was the effect of his manner of writing. His book is not like a regularly constructed edifice, a series of theorems deduced successively one from another, as they might have been conceived in the eternal mind: it is the simple journal of his thoughts, in all the disorder of their succession. We see in it a man who at first walks groping in a dark night—who spies the smallest glimmerings—who seeks to bring them together and reflect them—whom fallacious and transient lights sometimes mislead, but who at length arrives at a rich and extensive region.

Should we have been grieved if the great masters of the human race, the Archimedeses and Newtons, had thus made us the confidants of their genius? Newton, on being asked how he had arrived at his great discoveries, replied, by thinking long upon them. What pleasure would it have afforded us to have been made acquainted with the long series of thoughts from which at length sprung that grand conception of Newton—that thought, which is, so to speak, even at the present day, the soul of all his successors! His books have made us acquainted with the powers of nature; but it would only have been by seeing him thus in action, that we should have truly known the most beautiful of all the works of nature, the genius of a great man.

It must not, however, be supposed that Priestley's discoveries were all perceived by himself, or that he was able to develope them in his book as clearly as we distinguish them in it, and as we would at the present day develope them. When he made these discoveries, however, he was not acquainted with any other chemical theory than that of Stahl, which being formed from experiments in which the gases were of no account, could not embrace them, and still less foresée all their phenomena. Hence there is a sort of hesitation in his principles, a kind of embarrassment and uncertainty in his results. Wishing to find phlogiston in all things, he is obliged to suppose it at times quite differently constituted; in fixed air, very heavy and acid; in inflammable air, very light; in phlogisticated air, as having a property possessing none of the qualities of the other two. There are cases in which an accumulation of phlogiston diminishes the weight of the combination, it therefore communicates an absolute lightness to the mixtures into which it enters: in other cases it produces a contrary effect. Nothing seems uniform, and no general or precise conclusion is the result.

Modern chemistry alone could draw this conclusion, and for this it only required one or two formulæ:—*There is no phlogiston; pure air is a simple substance; phlogisticated air and inflammable air are also simple substanccs; combustion is only a combination of pure air with the bodies burnt.* Like the sublime words related in the book of Genesis, these few expressions have thrown light upon and disentangled all; chaos is reduced to order, each fact has assumed its place, and the whole has formed the most magnificent of pictures.

But, like the gods of the pagans, chemistry could create nothing out of nothing: it required matter, a subject for its prescription; and with this matter Priestley has had the principal merit of furnishing it *.

* See principally his memoirs

On Phlogiston, and the apparent conversion of water into air; Phil. Trans. 1783.

On the Principle of Acidity, the Composition of Water, and Phlogiston. Phil. Trans. 1788. Paris. On

In this respect, he may therefore with propriety be considered as one of the fathers of modern chemistry, and his fame be very justly associated with that of the authors of the celebrated revolution effected by it in human knowledge.

But he was a father who would never own his child. His obstinacy in maintaining his first ideas was of the most determined character. He saw without being moved their ablest defenders pass in succession to the opposite side; and when Mr Kirwan had, almost the last of all, abjured the phlogistic system, Priestley, left alone on the field of battle, issued a new defiance, in a memoir addressed to the principal French chemists.

By a fortunate chance the challenge was accepted at the moment, and on the very spot. M. Adet, then ambassador from France to the United States, happened also to be a worthy representative of the French chemistry, and replied to the new arguments brought forward against it. They almost all arose from the circumstance that Priestley, ingenious and skilled as he was in the processes of that transcendent chemistry of which he was the founder, had little experience in those of the common chemistry. He extracted, for example, from fixed air, substances into which he did not suppose it to have entered, and from this denied that it always owes its origin to carbon. When he formed water with oxygen and hydrogen, he always found a little nitric acid, and would not attend to the portion of azote which produced it *.

On the Phlogistication of the Spirit of Nitre. Ib. 1789.

On the Transmission of Acid Vapours through tubes of red earth, and on Phlogiston. Ib.

On the Generation of Air by Water, and the Decomposition of Dephlogisticated and Inflammable Air. Ib. 1793.

His Experiments on the Analysis of Atmospheric Air; and

Considerations regarding the doctrine of Phlogiston and the Decomposition of Water. 2 vols. 8vo, 1796 and 1797.

The doctrine of Phlogiston established, and that of the Composition of Water refuted. 8vo, 1800.

The same ideas have also been expressed by him, under somewhat different titles, in the Memoirs of the American Society, vols. iv. and v.

Reply to Cruickshanks's observations in defence of the new system of chemistry. Nicholson's Journal, vol. iv. p. 1.

He also published a multitude of articles in various other journals.

* Reflexion sur la Doctrine du Phlogistique, et de la Decomposition de l'Eau; traduit de l'Anglais, et suivi d'une response par M. Adet. 1798, 8vo.

His new writings did not, therefore, bring back to his opinions any of those who had abandoned them. He found, like many others who have attempted to arrest motions to which they themselves had given the first impulse, that ideas once thrown into the minds of men are like seeds, the produce of which depends upon the laws of nature, and not upon the will of those who scattered them. To which we may add, that, when they have once taken root, no human power is henceforth capable of plucking them up.

I have now arrived at the most disagreeable part of my task. Hitherto you have seen Priestley moving forward from one success to another in the study of human science, to which he yet devoted only a few leisure moments. We must now place him before you on another career, struggling against the nature of things, the first principles of which are covered with a veil which our reason in vain attempts to penetrate, seeking to subject the world to his conjectures, consuming almost his whole life in these useless efforts, and at length precipitating himself into the abyss of misfortune. Here I need, like him, all your indulgence. Perhaps the details, into which I am about to enter, will appear to some rather foreign to the place in which I speak; but to me it would seem to be peculiarly in this place that the terrible example which they present, ought to be heard with some degree of interest.

I have told you that Priestley was a clergyman. I must add that he passed successively through four religions before he ventured to publish any thing on the subject. Educated in all the severity of the presbyterian communion, to which we give the name of Calvinistic, and in all the asperity of the doctrine of predestination as taught by Gomar, he hardly began to reflect when he turned toward the milder doctrine of Arminius. But, in proportion as he advanced, it seemed as if he always found too much to believe. He therefore came to adopt the opinion of the Arians, which, after having been almost on the point of subduing Christendom in the times of Constantine's successors, has now found an asylum only in England, but which ranks among its supporters the names of Milton, Clarke, Locke, and even, as some say, of Newton, by whom it is in some measure indemnified, in these modern times, for the loss of its ancient power.

Arianism, while it declares Christ to be a creature, yet believes him to be endowed with a superior nature, produced before the world, and the instrument of the Creator in the production of other beings. It is the doctrine that has been clothed with such magnificent poetry in the *Paradise Lost.* Priestley, after professing it for a long time, abandoned it in its turn to become a unitarian, or what we call a Socinian.

There are perhaps very few among those who hear me that have ever been informed in what the two sects differ. The Socinians deny the pre-existence of Christ, and regard him only as a man, although they revere him as the Saviour of the world, and admit that the divine nature was united to him for this great work. This subtle shade of difference between the two heresies occupied for thirty years a pre-eminence which the most important questions in science might well have challenged, and led Priestley to produce incomparably more volumes than he ever wrote on the different gases *.

His creed is, that the primitive church was at first, like the Jewish, unitarian, but that it remained so for a very short time; that the first alteration of this doctrine arose from the gradual introduction of the ideas of the Gnostics, who appeared, as is well known, in the days of the Apostles, and carried into the west the principle of the Indian philosophy, that God made use of an intermediary agent for the creation of the world; that, on the other hand, the Greek philosophy, allying itself with Chris-

* The following are some of these works:

History of the Corruption of Christianity, 2 vols. 8vo. 1782; reprinted in 1786, under the title of Doctrine of the First Three Centuries, 4 vols. 8vo.

Exposition of the Arguments for the Unity of God, and against the Divinity and Pre-existence of Christ. 1783, 8vo.

Letter to Dr Horsley, with new proofs that the Primitive Church was Unitarian. 1783 and 1787, 8vo.

History of the Ancient Opinions concerning Jesus Christ. 1786, 8vo.

Defence of Unitarianism for 1787.

Letters to Dr Horne on the subject of the Person of Christ. 1787, 8vo.

Letters to Edward Burn on the Infallibility of the Testimony of the Apostles concerning the Person of Christ. 1789, 8vo.

Defence of Unitarianism for 1788 and 1789.

General History of the Christian Church until the Fall of the Western Empire, 2 vols. 8vo. 1789; and four others in 1804.

Unitarianism explained and defended. 1796, 8vo.

tianity, personified the Word, which, according to the idea of Plato, and the first Christian platonists, was but an abstract quality, an attribute, an act of divinity; that the desire of honouring more highly the legislator of the Christians, without too much altering the fundamental doctrine of the unity of God, made the person of Jesus be identified with these creatures of the imagination; that, from the intermediate agent of the Gnostics, Arianism is more particularly derived, while from the personification of the Word results the consubstantiation of Athanasius and the Nicene Fathers, and consequently the doctrine of the Trinity.

Priestley differed no less from the common opinions in the metaphysical part of his creed. True metaphysics has demonstrated in these latter times that it is impossible for the thinking substance to know by itself its own nature, just as it is impossible for the eye to see itself, because it would be necessary for it to issue out of itself, to contemplate itself and compare itself with other objects; while, on the contrary, it is only in itself, and its proper modifications, that it sees them, or thinks it sees them.

Priestley was either ignorant of these results, or was not restrained by them. Scripture and experience agree, in his opinion, in making the mind material. The fibres of the brain are the depositaries of the images produced by the senses: the power which these fibres have of mutually exciting their vibrations, is the source of the association of ideas. Feeling perishes with the body; but it revives with it at the resurrection, in virtue of the will and power of God. Until that period we shall sleep in total insensibility; the distribution of rewards and punishments awaits us only then.

A material mind is subjected to the necessary empire of external agents: there is no free will; absolute necessity regulates all our determinations. Why, then, rewards and punishments? Precisely that we may have this additional determinating cause in favour of virtue. Thus, it will easily be seen that he did not believe in the eternity of punishments *. It is

* His principal metaphysical works are:

Hartley's Theory of the Human Mind. 1775, 8vo,

Researches regarding Matter and Mind, with a history of the philosophiproper to remark, that several of these doctrines are those of the first Socinians, and that Priestley only supported them by new arguments.

It is not necessary for me to pronounce here upon questions so widely different from the studies which call us together, and which, besides, have been so often debated; it is enough to have been obliged to relate them. But it belongs to my subject to say, that Priestley supported them but too ably. His adversaries themselves acknowledged that he possessed a vast erudition, and a specious art in combining and directing his resources; they unanimously speak of him as one of the most powerful controversialists of these latter times, and as one of the most dangerous enemies of orthodoxy.

Writers of this description are not now dreaded in the Catholic church, where authority alone is the arbiter of faith, and where the writings that oppose its doctrines remain unknown to the great body of the faithful. But in Protestant countries, where every thing is submitted to argument, there continually reigns a sort of intestine war; the theologians are always in arms; the empire of mind is a bait constantly offered to their ambition, and where dialectics may still make vast conquests. This was apparently what Priestley attempted; and who will not pardon him? Power is so seducing, and that of which persuasion alone is the instrument appears so gentle.

Perhaps he also had the weakness to think, that, in these incredulous times, it was necessary to lighten the faith, as in stormy weather a ship is cleared of the most cumbersome part of its freight. In fact, it might be thought that, after rejecting so many doctrines, he had but one additional step to make to fall into absolute infidelity; but this he did not do. On the contrary, in theology, as in physics, he wished to occupy a station by himself, however perilous it might be, and he trusted to his courage for its defence. He could not suffer any to

cal doctrines concerning the origin of the soul and the nature of matter, as well as their influence on Christianity with reference to the pre-existence of Christ. 1777, 8vo.

The Doctrine of Philosophical Necessity explained. 1777, 8vo.

Free Discussions regarding the Doctrine of Materialism and of Philosophical Necessity, in a correspondence between Dr Priestley and Dr Price.

Letter to J. Bryant in defence of Philosophical Necessity. 1780, 8vo.

proceed farther than himself, nor could he bear to fall short of the point which he occupied; sometimes he attacked the orthodox; at other times repulsed the supporters of infidelity; and, in short, hardly had there appeared in Europe a work that seemed in the slightest degree directed, either against revelation in general, or the manner in which it was explained, which he did not think himself obliged to refute.

His activity was without bounds in this sort of war*; Atheists, Deists, Jews, Arians, Quakers, Methodists, Calvinists, Episcopalians, and Catholics, had alike to combat him. There are works of his against each of these creeds in particular, and I should with difficulty finish were I merely to mention their titles.

As a proof that all this was done in good earnest, he thought he could predict approaching events by Scripture. False prophets commonly assign a long period to their prophesies, that they may not be detected during their life. Priestley imagined himself surer of his point. He published in 1799 an address to the Jews, in which, from the revelations of Daniel and St John, he announced to them their approaching re-establishment in Palestine, the union of all religions, and the foundation of the reign of glory. Besides the calculation of the years, which refers to the commencement of the nineteenth century, that grand event was to be ushered in by the destruction of the papal power, the Turkish empire, and the kingdoms of Europe. The French monarchy, said he, which seemed so solid, has fallen; the rest will quickly follow; the Pope is dethroned and exiled; the Turk subsists only

* Independently of the polemical works already mentioned on the subject of unitarianism, he published the following in favour of revealed religion in general:

Letters to an Infidel Philosopher. 1781 to 1789, 3 parts, 8vo.

Letters to the Philosophers and Politicians of France on the subject of Religion; 1793, 8vo.; continuation 1794.

Reply to Thomas Payne's work entitled Age of Reason.

Observations on the Growth of Infidelity. 1796.

Discourse on the Proofs of Revealed Religion. 2 vols. 8vo, 1796 and 1797.

Letters to Volney, occasioned by his work entitled Ruins. 1797, 8vo.

Comparison of the Institutions of Moses with those of the Hindoos, and Remarks on Dupuis' Origine des Cultes. 1799, 8vo.

We pass over many small treatises on particular questions of theology.

through the pity of his neighbours. He might himself have seen a part of these apparent signs vanish.

I should have concealed such extraordinary details, were it not that our eulogiums are historical, and that, as such, I am imperiously called upon to present both sides of the character in them, as the first and most illustrious of our predecessors prescribed. Besides, is there not some utility in seeing from fact how far the best minds may be led astray, when they overleap the bounds that Providence has traced for our understanding? The wanderings of so fine a genius are a better preservative than its real misfortunes; for what generous man would not suffer even greater evils, were he sure of announcing truth and introducing happiness?

It was not precisely Priestley's theology that brought his misfortunes upon him (for in England every dogmatist enjoys toleration), but a system of politics which was too intimately connected with this theology,—I mean the politics of dissenters, which are almost always opposition politics. In France, the Protestants, from their religion, have been considered republicans; they were only so from oppression. In Ireland, it is the Catholics that pass for such, and the Protestants who rule them are royalists, because the king is of their party. This natural opposition is more violent in England than any where else, because there the dissenters are partially tolerated, and only partially. They are kept at a distance from honours and public offices; they are compelled rigorously to pay tithes for a religion which they do not profess; their children are not even admitted into the national universities; and yet they are allowed to become numerous and rich,—they meet together, speak, print, and enjoy all the means of inflaming their resentment.

Priestley was for thirty years the most eloquent, courageous, and, it might be said, the most obstinate organ of their complaints. He wrote a score of volumes with this view. It was with this object alone that he attacked those famous Letters in which Edmund Burke predicted, in a manner so terrific, and at the same time so true, the evils that would necessarily result from the French Revolution. Apparently the object of Priestley's reply was not rightly understood in this country; for it procured him the honour of being named a French citizen and member of the convention, two titles which did not seem then to suit so ardent a defender of revelation, or of universal toleration. He always, however, decorated himself with the former, but eluded the exercise of the latter, under pretence of not being sufficiently acquainted with our language.

Without pronouncing on the real merits of Priestley's political writings, I must be allowed to say, that they combine a rare moderation in language, with an uncommon loyalty in sentiment. He asks nothing for the protestant dissenters that he does not equally ask for the catholics, and even with more force, because they suffer more. No catholic has painted in more glowing colours than he, the oppression under which the great mass of the people of Ireland groan *.

I do not know whether the catholics took kindly of a unitarian the efforts which he made for them; but it is easy to conceive that this extension of his benevolence was not calculated to secure him the favour of the episcopalians. The hatred of the high churchmen also was almost entirely concentrated against him; all those who entered into controversy with him were sure of rich rewards, several of them had even bishoprics, which made him humorously observe, that it was he who held the list of the benefices of England.

But the aversion which he inspired was not confined to these lawful means of repression; and it appears but too true, that the writings and fanatical predictions of some episcopal ministers,

* His principal works on the English Legislature, with reference to the different sects, are,

Views regarding the Principles and Conduct of the Protestant Dissenters, in reference to the ecclesiastical and civil constitution of England. 1769.

Address of a Protestant Dissenter on the subject of Church Discipline. 1776.

Letter to Mr Pitt on the Toleration and Establishment of the Church. 1786.

The Conduct to be observed by the Dissenters for obtaining the Repeal of the Act of Corporation and the Test Bill. 1789.

He also wrote on more general political subjects, such as,

On the First Principles of Government, and the Nature of Political, Civil, and Religious Liberty. 1768, 8vo.

Observations on the Importance of the American Revolution, and on the means of rendering it profitable to the world. 1785, 8vo.

Sermons on the Slave Trade. 1788, 8vo.

powerfully contributed to the troubles of which he was the victim.

It was the period when the first dawnings of the Revolution divided not only France, but all the states, all the cities, and in a manner all the families of Europe. Open war was as yet carried on in France only, but dissension and dispute were already universal; and, what is singular, it was in the freest countries that the greatest ardour for a revolution displayed itself. It was at a time when the partizans of the British government saw no other resource left, than to use the means which had been then so successful against the enemies of the French government; mobs assailed the revolutionists, or those who were accused of being such.

One of the most terrible was the Birmingham mob of the 14th July 1791. Some persons of different sects, among whom there were also individuals of the episcopalian persuasion, celebrated a feast in honour of our revolution. It was noised abroad that Priestley was the promoter of this festival. False tickets of invitation, expressing very seditious sentiments, were fabricated, and attributed to him. It was asserted that absurd or criminal toasts had been drunk, while the assembly pronounced them entirely the reverse. At length the inflamed populace assemble from all points; the calumny circulates and increases; there are no horrors with which the guests are not charged. The house in which they are assembled is attacked, forced, and destroyed; the furious multitude have only the name of Priestley in their mouths, the dissenting minister, the chief of the revolutionists, against whom the hatred of the episcopalians had long been directed; this was the moment when they were to avenge themselves. The unfortunate old man was so little aware of what was imputed to him on that day, that he was even ignorant of what was going on in the town, and had not assisted at the dinner. But the band of rioters hear nothing; they imagine him to have fled; armed with torches and all sorts of destructive instruments, they fly to his house. It was a humble retreat, half a mile in the country, the fruit of his savings and frugality; he lived there with his wife and two of his children, in the simplicity of ancient manners. It was there that he had received the homage of so many travellers, illustrious from their birth or merit, who would not leave England without becoming acquainted with so great a man;—it was there that, for eleven years, he divided his time between the study of the sciences, the instruction of youth, and the exercise of charity, the principal duty of his ministry. It possessed but a single ornament, but that ornament was invaluable,—the immense collection of instruments, many of them invented and constructed by himself, the focus whence had issued so many new truths, so many discoveries that had been useful to these madmen themselves, for they were almost all labouring people from Birmingham; and, among the numerous manufactures of that city, there was scarcely one that did not owe some improvement in its processes to the discoveries of Priestley. But of what avail is gratitude against party spirit? Besides, what do the populace know of such services? Every thing was crushed into dust; the preparations that had been in trial for several months, and that were to resolve important questions, were destroyed; the registers of observations kept for several years were committed to the flames; various works that were in progress, a considerable library, containing notes, additions, and commentaries, underwent the same fate. In a few moments the whole house was burnt, or rased to the ground.

What an appalling moment! an old man, almost seventy, witnessing the destruction in a moment of what fifty years of unremitting assiduity, and an economy of every day—of every minute—had with so much labour procured him: not his moderate fortune, that was nothing; but the work of his hands, the conceptions of his mind, all that he still retained of ideas and experiments for the meditations of the rest of his life! His family, who had removed him to some distance on the approach of the mob, actually tore him away from this horrible spectacle.

The insurrection lasted three days, and the houses of his friends experienced the same fate as his own. As is usual, it was the victims that were accused, and the journals did not fail to announce that among Priestley's papers were found the proofs of a grand conspiracy. This calumny was sufficiently refuted by his subsequent residence, during two years, near

London, in the dissenting college of Hackney *, where he taught chemistry, and where he succeeded as a minister the celebrated Dr Price. Here his enemies had abundance of time to deliver him up to justice, and would have met with no opposition to their purpose, had there existed the slightest proof against him. But they contented themselves with painting him in the most frightful colours in the periodical writings and political pamphlets of the day.

There are few examples to be found of such an outbreaking of hatred; and this atrocious attempt to blacken the character of a man who did so much honour to his country, would be inexplicable, were it not that we had seen so many examples, within these last fifteen years, of the power of party spirit in poisoning public opinion, and had not fifteen centuries taught us to what an extent accusations, advanced under the pretext of religion, may be carried †.

There was nothing in his personal character that seemed calculated to excite such hatred. His controversies had no influence upon his sentiments; he was, for example, always on friendly terms with Dr Price, although they had often written against each other. Far from being any way haughty or turbulent in his manner, his conversation disclosed all the modesty of his writings, and nothing was more easy to him to say than those words; *I do not know*, a confession which costs most professed men of science so much to pronounce. His countenance bore the impress of melancholy, rather than of uneasiness; and yet he did not fear to join the society of a few friends, nor to give himself up to a gentle gaiety in this familiar connection. This man, so profound-

* He published, when in this situation, Heads of Lectures of a Course of Experimental Philosophy, particularly comprehending Chemistry. 1794, 8vo.

† On the Birmingham Riots, and the conduct and sentiments of Priestley during the Revolution, the following works may be consulted:

Familiar Letters addressed to the Inhabitants of Birmingham, for the purpose of refuting various accusations advanced against the Dissenters. 1790, 8vo, 5 parts.

Letters to Edmund Burke, occasioned by his Reflections on the French Revolution. 1791, 8vo.

Letter to the Inhabitants of Birmingham; Defence of the Revolution Dinner; by Mr Weiss. Recital of Facts relative to that Dinner, with the Toasts; by Mr Russell. 1791, 8vo.

Appeal to the Public concerning the Birmingham Riots. 2 parts, 1791 and 1793.

ly versed in science of various kinds, passed several hours daily in instructing young children. It was always the occupation that he preferred above every other, and his scholars still regard him with filial affection, several even with a real enthusiasm.

But no consideration could restrain him when he thought he had some truth to defend; and this trait of his character, so praiseworthy in itself, destroyed the effect of his amiable qualities, and formed the torment of his life, because he carried it to excess, and because he forgot that reasoning is but the smallest of the means necessary for propagating opinions which interfere with long-continued habits or with present interests.

The insults that were heaped upon him, and the fear of compromising the life and fortune of his friends, rendered at length a residence in his native country intolerable. His new establishment at Hackney, where his industry and patience had already enabled him to repair a part of the disasters of Birmingham, was unable to retain him; and as to emigrate to France during the war would have been to justify all the imputations of his enemies, he saw repose only in the United States of America; but he was long before he found it there; the prejudices that had inflicted upon him so much misery in England, followed him across the Atlantic, and until Mr Jefferson was nominated to the presidency, he was not without fear of being still obliged to quit his asylum.

The dedication which he makes of his Ecclesiastical History to that great magistrate, in gratitude for the tranquillity which he bestowed upon him, and Mr Jefferson's reply, afford beautiful models of the intercourse which may exist between men of science and men of power, without bringing disgrace upon either party *.

Priestley proposed to devote the rest of his life to that work, in which he intended to bring together into one view the developements and proofs of all his theological opinions; but he was arrested at the fourth volume by a fatal accident. His food was one day found poisoned, and nobody knew by what misfortune; his whole family was in danger, and after this he did

* We are aware that we have not by any means mentioned the whole of Priestley's works; we have even remarked, that there is as yet no complete catalogue of them.

nothing but languish. A gradual decay terminated his days after three years of suffering.

His last moments were filled up by the effusions of that piety which had animated his whole life, and which, from being ill governed, had caused all his errors. He had the Gospels read to him, and thanked God for having granted him a useful life and peaceful death. He considered as among the principal benefits which he had received, that of having been personally acquainted with almost all his contemporaries of celebrity. *I go to sleep like you*, said he to his young children as they were carried away from him; *but*, added he, looking upon those around him, *we shall awake together, and, I hope, to eternal happiness*, thus testifying in what belief he died. These were his last words.

Such was the end of that man whom his enemies accused so long of attempting to overthrow all religion and all morality, and yet whose greatest error was, that he mistook his profession, and attached too much importance to his peculiar sentiments, on matters where the most important of all sentiments should be the love of peace.

Facts in regard to the Hybernation of the Chimney Swallow, (Hirundo rustica). By the Reverend Colin Smith of Inverary. In a Letter to Professor Jameson.

Dear Sir, *Bocaird near Inverary, 22d June* 1827.

If those facts, which come under individual observation, in different places and at different times, were communicated and compared, much information might perhaps be collected, and much light thrown upon many parts of Natural History, which are still veiled in obscurity. I hope, therefore, that you will not consider me idly obtrusive, in making known to you the following particulars connected with the history of the swallow; because, though quite insufficient to determine the winter residence of this bird, they shew that he occasionally sinks into a state of torpor, from which he is recovered by the application of warmth.

On the 16th November 1826, a gentleman residing near the banks of Lochawe in Argyleshire, having occasion to examine a shade which served for a cart-house, and which seemed in a tottering condition, saw an unusual appearance upon one of the rafters, which crossed and supported the thatched roof. Upon procuring a ladder, he found, to his astonishment, that this was a group of chimney swallows (the *Hirundo rustica)*, which had taken their winter quarters in this exposed situation. The group consisted of five, completely torpid; and none of the tribe to which they belonged had been seen for six weeks previously. With a thoughtlessness which he, in common with every lover of science must regret, he took them in his hand as they lay closely and coldly together, and conveyed them to his house, in order to exhibit them as objects of curiosity to the other members of the family.

For some time they remained, to all appearance, lifeless; but the temperature of the apartment into which they were carried, being considerably raised by a good turf fire, they gradually betrayed symptoms of resuscitation, and, in less than a quarter of an hour, feeling that they were rather rudely handled, all of them recovered so far as to fly impatiently around the room, in search of some opening by which they might escape. The window was thrown up, and they soon found their way into the fields, and were never seen again.

Now, in this circumstance, which I am able to prove to the satisfaction of any individual, there is nothing contradictory to the supposed migration of the *Hirundo rustica* to Senegal, but there is enough to account for the popular notions regarding his domicile amongst us during the winter. For is it not possible that those birds, which are the produce of a second, or even of a late incubation, may often find themselves too weak to take those bold flights which the parent birds, as well as the produce of first amours in the earlier part of the season, perform, or may perform, with safety? And that He who is no less bountiful in the preservation than in the production of life, has made a provision for the existence of these birds, during the winter, such as he is known to have made for other animals, that have not the power of migration, nor a nature fitted for retaining *all* its vital functions, in every modification of circumstance. And it is to be remembered, that this supposition is not contrary to the first rules of philosophising, even were it proved that the *Hirundo rustica* does migrate: For it is not adducing more causes than are necessary, but merely arguing in accordance with a fact; and, though the fact may not be considered as perfectly conclusive, since this group were so unfortunately disturbed, and their capacity of retaining life during the winter, therefore, unascertained; yet, to destroy the validity of the reasoning, it is necessary to shew, that animals, which are torpid for a month or six weeks, cannot continue so for a longer time, without the total loss of their vital principles; in other words, that the suspension of organic action, in such animals, for a longer term than six weeks, is equivalent to the total abolition of such action. Those that become dormant amongst us are known to have the period of torpidity determined by circumstances purely adventitious, such as an early or a late spring; and, if it be legitimate to reason analogically in the present instance, the torpidity and resuscitation of the above-mentioned group of swallows, six weeks after the disappearance of the rest of the species, must be as conclusive, in every respect, as if they had been found and roused to feeling after a dormancy of six months.

I would beg to add, in speaking of this interesting bird, that, like the Tetrao tetrix, and several other birds, he frequents situations, for many seasons, which he deserts without any apparent cause. Thus, Gleneveraw, Argyleshire, the residence of C. Campbell, Esq. was a favourite resort of the swallow, and his evolutions, as he hunted his favourite insects, were a constant source of amusement to the intelligent proprietor of the place; but, in 1826, only a few pairs were seen, while the situation of the rest seemed to be occupied, and their office performed, by the common bat (*Vespertilio murinus*), which, contrary to its usual habits, ventured boldly forth, during the brightest hours of that bright season, and, seemingly exulting in the more than ordinary number of Phalænæ which fell to its share, glided along under the shade afforded by the larger trees. As late as 26th May of this year, no swallow had been seen in this part of Gleneveraw.

The sand-martin (*Hirundo riparia*) might, I should suppose, be frequently found dormant in its hole; though I have no other reason to suppose this than that, when warm weather occurs early in spring, he has often been seen going about, sluggishly indeed, according to the warmth of the atmosphere, or the comparative abundance of his food; and then, upon a change of weather, disappearing like the bat, till such time as the sun had exerted more of its genial influence upon the earth. Thus, the sand-martin made his appearance in Lorn this year, as early as 15th April, and was seen during the 16th and 17th, when the wind blew gently from S. W., and the thermometer ranged from 50° to 60° in the shade. But when the wind changed to the E., the thermometer ranged from 41° to 48°, and he disappeared till the 30th, when the wind was S. W., and the thermometer again ranged from 55° to 60°.

I need not add how much more probable it is, that this bird should seek shelter in the dry holes which it had dug for itself, than among reeds in a situation foreign to its habits. It is much more easy to believe, that it should migrate to any distance, than that it should possess the faculty of suspending its sentient powers, by an act of volition, and of again emerging from the waters, before their temperature had scarcely undergone a change. And, if they have been found in such situations, it might be well to ascertain whether they were dormant or dead; whether they were, like the group found on Lochaw-side, recovered to a confused sense of existence, and falling into the waters as readily as into any other situation, or actually seeking shelter from the severity of the weather, and dropping their sentient while they retained their living principles.

Thermometrical Observations, at Pitt-Town, New South Wales. By the Reverend JOHN MACGARVIE, A. M. Minister of the Scots Church, Portland Head. In a Letter to JAMES DUNLOP, Esq. Paramatta. (Communicated by Mr DUNLOP.)

DEAR SIR,

THE temperature of the atmosphere, and of the earth, as indicated by the thermometer, has been so often examined by yourself, in connection with Sir Thomas Brisbane, our late respected governor, that any thing I can say on the subject may appear like a tale twice told. But *your* observations were made at Paramatta, *mine* were made on the Hawkesbury, twenty miles farther in the interior, in full view of the Blue Mountains, and subject to dense fogs in the morning, and scorching heats at midday, from an almost vertical sun and hot winds.

The general average of the days, in this part of the colony, may be stated as follows, the varieties being very limited. In some, the morning sets in with a dense fog, which disperses about ten, or sometimes sooner, and ushers in a hot day. Other days are clear in the morning, and cold at mid-day, by reason of a strong cool breeze. Other days commence with a dark-blue haze setting in over the forest, which continues for some time, and is always followed by great heat in the sun's rays. Other days are remarkable for commencing with a clear sky in the morning, which increases to a hot clear noon, with a close, sultry, suffocating, warm wind, during the rest of the day. This is that sort of wind prevalent on the south side of the Equator, near the Cape of Good Hope, which seamen call a fiery south-easter. Other days are completely enveloped in clouds, when the thermometer ranges very little all day. Other days are remarkable for incessant rain. These varieties are so common in the colony, that it is no difficult matter to predict the kind of day from the appearance of the morning. Occasional deviations sometimes take place ; as in the case of occasional dry squalls, and thunder storms, which are very loud and long-continued ; but these are exceptions to the general rule.

The extremes of this division, the very hot days, on which the thermometer ranges from 30° to 40°, and the calm moderate days, on which it ranges from 3° to 4°, were so unlike the same days in England, that I considered it might be useful to know the fluctuations of the thermometer upon these days, to see if they might assist in forming or explaining some general rule that might account for the distribution of heat, and change of temperature.

As I have neither time nor inclination to indulge in lengthened speculation on the subject, I shall give you the results of my observations, made with great care, from which you will see that the thermometer, on these hot days, fluctuates in a most surprising manner, and that, were a man to take only the means at 7 A. M., 12 P. M., and 4 P. M.; or ten in the morning and ten at night, as others propose, he might obtain the extremes of the range; which might give him data for determining the temperature of the earth; but they cannot be depended upon, when intended to furnish correct notions respecting the temperature of the atmosphere, and its variations. The thermometer employed was the very delicate one made by Troughton, formerly in your possession, on which, you are aware, all dependence can be placed.

I. *Register of the Thermometer, at Pitt-Town, New South Wales, on the banks of the Hawkesbury, on 5th January* 1827, *a fair average midsummer day, with a strong cool breeze, blowing all day. At mid-day, grass* 88°. *Sand* 98°. *Water* 78°. *Air* $79\frac{1}{2}$° *to* 80°.

10h A. M.	$77\frac{1}{2}$°	Strong cool gusts of west wind, clear sun, hot.
10 30	78	Average rise in the hour 2 degrees.
11	$79\frac{1}{2}$	
11 30	77	Strong cool breeze increasing.
11 50	$78\frac{3}{4}$	Wind fallen, descent in 50 minutes $\frac{3}{4}$ths of a degree. Average rise in the hour a half degree.
12	80	
12 30	80	Average rise in half an hour 4 degrees.
1	84	And a shade less, wind nearly ceased. At this rate, not to be depended on, only for a few minutes.
1 30	$81\frac{1}{2}$	Breeze.
1 40	$82\frac{1}{2}$	Ditto fresher, and hot.
2	$83\frac{1}{4}$	Average rise $3\frac{1}{4}$th degrees in the hour.
2 15	$82\frac{1}{2}$	
2 40	82	Sun overcast, breeze strong, descent $1\frac{3}{4}$th degrees.
3	$81\frac{1}{2}$	Breeze strong, sun bright.
3 30	81	Ditto, do. descent $1\frac{1}{2}$ degree per hour.
4	81	Ditto, do. increasing.
4 30	$80\frac{1}{2}$	Ditto, do. overcast.
4 45	80	Very strong, loud, shrill wind, descent 1 degree.
5	$79\frac{1}{2}$	Severe gust.
5 15	$79\frac{1}{2}$	Very violent gust, descent half a degree.
6	81	Nearly calm.
6 30	$79\frac{1}{2}$	Still ditto.
6 40	79	Cold breeze, descent $\frac{3}{4}$ths of a degree.
7	$78\frac{3}{4}$	Sunset.
7 30	78	Moon clear on thermometer.
9	$76\frac{1}{2}$	

Thus throwing out the 84°, at 1 o'clock, for which I will not be answerable, the rise from 10 to 2 is equal to $5\frac{3}{4}$°, while, to fall the same quantity, it took six hours, making about $1\frac{1}{4}$° in the one case, and 1° in the other, per hour.

II. *Register of the Thermometer, on 6th January 1827, at Pitt-Town, on the banks of the Hawkesbury, being a fair average midsummer day, with a very strong cool gale blowing during the whole day.*

Thermometer in sun 92°, sand 98°, water 78°, evaporation in a strong cool breeze 65° in a minute and a-half. Thermometer 20 feet from the ground, and in the shade.

6h A. M.	70°	Sky clear, air cool, calm.	11h 30′, 40′ & 50′	77°	Rise 1°; and from 11 to 12 equal 1°.
6 30	71	Rise 3° per hour.	12	78	
7	73		12 15	78	
7 30	74½	Rise ¾°.	12 20	79	Strong breeze, rather hot.
8	73¾	Beautiful clear sky, sun coming more to north, no wind.	12 30	79	
			12 40	79½	
8 5	72¾	Crickets lively, which they seldom are, till thermometer about 74°.	12 50	80	Strong, somewhat hot; not suffocating, nor painful; sensibly warmer than at 12 h. Rise 2½°, and a shade more; hot breeze.
8 15	73				
8 25	73¼				
8 30	73½		1	80½	
8 45	74	Calm, agreeably warm, rise ¼°.	1 30	81	
			1 55	81¼	Rise 1¼.
9	74	A shade less, wind now perceptible, swallows lively about the houses.	2	81	
			2 20	81¼	A strong and violent gust of cool wind.
			2 40	81½	Rise ¼°.
9 10	74¾	Wind brisker.	3	82	
9 20	75	Sun more to the north, to which the front of the house is situated.	3 20	82½	Strong cold breeze from W. or N. W. with clouds.
9 30	75	A shade more, slight W. or S. W. wind.	3 40	82	Clouds over sun.
			4	82½	Clear of clouds; rise ½°.
9 40	75½	Slight long clouds from south to north.	4 30	81½	
			4 45	81	
9 45	75¾	Rise 2°.		81	
10	76	Wind getting brisker.	5	81½	Sun not clear; fall 1°.
10 10	76½	Strong gust, wind warm from west, and from the interior.	5 30	80½	Sun in a haze.
			5 45	80	And a shade less.
			6	79	Fall 1½°.
10 20	77	Strong warm wind.	6 15	79	
10 30	77	Very strong wind in gusts.	6 30	78¾	Clear, calm.
			6 50	78	Ditto a shade less.
10 40	77½	A powerful gale from W.	7	77¼	Sun down; horizon hazy; fall 1¾°.
10 45	77	Do.	7 15	76	Moon clear.
10 50	77½		9	76	
10 55	77½	Very violent gust; wind cool.			

Here, we see the thermometer rose gradually from six in the morning, till four in the afternoon; at least 12½ degrees in ten hours, or about a degree and a quarter an hour; and that it fell from 4 to 7.15 o'clock, $6\frac{1}{2}$ degrees, or about two degrees an hour. From 10 A. M., when it was 76°, to 4 P. M., when it was at its maximum $82\frac{1}{2}$°, it rose about a degree an hour, the air receiving heat slowly, and parting with it speedily.

These registers furnish information only respecting the increase and decrease of the heat of the atmosphere, but no accurate rule can be drawn from them respecting the minute incremental differences, in small portions of time. To secure an accurate account of the regular changes undergone by the air, at very short intervals, I consider a matter of some importance in arriving at any general law that may govern the distribution or increment of heat in the atmosphere. In every climate, the general characters of the days may be easily discovered by observation, and brought under a few heads. Accurate observations of the changes produced on the thermometer during these days, however few in number, if made at very short intervals, would be much more satisfactory to the meteorologist, than observations made only at morning, noon, and night. These give the extremes of variation, but all the delicate shades and tints of the picture are lost; for the changes on some days, in a few hours, are almost innumerable. To use, therefore, a homely Botany Bay simile, we see, by the one mode, only the outside of the bush, but we wish to see all the delicate flowers, leaves, and pods, of which it is composed. The following register of two days, kept in this manner, will show very clearly that an equal and gradual increment very frequently takes place in the early part of the day, but is not to be depended upon when heat has come to its meridional or vertical point, which is most frequently between three and four o'clock P. M. The register was kept with great accuracy to each quarter of a degree, and every variation and change was marked. The 7th and 8th of January were not fair average days of close suffocating heat, that could be depended upon. The 9th and 10th of January were particularly favourable. It must be recollected, that the sun is now nearly vertical, being on the tropic, and not much more than ten degrees from our zenith at mid-day; that he travels from the east to the north, and that the north-west wind blows from the interior opposite to the course of the sun.

III. *Register of the Thermometer, at Pitt-Town, New South Wales, 9th January* 1827, *being a fair average mid-summer day, with close stifling heat, and* without *a sultry wind.*

5h A. M.	66°	
5 30	66	
6	67	Clear, cool, calm, horizon hazy, indicating heat.
6 15	67	And a shade more.
6 25	67	And a shade less; light air of wind.
6 30	66¾	Air of wind, sensibly cooler than before.
6 35	66½	Ditto.
6 40	66¾	Ditto ceased.
6 45	67	And a shade more; calm.
6 55	67½	A shade more, rise 1¾°.
7	67¾	
7 5	67¾	Air somewhat cooler.
7 10	68	
7 15	68½	
7 20	68¾	
7 25	68½	
7 30	68¼	
7 40	68	
7 55	67½	Cool air, but no wind.
7 57	67¾	Cool wind, breeze fresh.
8 3	68	Shade more, breeze fresh; rise ¼°.
8 5	68½	Ditto.
8 7	68¾	
8 10	69	Breeze slackened.
8 15	69	Shade more, cool, calm.
8 20	69	Cool fresh air from N.W.
8 30	69½	Ditto, wind fresher.
8 35	69¾	
8 45	70	A shade more, breeze fresh, air cool.
8 53	70½	
8 57	71	Shade less; rise 3°.
9	71	Coal air of wind.
9 5	71¾	Ditto.
9 10	71½	
9 20	72	
9 40	73	Crickets and grasshoppers lively, and numerous.
9 45	73½	Refreshing strong breeze.
9 55	74	A shade less; milder, no wind; rise 3°.
10	74	
10 3	74½	
10 5	74¾	Slight breeze, mild.

10h 10′ A. M.	74¾°	Shade more, breeze stronger.
10 15	75	Strong cool gust from NW.; crickets silent as if by magic.
10 20	75½	Calm.
10 25	75¾	
10 27	76	Slight breeze.
10 30	75¾	Strong whistling gust.
10 33	75½	
10 35	75¾	Breeze over.
10 37	76	
10 40	76½	Cool breeze.
10 43	76¾	
10 47	76¾	And a shade more; haze indicating heat.
10 50	77	And a shade less; crickets again lively.
10 55	77¼	
11	77¾	Rise 3¾°.
11 5	78	
11 7	78¼	Warm, but strong, passing gust.
11 10	78¾	Ditto.
11 15	78¾	
11 25	79	Cool. calm.
11 30	79¼	Slight puff of wind.
11 37	80	
1! 40	80¼	
11 43	80½	Cool; calm; white haze.
11 45	80½	And a shade more.
11 47	81	
11 50	81½	
11 53	81¾	
11 55	82	
11 57	82	A little less; wind brisk, but gloomy; not painful.
12 0 P. M.	81¾	Rise 4½° per hour.
12 7	82	
12 15	82¼	
12 20	83½	A warm puff of hot air.
12 24	83	A cooler breath of wind.
12 27	83½	Heat of sun powerful.
12 55	84	Cool, equable, agreeable breath of air.
1 0	84	A shade more. Rise 2¼°.
1 5 10 15 20	84	
1 30	84½	
1 35	84¾	Warm air, causing spontaneous perspiration.
1 40	85	A shade more.

1h 45′ P. M.	85½°	
1 55	85½	A shade less. Rise 1½°.
2 0	85½	Hazy.
2 5 10 & 15, all	85	
2 30	85¼	
2 35	85¾	
2 40	85	
2 50	86	
3 0	86½	Calm, warm air; rise 1½°.
3 10	86	
3 15	85½	Sun slightly clouded, but air rather hot.
3 18	85	A slight cool air.
3 23	84½	Breeze.
3 26	84	Breeze a little stronger.
3 28	84	A shade less; strong gust; leaves of corn-husks flying about.
3 30	83¾	
3 33	83¼	
3 35	82¾	
3 45	82¼	
3 50	82½	
3 55	83	Wind ceased; sky hazy, threatening a gale.
4 0	82½	Fall 4°.
4 5	82½	Wind moderate.
4 10	82	Brisker do.
4 20	81¾	
4 25	81½	
4 30	81	Strong cool wind.
4 35	81	
4 40	80¾	
4 45	80½	
4 50	80	And a shade more.
4 55	80	A shade less.
5h 0′ P. M.	79¾°	Horizon hazy; zenith clear pale blue; fall 3¼°.
5 10	79½	Strong breeze.
5 20	79	
5 25	78¾	
5 30	78½	
5 40	78½	
5 45 & 50	78¾	
6 0	78¾	Sun in a haze, reflected light pale-red and glistening; sun's border yellow, calm; fall 1°.
6 5	78½	
6 10	78¼	
6 20	77¾	
6 25	77½	Sun's body of a brimstone yellow; reflected light dark-red, glistening; horizon hazy.
6 30	77¼	
6 35	77	Sun now dark blood-red, no reflection of rays, haze.
6 45	76¾	Sun sinking, as the poet says, 'in a sea of blood.'
6 55	76½	Sun down.
7 0	76½	Fall 2¼°.
7 10	76¼	Moon bright, night cool.
7 15	76¼	
7 30	76	
9 0	71	Here it descended about 1¼° every 30 minutes, when the night became cold and chill, after so hot a day.
9 38	68	

IV. *Register of the Thermometer on the* 10*th January* 1827, *at Pitt-Town, New South Wales, being a fair average day, with dense fog in the morning, clear sky at noon, and dark haze in the afternoon, with a hot suffocating wind.*

5 to 6h A. M.	63½°	Very dense white fog over the Hawkesbury, heavy dew.
6	64	Clear in zenith; no grasshoppers nor crickets.
6 5	64½	
6 10	64½	Fog dispersing; no wind; sun clear.
6 12	64¾	
6 15	65	Fog almost dispersed.
6 20	65½	
6 22	66	
6 25	66¾	
6 30 A. M.	67	
6 33	67¼	
6 35	67½	
6 37	67¾	
6 40	68	
6 45	68¼	Air cool and pleasant; range in this hour 4°.
7	69	
7 5	69	Cool air.
7 15	69¾	
7 18	70	
7 20	70	And a shade more.
7 22	70¼	Not a cricket heard.
7 30	70¾	

Register, &c. 10th January—Continued.

7 50 A. M.	72	Range in this hour 3½°, about half a degree every five minutes.
8	72½	Fair; no wind.
8 5	73	
8 15	73½	
8 20	74	Crickets heard, long unnatural note.
8 30	75	Clear pure sky, threatening a hot gale.
8 40	75½	Range of this hour 4¼°, or ¼ deg. every 4 min.
9	76¾	
9 5	76¾	Light air of wind.
9 10	77	A slight warm puff.
9 20	77½	
9 30	78	
9 40	78¼	And a shade more.
9 45	78½	A cool breeze in shade, but in the sun hot.
9 50	79½	Range of this hour 3°.
9 55	79¾	Calm, sun clear; crickets very lively, natural note.
10	79¾	
10 5	80½	No breeze.
10 15	80¾	
10 20	81¾	Strong gale of warm wind commenced.
10 22	82	Gusts whistling gust.
10 25	82½	Gusts abated.
10 30	82½	Calm.
10 35	82¾	Gale must have cooled the air 11 min. to ¼ deg.
10 45	83	Range of this hour 3¼°.
11	85	
11 5	85½	
11 10	84	Strong whizzing breeze cool.
11 12	83	Strong loud gust, cool.
11 13	82¾	Very violent gust of wind, hot, from NW.
11 15	83	Do. do.
11 17	83¼	Do. do.
11 20	82½	Cool, but strong breeze.
11 25	82½	Stiff cool gale.
11 27	82¼	Strong, cool, hissing gale.
11 33	82½	Do. do. crickets with long croaking note.
11 35	82½	Violent gust from NW.
11 40	83½	Rose suddenly.
11 43	83¾	Gale abated.
11 45	83½	Gusts renewed.
11 48	85	A shade less; warm breeze; sudden rise.
11 53	84¼	Breeze rather on the increase.
11 57	84	
11 59 A. M.	86	Warm air, sudden rise. Range in the hour ½°; greatest fall 3¼°; rise 3½° in 25 min..
12 P. M.	86½	Warm glow.
12 2	86¾	Do. breeze strong.
12 3	87	Do. violent gust, warm.
12 5	87½	Crickets very lively, natural notes.
12 7	87¾	Warm air.
12 9	87½	
12 12	88	Calm.
12 15	87	Cool gust.
12 18	88	Warm strong wind.
12 20	88	A shade more; violent gust of warm wind.
12 25	87¾	Cooler.
12 27	87½	Do.
12 30	87¼	Do.
12 33	87¼	Do.
12 35	87	
12 40	86¾	Strong cool gale, not a cloud in the sky.
12 45	86¼	Do.
12 47	86¼	
12 50	86	Strong wind, not scorching.
12 55	85¾	
12 57	85½	Strong, cool.
1	86	Strong but warm glow. Range ¼° down; rise in 20 min. 2½°; fall in 40 min. 2°.
1 2	87	
1 4	87¼	Warm suffocating wind, rise sudden.
1 5	87½	
1 7	87¾	
1 9	88	Crickets again in natural tune; had stopped in the cool gale.
1 11	87½	Strong gust.
1 40	88½	Strong warm wind.
1 45	87½	
1 50	87	
1 57	87½	Range in this hour 2° of rise in 9 min., and fall 1½° in 10 min. from $1^h\ 40^m$ to $1^h\ 50^m$.
2	87	
2 5	87	Cooling breeze.
2 10	86½	Very strong do.
2 15	87	
2 20	88½	Warm air.
2 25	89½	
2 26	89¾	
2 28	90	
2 33	90	A shade less.

