THE 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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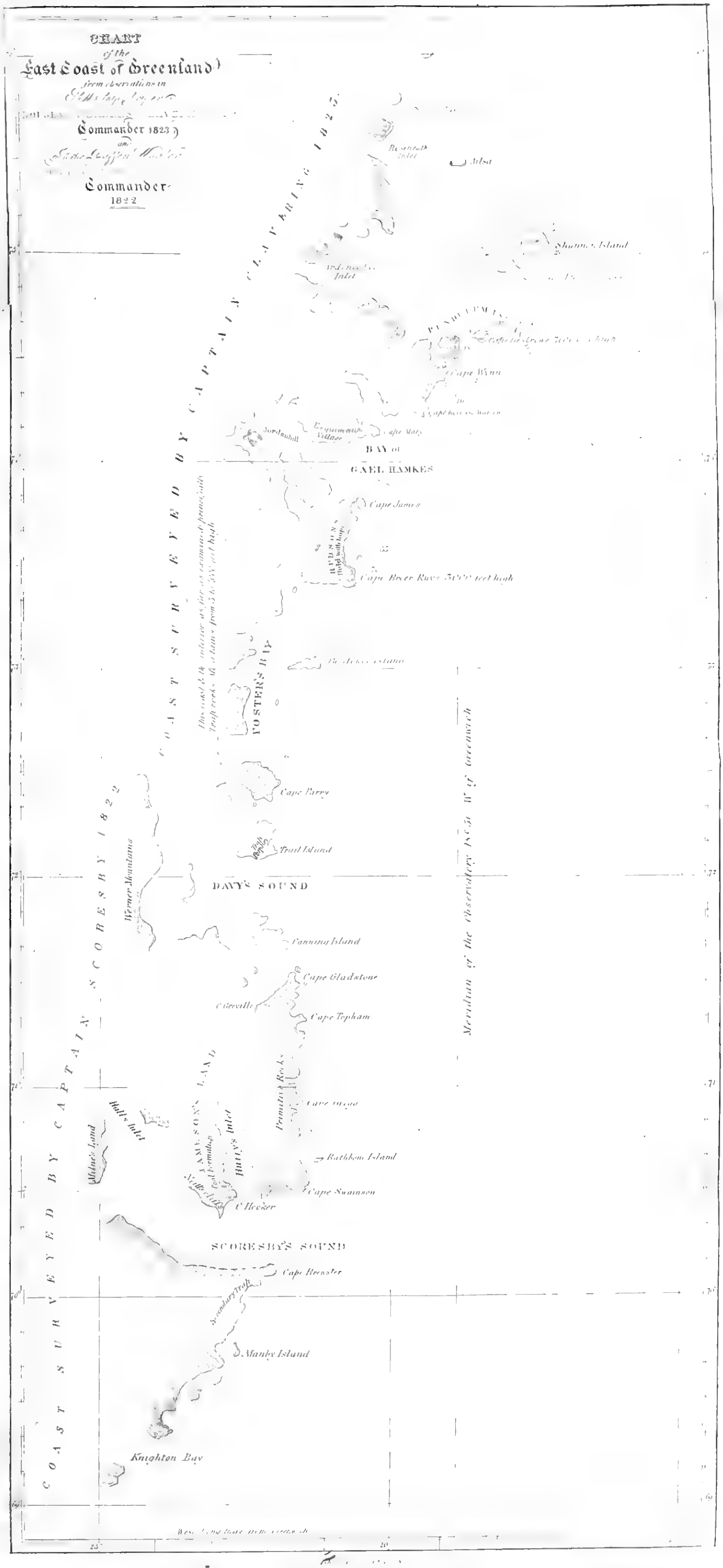
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THE

EDINBURGH NEW PHILOSOPHICAL JOURNAL.

Journal of a Voyage to Spitzbergen and the East Coast of Greenland, in His Majesty's Ship Griper. By DOUGLAS CHARLES CLAVERING, Esq. F.R.S., Commander. Communicated by JAMES SMITH, Esq. of Jordanhill, F.R.S.E.—With a Chart of the discoveries of Captains CLAVERING and SCORESBY.

MY late lamented friend Captain Clavering, previous to his departure for the coast of Africa, drew up, at my request, a journal of his voyage, and left it with me, with permission to publish it in any manner I saw proper. I delayed doing so, in the hopes that, upon his return, he might make it more fit for publication; but that event was destined never to take place. He sailed from Sierra Leone in the summer of 1827, and, it is conjectured, that, soon after, his ship was lost, and all on board perished; part of the wreck was found on the coast, but no other tidings were ever received of the unfortunate Redwing, or her gallant crew. In her commander, whose short but bright carreer was thus prematurely terminated, his country lost an officer who, by his zeal in the performance of his duty, and high professional acquirements, gave every promise of future eminence, and his friends one who was not less distinguished for his upright and honourable feelings, than for the most amiable and affectionate disposition.

Douglas Charles Clavering, the eldest son of Brigadier-General Henry Clavering and Lady Augusta Campbell, daughter of John, fifth Duke of Argyll, was born at Holyrood-House, 8th September 1794. He entered the navy at an early age, and served as midshipman, under Sir Philip Broke, in the Shannon frigate, on the American station. In the brilliant action of that ship with the Chesapeake, he distinguished himself for his coolness and gallantry, and his name was honourably mentioned in the Gazette. He afterwards served as lieutenant in the Mediterranean in the Spey sloop-of-war, and, in 1821, was appointed commander of the Pheasant, then on the coast of Africa. On his passage to join his ship, he met with Captain Sabine of the Royal Artillery, who was proceeding out to commence that remarkable series of observations on the length of the seconds pendulum, which extended from the equator to the most northerly accessible station on the surface of the earth.

He formed a friendship with that distinguished officer and man of science, which continued without interruption till his death; and, at his request, the Pheasant was appointed to the service of conveying him to the different stations. And such was the able and zealous manner in which Captain Clavering co-operated with him, that he was not only enabled to make the observations at every station in the most satisfactory manner, but without the slightest accident ever having taken place in moving the numerous and delicate instruments to and from the ship. The observations were made on this voyage at Sierra Leone, the Island of St Thomas, Ascension, Bahia, Maranham, Trinidad, Jamaica, and New York. In the course of the voyage, Captain Clavering, in conjunction with Captain Sabine, executed a valuable and extensive series of observations on the direction and force of the equatorial current, which, following the course of the trade-winds, is deflected by the coast of America to the northward, into the Gulf of Mexico, from which, passing between Cuba and Florida, it returns again into the Atlantic, under the name of the Gulf Stream.

The results of these experiments, illustrated by a chart, have been published by Captain Sabine in his Account of the Pendulum Observations. Much of the value of such observations must depend on the accuracy with which the ship's reckoning is kept. Captain Clavering, by his judicious arrangements and personal superintendence, introduced such a degree of precision into the reckoning, that it became little inferior as an element in the deduction of currents, to the observed difference of latitude and the chronometrical difference of longitude. Massey's selfregistering log was used as a check upon the estimated reckoning, and proved the value and efficacy of the attention paid to the latter, by its being a rare circumstance to find a difference between them amounting to a mile in twenty-four hours.

Upon the return of the Pheasant to Great Britain, the Board of Longitude determined that Captain Sabine's Observations on the Pendulum should be continued to the most northerly latitude to which it was possible to reach. For this purpose the Griper, which was one of the vessels that had been engaged in Captain Parry's first expedition in 1819–20, was selected, and Captain Clavering appointed to the command.

It will be seen that he availed himself of every opportunity that presented itself for prosecuting discoveries, and enlarging the boundaries of