Register, &c. 10th January—Continued.

2 35	89½	
2 40 & 45	89½	
2 55	89	
3	89½	Range of rise from 2^h 10^m, 3°.
3 7	90½	Warm strong gale.
3 15	89½	
3 25	88	Cool, shrill gale, hot.
3 30	88½	
3 35	88½	
3 40	88¼	
3 50	89	Range from 3^h 7^m to 3^h 25^m, 3°, fall of 2½.
4	89	
4 5	89½	
4 15	87½	
4 25	88½	
4 30	89	Gale.
4 35	88½	Glass very feverish.
4 45	87½	
4 50	87	
5	87	Range, descent of 2° in 30 min.
5 5	86	Moderate, sun clear.
5 20	85	
5 30	85	And a shade less; heat fully more oppressive than at 90, or less able to bear it.
5 40 P. M.	84¾	Glass more steady and regular.
5 50	84	Range down = 3°.
6	84	
6 10	83½	Sun with a curious yellow haze around him.
6 25	83	A shade less; light of sun yellowish; reflected light, on a white ground, a beautiful pale red.
6 27	82¾	
6 30	82½	Strong wind, haze; sun almost obscured, white spot in centre.
6 35	82	Sun like a ball of red hot metal.
6 50	82	Sun down, dark, hazy horizon, and indicating a hot stiffling night.
7	82	Range 2½° down.
7 15	81½	Moon clear.
7 20	81	
9 30	75½	Sky overcast, wind high, threatening a gale and rain; descent this hour 7°, indicating a descent of 1° in every 20 min.

V. *Register of the Thermometer on 11th January* 1827, *at Pitt-Town, New South Wales.*

The Thermometer during the following day, January 11, continued uniformly advancing and descending. Thus,

6^h A. M.	73½°	Light clouds, clear; no crickets.
8	74¼	
9	75	
9 5^m	77	Crickets lively.
10 20	83	
12 30	87	
12 40	87	
1 30	88	Hot, close, warm wind.
1 40	88	In sun 100°.
3 30	87	Sun overcast, threatens a squall.
4 20	82	Getting cool.
4 50	79	
6 35	73	Overcast; threatens a thunder storm. Thus, in 6^h 40^m it rose 14½°, and sunk 15° in the space of 5^h 20^m. This, however, does not shew the minute variation.

VI. *Register of the Thermometer, on 12th January 1827, at Pitt-Town, New South Wales, being a fair average midsummer day, covered with dense immoveable clouds, the sun not appearing all the day.*

This day was as remarkable for steady, undeviating, low temperature, as the preceding days were for unsteady fluctuating variations.

6h A. M.	71°	Cloudy, cool. No crickets; seldom heard till the thermometer is above 74°; yesterday crickets and grasshoppers flying about in all directions, to-day not one to be seen.
7 40m	71	
11	72	
2 P. M.	74	
4	71½	
5	71	
6	71	Range from 6 to 2, or eight hours, = 3°; from 2 to 6 P. M., or four hours, = 3°.

VII. *Register of the Thermometer at Pitt-Town, New South Wales, on the 18th of January 1827, being a fair average day; cool in the morning, glowing hot at mid-day, with a strong gale, and followed by a severe thurder gust, and cool calm evening.*

6 A. M.	76°	Mild, pleasant; cloudy; rose gradually to 12 P. M.
12 P. M.	90½	
12 27	90	
12 33	89½	Cool, wind howling, clouds dark.
12 40	89	Greatly overcast, threatens thunder.
12 45	88½	First peal heard distant.
12 55	87	Rain in large drops.
1 5	85½	Rain very heavy, wind strong.
1 10	84½	Severe squall, thunder loud and high.
1 15	83	Squall at its worst, heavy rain.
1 20	79	Wind abating.
1 25	77	Squall nearly over.
2 10	82½	Calm, with clouds.
2 40	82	Steady till this; fresh squall commencing.
3 30	77	Very severe thunder storm, squall from NE.
3 33	76	
3 40	76½	Gale abating; continued steady till 7 P. M.
7 30	74	
8 40	73	
9	73	

VIII. *Register of the Thermometer at Pitt-Town, 21st January 1827, being a fair average day, with light hazy clouds over the whole sky, painful scorching heat, and a strong hot gale from the sun, and going round from E. to W. by N. during the day.*

6 A. M.	73°	
7 30	74	
8	74½	
9 10	82½	Cloudy; clouds about 11 break away, and heat gradually increased till 2 o'clock.

TABLE—continued.

2 A. M.	97½	
2 30	98	
3 40	98½	Hands and face affected by strong heat. Air in breeze 104°, in sun 114½°, in warm shade 104°.
3 20	96½	
3 35	96	
4 35	95	
5 30	92½	Beautiful clear sky to the west.
6	91	Sun with a yellow tinge on the border.
6 30	91	
9	86	Continued to descend; lowest during the night about 76°. Highest rise 25½° in the shade; in sun, 41½°.

Sudden changes like these must try the strength of the strongest constitution. On the 18th of January, the change of temperature, in falling from greatest heat, in one hour, was 4¼ times greater than it had been on the 12th of January in four hours; and on the 21st January, the rise from 6 to 2, in the shade, was more than eight times that on the 12th January; and, in the sun, was fourteen times greater that it had been in the same space upon the same day.

From these observations, imperfect as they are, (and to do justice to meteorology would require more labour and unremitting attention than one man can bestow), we draw the following conclusions:

No.	Day.	No. of Observations.	Maximum Heat.	Hour of Maximum Heat.	Mean Heat by Average of Observations.	Hour corresponding to Mean Heat nearly.	Character of Day.
I.	Jan. 5.	26	83¼	2 0	$79\frac{18}{26}$	10 30	Warm, strong cool wind.
II.	6.	54	82½	3 20	$75\frac{7}{54}$	9 45	Strong cool gale.
III.	9.	137	86½	3 0	$73\frac{39}{137}$	9 45	Hot; no wind.
IV.	10.	147	90½	3 7	$80\frac{26}{147}$	10 5	Fog, suffocating wind.
V.	11.	13	88	1 30	$80\frac{10}{13}$	9 40	Hot, close wind.
VI.	12.	7	74	2 0	73	12	Cool, calm, cloudy.
VII.	18.	20	90½	12 0	81½	10	Hot thunder gust.
VIII.	21.	14	98½	2 40	$88\frac{5}{7}$	12	Scorching heat.
	Sum,	418	693¾	30 37	629	83 45	
	Mean of Av.	52	86 5	3 49	78⅝	10 28	

It is somewhat singular that the hour of maximum heat in this Table, and in the average, should occur about 3, or between 3 and 4 o'clock P. M., and that the average or mean temperature should occur about 10, the precise hours that seem to correspond with observations made in the northern hemisphere; and we have not any doubt that, if a continued series of experiments were made at very short intervals in this colony, the hours in averages would be found exactly to correspond.

Mr John Coldstream made a series of observations, for twenty-four hours, each month in the year, for one year, the results of which were published in the Memoirs of the Wernerian Society for 1823. According to the average result of these well conducted experiments, it was ascertained that the daily range of the thermometer was on an average about 9°.93, its maximum being 23°, which happened in August, its minimum 5° occurring in February. The average daily range would be much greater in this colony, when we know it sometimes ascends from 65° and 70° to 114°, and, according to your own accurate observations at Paramatta, even to 118½° in warm situations in the open air. It would, therefore, be a matter of singular utility, to have many sets of observations long continued, and at very small intervals, both at Paramatta and on the Hawkesbury, and perhaps on the Blue Mountains, and at Bathurst or Liverpool Plains, in this colony, that the general rule might be found by which the temperature of the earth is regulated, and changes of temperature produced. This has been recommended by Dr Dewey in America, and by Mr Coldstream in Britain, who very justly observe, " that this is a task that may be accomplished by the co-operation of many, but can never be done by any single individual." If this be the case in America and in Britain, where all " appliances and means to boot" may be readily procured, it must be greatly increased in this colony, where so little encouragement, and so few facilities, are given, even by men who profess to love and follow science for the sake of truth, that no man will think of encountering the difficulties. It will be long before an equally accurate set of experiments with your own shall be made we fear in this colony. Should an opportunity present itself to me, I shall not fail to embrace it. Yours, &c.

On the Materials which the Romans employed in their Buildings. By Mr C. T. Ramage, A. M. of Naples. Communicated by the Author.

THE materials which were used in the erection of the various edifices, which add so much interest to the ancient city of Rome, may be ranged under two great classes. The first consists of the common materials for building, which were found in the immediate neighbourhood of the city, such as limestone, pozzolana, clay, and silex; the second of those which were brought from a distance, white and coloured marbles, granites, and porphyries.

Their mortar was made, as it is at present, either from common limestone, or from a stone which Vitruvius calls silex, and which may perhaps correspond with our compact calcareous limestone. That which was obtained from the last, was employed in the construction of walls, while the other was used as plaster. This mortar was mixed either with *Arena fossica*, sand dug from pits, or *Arena fluviatica* and *marina*, from rivers and the sea. Of the first they had several sorts, black, white, and red, together with that to which we give the general name of *pozzolana*. The vicinity of Rome abounds with this last sort, and the inhabitants still use it for the same purpose. The place from which the sand was dug, was called *Arenarium*, and these excavations have no doubt given rise to the catacombs in Rome. The colour of this *pozzolana* is by no means uniform, for it is sometimes found red, sometimes purple, and sometimes the colour of tobacco. Its name is derived from *Pulvis puteolanus*, because it was originally found in great quantities in the neighbourhood of Pozzuoli, near Naples. It was particularly used for buildings under water, because it resisted the influence of that element, and acquired such a consistency as to form a solid mass of stone and brick. A proof of this is found in the ruins of the harbour of Antium, and of the mole of Pozzuoli, which is called the bridge of Calligula, though it must date its origin long before the reign of that emperor. It is curious to observe, that on the shore of Baiæ, where Horace accuses the Romans of attempting to deprive Neptune of part of his territory, the foundations of the houses in the sea still remain, while those on the shore have entirely disappeared, and left scarce a vestige behind them. On examining these foundations, it is found that they consist of this sort of cement, bricks, and sometimes pieces of tuffa. The sand from the sea and river was never employed when the other sort could be found, and the same observation may be made regarding gravel (glarea). The cement, according to Vitruvius, was composed of three parts of pit sand and one of limestone, or rather of two parts of river or sea sand, and one of lime. They generally added a third part of pounded shell to correct the defects of the sand, and to render the cement more firm and tenacious.

Clay was employed in the formation of their bricks, and must have been in great request in Rome, as their buildings are chiefly composed of this material. We are told by Vitruvius that, in his time, the bricks were dried by the rays of the sun, and he enters into a minute description of the method which they employed; in the ruins, however, existing at Rome, we observe only bricks baked by artificial fire. On an attentive examination of those found in Rome and Pompeii, we discover that the clay which they used was generally of two sorts, yellow and red, and that they mixed with it tuffa dust to render it more compact. Their size differs according to the use which was made of them, and the time they were formed. The bricks employed in courts are generally triangular; those which we call tiles, and which served to bind together the roof to the entire mass of the wall, are a foot and a half square; and those which were used for arches are quadrilateral, and are a foot and a half long and half a foot broad. All the ancient bricks are much finer in the grain, and are easily distinguished from those of the present day.

The stones which were employed in the buildings of ancient Rome, are the following: tuffa, which Vitruvius calls lapides rubri; peperino, or lapis albanus; travertino, or lapis tiburtinus; silex, and pumice-stone. The first four are found in the foundations and outer facings of the buildings, as well as in the internal construction of the walls and vaults; the silex was only employed in the pavement of the streets, and the interior masses of the wall; the pumice-stone was particularly used in vaults from its lightness. Tuffa is found in every part of the country round Rome; and the ancient quarries, alluded to by Strabo, may be seen near the Anio, at Cerveretta, five miles beyond the Porta Maggiore, to the left of the Via Collatina. It is a volcanic production, of a colour more or less red, and of no great solidity, as it is easily decomposed by exposure to the atmosphere. The foundations of the buildings on the Palatine Hill are of this stone, and the Temple of Fortuna Virilis, and the aqueduct of Claudius, are also built of it. In this case, they either rough-cast the outer part of the wall, or cut it in sufficiently large pieces to resist the action of the air; the first method is observed in the above mentioned temple, and the other is found in the aqueduct of Claudius. Tuffa was employed also in Rome and its neighbourhood, for that sort of building, which, from its form, was called reticulated. This commenced on the decline of the Republic, and ceased about the time of Caracalla. The vicinity of Naples abounds also with this stone, and indeed the city is almost entirely built of it. The grotto of Posillipo passes through a mountain of this sort, and the perforations in the neighbourhood of Cumæ, Baiæ, &c. which are supposed to have been the abodes of the Cummelii mentioned by Homer, are dug in the same volcanic matter.

Lapis albanus, Peperino, also a volcanic production, derived its name from Mount Albanus, and its quarries are seen at present in the neighbourhood of Marino; its greenish greyish colour, and the resemblance it bears to pounded pepper, has given rise to the vulgar name of Peperino. This stone, as well as that called *Lapis Gabinus*, resists the action of fire; and, on that account, Nero, according to Tacitus, issued a decree, after the burning of Rome, that all the houses should be built of one or other of these stones. The peperino is more solid than tuffa, and is less influenced by atmospheric changes, though it also suffers. The walls of Servius at Rome were built of it, as may be still observed under the temple of Victory, on the declivity of the Quirinal, where there are still some remains. It has also been employed in the erection of the enclosure of the forum of Nerva, the temple of Antoninus, and Faustina, &c. The *Lapis Gabinus* very much resembles peperino, and is found at Gabii, about twelve miles from Rome. Its colour is the same; but it is much harder and more porous; the ancients employed it more particularly for millstones.

Travertino, a name corrupted from Lapis Tiburtinus, was brought from the neighbourhood of *Tibur*, Tivoli; and even now you see the ancient excavations between the *Aquæ Albulæ* and *Pons Lucanus*, to the right of the road. It is a calcareous concretion, formed by sulphureous waters, and those of the Anio; it is extremely porous, resists the action of the atmosphere, and hardens in proportion as it is exposed; fire, however, decomposes and calcines it. The amphitheatre of Flavius, the sepulchre of Metella, and many other monuments on the Appian Way, are of this stone. Its colour is originally white, but, from long exposure, it acquires a yellowish hue, which adds much to the beauty of the buildings. The Romans cut it in large quadrilateral masses, and employed it without cement for their edifices. The temples and walls of Pæstum are of the same material, and the quarries where the cyclopic masses were excavated, are seen without the walls of the city. Some of the stones are twenty-four feet in length. There is a bridge at Benavento, which is observed to be of the same structure and same material. *Silex* is a different stone from the one which is known to mineralogists under that name; it is a basaltic lava, of an iron colour, which, from its peculiar hardness, was employed in walls and the pavement of streets. The quarries are found on the Appian Way, beyond the sepulchre of Cecilia Metella, and in many other places in the vicinity of Rome. Pumice-stone *, from its extreme lightness, was reserved for the erection of vaults; and you find it employed in those of the Coloseum, and the magnificent cupola of the Pantheon. It was brought from the neighbourhood of Vesuvius.

These are all the common materials which the Romans employed; and before we proceed to notice those ornamental stones, which added so much beauty to their edifices, we shall attempt to mark the different epochs in Roman history, when these materials were used.

The most ancient Roman buildings are constructed of the lapis albanus, because Alba was the first important conquest which the Romans made; and it is natural to suppose that they would prefer the stone which could be most easily procured.

* The pumice mentioned above is, we presume, vesicular lava, not the pumice of geologists.—Edit.

This continued to be used, not only during the regal government, but almost to the fall of the republic. The Carcer Mamertinum constructed by Ancus Marcius; Cloaca Maxima, the work of the Tarquins; parts of the Wall of Servius, under the Quirinal; the sepulchre of the Scipios, and many other ancient monuments, are built of this stone. When Tibur was subdued, A. M., 417, they began to introduce Travertino, which was ever afterwards promiscuously used with the lapis albanus. As it is harder and more compact than peperino, it was particularly used for ornaments, arches, and architraves. Thus, the Doric capitals and architrave of the tabularium, the insulated columns of the temple of Fortuna Virilis, and the arch of Dolabella on the Mons Cœlius, are composed of this stone. As far as we can perceive from the remains of antiquity, square masses of stone were used during the kings and the republic. But on its decline, they introduced that sort of construction which Vitruvius calls *Opus . ncertum*, and which must not be confounded with that formed of large polygons, which we see at Cora, Præneste, and other ancient cities of Latium. Vitruvius, indeed, tells us, and we can perceive it from the ruins, that this *opus incertum* consisted of small stones mixed with mortar. There is an example of it in Rome in the temple of Romulus, under the Palatine; at Tivoli, in the temple of Vesta; at Præneste, in the temple of Fortune, and in many other ruins scattered through the country. On the contrary, the walls of the above mentioned places are built of massive polygons of three, four, and five feet in length, and without mortar. The *opus incertum* is only an outward facing of the wall, and is supported behind by a mass of every sort of material.

The *opus incertum* was soon succeeded by the *opus reticulatum*, which is mentioned, by Vitruvius, as the fashionable architecture of his age, and which continued to be, more or less, used down to the reign of Caracalla. This reticulated construction derived its name from its resemblance to net-work, and was formed of stones found in the neighbourhood, which were cut into the form of coves. At Rome the stone is tuffa; at Præneste, calcareous limestone; at Tivoli, travertino; and at Tusculum, a kind of peperino, which the Italians call *Piatra Tusculana.* As this particular sort of construction could not be used in the angles of houses, they seem generally to have introduced bricks, and sometimes stones of a rectangular shape. There are several beautiful specimens of this reticulated work at Rome; the gardens of Sallust under the Quirinal, and the palace of Mæcenas, may be mentioned as worthy of inspection. In both these, you see this net-work promiscuously used with bricks, regarding which we shall now make a few observations.

The *Opus lateritium* or brick-work, began to come into general use in the time of Augustus, and maintained its ground to the fall of the empire; it was nearly equal in strength to the massive stone-work which was originally employed. There were many changes, during this long period, in regard to the form of the bricks, and the quantity of cement. In the reign of Augustus, they were generally made of a red earth, of a triangular form, and about an inch in thickness, as may be seen at the gardens of Sallust, at the palace of Mæcenas, under the Esquiline, and at the palace of Augustus on the Palatine. Under Tiberius, the earth was of a deeper red or yellowish, as is proved by the prætorian camp without the Porta Pia; and in the time of Nero, they mixed the yellow and red bricks in their buildings, as the aqueduct near the Porta Maggiore shews. They are much smaller than those of Augustus and Tiberius, and very little cement seems to have been placed between them. There are some other remains, in different parts of Rome, that seem to be of the same age and construction. Of the brick constructions of the time of Vespasian and his sons, we have some magnificent specimens in the amphitheatre of Flavius, the baths of Titus on the Esquiline, and the villa of Domitian. The two former approach nearer the construction of Augustus, and the latter resembles the brick-work of the palace of Mæcenas. The edifices built in the reigns of Trajan, Adrian, and the Antonines, exhibit the same construction, and though the baths of Caracalla are evidently deficient in good taste and beauty of design, yet the brick-work is nearly equal to that of the best times. After this there was a rapid decline in every thing connected with architecture, and even the brick-work did not maintain its original solidity. They no longer attempted to make them equal in size, and they introduced large portions of cement, which tended much to weaken the strength of the walls. From Caracalla to Diocletian there are few remains, and even of these we are unable to fix the exact period when they were erected.

It is curious to observe, that they now began to be economical in the use of bricks, and that they introduced a mixture of tuffa, as is evident from the restoration of the tomb of the Scipios, the circus of Caracalla, and the ruins adjacent to the circus. The numerous churches and basilicos, which were erected by the Christians in the fourth, fifth, and sixth centuries, such as St Croce a Gerusalemme, St Geovanni e Paolo, St Paolo, St Pietro in Vincoli, &c. and the walls which surround Rome on the left bank of the Tiber, and which are of the age of Honorius, exhibit the same poverty of materials; they have bricks of all sizes, with a great quantity of cement, which is of inferior quality to that used in earlier times. On the fall of the Roman empire, they even neglected the selection of proper materials to form their bricks, and even employed those which they took from more ancient buildings. At last they invented a method of cutting the softer stones, tuffa and peperinos, into small rectangular masses, and discarded entirely the use of bricks. The Italians call this *Opera Saracinesca*, because it was introduced when the Saracens occupied Italy. The walls of the Vatican, built by Leo IV. in the ninth century, are the first specimens which we have of it in Rome. This sort of construction continued to be used during the barbarous ages till the fourteenth century; the castle of *Capo de Bove*, near the sepulchre of Metella, built by Pope Boniface VIII., is a beautiful specimen of it. They sometimes cut marble in this rectangular shape, as may be seen in *Sorre de' Conti*, a work of Innocent III. of the thirteenth century.

To conclude this part of our subject, we may remark, that the Romans during the kings, and the time of the republic, employed in the public edifices square masses of stone; on the decline of the republic, they introduced *opus incertum;* under Augustus *opus reticulatum* and *lateritium* were promiscuously used; the *opus reticulatum* ceased under the Antonines, but the brick-work continued to the seventh century, and was succeeded by the *opera Saracinesca.*

We must reserve the observations we have to make on ancient marbles, granites, porphyries, and alabaster, till another opportunity.

On the Covering of Birds, considered chiefly with reference to the description and distinction of Species, Genera, and Orders. By Mr W. MACGILLIVRAY, Assistant to the Regius Keeper of the Edinburgh College Museum, and Corresponding Member of the Wernerian Natural History Society. Communicated by the Author.

BIRDS, like quadrupeds, are invested with a covering, which is connected with the skin, and lies immediately upon it. This covering is chemically of the same nature with the hair of mammifera, and the scales of reptiles and fishes, but it differs essentially in respect to its mechanical structure, being much more complex in its constituent parts than the envelope of these classes of animals. To this general envelope the name of *plumage* is given. In ordinary language it is more frequently called *the feathers*. It is peculiar to birds.

It may be presumed, that the plumage of birds serves to protect them from the injurious agency of external powers, such as cold, heat, rain, hail, &c. and that it operates in retaining the caloric generated in the body, and in developing or fostering electricity. The varieties of structure, magnitude, and proportion, and the degrees of connection, which its parts present, together with the diversified hues, and the varied capabilities of absorbing or reflecting light which it possesses, must, in a system where every thing is the result of design, originate from peculiar specific necessities, and be subservient to the welfare, or even the existence, of the individuals composing this beautiful, and, in many respects, highly interesting class of beings. Upon considerations like these it is not my design to enter. Their developement would constitute a task more than sufficient to confound the pretensions of the wisest; and I should more admire the mind that had discovered the causes, relations, connections, ends and objects of a feather, than that which had measured the magnitudes and distances of the planets, traced their orbits, and calculated the velocities of their revolutions. The plumage also answers another very important end in the economy of birds, being the medium of their locomotion in the air,—a faculty which gives them so many advantages over quadrupeds, and which is not possessed, in an equal degree, by any other class of animals.

The plumage, then, is the general covering of a bird, which usually invests all its parts, excepting the beak, eyes, tarsi, and toes. It consists of a great number of individual parts, which are denominated *feathers*. Besides these parts, however, so denominated, there are in most birds others, which, lying concealed among the former, and not making their appearance at the surface, are apt to be overlooked by superficial observers. These are the down-feathers, and hairs, or piliform feathers, which will be described in course, but which, for the sake of simplification, may be for the present overlooked. These individual parts or feathers are disposed upon the skin in what is called quincuncial order; that is, in lines intersecting each other at acute angles, and in such a manner as to lie over each other, like the tiles on the roof of a house; a circumstance denoted in Zoology as well as in Botany, by the term imbrication, their general direction being backwards, or from the head of the bird to the tail and extremities.

The plumage, as has just been observed, does not cover the whole surface of a bird; but, besides the parts mentioned, as being altogether bare, there are others, which, although covered over by the feathers, yet do not give origin to them, and are thus, in a particular sense, bare. These parts are: a line from the base of the upper mandible to the eye, called the lore or bridle; a line from the ear to the shoulder, on either side of the neck; a broader line from the fore-part of the sternum to the vent; a space upon the sides under the wings; and in female birds, and frequently in males also, during incubation, two circular spaces, or one transversely oblong space, of greater or less size, upon the abdomen. Other parts also occur in particular species or genera, which will become the subject of distinct consideration in their own place.

A feather may be defined an individual constituent of the plumage, having a distinct existence of its own, and by its association with others contributing to form the general envelope. Or, in another sense, it may be defined, a mass of indurated gelatinous matter, inserted by one extremity into the skin, connected by apposition in the greater part of its form with others, and in a portion of one of its terminal surfaces touching the air, having a root or proximal part of a tubular form, continued into an elongated and attenuated stem, laterally giving insertion to a series of connected filaments. A feather of the ordinary kind, or what may be assumed as a perfect feather, consists of the following parts.

1. The *tube* or *barrel*, (in Latin *tubus*, in French *tube* or *tuyau*), a tubular part, by which it is fixed into the skin. It consists of a thinnish transparent tube, or hollow cylinder, having the colour and texture of a thin plate of clear horn, and being chemically of the same nature. This tube, which is more or less protracted, being in some feathers scarcely a fortieth part of their length, as in the hypochondrial feathers of Paradisea apoda, while in others it exceeds a third, as in the quill-coverts of the Flamingo, is abruptly narrowed at the lower, or with reference to the connection of the feather with the skin, the proximal end, where it is closed up by a dry membrane, forming part of an apparatus that has been subservient to the growth of the other parts of the feather, and which now, in a dry and shrivelled state, extends along the whole length of the tube, in its interior. This part, when taken out of the tube of the feather, presents the appearance of a very thin transparent membranous tube, divided internally by transverse dissepiments. At each of these dissepiments the tube separates on pulling it gently, and each portion so obtained presents the appearance of an inverted funnel, the prolonged extremity of which, being continued into that of the next above it, an internal tube is produced, which occupies the centre of the membrane. This membrane is, in ordinary language, termed the *pith*, from its resemblance, if not in nature, at least in position, to the pith of a plant. It might, with more propriety, be named the *internal membrane of the tube*, *membrana tubi interior*, *membrane interieure de la tube*. The tube is invested externally with a sort of close sheath, consisting of several layers of condensed cellular membrane. With regard to the texture of the tube itself, it would seem to be composed internally, and, in its greatest thickness, of a uniform horny substance, which, in many species, however, shews longitudinal fibres, while the outer part, though not to a great depth from the surface, is composed of transverse or annular fibres. Hence the reason why, in making a pen, the slit is always cleanest when the outer layer has been scraped off. The longitudi-

nal fibres are distinctly seen in the quills of the domestic cock, and of the gallinaceæ in general. The tube terminates above, that is, distally with respect to the body of the bird, in the next part.

2. The *shaft* or *stem*, (in Latin *Rachis*, in French *La Tige).* This is a continuation of the tube, but considerably altered in its forms. It is generally as follows. From being of equal diameter with the tube, it gradually diminishes, so as to terminate in a point. Considered in respect to its length, it is more or less curved, the outer, upper, or anterior part, or back, as it may be called, being convex, the inner, under, or posterior part, or face, concave. The back is more or less convex, but generally in a small degree, considered in its transverse section. The face is formed of two convex surfaces, separated by a groove which runs along its whole length, or of two inclined planes meeting at an obtuse angle. The two sides are more or less plane, and gradually approximating, as is equally the case with the back and face, from the base toward the tip, where all four meet, and so terminate in a point. Internally the shaft consists of a soft, compact, elastic substance, of a white colour, having much of the mechanical nature of cork, and which might be named the *internal suberose substance of the shaft, materia rachis suberosa interna, la matière interne liègeuse de la tige.* It is separated longitudinally by a line proceeding from the groove of the face of the shaft, and this division can be traced along its whole extent even to the back, on the external surface of which there is sometimes a corresponding sunk line; but the two pieces of the corky matter are in close contact along this dividing line, and do not even separate distinctly by tearing them asunder. The external part, or horny envelope or case of the shaft, is much thinner than the tube, the latter of which is prolonged farther along the back of the shaft, than along its face, although there is no line of distinction between them. Some further explanations, however, are necessary here, before the structure of the shaft can be rightly understood. Where the tube terminates on the face of the feather, and where the groove of the shaft commences, the line of union of the dorsal and lateral surface of the shaft meets its fellow of the other side, having gradually left the posterior margin of the shaft, crossed its side obliquely, and be-

come anterior at this point; so that, at the commencement of the shaft, what is naturally considered as the back of the shaft forms the whole circumference of it, and does not become the real or geometrical back, until it has reached a certain height. It is this back only which is the true continuation of the shaft. We may suppose the corky matter imposed upon its anterior surface, and covered over by a prolongation of it, forming the coating of the sides and face of the shaft. The posterior wall of the shaft is much thicker than the others, and longitudinally grooved internally, or where it meets the pith; the anterior walls are considerably thinner, and the lateral comparatively very thin. About the point of union of the two lines mentioned, on the face of the feather, the corky matter commences, and is in contact with the anterior coat of the shaft, but posteriorly it leaves a vacuity, which extends some way up the shaft. The internal membrane of the tube having reached this point, divides, a portion passing upwards into the posterior vacuity, another passing to the surface of the feather, by a small aperture at the commencement of the median groove of the shaft, over which lies a small laminar prolongation of the tube. This arrangement is what is observed in quill-feathers in general; but in most ordinary feathers there is no vacuity behind, and the internal membrane makes its exit undivided at the commencement of the groove. The shaft is distinguished from the tube by its being opake, which is caused by the internal corky substance, the external horny coat being of the same nature as the tube, only attenuated, and more so, as has been said, on the back, than on the face or sides of the shaft.

3. The *webs* (in Latin *telæ*, in French *les toiles*), of which there are two, one on either side of the shaft. The web is a lateral prolongation of the external layer of the coat of the shaft, into a series of filamentous substances, ordinarily placed in apposition, and by their association in this manner forming a stiffish elastic expansion. The filaments of which the web consists are named barbs.

The *barb*, *barba*, *barbe*, is a very thin linear membrane, being an attenuated continuation of the outer pellicle of the shaft, and arising from it at the angle formed by the meeting of the dorsal and lateral surfaces, along the edge of the latter. The direction of the barbs is obliquely outwards with respect to the shaft, that is, inclining more or less at an acute angle toward the tip of the shaft. Each barb is flattened or compressed vertically with reference to the shaft, considering it horizontal with its face downwards, concave on the side next the tip, convex on the other, so as to fit to its neighbour on either side. It terminates at its lower part, or that on the concave surface of the feather, in a sharp edge, generally diaphanous, which is reflected in the direction of the tip of the feather. The body or substance of the barb is pretty uniform in thickness, and it is only when viewed in connection with the barbules that it could with any propriety be said to be triangular.

From the upper part or edge of each barb there proceed two sets, one on either side, of minute filaments, having a direction, with respect to the barb, similar to that of the barbs with respect to the shaft. These smaller filaments are named *barbules*, *barbulæ*, *les barbules*. It is by means of them that the barbs are firmly kept in apposition. The manner in which this is done, is not by the barbules of one barb interlocking with those of another, in the manner of dovetailing, or as the teeth of two combs might be made to alternate by mutual insertion, as I believe is generally supposed. The position and direction of the barbules do not admit of such union, seeing they meet each other at an angle, and therefore cannot interlock, which could only happen were they to meet vertically. The barbules of the side next the tube are shorter and more adpressed; those of the side next the tip of the feather are longer and more patulous. The latter are curved downwards at the extremity, while the former are curved upwards; and being placed in apposition they form two distinct and continuous edges, the incurvate or anterior series of one barb overlapping and hooking into the recurvate posterior series of the barb next to it. Although the connection of the barbs may not be easily seen in the ordinary feathers, yet it may in general be discovered in the quills and tail-feathers, without the aid of a glass. When the barbs are pulled asunder in the plane of the web, their cohesion is found to be very considerable in most feathers. When the posterior barb is pulled downwards out of the plane of the web, the cohesion is found still greater;

but when the anterior barb is pulled downwards, or the posterior barb upwards, there is found to be no cohesion at all. The curved form of the barbules is distinctly seen by the naked eye, in the tail-feathers of Buceros galeatus.

The barbules themselves frequently present an appearance similar to that of barbs, giving off laterally two series of filaments, which may be termed *barbicels, barbicellæ.* These filaments are much more sparse than those of the barbs, but their object appears to be the same, namely that of connecting the barbules, and retaining them in apposition. They are very distinctly seen, with the aid of a small magnifying power, in the quills of Falco fulvus, Diomedea exulans, and Buceros galeatus.

It may here be remarked, that, while what has been assumed, for the purpose of general description, as a perfect feather, is, what is termed in botany, supra-decompound, there is yet in feathers the following gradation in respect to division:

1*st,* A feather may have only a tube and a shaft, without any other part; for example, the quill of the cassowary.

2*d,* There are feathers which have a tube, a shaft, and barbs destitute of barbules; as in the crest-feathers of the golden pheasant.

3*d,* Feathers consisting of tube, shaft, barbs, and barbules; as in most birds.

4*th,* Feathers composed of tube, shaft, barbs, barbules and barbicels, as in the examples mentioned above.

A barb also may have barbules in one part, and be simple toward its extremity, which is a case of very frequent occurrence; but these, and similar modifications, will be more properly treated of, when we come to the varieties of form and structure exhibited in the plumage.

Feathers, then, in general, consist of three parts,—the tube, the shaft, and the webs; or they may be primarily divided into two parts, the tube and the vane, the latter of which consists of the shaft and webs. The webs consist of barbs furnished with barbules.

With respect to the immediate consequences of their mechanical structure, it may be remarked of feathers in general, that, from being convex above, they resist flexion or fracture more from beneath upwards than in any other direction; pulled to either side also, they feel stronger than when bent downward in the direction of their concavity. They are elastic, and this property, together with their curvature, tends to keep them close together, and enables the bird to present, when occasion requires, a more or less compact surface to the air. When the barbules are disjoined, they readily unite again, on being placed in apposition. The weaker the feather is, provided it be complete in all its parts, the greater is the cohesion between its barbs. Compare, for example, the quills of Diomedea exulans with those of Falco rufus; or quill-feathers in general with ordinary feathers.

The webs ordinarily consist of united barbs, more or less stiff, although elastic, and compact, in their whole length, excepting toward the junction of the shaft with the tube, where they are of a looser texture, often entirely disunited and floating. The lateral lines, from which the barbs arise, incline toward the median line of the shaft at this place, as has already been explained, and meet at its commencement.

At this point there is, in the feathers of a large portion of birds, a plumiform process, or small feather, which is of the following description: From the fore part of the tube, at the commencement of the shaft, and lying over the aperture by which the internal membrane of the tube escapes, rises a thin lamina, being a continuation of the substance of the tube. It gradually narrows, and is continued in the form of a very delicate thread, for a greater or less extent. From the sides of this shaft rise two series of barbs, and from the barbs two series of barbules, as in the ordinary feather itself, all the parts being extremely fine, and entirely disunited. The barbules are very much elongated and loose, resembling in these respects those of the lower part of the webs of feathers in general. This miniature feather may be called the *accessory feather*, *pluma accessoria*, *la plume accessoire*. In feathers possessed of this structure, the internal membrane of the tube comes out entire between the accessory feather and the feather properly so called, and is not continued internally along the back of the shaft.

In respect to this accessory plumule, there is a curious and beautiful gradation among birds. In the diving aquatic birds, or such as swim more than fly, there is a short laminar or squamiform continuation of the fore part of the tube, which is fringed with small barbs; as in the genus Carbo. In the duck tribe, some species are similar in this respect to the last division, for example, Anas cygnus, leucopsis, albifrons; in others, the accessory plumule begins to exist in a distinct form, but very small, as in Anas tadorna. In the volitant aquatic birds, as Sula, Larus, Sterna, the plumule becomes distinct, but is still small. In the lobe-footed water birds it also exists in this incipient state, as in Fulica atra, Podiceps cristatus. In the grallatores it attains the length of at least one-third of the feather. It exists in the genus Psittacus, developed in a considerable degree. In the genus Corvus, and the omnivorous birds of Temminck in general, it is commonly about half the length of the feather, but very narrow, and with few barbs. In the genus Turdus, and others allied to it, it is still slender, but nearly two-thirds of the feather in length. In the genus Otis, it is more developed. In the gallinaceous birds it is very remarkable, existing of very considerable size in the genera Phasianus, Gallus, Lophophorus, Polyplectron, Tetrao, Perdix, &c. In these birds it is broad, furnished with numerous tufty barbs, and reaching to about a third of the length of the feather from the tip. In the gallinaceous birds in general, the posterior ventral feathers are downy, and in them the accessory feather is very little shorter or narrower. It is remarkable that the genera Pavo (*P. cristatus* and *P. japonicus*), and Crax, have no accessory feathers. This is equally the case with the Columbæ. It receives its greatest development in the genera Casuarius and Dromiceius, where it is of equal, or nearly equal, size with the feather itself, and from being downy, has become perfectly similar in structure to it. Whether it exist equally developed in the ostrich I do not know, not having had an opportunity of examining that bird, but it probably does. Yet in the Rhea Americana, a bird closely allied to the emeu, the feathers are all perfectly simple, without even so much as a scale in the place of the accessory feather. I am aware that the double feather has been noticed in the emeu, the cassowary, and the ptarmigans; but in the other birds which I have mentioned, its existence does not seem to have been known I observe that some writers having seen the double feather in the ptarmigan in winter, have, in a manner that to me seems very strange, taken it for granted that it does not exist in that bird in summer, and assumed that the accessory plumule is a provision of nature for defending from the cold a bird so peculiarly exposed to it as they imagine the ptarmigan to be. How these theorists may dispose of the reasonings which they have founded upon such data, when they examine the summer plumage of the ptarmigan, and find the accessory feather equally developed in it, and comparing the red grous with the ptarmigan, discover that it, too, is amply provided with a downy envelope of the same nature, I know not. Moreover, if the bushy and downy accessory feather be a provision of nature for the defence of the birds of cold regions, why should the argus, the Macartney cock, the jungle fowl, the Java partridge, which inhabit the warmest regions of the globe, be furnished with them, and that, too, in so high a degree? The subject of the accessory plumule might, as will be perceived, be treated much more fully; but my object not being to make it occupy a more prominent place than other considerations, I must relinquish it for the present, with the concluding remark, that, in birds possessed of that sort of feather, the quills and large tail-feathers, as well as the first row of superior and inferior quill coverts, are in most cases perfectly simple, although there are some birds, especially among the gallinaceæ, and, in particular, the Lagopede grouse, which, in those feathers, have a very distinct rudimentary accessory feather, existing in the form of a short tapering lamina, fringed along its free edges with small simple bards.

Explanation of Plate III.

Fig. 1. Anterior dorsal feather of the cassowary.

2. Anterior dorsal feather of the emeu.

These two figures shew the accessory feather in its highest developement.

3. Inferior lateral cervical feather of Ardea cinerea.

4. Dorsal feather of Tetrao saliceti.

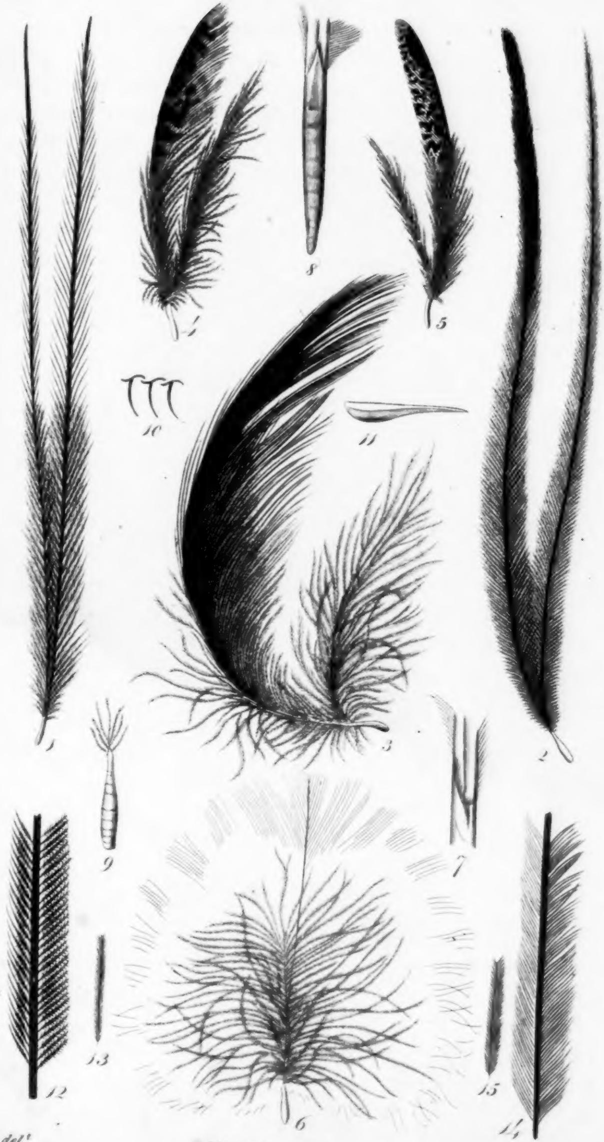
5. Dorsal feather of Polyplectron chinquis.

6. Pectoral feather of Falco buteo.

7. Part of a primary quill of the flamingo, shewing the union of the webs.

8. Part of a primary quill of Tetrao saliceti, shewing the accessory feather existing in the state of a small pointed lamina, fringed with simple barbs.

PLATE III.



W. M^c G del^t

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E. Mitchell sculp^t

Fig. 9. Part of a pectoral feather of Diomedea exulans, shewing an accessory feather consisting of a small pointed lamina, margined with a few downy barbs.

10. Sections of three barbs of a quill of Diomedea exulans, a little magnified, shewing the mode in which the barbs are connected by the barbules.

11. A barb of a primary quill of Tetrao lagopus, viewed laterally.

12. Part of a barb of a primary quill of Falco fulvus magnified, shewing the barbule, connected by barbicels.

13. The same of the natural size.

14. Part of a barb of a posterior dorsal (or train) feather of Pavo cristatus, magnified, shewing simple barbs.

15. The same of the natural size.

On Isopyre, a new Mineral Species. By W. Haidinger, Esq. F. R. S. E. Communicated by the Author.

1. *Description.*—Regular forms not observed. Very pure masses of considerable size, often nearly two inches in every direction, occur imbedded in granite.

Cleavage none. Fracture conchoidal; highly perfect, where the mineral is pure; of lower degrees of perfection, where there are foreign admixtures in it.

Lustre vitreous, often considerable. Colour greyish-black and velvet black, occasionally dotted with red, as in the heliotrope. Streak pale greenish-grey.

Opake, or very faintly translucent on the thinnest edges, with a dark liver-brown tint.

Brittle. Slight action on the magnetic needle.

Hardness =5.5...6.0. Specific gravity =2.912.

2. *Observations.*—Several specimens of the species of Isopyre are preserved in the cabinet of Mr Allan. Some of them are quite pure, and have no rock attached to them; others are imbedded in a kind of granite, chiefly consisting of quartz, crystals of which often penetrate the dark coloured mass of the isopyre. Some of the specimens were procured by Mr Allan three years ago, on a journey through Cornwall, in which I had the pleasure of accompanying him, from a miner in St Just; others

were given to Mr Allan by Mr Joseph Carne of Penzance, whose collection of minerals is particularly rich in the products of the western districts of Cornwall. The west of Cornwall is certainly the native country of the isopyre, but I am unable at present more accurately to indicate its locality, as I then considered the substance actually to be, what it was called, *black opal*, and, as such, much less interesting than it proved on more attentive examination, and omitted to take a note of the exact locality.

The resemblance of the isopyre to obsidian, or to what might be supposed to be the appearance of opal, when of a black colour, is very considerable; only the lustre of isopyre is less bright and glassy than that of obsidian. It is also very much like certain varieties of iron slag, and in fact it would be difficult to suspect the mineral not to be a product of the same kind of fusion which we are capable of producing in our own furnaces, if it were not associated with crystals of quartz, or did not contain, as in one of Mr Allan's specimens, small imbedded crystals of tin-ore and of tourmaline. In allusion to this appearance, and also on account of the perfect similarity of a globule melted before the blowpipe, with the fragment employed in the experiment, I propose the trivial name of *Isopyre*, for designating the mineral, from ἴσος equal, and πῦρ fire. The similarity of properties is even preserved in regard to magnetism, the globule obtained by exposing a fragment of the mineral to the blast of the blowpipe being magnetic, as well as the fragment itself, and even in a higher degree.

From the description given * of the Tachylite of Breithaupt, this mineral should much resemble the isopyre. Its specific gravity is much lower, being only 2.5...2.54, so as to preclude the possibility of their belonging to the same species. It occurs in basalt and wacke at Sæsebuehl, near Gœttingen, likewise only massive.

* Leonhard, 2d edit. p. 781.

Chemical Examination of Isopyre. By EDWARD TURNER, M. D., F. R. S. E., Lecturer on Chemistry, Edinburgh. Communicated by the Author.

BEFORE the blowpipe the isopyre fuses without the disengagement of any gaseous matter; and melted with salt of phosphorus, it gives evident indications of the presence of silica. On reducing it to powder, and exposing a portion of it on platinum wire to the blowpipe flame, a rich green tint appears. Acids act upon it with difficulty; but it is easily and completely decomposed by an alkaline carbonate. Heated to redness it does not give off water, nor suffer any loss in weight.

Having ascertained by preliminary trials that the isopyre consists of silica, alumina, oxide of iron, lime, and a little copper, without either manganese or magnesia, I proceeded in the following manner to the analysis, in which I was assisted by my friend Mr Copland. Of the isopyre in fine powder 20.625 grains were mixed with 80 grains of the carbonate of soda, and exposed during half an hour to a red heat. The mass, which had acquired a yellowish tint, and contracted considerably, was dissolved by dilute muriatic acid. The solution was evaporated very slowly to perfect dryness, and the silica separated in the usual manner. After exposure to a red heat, it weighed 9.71 grains, equivalent to 47.09 per cent. The silica proved on examination to be quite pure.

From the solution, thus freed from silica, the copper was precipitated by sulphuretted hydrogen. The sulphuret of copper was then dissolved in nitromuriatic acid, the excess of acid expelled by evaporation, and the peroxide of copper precipitated by pure potash. The oxide of copper, after being heated to redness, weighed 0.40, amounting to 1.94 per cent.

After separating the copper, the solution was heated with nitric acid, in order to convert the iron into peroxide, and the iron and alumina were then thrown down by a very slight excess of pure ammonia. The peroxide of iron and alumina were then separated as usual by pure potash, and deprived of water by heat. The former amounted to 4.14 grains, or 20.07 per cent., and the latter to 2.87 grains, or 13.91 per cent.

The lime contained in the ammoniacal solution was precipitated by oxalate of ammonia. The oxalate of lime, decomposed and rendered caustic by heat, yielded 3.19 grains, or 15.43 per cent. of pure lime.

To ascertain if an alkali is contained in isopyre, 30 grains of the mineral in fine powder were decomposed by 180 grains of the carbonate of baryta, and the earthy and metallic substances removed in the way above mentioned. After expelling the ammoniacal salts by heat, there remained a trace of soda, which was most probably derived from the reagents.

In order to discover if any acid is contained in isopyre, I decomposed 20 grains of the mineral by carbonate of soda, and removed the soluble parts by distilled water. In the alkaline solution, neutralized by nitric acid, muriate of baryta discovered a trace of sulphuric acid; but I was unable to detect the presence either of the muriatic, phosphoric, fluoric, or boracic acids. The sulphuric acid is most probably derived from the copper being combined wholly or in part with sulphur; at least, on digesting isopyre in powder with nitromuriatic acid, the solution was found to contain both a little copper and sulphuric acid.

According to this analysis, the isopyre is composed in 100 parts of

Silica, -	47.09
Alumina, -	13.91
Peroxide of Iron,	20.07
Lime, -	15.43
Peroxide of Copper,	1.94
	98.44

I forbear to speculate concerning the precise atomic constitution of isopyre, since it is impossible to depend on the purity of a mineral which is both opaque and uncrystallized. With respect to the iron, it must in part be in the state of black oxide, as appears both from the colour of the mineral and from its being attracted by the magnet. The copper can scarcely be regarded as an essential constituent; for, though I have seen no specimen which is free from copper, the quantity of that metal is not constant. I found it on one occasion considerably below 1 per cent.

Biographical Notice of Count Lacepede, *and account of his Work on the Natural History of Fishes.*

Count Lacepede, in early life, by his experiments and views in philosophy, attracted the notice of Buffon, who ever after remained much attached to him. His skill and knowledge of music was so great that he became the friend of the celebrated composer Glück. He wrote the music of the opera of Omphali, and afterwards an interesting work in two volumes octavo on Music and Poetry, which procured him marks of respect from Frederick II. of Prussia, and, what he prized more, the approbation and esteem of Sacchini. His works on electricity, and general and particular physics which followed, were not successful. Buffon proposed to him to write a continuation of his Natural History of Animals, to which he agreed. Some months before Buffon's death, which took place in 1788, the first volume of his history of Reptiles, comprising oviparous quadrupeds, made its appearance; and, in the following year, the second volume, containing the natural history of Serpents, was published. These works are distinguished for the elegance of their style, and the numerous interesting facts which they contain. About this time, the political agitation of France commenced, and Lacepede was for several years enveloped in the frightful vortex of the Revolution at Paris, from which he escaped with his life by a fortunate chance, and retired to the country.

Of all the occupations, says Baron Cuvier, in which M. de Lacepede had been induced to engage, the sciences alone, as is usual with them, remained faithful to him in the time of misfortune, and it was with them that he consoled himself in his retreat. Resuming the habits of his youth, passing the day in the midst of the woods or on the banks of the rivers, he traced the plan of his Natural History of Fishes, the most important of his works. Immediately after his return he commenced its composition, and at the end of two years, in 1798, he found himself in a condition to publish the first volume. Five volumes appeared in succession, the last in 1803.

This numerous class of animals, perhaps the most useful to man after the domestic quadrupeds, is the least known of all; it is also the least calculated to afford interesting developement.

Cold and mute, passing a great part of their life in inaccessible depths, or exempt from those passionate movements which bring quadrupeds so near ourselves, shewing nothing of that conjugal tenderness which is admired in birds, nor of those labours so varied and ingenious, which render the study of insects as important for general philosophy as for natural history, the fishes have scarcely any thing else to present to our curiosity than forms and colours, whose descriptions necessarily follow the same plan, and impress an inevitable monotony on the works which treat of them. M. de Lacepede made great efforts to overcome this difficulty, and often succeeded in doing so. All that he could collect regarding the organisation of these animals, their habits, the wars which the human species wages against them, and the benefit which it derives from them, he has given in a pure and elegant style; he has even diffused a charm over his descriptions of them, whenever the beauties, which have been imparted to them in so high a degree, permitted their being presented to the admiration of naturalists. And in fact, what can afford a greater subject of admiration than those brilliant colours, that glare of gold, steel, ruby, and emerald, profusely poured upon beings which man is scarcely ever naturally to meet with, and which are never almost seen in the obscure depths where they are retained. But still words cannot have the same variety, nor the same glow; the art of painting itself is insufficient to represent all the magnificence of such scenes.

At the same time, the difficulties of which we speak relate only to form, and do not arise from the desire so natural to an author who succeeds Buffon, to be read by people in general. There are others more intrinsic, and of which the naturalist alone can form an idea. Before writing his first page on any class of animals whatever, the naturalist, who would merit the name, must have collected as many species as possible, must have compared them both with regard to their internal structure and external appearance, must have grouped them according to their general characters, extricated them from the confused, incomplete and often contradictory articles of his predecessors, and referred to them the observations, still more confused and obscure, of travellers, for the most part ignorant or superstitious, and yet the only witnesses who have seen these animals in their native climate, and who could speak of their habits, the advantages which they afford, and the injuries which they occasion. To appreciate these testimonies, he must know all the circumstances of the authors which he consults, their moral character, and their degree of instruction; he must be able to read almost all languages. The historian of nature, in a word, cannot overlook any of the resources of criticism (that art of finding out the truth so necessary to the historian of man), and he must moreover join to it a multitude of other talents.

M. de Lacepede, when he composed his work on fishes, was far from being placed in circumstances under which the resources of which we speak were entirely at his disposal. The anatomy of fishes was not sufficiently advanced to furnish him with the basis of a natural distribution. A general war had established an almost insurmountable barrier between France and the other countries; it had shut up the seas against us, and separated us from our colonies. Foreign books, also, did not reach us; nor did travellers bring home those collections, so numerous and so rich, which arrived among us as soon as the seas were open; even Peron himself, who had been employed in a voyage of discovery during the war, had not arrived when the work was finished. The author, therefore, could only take for the subjects of his observations, the individuals collected in the Royal Cabinet before the war, and those afforded by the cabinet of the Stadtholder, which was brought to Paris after the conquest of Holland. Of the naturalists who had preceded him, he selected Gmelin and Bloch as his principal guides, and perhaps he followed them too faithfully, punctual as he was in observing the same courtesy toward authors as to society. The drawings and manuscript descriptions of Commerson, and paintings formerly made by Aubriet, after drawings by Plumier, were almost the only unpublished resources which it was possible for him to have access; and yet, with materials so poor, he succeeded in collecting upwards of 1500 fishes, whose history he traced; and estimating at the highest the number of species described more than once, a kind of error unavoidable in such a work, and which sometimes he fell into, there would remain from 1200 to 1300 undoubted and distinct species. Gmelin had only about 800, and Bloch in his great work did not exceed 450; and there are not more than 1400 in his *Systema*, which appeared after M. de Lacepede's first volumes, and which was compiled under circumstances much more favourable.

These numbers will still appear small to those who may be aware that the Royal Cabinet in Paris alone now contains upwards of 4000 species of fishes; but such has been the activity of science over all the world, since the opening of the seas, that all the collections have been doubled and tripled, and an entirely new era has commenced in natural history. This circumstance derogates nothing from the merit of the writer, who did all that it was possible to do at the period when he commenced his investigations; and such was M. de Lacepede. Even at the present day there is no work on the history of fishes superior to his, and he is always quoted on the subject. The work of Dr Shaw, in which the descriptions are arranged according to Linnæus's system, is much indebted to Lacepede. And even when the immense materials collected in these latter years shall have been put together in another work, the brilliant pieces of colouring, full of sensibility and deep philosophy, with which M. de Lacepede has enriched his work, will not be forgotten. Science, from its nature, is every hour advancing; there is no observer who may not outdo his predecessors in facts, nor any naturalist who may not improve upon their systems; but the great writers will not remain the less immortal.

The natural history of fishes was followed, in 1804, by that of the Cetacea, which terminates the great system of vertebrate animals. M. de Lacepede considered it as the most perfect of his works; and in fact he treated the historical and descriptive part, that referring to the organisation, and the methodical characters, better than in any other. His style also rises in some measure in proportion to the grandeur of the objects. He augments by about a third the number of species, enrolled before him in the great catalogue of animals; but since his time this department of science has also been improved. The posthumous work of Camper, and those of some other naturalists, have thrown much light upon the osteology of the Cetacea.

1. *On Osmelite, a new Mineral species.* 2. *Description of a new species of Pyrites.* 3. *Mineralogical examination of Russian Platina Sand.* By Professor Breithaupt of Freyberg.

1. *On Osmelite.*

THE name of this mineral is derived from οσμη smell, and λιθος, stone. Its characters are as follows: Colour greyish-white, which passes into a tint between smoke and yellowish grey. Planes, which have been exposed to the weather, have their colour changed into dark hair-brown. It consists of thin prismatic concretions, either scopiformly or stellularly arranged, and these again collected into coarse granular concretions, forming massive portions. Cleavage visible only in one direction, owing to the thinness of the prismatic concretions, which indeed pass into fibrous. Its form is conjectured to be rhomboidal. Is strongly translucent. It feels rather greasy. Its hardness, owing to the fibrous structure, is difficult to determine; it appears, however, from some trials on the file, to be intermediate between that of fluor-spar and apatite. Specific gravity = 2.792 to 2.833.

It gives out, in the common temperature of a room, a distinct clayey smell, which is increased by breathing on it, or when brought from a warm to a cold place. In the mouth it tastes like clay, and appears as if it would dissolve like clay, although no change takes place.

This species is distinguished from the zeolites by its greater specific gravity. It approaches to tabular spar in hardness and specific gravity, but in no other characters.

It occurs superimposed on calcareous spar, mixed with datolite,—in veins in trachyte, in a hill at Niederkirchen, near Wolfstein, on the Rhine.

2. *On a new Species of Pyrites, from Skutterud, in Norway.*

This mineral was met with at Skutterud, in Norway, by M. Winkler, brother-in-law to Breithaupt. That mineralogist considers it a new species, and describes it under the following name in Poggendorf's Journal.

Hard Cobalt Pyrites.—Colour fresh and beautiful dark tin-white. Occurs massive. Primary form *hexahedron.* Its most distinct cleavage hexahedral,—next in distinctness octahedral, and the least perfect rhomboido-dodecahedral. Traces of concretionary structure parallel with octahedral planes, intimate that the octahedral figure is to be expected. Lustre shining and metallic. Hardness equal that of glassy actynolite, or = 7.25 — 7.75 (Breithaupt's scale). Specific gravity = 6.74 — 6.84.

On charcoal, before the blowpipe, it gives out copious arsenical fumes. Melted with borax, it affords a beautiful blue glass. Arsenic and cobalt are thus shewn to enter into its composition.

This new species of pyrites is distinguished from the axotomous arsenical pyrites of Mohs, by inferior specific gravity and crystallization-system ; from antimonial nickel-pyrites of Breithaupt, by greater weight and greater hardness; from cobalt-pyrites (*Weissen Speiss-cobalt*), by its more distinct hexahedral cleavage and greater specific gravity.

It occurs along with glance-cobalt, copper-pyrites, glassy actynolite, precious serpentine, quartz, and sometimes cobalt-bloom.

3. *Mineralogical examination of Russian Platina Sand.*

I was favoured by M. Schwetzau with a quantity of the Platina-sand, washed out of the sand of Nijnotaguilsk, in the government of Perme, in Siberia. Of this Siberian sand there are two kinds: the one is ferriferous, and contains platina; the other, which is purer and more quartzy, afforded principally remarkably fine wash-gold.

The platina-sand, even at first glance, appears composed of grains of different kinds. I separated, by the eye, the following minerals: 1. *Platina.* 2. *Gold.* 3. Irid-osmine. 4. *Silver-white flat grains.* 5. *Iserine, or magnetic iron-sand.*

The grains, from their appearance, could not have rolled far, and must have been found at no great distance from the place of their origin, for many of them are very sharp-edged, or even bristled with points.

1. *Platina-grains.*—I attempted to separate these from the iserine-grains, by means of the magnet, but was surprised to find that not only the iserine, but also many of the platina-grains, adhered to it. I found that some of the platina-grains were

magnetic, others not; hence these two kinds are probably varieties of two distinct species.

First species: *Common Platina.*—It is the same with the platina brought from America by Humboldt, and possesses the following characters:

Colour *platina-grey*, which is different from steel-grey. On concave places there is observed a yellowish appearance.—The grains are angular and bristled, seldom blunt-edged; the crystals are hexahedral, and grouped, as in silver-glance.—Hardness = 70. — 8.5 *. Is perfectly malleable. Specific gravity 17.001 — 17,608. A large American specimen in the Wernerian cabinet was 16.914. It is well known that the native platina is always lighter than that prepared by chemical means.

Second species: *Ferruginous Platina.* The colour is *platina-grey*, but darker than in the preceding species. In hollows in the specimens, the surface is tarnished, from dark-brown to black, as in meteoric iron. The grains and crystals have the same forms as in the former species.—Hardness = 8.0 — 8.5. Malleable, but not so completely so as in the first species. Specific gravity 14.666 — 15.790. It is magnetic, and in some grains not only repels, but also attracts. It is distinguished from the former species by lower specific gravity, less perfect malleability, and its affording, by chemical trials, a considerable portion of iron.

2. *Gold.*—I found few grains of gold in the platina-sand: these were partly *gold-yellow*, partly *greyish-yellow*. Is Werner's greyish-yellow gold, gold combined with platina?

3. *Irid-osmin.*—This species, which is a compound of iridium and osmium, presents the following characters:

The colour is not steel-grey, as is generally believed, but a middle colour, between whitish lead-grey and common lead-grey. It occurs crystallized in low hexagonal prisms, which have an axotomous cleavage. Hardness = 8.0 — 8.75. Is imperfectly malleable. Specific gravity = 17.969 — 18.571.

It would be desirable to have iridium and osmium again examined. Iridium will probably be found to possess a higher

* Scale of hardness here used is that of Breithaupt, in his Mineralogy, 7 = that of glassy actynoite, 8 = that of adularia, 9 = quartz.

specific gravity than platina, and probably belong to the tessular system. The osmium, on the contrary, appears to belong to the electro-negative metals, which possess a hexagonal crystallization, such as arsenic, tellurium and antimony.

4. *Silver-white Flat Grains.*—They appear to be palladium.

Concluding Remark.—In the portion of platina-sand I examined, the large half was ferruginous platina, the smaller common or true platina. The remaining grains composed about $\frac{1}{200}$th part of the whole.

Chemical Examination of Tourmaline. By Prof. C. G. Gmelin.

Gmelin arranges the Tourmaline under three subdivisions, these depending on the chemical composition. The following are the results of his analyses:

A. *Tourmaline which contains Lithion.*

Three varieties of this kind were examined: 1. Red tourmaline or rubellite, from Rözna, in Moravia; its specific gravity =2.96 to 3.02. 2. Red tourmaline, from Perm, in Siberia. Specific gravity = 3.059. 3. Celandine green tourmaline, from Brazil. Specific gravity = 3.079. The following table gives their constituent parts:

	1. *From Rozna.*	2. *From Perm.*	3. *From Brazil.*
Boracic Acid, - -	5.74	4.18	4.59
Silica, - - -	42.13	39.37	39.16
Alumina, - - -	36.43	44.00	40.00
Black Oxide of Iron,	...	...	5.96
Oxide of Manganese,	6.32	5.02	2.14
Lime, - - -	1.20	...	...
Potash, - - -	2.41	1.29	...
Lithion, - - -	2.04	2.62	3.59 *
Volatile matter, -	1.31	1.58	1.58
	97.58	97.56	97.02

B. ***Tourmaline which contains either Potash or Soda, or both, without Lithion, and a minute portion of Magnesia.***

Of these the following were analysed: 1. Black tourmaline, from Bovey, in Devonshire, which occurs along with quartz and

* With trace of Potash.

apatite. Specific gravity = 3.246, at + 8° R. 2. Black tourmaline, from Eibenstock, in Saxony. Specific gravity = 3.123, at + 8° R. 3. Black tourmaline, from Chesterfield, in North America. Specific gravity = 3.102, at + 8° R.

	1. *From Bovey.*	2. *From Eibenstock.*	3. *From Chesterfield.*
Boracic Acid, - - -	4.11	1.89	3.88
Silica, - - -	35.20	33.05	38.80
Alumina, - - -	35.50	38.23	39.61
Oxide of Iron, - - -	17.86	...	7.43
Black Oxide of Iron,	...	23.86	...
Oxide of Manganese,	0.43 *	...	2.88 †
Magnesia, - - -	0.70 ‡	...	...
Lime, - - -	0.55	0.86	...
Natron, - - -	2.09	3.17 §	4.95
Loss, - - -	...	0.45	0.78
	96.44	101.51	98.33

C. *Tourmaline which contains a considerable quantity of Magnesia.*

1. Black tourmaline, from Käringbricka, in the Swedish province of Westmanland. Specific gravity = 3.044, at + 9½ R. 2. Black tourmaline, from Rabenstein, in Bavaria. Specific gravity = 3.113 at + 13 R. 3. Black tourmaline from Greenland. Specific gravity = 3.062, at + 5½ R. 4. Dark brown tourmaline, in mica-slate, from St Gotthardt, Specific gravity not accurately determined.

	1. *From Karingbricka.*	2. *From Rabenstein.*	3. *From Greenland.*	4. *From St Gotthardt.*
Boracic Acid, -	3.83	4.02	3.63	4.18
Silica, - - -	37.65	35.48	38.79	37.81
Alumina, - -	33 46	34.75	37.19	31.61
Magnesia - -	10.98	4.68	5.86	5.99
Black Oxide of Iron,	9.38	17.44	5.81	7.77
Oxide of Manganese,	...	1.89	Trace,	1.11
Potash, -	2.53	0.48	0.22	1.20
Natron, -		1.75	3.13	...
Lime, - - -	0.25	Trace.	...	0.98
Loss, - - -	0.03	...	1.86	0.24
	98.11	100.49	96.48	90.89

The great loss in the analysis of the St Gotthardt tourmaline is not easily explained: it may be owing to the escape of a volatile alkali.

* With trace of Magnesia. † With trace of Magnesia. ‡ With trace of Manganese.
§ With Potash and trace of Magnesia.

Chemical Examination of Russian Platina. By Ch. Ossann, Professor in Dorpat.

THE Platina, from ore of the Urals, is more varied in character than that found in America.—I have already been enabled to distinguish four different sorts, and I am told there are still more. One of the kinds, that which is most abundant, is sold at the mint in Petersburg. It consists of grains of different descriptions. Small grains can be separated by means of the magnet, resembling the magnetic grains in the platina of Brazil. The other grains are partly of a lighter and darker lead-grey colour, and about a line in diameter,—partly of a gold-yellow colour, and some are small, flattish, and shining metallic. In the following analysis I used the bluish-grey coloured grains. The following results were obtained in soluble matter:

		In per cent.
Palladium, - - -	0.0198	1.64
Rhodium, - - -	0.1354	11.07
Platina, - - - -	0.9752	80.87
Copper, - - - -	0.0245	2.05
Iron, - - - - -	0.0279	2.30
Sulphur, - - - -	0.0095	0.79
Trace of Iridium.		
Residuum, - - -	0.0013	0.11
	1.1936	98.83

Poggendorf's Journal.

On the History and Constitution of Benefit or Friendly Societies. By Mr W. Fraser, Edinburgh. Continued from p. 139.

VIEWING the distributions of Friendly Societies as now quite unconnected with charity, and holding each individual to be entitled to benefit upon the equitable principles of mutual assurance, it is essential to the just rights of the members, and to the permanence of every society, that the contributions and allowances should be originally made adequate to each other. For this purpose there are three fundamental principles which require, in the first place, to be held as either established or assumed, as upon these the whole calculations must necessarily be founded. 1*st*, The average rate or quantity of sickness to which the members will probably be subjected in every period of life; 2*dly*, The rate of mortality or number of deaths that will occur at every age; and, *3dly,* The rate of interest which will most likely be obtained for money. These three points shall therefore be considered in their order.

Rate of Sickness.

It does not appear that, till within the last half century, the least attention had ever been paid in this or any other country to the law of sickness. About the year 1771, Dr Price, the celebrated writer on Reversionary Payments, first turned his attention to the subject, and, during the next twenty years, had it frequently under his consideration. In 1789 he was required, by a Committee of the House of Commons, to compute tables of contributions and benefits for sickness and old age, in consequence of a bill then before Parliament, by which it was proposed to establish life annuities in parishes for the benefit of the poor, to be defrayed by parochial assessments.

In the formation of these tables, Dr Price could not calculate upon the rate of sickness with any degree of accuracy, no satisfactory observations having been previously made upon the subject. He supposed, however, that as death is usually preceded by a longer or shorter period of disease, the average duration of sickness among mankind would be in proportion to the mortality; and as the rate of mortality had been pretty well ascertained, he concluded that the quantum of sickness at corresponding ages might be reckoned on without great error. He therefore assumed the following individual average rate of sickness, as that which would most probably be experienced by Friendly Societies:

Age.	*Sickness.*	*Weeks.*	*Days.*	*Hours.*	*Proportion of Sick Members.*
Under 32 years	1.0833	1	0	14	1 in 48
32 to 42	1.3541	1	2	11	1 in 38.4
43 to 51	1.6249	1	4	9	1 in 32
51 to 58	1.8957	1	6	6	1 in 27.42
58 to 64	2.1666	2	1	4	1 in 24

That is, that among forty-eight persons under 32 years of age, there would occur 52 weeks of sickness in the course of a year, or that somewhat more than 2 in 100 would be constantly unfit for their employment; and that among persons from 32 to 42 years of age, from 43 to 51, from 52 to 58, and from 58 to 64, this quantum of sickness would be progressively increased by a fourth part in each period.

Upon this assumed rate Dr Price accordingly prepared tables of contributions and allowances to the age of 65, and laid them before Parliament; but added, with regard to sickness occurring under 32 years of age, that "various reasons, and particularly the experience of friendly clubs, determined me to believe, that the proportion of the sick to the well in such a society will not be so great as this, and, consequently, that the weekly allowances during sickness will be more than supported by weekly contributions not exceeding a forty-eighth part of that allowance."

The Bill and Tables were sanctioned by the House of Commons, but lost in the House of Lords, on account of the burden which it was thought the scheme would impose on the landed interest. The tables, however, were afterwards given to the public in the 7th edition of Dr Price's work on Reversionary Payments; but being professedly founded on supposition, and incorporated with subjects of an abstruse nature, they did not meet with that attention which they merited. Till very lately, few societies in England ever adopted them, and even those only partially; while such tables, it is believed, remained wholly unknown to Friendly Societies in Scotland.

In the latter country, the first attempt, of which we have any notice, to calculate upon the probable rate of sickness, occurred in 1801, in the case of the Society or Incorporation of Sailors of Prestonpans. A few individuals had endeavoured to deprive the seamen of that town of the privileges and capital of their institution, but they vindicated their rights before the Court of Session, and recovered possession of their funds. Upon the case being finally decided, the Court directed new regulations to be drawn up, and submitted for their approval. This duty devolved on Charles Oliphant, Esq. writer to the Signet, their law-agent, who having felt great difficulty in adapting the future allowances to the revenue, consulted with the late Reverend Mr Wilkie, a writer on annuities. This gentleman afterwards reported on the subject, but stated it to be impossible to calculate accurately for the schemes of Friendly Societies, so long as the law of sickness remained to be ascertained. The contributions and allowances proposed by Mr Wilkie, however, proceeded on the assumption that one-twelfth part of the members would be constantly sick, a proportion which upwards of twenty years' experience has shewn to have been far too high.

At a later period, when the numerous failures of Friendly Societies began to attract more general attention, several of their members were led to attend to the probable rate of sickness. Mr R. Wilson, and some other individuals in the village of Methven in Perthshire, instituted a survey to ascertain the sickness for one year among the whole male population of the parish above fifteen years of age, with a view to obtain data for calculating the scheme of a Friendly Society; when it was ascertained, that, from mental or bodily imbecility, one in every twenty-one of the male population of that parish could not at any time of their lives have been admissible into a Friendly Society. Mr Gavin Burns of Hamilton, in his pamphlet on Friendly Societies, already alluded to, estimated that one in every twenty of the members of a society would be constantly sick, or at all events not above 1 in 17. Mr Borland of Paisley, and Mr Dick of Bathgate, it is believed, also paid some attention to the subject; but comparatively little benefit resulted from these investigations.

The great importance, however, of ascertaining the law of sickness, from actual experience, continued to be still farther pressed on Mr Oliphant's attention, by his being frequently consulted in Friendly Society affairs, and from witnessing the serious evils that were constantly arising to their members from miscalculation. At a conference with the intelligent Directors of the Deanston Society, whose questions he had been unable satisfactorily to answer, the expediency of instituting a public inquiry on the subject was forcibly suggested. In 1819, Mr Oliphant brought forward the case in the Highland Society of Scotland, and moved that premiums should be offered to Friendly Societies for returns of the ages of their members, and the sickness which had been found by experience to correspond with those ages. This motion was ultimately agreed to, and a committee appointed to conduct the inquiry. Schedules for collecting returns were then issued throughout Scotland, with an exemplification of the form in which the information was required *, and two premiums of twenty guineas each were

* The Schedule and Exemplification were both carefully arranged by Mr Will of the Customs. These will be found very useful in assisting such so-

offered for the most valuable returns. In the course of two years, returns were received from upwards of seventy societies, situated in sixteen different counties, embracing periods of 3, 10, 20, 30, 40, and even 50 years, and comprising upwards of 100,000 members. The great mass of information thus obtained was carefully digested and arranged by the committee, with the assistance of several other gentlemen who took an interest in the subject, but more particularly with the aid of Mr John Lyon, late house-governor of Watson's Hospital, and now one of the Masters of the High School, Leith; of the late Mr James Skirving of the Stamp-Office; and of Patrick Cockburn, Esq. accountant in Edinburgh *.

In these returns, the number of free-members (*i. e.* those entitled to benefit) during each year, were classed, according to their ages, in decades or periods of ten years; and the number of weeks' sickness experienced by each class was arranged in the same manner. The average rate or law of sickness was thence deduced, by allotting to each individual an equal share of the sickness occurring in his class. Thus, supposing the members between 20 and 30 years of age in any society to have amounted to 104, and the sickness experienced by the *whole* of that class, during one year, to have been 52 weeks, then this was equal to half a week for *each*, and consequently the same, with regard to the payments, as if one member had been permanently sick, and received benefit for that length of time. The sickness of the other four classes, or till 70 years of age, was calculated in the same way; but above that age, and below 20, the number of members was too limited for being the basis of any calculation that could be relied on. The following table of results will exhibit more clearly the mode adopted in classing the number of members and weeks of sickness, as well as the extensive data from which the law of sickness has been deduced.

cieties as may still wish to review their own experience, and they will be seen at pp. 260–262 of the published Report of the Committee of the Highland Society on Friendly Societies.

* To Mr James Cleghorn, accountant in Edinburgh, Friendly Societies are also much indebted, not only by the attention which, as Editor of the 6th volume of the Highland Society's Transactions, he paid to the Committee's Report while in the press, but likewise by the ready and able assistance he has since given in establishing several societies upon proper principles. See also his excellent article on the subject in Farmer's Magazine, vol. xxv. p. 389.

SUMMARY of RESULTS of RETURNS by FRIENDLY SOCIETIES *of* SCOTLAND, *for various periods of years from* 1750 *to* 1821, *established in the Counties of Ayr, Berwick, Cromarty, Dumfries, East Lothian, Edinburgh, Forfar, Lanark, Linlithgow, Peebles, Renfrew, Perth, Ross, Roxburgh, Selkirk, and Stirling, to the Schedule issued by* THE HIGHLAND SOCIETY OF SCOTLAND.

	NUMBER OF FREE MEMBERS,								NUMBER OF WEEKS OF SICKNESS OF FREE MEMBERS,							
	Under 20 years of age.	20—30.	30—40.	40—50.	50—60.	60—70.	Above 70.	TOTAL.	Under 20 years of age.	20—30.	30—40.	40—50.	50—60.	60—70.	Above 70.	TOTAL.
1*st*, 15 Societies,	304	3591	7054	6986	4094	1430	255	23714	107	1718	4239	6067	6470½	8656	5744½	33002
2*d*, 8 do. *	4	1357	3156	2744	1673	720	222	9876		354	1235	2029	2538	2909	2977	12042
3*d*, 24 do.	284	8158	14024	9493	4638	1830	479	38906	116	4738	10628	10235	8910	10783	6900	52310
4*th*, 9 do.	35	544	801	598	355	148	85	2566	3	356	556	488	771	765	2360	5299
5*th*, 11 do. *	20	445	1041	1042	601	253	78	3480	22	277	692	1180	1278	1858	622	5929
6*th*, 12 do.	409	9414	10185	4256	1237	167	8	25676	153	6464	7554	5807	3724	651	39	24382
79 SOCIETIES †,	1056	23509	36261	25119	12598	4548	1127	104218	401	13907	24894	25806	23691½	25622	18642½	132964

Nota.—Nos. 4*th* and 5*th* are Returns for three years, 1819, 1820, and 1821.

* These Returns are corrected according to the Reporter's supposition.

† There were but 73 *different* societies, for six were given twice, both for a long and a short period.

Average Sickness for each Individual, deduced from the above.

Age.	Weeks and Decimals.	Weeks.	Days.	Hours.	Proportion of Sick Members.
Under 20	0.3797	0	2	16	1 in 136.95
20–30	0.5916	0	4	3	1 ... 87.89
30–40	0.6865	0	4	19	1 ... 75.74
40–50	1.0273	1	0	4	1 ... 50.61
50–60	1.8806	1	6	3	1 ... 27.65
60–70	5.6337	5	4	10	1 ... 9.23
Above 70	16.5417	16	3	19	1 ... 3.14

By the results here deduced from actual experience, it appears that there is a considerable difference in the lower ages between this rate and that assumed by Dr Price, his being greater in every period except the two last. It here also appears, that from 20 to 50 years of age, sickness gradually increases with the advance of life, in the ratio of nearly one-tenth part of a week for every five years of age, but that after 50 it increases more rapidly; for, while the annual sickness between 30 and 40 years of age is only about five days, and between 40 and 50 little more than a week,—from 50 to 60 it is doubled, being nearly *two* weeks, and above 70 upwards of *sixteen* weeks. This rate of sickness no doubt varied very materially in different societies, being above this average in some and below it in others; but such discrepancies were seldom found, except in cases where the number of members was too small to afford a range for a fair average. Something, however, may have depended upon the occupations in which the members were engaged, and whether situated in the country or in towns.

It is likewise to be observed, that the above is only the annual rate of sickness to an individual, as experienced by societies on an average of each ten years; and consequently, when exhibited for each particular year of age, it must be somewhat less in the first, and more in the concluding, years of the decade. Thus, the average sickness in the 60th year of age will be only 2 weeks 2 days, but in the 70th, 10 weeks 5 days. In order, therefore, to exhibit the whole range of sickness more correctly, and to found a basis for accurate computation, it became necessary to calculate two sickness tables, upon a graduated scale, from 20 to 70 years of age. The one of these tables is "with reference to an *individual*," or "exhibiting the quantum of sickness which an individual, on an average, experiences each year from 20 to 70 years of age;" and the other is "with reference to a *society*, exhibiting the law of sickness, as affected by the law of mortality, from 20 to 70 years of age; or the quantum of sickness which takes place each year from 20 to 70 years of age among 1005 persons, all commencing the 21st year of their age at the same time, the number of persons decreasing according to the law of mortality, and the quantum of sickness increasing according to the law of sickness;—all shewn in weeks and decimals of a week." These two tables we shall here combine, adding the number of members alive in the middle of each year, according to the rate of mortality adopted in the Report.

LAW of SICKNESS, exhibited in Weeks and Decimals of a Week.

Age.	Number of Members alive.	Aver. Sickness to an Individual.	Average Rate of Sickness in a Society.	Age.	Number of Members alive.	Aver. Sickness to an Individual.	Average Rate of Sickness in a Society.
21	1000	.575	575.000	46	727	1.032	750.264
22	990	.576	570.240	47	714	1.108	791.112
23	980	.578	566.440	48	701	1.186	831.386
24	970	.581	563.570	49	688	1.272	875.136
25	960	.585	561.600	50	675	1.361	918.675
26	950	.590	560.500	51	661	1.451	959.111
27	940	.596	560.240	52	647	1.541	997.027
28	930	.603	560.790	53	633	1.633	1033.689
29	920	.611	562.120	54	619	1.726	1068.394
30	910	.621	565.110	55	605	1.821	1101.705
31	900	.631	567.900	56	590	1.918	1131.620
32	890	.641	570.490	57	575	2.018	1160.350
33	879	.652	573.108	58	560	2.122	1188.320
34	868	.663	575.484	59	544	2.230	1213.120
35	857	.675	578.475	60	528	2.346	1238.688
36	846	.688	582.048	61	512	2.500	1280.000
37	835	.702	586.170	62	496	2.736	1357.056
38	824	.718	591.632	63	479	3.100	1484.900
39	812	.737	598.444	64	461	3.700	1705.700
40	800	.758	606.400	65	443	4.400	1949.200
41	788	.784	617.792	66	423	5.400	2284.200
42	776	.814	631.664	67	403	6.600	2659.800
43	764	.852	650.928	68	381	7.900	3009.900
44	752	.902	678.304	69	359	9.300	3338.700
45	740	.962	711.880	70	336	10.701	3595.536

As decimal parts will be hereafter frequently used, and as it is desirable that nothing should remain unexplained to society members, we shall, for the benefit of such readers, give an example of the mode of converting these parts into days, hours and minutes.—The figure to the right of the point signifies so many 10th, the next 100th, and the third 1000th parts of a week. To bring these into days and hours we have only to multiply them first by 7, the number of days in a week, then by 24, the number of hours in a day, inserting a point to the left of the three figures in each sum, and whatever remains is the number wanted. Hence,

.575 decimals,
Multiplied by 7, the number of days in a week,

make 4.025, and by striking off the three figures to the right for the three originally, 4 days remain.
And again by 24, the number of hours in a day,

.100
.50

make .600, not an hour more, but 6-tenths of an hour, or 36 minutes, as seen by multiplying .600 by 60, the number of minutes in an hour.

Thus it appears, from the above Table, that each society member, during the 21st year of his age, is liable, on an average, to 4 days of sickness.

The returns did not state the different degrees or intensity of sickness with such accuracy as could be relied on, but it is stated (*Report*, p. 108) that "the following general proportion between the different kinds is drawn from the returns, and may be taken as an approximation to the true one, till future observations afford a better standard.

"Of 10 weeks of sickness among persons of all ages under 70,

2 may be assumed as bedfast sickness,
5 walking ditto,
3 permanent ditto,

In all 10.

"Or if the allowances are regulated by the duration of sickness, then of 10 weeks of sickness it may be assumed that

$2\frac{1}{2}$ weeks will be sickness of the first quarter,
3 second and third ditto,
$4\frac{1}{2}$ unlimited duration,

In all 10."

Such were the results obtained by the inquiry of the Highland Society of Scotland into the rate of sickness among the members of Friendly Societies;—an inquiry which reflects the highest honour on the philanthropic individuals by whom it was originated and conducted to a close, and which will, from the importance of the results, prove one of the most beneficial undertakings of that highly patriotic and useful institution.

As already mentioned, the subject was next brought before Parliament in 1825, by Thomas Peregrine Courtenay, Esq., and a Select Committee was appointed by the House of Commons to take whatever steps might seem necessary. This Committee did not pursue the course adopted by the Highland Society,—that of requiring returns of the sickness experienced among Friendly Societies in England, but called before them such professional gentlemen and others as were supposed to be best acquainted with their affairs. Neither did they confine their investigation to sickness only, but went into a very wide field of inquiry as to the rate of mortality, the average number of births resulting from each marriage, and various other matters connected with Health and Life Assurance. In attempting, however, to give a brief view of their proceedings, we shall, for the present, confine our attention to what relates to the rate of sickness.

By the Minutes of Evidence annexed to the Report it appears, that in England, as in Scotland, Friendly Societies are continually becoming bankrupt, and that very few are established upon proper principles. It likewise appears, however, that, since the statutory enactment in 1819, which requires the rules of all societies in England presented to the Justices for sanction, to have the certificate of two actuaries or accountants that they are founded upon proper calculations, some attention has been paid to the average rate of sickness. Several new societies, upon a very extensive scale, and on scientific principles, have also been instituted in London, Nottinghamshire, and Hampshire, which promise to have a very beneficial effect on other societies in England.

The first witness examined (*March* 8. 1825) was the Reverend J. T. Becher, chairman of the Quarter-Sessions of Southwell, founder of the Friendly Institution there, and author of various pamphlets on Friendly Societies. He states, "Respecting sickness, I have deduced my information from the investigation of several societies, whose rates of assurance, and the state of whose funds, I now submit. I have likewise calculated that the sickness of human life, being the general cause of mortality, is in a great degree commensurate with that of mortality; it is the relation necessarily subsisting between cause and effect."—"The Southwell tables calculate the number of sick members under the age of 25 at 1 in 46.22; from the age of 25 to 30 at 1 in 37.81; from 30 to 40 at 1 in 32; and from 40 to 50 at 1 in 27.73; which proportions common observation will convince us exceed the ordinary proportions of sickness prevailing around us. Indeed, the health of the members in the Southwell Institution has, during the short period of our existence (about two years), been so favourable, and the judgment of the surgeon so satisfactory, that although several have entitled themselves to an immediate allowance in sickness, we have, in twenty-one months, only paid L. 1, 18s. for such assurances, and among our members not a death has occurred."—"In the Castle Eden Friendly Society, in the county of Durham, the average number of members during 30 years, ended on 31st December 1823, was 178, and the average proportion of permanent sick 1 in 100.1; and in the Friendly Society, held at the Crown Inn in Southwell, the average number of members for 29 years, ended on 31st December 1823, was 67.4; and the permanent sick 1 in 135.8. In the Friendly Society at Lowth, in Lincolnshire, the average number of members for eight years ended on the 31st of December 1822, was 71.1, and for nine years, ended on 31st December 1823, 74.5. During the former period, the proportion of permanent sick was only 1 in 163.5, and during the latter, 1 in 127.4." It may here be remarked, that, in all these societies, except that at Southwell, the sickness is taken upon an average of the whole members in each society, without distinction of age, in the same way as had been done by the Reverend Mr Wilkie and Mr Burns, in the cases formerly noticed. But it must be obvious, that no satisfactory results could be obtained from any rate of sickness thus deduced, it being evident that, in other societies consisting of the same number of members, but of different ages, a very different rate might be found. It will be seen that Mr Becher was fully aware of this, for to the question, "Do you conceive that the average quantity of sickness, at different ages, increases as the value of life diminishes?" he answers, "I do, most decidedly; if there is any authenticity in the returns attached to the Report of the Scotch Highland Committee, these will confirm it.—You think that as a man advances in life, he is more liable to sickness? Undoubtedly he is, both in its frequency and in its duration.—Are you acquainted with that table (*The table of the Law of Sickness, framed by the Highland Society, given at p.* 283. *of this Journal*)? I am acquainted with the Scotch tables; and here the Committee will see that their progression of sickness begins at 21, and goes on increasing until the age of 70." *Report*, pp. 28, 29.

March 10.—Mr George Glenny, actuary to the Royal Union Association or Friendly Society, London.—"Are you acquainted with the Report on Friendly or Benefit Societies, lately published by a Committee of the Highland Society of Scotland? Yes.—Have you examined the tables annexed to that Report? Yes.---State your opinion of them? My opinion is, that the data are too low.---You mean by too low, too low for the districts with which you are acquainted? Yes.---Do you apprehend that the data upon which the tables were formed were incorrect? I must give a qualified answer. I think the tables, as produced from the returns which were made, correct; but there are many reasons which I could give why the returns should not be correct. I apprehend, that if any societies did not send their returns, they would be the societies whose affairs were the most desperate, and who would naturally have the greatest reluctance to an *exposé*. I do not know that any society did so refuse, but the great variety of the returns, the great variety of the data to be taken from each of these returns, induced me to think, that although it will be highly useful, in every stage of Friendly Societies, to consult these, yet they are not sufficiently high to use for tables of contribution. ---Does not that very much depend on the payment for management? Greatly; I provide the table first for the benefits, and then I put on every monthly payment a certain sum for management, which I think adequate."---"Having the book there, refer to Table III. (*supra* p. 283.) have you constructed any table upon a similar principle? Not exactly. I have obtained results upon a similar principle, upon which I have calculated my tables.---You mean you have obtained results from a variety of Friendly Societies? From a variety of Friendly Societies, and from a variety of bodies of men, and manufacturers. I have also obtained the opinion of a vast number of medical men, on the average sickness of population.—Could you easily construct a table upon a similar principle? I am now occupied in such an undertaking, but it is an undertaking of such magnitude, that I do not consider myself in a state to give up the results at present. I do not think them sufficiently correct. I have formed my sickness tables in the Royal Union from very closely examining those of Dr Price, and making very little alteration for actual observation; and I am confirmed in an opinion now, that notwithstanding what may have been done, at present Dr Price's sickness tables are the nearest correct of any thing yet published.—You consider them a trifle too high? I do." Mr Glenny then states, that, in many professions, such as gilders, painters, watchmakers, and workers in lead, he had found the sickness or inability for labour very great, although the mortality was by no means greater than among other professions.---Pages 39, 40.

March 11.—John Finlaison, Esq. actuary of the National Debt Office.—"Have you attended at all to the average prevalence of sickness at different ages? I have not; because I conceive it is totally impossible to obtain authentic materials, sufficient to reduce that subject to any certain law."—"When you say that sickness is incapable of valuation, you mean that there are no data whereon any calculation can be made? I mean that life and death are subject to a known law of nature, but that sickness is not; so that the occurrence of one event may be foreseen and ascertained, but not so the other."—"Do you apprehend that the same law, that is to say, the same habit and frequency of occurrence, exists as to sickness as with respect to death? I apprehend there is no certainty of this conclusion.—Not in the same climate, and among the same class of people? I should apprehend not; at any rate, no observations have been hitherto published that would shew that sickness follows any general law.—Are you acquainted with Dr Price's tables as to sickness? I am.—Are you aware upon what principle they were formed? I apprehend they are not formed upon any authority that would induce me to adopt them; they are very vague. They were formed upon this principle, that sickness increases in the same proportion as life advances? Yes, but I deny the conclusion; there is a constant and given mortality operating upon life, but no such law exists as to sickness."—"Are you acquainted with the Report of the Highland Society of Scotland upon the subject of Friendly Societies? I am not, further than that since I have been before the Committee, I have looked at the Report from that body.—You are aware that the sickness table appended to that Report is formed upon the experience of 70 or 80 societies in Scotland? Yes.—Supposing the returns from those societies to be accurate, do you conceive that Table III. (*supra*, p. 283) is formed therefrom upon correct principles? I do not; because, in the first place, supposing it were possible to conceive that sickness follows, among particular classes of men, an uniform and constant law, still the returns now shewn to me, and their results, are exceedingly vague, and much too limited, in my decided opinion, to enable any correct inference to be drawn of the rate of sickness to which human life at every age is subject, because it is not clear from the returns, whether the parties were of the ages stated when enrolled, and whether the sickness grew out of each class enrolled at each age, or whether the ages at which the sickness is stated to have occurred, took place when the parties enrolled at a younger age had attained an advanced age. I may add, generally, that the extraordinary differences of sickness among the societies reported, is the strongest reason with me for doubting the correctness of any conclusion to be drawn from the whole; besides, the sickness which may prevail in various districts of one country among one particular class of persons, affords no just criterion of that which may prevail in another country, under other circumstances: And, again, I beg leave to submit my humble but firm opinion to the Committee, that it is totally impossible, from any observations hitherto formed, to deduce the conclusion, that sickness occurs in any given ratio, the more as this question is not new to me, having been frequently before applied to on the subject, and having considered it very maturely." Page 47.

March 15.—William Morgan, Esq. actuary to the Equitable Assurance Society, and upwards of fifty years engaged in calculations depending on human life, states, that he has of late been frequently referred to upon the rules of Friendly Societies; that he has always found the tables of Dr Price correct; and that the opinions he has since given on particular tables submitted to him, have been, as far as the cases were applicable, formed upon the same principles as those tables.—"Have the goodness to state to the Committee the principle upon which you calculate the probable occurrence of sickness? I take them pretty much according to the degree of mortality; I suppose about 1 in 40 sick. The table says 1 in 48, and I find that accords more with actual experience."—"Do you think it consistent that there may be a great deal of sickness, and yet that it may not affect life? No, I estimate from experience in different clubs. I have had a manuscript paper of Friendly Societies, sent me from Scotland, for many years, which confirms the rate we take."—"Plumbers and glaziers, and other hazardous trades, are excepted out of the clubs."—"Are you acquainted with the Report lately published by the Highland Society in Scotland, on the subject of Friendly Societies? They sent me the book, but I have not had time to read it."—Pages 50, 51.

March 18.—Mr Joshua Milne, actuary to the Sun Life Assurance Society, states, that he has been frequently called on professionally to settle the rules or tables of Friendly Societies, but that in no instance had he been able to give the information wanted, as they could not be reduced to calculation. —"You are aware of Dr Price's tables? Certainly, but I have never investigated them.—You are aware of the principle on which they are formed? Not very accurately, not from accurate information. I beg leave to state the reason why I have not looked more accurately into the tables in Dr Price's work: it was, that I was satisfied, on looking at the subject, that there could be very little dependence placed upon them; they seem to have been taken on a gross average; that such must be the average of sickness; and I had no data from which my conclusions could be drawn entitled to confidence."—Page 56.

March 18.—John Finlaison, Esq. again examined. He is "still of opinion that, with the materials now existing, we are unable to reduce the event of sickness to a determinate law; but, nevertheless, I apprehend that it might be considered analogous to insurance against fire and sea-risk, and judged of by experience with tolerable accuracy." He farther observes, that there exist extensive data for forming a judgment on the subject among the labouring classes in his Majesty's arsenals, as also in every regiment in England, and submits the propriety of obtaining returns from these and similar sources. He likewise handed to the Committee the form of a return, which he conceived Friendly Societies could comply with, and without any difficulty.—Page 58.

April 22.—Charles Oliphant, Esq. convener of the Committee of the Highland Society on Friendly Societies. This gentleman having explained minutely to the Committee the way in which the returns to that body had been collected, and the manner in which their sickness table was framed,

Mr John Finlaison was again called in. "When you gave an opinion to this Committee on the 11th of March, upon the formation of the Scotch Tables, had you made yourself master of the mode in which the tables were constructed in their book? I had not; for I only then saw the book for the first time in the committee-room."—"Have you looked at the Report since? I have: I have looked at the Report, and looked at the mode in which the tables were constructed;" but he is still not able to give any farther "opinion upon the tables, except that as much was done as was possible with the means which the framers of that Report possessed; yet I think that the data must be considered as far too limited to deduce tables of premiums from.—When you say that the data are far too limited, do you mean that the number of persons was too small? Yes; but I consider that the foundation is laid by that method for perfecting the information, so that at a future period something may be done.—You conceive, then, that the mode which the Highland Society adopted was the correct mode of coming to the result they desired? I am not exactly prepared to give an opinion upon that question; I don't know that it is the best mode that could be adopted.—Because you said before that it was not? Will you be so good as to read what I said before on that subject? You were asked, 'You are aware that the Sickness Table appended to that Report is framed upon the experience of seventy or eighty societies in Scotland; and then, supposing the returns from these societies to be correct, do you conceive that Table III. is formed upon correct principles?' and you said you did not; Now, are you satisfied upon that point? I am not any farther satisfied than I was before."

Mr Oliphant re-examined. "You heard the last observation of the witness (Mr Finlaison), will you have the goodness to make your observations upon it?" "The statement made by Mr Finlaison is mentioned in his deposition, which I have seen; but he mentions that he had not read the report at that time. On looking at the report you will please to observe, that the sickness is always referred to the exact age when it occurred. Under the column Free Members, the number of members during the year is given in each class; and under the head of Allowances, the sickness arising in that class, and during that year, is given. The error into which Mr Finlaison has fallen, may have arisen from the abbreviated form in which it was necessary for us to exhibit the results. The details from which these are derived form a volume about the size of an ordinary atlas. We could not publish such voluminous details, and the abbreviated form adopted in exhibiting them, has, I presume, given rise to the misconception."—"What proportion of the societies do you apprehend did give the information? An extremely small proportion. Whilst from the whole kingdom of Scotland, we collected returns from between 70 and 80 societies, I have had an application from the societies of Edinburgh, signed by the representatives of from 40 to 50 societies, which shews that the number giving returns was a very small proportion."—"Do you apprehend that there are any other means by which more extensive information, with respect to the Scottish societies, might be obtained at present with respect to Scotland? I do not think that there is; for it was not, I am persuaded, so much from the want of inclination that the number of returns was limited, as from the want of ability. Returns could only be made where the society clerk, or some of the members, had a taste for research and calculation, and the moment that societies come to keep their records in a proper way, there will be no difficulty, I apprehend, in getting information. The Highland Society are endeavouring to induce them to keep their books in a more correct form, by offering premiums to the schoolmasters of Scotland to assist the Friendly Societies, by framing and teaching systems of book-keeping adapted for these institutions; and it is contemplated, in the course of a few years, their books will be so arranged as to afford readily every desirable information. If further returns are then called for, I am satisfied they will be given willingly to any extent that may be required. There is a change of feeling taking place, and the reserve which formerly prevailed, as to affording information, is wearing fast away."—"Has the average sickness in the Scottish societies, been compared with any statement that may be depended upon of sickness in England, or elsewhere? So far as my information extends, no inquiry as to the average rate of sickness, with reference to the age of individuals, had been instituted any where, previous to that by the Highland Society of Scotland."—"Except the statement given by Dr Price, which proceeded upon supposition, I do not know any statement that has been given of sickness, with which the results of the Highland Society's inquiry can be compared."—Pages 74, 76, 80.

Several other gentlemen and managers of Friendly Societies were examined, but as their opinions, and the various institutions to which they referred, were all founded on Dr Price's rate of sickness, it would be superfluous to enter farther into detail. We shall, however, give the concluding deposition of a gentleman already frequently noticed, and the substance of certain documents therein referred to.

June 17.—"John Finlaison, Esq. again farther examined. Have you, since you were last here, provided the proposed Form of Return to be made by Friendly Societies? I have, and beg leave to give it in amended, containing the additional information which the Committee desired.—Have you any thing further to add to the Committee? Having now been examined before the Committee several times, on the subject of sickness, I beg to observe, that I have devoted very particular attention, and have gone through a great deal of investigation, to ascertain whether sickness, throughout the whole or any part of human life, follows a constant law; and the result of those inquiries has been, that I must modify, in a very great degree, the opinions which I originally delivered. I am now strongly inclined to think, that the recurrence of sickness is constant to a much greater degree than was hitherto supposed; and I am supported in that opinion, no less by the facts and reasoning contained in the memoir which I have this day submitted, than by an extraordinary result, deduced from a work published by Sir Gilbert Blane in 1822, on the diseases in London, in which I find a remarkable consistency in the proportion between sickness and death. Now, as the rate of mortality is known, the rate of sickness, if the average time that each person were sick be computed, is also known. Thus, in Sir Gilbert Blane's book it appears, page 152, that, in the course of his private practice, he had 3,816 cases, which gave 382 deaths, which I infer was among the higher classes; whereas in his hospital practice at St Thomas's, comprehending entirely the lower orders, and certainly the severest kinds of sickness, he had 2,406 males, out of whom 239 died, and 1429 females, out of whom 135 died; so that it appears, that out of 10,000 patients, 1001 of the upper classes died, and 993 males, and 944 females, which I think a very surprising coincidence; and which farther demonstrates this important fact, that very severe sickness among the lower orders is not more frequently terminated by death than among the higher. If, therefore, the simple fact of the average time of sickness had been stated, there would be no difficulty in computing the sick allowance; and this fact, as well as an extension of the inquiry, is very easily attained by reference to the records of the other hospitals in London. I beg farther to inform the Committee, that the hypothesis which I hazarded in the conclusion of my memoir, is, on stating the same to several physicians, considered to be reasonable, and is, in fact, completely supported by the above details.—You have stated the results of Sir Gilbert Blane's practice among the higher orders, and also of his hospital practice; do you not think a very different result might be expected from the mortality of the lower classes, who have not the advantage of getting into hospitals? I certainly had supposed that those who were admitted into hospitals were the lower classes, as far as concerns London, and the worst cases; but although there may, in other parts of the country, be many of the lower orders, who have not the advantage of getting into such establishments as the hospitals in London, yet I am not prepared to say that the mortality among them would be greater, for this reason, because, in slighter cases, the country situation would seem to have its advantages, and in the severer sickness they can in general receive medical advice and attendance, if not the comforts of an hospital. I am not, however, able to form any conclusion as to how the fact may be. In reference to the conclusion to be derived from Sir Gilbert Blane's details, I beg to observe, that, supposing them to be borne out by farther researches, they are most important in enabling us to determine the sickness which occurs at one age as compared with another, for, by the law of mortality already discovered, we know the number of deaths which takes place at each age. Now, by Sir Gilbert Blane's statements, it appears that the number of patients were ten times the number of deaths. In my hypothesis, however, I assumed, that the sickness which terminated mortally was only a twelfth, and not a tenth, of the whole sickness which occurs, because, in reference to the patients mentioned by Sir Gilbert Blane, as having been received into the hospitals, it is to be supposed that those very patients may have had sickness for some time at least before applying to be admitted into the hospital, and that some of them also left the hospital without being cured. I allow, therefore, two-twelfths for these circumstances, and I think, that, with that allowance, the proportion between sickness in general and sickness which terminates fatally, is as supposed by me in the Statement which I gave in, and had written before I read Sir Gilbert Blane's Report."—Pages 96, 97.

In the Statement above referred to, Mr Finlaison gives the following opinions, and interesting observations.

"With regard to the quantum of sickness prevailing among individuals in the labouring class of society, there are at present no other materials extant for estimating its amount, than those collected by the Highland Society; but it will be seen in the sequel, that, although I have laid down, in the shape of tables, the conclusions resulting from those materials, I am aware that those conclusions cannot be relied on, even for ordinary purposes, with safety, until further information on this important subject is collected. They are, however, capable of being fully rectified or corroborated by materials, which are fortunately accessible, and which can easily be furnished on an extensive scale, if your Honourable Committee should so require."

"It appears that the whole number of weeks allowances in the above statement (that of the Highland Society), which were granted to persons of all ages *under* 50, was - - - - - 65,008

"While the total number of members, co-existing under the age of 50, some or other of whom must have received the said allowance, was - - - - - - - - - } 85,945

which is the same as if each one of them had received .75639071 fractional parts of a week's allowance in every year under 50 years of age. It is, however, to be kept in mind, that members, on entering Benefit Societies, are usually admitted under 30, at least in the majority of instances, and they would be rejected, if, on becoming candidates, they were in unsound health, which may account partly for the diminution of sickness in the younger classes of age, in the foregoing statement, without inferring that sickness is of less frequent occurrence in general at those ages."

"Materials exist, however, which may be furnished with facility, for estimating the sickness now actually prevailing among the labouring classes, to a degree probably of very considerable accuracy. There is in the Navy Office a Pay List received annually from each of the seven Dock-yards, containing the age of every workman, artificer, or labourer, in those great establishments, the amount of his wages or earnings in the year, and the number of days in which he received no wages, by reason of sickness, the fact of such sickness being always verified by the public medical officer. I have not been permitted to avail myself of this document extra-officially, else I would now have submitted the result to your Honourable Committee; but, on a cursory view, and taking out the cases of the first 313 names that presented themselves, I observed that they had been subject to 1403 days' sickness, out of the number of working days in a year, which probably do not exceed 307 days. Which is the same as if .0146 parts of his whole time were lost by each man, or .7592 parts of a week; and this coincides surprisingly with the sickness reported by the Highland Society, under 50, which, as above stated, was .75639 parts of a week."

"The State of Sickness prevailing among the Army in garrison and quarters in England, presents, however, a very different result from the returns made to the Highland Society. An Abstract is preserved in the Adjutant General's Office, of the musters made on the 25th of every month, of each regiment or corps in England, showing, exclusive of officers and non-commissioned officers, the number of rank and file actually in England composing the corps, with the number of them who are sick on the day of muster, whether they are in general hospitals, regimental hospitals, or sick quarters. These details are all carefully summed, in three divisions, for Cavalry, Infantry, and Foot-Guards, so that the result for any number of years may be copied out with the utmost facility. It is understood, that at present there are few, if any, in the army, above the age of 45, and that their average age is decidedly under 30. Moreover, it is well known, that they are picked and chosen young men when entered, and that those who afterwards become diseased and unhealthy, are discharged from time to time; that they are regular in their habits, free from exhausting labour, from the cares of families, and from most causes which superinduce disease. Their occasional sickness cannot easily be much exaggerated by imposture; and abating the single consideration, that some part of them are perhaps regiments returned from foreign service with debilitated constitutions, it would, on the whole, seem that the army quartered in England ought to present sickness at a minimum among mankind.

"I have been favoured with the results for each month, in the years 1823 and 1824, which I have combined; and it appears,

	The Total Rank and File present, or accounted for in 24 Musters	Of whom there were constantly Sick at the time the Musters took place,
Cavalry, - - - -	94,293	3,791
Infantry, - - - -	126,513	6,297
Foot Guards, - -	92,889	3,961
Total, - -	313,695	14,049

So that there were constantly sick of the Cavalry, - 4.0204 per cent.
of the Infantry, - 4.9773 per cent.
of the Foot Guards, 4.2642 per cent.
And of the whole Army, 4.478553 per cent.

"It further appears, that, in the two musters which took place,

	Rank and File.	Of whom Sick.		Per cent.
On 25th January 1823 and 1824, there were	24,281	1089	being	4.4850
25th February, - - - - -	25,117	1107	...	4.40737
25th March, - - - - - -	25,183	1148	...	4.55862
25th April, - - - - - -	26,157	1220	...	4.66414
25th May, - - - - - -	26,244	1227	...	4.67535
25th June, - - - - - -	25,649	1134	...	3.51190
25th July, - - - - - -	25,417	1027	...	4.04060
25th August, - - - - - -	27,007	1385	...	4.86911
25th September, - - - - -	27,416	1340	...	4.88766
25th October, - - - - -	27,401	1244	...	4.53998
25th November, - - - - -	26,840	1135	...	4.22876
25th December, - - - - -	26,983	1063	...	3.93952
Total,	313,695	14049	being	4.478553

So that

For every	100.000	sick on	25th June,
there were	112.176	...	25th Dec.
...	115.054	...	25th July,
...	120.412	...	25th Nov.
...	125.498	...	25th Feb.
...	127.705	...	25th Jan.
...	129.274	...	25th Oct.
...	129.805	...	25th Mar.
...	132.774	...	25th April,
...	133.129	...	25th May,
...	138.645	...	25th Aug.
...	139.174	...	25th Sept.

But, on the whole two years, the rate of sickness is remarkably constant and uniform, and being equal to 4.478553 ℔ cent, this is the same as if 100 soldiers had sustained among them 233 weeks of sickness every year, or as if each had been sick 2.33 weeks, which is more than thrice the quantum of sickness prevailing among Benefit Societies, according to the returns of the Highland Society.

"In this state of uncertainty, and until more extensive information as to the sickness prevailing among the labouring classes can be obtained, we can only adopt the data furnished by the exertions of the Highland Society as the measure of Value for Sick Allowances;" and, upon that data, Mr Finlaison then gives numerous rules and tables, shewing, at every age, the sums requisite for defraying any specified allowances, in sickness, old age, and at death. He concludes by remarking, that "If, in our present uncertainty as to the fact of the frequency and duration of sickness among the labouring classes, we were permitted to assume, what may seem a reasonable hypothesis, the following might perhaps be hazarded, merely as speculation: 1st, That every sickness terminating in death is, on a medium, of five weeks' duration; and, 2dly, That the sickness which terminates in death is, on a medium, one-twelfth part only of the sickness to which mankind is subject."---*Rep.* p. 152.

The Committee also applied for information on the subjects of their inquiry to the Philanthropic Society of Paris, through Baron B. Delessert, a gentleman who, in connection with that institution, had taken a great deal of trouble on behalf of Friendly Societies in France. A number of interesting documents were in consequence received as to the population, births, and mortality of France; but the Baron remarks, that, "although our researches were renewed, on the publication of an interesting Report made by Mr Oliphant, inserted in the Transactions of the Highland Society, we have not as yet been able to procure from the different societies in Paris, a table of diseases and mortality sufficiently accurate and complete to send you. But after an experience of fifteen years, we have satisfactory grounds for believing, that out of 100 operatives, from 20 to 60 years of age, there are constantly on an average one to two confined to their beds by sickness; and two to three suffering under lighter illness, or convalescent."—*Rep.* p. 162.

We have been thus liberal in our extracts, from a desire to give all the information which has been hitherto obtained regarding the average rate or law of sickness,—a subject entirely new to the great body of the members of Friendly Societies, but which must of necessity form an essential element in framing the tables of every society on proper principles.

From the evidence above quoted, it will be seen that considerable dubiety at first existed even among some of the professional witnesses, as to the practicability of reducing the occurrence of sickness to any given law; but it will likewise be seen, that every doubt was removed, as soon as due attention was paid to the subject. On a question so lately brought forward, and so difficult of solution, as the *true* rate of sickness, it is not surprising that there should have been some discrepancy of opinion. On this point, however, the Committee, after referring to Dr Price's Table, report to the House of Commons as follows:

"Mr Morgan, the nephew of Dr Price, and actuary to the Equitable Assurance Office for Lives and Survivorships, continues to use this table; and Mr Frend, actuary to the Rock Assurance Company, and also an eminent mathematician, entirely concurs with Mr Morgan. These two gentlemen have been employed in certifying, under the act, the tables of a great number of societies; among others those of a very considerable society, which has attracted much of the public attention, the Friendly Institution founded at Southwell in Nottinghamshire, by the Reverend John Thomas Becher, under the presidency of Vice-Admiral Sotheron, one of your Committee.

"The tables of this society have been adopted by a society upon a large scale lately formed in Hampshire, by Mr Fleming, another of your Committee, and by others which are in progress. The payments required by these tables, for provision against sickness, are somewhat greater than those required by Dr Price; the excess may be considered as necessary, for greater security, and for the expence of management."

"The House will find in the evidence, and in the paper of Mr Finlaison, frequent reference to the Scots Tables. The tables here intended, are those which are appended to a Report on Friendly or Benefit Societies, exhibiting the law of sickness, as deduced from returns by Friendly Societies in different parts of Scotland, drawn up by a Committee of the Highland Society of Scotland." "Returns were received from about 80 Societies, and various tables were constructed upon the result. One of these was framed upon a principle entirely new, (see above p. 283.), and purported to give in weeks and decimals of a week, the average duration of sickness likely to occur to an individual of each age, during a year. This average is found to be, in all the earlier periods of life, considerably less than the average assumed by Dr Price, or in the Southwell tables. Whether this difference is owing to a defect in the form in which the statement of facts was required, to the defective mode in which the requisition was answered, to the superior healthiness of the districts to which the returns applied, or to what other cause, your Committee have not formed a decided judgment. Much detail upon all these points will be found in the evidence; but the Committee have not found it necessary to pursue a more extended inquiry into this question, because they trust that they have procured, and still more that they will have pointed out the means of procuring, a body of information, more complete, more accurate, and more generally applicable. They desire, however, to recommend the Report to the perusal of all persons who take an interest in inquiries of this nature, and they have derived many valuable hints from the proceedings of the society, and from the evidence of Mr Oliphant, writer to the Signet, by whom the Report was framed.

"But the Committee certainly do not feel justified in recommending these Scots tables, or any which require payments lower than those required at Southwell, for adoption by any society in England."—*Rep.* p. 14, 15.

Such is the conclusion which has been come to by the Honourable Committee, with regard to the tables that ought to be preferred for benefits during sickness; and it now only remains to consider how far that conclusion is supported by the facts and evidence which have been adduced.

The highest rate of sickness exhibited, is that of the army, which is more than treble the average deduced by the Highland Society; but it will be obvious that the sickness of the army can never apply to the working classes. The operative cannot give up his work upon every slight accident or illness, but must continue as long as possible to labour, on account of his society allowances (if any) being usually less than his wages, by the wants, perhaps, of a family, and from the danger of being deprived of his employment. The very slightest indisposition, again, immediately consigns a soldier to the hospital; and neither is he restrained by any pecuniary interest from practising imposition, for, during sickness, his pay is always sure, he is not afraid of losing his situation, and he is freed from all duty whatever. These and other causes may go far to account for the high rate of sickness resulting from the army reports.

The rate of sickness *assumed* by Dr Price was acknowledged even by himself to be higher than what would probably be found by experience, and Messrs Finlaison, Glennie, and some others are of the same opinion. A still higher rate, however, (no less, under 50 years of age, than *double* that appearing from the returns to the Highland Society), has been assumed for the tables of the society at Southwell, although the Reverend Mr Becher, their manager, is convinced that it "will exceed the ordinary proportion of sickness prevailing around us," and although no general experience has yet shewn such a rate to occur. It is likewise to be observed, that such an excess is not required by this society for the expence of management, a separate fund being otherwise provided for that purpose.

The law of sickness deduced by the Highland Society of Scotland was obtained by taking the means of 101,510½ weeks of *actual sickness*, which had been experienced among 100,817 society members, at all ages, variously employed, and situated both in the country and in towns. That rate, again, according to Mr Finlaison, is verified by the sickness occurring among the artificers under 50 years of age, employed in his Majesty's Dock-yards, their average sickness being .75920 parts of a week, while that obtained by the Highland Society is .75639. This coincidence, however, is rather remarkable, and it will probably be found, upon farther investigation, that the average rate of sickness of the artificers in the Dock-yards is considerably above that of the working classes in general; for, besides the epidemic diseases and extremely noxious employments to which those in the Dock-yards are well known to be exposed, "it is calculated, that, upon an average, between three and four thousand men annually wound or otherwise injure themselves in following their mechanical occupations in the Dock-yard, to such an extent as to oblige them to apply for chirurgical assistance; and that of the aggregate number, about four hundred, or about the proportion of one to nine or ten, are for a time incapacitated from pursuing their labours. During the last six months of the year 1824, viz. from the 24th of June to the 31st of December, upwards of 250 of these mechanics were laid up from their duty, in consequence of various hurts, more or less severe, but none of them presenting any thing peculiar in their character or circumstances *."

From all those facts, then, and with the utmost deference for the opinion of the Committee of the House of Commons, we must be allowed to conclude, that the high rate of sickness assumed by the two societies in Nottinghamshire and Hampshire is not warranted by the experience of the working classes in general,—that the Law of Sickness deduced by the Committee of the Highland Society is the most satisfactorily authenticated of any yet published,—and therefore, that, until a better standard be obtained, the tables given in the Report of that body

* See observations on Dr Butter's "Remarks on Irritative Fever, commonly called the Plymouth Dock-yard Disease," in the Edinburgh Journal of Medical Science, vol. i. p. 361.

should be held as a guide for at least all Friendly Societies in Scotland.

As formerly mentioned, a Select Committee of the House of Commons was again appointed during the session of 1827; the result of whose labours we shall be enabled to give in a future Number of this Journal.

(*To be continued.*)

The Brain of the Common Dolphin compared with that of Man. By M. F. Tiedeman.

M. Tiedeman proposes to publish, in the Journal of Physiology, conducted by Treviranus and himself, a series of monographs on the brain of various animals, with the view of subsequently eliciting conclusions relative to the structure of the brain in general, or to its organisation in the different classes and orders of the animal kingdom. In volume second of the Journal of Physiology there is a very interesting memoir "on the brain of the dolphin, as compared with that of man *."

With reference to the points of resemblance, and the differences that present themselves on comparing the brain of the dolphin with that of man, M. Tiedeman states the following results.

1. The brain, properly so called, of the dolphin, is distinguished from that of monkeys, by its great size, and next to the brain of the orang-outang approaches nearest, in this respect, to the human brain.

In relation to the nerves, the spinal marrow and cerebellum, it is much smaller than the brain of man. The individual, of which M. Tiedeman dissected the brain, was six feet long. The author does not mention the weight of the brain, but the figures (which, however, appear a little diminished,) and the different parts pointed out in the description, may afford an idea of it.

2. Each of the cerebral hemispheres is composed, as in man and the monkey tribe, of three lobes, an anterior, a middle, and

* Zeitschr. für Physiologie, t. ii. p. 251.

a posterior. The hemispheres are evidently smaller in proportion than in man, for they do not cover the cerebellum completely.

3. The brain of the dolphin is comparatively much broader than that of man, while the contrary is the case in the other mammiferous animals. The shortness of the brain in the dolphin is probably connected with the absence of olfactory nerves.

4. The cerebral hemispheres of the dolphin present much more numerous circumvolutions and grooves than those of any other animal. They are even proportionally more numerous than in man. In the latter, also, their arrangement is not symmetrical, contrary to what is observed in all other animals.

5. The lateral ventricles are composed in the dolphins, as in man and the monkeys, of three horns, an anterior, a middle, and a posterior; while two horns only are met with in the other mammifera.

6. The mammillary eminences are blended into a single mass, as in most of the other mammifera. Man, and the orang-outang, on the contrary, present two distinct eminences.

7. The three pillared vault, the cerebral partition, the cornua ammonis, and the corpora striata, are, with relation to the brain, smaller in the dolphin than in man.

8. The quadrigeminous tubercles form, as in the other mammifera, larger masses than in man.

9. The cerebellum is distinguished by being proportionally larger than in man, and its middle part is not symmetrical, as in seals, and several other animals.

10. The medulla oblongata has not the trapeze, as in man and the orang-outang.

11. The brain of the dolphin is essentially distinguished from that of man and all the other mammifera, by the absence of olfactory nerves. The other cerebral nerves compared, with regard to size, with the volume of the brain, and the brain of the dolphin being compared with the base of the brain and with the nerves of man, are much larger than in man. This, therefore, affords an additional confirmation of the important proposition of Sœmmering, that man possesses the largest brain, in proportion to the size of its nerves.

The remarkable developement of the brain in the dolphin, a developement which gives it, in this respect, a rank immediately after man and the orang-outang, might lead to the inference of a proportional developement of the intellectual faculties; but, with reference to this subject, we have only the relations of fishermen, who affirm, that the dolphin, like the whales, loves to live in society, that it performs great migrations, has a great attachment to its young, and defends them courageously when they are pursued.

The figures of the plate accompanying this memoir represent the brain of the dolphin: 1*st*, by its upper surface; 2*dly*, by its base; 3*dly*, the cerebellum and tubercula quadrigemina; 4*thly*, the vertical section of the cerebellum made in the middle; 5*thly*, the brain, without the upper part of the hemispheres, which are removed to the level of the centrum ovale of Vieussens, and of the lateral ventricles.

Of the Changes which Life has experienced on the Globe.

Fossil remains of the animals which preceded man upon the earth are every day discovered on both continents; and every day are the documents regarding the history and successive changes of the various races that existed before the present, increased by new facts. This is equally the case with the vegetation which embellished the earth at that remote period, and with which those primitive animals were necessarily in close connection. New animals and vegetables have assumed the place of those that have been destroyed, and whose ancient existence is only revealed to us by their fossil remains. Thus, in the course of the ages that preceded the appearance of man upon the earth, its surface has successively changed its aspect, its verdure and its inhabitants; the seas have nourished other beings, the air has been peopled with other birds.

The remains of these various successions of animals and vegetables attest that they were at first much more uniform. The vegetables of the coal formation, for example, scarcely present any difference, whatever may be the latitude, the longitude, or the elevation at which they are found. Europe, Asia, and the two Americas, alike produced elephants, rhinoceroses, mastodons, &c. The differences which vegetables and animals exhibit at the present day, according to the various climates or situations in which they occur, have been gradually established under the predominating influence of a small number of natural causes, and constitute at length the order of distribution which life now presents at the surface of the earth.

Originally life extended from one pole to the other, and animated the whole of this surface. The frozen regions of the North, and the snow-clad summits of the Alps, were covered with the same verdure; and the forms of the pristine animals and vegetables presented either extraordinary types of which we have now no example, or species which belonged to families and genera still existing, but in most cases only between the Tropics. As we approach nearer to the present times, we find in all places remains more and more resembling those of the plants and animals which now live in the same country. At a later period, the original races of animals and vegetables were gradually expelled from the north toward the south, from the summits to the plains, in proportion as the uniform mean temperature of the earth's surface yielded to more powerful causes, which brought about the establishment of climates. These gradual variations in the temperature, the lowering of the general level of the seas, the equally successive and gradual diminution of the energy of volcanic phenomena arising from the original igneous state of the earth, as well as of the strength and power of atmospheric phenomena, and of the tides—such were the regular, general, and continued natural causes of the modifications which life has undergone, and of almost all the changes that have been produced upon the earth's surface. The results of these first causes, such as the establishment of local influences over the temperature of the same climate, the formation of a multitude of particular basins, some containing salt, others fresh water; the pouring out of these lakes into one another, and into the great basin of the sea; the partial debacles which thence resulted; the ravages of the sea on the low parts of the continents at first, and then the formation of vast lagoons in the same places; lastly, the establishment of the general system of draining and watering, or of the hydrographic reticulation which covers the globe—such were the irregular, and more or less violent and perturbing secondary causes of the partial vicissitudes experienced by animal and vegetable life. The beings, which were unable to resist the influence of these various causes were destroyed and disappeared from the earth, with the circumstances for which they were created; new species appeared with new conditions of existence. But, in examining the series of fossil remains that are found buried in the strata of the globe, there is nowhere perceived a distinct line of demarcation between the different terms of that series, so as to prove that life has been once or oftener totally renewed on the earth. On the contrary, we discover in it a proof of the successive and gradual change which we have pointed out. Certain primitive types have indeed completely disappeared, but they are found existing at various epochs, and their remains are blended with those of more modern types; along with new species of types still existing, we find some of anterior epochs; certain genera that yet obtain are common to all the terms of the series; and toward the end of the series, we find the remains of some of our present species along with ancient types and extinct species. In consequence of the establishment of climates, life has almost entirely abandoned the polar countries, and the glaciers have usurped, on the high summits, the place of the verdure of primeval times. Palms, date-trees, cocoas, dracænæ, pandani, arecæ, the great reed, and the arborescent ferns, have forsaken our climates, together with the elephants, tigers, panthers, hippopotami, the gigantic tapirs, the rhinoceroses, palæotheria, anaplothæria, mastodons, and other extinct animals, as well as those enormous reptiles whose forms were so extraordinary. Sole masters, in those times, of the countries now subjected to the dominion of man, these animals are either entirely destroyed, or now live only between the tropics.

Man appears to have arrived upon the earth only after its surface was adapted to receive him, after the establishment of climates, and when a happy equilibrium among the elements had determined the permanency of the present state of things, or at least had rendered its variations almost imperceptible.

Such is a brief view of the changes which life has experienced at the surface of the globe, and of the causes which have produced those changes. Our theory, which is founded on all the facts that have been established, cannot but prevail over the systems hitherto proposed, for it is in harmony with the natural laws of order and permanency which rule the universe, and is, moreover, supported by the most accredited physico-mathematical theories; whereas those systems, founded upon perturbations of cataclysms, which science, facts and human reason equally reject, only increase the number of those imaginary conceptions which have been successively published for several centuries.

The above will suffice to shew, that there is no subject which, in all points of view, is more worthy to excite the interest and meditations of philosophers, and the investigations of geologists and naturalists.

The Disasters of Tivoli.

THE city of Tivoli, whose origin is lost in the obscurity of remote ages, is situate on the slope of a steep rock, traversed by the Anio, which in this place precipitates itself from a height of more than 100 feet, and then proceeds to water the plain of Rome, where it soon unites with the Tiber. The rock is formed of a sort of conglomerate, rather friable, and subject to be worn away by the river, which, in the impetuosity of its descent, has scooped out numerous caverns, to which the poets have given the mythological names of the Grottoes of Neptune, the Syrens, &c. Every body has seen paintings or engravings of these sportings of nature, which present the most varied appearances, and render the site of Tivoli one of the most curious in the world. The rock on which the city is built has been perforated in various directions by the river, which has formed numerous subterranean caverns, of which the inhabitants have availed themselves for the purpose of putting in motion several forges and manufactories which give a very animated appearance to the country. A little above the town, the Anio had been divided into two branches, by means of a sluice, which threw the greatest mass of its waters to the left, on the side next the town, whence, after passing under the broken bridge, they proceeded to be engulfed in the Grotto of Neptune, immediately beneath the Sibyl's Temple. This branch filled the subterranean canals of which we have spoken, and after passing through the *Villa Mecene*, fell in broad sheets called the *Cascatelles*.

The right branch of the river watered another part of the city, and, after passing under the bridge of St John, formed the Cascade of Bernin, and fell into the Gulf, not far from the Cave of the Syrens, margined with trees and shrubs.

During the last inundation of the river, the waters attacked the dike forming the sluice so violently that they broke it in several places, and precipitating themselves with their whole weight on the right side, left dry the left branch, which supplied Tivoli with water, and formed the *Cascatelles*. Several houses were carried away by this sudden irruption; and the Church of St Lucia was overthrown, as well as some old walls along the banks of the river.

This disaster, the details of which have been related in the public prints, is not the first that has been mentioned in history. In the preceding ages the city of Tivoli had been exposed to similar floods, and had suffered from the ravages of the river, which becomes formidable at this place, by the rapidity of its current, and the violence with which it precipitates itself over the rocks. The most distinguished architects and engineers were successively employed in repairing these ravages; and it was after an irruption which took place about the end of the 17th century, that the celebrated Chevalier Bernin formed the cascade which bears his name.

As soon as the irruption of the 16th November last was known at Rome, the Pope hastened to send to the place engineers, who were directed to examine the state of things, prevent any further damage, and repair the injuries sustained, as quickly as possible. Their first care was to prop up the buildings that were already undermined, and that threatened to destroy in their fall a great number of other houses. The spectacle which Tivoli presented was frightful. Piles were hastily driven, which were supported with stones and fascines, to guard the right bank, which was already damaged, preserve it from total destruction, and get the river to return to its channel. They had next to endeavour to force a part of the water into the right branch, which, in consequence of this event, was left dry, as we have already said, and left unemployed the numerous manufactories and mills which it formerly moved. Ancient traditions had given rise to a conjecture, that, in the time of the Romans, there existed a subterranean canal which conducted the waters in that direction, but of which all traces had been lost for many centuries. After several days of assiduous research, this canal was at length discovered. The gravel that obstructed it was removed, the water was immediately introduced, and the numerous manufactories, which had ceased for a month, were again put into activity. The inhabitants of Tivoli, in the joy caused by the discovery of this canal, sent a deputation to Rome, headed by their worthy bishop, to carry to the Pope the homage of their gratitude, and request him to allow the canal to be named after Leo the XIIth, which was granted them.

At the moment when we write, the labours are continued with the greatest activity, and the engineers will soon have to decide in what manner the dike of the sluice is to be repaired, and what direction the bed of the river will receive in that part to prevent the repetition of similar accidents. The environs of Tivoli resound with redoubled blows of the hammer, the roads are crowded with carts and beasts of burden carrying materials for the new works. The stranger who visits Tivoli from curiosity, as well as the citizen who views these works so interesting to himself, load with praises and blessings the sovereign who repairs so many disasters, and also bestow upon his minister the praises which the zeal and foresight displayed by him on this occasion merit.

Essay on the Domestication of Mammiferous Animals, with some introductory considerations on the various states in which we may study their actions. By M. Frederick Cuvier.

The strangest prejudices have been formed regarding the state of animals in captivity, and the most singular judgment passed upon the works to which their actions have given rise. To prevent, as much as possible, the application of similar ideas to the present essay, on the domestication of mammifera, I shall commence with some considerations calculated to rectify these ideas, and to afford juster notions than appear to have been entertained regarding animals, and the various states in which we may study their habits. I am the more induced to follow this plan, as, in this respect, domestic animals have not been more correctly judged of than captive, and because, from the errors into which people have fallen, it would be impossible to receive without prejudice a work on the actions of animals, considered in a general and philosophic point of view.

It is maintained that animals can only be studied with advantage when they enjoy a perfect independence. It is indeed admitted that those which are domesticated may furnish some useful knowledge; that their study is calculated to direct us to the means of subjugating them, of rearing and improving them with relation to our wants; that it apprizes us of the services which we have received from them, and of those which they are still capable of rendering us; and that by thus studying them, we are even enabled to discover the designs which Providence had in view in placing them upon the earth. But it is said, what could animals reduced to slavery teach us? Under the weight of the restraint in which we are obliged to hold them, we obtain from them actions that are only artificial and consequently little calculated to unveil their nature. It would be quite otherwise were they in a state of liberty. Then their nature would manifest itself, and the more so the less constraint they experienced from the circumstances in which they were placed; for as the most complete slavery is the situation the least favourable to the exercise of the faculties, the most entire independence, or the state of nature, is the best adapted for their exercise and developement. "The wild animal," says Buffon, (T. iv. p. 169.), "obeying only nature, knows no other laws than those of necessity and liberty."

This in fact is the opinion that is held with regard to the comparative advantage of studying animals in the three states in which they present themselves to our observations, judging at least from the little that has been published on the subject. Domesticated animals, and those in captivity only make known to us a state contrary to nature, the consequences of which, in respect to the former, relate exclusively to man; and in respect to the latter, to the means which have been employed to make them act and be observed. It is only animals in a state of freedom that shew themselves to us such as they are, such as they have been made, with the full possession of all their faculties; they alone allow us to trace without error the true origin of all their determinations.

The origin of these ideas is easily discovered. They proceed from the same source as most of the errors which have been entertained with respect to the nature of animals; the ideas to which the study of man gave rise were applied to these beings. But if slavery, if absolute submission to the will of another is the situation the most repugnant to the moral and intellectual developement of the human species, one essential character of which consists in liberty, what reason would there be for animals, which are deprived of all liberty, properly so called, experiencing the same effects from slavery as ourselves? And further, the errors into which men have fallen regarding this imaginary state of nature, the only state, it has been said, in which man can shew himself in all his grandeur, and in all his beauty, must have influenced the ideas which have been formed of animals, the wildest state of which has always been considered as the true state of nature, and must have still more strongly convinced us of the hopeless attempt to acquire a knowledge of them in any other than their state of perfect independence.

Most of these errors might have been avoided by the consideration that, in establishing, as a principle, that these animals unveil their nature to us only in a state of absolute independence, and in yet admitting that they may act in a state of domestication, and even of slavery, was the same thing as saying that they have the faculty of not acting according to their nature; that they are susceptible of obeying desires which have not been imparted to them; that they manifest other dispositions than those which they have received; in a word, that they may be something else than what they ought to be in virtue of the laws of the universe, and that man may have the power of changing their nature, and of destroying the laws of creation.

To examine therefore this idea, and trace its consequences, is all that is necessary to shew at least its weakness; and some further considerations will serve to refute any arguments that might still be urged in its support.

Were liberty necessary in order to animals manifesting themselves to us such as they originally came from the hands of nature, it would be as impossible for the wild as for the domesticated or captive animals to do so, for the former no more enjoy that imaginary state of absolute independence which is called the state of nature, than the latter. All of them lie under the unavoidable influence of the circumstances in the midst of which they are placed. These conditions may change, but the nature of animals does not change. If some of them act differently from others, they produce different effects, but these effects have always relation to the faculties of the being which manifests them. A wild animal, amidst the forests of a desert region, will not have any very close resemblance to what it would be in the midst of a very populous country. It will be still more widely different, if reduced to captivity, or converted into a domestic animal, and will lose altogether its original character. But whatever differences these various states may present, this animal will always be the same; it is only in its own nature that the means will be met with which are calculated to put it in harmony with this diversity of situations, and the facts which it presents to us in the one situation, if they are numerous and diversified, may afford us the means of deducing its faculties as accurately as we should deduce them from facts presented by the others. All consists in knowing how to observe and estimate the circumstances under which the facts manifest themselves.

But let us see what we should learn from animals in the highest state of independence which we can imagine, that is to say, in that situation which is regarded as a perfect state of nature; and that the independence may be more complete, let us take one of those animals whose wants may be the most easily satisfied, a ruminating animal, and place it in the midst of those rich savannas of South America, from which we shall even remove the animals which might, in the smallest degree, disturb its tranquillity. So long as its wants are satisfied, it will remain at rest in the couch which it has chosen for itself, immersed in a state of sleep so much the more profound the greater its security is. Hunger awakens it, it will find within the compass of a few steps wherewith to satisfy itself; if it be thirst, the neighbouring brook will quench it; and there will be no change in this mode of existence, until the moment when the torments of love will come to disturb it. Then impelled by a blind fury, it seeks out a female, calls her with loud cries, follows her traces, overtakes her, kills her if she resists and is unable to flee, satisfies his wants if she participates in them, and if he remains victorious over the rivals which he may have to encounter. Presently his strength fails, his ardour is blunted, and he returns to his retreat to seek a repose which has become necessary to him, and which the passion of love, the only one which his situation puts him in the way of experiencing, will periodically come to disturb once every year.

If, instead of a herbivorous, we take a carnivorous animal, what shall we have to add to the uniform picture which we have traced? Instead of pasturing, this new animal will lie in wait for its prey, or pursue it, which will subject it to pains and efforts that would have been unnecessary had it fed upon vegetable substances. More rest will then perhaps be necessary for it; but the nutritive qualities of flesh rendering the recurrence of hunger less frequent, will allow him to indulge in it. Thus all the difference which this animal presents to us, compared with the former is, that the searching for its food may require of it more or less cunning, prudence and strength, whether it has only to provide for its own wants, or moreover to supply those of its young.

What is the conclusion to be drawn from the life of such animals? Nothing more than from the life of animals subjected to the closest captivity. But let us drag both from the nearly complete state of inactivity in which we have supposed them to be living; let us place them, as they are naturally placed upon the earth, under the most complicated circumstances; let us vary their situation, as it varies amid the fortuitous occurrences which are continually taking place here below; let us multiply their wants, and even increase the dangers to which they are exposed; let new relations suggest, as it were new desires and new resources; and then we shall see another picture unfold itself before us. It would still, however, be erroneous to suppose, that the state in which animals naturally occur upon the earth, however complicated it may be, is the best adapted to forward their developement. It is not the ordinary conditions of animal existence, those which first present themselves in all the circumstances where human industry does not interfere, that are the best calculated to make animals act in a manner favourable to the unfolding of their faculties. The equilibrium which is constantly tending to establish itself among all the powers which simultaneously act here below, gives to the most energetic a preponderance over the more feeble, which never leaves the latter the liberty of acting; and it is only by mastering these predominating powers, by attenuating them, that we come to discover the others, that we render them sensible, and vary their effects.

In their natural independence, that is to say, such as it may be in all the circumstances in which it naturally occurs, animals are under the yoke of these predominating powers: and they may then inform us of the place which they occupy among the other beings submitted to the same powers, of the relations in which they stand to them, and of the influence which they exercise in the general economy; but, in this state, they can only, in common, afford us very confined and always doubtful ideas, regarding their general faculties; for, in this case, it does not depend upon us to submit them to experiment, in order to confirm our conjectures. Let us ask in fact, what is the knowledge that has been obtained from the observation of animals in a state of liberty alone? The answer will be easy and imposing; it is to the greatest of naturalists that we are indebted for it; to Buffon, who tells us what every body has repeated after him, "that to fierceness, courage and strength, the lion joins nobility, clemency and magnanimity; that he often forgets he is king, that is to say the strongest of all animals; that, walking with a tranquil pace, he never attacks man, unless when provoked; that he does not accelerate his steps, or run, or pursue, unless when pressed by hunger; that the tiger, on the other hand, while meanly ferocious, cruel without justice, that is to say, without necessity, seems always thirsty of blood, although satiated with flesh; that his fury has no other interval than that of the time necessary for preparing new ambushes; that he seizes and tears a new prey with the same rage which he has just exercised, but not assuaged, in devouring the first," &c.

Now these differences between the lion and the tiger, can only be relative to the circumstances in which the individuals so described had lived, for these animals have nearly the same disposition. Placed in the same circumstances, they have constantly presented the same phenomena to us; they have shewn us that the one is as easily tamed as the other: that they become equally attached to their keepers, experience the same feelings for the benefits which they receive, and that their hatred or their rage is provoked by the same causes; that their sports are similar, as well as the manifestations of their fears or desires; that they seize their prey with the same avidity, and defend it with the same fury; in a word, that their natural dispositions are absolutely the same. What has not been said of the hyena? Its very name has become the emblem of the most sanguinary cruelty; and, in imitation of Buffon, the most sagacious naturalists have adopted the prejudice which places this animal in the first rank of ferocity. The truth is, that the hyena, treated with kindness, comes to the feet of its master, like a dog, soliciting caresses and food; and we have several times seen it doing so. I might multiply examples of this kind to infinity, and hence prove, on the one hand, that, in a state of independence, animals exist under circumstances so concealed, that we can only very rarely appreciate the influence which they exercise over them; and, on the other, that captivity, by affording us the means of withdrawing animals from the powers which, in the contrary state, rule over or restrain them, in order to subject them to the other powers, permits us to make a more accurate and more complete examination of them; and, in this respect, we see that all the productions of nature are subjected to the same rules. What should we have known in natural philosophy, had we simply observed the phenomena which appear of themselves in the actual state of the world, and not acted upon them by instruments adapted for modifying them; and does it ever come into the mind of any one that the results which the chemist obtains by artificial means are not natural, and are incapable of revealing to him the laws which form the object of his researches? But to shew the advantage which the study of animals may derive from their captivity, examples more important than those which we have yet adduced are necessary.

It is undoubtedly because we have constantly been in the habit of observing wild animals in a state of liberty alone, and because we have confined ourselves to describing the actions which then accidentally presented themselves, that this important branch of natural history has hitherto only been enriched by isolated facts, which have often appeared to be without mutual accordance, because no bond united them, and because no principle directed the observer in his inquiries; for no principle could be deduced from these hypotheses, which originated in the desire of explaining the cause of the actions of brutes, in order to harmonise them with the idea which was formed of the cause of the actions of man. These hypotheses, not having any foundation in nature, could only mislead those who rested upon them. Pure empiricism would have been preferable. Unfortunately the narrow circle in which empiricism was confined, became an almost insurmountable obstacle to the further progress of the science; on the contrary, no sooner were animals in a state of captivity subjected to rational observation, than the branch of natural history which investigates the actions of animals and their causes, rose to the rank of a science by the general truths with which it was enriched.

For a long time it was admitted, that the moral perfection of man depended upon the perfection of his organs; and if this error at length yielded to evidence, it was yet cherished in full force with reference to animals. Those who had the most delicate senses, the most pliant limbs, and most favourable to motion, were necessarily the most intelligent; and the monkeys and carnivora seemed to confirm this rule. But the possession of several seals, that is to say mammifera whose limbs are converted into fins, which are destitute of external ears, whose eyes, formed for a liquid medium, can only see imperfectly in the air, whose nostrils open only when the animal inspires, and whose body clothed with a thick layer of fat has, so to speak, no sense of touch excepting at the points where the moustaches are affixed, has demonstrated, by means of actions artificially provoked, that the extent of intellect is no more proportional to the perfection of the organs in animals than in man. And this truth has given rise to the idea that the most accurate knowledge of the organic parts of animals can afford no satisfactory information regarding their nature and their relations to other beings, if we are ignorant of the cause which animates and guides them, the power which acts upon their organs, and which directs and determines their motions.

All the analogies founded upon the observation of animals in a state of liberty made it in general be regarded as a certain fact, that the intelligence of each animal in its development followed the progression which we observe in the development of the human intellect. Thus the animal, like man, was born with intellectual faculties, of which the simple germ could only at first be perceived; in its youth these faculties shewed more vivacity than strength, and they only arrived at their perfection when they were matured by age. The study of animals in a state of captivity has had the effect of destroying this prejudice; for it was necessary to compare them with themselves at different periods of their life, and consequently to follow their development, in order to perceive that the young are incomparably more intelligent than those which have attained the age of maturity. And all animals were not calculated for this sort of inquiry; we could not reckon upon the species modified by domestication; those whose intellect is limited gave no sensible result; and the carnivora, constantly obliged to exercise all their faculties, were in the same condition. It was necessary to have recourse to the species which with respect to intellect have been more favoured, and yet whose existence does not absolutely depend upon the use which they make of it; in a word, to the monkeys, which live on fruits, a species of food always abounding in the countries they inhabit, and which can never be brought in a nearer relation to us than the state of captivity. But this observation is not confined to the establishing of a new and important fact; it has, moreover, thrown light upon a question of high interest. In observing that in their early youth the intellectual faculties with which animals have been endowed have acquired all the extent and activity of which they are capable, and that they begin to diminish as soon as the age of vigour arrives, we have acquired a new demonstration of the fundamental difference which distinguishes them from man. Previous to this we could only, like several observers, have found this difference through the analysis of their fortuitous actions, in which the reflective faculty never manifests itself; now it arises from the very phenomenon which we have been pointing out. In fact this phenomenon would never have been observed, if the animals which have presented it to us could have nourished and perfected, in the age in which they naturally diminish in strength, the faculties which they have received, and which we possess in common with them, by means of that faculty which belongs to us exclusively, and permits us to prolong, as it were indefinitely, the exercise of the former; if, in a word, for their preservation, nature in place of strength had bestowed on them reflection.

It is not merely truths which may be deduced from contingent and fortuitous actions that we obtain from animals kept in a state of captivity; these animals also afford us information respecting those which result from their necessary actions, from actions which seem to be most invariably determined by their intimate nature, by the destination which they have received as to the point of the earth upon which they have been cast; from actions, in a word, which their instinct produces; and instinct exists without alteration only in animals of the wild race.

So long as beavers had only been observed in their native liberty, it was seen that those which live collected into bands in wild countries construct habitations, and that the solitary individuals, such as are sometimes met with, especially in populous countries, made their retreat in the natural excavations of the banks of lakes and rivers; and it was concluded from these facts, "that these animals do not labour and build by a physical power or necessity, like ants and bees; that they do it by choice, and that their industry ceases whenever the presence of man has diffused its terror among them." It is Buffon who tells us so, and it is he whom I quote in preference; for of all the authors who have written upon the nature of animals, he is incontestibly the one who formed the most elevated and the justest ideas regarding it. If however that great naturalist had been disposed to observe some of these solitary beavers, if he had formed the idea of placing them in suitable circumstances, and of giving them the materials which they commonly employ in building, earth, wood, stone, he would have seen that their solitude, and the presence of man, did not make them intermit their labours, that they still took care to build; and instead of seeing in the houses and dams of beavers united into bodies, "the result of common projects founded upon rational agreements, of natural talents perfected by repose," he would only have seen the fruits of an industry entirely mechanical, the results of a purely instinctive want. In fact, several solitary beavers on the banks of the Iser, the Rhone, and the Danube, have shewn to us, in the numerous experiments to which we have subjected them, that they are constantly impelled to build, without however there resulting any other advantage to them than that of satisfying a blind necessity, which they are somehow forced to obey.

One of the errors which the exclusive observation of wild animals gave rise to and kept up, and the influence of which has been so manifestly exercised over all the systems which have had for their object the natural state of man, and the effect of different kinds of food upon his moral development, consists in the belief that the herbivora have a milder, more tractable, and more affectionate character, than the carnivora. The gazelle became the emblem of gentleness as well as of beauty; and it was nearly the same with the hind and several other animals having large eyes, and a timid and light gait; while the tiger, the panther, the hyena, the wolf, had only a brutal ferocity, and manifested only feelings of hatred and cruelty. Closer observation, more circumstantial, and more calculated to shew us these animals such as they are, obliges us completely to reverse the application of these ideas, and to transfer to the one set of animals what we had applied to the other. In fact, all the adult ruminantia, the males especially, are rude untractable animals, which no good treatment softens, nor any benefit renders captive. Although they recognise him who feeds them, they are still far from being attached to him, and in administering to their wants he must be always on his guard against them; for the moment he ceases to intimidate them, they are liable to strike him. It would seem as if a secret feeling induced them to shun or to treat as an enemy every species of animal foreign to their own. We have seen that the case is very different, even with the animals which feed the most exclusively upon flesh. The reason is, that the one set of animals have a coarse and limited intellect, while the others are not less remarkable for the extent than for the delicacy and activity of theirs. So true it is, that even in animals the development of this faculty is more favourable than hurtful to the good feelings or benevolent affections.

I have thus in some measure shewn that if animals in a state of liberty are calculated to instruct us with regard to the part which they act upon the earth, they are little fitted to unveil the general causes of their actions, namely, the faculties of their intellect, and that it is only by means of captive animals that we shall obtain this knowledge. Shall we conclude from this that the study of animals, such as they exist in their natural state, ought to be renounced, that all inquiry into the economy of this world, in which they occupy so conspicuous a part, should be abandoned? For it is too evident that the difficulty of studying animals in a state of liberty is so great, that it is almost equivalent to an absolute impossibility. Whenever they can obey their feelings they distrust whatever they do not know, and fly from or attack whatever assails them. Besides how should we reach for the purpose of observing them those which inhabit the wild or remote countries which we scarcely know? And, moreover, the mere pursuit of an animal entirely changes its natural conditions, and it can only then be viewed as an animal constrained by violence, and placed under circumstances quite as unnatural as those to which animals in a state of captivity are reduced.

These difficulties would, without doubt, be insurmountable; problems whose solution is so remote are more calculated to restrain the efforts than to sustain the zeal of inquirers. Fortunately it is not necessary to surmount them in order to attain the object in the way of which, as a barrier, they seem placed; and the knowledge of this world, in all that relates to animals, is neither founded upon purely rational views, nor upon chimerical hopes. If it is impossible to arrive at it directly, without almost insurmountable obstacles, we can at least be led to it in an indirect manner, and the path which we now open up is assuredly the shortest and most certain.

In fact if the existence, and the various circumstances of an animal on any given point of the earth, are the consequence of the faculties and propensities with which it is endowed, and of the fixed or varying conditions which are peculiar to this point of the globe, that is to say, the consequence of power by means of which this animal struggles with and sustains itself against those which are affixed to it, from the moment that we know the general faculties of its species and its dispositions, we can determine, even in advance, its individual actions in all the situations in which it may be placed; and from this time it will no longer be required, in order to determine the mode of existence of a particular species in a given country, to discover the individuals of that species, to follow them through all the details of their existence, to hunt them for the purpose of getting hold of them; it will be sufficient to appreciate correctly the circumstances in which they are placed, which is a much easier matter, and much less subject to error. It is from chance that all sciences proceed; and zoology, properly so called, will have no true foundation until it proceeds like them.

Thus, on whatever side we view the question we constantly arrive at this truth,—that the methodical examination of animals in captivity, is one of the surest means which have been given us of studying them, and of knowing them as they should be known by the naturalist.

And now that it has been established as a firm principle that animals never conduct themselves otherwise than in conformity with their situation and faculties, that is to say, with the powers which act within them, and those which act without them, I may enter upon my subject, and consider the source and effects of domestication, without any fear that the facts which I may have to relate, or the inferences which I shall draw from them, will be rejected under the pretext of their not being natural.

The absolute submission which we require of animals, and the sort of tyranny with which we govern them, have led to the idea that they obey us as absolute slaves, that the superiority which we have over them is sufficient to constrain them to renounce their natural love of independence, to bend them to our pleasure, to satisfy such of our wants as their organisation, their intellect, or their instinct permit us to employ them for. We conceive, however, that if the dog has become so good a hunter through our care, it is because he was so naturally, and that we have only aided the development of one of his original qualities; and we find that it is much the same with all the various qualities which we seek for in our domestic animals. But as to domestication itself, the submission under which we bring these animals, it is to ourselves alone that we attribute it; we are the exclusive cause of it; we have commanded their obedience, as we have constrained them to live in captivity. The cause of our error is, that judging from simple appearances, we have confounded two ideas essentially distinct, domestication and slavery; we have seen no difference between the submission of the animal and that of man; and from the sacrifice which the slave of our own species is forced to make to us, we have thought that the domesticated animal makes a similar sacrifice. Yet these two situations have nothing in common; the distance between the domesticated animal and the enslaved man is infinite; it is the same as that which separates the simple will from liberty.

The animal in domesticity, as well as the animal living in the woods, makes use of its faculties within limits marked out by its situation. As it is never solicited to act but by external causes, and by its instincts, from the moment that its will conforms itself to the necessities which surround it, it sacrifices nothing of it; for the will consists in the faculty of acting spontaneously according to all the wants which one feels and by which he is naturally solicited, but which he does not know. Such an animal, therefore, is not essentially in a different situation from that in which it would be if left to itself; it lives in society without constraint on the part of man, because without doubt it was a social animal, and it has a chief to whose will it conforms itself within certain limits, because, probably, it had a chief, and because this will is the strongest of the circumstances which act upon it. There is nothing in this that is not conformable to its propensities; it is satisfying its wants; we do not see that it experiences others; and this is the very state in which it would be, if in the most perfect liberty; only its chief is a master who has an immense power over it, and who often abuses that power; but frequently also this master employs his power to develope the natural qualities of the animal, and in this respect the animal is truly improved; it has acquired a perfection which it could never have attained in another state, under other influences. What a difference between this animal and the enslaved man, who is not only a social being, who has not only the faculty of willing, but who is moreover a free being; who is not confined to conform himself spontaneously to his situation by the blind influence which it exercises over him, but who can know it, judge of it, appreciate its consequences, and feel its restraints. And yet this liberty which may make him contemplate his situation, shews him all that is disagreeable in it; he sees that he is chained, that he can make no use of his liberty, that he must act without it, that he consequently descends beneath himself, that he is degraded to the level of the brute, that he has even fallen beneath that level; for the animal satisfying all the wants which it experiences, is necessarily in harmony with nature, with the circumstances in the midst of which he is placed, while the man who does not satisfy his, who is forced to renounce the most important of all, is far from being in this state; he is in the moral world what a mutilated being or a monster is in the physical.

Without doubt the liberty of man, which essentially resides in his imagination, cannot be restrained, and in this sense the man who is reduced to the necessity of performing the office of a beast of burden is yet but a slave. But thought which is not exercised soon ceases to be active; and why should the thought of a man be exercised who cannot conform his actions to it? And if, notwithstanding his abject state, it preserves some degree of activity, on what will it exercise itself? The character and manners of the slaves of all ages may answer.

It would be impossible for us to ascend to the source of the fundamental differences which exist between the domesticated animal and the enslaved man, were not the difference of the resources to which we are obliged to have recourse for subjecting animals, and for subjecting man, sufficient to make us presume that beings which are only to be mastered by entirely opposite means no more resemble each other after than before submission, and that slavery and domesticity are widely different.

In fact man can only be reduced to slavery and kept in it by force, for it is part of the character of liberty to obey itself only. The will, on the contrary, existing only in the wants and manifesting itself only by them, the animal can only be reduced to domesticity by seduction, that is to say, only by acting upon its wants, whether for the purpose of satisfying or of weakening them.

Hence the principle that violence would be ineffectual for disposing a wild animal to obedience. Not being naturally inclined to approach us who are not of its species, it would flee from us, if it were free, at the first feeling of fear which we should make it experience, or it would hold us in aversion if it were captive. The only method by which we can attract it and render it familiar is by inspiring it with confidence, and this confidence can only be inspired by benefits. It is therefore by such benefits that all attempts to reduce an animal to a state of domestication ought to commence.

Good treatment especially contributes to develope the instinct of sociability, and to diminish proportionally all the propensities that might act in opposition to it; and for this reason, no subjection in animals is ever so complete as that which is obtained by operating an amelioration of their condition.

(To be continued.)

Experiments with Bottles sunk into the Sea, made during a Voyage from New South Wales. By Mr JAMES DUNLOP. In a letter to Professor JAMESON.

SIR,

HAVING on my voyage (*per* ship Portland) from New South Wales made the following experiments with bottles, &c. sunk into the sea, if you find a description of them to be of service, they are at your disposal.

Experiment 1.—April 9, in Lat. 24° South, and Long. 43° 10′ West, the ship becalmed off Rio de Janeiro, the boat was lowered down, and rowed a short distance from the ship; the deep-sea lead was let down 80 fathoms with the following experiments attached to it, consisting of a common porter bottle well corked and pitched over, and secured by a covering of new canvas, which was also covered with a thick coat of pitch; also a tin canister with holes pierced in its bottom, and open at the top, in which were placed four small thermometer tubes filled with mercury, all of which would burst with a less temperature than 100° of Fahrenheit; also five small glass globes hermetically sealed by the blowpipe, two of which were vacuum (or as nearly so as I could make them), other two were suffered to cool, previous to their being sealed, and the fifth contained a small globule of mercury to enable me to detect any damp, as an experiment on the porosity of glass; three glass phials, well corked, and firmly secured by leather coverings, tied round the necks, and further secured by a coating of sealing-wax, were also put into the canister. After letting them remain ten minutes at the depth of 80 fathoms, the line was hauled in, and the experiments examined. The porter bottle was nearly filled with water, and the cork floating inside; the covering of canvas and pitch was pressed concave into the mouth of the bottle, but the pitch was not cracked or broken. The four thermometers, and also the small glass globes came up unbroken. I examined the one which contained the small globule of mercury, and it gave not the slightest indications of damp having penetrated through the glass. The three phials came up full of water: of one of them the cork was forced in, and swimming in the water; in another, the cork was forced about half an inch into the neck; and the cork of the third was not apparently affected or displaced in the least degree, although the phial was full of water, and also several pieces of the sealing-wax lying in the bottom, which by no means could have got into the bottle, but by the cork being driven in. The wax on the top of each was broken or cracked in regular concentric rings from the centre, and the coverings of leather burst, as well that in which the cork was not displaced as in the others. Indeed the hole in the leather which covers the phial with the remaining cork is larger than in the others, in which the cork is driven in; which in all probability may be accounted for, by considering this cork to have been tighter fitted into the phial, and requiring a greater force to displace it: there would be a greater rush of the water into the phial, and the cork forced again into its neck. I think it more than probable this has been the case, otherwise the bits of sealing-wax could not have got into the phial had the cork retained its situation; neither could we account for the bursting of the leather and wax which fastened down the cork.

In preparing for the second set of experiments, I attempted to guard against the possibility of the corks being forced in, or the pressure of the circumincumbent column at all affecting the corks. I prepared two (four or five ounce) phials: the corks were dipped in strong gum dissolved in ether, and thrust into the mouth of the phials; they were allowed to remain in this state for several days to dry. The corks were then cut close to the mouth, and covered with several thick coats of varnish, and afterwards covered with leather firmly tied round the neck, which was also covered or soaked in varnish, and suffered to dry; and for farther security, the heads and necks of the phials were immersed in brass caps, filled with melted sealing-wax, to prevent the possibility of pressure upon the corks. I also prepared a small phial by simply thrusting in the cork as tight as possible, and cutting it close to the mouth, and afterwards covering the mouth and neck of the phial one-fourth of an inch thick with black sealing-wax. On the 15th May, in Lat. 5° North, and Long. 26° West (the ship becalmed), these three phials were wrapped in old canvas, and, together with the thermometers and glass globes used in the former experiments, were all put into a tin case, open at the top, and fastened to the line just above the lead: a porter bottle, fitted up as formerly, was also attached to the line. The boat was rowed a short distance from the ship, and the lead let down 180 fathoms, and allowed to remain about eight or ten minutes at that depth before we commenced hauling in the line. On examining the experiments, the two (five ounce) phials, which were secured by the brass caps, were broken or crushed to powder, with the exception of the thick part of the bottom, and the neck which was protected by the brass caps. The other small phial, which was much stronger in the glass, and only secured by the cork, covered one-fourth of an inch thick with sealing-wax, was not broken or injured in the least, though a very minute quantity of water had found its way into the phial, probably through the wax and cork, and, I have no doubt, had the phial been allowed to remain sufficient time at that depth, that it would have filled with water, probably without breaking the wax, or forcing in the cork. Neither the thermometers nor the small glass globes were broken, nor could I perceive the slightest appearance of damp in the small globe which contained the globule of mercury, to indicate porosity in the glass. The porter bottle came up full of water as formerly.

The porter bottle in this, and also in the other experiment, was prepared by Captain Mood, commander of the Portland, who assisted and gave every facility for making experiments, when the weather and circumstances would permit.

My object with the thermometer, was to ascertain whether an increase of temperature took place at a considerable depth in the ocean; and not being provided with a self-registering thermometer, the only resource I had was to make several about three inches long, and by immersing the bulbs in water heated to a known temperature, the superfluous mercury was forced out, and the moment it began to subside the tube was sealed by the blowpipe. The one which indicated the lowest temperature, required about 73° or 74° of Fahrenheit to raise the mercury to the top of the stem; but experiment proved the unsatisfactory results I might have expected, as it required a temperature above 80° to burst the slender bulb. The experiments of Captain Sabine and others prove the temperature of the ocean to decrease at considerable depths below the surface.

I think it can hardly fail to convince any one who makes the experiment of sinking bottles in the sea, and assists personally at the hauling in of the line, that the great force necessary to haul it in must be occasioned by the pressure of the superincumbent column of water. And I have no doubt that the same experiment may be performed, and powerful effects produced, on a bottle well corked and secured being placed in a cast-iron cylinder filled with water, and the *force applied by a hydrostatic press*, on the top of a solid piston (which must be well fitted into a smaller cylinder fixed on the top of the larger one), the piston pressing upon the surface of the water in the small cylinder. And many interesting experiments might be performed in the lecture-room, by substituting a very strong cylinder of glass, having its ends ground parallel, and fitted into brass caps accurately ground to fit the outside of the ends of the cylinders, and the bottom of the caps lined with leather, to prevent the pressure of the screws, necessary to connect the caps and keep them water-tight, from chipping the glass. To one of the brass caps must be fixed a well bored cylinder, for the solid piston to slide in, &c. Sea-water might be used in the cylinder, with a thermometer to show what capacity water may have to retain its caloric when under a high pressure. Such experiments would be interesting to compare with experiments which have been made on the temperature of the sea at great depths; and also the specific gravity of the water in the cylinder ascertained before and after the experiment, which would probably throw light on the subject of increased specific gravity of water drawn from great depths, and also whether the effects of pressure on water are permanent, and owing to the imperfect elasticity of water. I am, &c.

James Dunlop.

Dalry, *25th Aug.* 1827.

Observations and Experiments on the different kinds of Coal. By M. Karsten. Continued from p. 71.

THIS general manner in which coals comport themselves may, however, be considerably modified by other circumstances. When intermixed with mineral charcoal, as is often the case, they are rendered very difficult to kindle. In good coals, whether with intumesced or conglutinated coke, the obstacle which results from the mixture of a great quantity of mineral charcoal, becomes less sensible; but a coal with pulverulent coke, may thus become altogether useless, because its mass becomes so compact, that it arrests the passage of the air.

Another obstacle is produced by the quantity of earths which occurs mixed with the mass of the combustible. A coal which leaves much ashes, developes but a slow and feeble heat, because the ashes oppose the access of the air. The same obstacle presents itself in the case in which the body of the combustible itself leaves little ashes, but where the stratum is, as it were, interlarded with clay or slate. If it be the body of the coal itself that is much divided by numerous fissures or partitions, this circumstance may render a coal with pulverulent coke altogether useless, for such a coal in burning falls into small pieces, which, far from agglutinating themselves together so as to form a loose and light mass, on the contrary, apply themselves so closely to one another, that the affluent air finds no passage through them.

Is the object in view the production of coke? Then several circumstances are to be considered, which may make the coke of one coal be preferred to that of another, although each may be a perfectly pure charcoal; that is to say, although the purity of both may only be altered by a small quantity of ashes. In the first place, regard ought to be had to the more or less loose or light state in which the cokes, obtained from different coals, present themselves. Matters, however, go on differently here, from what they do in those wood-charcoals which are obtained from the hardest or the softest woods, or in those charcoals which are produced from straw or other vegetable fibres,—from substances, in short, which, in their original and undisturbed state, were very loose and very light. In coals, the loose and light aspect of the charcoal is occasioned by the manner in which the coals comport themselves, whether they be coals with intumesced, or coals with conglutinated, coke; whereas, in unaltered fibres of wood, this aspect is only the effect of the original density of the fibres.

Thus, a comparison between the different degrees of lightness of the cokes obtained from coals, and those of the charcoals procured from still unaltered vegetable fibres, could only take place with regard to coals with pulverulent coke. But the intumesced cokes are in reality a charcoal in a state of partial fusion, which the almost silvery colour of several of these cokes already indicates. The large proportion of hydrogen which coals with intumesced coke contain, and, at the same time, the small proportion which the oxygen bears to the hydrogen, produce the following effect: the coal, at the moment when the decomposition of that combustible is effected, passes into a state of partial fusion. There results from this, that the mass, which is softened throughout, and of which a part has become adhesive, is often intumesced by the vapours and gases which are developed. It then extends in all directions, and frequently swells out like an agglomeration of vesicles.

The coals in which the proportion of oxygen is much superior to that of the hydrogen, act differently: they do not soften either before or during their decomposition. What did not adhere together previous to carbonization, because it was intermixed with foreign matters, or had only thin walls interposed between its parts, still remains in the same state after carbonization; and each isolated fragment, which in such a coal does not immediately adhere to the mass, is carbonized separately, and on its own account. There results from this, that, according to the proportion which the hydrogen bears to the oxygen, the state of the cokes obtained will differ very much. From those which swell to such a degree as to present the aspect of a light slag, to those which preserve the external appearance of the coal while they diminish in bulk, there exists an uninterrupted series of transitions.

In the good coals with conglutinated coke, the proportion of the hydrogen to the oxygen is still favourable enough for the fragments of combustible, which previously were not in immediate contact, but were separated by surfaces or partitions, becoming soft during the process of carbonization, uniting themselves to the mass, and forming together a single body. This effect of the process of carbonization becomes particularly striking, when, after destroying the aggregation of the mass of coal by pulverizing it, its powder is submitted to distillation.

On the other hand, a coal which has passed into the state of a more or less complete fusion, ought, on account of its smooth, and, as it were, semivitrified surfaces, to kindle with more difficulty than an unmelted coal, which presents uneven surfaces. This is actually what is observed in the incineration of cokes; for the intumesced cokes, being placed under the muffle of an assay furnace, require for their complete combustion a higher temperature, or more time at the same temperature than the conglutinated cokes, and still more than the pulverulent cokes. For the same reason, also, the coke obtained from mineral charcoal is more readily reduced to ashes under the muffle than the intumesced coke of a coal of the third class. But the case is quite different, when a mass of coke, formed into a heap, is made to burn with the aid of a current of air, whether natural or artificial, and not to be consumed gradually by the action of the burning air, which operates upon the surface of the combustible, as takes place under the muffle. The intumesced cokes maintain the mass in such a state of motion, on account of the augmentation of their proper volume, that the passage of the decomposed air is never for a moment disturbed or interrupted.

The conglutinated cokes already form a more compact and more firm mass. With regard to the pulverulent cokes, whether from the commencement of the operation they were already reduced into small pieces, or whether in the combustion, which is gradually operated, they diminish in size, all the interstices are so obstructed that the decomposed air finds no issue, and then the combustion is arrested not from want of access of air, but from cessation of the current of air. The powder of wood-charcoal when heaped up so as to form a large mass, owing to its closeness burns with difficulty, notwithstanding the briskest affluence of air. From this manner of burning it might almost pass for a glance-coal.

Whatever may be the reasons of preference which we have stated in favour of coals with intumesced coke, such coals cannot be employed in certain cases and for certain objects. Cokes that are too much intumesced, if they are heaped together in large pieces, fall into cinders or fragments, and this arises partly from their weight. This reduction to small fragments still increases, if such cokes are to be burnt in *fourneaux à cuve*, or if they are stratified with the substances which it is intended to melt or reduce. Thus, coals with highly intumesced coke do not furnish a suitable combustible for the treatment of iron-ore in the high furnace (*le haut fourneau*); but in the cases in which the pressure is less considerable, where, consequently, there is no reason to dread the reduction of the coke into small fragments, they may be employed, even for the use of *fourneaux à cuve*, such as Wilkinson's furnaces, *fourneaux à manche*, and *demi-hauts-fourneaux*; then such cokes always answer best. In general, it is the state of loose aggregation, or the lightness of cokes, which entirely decides as to their employment in the *fourneaux à cuve*.

A coal with intumesced coke, when it passes into coal with conglutinated coke, furnishes an excellent combustible for the use of high furnaces for melting iron-ore; but coals with intumesced coke, which are not too much swelled, are the best of all for this object. A coal with conglutinated coke must not have too many natural joints, because, in the carbonization, it is reduced to too small fragments. Lastly, a coal with pulverulent coke cannot be employed, if it does not present itself in large masses, which keep together, and, in the process of carbonization, form large pieces of coke.

A coal which intumesces a little, is therefore always preferable to that which only conglutinates, and still more to that which furnishes a pulverulent coke; for, if the first presents natural fissures, its property of intumescing destroys their bad effect; and even in this coal, the solutions of continuity, the partitions of mineral charcoal and of foreign mixtures, which the mass may present, cease in a great measure to be hurtful, on account of the intumescing.

In the coals with conglutinated coke, and especially in those with pulverulent coke, the frequency of fissures, which, even without the existence of real joints, may result from the mere want of uniformity of substance, is an inconvenience which of itself suffices to render these combustibles altogether incapable of being converted into coke.

An excessive quantity of ashes may also become an obstacle in the way of employing cokes for *fourneaux à cuve;* and the lighter the cokes are, or the more they fall into fragments in the furnace, the greater obstacle will the ashes yield; the reason of which is, that they increase the difficulty of combustion, and envelope the surface of the coke before they have been brought to a state of melting. This difficulty of fusion, which results from too great a quantity of ashes, makes the melted mass remain in the state of a paste. There follows from this, not only that the air traverses such a mass with difficulty, but also that a part of the effect of the incandescent coke must be employed to melt the ashes.

For obtaining coke, as this is practised, by means of the small debris furnished by the breaking up of the beds of combustible in mining, it is obviously only coals with vesicular coke that can be used. Such cokes are sometimes very liable to fall into crumbs, whether on account of the nature of the mass itself, or on account of an accidental admixture of slate, clay, or other foreign substances, which, from the effect of carbonization, are inclosed in the mass; and, in consequence, cause these cokes, under a strong pressure, to fall more easily into fragments. Then they become altogether incapable of being used for the fusion of iron-ore in great furnaces. And further, the abundance of foreign mixtures which the combustible must also bring into fusion, renders these cokes unfit for being employed in the *fourneaux bas à cuve*, commonly called *fourneaux à manche*.

On the other hand, coke prepared with the small debris of a coal with vesicular coke, when this coal is perfectly pure, and as exempt as possible from foreign mixtures, may answer quite as well as coke produced from the same kind of coal, had it been in large pieces. It might happen, however, that a coke coming from coal in large pieces, might present more firmness than one that would result from small debris. Then, consequently, the former would be less exposed to break down into small pieces in the *fourneaux à cuve*, at least in very high furnaces, and under a great pressure of ore.

If pyritous coals are carbonized, the coke which results contains in general so much the more sulphur in proportion to the larger quantity of iron pyrites that occurs in the mass of combustible; but M. Karsten asserts, that hitherto he has not observed that the mixture of a great quantity of pyrites rendered a coal incapable of being converted into coke, nor the cokes produced by it incapable of being employed in metallurgic operations, from the idea that the quantity of sulphur contained in them would have too prejudicial an influence upon the quality of the product to be obtained. According to the author, this no doubt is an inconvenience, but it does not furnish a sufficient reason for entirely excluding pyritous coals from the preparation of cokes for metallurgic purposes.

The case is different with respect to lighting by gas. When the pureness of the coal is very much altered by the presence of iron pyrites, this inconvenience may entirely prevent the employment of such a combustible, if the object in view be to distill it in the dry way for the purpose of obtaining from it a gas adapted for lighting. As we have already seen from the composition of the different sorts of coal, the employment of a coal for this purpose does not depend solely either upon the quantity of carbon which it contains, or upon its proportion of hydrogen; but upon the relations which exist in the coal between the carbon, the hydrogen, and the oxygen considered together. A coal very rich in carbon, in which the proportion of oxygen to hydrogen is as small as it can be, is very well adapted for the purpose of lighting: it affords gas of excellent quality, although not in great quantity. Although the quantity of carbon diminishes, and that of hydrogen increases, it does not follow that the coal is better adapted for lighting, unless, along with the diminution of carbon, there is an increase of the relation of the hydrogen to the oxygen.

M. Karsten, in this manner, makes application of his principles to the combustibles of which the analysis has been presented in the preceding Table.

Of the coals of Wellesweiler, near Saarbruck, No. VI., of the country of Essen, in Westphalia, No. VII., and of Newcastle in England, No. XI., the first and third of which present a somewhat larger proportion of hydrogen than the second, it is the Essen coal, No. VII. that answers best for lighting, while the Wellesweiler coal, No. VI., that which contains most hydrogen of the three, is the coal which is least adapted for the same purpose. The Beuthen coal, No. V., is still less adapted for the purpose, and that from Berzenskowitz in Silesia, No. IV., as well as the two kinds of coal indicated by Nos. VIII. and IX. of the Table, are very bad for lighting.

On the other hand, the Cannel coal, No. X., is superior to all the others, not on account of its absolute contents in hydrogen, which are not even so great as those of wood, but because the hydrogen, at the same time, bears a great proportion to the oxygen. It is this proportion, therefore, and not the absolute quantity of the carbon, considered by itself, any more than the quantity of hydrogen or of oxygen, that in a coal determines its relative capability of furnishing gas for lighting. The cannel coal, No. X. contains 19 per cent. of oxygen, and the Wellesweiler coal, No. VI., contains less than 15; yet the former is perhaps better adapted than the latter for lighting by gas.

There is a substance which is always met with in coal deposits, and never in those of lignite. We have already made mention of it: it is *mineral charcoal* *, a pulverulent combustible, of a fibrous structure, which the Germans name *Faserkohle*, and which has sometimes been named Anthracite, because it is commonly regarded as very difficult to burn. This substance is interposed in the coal in beds which are perfectly distinct, often very thin, and always parallel to the stratification of the beds. By a great number of trials, M. Karsten has found that, in this substance, the contents in charcoal are larger than in the coal which comes from the same bed. He considers it certain that the mineral charcoal has contributed to the formation of the coal, and that a great part of the latter consists of that same vegetable fibre from which resulted the mineral charcoal preserved in the impressions of coal. Mineral charcoal, he adds, is one and the same substance with coal. This is so true, that the pre-existence of the fibres of plants, which, in the state of isolation, formed the mineral charcoal, can only be recognized by the vegetable impressions which have remained in the combustible. But, according to the author, mineral charcoal is not, by any means, so difficult of combustion as is commonly thought. Under the muffle of an assay furnace, this substance burns with a sort of flame which proves it to be very far from being in a state of pure charcoal. The residue in charcoal which it yields on being distilled in the dry way, is incomparably more easy to burn than the vesicular cokes of coal.

In reality, in the operation of a high furnace, mineral charcoal, when it occurs in large quantity, resists the action of the most active blowing machines; it reappears at the mouth of the furnace, under the aspect of a fine charcoal powder, which is named (*Poussier*) coal-dust, and it then seems to have undergone no alteration. But the same effect would take place were powder of wood-charcoal applied in the same manner. It is the pulverulent state in which it exists, that makes mineral-charcoal act as if it were combustible, and which, in many circumstances, renders its employment dangerous in a high furnace for melting iron. Cokes themselves, when reduced to very small fragments, heaped upon each other, produce a similar effect, although less complete.

The same difference that is observed in the composition of

* Vide Jameson's Mineralogy.

coal, occurs in that of mineral charcoal; when this substance presents itself isolated among the other parts of the coal, it differs from it only in having a much greater proportion of charcoal. But its composition is regulated by the relations which exist among the constituent parts of the mass of coal, in the midst of which it occurs interposed. This proves that the same circumstances were in action during the formation of both substances, but that the mineral-charcoal was more quickly formed, the cause of which can only be sought for in the original nature of the vegetable fibres.

M. Karsten presents, in a table, the results of some of the comparative trials to which he submitted mineral charcoal and coal, both coming from the same spot. The following are the results of distillation in the dry way, for 100 parts of each of the two substances.

Places from which the Specimens analysed came.	Mineral Charcoal.			Coal of the same localities.
	Residue in Charcoal, in 100 parts.	Ashes coming from the residue in Charcoal for 100 parts.	Remains in pure Charcoal for 100 parts. Contents in Charcoal.	Residue in Charcoal after abstraction made of the Ashes, for 100 parts. Contents in Carbon.
1. Mine of Glücksburg, near Ibbenbühren, - -	96	2.8	93.2	87.9 Pulverulent Coke.
2. Another mine in the same place, - - -	95.3	2.2	93. 1	81. Intumesced Coke.
3. Mine of the circle of Westphalia, - - -	97.4	1.66	95.74	91.4 Pulverulent Coke.
4. Mine of the neighbourhood of Waldenburg (Lower Silesia), -	91.9	3.95	87.95	59.8 Intumesced Coke.
5. Mine of Konigsgrube (Upper Silesia), -	89.85	7.55	82.30	63.2 Conglutinated Coke.
6. Mine of Pottschapel, near Dresden, - -	79.33	1.3	78.03	41 Intumesced Coke.

It is known, that, in the dry distillation, the coals, with intumesced coke, on account of their greater contents in hydrogen, always afford less charcoal in proportion than such coals, whether with conglutinated coke or with pulverulent coke, as have really the same contents in carbon. In recalling this fact to mind, we see, by the preceding table, that the contents in carbon of mineral charcoal are entirely regulated by the nature of the coal, in the midst of which it presents itself. For example, in the same manner as Nos. 1. and 2. of the table bear each the numbers 93, for the remains in pure charcoal obtained from the mineral charcoal, the table would bear the number 87.9 of coke, in reference to the coal of the same points, as well in the case of No. 2. as in No. 1., if, in both, the coal had furnished a pulverulent coke; but, in the second case, the coal has furnished an intumesced coke, a coke which is always less abundant when the contents in carbon are the same. This is the reason why, in No. 2., there are only 81 parts of that residuum in charcoal which is called coke. The same reasoning will apply to the other numbers of the table.

It is remarked, moreover, that, in mineral charcoal, the contents in carbon vary from 78.03 to 95.74 per cent.; while, in the coals of the same localities (Nos 6. and 3.), they vary from 41, in contumesced coke, to 91.4, in pulverulent coke. M. Karsten concludes from this, that mineral charcoal often contains much less carbon than many coals. The pulverulent state of the residuum which the carbonization of the former affords, sufficiently indicates, continues the author, that in mineral charcoal, the proportion of oxygen must be much greater than that of hydrogen. Lastly, The examination of mineral charcoal appears to him to prove that, in the formation of coal, some parts of the vegetable fibres have advanced more rapidly than others towards carbonization.

M. Karsten then states considerations calculated to furnish the means of ascertaining in some measure the composition and properties of coals by their mere aspect. The following are the principal ideas of the author:

It is only in coals which are very rich in carbon, that a certain homogeneousness of the mass is observed. All the fossil coals, with a small proportion of carbon, consist of a mixture of charcoals, of which some are rich, and others poor, in carbon.

When a mass of coal is interrupted, whether by alternating beds of combustible, richer or poorer in carbon, or by walls of fissures, or by interposed beds of mineral charcoal, these circumstances may frequently decide as to the employment of such coal for a particular object. It is from this important consideration, from the circumstances of a mass of coal in this respect, that mineralogists have distinguished different sorts of this combustible by names, which it will suffice just to mention here:

Pitch-coal, or piciform-coal, having the lustre of pitch (*Pechkohle*) ; Slate-coal (*Schieferkohle*) ; compact or cannel-coal (*Kennelhohle*) ; Foliated coal (*Blaëtterkohle*) ; Columnar coal (*Stangenkhole*) ; Coarse coal (*Grobkohle*).

An alternation of beds of coal, some richer, others poorer in carbon, with frequent interpositions either of fissures or of partitions, or even a frequently repeated alternation of very thin beds of mineral charcoal, dividing the mass of combustible,—such are the circumstances which afford proof, sometimes that a coal is slaty, sometimes foliated, sometimes passes from slaty to foliated coal, according as such effects are more or less numerous. If the arrangement of the combustible substance in thicker beds appears to the eye to remain constant, a coal rich in carbon, which therefore exhibits the lustre of pitch together with the conchoidal fracture, is named Pitchcoal; while a coal poorer in carbon, and of a dull appearance, is named Cannel Coal. These two kinds of coal, the one richer in carbon, and the other poorer, when they are intimately united with one another, and not disposed in alternating beds, occur in mineralogical systems under the denomination of Coarse Coal.

If sufficient importance be attached to the separations of the mass of combustible to make it the basis of a classification of coals, then, without doubt, matters may be allowed to continue so; but, in that case, it cannot be hoped that the name given to the body which it is to designate, should present an accurate image of it to the eye. A slaty coal may differ as much from a coal of the same name, as two pitch coals, or two cannel coals, may differ from each other ; and these manifest a mutual accordance only in certain respects, while in other respects they are much more widely separated from each other than a foliated coal is from a pitch coal, or a slate coal from a compact coal. The *colour*, *lustre*, *cohesion*, and *hardness* of the combustible, are in general the only properties from which the external and distinctive characters of coals are derived ; for the specific gravity is an uncertain guide in this respect, on account of accidental mixtures. But these properties themselves do not seem to be sufficient, if it be required that, with the external characters, the intimate nature and composition of coals be at the same time determined. The true difficulty, however, lies solely in this, that coal is almost always a mixture of at least two different kinds, which are considered as a homogeneous whole; but, in this respect, coal does not form an exception to the general law, that the chemical composition of an inorganic body is manifested by its external properties.

An intense black colour in coals, joined to a high degree of lustre, as well as a considerable hardness, always indicate that they contain a large quantity of carbon, and that the oxygen in them predominates over the hydrogen. The species of lustre determines the relation of the carbon to the other constituent parts. Pitchy lustre indicates a smaller proportion of carbon; the passage of this lustre to the semi-metallic indicates a greater. Blackness of colour, high lustre, and slight cohesion and hardness, characterise the coals which are rich in carbon, and in which the hydrogen predominates over the oxygen. A black colour, a dull appearance, and a marked cohesion, with a certain degree of hardness, are the signs which indicate a coal less rich in carbon, in which the oxygen predominates in a high degree over the hydrogen. When the colour becomes a dark brown, it implies that the proportion of hydrogen has increased with relation to the oxygen. If, while the black becomes less intense, the coal presents a duller aspect and an inferior degree of hardness, its cohesion remaining the same, it is because the combustible still contains less carbon, at the same time that the oxygen predominates over the hydrogen.

If it be wished, according to what has been stated, to determine precisely the nature of a coal, it appears sufficient to point out whether or not the mass is homogeneous, and what are its characters with respect to colour, lustre, cohesion, and hardness. Should it be required, the carbonisation will make known the quantity and appearance of the residuum in charcoal; it will thus complete the disclosure of the composition of the combustible.

With regard to the specific gravity of coals, it presents few means of characterising them, not only on account of accidental mixtures, but on account of all the variable circumstances which may have accompanied their formation. In reality, coals which are very rich in carbon commonly have a great specific gravity, but this is only in the case where the oxygen predodominates over the hydrogen. If the proportion of the latter increases, then the coals which are very rich in carbon often present a much less specific gravity than the combustibles in which the proportion of carbon is small. It may be admitted as a general rule, that the proportion of carbon being the same, the mineral combustibles which have the smallest specific gravity, are always those in which the relation of the oxygen to the hydrogen is the smallest that it can be.

M. Karsten proceeds next to an examination of glance-coal, anthracite, and graphite.

The author thinks that the combustibles known by the name of glance-coal, whether of Schœnfeld or of Lischwitz in Saxony, or of Visé near Liege, are nothing else than a coal which contains a very large proportion of carbon. He is led to suppose that graphite and true glance-coal, that of Rhode Island, for example, were originally substances analogous to coal; but that, in these substances, the separation of the constituent parts of coal is so advanced, that, at the present day, they have almost all attained the state of pure carbon. From the experiments which M. Karsten has made with reference to this subject, he concludes, that native graphite is erroneously considered as a carburet of iron, and that this substance should not be confounded with the graphite which is artificially obtained in furnaces. This latter substance, says the author, comes much nearer to glance-coal in its lustre, its hardness, and its resistance to combustion, than to native graphite. The two kinds of graphite have only perhaps been confounded together, because they both have the property of staining the fingers. Perhaps the graphite of high furnaces, from the strength of its lustre, and the difficulty of its combustion, presents a transition from glance-coal and native graphite to diamond.

According to the author's researches, the native graphite of Borrowdale in England contains at the most 15 per cent. of foreign parts, which consist of silica, alumina, oxide of iron, oxide of manganese, magnesia, and oxide of titanium, with a trace of chrome and lime; but the proportion of oxide of iron in the ashes it contains never rises above 2.75 per cent. Thus, in 100 parts of graphite, there would be at the most 1.9 per cent. of metallic iron; whereas this substance is commonly regarded as composed of 95 parts of carbon, and 5 of iron.

Native graphite is not therefore a carburet, according to M. Karsten; it is a carbon, the pureness of which is altered by an accidental mixture of mineral matters which contain iron. The author concludes from this, that the differences which exist between native graphite, glance-coal, diamond, and artificial graphite, must not henceforth be attempted to be explained by the proportion of iron which is observed in the first and last of these substances. Let us rather avow, he adds, that our knowledge is not yet sufficient to enable us to unveil the cause of the differences in the phenomena which these substances present with respect to light, and their other physical properties.

To be concluded in our next Number.

Observations on the Cow-tree of the Caraccas; and on the Culture of the Nutmeg-tree. In a Letter from Mr David Lockhart, Curator of the Botanical Garden in Trinidad to Aylmer Bourke Lambert, Esq. F. R. S. V. P. L. S. &c.

I have just returned from an excursion to Caraccas, where I collected the juice of the Cow-tree (Palo de Vaca), and I have now the pleasure of sending you a phial of the milk, together with a few leaves, and a portion of the root of the tree. The *Palo de Vaca* is a tree of large dimensions. The one that I procured the juice from, had a trunk 7 feet in diameter, and it was 100 feet from the root to the first branch. The milk was obtained by making a spiral incision into the bark. Carauo, the place where I met with the tree, is about fifty miles east of La Guayra, and at an elevation of from 1000 to 1200 feet above the level of the sea. It is likewise found between Cape Codera and Barcelona. The milk is used by the inhabitants wherever it is known. I drank a pint of it, without experiencing the least inconvenience. In taste and consistence, it much resembles sweet cream, and possesses an agreeable smell. I was so fortunate as to procure some young trees and roots of the *Palo de Vaca*, which I will endeavour to increase, and, if I prove successful, you may expect to have a plant. I am sorry that I was not able to collect any specimens worth sending during my visit to Caraccas, my stay being limited to eight days, six of which were spent in procuring the cow-tree. I however picked up a few seeds, which are sown in a mixed state at St Ann's, and which are likely to afford something interesting. I am glad to hear that botany goes on prosperously in Europe. I am sorry to say, that, during nine years' residence in this part of the world, I have found very few persons who take an interest in the advancement of science, the principal aim of the people here being to make money in every way they can. For the last eighteen months, from close attendance to the garden, I have had but little time to devote to collecting.

You will be happy to learn, that we have succeeded in increasing the Nutmeg-tree, both by inarching and by laying; for from seed they cannot be depended upon, as they have been found to produce so few female trees, not more than one in thirty or fifty. We have likewise ascertained, during the last season, that the female trees sometimes produce male flowers. A tree that was raised at the garden of St Vincent's and brought hither, produced, in June 1824, male flowers; and in June 1826 the flowers were all female. The same tree this year shews abundance of fruit, which are likely to ripen. In 1823, the first flowers that one of our female trees produced, were all male. We have now ten fine female trees in the garden, and one of them has at least 700 fruit on it. We have about forty more of the same sex, raised by inarching and layers. The climate and soil of this island seem congenial to the Nutmeg-tree.

TRINIDAD, *April* 30. 1827.

Note by Mr Don.

I had an opportunity of examining attentively the leaves of the *Palo de Vaca*, and found them to approach very close to those of several South American species of *Ficus*. The disposition of the nerves and veins was precisely similar, which, together with the insertion and consistence of the leaves themselves, appear to justify the propriety of the place assigned to the *Palo de Vaca*, by M. Kunth, who has arranged it in the family of *Urticeæ*, under the name of *Galactodendron utile;* but neither he nor myself have seen either the flower or fruit; so that as a genus, it rests on very insufficient grounds. The tree, however, is evidently related either to *Ficus* or *Brosimum*. The juice contained in the phial sent to Mr Lambert had the appearance of sour cream, and, notwithstanding that it had suffered materially from the long voyage, the taste was by no means unpalatable.

To prevent any misconception of the method taken to increase the female Nutmeg, it may be proper to remark, that, by inarching, he means inarching the branches of the female tree on the young plants produced from seed, by which mode a certain supply of female trees is obtained; whereas from seed, several years must elapse before the trees produce flowers, and then the result must be frequently disappointing; more especially if the disproportion between the number of male and female trees from seed be so great as Mr Lockhart has observed. A very few male trees will be found sufficient for a whole plantation of females. I do not remember of any other instances on record of an absolute change of sex, than the striking ones mentioned above by Mr Lockhart, as occurring in the nutmeg tree. It is a fact well deserving the attention of physiologists. Individual plants, producing at the same time male and female flowers, are of common occurrence.

Observations on the Structure and Nature of Flustræ. By R. E. Grant, M.D. F.R.S.E. F.L.S. M.W.S. Fellow of the Royal College of Physicians of Edinburgh, Prof. of Zoology in the University of London, &c. (Continued from p. 118.)

In examining the anatomy of the other species of Flustræ above mentioned, more care is required than in the examination of the *F. carbasea*, as the two plains of cells composing the branches of the *F. foliacea* and *F. truncata* require to be carefully separated from each other, and the sessile species, *F. telacea*, *F. dentata*, and *F. pilosa*, require to be removed from the surface of the fuci, or other substances to which they adhere, in order to render them sufficiently transparent to allow their minute structure to be perceived through the reflecting microscope. The *Flustra foliacea*, Lam., like the *F. carbasea*, already described, is an inhabitant of deep water, and is very rarely met with in a fixed situation near the shore, or in places accessible at ebb tide, though, from the immense quantities of it which I have found drifted alive on our eastern and western coasts, and constantly brought up by the dredges from oyster-beds, it appears to be the most abundant species on the British shores. It generally adheres to shells or stones, on the surface of which it first spreads like a sessile species with a single plain of cells, then rises up in the centre of the expanded base in a branched form, when its branches are always composed of a double plain of cells. It is a very large species, its branches often amounting to many hundreds, and presenting on their two surfaces some hundred square inches of cells. It has a strong and pleasant odour of violets, which it retains for some time after being taken from the sea, and it is probably the species which the inhabitants of Iceland are said to chew as a substitute for tobacco. The branches have a thick, opaque, and coarse appearance, generally a yellowish-grey colour, and a rough surface covered with minute reverted spines; they are variously subdivided, but most frequently present a broad palmate form, terminated by numerous rounded and expanded digitations. The sides of the stems and lower branches do not present the thickened, opaque, and compact margins we find in the *F. truncata* and *F. carbasea*, which are much more delicate species. The tips of the branches are thin, soft, and transparent, as in other branched species, and as in the anterior margin of sessile species, from their containing little calcareous matter, and from the polypi in that situation being young, colourless, and translucent. The boundaries of the cells on the opposite plains do not coincide, nor have they any determinate relation to each other in their position. The broad rounded extremity and the aperture of the cells are always above, the contracted and flat base always below. The cells are arranged on each surface, as in the *F. carbasea;* the opaque sides of the cells form continuous ramified lines from the base to the apex of the branches; and the first cell of a new series in the middle of the branch is always smaller than the cells which surround it, being confined to a small angular space, formed by the bifurcation of the opaque lateral wall of a perfect cell. The tips of the branches are never bounded by a smooth continuous line, as we observe them in the *F. carbasea* and *F. truncata*, but are terminated by the round bulbous extremities of the last two rows of cells; this remarkable difference is observable by the aid of a common lens.

The cells are shorter and proportionally broader than in the *F. carbasea*, being about the sixth of a line in length, and a little more than half as much in breadth. By tearing the two plains of cells asunder, we render them nearly as transparent as in the *F. carbasea*, and can distinctly perceive the structure of the parts within. The aperture of the cells is formed by a semicircular lid, convex externally and concave internally, which folds down when the polypus is about to advance from the cell. The opening of this lid in the *F. truncata*, where it is very long, appears through the microscope like the opening of a snake's jaws, and the organs by which this motion is effected are not perceptible. The lid of the cells opens and shuts in *flustræ*, without the slightest perceptible synchronous motion of the polypi. We sometimes observe parts, in other calcareous zoophytes, possessing distinct power of motion, though apparently unconnected with the body of the polypi; thus in the *Cellaria avicularia*, Lam. whose polypi have the same structure, and the same connection with the cells as in *flustræ*, I have observed in living specimens a constant motion of flexion and extension in the remarkable testaceous processes shaped like a bird's head, and attached by peduncles to the outside of all the cells. These processes or organs are likewise provided with lateral folds, like the valves of a shell, which have a distinct and regular motion corresponding with the flexion and extension of the entire process. The aperture of each cell of the *F. foliacea*, is defended by four projecting spines, which arise from the calcareous margin of the cell. There are two spines on each side of the aperture, and the upper two are more than twice the length of the lower pair, and slightly curved upwards. When we look transversely on the surface of a branch, the spines appear to be arranged in very regular transverse curved rows, and when we observe the surface longitudinally, they appear to be arranged in very regular longitudinal straight lines. The spines are calcareous, tubular, cylindrical, shut at their extremity, and appear obviously destined to protect the expanded polypi. The two pairs of spines belonging to each cell are placed only on the upper half of the cell, although, from the contiguity of the cells, the lower half of each is likewise defended by the spines of the adjacent cells, so that they serve also to protract the polypi when in a retracted state. No projecting spines of this kind are found in the *F. carbasea*, and they form the most obvious character of the *F. foliacea*. The bundles of minute spicula pointing horizontally inwards from the margins of the cells in the *F. carbasea* are not present, nor apparently required in this species. By the aid of the microscope, we perceive the same vascular appearance of the thin membranous covering of the cells as in the *F. carbasea*, the same dark round spot in the center of those cells which have lost their polypi, the same imperfectly formed empty cells along the margins of the branches, and similar rudimentary polypi in the last two or three rows of cells at the free extremities of the branches.

The polypi of the *F. foliacea* are about twice as long as the cells, have their body coiled up in a spiral turn, and bifurcated near its lower extremity, and they have the same attachment by bundles of soft loose fibres to the aperture and base of the cells, as in the species already described. They have only fourteen tentacula, sometimes thirteen, which are very long, slender, and ciliated on their two lateral margins. The expanded tentacula form a bell-shaped cavity, into which there is a constant current of water, produced by the incessant rapid vibration of the *ciliæ*, and in the center of this cavity is the circular prominent retractile mouth of the polypus. The tentacula remain in this expanded and regular form, when the polypi are found hanging dead from their cells; and the same is observed in many other zoophytes, which enables us to observe their number and form with more ease through the microscope. The head of the polypus is small, the body comparatively strong, the continuation of the body below the bifurcation very thick, conical, and tapering to its posterior termination, the globular appendix of the body, and its tubular cervix, are smaller than in the *F. carbasea*, and the same opaque matter is found in the cavity of the globular sac. A distinct and constant revolution of particles is seen in the whole of the tube leading from the body of the polypus into the round sac, as if produced by ciliæ placed within; there is no pulsation or contraction of the part, nor can we perceive any fluid passing from that cavity into the vessels so extensively ramified on the coats of the cells. A similar continued vibratory motion is seen within the mouth in most polypi, which is undoubtedly produced by ciliæ in that situation; these minute processes appear to be the only active organs in the circulation of the fluids in zoophytes. The body of the polypus has the usual red colour, while the head and arms are nearly colourless. The long cylindrical and curved body of the polypus is tubular to its posterior termination, which is shut; and we can sometimes perceive a small bolus of food moving to and fro in the conical part of the body below the bifurcation. The globular sac in this species does not appear to be connected with the formation of the ovum, nor with the regeneration of new polypi in the old cells.

The ova of this species of flustra begin to appear early in autumn, and continue to be generated in the cells during the whole winter; those of the *F. carbasea* make their appearance later in the season; and I have elsewhere shewn, that, in other zoophytes, different species of the same genus vary much in their season of generation, though residing together on the same rock. The ova first make their appearance at the narrow base of the cells as very small, pale-red, gelatinous spheres, and the polypi of such cells are generally removed, and only a small round dark brown spot is seen in their stead, in the center of the cells. There is but one ovum in each cell, as in other *flustræ* and calcareous *cellariæ;* and, as it enlarges in size, it advances higher in the cell, till, in its mature state, it occupies the broad upper part of the cell. When the mature ovum is found at the summit of the cell, we observe a distinct wide helmet-shaped capsule surrounding it, and separating it from the cavity of the cell. By examining the ovum within this capsule, with the microscope, we perceive its ciliæ in rapid motion; and I have frequently observed the ovum, in this situation, contract itself in different directions, shrink back in its capsule, and exhibit other signs of irritability before its final escape. The helmet-shaped capsule of the ovum is open at the top, and connected with the aperture of the cell, so that the ovum readily escapes, by contracting its body and moving its ciliæ. On escaping from the cell, the ovum glides to and fro by the action of its ciliæ, and, after fixing, it is converted into a single complete cell, from which new cells shoot forward. Polypi make their appearance in shut sacs, at the bottom of the new cells, when they are sufficiently formed to protect them. When the ovum has escaped from the cell, the dark round spot in the center of the cell enlarges, and a new polypus shoots out from that point, so that, at this season, we observe young polypi, in every situation, on the branches, the whole of the old cells are thus never found entirely deserted, the same cells may repeatedly produce ova and polypi, and the whole zoophyte retain its energy for several seasons.

Account of an Aurora Borealis, observed at Edinburgh 16*th January* 1827; *with some particulars of another, of a preceding year.* With a Plate. By D. Blackader, Esq. Communicated by the Author.

About 9 o'clock, p. m., evening fine, brilliant moonshine, a beautiful white, opaque, drapery of cloud, extending from the zenith to within about 15° of the NW. horizon. The wind had for some days been boisterous and variable, and had veered, in the morning, from NW. to NE.; but the air was now calm and serene. In the course of a few minutes the cloudy tissue had entirely disappeared, and a brilliant aurora was exhibited, in rapid change of feature, and distinguished by unusual proximity. Horizontal cloudy vapours, of great tenuity, repeatedly accompanied its more brilliant evolutions, seeming to support its columns; appearing and vanishing with the more vivid coruscations. Thereafter, the aurora became extended, to right and left, forming the segment of a large circle, although not exceeding in altitude more than 15°, and, at either extremity, vanishing, like the higher strata of clouds, in the blue expanse. This arch may be conceived of by means of the sketch, Plate IV. No. 1.; whereof the landscape includes an angle of about 90°, having its centre in the magnetic meridian; near to which a principal star is seen, at that hour. The lower edge of this arch was always above that star. Subsequently, a second arch was formed in front thereof.

On the right extremity, the arch always presented a broken or interrupted line, with recurrence of separate masses of luminous spears, of a brilliant bluish-white lustre; a golden tint, and burnished lustre, distinguished the continuous arch of the central portion, which, towards the left, became coppery. The second, or front line, was uncommonly distinct, and much nearer than the one first formed. Other figures, afterwards formed, were still lower, and nearer to the observer. A powerful beam, from one of these more advanced figures, traversed the arch, and formed a marked contrast, in point of intensity, at the point of bisection. The circular, or crescent-shaped figures, in which the spears of light were often arranged, occupied planes, sometimes inclined to the right, which evidently traversed the line of vision; their nearest, and always broader, margin, being apparently depressed a number of degrees below it; otherwise, that broader and brighter margin must have covered the farther half; unless, indeed, the nearest were the more elevated; which, however, could not be the case, unless by great ocular deception. Had they occupied the same plane, the laws of perspective would have placed them in the reverse, in point of apparent elevation. See sketch, Plate IV. No. 2.

In general, the principal arch was never obliterated during the greater part of an hour; and although, at first view, it seemed to be composed of a stratum of continuous brilliant light; yet, upon subsequent observation, small portions were projected beyond the common line, with encroachments, also, on the inferior margin. At times, this became more apparent, with re-entering angles. Suddenly a great portion of the arch would break up, forming circular and curved figures, the bases of immense tubular fasciculi, which soon vanished, instantaneously; to be again reconstructed, and to undergo new transformations.

About 10 P. M. the whole disappeared; the arch having previously reoccupied the original position, above the star; and it never retreated farther towards NW. Nor was it followed with any luminous appearance, gradually retreating below the horizon, in that direction, with decreasing brightness; which is commonly the case. At this period, a few scattered clouds, proceeding rapidly from SW., had already crossed the magnetic meridian, near the horizon, although the south wind had not yet been perceived at the surface of the earth. Next day it stood in that quarter, bringing a great body of the turgid cloud, peculiarly dense, compacted, and low; and the former tempestuous weather again ensued.

It may here be remarked, that, on the 16th, the stormy weather had been much felt on the coast of Ayrshire, proceeding from NW., followed with a severe storm of thunder and lightning.

The following remarks seem necessary to illustrate this remarkable aurora.

1. The streams, or spears of light, were uniformly projected downwards, from an immense elevation; in this particular bearing a resemblance to the usual appearance of the larger shooting-stars, or those nearest the observer. The colour of *their* light is also similar, and they coincide in being most brilliant at the expanded or lower portion; where, in each, the rapidity of projection, emulating the glance of thought, seems to be arrested in the act of dissolution, when they gradually disappear. The shooting-stars are the more evanescent, and frequently more brilliant. The shape of the diminishing swells, exhibited at the period of dissipation, indicate that this meteor is of the spheroidal form. On some occasions, also, their exit takes place beyond the verge of the horizon, or is concealed by the vapours interposed in that direction. The expiring blaze is by these means concealed; but the course of the meteor appears much more extended, in proportion to the distance of that course from the zenith.

2. The difference in the colour and intensity of the light of this aurora, from right to left, bore a resemblance to that of the moon, when near the horizon, compared with her light at a greater elevation. The cause may be found in the incipient change, on the lower atmosphere, which had commenced on the south or south-west, with the wind from that quarter.

3. A luminous undulation seemed to traverse, by fits, different portions of the lengthened congeries of luminous forms, which, less or more developed, appear to constitute the grand arch. For some time this undulation was uniformly from right to left. Towards the close it occurred repeatedly in the contrary direction. A very short observation was sufficient to satisfy me that no undulation takes place. It is merely the effect of a strong light behind the line under view, and concealed thereby,—passing to and fro, to right or left, it successively imparts an increased luminosity, of different intensities, which, being transmitted in succession, through the various and varying forms of the front line, produces an appearance of undulation. The posterior light may easily be detected, passing the less perfect portions of the front line; for here the expression of an un-

dulation disappears, and the play of the remote streams of light is brought directly to the eye.

The resemblance of an immense vibrating curtain was readily suggested by the form of the front line of the arch, when most irregular, and particularly when the posterior lights, in frequent motion, combined their efforts with the various flitting motions of the front. But I do not apprehend any lateral motion of these luminous rays. I conceive that what appears to be motion, is merely an effect of the vertical projection of circular screens in lateral succession; the deception being aided by the great rapidity, and the distance and indistinctness of the operations. It seems quite possible that the front-swells of the principal or chiefly stationary arch, concealed similar curtained extensions on the same plane. As a counterpart, the second arch becoming broader and brighter than the first, covered a great portion of it longitudinally, and concealed the star. Thereafter the succession of advanced lights, already described, reappeared in front of the western half.

4. As the aurora borealis and the shooting star stand connected with changeable weather, or, at least, with extensive transposition of masses, or strata of the atmosphere; and, as the aurora has, by continued observation, been connected with a change of current, in the region of the lower clouds, often extending to the earth, whereby the south-west or equatorial currents displace those from the north-east, without disturbance of the strata occupying more serene altitudes; it would seem very possible that the different states of electricity in the contiguous strata, might dispose to equalization, in the form of the aurora, or, under other circumstances of transposition of strata, in that of the shooting-star.

5. After the aurora of the 16th had disappeared, a thin reticulated cloudy tissue could be discerned, of seemingly great elevation. But the actual height of the higher tiers of clouds, viewed by moon-light, is not easily estimated. The splendour and peculiar light of this aurora, opposed to a brilliant moon, afforded no point of comparison whereby to estimate its elevation, although it appeared most provokingly near. For the nature of its light seemed quite distinct from that of any of the heavenly bodies; and what it wanted of intensity, seemed to

be supplied by proximity, although defective in point of radiance. But its position relatively to the star, and the relation of its extremities to the earth, combined with its apparent length, may possibly afford some criteria. Its nebulous, evanescent accompaniments, were too circumscribed to offer any certain data. They may have been thin clouds, illuminated by the aurora, which seems to be corroborated by the fact, that only the most southerly and lowest portions were accompanied with them, and this only under their lower extremities. Their forms seemed to bear relation to the position and intensity of the lights, in the absence of which they would have been invisible.

At whatever altitude the aurora makes its appearance, it in general gradually retires in the direction of north-west, until it descends below the horizon, which is commonly accomplished by 11 P. M. In proportion as the horizontal distance is increased, the longitudinal extent of the meteor is contracted. In the Arctic Regions, when the aurora presents a continuous arch, it is a small segment, in this particular resembling the arch described by the clouds of that region, which, in the winter at least, is comparatively low, and the aurora also is perceptibly low in proportion,—which circumstances combine in producing an appearance of radiation, with divergent rays.

The singular and very striking aurora noticed on a former occasion, as occurring here, in March 1825, was not without parallel. I have since learned that Professor Hallström of Abo, had observed similar black rays. The sketch 3. of Plate IV. may assist to form an idea of it. And it may be permitted to account for their appearance on possible principles. Thus the stratum of clouds often formed immediately above that which, on that occasion, was interposed as a dark screen betwixt the eye and the lower portion of the northern regions of the heavens, is very fertile of detached turgid clouds, which seldom move with rapidity. Over that screen of continuous clouds, the aurora light was brilliant, proceeding from a quarter depressed below its margin, and illuminating its superior edge; all below, with the intervening landscape, being involved in pitchy darkness. Suppose a few of these detached masses of cloud to be extended, from right to left, at various distances behind the screen, it is certain that the light beyond them would project their shadows in a pyramidal form, provided the light were sufficiently broad and extensive; and that these shadows would appear on the verge of the screen of dark cloud, provided that it, the detached clouds, and the aurora lights, were upon the same plane, and within certain distances of each other. It remains to account for the irregular and sometimes huddling motion of the dark rays, at times stationary. But this exactly corresponds to the lights proceeding from an aurora in full play; and particularly it corresponds with what has been termed a luminous undulation in extended lines of aurora.

That aurora was accompanied with a luminous arch of great apparent altitude passing through the zenith, stationary nearly two hours, and gradually disappearing with the aurora. It had none of that effulgence which the aurora often exhibits; but a soft whiteness, resembling the appearance of some kinds of cloud, a feature common to similar arches. Towards the close, it appeared to be broken into fasciculi, which traversed it at acute angles, and which were not strongly defined. Similar arches have been observed in different places, at the same instant, appearing in the zenith of each, and apparently much more elevated than the more fixed portions of any aurora. Are they to be viewed as the reflexion of the light of those auroras with which they are accompanied, proceeding from a thin stratum of cloudy tissue?

Overland Arctic Expedition.

WE have learned, with much satisfaction, that dispatches have reached his Majesty's government from Captain Franklin, announcing the safe return of the expedition, commanded by that able and enterprising officer, to the winter quarters at Bear Lake, after exploring the coast of the Arctic Sea to the extent of thirty-six degrees of longitude.

The expedition, consisting of Captain Franklin, Lieutenant Bach, Dr Richardson, and Mr Kendall, with twenty-four men, (of whom twenty were British, two Canadians, and two Esquimaux), left Bear Lake towards the end of June 1826, in four small row-boats, and descended the Mackenzie in company until the 3d of July, when Captain Franklin detached Dr Richardson and Mr Kendall, with a party, in two of the boats named the Dolphin and Union, to survey the coast to the eastward; while he himself, with Lieutenant Bach, and the remainder of the expedition, directed his course to the westward.

They reached the sea on the 7th of July; on the 9th they were stopped by a compact field of ice adhering to the shore, and the remainder of the month was spent in pushing the boats through the partial openings formed in the ice. Their progress in this way was not only tedious and hazardous, but also extremely laborious; nor, from the nature of the coast, was the danger diminished, when, in the month of August, the ice gave way, and afforded them a passage. The approach to the shore was so difficult from the shallowness of the water, that they could seldom get nearer than a mile or two, even by dragging the boats through the mud; and only once were they able to effect a landing on the main shore after passing the 139th degree of longitude. On all other occasions they were obliged, when in need of repose or shelter, to have recourse to the naked, sandy, or gravelly reefs which skirt the coast. On these cheerless banks they were detained by frequent storms, and dense fogs, one of which lasted eight days;—and they occasionally suffered from the want of fresh water, having once passed forty-eight hours without that needful refreshment. Notwithstanding these formidable obstacles, such was the zeal and perseverance of the adventurers, that, by the 18th of August, they attained nearly the 150th degree of longitude, after having been carried by the trending of the coast beyond 70½ degrees of north latitude.

They were now nearer to Icy Cape than to the Mackenzie, and whether Captain Franklin advanced or turned back, the difficulties and dangers were numerous. Since their arrival on the coast the party had made the utmost exertions for forty-two days in getting thus far; they had reason to fear that the stormy weather would become more frequent as the short and precarious summer of that climate drew to a close, and that the navigation of the sea would not continue practicable for their small open boats above a fortnight, or at the very utmost for three weeks longer. The Blossom was appointed to meet the expedition in Behring's Straits, and all the skill and perseverance of an accomplished British seaman were exerted by

Captain Beechy, the commander of that vessel, to reach the rendezvous; but Captain Franklin had already extended his voyage as far as prudence, supported by courage, could warrant. To have continued it beyond this period, along an unknown coast, in quest of a passage to the appointed place of meeting with Captain Beechy, would have been rashness. It remained therefore only to return by the outward route, of which the dangers were lessened by being known. By the end of August they reached the mouth of the Mackenzie, after having encountered heavy gales of wind on the passage, and arrived at Bear Lake on the 21st of September.—The inhabitants of the coast are numerous, and we understand that, on the voyage out, the boats having grounded on a shoal, upwards of 250 Esquimaux, arming themselves with large knives, rushed into the water, attempted to carry off the stores, and even threatened to destroy the whole party. The cool bravery evinced by the expedition, deterred them from putting their threat into execution, and the judicious measures of the commanding officer, ably seconded by the courage and conduct of Mr Bach and the boats' crews, ultimately rescued every thing of importance from the hands of these freebooters, without any personal injury having been sustained on either side. Other meditated attacks, both of Esquimaux and Mountain Indians, were frustrated with equal good fortune. Previous to the return of the expedition, however, the Esquimaux were drawing towards the mouth of the Mackenzie, with the view of assembling a large force there; and had it been detained by the weather, or any other accident, above two days longer on the coast, it could scarcely have escaped without a conflict.

The eastern detachment under Dr Richardson and Mr Kendall succeeded in surveying the coast between the Mackenzie and the Coppermine, having, in the prosecution of their voyage, doubled Cape Bathurst in lat. 70° 37′ N, long. 126° 52′ W, and entered George the Fourth's Coronation Gulf, by a strait, which led them nearly two degrees of longitude to the eastward of the Coppermine. They quitted their boats near the mouth of that river, and, by travelling overland, reached the establishment at Bear Lake on the 1st of September.

Much credit is due to Captain Franklin for the judicious arrangements that enabled him to complete with safety this extensive survey of the Arctic coast. Only eleven degrees of longitude remain unknown to the westward of the Mackenzie, and the discoveries of Captain Parry interlink with those of Captain Franklin to the eastward, so that the complete knowledge of the North-west Passage has been nearly attained. This has been an object of British enterprise for three centuries, and the discoveries that have been made by expeditions equipped expressly for that purpose, from the voyage of Sebastian Cabot in 1496, downwards, have not only contributed to raise the naval fame of England to the proud pre-eminence it has attained, but have given rise in the New World to some of the most remarkable establishments recorded in the history of mankind, and produced a lasting influence on the affairs of the Old.

A Tour to the South of France and the Pyrenees in the year 1825. By G. A. Walker Arnott, Esq. F.R.S.E. F.L.S. M.W.S. &c. (Continued from p. 164.)

On the 31st May we set off in the diligence for Barcelona, and, passing by Bellegarde, the frontier town of France, and La Jonquiere, that of Spain, in each of which we were visited by the customhouse officers, we slept at Girona. The fortress of Figueras lies between this and the frontier, and was in possession of the French army of occupation: there we had breakfast, and saw for the first time the Catalonian mode of drinking. A glass jar, shaped like an urn or a coffee-pot, or, in lieu of such, a small wooden barrel, is furnished with two openings: the one is wide, and placed where the handle usually is, opposite to the spout, which is long, straight, and tapered to a fine point. Through the former the liquor is poured into the vessel; through the latter it is poured into the mouth. Much more cleanliness is certainly shown by drinking in this way, than that all should put their mouth to the same pot, as is done frequently in other countries. In Catalonia, one holds the jar as high up as he can, and, by inclining it, a continuous but slender stream reaches his mouth. The difficulty at first is as much to continue to swallow, while the stream is constant, as to lead the stream to the mouth; but sufficient address is soon acquired. The next day we arrived at Barcelona.

On all the route, we took every opportunity, whether owing to bad roads, hills to ascend, or a change of horses, to get out of the diligence, and separate to the right and left, in order to examine the vegetation of the country. Our principal success was in the woods of Granita, and along the sea-shore from Pinede to Barcelona. Between Las Caldas and La Granita, we gathered *Helianthemum tuberaria*, *Cistus florentinus*, and a *Euphorbia*, perhaps a remarkable purplish variety of *E. verrucosa.* All the wastes there might be truly termed heaths; for, as in Scotland, whole hills were chiefly covered with species of *Erica;* and we observed *E. scoparia* and *arborea* among the number. The latter part of the road was interesting on many accounts: the number and size of the towns and villages on the coast,—the cleanness and even elegance of the dress of the peasantry, and the general appearance of ease and health,—form a complete contrast with the universal desolation, the disgusting filth, and the degraded state of the inhabitants, that one meets in the interior. As far as regards the natural productions, the fine climate of the coast of Catalonia gives to them a vigour unknown even in the south of France. The *Agave Americana* planted here along the road-sides as hedge-rows, flowers at the ninth or tenth year, whereas at Perpignan it flowers so very seldom, as to bear the appellation of "the plant that flowers as often as an Englishman smiles." At the time we passed through Catalonia, the scapes of this plant were still young; few exceeded twelve or fifteen feet, and the pedicles not being developed, they presented the appearance of gigantic shoots of asparagus. In some favourable situations they were much higher, and resembled at a distance the masts of ships: they frequently, I was informed, attain twenty-five or thirty feet, and all that in the course of a week or ten days. Notwithstanding this rapidity of vegetation, the scape is harder than oak, bidding defiance to the sharp edges of the strong knives we used for cutting down plants. Different species of *Cactus* or Indian Fig, forming thick bushes four or six feet high, displayed their splendid yellow and red blossoms in the utmost profusion:

these also serve as hedges; the cattle do not dislike the young shoots, and the old plants serve as fuel to heat the bakers' ovens. Few plants deserve so well as these the application of the Scottish motto, "*Nemo me impune lacesset*," as they are covered with an infinity of tufts of minute bristles, sharper than needles, and barbed backwards. The state of the fields shew that much more dependence is put on the favours of nature than on the efforts of art. The olive, the carob tree, the vines, and the corn crops, were almost always mixed so closely together, as to impress the idea, that, if any one of them afforded a good return, it was owing to the strength of vegetation alone.

The day after our arrival (the 2d June) was the *Fête Dieu.* Such peasants as were in town were all neatly dressed, and most of the men wore the red Catalonian bonnet. In the evening, we took our places to see the procession. As I believe this was nearly the same as in Italy, there is no occasion for me to describe it in detail. I shall merely remark, that the first that made their appearance amidst the thunder of the artillery, were two enormous puppets, representing a giant and giantess, about twelve or fifteen feet high, supported, of course, on the shoulders of men concealed within their dress: behind them came a man on an ass, beating a kettle-drum, and then a band of military music. This scene was intended to represent the flight of the pagans before the true religion. It was, however, unhappily executed, as the two figures were in no haste, but every now and then stopped, and danced for about a minute to the sound of the music. Nor do the Barcelona ladies think that these pagans are a bad sort of people, as the giantess gives out the fashion for the female dress for the ensuing twelvemonth. The streets were lined by the military, who, as well as the multitude present, fell on their knees, when the canopy containing the last symbol, that of the body and blood of our Saviour, made its appearance. This had certainly a fine effect, and a great show of devotion; but the charm was speedily broken. Scarcely was the symbol past, when all order and regularity were ended: they had seen all they wished,—confusion was the order of the day,—every one jostled his neighbour, and endeavoured to reach his home as quickly as possible. Flowers of the Spanish broom, or *Spartium junceum*, were scattered from the windows on the crowds beneath, during the whole of the procession, the meaning of which I did not well ascertain.

We remained four days at Barcelona, during which we made two short botanical excursions. The one around Mont Jouy was very successful. We met with *Lotus ornithopodioides* and *edulis*, *Atractylis cancellata*, *Stachys hirta*, *Helianthemum brevipes*, and some others. The Carob tree (*Ceratonia siliqua*), which at Montpellier is almost a green-house plant, grows here to an enormous size: it was now in fruit. On Mont Jouy itself, I observed several curious lizards, particularly the *Gecko fascicularis:* this animal is supposed, with some reason, to be what is translated " Spider" in the Old Testament (Prov. xxx. 28.); and it is somewhat worthy of remark, that its Italian name *Tarantala*, is that also of the large poisonous spider.

Our second excursion was of less consequence: we merely traversed the cultivated grounds towards Sarria. We, however, observed *Cyperus rotundus*, *Lactuca tenerrima*, and *Anthyllis tetraphyllis*, in tolerable abundance. All the fields of beans round Barcelona, and I believe I may say the same in general terms of Catalonia, were infested with the *Orobanche pruinosa**, Lapeyr. A yellow species also grows on them, but more sparingly, and appears to be a mere variety of the other. *Schismus marginatus* grew plentifully on the ramparts of the town.

The limits we were obliged to place to our residence in this part of the country, prevented us from visiting Mont Serrat. This mountain, however curious on many accounts, ought to be examined by every botanist who goes to Barcelona: three or four days additional will suffice. From what I could learn, it would be no imprudent plan previously to insure his life, as the mountain, during the Spanish troubles, has been made the head-quarters of some bands of banditti, who know how to put in practice the adage, that " dead men tell no tales." Should one feel no inclination to go there, or have but a day or two to spend at Barcelona, the most proper places for botanizing are along the coast: the interior being always in cultivation, must be less rich in indigenous plants.

* Is not this the same with *O. crenata*, Forsk.?

Barcelona is situated in the midst of an extensive cultivated plain; scarcely does there appear an elevation higher than the walls any where in it, excepting the fortress of Mont Jouy, which rises up steep on all sides close to the town. This plain is bounded by a range of hills on the north, west and south, at about five or ten miles distance. There are some fine public walks within the walls; but the principal one is the Rambla, similar to the Boulevards at Paris, and is every evening covered from seven or eight until ten o'clock by beaux and belles, who come there to enjoy the cool air, after the heat of the day. The houses are neat, built of stone or brick, and painted over a brown smoky colour, on which is delineated figures of people, or other devices. The town is stored with churches and monasteries; and there are, I believe, six colleges, and as many hospitals, in one of which there is a cabinet of natural history. The Custom-house has a façade of stucco, in imitation of marble, and is a very fine building; but the Exchange is much more magnificent, the balusters and rail of the staircase being of finely polished marble. In an upper room was an exhibition of paintings, chiefly done by the students, but scarcely worth the seeing. There was here exposed a drawing of a plant that has hung suspended from a wire out of a window for several years, without receiving any nourishment but what it receives from the atmosphere: it bore the name of *Amalia aërisincola*.

Barcelona possesses a small botanical garden, to which is attached a professorship, occupied at present by Dr Bahi (after whom Lagasca has named his genus *Bahia*), an able physician, and newly returned to Barcelona, after three years of persecution that he has suffered under the different governments that have succeeded each other in Spain. Having been the first to declare that the disease that made here such ravages in 1822 was the yellow fever, he drew upon himself the enmity of the merchants of every class, who saw that their projects were to be injured by the measures taken to prevent contagion. Accused of servility under the constitutional regime, and of liberalism under the present government, he was obliged to conceal himself for a long time among the mountains in the interior; and it was but lately he obtained permission to return to Barcelona, to recommence his profession. The garden, which has neither enjoyed the advantages of a zealous botanist nor of a grant of money to defray the expences, has been almost allowed to go to wreck during the political dissensions; the wages even of the gardener not having been paid for two or three years. Scarcely does there remain five hundred species; but among these are the *Schinus molle*, *Varronia alnifolia*, *Cæsalpinia sappan*, *Acacia longifolia* and *horrida*, *Physalis aristata*, and some other species cultivated in our hot-houses, scarcely above the rank of shrubs, but which here in the open air attained a considerable magnitude *. We saw here the *Amalia aërisincola*: it has hung out of the window, we were informed, for fifteen or twenty years, and still bears its flowers every summer. We advised Dr Bahi to put it in earth for a season, as by that means it would become much stronger, and

* In this garden we met with *Helianthemum croceum* of Dunal and Lagasca. As this species is much confused with *H. glaucum*, perhaps the following observations, made, in December 1825, with Professor De Candolle's permission, on his herbarium, may be of use. 1. In this herbarium there is a specimen of *H. glaucum* from Lagasca, with the note " *Cistus glaucus*, Cav. Ic. 3, t. 261, absque dubio, collatum cum specimine originali," presented to M. Decandolle in 1819: This specimen has the calyx almost woolly; the hairs are white, and not very rigid, and are distributed almost entirely on the somewhat prominent nerves: this was recognised by Dunal as his var. α.—2. The var. β. of Dunal differs solely by the hairs on the nerves of the calyx being very rigid, or rather hispid. In both these varieties the leaves are well described in the " Prodromus."—3. *H. croceum*, Desf. Two specimens of this exist in Professor De Candolle's herbarium, both given by Desfontaines, and these shew that the figure in the " Flora Atlantica" is by no means correct. The calyx is in reality furnished with long hispid hairs on the very prominent nerves; moreover, the whole calyx and the hairs are of a brownish-yellow colour: the upper leaves are broadly lanceolate, and somewhat acute: the fruit is pubescent, as in *H. glaucum*. The *H. croceum*, Desf. I therefore consider a mere variety of *H. glaucum*, Cav. As a variety, however, it is distinguished from the two mentioned by Dunal, by the colour of the calyx and the hairs of it, as well as by the yellowish hue of the whole plant, and the croceous petals.—4. *H. croceum*, Dun. in De Candolle's Prodromus, is another question. Though pretty well represented by the figure in the " Flora Atlantica," it neither agrees with the above mentioned specimen given by Desfontaines of his *H. croceum*, nor with his description. The calyx is, as Dunal describes it, hoary and pubescent, but not hispid: it is the *H. croceum* given by Lagasca to De Candolle, and is apparently, from the localities attached, extremely common in the South of Spain. The specimens we gathered in the garden of Barcelona had the petals yellow, and not of a saffron colour, as the name imports.

suffer dividing at the root; but he was, determined it should support the specific name he had conferred on it. It appears to be a *Tillandsia* from South America: the flowers are blue, and it is probably a described species. No climate in Europe is more healthy, and more equal than that of Barcelona; none so well adapted for the establishment of a botanic garden on a grand scale, if the government of that unfortunate and degraded country were of a nature to permit a distinguished botanist to exercise there his talents, or had sufficient liberality to give him the necessary funds for such a purpose.

(To be continued.)

On the Theory of the Diurnal Variation of the Needle. By S. H. Christie, Esq. F. R. S.*

Mr Christie having been led to doubt the validity of the moving easterly variation adopted by Canton, but, at the same time, having observed that the changes in direction and intensity appear always to have reference to the position of the sun, with regard to the magnetic meridian, was led to connect these phenomena with Professor Seebeck's discovery of thermo-magnetism, and Professor Cumming's subsequent experiments; and to refer the phenomena of diurnal variation to the effect of partial heating, modified, perhaps, by that of rotation, and by peculiar influence in the sun's rays.

In support of this opinion, he cites passages from papers by Professor Cumming and Dr Trail, who appear to have been impressed with a similar idea. But in place of looking to the stony strata of which the earth's surface consists, as the elements of the thermo-magnetic apparatus which this doctrine requires, the author regards them as rather consisting of the atmosphere, and the surfaces of land and water with which it is in contact. Thermo-magnetic phenomena, he remarks, have hitherto only been observed in metallic combinations; but this may be owing merely to the small scale on which our experiments are conducted.

* The above is a brief account of an interesting memoir read lately before the Royal Society of London.

To put to the test of experiment whether thermo-magnetism could be excited when the surfaces of two metals, instead of touching at one point, were in symmetrical contact throughout, the author first employed a compound ring of bismuth and copper, the copper outwards; and he found, that, to whatever point heat was applied, magnetic powers were developed; a needle being affected differently according to the different positions in which the ring was placed with regard to it. After a lapse of two years from this first experiment, the author resumed the inquiry with an apparatus consisting of a flat ring of copper, having its inner circumferences grooved and united firmly, by soldering and fusion, to a plate of bismuth, cast within it; the whole forming a circular plate, twelve inches in diameter, weighing 119 ounces Troy, which was made to revolve in its own plane.

Heat was applied by a lamp to a given point in the circumference of this plate, and a delicately suspended needle partly neutralized, was placed near it, and the deviations observed in all positions of the heated point, which was made to revolve, the lamp being withdrawn. These experiments led him to conclude, that the effect of so heating a portion of the circumference, was to create a temporary polarity in the plate, the law of which he explains. He then details a set of experiments, by which he was convinced, that a uniformity of action obtained to whatever part of the circumference the heat was applied. He next instituted a series of observations for determining the laws which govern the magnetic phenomena, resulting from the application of heat as above described; the results of which are stated in the form of tables.

Four poles appear to be produced, two north and two south, the two north both lying in one semicircle, and the south in the other, but not in alternate quadrants, and all of them lying rather nearer to the center than the line of junction of the two metals. The experiments were pursued in a variety of positions of the plate, with respect to the meridian and horizon, and with a similar general result.

From these experiments the author concludes, that uniformity of junction of the two surfaces of a thermo-magnetic combination, is no obstacle to the developement of transient polarity. Regarding the earth and its atmosphere as such a combination, and limiting our views to the intertropical zone alone, we should have two magnetic poles produced on the northern, and two on the southern sides of the Equator, the poles of opposite names being diametrically opposite to each other.

To apply this to the earth, it is necessary to know the times of greatest heat in the twenty-four hours: this may be assumed at three o'clock in the afternoon. The apparatus used by the author not affording, when adjusted to the latitude of the place, sufficient magnetic power to render the effects distinct, he substituted for it artificial imitation, consisting of two magnets, six inches long, so placed with respect to a revolving axis parallel to the axis of the earth, as to imitate the position of the poles produced by thermo-magnetism in his plate, and making the apparatus revolve round this axis, he noticed the deviations produced thereby on a compass, placed horizontally over it. These deviations he then compares at length, with those actually observed, 1*st*, by Lieutenant Hood, in 1821, at Fort Enterprize, lat. 64° 28′ N.; 2*dly*, by Canton, in London, in 1759; 3*dly*, by Lieutenant Foster, at Port Bowen, in 1825; 4*thly*, by Colonel Beaufoy, on Bushy Heath, in 1820. The results of this comparison are, on the whole, generally such as to indicate a conformity between the hypothesis and fact, with the exception of some deviations from the exact times of maximum and minimum variation, which could not but be expected.

The author then considers the manner in which the distribution of land and sea over the globe modifies the point of greatest heat, and, in consequence, the place of the diurnal poles. He next observes, that, at the commencement of the experiments, he had no idea of being able to reduce the deviations of the needle to so simple a law as that resulting from a polarity, in a particular direction, communicated to the plate; but that he considered it of the greatest consequence to ascertain whether the deviations on the outer edge of his plate had the same general character with those within, at the time of junction of the metals; since these situations of the needle would correspond to great elevations in the atmosphere, and points near the earth's surface respectively, the character of the deviations turns out to be the same in both cases, so that, in this respect, the hypothesis, so far as is known, agrees with observation.

One general effect of some experiments, with a hollow copper shell filled with bismuth, afforded a striking correspondence with nature. The whole equator being heated, and one part more than the rest, he uniformly found that the elevated pole being towards the north, the north end of the needle deviated when the place of heat was on the meridian above the horizon, and south when below, which is precisely the character of the diurnal variation in north latitudes.

Account of Mr Crawford's Mission to Ava.

OUR friend, and former pupil, the distinguished author of the History of the Indian Archipelago, Mr Crawford, was some time ago sent by the Governor-General of India, as envoy to the court of Ava. The following account of the mission, from the Calcutta *Government Gazette* of 1st March last, we are confident, will be read with interest by the general reader, and also by the natural historian.

"THE mission left Rangoon on the 1st September, and reached Henzada on the 8th. Here we were received with much polite attention by the future Viceroy of Pegu, who has the rank of a wũngyi, or counsellor, the highest enjoyed by a subject. He was very solicitous, however, to prevent our going further, intimating that he was himself vested with full powers to treat with us upon every possible subject.

"He had no opportunity, however, of exercising his plenipotentiary powers upon the present occasion, for the mission, disregarding his pretensions, on the afternoon of the 10th quitted Henzada, and on the afternoon of the 14th, a few miles beyond Myanaong, or Loonzay, entered the hilly region, which is the proper geographical boundary of the Burman race—all to the south being the Delta, or *debouchement* of the Irawadi, and the true country of the Peguans or Talains.

"Pursuing our journey with hills now pressing down to the river on both sides, and which struck us at the time as peculiarly picturesque and beautiful, after passing through the long tiresome champain of the Delta of the Irawadi, we reached Prome on the evening of the 15th. This is one of the largest towns in the Burman empire, and appeared to be not less populous than Rangoon. The inhabitants, since the war, had returned to their homes—the place was in a good measure restored, and although it had been long the head-quarters of the British army, there was now no re-action or persecution. All this bore favourable testimony to the moderation of the Myowũn, or governor, whom we found an extremely respectable man.

"We left Prome on the 17th, and on the 20th reached Patnagoh and Melloon, the scene of the conferences in December 1825, which led to the first treaty, which was never ratified, or even transmitted for ratification, a breach of engagement for which the Burmese received signal castigation on the spot.

"On the 21st we left those places, and on the 22d reached Renangyoung, or the 'Fetid Oil-brooks,'—in other words, the Petroleum Wells. In the afternoon we visited the wells, and the remarkable and sterile country which surrounds them, abounding every where with fossil remains of one of the last great changes which the globe has undergone.

"On the 23d we left Renangyoung, and in the course of the forenoon passed Senbegyoung, from which leads the best road from Aracan, and by which Major Ross and a battalion of sepoys proceeded in the month of March last*.

"On the morning of the 24th we reached Pugan, and staid there for that day, and part of the following, examining the curious antiquities of this place, the most remarkable in the Burman dominions, and the extensive ruins of which, if such evidence were not too well known to be delusory, might lead to the supposition, that in former ages the Burmese were a people more powerful and civilized than we now find them.

"On the 27th we passed the confluence of the Kyendween and the Irawadi. The prospect afforded by their junction is far from imposing. Both rivers are here confined to a narrow bed, and the tongue of land which divides them is so low, and covered with reeds, that it may easily be mistaken for an island, and consequently the smaller river to be only a branch of the larger.

"The prospect hitherto presented, in a route little less than 400 miles, was that of a country imperfectly cultivated and inhabited, and by far the greatest part of which was covered with a deep forest, or with tall reeds and grass, among which there was scarcely any evidence of culture or occupation. We were now, however, within 50 miles of the capital, and the scene began greatly to improve: the country became level, the nearest ranges of hills to the east being at least 30 miles distant, and the Aracan mountains, to the west, not less than 50 in the nearest part, and 60 or 70 in the distant. The villages and cultivation had increased considerably; but neither here nor any where else did we see evidence of a dense population or active industry.

"At two o'clock in the afternoon we passed Yandabū, where the treaty was dictated to the Burmans, and sailed within a stone's throw of the great tree where Sir A. Campbell's tent was pitched, and the conferences were held.

"On the afternoon of the 28th we reached Rapatong, a village on the east bank of the river: this was the spot at which the Burmese contemplated making their last effort, had the British army not been arrested in its progress by the treaty of Yandabū. Here they were encamped, under the old chief Kaulen Mengyi, the whole disposable force not exceeding 1000 men, and the greater number of these consisting, not of soldiers, but of the personal retainers and menial servants of the chiefs. Two forced marches would have carried Sir A. Campbell to Ava, on a good high road, with nothing to resist him but the dispirited fugitives just mentioned. In the evening we reached Kyaktalon, twelve miles from Ava. A short way before coming to that place, a deputation, headed by a secretary of the Lotoo, met us, to compliment us on our arrival, and usher us into the capital.

"On the morning of the 29th we left Kyaktalon. After we had proceeded

* See an account of this journey *Asiat. Journ.* vol. xxiii. p. 14.

a few miles, an order from the court arrived, requesting that we might stop where we were, as it was the intention to send down a deputation of persons of superior rank to conduct us. The promised deputation, consisting of a woonduck and three saredaugyis *, accordingly came, and on the morning of the 30th we arrived at the capital, anchoring about two miles below the city, opposite to the place appointed for our temporary residence. Thousands flocked down to the bank of the river, out of curiosity to see the steam-vessel. A similar curiosity was displayed every where else on our journey, nearly the whole population of towns and villages turning out to see her.

" On landing, we were received with ceremonious politeness by a Wūngyi and Atwenwūn, the two highest classes of officers under the Burmese government. These were the individuals who had negociated and signed the treaty of Yandabū. The politeness which dictated the selection of these two individuals was obvious.

" Our audience, under various pretexts, was put off from day to day, until the 21st of October. In the mean while we were treated with attention. The expences of the whole mission were paid, and we were put under no other constraint than that of not being permitted to enter the walls of the town, a liberty which would have been contrary to established etiquette. Meanwhile the negociation had commenced, and on the 13th, 14th, and 15th, we were present, by special invitation, at the annual display of boat races, which take place yearly, when the waters of the Irawadi begin to fall. The King and Queen, with the princes and nobility, were all present. The splendour of this pageant far exceeded our expectation, and would have made a figure in the Arabian Nights' Entertainments, as one of the good things got up by virtue of Aladdin's Lamp.

" The period chosen for our presentation was that of one of the annual festivals, when the tributaries, princes, and nobility, offer presents to his Majesty, and their wives to the Queen.

" Boats were sent for our accommodation, and about 10 o'clock in the forenoon we reached the front of the palace. An elephant was appropriated to each of the English gentlemen, and the procession moved on, until arriving at the Ring-dau, or hall of justice, which is to the east side of the palace, where we were detained for nearly three hours, to afford us an opportunity of admiring the pomp and magnificence of the Burmese court, but, above all, to afford the court an opportunity of displaying it.

" At that place the whole court, with the exception of his Majesty, passed in review before us, beginning with the officers of lowest rank, and ending with the princes of the blood. The courtiers were in their dresses of ceremony, and each chief was accompanied by a numerous retinue, besides elephants and horses. The retainers of Menzagyi, the Queen's brother, the most powerful chief about the court, could not have been fewer than 300.

" We were at length summoned into the royal presence. The etiquette insisted upon with Colonel Symes seemed not to have escaped the recollection of the Burman officers, and they would have us to practise the same ceremonies he had been necessitated to submit to; but times had changed. These ceremonies consisted in making repeated obeisances to the walls of the palace,

* Principal secretaries.

and in walking barefooted, or at least without shoes, across the court-yard. All this we peremptorily refused, although the officers who led the procession shewed us a very good example, in prostrating themselves repeatedly, by throwing their bodies upon the bare ground. Upon reaching the bottom of the stairs, leading to the hall of audience, we voluntarily took off our shoes, passed through the long hall, and seated ourselves in front of the throne. His Majesty did not keep us long waiting. After a hymn had been chaunted by a band of brahmins in white, he made his appearance, upon the opening of a folding door behind the throne, and mounted the steps which led to the latter briskly. He was in his richest dress of state, wore a crown, and held in his hand the tail of a Thibet cow, which is one of the Burman regalia, and takes the place of a sceptre.

"He was no sooner seated than her Majesty, who, whether on public or private occasions, is inseparable from him, presented herself in a dress equally rich with his, and more fantastic. Both had on a load of rich jewels. She seated herself on his Majesty's right hand. She was immediately followed by the Princess, their only child, a girl about five years of age. Upon the appearance of the King and Queen, the courtiers humbly prostrated themselves. The English gentlemen made a bow to each, touching the forehead with the right hand. The first thing done was to read a list of certain offerings made by the King to some temples of celebrity at the capital. The reason for doing this was assigned. The temples in question were said to contain relics of Guatama, to be representatives of his divinity, and therefore fit objects of worship. His Majesty having thus discharged his religious obligations, received, in his turn, the devotions and homage of the princes and chiefs.

"The King did not address a word in person to the officers of the mission, but an atwenwoon, or privy-councillor, read a short list of questions, as if coming from the King. These, as far as I can recollect, were as follows:—

"'Are the King and Queen of England, their sons and daughters, and all the nobility of the kingdom, well?

"'Have the seasons been of late years propitious in England?

"'How long have you been on your voyage from India to this place?' &c.

Betel, tobacco, and pickled tea, were after this presented to the English gentlemen; a mark of attention shewn to no one else. They afterwards received each a small ruby, a silk dress, and some lackered boxes. This being over, and a few titles bestowed and proclaimed throughout the hall, the King and Queen retired, the courtiers prostrating themselves as when they entered. Their Majesties had sat in all about three-quarters of an hour. The Burman court, upon the present occasion, appeared in all the pomp and splendour of which it is capable, and the spectacle was certainly not a little imposing. The princes and nobility were in their court dresses, of purple velvet, with a profusion of lace and gold. The hall of audience is a gorgeous and elegant apartment, supported by ninety-six pillars, and the whole is one blaze of rich gilding.

"In going through the court-yard, the white elephant and some other royal curiosities were shewn to us, and we stopped for a moment to see an exhibition of tumblers, buffoons, and dancing girls.

" After the audience, the gentlemen of the mission were occupied for several successive days in paying visits to the heir apparent, the Prince of Sarrawadi, the Dowager Queen, and the Queen's brother. By all these personages they were received with marked politeness and attention. The ladies presented themselves on these occasions as well as the men. There was no reserve in respect to the fair sex.

" The negotiation was then renewed, and on the 23d of November, besides settling some points respecting frontiers, a short treaty of commerce of four articles was concluded.

" The mission continued at the Burman capital in all about two months and a half, and quitted it on the 12th of December, after being honoured with two audiences of his Majesty; the one on occasion of catching a wild elephant, and the other on that of weaning a young one, favourite diversions of the King. On the occasions in question, his Majesty threw off all reserve, and conversed freely and familiarly with our countrymen. On the day of departure, presents were sent for the governor-general, and each of the English gentlemen received a title of nobility.

" The Irawadi, which, swollen by the periodical rains, was deep and broad in coming up, was found in descending to have fallen from twenty to thirty feet; and the navigation consequently proved extremely intricate and tedious. The steam-vessel was in all aground fifteen days, and frequently ran the risk of being totally lost. The voyage to Rangoon occupied thirty-five days, which, in a small boat suited for the river, ought to have been performed in ten. At Pugan, about eighty miles below Ava, the mission was for the first time informed of the insurrection of the Talains. At Henzada and Donabew the inhabitants were seen flying from the seat of insurrection. The insurgents were first seen at Paulang. This place, where the river is not above sixty yards broad, was strongly stockaded in three places, and the Talains were seen standing to their arms. The steam-vessel came-to for a few moments to request a safe passage for the baggage and boats which were behind, and for the boats of some merchants which accompanied them, amounting in all to about twenty-two. Boats put off immediately, and the Talains came on board without the least hesitation. They were full of friendly professions, and requested only our neutrality. Our visitors saluted us in the manner of English sepoys, standing up. This, they said, was the positive order of his Talain Majesty, who declared he would permit no one henceforth to crouch in his presence, or that of any other chief. They also boasted that they treated their prisoners after the English fashion, that is to say, disarmed them and set them at liberty, without offering them any personal violence. They claimed the greater merit for this, on account of the conduct observed by the Burmans towards them, who, they alleged, put all their prisoners to death, or, as they expressed it, ' divided them into three parts.'

" On the morning of the 17th the mission reached Rangoon. The Burman flag was seen flying on one side of the river, and the Talain on the other, not 600 yards asunder. The town of Rangoon was invested on all sides by the Talains, and the suburbs had been burnt to the ground. We had hardly been at anchor half an hour, and were engaged in reading our letters and newspapers, when the garrison made a sortie, and an action took place, reckoned the most considerable since the commencement of the insurrection. On both sides it was paltry and contemptible to the last degree. The Talains, in one place, caught sleeping or cooking, fled to their boats, and were soon seen crossing the river in great numbers. At another post, between the town and the great pagoda, they were more vigilant, and easily repulsed a feeble and cowardly attack made by the Burmans.

"On the 23d the mission left Rangoon, and in less than four and twenty hours reached the new settlement of Amherst, in the harbour of which we found lying the Company's ships, *Investigator* and *Ternate*, and a large fleet of gun-boats. To these in a few days were added the large merchant ships *Almorah*, *Felicitas*, and *Bombay Merchant*, with two trading brigs and some schooners. This was a curious spectacle, in a harbour which was not known to exist ten months ago. The settlement contains from 1,600 to 1,700 inhabitants. Maulemhyeng, the military cantonment, twenty-seven miles further up the river, contains twice this number, chiefly camp followers. Neither of them had a single inhabitant a few months back, but, on the contrary, were covered with a thick forest. This fine country already produces some of the necessaries and comforts of European life, in a degree which, under all circumstances, is remarkable. Fowls are to be had in abundance for five rupees per dozen; a milch buffalo and calf for fifteen rupees: fish is in abundance, and of excellent quality: the best kinds are the calcop, the large mullet, and the mangoe-fish. It is curious that this last is found in plenty, both in the rivers of Rangoon and of Marttban, with roes, for nine months of the year, or from December to August inclusive; whereas in the Hooghly, three months is the utmost limit of their season.

"On the 26th, the mission proceeded to Maulemhyeng, and on the 28th ascended the Ataran river in the steam-vessel. This stream, which is deep and free from danger, might be navigated for fifty miles up by vessels of 300 to 400 tons burthen. It leads to teak forests, distant about seventy-five miles, inexhaustible in quantity, and of the largest scantling.

"On the 8th of February, the ship *Bombay Merchant* having been taken up for the accommodation of the mission, the members embarked that evening, and on the following morning sailed for Calcutta.

"The following is a very brief sketch of what has been observed by the mission in the department or science of statistics. In the departments of mineralogy and geology, it is to be regretted, that no scientific observer accompanied the mission. Our party, however, were assiduous collectors, and the collection brought back is so extensive, that it would afford men of science a very tolerable notion of the mineralogical and geological constitution of the countries which were visited. From between the latitude of 15° and 16°, to between that of 18° and 19°, is a low alluvial country, forming the *debouchement* of the Irawadi river. Here not a mountain or a stone is to be found, except in a very few places, such as Rangoon and Syriam, where a little cellular clay iron-ore presents itself in low hills. In about lat. 18° 30′ we quit the Delta of the Irawadi, the native country of the Talain race, and enter at once into a hilly region, which extends almost all the way to Ava, or to about the lat. of 21° 50′. The Irawadi, in all this course, is skirted by hills of from about 300 to 500 feet high. The lowest portion of these is composed of breccia, calcareous sandstone, cellular clay iron-ore, with beds of sand and clay; and the highest of blue mountain limestone. The lowest portions are alluvial, and highly interesting to the geologist. The gentlemen of the mission discovered in these abundance of sea-shells, with fossil wood and bones. Among the latter are the bones of the fossil elephant, or mammoth, fossil rhinoceros, various ruminant animals, alligators, and tortoises. An immense collection of these has been brought round for the government. Some of the bones are of great size, and all completely petrified. There are among them the teeth, and such other portions of the skeleton as will enable the experienced naturalist to determine the genera and species to which they belonged. These were obtained close to the celebrated petroleum wells. From their great induration, and having been little rolled, they are, generally, in a very perfect state. The bones, as well as the fossil-wood, are found superficially in gravel, the same situation in which similar diluvian or antediluvian remains have been found in other quarters of the globe.

" The ranges of mountains to the E. and N. of Ava, as far as twenty miles, and those close to the city, on the western bank of the river, are all of marble, and this of many varieties. The white statuary marble, some of which is very beautiful, is brought forty miles down the river, from a mountain on its eastern bank.

" The great ranges of mountains, dividing the Burman dominions from Arracan on one side, and Siam on another, are reasonably supposed to be primitive. In the last direction, the roots of these seem to extend to the new settlement of Amherst, where we find granite, quartz, and mica slate. Some continuous low ranges, in the Martaban district, are composed entirely of quartz rock. Blue mountain limestone is a frequent formation in the same district, from which lime of much purity is manufactured. Detached rocks of this substance are scattered over the plains. These rise abruptly and perpendicularly to the height of from 300 to 500 feet, and in one place to 1,500. They contain some spacious caves, which have been converted into places of worship. One of these rocks is so remarkable, that it deserves particular mention. Its perpendicular wall confines the Ataran for several hundred yards on its right bank. About its middle it is penetrated by a branch of the river, which flows quite through it by a magnificent arch. This is a highly picturesque object.

Neither the proper Burman nor Talain country appears to be rich in metallic ores, with the exception of those of iron, tin, and antimony. The principal consumption of the country in iron is supplied from the great mountain of Poupa, on the eastern side of the Irawadi, and near the latitude of 21°. Lao, the country of the Shans, as it is denominated by the Burmans, is on the contrary, extremely prolific in metals. The singular passion of the Burmans for the study of alchemy, has brought collections of the ores of Lao into the market of Ava, and this circumstance enabled the gentlemen to make collections of them. The ores thus obtained consisted of those of iron, silver, lead, copper, and antimony. The Shans possess the art of smelting all these, and bring them in their metallic state into the market of Ava. The silver ores in the Burman dominions are, however, wrought to the greatest advantage by the Chinese. The mines exist about twelve days' journey to the NE. of Bamoo, towards the Chinese frontier.

"The celebrated sapphire and ruby mines which have always afforded, and still continue to afford, the finest gems of this description in the world, are above five days' journey from Ava, in a direction ESE., and at two places called Mo-gaot and Kyat-pyan. The different varieties of sapphire, both in their crystallized and rough state, and the matrix, or rather gravel, in which they are found, were seen, examined, and collections made. In these mines are found the following gems or stones: the red sapphire or oriental ruby, the oriental sapphire, the white, the yellow, the green, the opalescent, the amethyst and girasol sapphires, the spinel ruby, and the common corundum, or adamantine spar, in large quantities.

"The oriental ruby, perfect in regard to water, colour, and freedom from flaws, is scarce and high-priced even at Ava. The blue sapphire is more common, and cheaper; one specimen exhibited to us weighed 951 carats, but it was not perfect. The red sapphire never approached this magnitude. The other varieties are all rare, and not much esteemed by the Burmans, with the exception of the girasol sapphire, of which we saw two or three very fine specimens, and the green sapphire or oriental emerald, which is very rare. The king makes claim to every ruby or sapphire beyond 100 ticals value; but the claim is one not easy to enforce. The miners, to avoid this sage law, break the stones when they find them, so that each fragment may not exceed the prescribed value. His Majesty last year got but one large ruby; this weighed about 140 grains avoirdupois, and was considered a remarkable stone. Sapphires and rubies form a considerable article of the exports of the Chinese, who are the cleverest people in the world in evading the absurd fiscal laws made by themselves and others. The use they put them to is that of decorating the caps of their mandarins, or nobility. Precious serpentine is another product of the Burman empire, which the Chinese export to a larger value.

"The gentlemen of the mission examined carefully the celebrated Petroleum Wells, near which they remained for eight days, owing to the accident of the steam-vessel taking the ground in their vicinity. Some of the wells are from 37 to 53 fathoms in depth, and are said to yield at an average daily from 130 to 185 gallons of the earth-oil. The wells are scattered over an area of about sixteen square miles. The wells are private property, the owners paying a tax of five per cent. of the produce to the state.

"This commodity is almost universally used by the Burmans as lamp-oil. Its price on the spot does not, on an average, exceed from 5d. to 7½d. per cwt. The other useful mineral or saline productions of the Burman empire are coal, saltpetre, soda, and culinary salt. One of the lakes affording the latter, which is within six or seven miles of the capital, was examined by the gentlemen of the mission.

"The success of the mission has been the completest in the department of botany. This will readily occur to readers when they recollect the talent, zeal, industry, and skill of the gentleman at the head of this branch of inquiry. Dr Wallich has been left behind at Amherst, to complete his inquiry into the resources of the valuable forests of that and the neighbouring districts. Until this be effected, the full extent of his successful researches cannot be known. The number of species collected by him amounted, when the mission left him at Amherst, to about 16,000, of which 500 and upwards are new and undescribed. Among these last may be mentioned seven species of oak, two species of walnuts, a rose, three willows, a raspberry, and a pear; several plants discovered by him are so remarkable, as to constitute themselves new genera. Among the latter may be mentioned one which has been called *Amherstia*, in compliment to the Lady Amherst. This constitutes, probably, the most beautiful and noble plant of the Indian *Flora*. Two trees of it only are known to exist, and these are found in the gardens of a monastery on the banks of the Salwen. The number of specimens brought to Calcutta amount to little less than 18,000, among which are many beautiful live plants for the Botanical Garden, chiefly of the orchideous, scitamineous, and liliaceous families. Dr Wallich, when at Ava, obtained permission of the Burmese government to prosecute his botanical researches on the mountains about twenty miles from Ava. In these, which are from 3000 to 4000 feet high, he spent eight days, and brought from them some of the finest parts of his collection. These mountains contain several plants which are common to them with the Himalaya chain, but the greater part of their *Flora* is rare and curious. The botany of the new provinces to the south is considered to be highly novel and interesting, combining, in a great degree, the characters of the *Floras* of continental India and the Malayan countries.

"In economical botany a good deal has been effected. The tree producing the celebrated varnish has been discovered and described, and the process of extracting and using the varnish observed. The different mimosas producing catechu have also been determined, and the processes for extracting the drug observed. The localities of the different teak forests throughout the Burman empire, as well as the quality and price of the timber, have been ascertained. The valuable forests of this tree, discovered in our recent cessions, were upon the point of being minutely explored by Dr Wallich. Lieut. Scotland, under the instructions of Sir A. Campbell, had, just before the arrival of the mission at Amherst, made a journey by land to the Siamese frontier, in the course of which he passed through two teak forests, towards the source of the Ataran river. The largest of these was five miles in breadth, and scarcely contained any other tree than teak, many of which measured from eighteen to nineteen feet in circumference.

"One of the oaks already mentioned, and which grows to a large size, is found in great abundance, close to the new settlement of Amherst; and should it prove a valuable timber, which is most probable, it may be obtained with every facility. A fine durable timber, called by the Burmans *thingan*, and which they place next to the teak, or almost on an equality with it, is found every where throughout the new provinces. Dr Wallich has ascertained this to be the *Hopea odorata* of Roxburgh. Another valuable timber, the uses of which are well known in our Indian arsenals and timber yards, the soondree, *Herietera robusta*, is found largely in the maritime parts of the Martaban district, and of a size much exceeding what is brought from the Sunderbunds of the Ganges. Of these woods, and many others in use amongst the natives, although as yet unknown to us, specimens will be brought to Bengal by Dr Wallich, for the purpose of subjecting their qualities to rigid experiment.

"In the department of zoology, if we except the fossil bones already described, the inquiries of the gentlemen of the mission have not been so successful. The features of the animal kingdom, indeed, differ much less from those of Hindostan than the vegetable. Still there is, no doubt, much room for discovery, when the countries are leisurely explored by experienced naturalists. In the Martaban provinces, the forests of which teem with the elephant, the rhinoceros, the wild baffaloo, ox, and deer, a new species of the latter is believed to exist. In the upper provinces a species of mole-rat is very frequent, and thought to be an undescribed animal. Some of the officers of our army imagined that they had ascertained the existence of the jackall and fox in the upper provinces of the Burman empire, but this seems to be a mistake. It is a singular fact, that neither these animals, nor the wolf, hyena, nor any other of the genus *canis* is found there, with the exception of one animal, which is yet undescribed, and the howl of which it was that was mistaken for that of the jackall. The feline tribe, especially the larger species, are but rare in the upper provinces of the Burman empire, but too frequent in the lower. The night before we left Maulamhyeng, a tiger was shot in the heart of the cantonment, by a party of officers who lay in wait for him. Two or three of the smaller species of this family, found in Martaban and Pegu, are thought to be as yet unknown to naturalists. In Martaban, two new species of pheasant have been found, of which living specimens have been sent to Calcutta. The celebrated elephant must not be forgotten. At Ava there is but one Albino elephant; this, a male of about twenty-five years of age, was repeatedly seen and examined by the gentlemen of the mission; and his Majesty has made a present to the Governor-General of a drawing of the animal in its state caparison, which is no bad specimen of Burman art.

"As connected with this department, may be mentioned the existence at Ava of a man covered from head to foot with hair, whose history is not less remarkable than that of the celebrated porcupine man, who excited so much curiosity in England, and other parts of Europe, near a century ago. The hair on the face of this singular being, the ears included, is shaggy, and about eight inches long. On the breast and shoulders it is from four to five. It is singular that the teeth of this individual are defective in number, the molares, or grinders, being entirely wanting. This person is a native of the Shan country or Lao, and from the banks of the upper portion of the Saluen or Martaban river: he was presented to the King of Ava, as a curiosity, by the prince of that country. At Ava he married a pretty Burmese woman, by whom he has two daughters; the eldest resembles her mother, the youngest is covered with hair like her father, only that it is white or fair, whereas his is now brown or black, having, however, been fair when a child, like that of the infant. With the exceptions mentioned, both the father and his child are perfectly well-formed, and indeed, for the Burman race, rather handsome. The whole family were sent by the King to the residence of the mission, where drawings and descriptions of them were taken. Albinos occur, now and then, among the Burmese, as among other races of men. We saw two examples; one of these, a young man of twenty, was born of Burmese parents. They were ashamed of him, and considering him little better than a European, they made him over to the Portuguese clergyman. The reverend father, in due course, made him a christian.

"With respect to the literature and language of the Burmans, the mission was placed, in many respects, under very favourable auspices. One of the members of it, Dr Judson, had acquired a knowledge of both far exceeding what any other European had ever done before him. Vocabularies have been collected of some of the numerous dialects spoken within the Burman dominions, and which, in all, are not fewer than eighteen in number. Of the books which have been brought from Ava by the mission, may be mentioned a collection sent by the King to the Governor-General; among other works which this collection contains, is a Pali dictionary and grammar, with Burman translations, and some histories of Gautama, or Budd'ha, highly esteemed by the Burmans.

" Burman history, such as it is, has been investigated with some success, and chronological tables of its principal events, true or alleged, been procured. These tables go as far back as 543 B.C. The first monarchs are said to have come from India, that is, from Magadha or Bahar, and to have fixed the seat of their government at Prome, where it continued for 336 years. Traces of the walls of the ancient capital are still to be seen a few miles distant from the modern town. The seat of government was afterwards transferred to Pugan, in the year of Christ 107, where it continued for more than twelve centuries. Hence the wonderful extent of the ruins of that capital. In 1322 the seat of government was transferred to Sakaing, and in 1364 to Ava, when it continued for 369 years, or until the capture of the place by the Talains. Alompra, or Alaong-Bura (one that expects to be a Budd'ha), made his native town, Monzaba (Motsobo) the capital of the empire in 1752. His descendants, by a silly and superstitious caprice, have been shifting the capital ever since. One of his sons removed it to Sakaing, another to Ava, another to Amerapura, and his present Majesty to Ava again, in 1822. Each of these barbarous changes was nearly equivalent to the destruction of a whole city. From the foundation of the monarchy to the present time, there have reigned 128 kings, which gives an average of something more than seventeen years to a reign.

" Of relics of antiquity far more have been discovered than might have been expected to exist from previous accounts. The most remarkable are to be seen at Pugan, Sakaing, Sanku, and Angl-e-ywa. The mission had an opportunity of examining those of the two first, which consist of temples and inscriptions. The most remakable by far are the ruins of Pugan, which extend for twelve miles along the eastern bank of the Irawadi, and to a depth of five or six. Many of the temples are still entire, and exhibit a style of architecture, and a superiority, both in building and materials, which far excel the present efforts of the Burmans. In one of the old temples at this place we found, to our surprise, images in stone, of braminical origin. These were figures of Vishnu, Siva, and Hanuman. Near another temple was discovered a small but neat and perfect inscription in the Deva Nagari. At Pugan we discovered not less than sixty inscriptions on sandstone; and including Sakaing and other places, we found in all not less than 330. In one place alone, the great temple of the Arracan image, near Amerapura, the late king had collected from various parts of the country no less than 260 such monuments. A few of these are on fine white marble, but the greater number upon sandstone. In form, the stones resemble the tomb-stones placed at the head of graves in an

English church-yard. Some are in the round Pali character, and others in the Burman; but the greater number in the former. They all contain dates, and generally the name of the reigning king, with references to some historical event; but the chief object is to commemorate the founding of some temple or monastery. Translations of several of these inscriptions have been effected, and good drawings made of some of the most striking of the ancient temples. Information, in considerable detail, has been obtained respecting the condition of manufacturing and agricultural industry amongst the Burmans, the state of landed tenures, the wages of labour, the price of food, and the rate of population. Barbarous as the Burmans must be admitted to be, in comparison with the Hindus, the Chinese, the Persians, and the Arabs, they have still some advantages over these nations, the natural result of the frame of society among them. The population is thinly scattered over an immense tract of fruitful country; the most fertile lands are so abundant that every man may have as much to cultivate as he chooses to occupy; food is low priced; labour highly rewarded. The people are easy in their circumstances, as far as mere food, clothing, and dwelling are concerned, and there is much equality amongst them; for if there be some rich, there are none very poor, and there is scarcely any beggary. These natural advantages are far more than counterbalanced by the possession of a government lawless and despotic, and from the oppression of which, the poverty of its subjects is their best protection. No man must here presume to be rich. If he acquire wealth, it is at the peril of becoming a prey to the harpies of government. Sooner or later he will get into trouble, and his property must be ultimately swallowed up in those sweeping confiscations which extinguish every germ of prosperity in the country.

"The population and resources of the Burman empire seem to have been greatly exaggerated. The inhabitants have been reckoned at 17,000,000 at 19,000,000, and even at 33,000,000. Let any one accustomed to consider such matters, look at the country along the banks of the Irawadi, from the sea to Ava, a course of 500 miles, the best part of the kingdom; he will then see that the greater portion of it is covered with primeval forest, without vestige of present or former culture, and he will be convinced of the utter improbability of such exorbitant estimates.

"The following fact will convey a better notion of the true state of population and improvement than any yet before the public. The three towns of Ava, Amerapura, and Sakaing, with the districts annexed to them, contain an area of 283 square miles, and constitute by far the best cultivated and most populous portions of the empire. It is nearly exempt from taxation, being favoured through ancient and established usage, at the expense of the rest of the country. It contains, according to the public registers, 50,600 houses, and each house is estimated to have seven inhabitants, which makes their total population only 354,200. Ava itself certainly does not contain ,00 0 inhabitants; and in population, wealth, industry, and trade, is greatly below the capital of Siam. The other large towns of the Burman empire, such as Rangoon, Prome, Monchabu, Monay, &c. which are not above a dozen in number, do not any of them contain above 10,000 inhabitants. The population of Rangoon was ascertained by an actual census in our own time, and found to amount only to between 8,000 and 9,000. It used formerly to be estimated s high as 30,000.

Account of a new Calceolaria, and of Nepenthes distillatoria, mas. which have lately flowered in the Royal Botanic Garden, Edinburgh. Communicated by Dr Graham.

Calceolaria purpurea. *10th September* 1827.

C. *purpurea;* herbacea, caulibus pluribus, erectis, ramosis; foliis venoso-rugosis, hispidis, radicalibus cuneato-spathulatis, serratis, postice integerrimis, petiolatis, subacutis, cauliniis cordatis, decussatis, superioribus minoribus integerrimis; Corymbis terminalibus, multifloris.

Description.—*Stems*, many from the same root, erect, pubescent. *Root-leaves* spathulato-cuneate, somewhat acute, with a strong middle rib, veined, wrinkled, with a few long, scattered hairs on their surface; *stem-leaves* cordate, broad, decussating, more wrinkled than the root leaves, uppermost pair nearly smooth, and quite entire. *Corymbs* terminal; *bracteæ* 2, ovate, at the base of the corymb; *pedicels* numerous, slightly bent, filiform. *Calyx*, segments ovate, pubescent. *Corolla* rather small, of uniform reddish-violet colour, upper lip nearly half the size of the lower, which is doubly furrowed.

The seeds were received in December 1826 from Mr Cruckshanks, who collected them on the Cordilleras. The habit of the plant is quite that of *Calceolaria corymbosa*, next which it should be placed, and it seems to require the same treatment. It flowered at the Royal Botanic Garden, Edinburgh, in the beginning of August 1827.

Nepenthes distillatoria.—Mas.

N. *distillatoria;* caule suffruticoso, subramoso, cirrhis scandenti; foliis sparsis, oblongo-lanceolatis, petiolatis, aveniis, decurrentibus, ascidiis subventricosis; racemis oppositifoliis, prope summos ramorum, subsimplicibus.

Description.—*Stem* eight feet high, round, below slender and somewhat woody, above twice as thick, and more herbaceous, branching. *Buds* small, and placed above the axils of the leaves, many of them abortive. *Leaves* entire, channelled, undulated, glabrous, scattered, 1–1½ feet long, exclusive of the cirrhus, but including the petiole, along which they are broadly decurrent, and which is about 3 inches long, half stem clasping, and decurrent half-way to the next leaf below, veinless, or veins only obscurely seen, and not prominent, on either side till dry, after which several slender veins and nerves are observed, nearly parallel to the middle rib, and reticulated with transverse veins: middle rib strong, prominent behind, drawn out into a *cirrhus* from 10 to 12 inches long, flattened on its upper side, and convolute in the middle, enabling the plant to climb, from this point somewhat thickened and turned down, having at its extremity an erect *pitcher*, which is wedge-shaped behind when young, afterwards in its lower half obscurely conical, above this contracted a little, and nearly cylindrical, its mouth oblique, with a rounded, regularly and transversely wrinkled edge, and a round lid connected by its posterior margin to the highest portion of the oblique mouth, where alone the wrinkled edge of the pitcher is interrupted. The outer edge of this border is revolute after the lid rises, but before this is erect, and passes within the sides of the lid, which at that time are folded down. Diameter of the lid from back to front is 2 inches, transversely it is 2¼ inches. Two prominent and curved ribs (between which, and also between them and the edges, the lid, otherwise flat, is somewhat depressed) run on its upper surface from the base towards its anterior edge, and from the point of their union at the base, is projected a small awl-shaped spur, and along the back of the pitcher a nerve, which becomes less prominent towards the extremity of the cirrhus. Along the front of the pitcher are two prominent ribs, extended from the edges of the flattened surface of the cirrhus: these are more prominent than the nerve on the back, and more or less completely flatten the pitcher on its anterior surface, which is the heel of the wedge in its young state. *Lid* at first closed, afterwards raised to about a right angle with the oblique opening of the pitcher, and is never again closed. Before the opening of the lid, rather more than a drachm of limpid fluid was formed within each of the largest pitchers on our specimen. This had a subacid taste, which increased after the rising of the lid, when the fluid slowly evaporated. My friend Dr Turner perceived it to emit, while boiling, an odour like baked apples, from containing a trace of vegetable matter, and he found it to yield minute crystals of superoxalate of potash, on being slowly evaporated to dryness. The pitcher whose contents Dr Turner analysed was a large one, it had not opened, and the whole fluid weighed only 66 grains. The upper part of the pitcher decays first; and the line at which this is observed, is often quite defined. Our largest pitchers measure 6½ inches from the highest part of the oblique mouth to the lowest part of the curvature at their base; the greatest circumference 4¼ inches. *Flowers* diœcious. Perfume offensive, resembling in kind, though less in degree, that of the *Lilium pomponium*. *Raceme* solitary, opposite to a leaf near the extremity of the branch; its extremity nodding, till the flowers expand in succession, when it is elongated, and becomes erect. *Peduncle* round, about 2¼ feet long, of which about 11 inches at the base is without flowers; *pedicels* round, ½–¾ inch long, clustered irregularly, and frequently bifid supporting two flowers, having a small subulate bractea on the lower side near the base, and sometimes the appearance of an abortive one opposite and nearer the flower. *Calyx* 4-parted, spreading or slightly divaricated; *segments* blunt, coriaceous, concave, and containing honey, green within when first opened, afterwards red in the middle; two opposite segments slightly overlap the two others in the bud. *Anthers* numerous, collected into a capitulum on the top of a hollow club-shaped pedicel, formed by the united filaments; *pollen* an abundant yellow powder. The middle rib of the leaf, the cirrhus, the whole outside of the pitcher when young, but its ribs chiefly when old; the peduncle, pedicels, every part of the calyx which is exposed in the bud, and a narrow triangular space extending upwards from the axil of the leaf to the bud, which it includes, are covered with a rusty pubescence; every other part of the plant is smooth. The whole is green except the lower part of the stem, which is brown; but the leaves, at first darkest above, become yellow in fading, and there is a tendency in them, and in almost every other part of the plant, to become red, particularly in the lid, and especially its under side, which uniformly acquires a deep red somewhat mottled colour, though at first it is quite green.

This plant is certainly the same species as the female specimen figured from the collection of Messrs Loddiges in Botanical Cabinet, t. 1017., under the name of *N. destillatoria*, and in Bot. Mag. t. 2629. under the name of *N. Phyllamphora*. The seeds from which they sprung were, I believe, introduced from Ceylon at the same time. What Linnæus meant by his *N. destillatoria*, does not certainly appear, for he refers to the *Cantharifera* of Rumphius's Herbarium Amboinense, v. 5. t. 59. f. 2., and to the *Pandura Zeylanica* of Burmann's Thesaurus Zeylanicus, t. 17., —figures of plants which differ altogether from each other, as the first, at least, does from the subject of the present article. If any conclusion could be drawn from the bad figures of Pluckenetius and Grimm, to which reference is also made by Linnæus, I should believe that these also differed from each other, and those quoted alongst with them, as they certainly do from the present species. Our plant differs from the description of *Phyllamphora* of Loureiro in the stem being branched, the leaves veinless, and scattered, the inflorescence a lateral raceme, in which the pedicels are frequently bifid, supporting two flowers, and in the anthers being more numerous. In Loureiro's plant, the stem is described as simple, the leaves lineato-veined and opposite, the inflorescence a terminal, perfectly simple spike. Our plant, however, has only produced two branches besides the leading shoot; and this tendency may possibly have been given by its top having been injured several months ago. The universality of the buds in the axils of the leaves, however, makes me believe in the branching being natural. Near the extremity of each of the three shoots, a raceme is produced. Our plant farther differs from Loureiro's description, in the lid never closing after it once opens; but the power of alternate opening and closing, even in his plant, was probably imaginary, as his statement of the pitchers receiving the night dews certainly is. The fluid which they contain is undoubtedly a secretion, but for what purpose does not appear. It is stated to have nearly filled one-third of the pitcher in Messrs Loddiges plant; but with us it never much exceeded a drachm, even in the largest pitchers, whose capacity was three ounces five drachms. The outline figure in Bot. Mag. t. 2629. is very good; but the detached pitcher is much too contracted in its upper half, and the lid is not nearly so flat as it always is after it has been fully opened. The site of the two large nerves is occupied by prominent wings, and the base is bent exactly in the opposite direction from that which it takes in the outline figure, and in the specimen which I have described. We have two plants which scarcely yet exceed the size of seedlings, in which these wings, strongly ciliated, are present; and, as in the detached pitcher, t. 2629. their pitchers are so bent at the base that the cirrhus passes between the wings. It is probable, therefore, that these appearances are peculiar to plants which have not yet advanced to maturity. The youngest pitcher on the large plant has the same relative situation to its cirrhus that the oldest has, and the same absence of wings. In Rumphius's figure, the position of the pitchers is always, as in the detached pitcher of the Magazine. The imperfect figure given by Ammannus of his *Bandura Zingalensium* in Miscell. Curios. Ann. prim. decur. 2. t. 13., seems to approach nearly to the present species.

The *N. distillatoria* of Linnæus is quoted by Lamarck under *N. indica*, and, notwithstanding some difference in the description, I believe this (*N. indica*) to be our species, though reference is made from it to Plukenetius, Ammannus, Burmann, and Rumphius, to the last indeed with doubt. Where a change of name has become necessary, it is an evil which must be endured, but as no necessity appears to exist here, I retain that by which our plant was universally known, at least in this country.

Our specimen has been constantly kept in the stove, and now produces a very striking effect, by supporting itself on the adjoining plants, and hanging from them its pitchers. It gives off suckers, but not freely, a circumstance remarked in the female plant by Mr Loddiges. Mr Macnab has succeeded in propagating two plants in this way.

Celestial Phenomena from October 1. 1827 *to January* 1. 1828, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Aberdeen.

The times are inserted according to the Civil reckoning, the day beginning at midnight. —The Conjunctions of the Moon with the Stars are given in *Right Ascension.*

OCTOBER.

D.	H.	′	″		D.	H.	′	″	
3.	10	57	50	☌ ♀ γ ♍	9.	14	0	13	☌ ♀ ϑ ♍
5.	1	54	6	○ Full Moon.	10.	4	33	19	☌ ♂ σ ♌
5.	9	37	35	☌ ☽ ι ♓	13.	0	50	23	☾ Last Quarter.
7.	10	29	30	Sup. ☌ ☉ ♀	13.	3	4	55	☌ ☽ ♄
7.	16	7	10	☌ ☿ ♃	14.	20	17	15	☌ ☽ 1 α ♋
9.	10	28	43	☌ ☽ ι ♉	14.	21	21	6	☌ ☽ 2 α ♋

OCTOBER.

D.	H.	′	″	
*16.	1	24	28	☌ ♀ ♃
16.	3	50	8	☌ ☽ π ♌
18.	1	57	0	☌ ☽ ♂
18.	3	48	35	☌ ☽ υ ♌
18.	22	44	25	☌ ☉ ♃
20.	13	13	25	☌ ☽ ♃
20.	15	19	28	● New Moon.
20.	21	54	12	☌ ☽ ♀
21.	5	9	17	☌ ☽ λ ♍
21.	18	44	28	☌ ☽ 2 α ♎
21.	22	30	27	☌ ☽ ☿
22.	11	30	58	☌ ☽ 4 ζ ♎
22.	21	18	32	☌ ♂ β ♍
23.	0	49	57	☌ ☽ 1 β ♏
23.	0	51	16	☌ ☽ 2 β ♏
23.	3	20	13	☌ ☽ ν ♏
24.	4	20	7	☉ enters ♏
24.	6	24	28	☌ ♀ λ ♍
26.	18	45	44	☌ ☽ ♅
27.	6	39	21	☌ ☽ β ♑
27.	9	19	23	☽ First Quarter.
30.	18	56	54	☌ ♀ 2 α ♎

* The Geocentric Conjunction will take place in Longitude 204° 9′ 22″
Æ in time, - 13h 31′ 2″

Decl. { ♀ 8° 23′ 27″ ; ♃ 8 22 51 } South.

NOVEMBER.

D.	H.	′	″	
1.	16	58	55	☌ ☽ ε ♓
2.	2	34	4	☌ ☽ ρ ♏
3.	16	44	44	○ Full Moon.
4.	16	50	13	☌ ♂ η ♍
5.	18	19	47	☌ ☽ ε ♉
7.	11	33	25	☌ ☽ ♄
7.	20	44	53	☌ ☿ α ♏
9.	22	15	12	☌ ♀ κ ♎
10.				☿ greatest elong.
11.	4	34	4	☌ ☽ 1 α ♋
11.	5	39	2	☌ ☽ 2 α ♋
11.	20	30	26	☾ Last Quarter.
12.	3	3	14	☌ ♀ λ ♎
12.	12	39	32	☌ ☽ π ♌
14.	10	53	41	☌ ♀ 1 β ♏
14.	11	10	21	☌ ♀ 2 β ♏
14.	13	34	16	☌ ☽ υ ♌
15.	20	3	29	☌ ☽ ♂
16.	16	50	28	☌ ☽ α ♍
17.	7	13	25	Em. III. sat. ♃
17.	9	43	44	☌ ☽ ♃
17.	15	24	27	☌ ☽ λ ♍
18.	6	51	9	☌ ☽ 2 α ♎
18.	22	28	12	☌ ♀ α ♏
19.	2	51	29	● New Moon.
19.	21	25	28	☌ ☽ ♀
20.	10	55	27	☌ ☽ ☿
23.	0	47	17	☉ enters ♐
23.	2	44	27	☌ ☽ ♅
23.	13	1	7	☌ ☽ β ♑
24.	11	10	45	Em. III. sat. ♃
24.	19	18	49	☌ ☿ ♀
25.	17	52	33	☽ First Quarter.
26.	12	56	30	☌ ♂ θ ♍
28.	17	34	49	☌ ♀ θ Oph.
28.	22	53	52	☌ ☽ ε ♓
29.	13	4	36	☌ ♀ B Oph.
30.	1	30	–	Inf. ☌ ☉ ☿

DECEMBER.

D.	H.	′	″	
3.	1	31	10	☌ ☽ ε ♉
3.	2	23	38	☌ ♂ α ♍
3.	6	26	23	Im. I. sat. ♃
3.	7	32	20	☌ ♃ λ ♍
3.	10	27	28	○ Full Moon.
5.	0	20	4	☌ ♂ ν ♍
6.	16	31	18	☌ ☽ ♄
7.	11	14	48	☌ ☿ 2 β ♏
7.	11	21	30	☌ ☿ 1 β ♏
8.	11	45	25	☌ ☽ 1 α ♋
8.	12	50	48	☌ ☽ 2 α ♋
9.	5	6	31	Im. II. sat. ♃

DECEMBER.

D.	H. ′ ″		D.	H. ′ ″	
9.	10 11 5	☌ ☽ ο ♌	17.	1 28 0	☌ ☽ ☿
9.	20 15 6	☌ ☽ π ♌	17.	12 6 48	☌ ♀ ο ♐
10.	17 57 50	☌ ♀ λ ♐	18.	13 49 15	● New Moon.
11.	15 3 31	☾ Last Quarter.	19.	4 42 1	Im. I. sat. ♃
11.	22 17 34	☌ ☽ υ ♌	19.	20 32 41	☌ ☽ ♀
13.	0 44 20	☌ ☿ 1 β ♏	20.		☿ greatest elong.
13.	0 47 20	☌ ☿ 2 β ♏	20.	14 11 19	☌ ☽ ♅
14.	3 3 11	☌ ☽ α ♍	20.	22 3 35	☌ ☽ β ♑
14.	13 26 34	☌ ☽ ♂	22.	13 29 43	☉ enters ♑
15.	2 7 46	☌ ☽ λ ♍	25.	5 33 27	☽ First Quarter.
15.	5 41 20	☌ ☽ ♃	26.	4 30 55	☌ ☽ ε ♓
15.	13 29 44	☌ ♀ 1 ν ♐	26.	6 35 33	Im. I. sat. ♃
15.	15 48 48	☌ ☽ 2 α ♎	26.	7 16 29	☌ ♂ λ ♍
15.	17 19 20	☌ ☿ ν ♏	29.	4 36 27	☌ ♀ ♅
16.	8 28 57	☌ ☽ 4 ζ ♎	30.	4 43 43	Im. III. sat. ♃
16.	21 33 37	☌ ☽ 1 β ♏	30.	6 50 30	☌ ☿ ρ Oph.
16.	21 34 53	☌ ☽ 2 β ♏	30.	6 56 48	Em. III. sat. ♃
16.	23 59 49	☌ ☽ ν ♏	30.	7 47 49	☌ ☽ ε ♉

Times of the Planets passing the Meridian.

OCTOBER.

D.	Mercury. H. ′	Venus. H. ′	Mars. H. ′	Jupiter. H. ′	Saturn. H. ′	Georgian. H. ′
1	12 10	11 42	10 14	12 42	6 46	19 6
5	12 18	11 48	10 8	12 30	6 32	18 50
10	12 28	11 52	9 59	12 13	6 13	18 31
15	12 37	11 56	9 52	11 59	5 54	18 11
20	12 46	11 59	9 44	11 42	5 35	17 52
25	12 55	12 3	9 36	11 26	5 16	17 32

NOVEMBER.

D.	Mercury. H. ′	Venus. H. ′	Mars. H. ′	Jupiter. H. ′	Saturn. H. ′	Georgian. H. ′
1	13 7	12 10	9 25	11 5	4 51	17 6
5	13 12	12 14	9 17	10 53	4 33	16 50
10	13 16	12 19	9 9	10 36	4 13	16 31
15	13 15	12 26	9 1	10 21	3 54	16 12
20	13 2	12 32	8 53	10 5	3 33	15 54
25	12 34	12 39	8 44	9 49	3 10	15 35

DECEMBER.

D.	Mercury. H. ′	Venus. H. ′	Mars. H. ′	Jupiter. H. ′	Saturn. H. ′	Georgian. H. ′
1	11 51	12 48	8 34	9 31	2 47	15 12
5	11 8	12 55	8 28	9 20	2 31	14 57
10	10 41	13 3	8 20	9 2	2 11	14 38
15	10 28	13 10	8 11	8 45	1 49	14 18
20	10 27	13 18	8 4	8 30	1 28	14 1
25	10 31	13 25	7 55	8 13	1 7	13 42

On the 3d of November, there will be an Eclipse of the Moon, which will be *partly visible:*

		D.	H.	′	″
The Eclipse begins,	-	Nov. 3.	15	0	40.6
Moon rises eclipsed,	-	-	16	6	40
Middle,	-	-	16	38	47.9
Ecliptic opposition,	-	-	16	44	43.8
End of the Eclipse,	-	-	18	16	54.6

Digits eclipsed, 10 dig. 30′ 20″.9, on the north part of the Moon's disk, or from the south side of the Earth's shadow.

SCIENTIFIC INTELLIGENCE.

METEOROLOGY.

1. *Squalls of Wind on the African Shores.*—It is well known that on the African shore violent squalls of wind and rain are very often met with by ships on the coast. They are almost always accompanied by the most vivid electrical phenomena; and though perhaps less dangerous in their effects than the thunder storms which occur in colder climates, exhibit appearances vastly more magnificent. The following particulars I have heard my father relate frequently concerning these squalls; and their connection with some of the recent discoveries in electricity will at once be perceived. The approach of the squall is generally foreboded by the appearance of jet black clouds over the land, moving in a direction towards the sea, at the same time that a gentle breeze blows towards the shore. In these circumstances, the precautions which my father usually adopted, was to take in immediately all sail, so as to leave the ship under bare poles, and send the whole of the crew below decks. As the tornado approaches nearer, the rain is observed to be gushing down in torrents, and the lightning darting down from the clouds with such profusion as to resemble continued *showers* of electric matter. When, however, the squall comes within the distance of about half-a-mile from the ship, these electric appearances altogether cease; the rain only continues in the same manner. As the tornado is passing over the ship, a loud crackling noise is distinctly heard among the rigging, occasioned by the electric matter streaming down the masts, whose points serve

to attract it; and I think that I have been told, that, when this phenomenon takes place at night, a glimmering of light is observed over every part of the rigging. But when the squall has removed to about half-a-mile beyond the ship, exactly the same appearances return by which the squall was characterised in coming off the shore, and before reaching the same distance from the ship. The lightning is again seen to be descending in continued sheets, and in such abundance as even to resemble the torrents of rain themselves which accompany the squall. These squalls take place every day during a certain season of the year, called the Harmatan season. The jet black clouds begin to appear moving from the mountains about nine in the morning, and reach the sea about two in the afternoon. Another very singular fact attending these tornadoes is, that after they have moved out eight or nine leagues to sea, when they become apparently expended, the lightning is seen to rise up from the sea. The violence of the wind, during the continuance of the squall, is excessive.—*D. M. Milnegraden.*

2. *Human Voice heard at a great distance.*—The distance at which the human voice is heard, has been long well known. A remarkable instance of this fact is mentioned by Captain Parry, in a former Number of this Journal, in which the human voice was heard at a distance of 1.2 English miles. Dr Young in his Lectures on Natural Philosophy, states, on the authority of Derham, that a man at Gibraltar heard the human voice at the distance of ten English miles.—*Young's Lectures,* vol. ii. p. 266.

3. *Method of reducing Barometrical Observations to a standard Temperature.*—Various tables have been published by different authors for reducing barometrical observations to a standard temperature. Though great care seems to have been bestowed in drawing up some of these tables, it is singular how little discrimination has been employed in selecting the data, from which they have been calculated. Many retain the rate of expansion according to De Luc, neglecting the determinations of later experimenters, and some of them have even made the relative expansion of mercury in glass tubes, the basis of their calculations, not reflecting that the diminution of specific gavity

by heat is absolute, and noway affected by the nature of the containing tube. The expansion deduced by the different philosophers who have examined it, is here given, omitting the results of Sir G. Shuckburgh, as being rather too far from the mean of the others.

	Expansion of Mercury from 32° to 212° Fahr.
De Luc, - - - - - -	$\frac{1}{56}$
Lavoisier and Laplace, - -	$\frac{1}{55.22}$
Hallstrom, - - - - -	$\frac{1}{55}$
Dulong and Petit, - - -	$\frac{1}{55.5}$
Mean. - - - - -	$\frac{1}{55.43}$

From 1° of Fahrenheit's scale this is equal to $\frac{1}{9977.4}$ or ·00010023; which may be called one ten-thousandth, without the most trifling error in practice. The barometric column may therefore be reduced to the standard temperature of 32° Fahrenheit, by the following simple rule, which will make a table unnecessary: *Before the first three figures of the observed height, place two cyphers, multiply by the temperature of the mercury, 32°, and subtract the product from the observed height.* Example, barometer 30.597, temperature of mercury 74°.

$$74 - 32° = .00305 \times 42 = .128 \text{ and } \begin{array}{r} 30.597 \\ 128 \\ \hline 30.469 \end{array} \text{ correct height.}$$

When the temperature of the mercury is lower than 32°, the temperature is to be subtracted from 32°, and the product of the whole is to be *added* to the observed height. Thus, let the barometer be as before, and the temperature 15

$$32° - 15 = 17, = .00305 \times 17 = .052, \text{ and } \begin{array}{r} 30.598 \\ 052 \\ \hline 30.649 \end{array} \text{ correct height.}$$

J. Foggo.

4. *Aurora seen in the daytime at Canonmills.*—The morning of Sunday the 9th September was rainy, with a light gale from the north-east. Before midday the wind began to veer to the west, and the clouds in the north-western horizon cleared away: the blue sky in that quarter assumed the form of a seg-

ment of a very large circle, with a well defined line, the clouds above continuing dense, and covering the rest of the heavens. The centre of the azure arch gradually inclined more to the north, and reached an elevation of nearly 20°. In a short time very thin fleecy clouds began to rise from the horizon, within the blue arch; and, through these, very faint perpendicular streaks of a sort of milky light could be perceived shooting: the the eye being thus guided, could likewise detect the same pale streaks passing over the intense azure arch; but they were extremely slight and evanescent. Between 9 and 10 in the evening of the same day, the aurora borealis was very brilliant: so that there is no reason to doubt that the azure arch in the morning, and the pale light seen shooting across it, were connected with the same phenomenon.

5. *Aurora Borealis.*—On the 29th of August last, we observed at Milnegraden, in Berwickshire, from 11 until half past 12 o'clock, a fine display of the polar lights. The centre of the arch appeared to be nearly in the magnetic north, and its light as well as that of the beams was brilliant. The evening was clear and calm; but on the following morning the wind changed, and heavy rain, with a strong gale of wind succeeded. On Sunday evening, 9th instant (September), we noticed at Roslin another display of the polar lights. They were first visible about 8 o'clock P. M., and continued until 12 at night. When first observed, they appeared in the form of a single luminous arch, low in the atmosphere, (to the eye at times appearing almost to touch the surface of the earth), extending from NW. to SE., with accompanying flitting beams. After some time, the position of the arch gradually changed, and at length became nearly stationary, in a NE. and NNE., and SW. and SSW. direction. It gradually rose higher in the atmosphere, became double, its light grew more intense, the beams more numerous, and exhibiting their usual flitting motion. Towards 12 o'clock the beams and arches became faint; at length there remained but a faint pale yellowish light occupying the space, which, in its turn, at length disappeared. These lights, as is generally the case, were accompanied with cirrus clouds. It is worthy of remark, that the cirrus cloud, when carefully observed, appears generally more or

less agitated,—a fact illustrative of its connection with the polar lights. It is even probable, that the cirri observed during the day time are often accompanied with polar lights, which, however, are invisible, owing to the stronger light of the sun. This display of the polar lights, like that of the month of August, was followed by a change of wind, rain showers, and gales of wind.

6. *Meteor.*—A very fine meteor was seen at Laytonstone, about four miles north of Greenwich, on the 21st of May last, at $10^h\ 30^m$ P. M. When first seen, the meteor had the appearance of a small spark, moving slowly in an oblique direction across the western sky. When about half through its course, the light suddenly and rapidly increased in splendour, assuming a very rich yellow hue, and emitting sparks from the main body. After this appearance of ignition, it left a few feeble sparks, which continued to move in the same right line a short space, and then disappeared. Jupiter shone at a little distance above the meteor, but very far short of its brilliancy; though similar in its explosive appearance to a rocket, the meteor was at once to be distinguished from any projectile of that kind, by the remarkable straight direction of its course, from first to last, without the least appearance of the course which the attraction of gravitation to the earth would have occasioned. The following observations were immediately taken respecting its course: Altitude of its first point of appearance 28°; altitude of its last point of extinction 10°; length of its course 28°; bearing of its first point 54° west from south; bearing of the last point 37° west from south; the time occupied in traversing its course rather exceeded four seconds. The meridian of Greenwich is scarcely half a second west of the place of observation. The above memorandum may be interesting to other observers, and serve as materials for calculation.

7. *Luminous Cross in the Heavens.*—Luminous crosses, occasioned by peculiarities in intersecting halos, are sometimes observed in the sky, particularly of arctic countries. Some pretended miraculous crosses which have been seen in the air in modern times, are to be traced to atmospheric reflections. In the month of February 1827, a shining cross, we are informed by

the public journals, was observed in the air at Poictiers, towards the close of a mission which was preached there. Four thousand persons, we are told, saw it; many considered it as miraculous, but it was remarked by others, that, before the conclusion of the sermon, a cross was erected on the ground, and then it was, and not till then, that the luminous cross appeared in the atmosphere.

8. *Polar Lights in Siberia.*—Baron Wrangel remarks, that, in Siberia, when shooting stars pass across the space occupied by polar lights, that fiery beams suddenly arise in the place traversed by the shooting star. Further, that, when a polar beam rises high towards the zenith, when the full moon is also high, it gradually forms a luminous circle around the moon, at a distance from her of from 20° to 30°; remains in this form for a short time, and then disappears.

HYDROGRAPHY.

9. *Water of the Dead Sea.*—Five different analyses have been made of the famed water of the Dead Sea, the first by Macquer, Lavoisier, and Le Sage, (Mem. de l'Acad. de Scienc. p. 1778); the second by Dr Marcet, (Phil. Trans. for 1807, p. 296); the third by Klaproth, (Beit. b. v. p. 185); the fourth by Gay Lussac, (Ann. de Chim. et Physique, t. xi. p. 197); and the fifth by Hermbstadt, (Schweigg. Journ. bd. 34, s. 153). A sixth analysis has just been published, by C. G. Gmelin, in the Memoirs of the Wirtemberg Society, vol. i. Gmelin's investigation is interesting on account of his having detected brome as one of the constituents of this water. The following is the result of his analysis: chloride of lime, 3.2141; chloride of magnesia, 11.7734; bromate of magnesia, 0.4393; chloride of soda, 7.0777; chloride of potash, 1.6738; chloride of alumina, 0.0896; chloride of manganese, 0.2117; muriate of ammonia, 0.0075; sulphate of lime, 0.0527=24.5398; water, 75.4602.

10. *Analysis of the Water of the River of Sagis in Siberia.*—The river Sagis flows in the Kirgis Steppe, between the Lake Aral and the Caspian Sea, and contains so much saline matter, that its water is not drinkable. A portion of this water was examined by Dr Hess, at present in Ixkutsk, who found in

1000 parts the following salts :—Sulphate of soda, 6.835 ; sulphate of lime, 4.511 ; muriate of magnesia, 3.941 ; and muriate of soda, 70.598=85.885.

11. *Dr Daubeny's Circular requesting information in regard to Mineral Waters.*—For many years past we have urged the importance of attention to the chemical and natural history of hot-springs and mineral waters, and we are happy to find the subject taken up by one so well qualified to do it justice as our friend Dr Daubeny. The following copy of the *printed circular* will explain Dr Daubeny's wishes.

"Sir, Being desirous of investigating the properties of such of our mineral waters as appear as yet to be known but imperfectly, I take the liberty of soliciting information respecting those in your neighbourhood, and of submitting to you for that purpose the following queries :—1*st*, Are you aware of any springs in your country, or in those adjacent, the heat of which exceeds the medium temperature of our climate ? 2*d*, Is the temperature of such springs fixed or variable ? 3*d*, Do you know of any distinguished from ordinary water by certain peculiarities, either sensible or chemical ? 4*th*, Are you acquainted with any to which medical virtues are or have been ascribed, or which, when taken, produce any remarkable effects on the animal functions ? 5*th*, Do the springs above alluded to give out any gaseous products, and of what description ? 6*th*, What is the geological character of the stratum from which they arise ? 7*th*, What effects do they produce on the stones and other substances with which they come in contact, upon the contiguous soil or upon animals ? 8*th*, Are there any works in which a detailed and authentic account of such springs may be found ? In addition to answers to the above queries, I beg leave to request any further information relative to hot or mineral waters which you may have it in your power to afford me ; and shall likewise feel obliged by receiving samples of the more remarkable ones, carefully corked and sealed on the spot, and in quantity not less than a pint. They may be addressed to the Chemical Laboratory, Broad Street, Oxford, for Charles Daubeny, Professor of Chemistry, Oxford."—*Oxford*, 13*th July* 1827.

GEOLOGY.

12. *Rule to be followed in examining Caves containing Fossil Animal Remains.*—Professor Buckland states, that the best rule to follow in pursuit of antediluvian remains in caverns, is to select the lowest part in which any diluvium can have accumulated, and there dig through the stalagmitic coat, and seek for the teeth and bones in the mud and pebbles that lie below. He also proposes, as a test for distinguishing bones of this antiquity,

their property of adhering to the tongue, if applied to them after they are dry,—a property apparently derived from the loss of animal gelatine they have sustained, without the substitution of any mineral substance, such as we find in the bones imbedded in the regular strata. This test extends equally to the bones of the osseous breccia of caverns and fissures, and to those in all superficial deposites of diluvium, excepting such as are too clayey to have admitted the percolation of water; but the property of adhesion is rarely found in bones from recent alluvium, or from peat-bogs; nor does it exist in human bones, which Dr Buckland has examined from Roman graves in England, and from the Druidical tombs of the ancient Britons, nor in any of the human bones which he has discovered in the caves of Pairland and Wokey Hall. Dr Buckland proposes to apply this test to the much disputed case of human bones, said by Schlotheim to have been discovered in the cave of Kostritz, in contact with those of the rhinoceros and other extinct animals.—*Annals of Philosophy*, *August* 1827.

13. *On Chains of European Mountains.*—The third volume of the Recueil des Memoires de la Société de Geographie is in the press. It entirely consists of the important work of M. Bruguière, on the Chains of the European Mountains, to which the Prize of the Society was awarded in 1826.

14. *Death of Professor Brocchi.*—Professor Brocchi, so well known by his numerous works on geology and conchology, and who was employed for five years in travelling through Africa, at the charge of the Pacha of Egypt, as director of a company of European miners, died, just as he was on the point of returning to Europe with the result of his various researches.

15. *Discovery of Fossil Mammalia in Auvergne.*—Very interesting fossil bones have lately been discovered in Auvergne, of which figures and descriptions are at present in the progress of publication. The bones are buried in a series of sandy strata, about two metres thick, arising from the debris of primordial deposits, and containing some fragments of lava. These beds of sand are covered by a bed several hundred feet thick of volcanic tufa, composed of fragments of pumice, and containing pieces of basalt, and considerable blocks of lavas, resembling

those of Mont-Dore. This deposit is interrupted by a bed of rolled pebbles; it forms the platform which crowns the mountain of Perrier. Under this deposit, which contains bones, there is a thick bed of pebbles of a large size, volcanic and primitive, of from three to four metres thick, which rests immediately upon the limestone deposited in fresh water-lakes, the strata of which contain, along with other remains of animals, a multitude of shells analogous to those which live, at the present day, in our marshes and brooks. The bones of this latter deposit, which is the oldest in the order of time, belong to genera which no longer exist on the earth, and to species of genera still existing, but which are themselves extinct. They belong to lophiodons, anaplotheria, civets, species of the genus lagomys, fresh-water tortoises, crocodiles, and serpents. Among them are eggs perfectly preserved, and skeletons of birds. The more modern deposit contains bones of tapirs, elephants, rhinoceroses, horses, hippopotami, mastodons, beavers, dogs, mice, of several large cats, tigers, panthers, and eleven or twelve different species of the deer kind. All these bones completely retain their original form, even their chemical nature has been little altered; for they contain thirty-six parts of phosphate of lime, and seven of animal matter.

16. *Teneriffe Filtering Stone.*—The filtering stone of Teneriff is one of those modern calcareous formations described by Dr Fitton, in his interesting geological view in Captain King's Voyage. Von Buch, in his Geology of the Canary Islands, describes the filtering stone as daily forming on the sea-shore, by the agglutination of broken shells, and fragments of trachyte and basalt, by means of a calcareous sinter deposited from the comparatively hot sea-water of the tropical seas; and most of the grains of the rock thus formed have a calcareous crust, formed around a nucleus of trachyte, basalt, or fragments of shells, and the whole much resembles oolite or roestone. He adds, "Since I witnessed the formation of the filtering stone, I do not deny that the oolite of the Jura limestone may have been formed by agitation, in warm water, of fragments of shells; and I doubt not that beds of oolite may, even now, be depositing in this way on the coral banks of the tropical regions." In Captain Campbell's

account of the Island of Ascension, published in a former number of this Journal, a modern calcareous formation is mentioned, and rocks of the same description occur in Scotland.

MINERALOGY.

17. *Hydrosilicite, a new Mineral Species.*—Dr Kuh, in his inaugural discourse, entitled " De Hydrosilicite, nova fossilium specie, Berlin 1826," informs us, that he found, in the serpentine of Frankenberg in Silesia, along with chrysoprase, opal, and pimelite, a mineral which he names Hydrosilicite. It is white, without lustre, feels greasy, translucent, fracture even, soft, does not adhere to the tongue, amorphous, and appears to be almost entirely composed of pure silica and water.

18. *Chrome in different Minerals.*—According to Walchner's experiments, chrome occurs not only in the different varieties of olivine, but also in several other minerals, in which magnesia is a constituent part, as in many steatites, actynolite, all serpentines, greenstone, basalt, &c.

19. *Fluoric and Muriatic Acids in Apatite.*—Gustave Rose finds that apatite contains not only muratic acid, but also occasionally a considerable portion of fluoric acid.

20. *Glaukolite, a new Mineral Species.*—This mineral, found by Menge in Siberia, occurs imbedded in a compound of compact felspar and granular limestone, which sometimes contain scales of talc. Its colour is lavander blue, which sometimes passes into green. It is translucent on the edges, with a splintery fracture, vitreous lustre, a hardness intermediate between that of fluorspar and felspar, and a specific gravity of 2,721. According to Dr Bergemann it contains the following constituent parts: Silica 50.583; Alumina 27.600; Lime 10.266; Magnesia 3.733; Potash 1.266; Natron 2.966; Oxide of Iron 0.100; Manganese 0.866; Loss 1.733. = 99.113. The iron and manganese are not essential constituent parts of glaucolite, as is shewn by the range of colour extending from blue to white. The magnesia appears to be derived from the talc scales. Hence if silica, alumina, and lime with alkali, be considered as the constituent parts of glaucolite, the following will be their proportions; Silica 54.58; Alumina 29.77; Alkali 4.57; Lime 11.08 = 100.00.—*Poggendrof's Annalen, St.* 2. 1827.

21. *Ilmenite is Axotomous Iron Glance.*—In the January Number of the Annals of Philosophy, M. Levy says Ilmenite is the axotomous iron-glance of Mohs ; more lately Gustave Rose has come to the same conclusion. He finds the axotomous iron glance to be titaniferous,—a fact which need not surprise us, when it is recollected that iron-glance and titaniferous iron-ore, have the same crystallisation.

22. *Apatite in Secondary Trap and Trachyte.*—Apatite or phosphate of lime, in small crystals, occurs imbedded in the secondary greenstone of Salisbury Craigs in this neighbourhood. It has also been found in the trachyte and hornblende of the Eifel in Germany.

23. *Boracic Acid in Mica.*—Gmelin, in using the blowpipe test of Dr Turner, for ascertaining the presence of the boracic acid in minerals, has detected it in the lepidolite of Rozna and Uto, in the pinite of the Valley of the Mulda near Penig in Saxony, and in mica of a graphic granite from Siberia. He has also, in the moist way, found boracic acid in a silver white mica from Fahlun. The proportion in lepidolite appears about 4 per cent.

24. *Curved Lamellar Heavy Spar, a new Species.*—This mineral, as it occurs in the Freyberg mining district, according to Breithaupt, has a specific gravity of 4.02 — 4.29, whereas that of true heavy spar is 4.30 — 4.58 ; further, it is a compound of sulphate of barytes and sulphate of lime. It decays more readily than straight lamellar heavy spar, owing to the anhydrous sulphate of lime passing on exposure into gypsum. He names it *calcareous heavy spar*.

25. *Fluoric Acid in Felspar.*—The genus felspar, according to Breithaupt, contains at least seven well marked species, viz. petalite, perikline, orthoklas, tetartine, oligoklas, Labrador, and anorthite. All the species have been found to contain fluoric acid.

BOTANY.

26. *Botany of the Dutch East India Possessions.*—The celebrated Dutch Naturalist, Dr Blume, has lately arrived in Europe, after a residence in Java of nine years. He has brought with him an immense collection of objects of Natural History, and intends publishing an extensive work on the botany of the Dutch

East India Possessions. As precursory to this work, he published, at Batavia, a View of the Vegetable Kingdom of Java, in Fifteen Parts.

27. *Common Sugar existing in the form of grains in the flowers of Rhododendron ponticum.*—M. Jaeger discovered, in April 1825, on a plant of Rhododendron ponticum, which he kept in his room, and which was covered with flowers, grains of common sugar, pure and of a white colour, on the inner surface of the upper division of the corolla. The quantity of grains collected from about 140 flowers amounted to 275 centigrammes. The mean weight of each grain was two centigrammes. The physical and chemical properties of these grains approach so much to those of common sugar, that no essential difference could be detected between the two substances.

28. *On the Cotton of the Ancients.*—The synonymy of the vegetables known to the ancients, is one of the most difficult points of science to establish, and is a continual subject of regret, especially when reference is made to vegetables, which have been extensively employed. M. Mongez has therefore rendered a service to science, by clearing up this part of the history of cotton, in a memoir lately published. Two very different vegetables have been confounded under the name of cotton, the *Bombax* and the *Gossypium* or cotton tree. It is the former of these that was designated by Herodotus, as well as by Strabo, who relates, that the Macedonians employed in Babylonia, the down of the tree which bears wool to make housings for horses. Theophrastus speaks of both. The substance which Virgil mentions as fabricated by the *seres*, is the cotton which came from Bactria, called *serique*. The *Gossypium* was only cultivated in Egypt after the time of the Ptolemies; in the Western Morea, in the second century. Asia and Persia, among other countries, already possessed very celebrated manufactures of cotton. It was used as a substitute for papyrus, and the parchment which succeeded it, until it was itself replaced by paper made from flax and hemp. The word *cotton* evidently comes from *g'hotten*, by which the Arabians, who cultivated this vegetable before the commencement of our era, designated it, and from *Cottonara* (now *Canora*), a country on the coast of Malabar, from which the Arabians and Egyptians carried it into their respective countries.

29. ***Brick Tea.***—The Mongols, and most of the Nomadic tribes of middle Asia, make use of this tea; it serves them both for food and drink. The Chinese carry on a great trade in it, but never drink it themselves. In the tea manufactories, which are for the most part in the Chinese government of Fokien, the dry, dirty, and damaged leaves and stalks of the tea are thrown aside; they are then mixed with a glutinous substance, pressed into moulds, and dried into ovens. These blocks are called by the Russians, on account of the shape, *brick tea.* The Mongols, the Bouriats, the inhabitants of Siberia beyond Lake Baikal, and the Kalmucks, take a piece of this tea, pound it in a mortar made on purpose, and throw the powder into a cast-iron vessel, full of boiling water, which they suffer to stand a long time upon the fire; adding a little salt and milk, and sometimes mixing flour fried in oil. The tea, or broth, is known by the name of Satouran. It is very nourishing.—*Timkouski's Travels.*

ZOOLOGY.

30. *Asiatic Elephant*—Cuvier says the Asiatic elephant is fifteen or sixteen feet high This appears to be a mistake; elephants in India rarely, if ever, exceed eleven feet in height.

31. *Organization of the Camelopard.*—At a meeting of the Academy of Sciences, Paris, 10th August, M. G. St Hilaire, demonstrated from the skull of a young giraffe, that the horns of this animal are not simple excrescences of the frontal bone, as commonly supposed, but a superadded bone, which it is possible at a particular period to separate. This circumstance is common to the cervi or deers, among which M. Geoffroy proposes to class this animal.

32. *On the Gossamer-web.*—A paper was lately read before the Linnean Society, entitled, "Observations and Experiments made with a view to ascertain the means by which the Spiders that produce Gossamer effect their Aërial Excursions; by John Blackwall, Esq. F.L.S. of Crumpsall Hall, near Manchester." After noticing that, in the absence of accurate observation, the ascent of gossamer-spiders through the atmosphere had been conjecturally ascribed to several causes, such as the agency of winds, evaporation, electricity, or some peculiar physical powers

of the insects, or from their webs being lighter than the air, Mr Blackwall states, that the ascent of gossamer takes place only in serene bright weather, and is invariably preceded by gossamer on the ground. He then details the phenomena of a remarkable ascent of gossamer, October 1, 1826, when, a little before noon, the ground was everywhere covered with it, the day being calm and sunny. A vast quantity of the fine shining lines were then seen in the act of ascending, and becoming attached to each other in various ways in their motion, and were evidently not formed in the air, but on the earth, and carried up by the ascending current, caused by the rarefaction near the heated ground; and when this had ceased in the afternoon, they were perceived to fall. An account is added of two minute spiders that produce gossamer, and of their mode of spinning; and particularly when, impelled by the desire of traversing the air, they climb to the summits of various objects, and thence emit the viscous threads in such a manner, as that it may be drawn out to a great length and fineness by the ascending current, until, feeling themselves sufficiently acted upon by it, they quit hold of the objects on which they stood, and commence their flight. Some of these insects, which were taken for the purpose of observation, when exposed to a slight current of air, always turned the thorax to the quarter from whence it came, and emitted a portion of glutinous matter, which was carried out in a line.

33. *Identity of the two nominal Species of the Ornithorynchus.*—In a memoir printed in the *Annales des Sciences Naturelles* for December 1826, M. Geoffroy St Hilaire proves, from facts observed by him in a number of individuals of ornithorynchus, that the pretended specific characters taken from the red or brown colour of the hair, or the relative size of the spur in the male, are of no value, the circumstances on which they are founded being irregular, and indicative merely of individual differences.

34. *Glandular Apparatus, lately discovered in Germany, on the Abdomen of the Ornithorynchus.*—M. Geoffroy St Hilaire, in a paper in the *Annales des Sciences Naturelles*, December 1826, denies that the gland discovered by Meckel, and considered by him as the mammary gland of the ornithorynchus, is a true mammary gland. He founds his opinion on the organisa-

tion of the gland in question being entirely different from that of the mammary gland in woman, and especially in the marsupial animals, in the absence of all traces of teats, together with the existence of a beak, which would render suction extremely difficult, if not impossible, and on various other circumstances. He thinks that the gland in question is analogous to that which exists on the sides of the salamanders, or still more to the glandular apparatus on the abdomen of the sorices or shrews which is destined to secrete a fetid humour, especially during the breeding season.

35. *Remarkable Hybrid.*—"There is here at present an animal produced between a stag and a mare. The authorities of the place have attested the phenomenon. The appearance of the creature is very singular; the fore part is that of a horse, the hinder part that of a stag; but all the feet are like those of the latter animal. The same stag has covered another mare. The king has purchased the hybrid for the *Pfaucninsel*, where there is a menagerie."—*Extract of a Letter to M. de Ferussac, dated Berlin, 27th January* 1827.

36. *Microscopic Observations on Animal Tissues;* by Dr Hodgkin, and J. J. Lister.—In a very interesting paper in the *Annals of Philosophy*, for August 1827, Dr Hodgkin and Mr Lister state the results of their microscopic observations on animal tissues, which differ much from those of an excellent observer, Dr Edwards of Paris. Dr Edwards maintains that the elementary parts of all the tissues are globular; whereas our authors find that muscle, nerve, artery, and cellular membrane, are fibrous. The brain appears to have a globular structure. The minute particles of milk are globular, but those of the blood are circular, flattened, and transparent.

37. *Camelopard.*—Hitherto natural historians have committed the same error with respect to the camelopard, that they have committed with respect to the rhinoceros, the elephant, and other large animals; namely, the error of recognising only one species. The camelopard now at the Museum at Paris, differs in so many essential anatomical characters from the kind at the Cape, that it cannot be doubted that there are at least two kinds. The new one is called the Senaar Camelopard, from the name of the country where it lived. A curious circumstance recently

happened with reference to it. Some Egyptians going to see it in the dress of their country, the animal gave evident signs of joy, and loaded them with caresses. This fact is explained by the lively affection which the camelopard entertains for the Arab to whose care it is entrusted; and it was therefore naturally rejoiced at the sight of the turban and costume worn by its keeper. M. Mongez has been reading at the Academy of Sciences, a paper, tracing the natural history of the camelopard, from the testimony of writers who have spoken of it, either as having themselves seen the animal, or as having long lived with persons who were acquainted with and had observed it. He points out Moses as the most ancient writer who has mentioned the camelopard; expresses his astonishment at the silence of Aristotle respecting it, and concludes from that silence not only that the camelopard was at that time unknown to the Greeks, but even that it did not exist in Egypt, as otherwise Aristotle, who had travelled into that country, could not have failed to remark it. The first living camelopard that appears to have been seen in Europe, was in the time of Julius Cæsar, the year 708 of the Roman era. After that period, it was introduced into Rome by the Emperors, on various occasions; sometimes in the games of the circus, sometimes in the triumphs over the African princes. Albert the Great, in his treatise *De Animalibus*, is the first writer of modern times who speaks of the camelopard. In 1486, one of the Medici possessed one at Florence, which lived there for some time. It appears that the camelopard is sometimes a very savage animal; and it is supposed that the difference in its character arises from a difference in its education and treatment.

38. *Hirudo muricata*, Linn.—It has been thought (*Journal of Science*, No. xiii. p. 161.), that the ova and young of this species of sea-leech had remained unknown till this season (1827). It is but doing justice, however, to a distinguished observer of this place (John Graham Dalyell, Esq.) to mention, that, in the year 1822, he bred this animal in jars of sea-water, watching all the changes, from the laying of the eggs to the evolution of the perfect animal. Beautiful drawings of the ova and young, made in July 1823, and bearing that date, are now before us; and in some MS. notes which accompany the drawings, Mr Dalyell remarks, " The *Hirudo muricata* propagates by eggs of

singular conformation, forty or fifty of which are found deposited in irregular groups, on shells or other substances. A short stalk rising from a broad thin sole, firmly attached to the substance subjacent, is crowned by a globular head, with a distinct umbilicus on the side. Here is contained a tenacious transparent albumen, of the faintest red. The egg is originally of a fine soft downy aspect, white, or rather tinged with the lightest carnation; the umbilicus of beautiful orange. But the whole speedily alters, and in two or three days, becomes of that dark uniform olive, under which it always appears when withdrawn from the sea. Each egg contains a single embryo, which, on attaining maturity, issues through the umbilicus. It is then about an inch long, and of a brown colour. Both eggs and young have been produced in my possession, from January until April." Mr Dalyell has remarked some curious facts respecting this animal. "If solitary, it is torpid in confinement. But, on a stranger leech being introduced, both seem to experience very agreeable sensations. Their necks are intertwined, considerably activity is displayed, and one or more milk-white vesicles, resembling minute grains of oats in figure, are seen protruding from the neck or its vicinity. Some observers have represented a leech, apparently the *muricata*, with horns. Have they been deceived by the vesicles,—or is there really a leech with horns?" None such has ever occurred to Mr Dalyell among eight species of Scotch leeches, of which he possesses drawings and descriptions.

39. *The Elk.*—That magnificent animal the elk, the monarch of the northern forests, and which so greatly exceeds every other in size, is an inhabitant of the more southern latitudes of Sweden and Norway; but is not found in Finmark. This animal possesses, in a singular degree, the qualities of both the horse and the ox, combining the fleetness of the former with the strength of the latter in drawing burthens. In former times, when it was found in greater abundance in Sweden, the powers of this animal were made subservient to purposes of public utility; and Fischerström informs us, that, in the reign of Charles the Ninth, elks were made use of for the purpose of conveying couriers, and were capable of accomplishing, what would appear incredible, namely, 36 Swedish miles, about 234 English miles, in a day, when attached to a sledge, which far surpasses the powers

of the rein-deer. Darelli, a Swedish gentleman, published, some years ago, in the Transactions of the Academy of Sciences (Vetenskaps Academiens Handlingar), an interesting account of the habits, as well as singular docility and sagacity, displayed by a male elk, which, having been caught when young, upon his property, had been kept domesticated by him for many years. He introduces some curious speculations upon the uses to which these animals might be applied in time of war; asserting, that a single squadron of elks, with their riders, would put to immediate route a whole regiment of cavalry; or, employed as flying artillery, would, from the extraordinary rapidity of their motions, ensure the victory. The facility with which they are able to cross rivers and broad fiords, would render them likewise extremely serviceable during a campaign, for the purposes of reconnoitring, conveying despatches, &c. A remarkably fine living specimen was recently sent over to this country from Vermeland, where it had been taken when young, and was intended as a present to his Majesty from Mr Wise, the consul-general of Sweden. Notwithstanding it was tractable to a singular degree, an accident most unfortunately befel it, owing to the stupidity and neglect of its attendants, when on its road between Harwich and London, which was the occasion of its death. Although not more than two years old, it was of the surprising height of nineteen hands (*i. e.* 6 feet 4 inches), being thus very much above what is considered a great height for a horse, viz. sixteen hands; it had still not arrived at its full growth, and, in all probability, would have attained an additional foot *.—*Brooke's Travels in Lapland* †.

ARTS.

40. *Green Fire.*—This is made of equal parts of pounded nitrate of barytes and charcoal, well mixed together. It is used in ghost scenes, and gives out a greenish flame with a white smoke, and makes the countenance assume a deadly hue.

41. *Object of Embalming in Egypt.*—A French chemist, M. Julia Fontenell, in a discourse delivered on occasion of the opening of an Egyptian Mummy in the Theatre of the Sorbonne at

* Mr Pennant says, that the greatest height of the elk is seventeen hands.

† A fine skeleton of the elk has been lately presented to the Edinburgh College Museum, by Mr Seton of Stockholm.

Paris, has delivered an opinion respecting the cause of embalming in Egypt, that the Egyptians were led to it from physical necessity. During four months of every year, the inundation of the Nile covers almost entirely the whole of the surface of Egypt which is under cultivation. Under the reign of Sesostris, for an extent of territory of about 2250 square leagues, there would be a population of 6222 persons per square league, which would present 350,000 deaths per annum. These corpses must be gotten rid of, either by burning or by interment; if the latter, they must be burned around the inhabited spots, or in those which were inundated by the Nile, and then the decomposition of these bodies would have been a source of infection; and for burning bodies there was a want of a sufficiency of wood. But the soil of Egypt abounds in springs of natron, and sub-carbonate of soda; and as this substance is antiseptic, the inhabitants were naturally led to preserve with it the corpses of the dead. In support of this opinion, that sanitary views alone were the cause of embalment, down to the third century, before the christian era, when the practice was discontinued, M. Fontenelle observed, that, during the whole of that period, the plague was unknown in Egypt, where it is now endemic.

42. *Lithographic Drawings of the celebrated Masters of different Schools.*—Lithographic impressions of select drawings, by celebrated masters of all the schools, from the collection of the Archduke Charles, will speedily appear. This collection contains 14,000 original designs. The work will be published in livraisons, the number of which is not yet fixed. The early numbers will contain the Schools of Italy and Germany, and the latter the Schools of France and the Netherlands. A part will be published monthly. Each plate will be 26 inches long, by 18 broad.—*Foreign Quarterly Review*, No. I.

43. *On Mosaic Printing.*—Senefelder, the inventor of Lithography, has discovered a new mode of printing from paintings, which has all the qualities of those executed in oil. He has termed it *Mosaic Printing*, and it is remakable for its beauty, lightness, and durability.

44. *Fluid Telescopes.*—Our readers will be pleased to learn that the construction of fluid telescopes, first projected by Dr Blair, forms at present a subject of considerable interest in London, Messrs W. and T. Gilbert, of Leadenhall Street, having

lately completed two, one of 6 inches, and the other of $3\frac{1}{4}$ aperture, which, as experimental results, are very satisfactory. The principle of the construction, which is Professor Barlow's, possesses some novelty, and some important advantages, one of the most valuable being, that the telescope may be made considerably shorter than in the usual refractors, without a corresponding diminution of the focal powers, the focal length being nearly double the length of the tube, as in the Gregorian reflector. We are assured that, with the small telescope, with a power of only 46, polaris is distinctly doubled, and the small stars well defined; and with higher powers, all the double stars of Sir William Herschel's third class are distinctly separated, and several of the second class; the larger telescope has not at present been submitted to so severe a test, but neither the maker, nor the projector, has any doubt of its answering equally well, and being proportionally more powerful. Our correspondent, however, informs us, that, in the larger telescope, in particular, a secondary spectrum is formed, from the irrationality of the original spectra, which is very obvious on a Lyra and Arcturus, although scarcely perceptible with less luminous stars; but this, it is expected, will be removed by the mixture of other fluids. We hope, in our next number, to be able to explain more particularly the nature of this novel construction, as well as to announce the completion of one of much larger dimensions, as we understand it to be the intention of the spirited and ingenious makers to carry the construction to its utmost possible limits. We can only say they have our best wishes. It is always gratifying to see men of sound theoretical knowledge combining their efforts with others of practical skill and ingenuity, because, from such combination of talent, we have every reason to expect valuable results. In the present instance, these interesting experiments are in excellent hands, and we cannot but look forward with confidence to their ultimate success.

STATISTICS.

45. *View of the Scientific and Literary State of different parts of Italy. (Revue Encyclop. Jan.* 1827.)—In this account of the State of Literature and Science in Italy, there is more said of the former than of the latter; nevertheless, it shews

the constantly increasing progress of civilization in the different parts of that country. The two cities which present the most brilliant results in this respect are Florence and Milan ; they cultivate at once, and nearly with the same success, the sciences, letters and arts *. In each of these two capitals vast enterprizes are entered upon for the publication or reproduction of esteemed works, new or old. Venice, formerly so active, seems now immersed in torpidity, unless with respect to the fine arts. The same is to be said of Genoa. Turin publishes memoirs, but with less zeal or splendour than Milan. Naples furnishes excellent works on the antiquities which surround it. What shall we say of Rome? There is nothing of importance done there now, excepting in philology. It would be unjust to overlook Bologna, which is distinguished in the medical sciences, in mathematics and painting. In fine, the great number of Academies, and learned and literary societies existing in Italy, proves that, in that country, the improvement of the human mind is every where considered as an important object.

46. *Number of Crimes in Prussia.*—In the *Annales sur l'Administration interieure de l'Etat*, a very useful work, published by M. Kamps, there is contained some very interesting information respecting the crimes committed in Prussia. It is truly remarkable how much their number varies according to the different provinces. The province of Pomerania stands in the first rank as to morality. Among 4,760 individuals, there was only a single criminal. In the lowest rank are found the cities of Cologne, Aix-la-Chapelle, Dusseldorf and Munster, where one criminal is reckoned in every 400 individuals. It is the same with regard to robberies. In 6432 Pomeranians, and in 3000 inhabitants of Eastern and Western Prussia and Silesia, there is not more than one robber. But there is reckoned one for every 800 inhabitants of Treves and Coblentz ; and the same for every 400 inhabitants of Aix-la-Chapelle, Dusseldorf, Cologne and Munster. Wherever there are most holidays, there also are most robberies. Other crimes, however, are proportionally rarer in those cities. At Aix-la-Chapelle and Co-

* Each of them publishes a great number of journals, especially Milan, in which there are so many as twenty on science or literature.

logne there is but one murderer out of 60,000 individuals, and the same out of 35,000 in Saxony and in the country of Munster. But the country in which most crimes are committed is the district of Marienwerder, where, out of 25,000 individuals, there is one murderer.

NEW PUBLICATIONS.

Illustrations of Zoology, being representations of new, rare, or otherwise remarkable subjects of the Animal Kingdom, drawn and coloured after Nature, with Descriptive Letter-Press. By JAMES WILSON, Esq. F. R. S. E. Member of the Wernerian Natural History Society. William Blackwood, Edinburgh, and T. Cadell, London. No. II.

IN our last Number we gave a brief account of the commencement of a periodical work, the first of its kind attempted in Scotland, embracing the whole range of Zoology, and of a nature sufficiently general and miscellaneous to prove attractive to a numerous class of readers, though devoted to the illustration of a single science,—that of Natural History. Of its plan and execution we augured well, and our hopes have been increased, rather than diminished, by a perusal of the second Number. We again, therefore, recommend it to the attention of our readers, not only as a novel and highly interesting addition to our stock of scientific publications, but as an earnest and forerunner of a more general taste for the pursuits of natural history, than has hitherto been manifested in Scotland. Indeed, the genius of the artist, and the skill of the typographer, have been all along so sparingly employed in aid of the natural sciences in this quarter of the island, that little can be said either in reprobation of the lukewarm patronage of the public, or in favour of such works as may be alleged to have suffered from the darkness of an undeserved oblivion. From the well known fact, however, that many volumes, in various departments of literature, of the most elegant and ornamental kind, had proceeded from the Scotch press, it might have been fairly inferred, that it was rather from a deficiency of public encouragement than any want of skill in the profession, that so little had been done in illustration of scientific subjects. We are sanguine that a better, or more extended, taste is now prevailing, and that the success attending the execution of such works as that now before us, will be commensurate with the higher and more improved character which they have assumed. Without quoting the tritest maxim of political economy, it may indeed be assumed as certain, that the advantage will prove reciprocal, and that a more general taste for ornamental works of Natural History will be met by corresponding exertions on the part of those whose productions will reflect no discredit either on the art, the science, or the literature of Scotland.

The present Number of Mr Wilson's Illustrations contains six coloured representations of remarkable animals. The first Plate is devoted to the Asiatic and African Orang-Outang, and is engraved after admirable drawings from life by the late Mr Howitt. The figures of the Asiatic species especially, pourtray the character and aspect of that singular animal in a manner superior to what we have yet observed in any former representation of it. They greatly excel that of Mr Sydenham Edwards, which we believe was taken from the same individual.

"Allied," Mr Wilson observes, "to the human race by a grotesque resemblance in their form and structure, the principal species of this numerous and diversified genus (*Simia*), familiarly called Apes, Monkeys, and Baboons, have for a long period excited the attention of the philosophical anatomist and natural historian. The labours of Camper, Tyson, and Tilesius, of Geoffroy, Lacepede, Audebert, Blainville, and the Cuviers, have been successively bestowed on the illustration of this tribe of animals; and though many points in their history still remain obscure, a considerable advancement has no doubt been recently made towards their complete elucidation. It would take long to tell of the numerous subgenera which have been formed in the course of their systematic arrangement; and as these may be more conveniently discussed in a future Number of this work, in which I shall have occasion to describe some of the monkey tribe, properly so called, I shall confine my observations, for the present, to the first division of the genus *Simia*, viz. the Greater Apes, or Orang-outangs.

"It appears probable, that the ancients were not acquainted with either the African or Asiatic orang-outang, although a passage in the *Periplus Hannonis* has been supposed by some authors to indicate the chimpanze with sufficient accuracy to establish their knowledge of that species. The *Pithecos* of the Greeks, and the *Simia* of the Latins, of which we have notices of a sufficiently imperfect nature in the works of Aristotle and Pliny, seems to have been no other than the magot or Barbary ape (the *Simia Innuus* of modern times), which, in a state of domestication, breeds in France, and still occurs in a wild state, on the least accessible parts of the rock of Gibraltar. No doubt, in the *pithecus* of Galen, a double opening is said to have been observed in the cavity of the larynx, a character believed by many to be peculiar to the orang-outangs, and Camper was certainly of opinion that that ancient physician had anatomised and described the last-named animal; but M. De Blainville has lately exhibited conclusive evidence, that the subject of Galen's observations was no other than the common magot. The *Simia Porcaria*, as indicated by Aristotle, appears to have been a baboon; and, in regard to the *Kebos* or varied monkey, the *Callithina* (beautiful-haired) or green monkey, and the *Cercopithecos* or long-tailed guemon, which, I believe, constitute the remaining species of the genus described by ancient writers, none of these has ever been confounded with the subjects of the present inquiry. The orangs, or greater apes, have been divided into several subgenera, which differ in locality, colour, and relative proportions, but agree in having the hyoid bone, the liver, and the cæcum, formed like those of man."

Our author then enters upon the first division of the great Linnæan genus Simia, viz. the subgenus *Troglodytes*, of which he gives the characters, and then details the natural history of the only species which it contains, the Man of the Woods, or *Homo sylvestris* of Tyson, commonly called the Black Orang-outang. These details are commenced with the following introductory paragraph:

"Although the Black or African Orang of all known animals bears the greatest resemblance, both in face and figure, to the human species, and, in consequence of this resemblance, has not only been honoured by the foremost place in our arrangements of the brute creation, but even placed as co-ordinate with *Man* himself, he owes this elevation much more to his organic structure than to any real superiority in his mental endowments. In a state of domestication, he is far surpassed in acquired wisdom both by the dog and the elephant; and even the much-vaunted instinctive intelligence of his natural condition is inferior to that of several four-footed creatures. That his movements and modes of life should approximate in some degree to those of the 'nobler savage,' is a necessary consequence of his physical structure, by which he is also enabled, in captivity, to imitate more closely than any other animal, the external actions of mankind; but the moral and intellectual attributes with which he has been gifted, must be referred to the fertile imagination of the natural historian. An historical account of the Orang-outang would indeed prove little else than a summary of error and misrepresentation. To say nothing of the female described by Dr Bontius, the modesty of which was so great, that she could not endure to be looked at by such of the learned Esculapian's male friends as were strangers to the domestic circle; even the sage *Linnæus*, in an early edition of the *Systema Naturæ*, has recorded his *Homo nocturnus*, or Night Wanderer, as thinking after the fashion of an intelligent creature, and giving utterance to his thoughts in a *whistling* language. The history of these animals, as given by Buffon, is equally unsatisfactory. He evidently confounds two distinct kinds, the Chimpanzé, Jocko, or African Orang-outang, and the red or Asiatic species;—the former of which is the *Simia troglodytes* (Plate V. Fig. 2.), the latter the *Simia satyrus* (Plate V. Fig. 1. and 3.) of systematic writers. It seems the more remarkable that these two creatures should have been thus blended into one, as they not only differ so widely in their external characters, but have an entirely different geographical location; the Chimpanzé, or Black Orang, being confined to Africa, and occurring chiefly in the districts of Congo and Angola, whereas the Red Orang is an inhabitant of the south-eastern parts of Asia, and the great Islands of Borneo and Sumatra. Passing by the impostures of Gamelli Carreri, it may be asserted, that the equally amusing, and scarcely more authentic, narratives, which Buffon and others have compiled from the writings of Francis Pyrard, Father Jarrie, Guat, and Froger, must be consulted with an extreme degree of caution, by whoever seeks to study the genuine natural history of these extraordinary creatures. We have in truth little of what is really authentic, especially in the history of the African Orang; the more detailed and accurate narration of some recent observers being applicable chiefly to the Asiatic species."

The history of the Black Orang is followed by that of the brown or Asiatic species, of which many amusing particulars are given from the pen of the late Dr Clarke Abel. The second plate represents a South American bird, of very rare occurrence, called the *Quezal*, which Mr Wilson classes with the *Curucui*, under the name of the Golden Trogon. This is the species which has lately excited so much admiration in the Edinburgh Museum. The following is its description and history, as given by Mr Wilson:

"Head, neck, breast, back, scapulars, wing and tail coverts, of the richest golden-green, with vivid reflections of blue and yellow. Primary and secondary wing-feathers very dark mulberry-brown, approaching to black. Inferior parts, and under tail-coverts, of a deep carmine-red. Tail black, except the two outer feathers, which are white, with black quills and bases. The two central upper coverts of the tail of extraordinary length and brilliancy. Bill in the living bird orange-red, changing some time after death to yellowish horn-colour. Feet and legs dark brown or black. Tarsi short, and covered with blackish-brown feathers, edged with golden-green. Claws brown. Colour of the iris unknown.

"Of the splendour of this rare and remarkable species, neither description nor delineation can convey any adequate idea. The greater proportion of its plumage is apparently composed of burnished gold. The head ornamented by a brilliant crest of decomposed barbs, the wing-coverts falling in flakes of golden-green over the deep purplish black of the primary and secondary quill-feathers, the rich carmine of the lower parts bestowing a warmth and depth of effect which no Venetian painter ever equalled; and the long, waving, and highly metallic feathers of the tail-coverts extending more than twice the length of the whole body, present a combination of beauty probably unexampled among the feathered tribes.

"We unfortunately know little or nothing of the natural history of this beautiful bird. It is greatly prized by the native tribes of those countries in which it occurs, who make use of its skin as an ornament of dress, when clothed in more than usual pomp, 'with feathered cincture bright.' The long feathers of the tail-covers are also employed in the head-gear of the Peruvian damsels of the highest rank. It is considered as a gift worthy the acceptance of a king, and is occasionally presented as a mark of honour to the envoy of a foreign state. I believe the first specimens, ever seen in this country, were lately brought fron Vera Paes, in Central America, by J. C. Schenley, Esq. who obtained them in the course of his diplomatic mission, and kindly transmitted one to the Edinburgh Museum. The finest example of the kind in Europe, is in the possession of the family of the late lamented Mr Canning, to whom it was likewise presented by Mr Schenley.

"Owing to the great extent of the two central feathers of the upper coverts of the tail, I have been obliged to reduce the figure, on Plate VI. to one-half of the natural size. In Mr *Canning's* specimen, these beautiful plumes measured three feet and a half in length. The female of this bird is not yet known to naturalists; from which it may be inferred, that her plumage is less magnificent than that of the male, and that, being consequently held in lower estimation, she is less frequently sought for or obtained."

The third Plate contains a figure of the *Scarlet Ibis* in a peculiar state of plumage, exhibiting the natural transition from the *Tantalus Fuscus* of Gmelin to the *Ibis ruber* of Cuvier, in other words the passage from youth to age, through the intermediate condition of adolescence. The letter-press description of this and the foregoing plate, is preceded by a short introduction to the orders and genera to which the species represented respectively belong. The fourth and concluding Plate, exhibits a picture, of the size of life, of that unique bird from the northern regions, named, by our intrepid and distinguished countryman Dr Richardson, *Ross's Gull*, drawn from the only known specimen, which was some time ago presented to the Edinburgh Museum by the Lords of the Admiralty. Its description and history conclude the second number of Mr Wilson's Illustrations.

2. *A Tabular and Proportional View of the Superior (Alluvial and Tertiary Formations), Supermedial (Secondary Rocks), and Medial Rocks (partly Secondary and partly Transition Rocks.)* By Henry T. De la Beche, F. R. S. F. L. S. F. G. S. &c. William Phillips, London.

We recommend this interesting tabular view to the attention of geologists, particularly those who are studying the geognostical relations of the rock formations of Great Britain. The practical miner, the coal viewer, even the road-maker, will find it to his advantage to consult M. De la Beche's table of formations.

3. *A Tabular View of Volcanic Phenomena, comprising a List of the Burning Mountains that have been noticed at any time since the commencement of historical records, or which appear to have existed at antecedent periods; together with the dates of the respective Eruptions, and of the principal Earthquakes connected with them.* By Charles Henry Daubeny, M. D. F. R. S., Professor of Chemistry in the University of Oxford, &c. Intended as a Companion to the Description of Active and Extinct Volcanoes lately published by the same Author. W. Phillips, London; S. Vincent, Oxford; J. Black, Edinburgh.

The excellent descriptive work on volcanoes by Dr Daubeny, and the previously published "Considerations on Volcanoes," by Mr Scrope, have directed the particular attention of British geologists to volcanoes. The subject is still in its infancy, and therefore we hail with pleasure every contribution which adds to our information, and extends our views, in regard to volcanic agency and phenomena. The beautiful tabular view of Dr Daubeny presents at a glance a well arranged, accurate, and comprehensive view of much that is interesting in volcanic history and description, and therefore we do not hesitate recommending it to the attention of the geologist.

4. *Memoir on the Geology of Central France; including the Volcanic Formation of Auvergne, the Velay, and the Vivarais.* By G. Poulett Scrope, F. R. S. M. G. S. &c. London, Longman, Rees, Orme, Brown, and Green. 4to, with volume of coloured Plates. 1827.

This work we consider as a more valuable contribution to science than that previously published by the same very active and ingenious geologist. We can bear testimony to the accuracy of his descriptions, and the correctness of his numerous illustrative geological sketches. There is less of speculative geology in this volume than in the former, a quality which confers on it a higher scientific character. Mr Scrope, we understand, is young; so much the better; for with his excellent talent for observation, combined with his enthusiasm, and great activity, much may be expected to result from his future labours.

List of Patents, granted in England, from 26th May to 15th August 1827.

1827.

May 26. To W. J. H. Hood, of Arundel Street, Strand, Lieutenant, R. N. for improvements on pumps, chiefly applicable to ships.

To G. Bruges, of Bagnigge Wells, for improvements in the construction of wheeled-carriages.

To T. Clarke, of Market Harborough, for improvements in manufacturing carpets.

June 1. To Malcolm Muir, of Glasgow, for machinery for preparing boards for flooring and other purposes.

8. To J. W. Clarke, of Tiverton, for his improved mode of attaching, fixing, or securing the deadeyes to the channels and sides of ships.

To J. C. Daniell, of Stoke, Wiltshire, for improvements in preparing wire cards, and dressing woollen and other cloths.

To C. Phillips, Esq. of Rochester, Captain R. N. for improvements on capstans.

12. To Hugh Evans, of Great Surrey Street, Surrey, Lieutenant of Marines, and W. R. Hall King, of No. 66, Snow Hill, for their New table apparatus to promote the ease, comfort, and economy of persons at sea.

15. To D. Don, of No. 9, Lower James Street, Golden Square, London, millwright, and A. Smith, of No. 28, Wells Street, Oxford Street, builder, for their methods of making shutters and blinds of iron or steel, or any other metal, or composition thereof; and improved methods of constructing and fixing shutters and blinds of iron or steel, or any other metals or materials, and methods of uniting in shutters the double properties of shutters and blinds.

16. To S. Robinson, of Leeds, flax-dresser, for improvements in machinery for hackling or dressing and cleaning hemp, flax, and tow.

To L. Dexter, of King's Arms Yard, Coleman Street, London, Esq. for improvements in machinery, communicated from abroad, for the purpose of spinning wool, cotton, and other fibrous substances.

21. To Rear-Admiral Henry Raper, of Baker Street, Mary-le-bone, for a new system of signals; first, for communicating, by day, by means of flags, &c., in which system the colours of the flags which have heretofore served to distinguish the signals, and are subject to be mistaken, may be dispensed with; and, secondly, for communicat-

ing, by night, by means of light; and which system of signals is more conspicuous, expeditious, and certain, than any hitherto employed.

June 26. To Lieutenant James Marshall, of Chatham, Kent, for improvements in mounting guns or cannon.

28. To John Felton, of Hinkley, Leicestershire, for a machine for an expeditious and correct mode of giving a fine edge to knives, razors, scissors, and other cutting instruments.

To Thomas Fuller, of Bath, for improvements on wheel-carriages.

July 3. To Walter Hancock, of Stratford, Essex, for his improvements on steam-engines.

4. To William Wilson, of Martin Lane, Cannon Street, for extracting spirits and other solvents used in dissolving gums and other articles employed for stiffening hats, &c. and converting such spirit (after rectification) into use.

To Rene Florentin Jenar, of Bunhill Row, for improvements in lamps.

To George Poulton, of Stafford Street, Old Bond Street, for an instrument for writing, which he denominates a self supplying pen.

To Thomas Sowerby of Change Alley, Cornhill, for improvements in the construction of ships' windlasses.

To Rene Florentin Jenar, of Bunhill Row, for his method of filling up, with metal, or other suitable material, the holes or interstices in wire-gauze, or other similar substances, which he denominates metallic linen.

12. To John Snelton Shenton, of Husband Bosworth, Leicestershire, for improvements in the mechanism of water-closets.

To Edward Barnard Deeble, of St James's Street, Westminster, for a new construction and combination of metallic blocks for forming caissons, jetties, piers, quays, embankments, light-houses, foundations, walls, &c.

To Robert Vazie, of York Square, St Pancras, Middlesex, for improvements in processes, utensils, and apparatus, applicable to the preparing, extracting, and preserving various articles of food, the component parts of which are of different dimensions, proportionate to their uses.

13. To William Church, of Birmingham, for improvements in apparatus for spinning.

18. To George Anthony Sharp, of Putney, for an improved table urn.

To Robert More, of Underwood, Stirlingshire, distiller, for improvements, communicated from abroad, in the process of preparing and cooling worts or wash from vegetable substances, for the production of spirits.

To Edward Dodd, of No. 62. Berwick Street, for improvements on piano-fortes.

August 1. To Thomas Peek, of St John Street, Clerkenwell, for a revolving steam-engine.

To William Parkinson, of Barton-upon-Humber; and Samuel Crosley, of Cottage Lane, City Road, Middlesex, gas-apparatus manufacturer, for an improved method of constructing and working an engine, or producing power and motion.

To Joseph Maudslay, of Lambeth, for an improvement on steam-engines.

To Lionel Lukin, Esq. of Lewisham, Kent, for improvements, partly communicated from abroad, in collars and saddles for draught and carriage horses.

To Eugene du Mesnil, Esq. of Soho Square, for an improvement in stringed musical instruments.

4. To Anthony Scott, of Southwark Pottery, Durham, for an apparatus for preventing the boilers of steam-engines, &c. becoming foul, and for cleaning the same.

To Peter Burt, of Waterloo Place, Limehouse, mathematical instrument maker, for an improved steam-engine.

13. To John Underhill, of Parkfield Iron-works, Wolverhampton, iron-master, for improvements in machinery for passing boats, &c. from a higher to a lower, or a lower to a higher level, with little or no loss of water; also applicable to the raising or lowering of weights on land.

To William Dickinson, of Bridge Street, Southwark, for an improved buoyant bed or matrass.

To Thomas Breidenback, of Birmingham, for improvements on bedsteads, and in making articles to be used in various ways, with bedsteads, from a material hitherto unused for such purposes.

To W. Alixis Jarrin, of Bond Street, confectioner, for improvements in apparatus for cooling liquids.

14. To William Chapman, of Newcastle-upon-Tyne, for improvements in waggons for railways.

15. To Henry Pinkins, of Philadelphia, North America, and of the Quadrant Hotel, Regent Street, for an improved apparatus for generating gas, to be applied to lights and other purposes.

To William Spong, of Aylesford, Kent, for an invention for diminishing friction in wheel-carriages, water-wheels, and other rotatory parts of machinery.

List of Patents granted in Scotland from 14*th June to* 5*th September* 1827.

1827,

June 14. To Philip Jacob Heisch of America Square, in the city of London, merchant, for an invention communicated to him by a certain foreigner residing abroad, with whom he is connected, "of certain Improved Machinery for Spinning Cotton."

30. To Solomon Robinson of Leeds, in the county of York, flax-dresser, for an invention of "Improvements in Machinery for Hackling or dressing and clearing Hemp, Flax and Tow."

July 2. To Lambert Dexter of King's Arms Yard, Coleman Street, in the city of London, Esq. for an invention communicated to him by a certain foreigner residing abroad, "of certain Improvements in Machinery for the purpose of spinning Wool, Cotton, and other fibrous substances."

5. To Timothy Burstall and John Hill, both of Leith, engineers, for an invention of "certain Improvements on Locomotive or Steam-Carriages."

Aug. 4. To Robert More of Underwood, in the county of Stirling, distiller, for an invention communicated to him by certain foreigners residing abroad, and discoveries made by himself, "of certain Processes for rendering Distillery Refuse productive of Spirits."

To Robert More of Underwood, in the county of Stirling, distiller, for an invention communicated to him by certain foreigners residing abroad, and discoveries made by himself, "of certain Improvements in the process of preparing and cooling Worts or Wash from vegetable substances, for the production of Spirits."

8. To William Church of Birmingham, in the county of Warwick, Esq. for an invention of "certain Improvements in Apparatus for spinning Fibrous substances."

23. To Charles Phillips, Esq. of Rochester, in the county of Kent, Captain in the Royal Navy, for an invention of "certain Improvements on Capstans."

Sept. 5. To Gabriel de Soras of Leicester Square, in the county of Middlesex, Stacey Wise and Charles Wise of Maidstone, in the county of Kent, paper-makers, for an invention communicated to them by a foreigner residing abroad, "of certain Improvements in Sizing, Glazing or beautifying the materials employed in the manufacturing of paper, pasteboard, Bristol boards, and other substances."

LIST OF PLATES IN THIS VOLUME.

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P. Neill, Printer, Edinburgh.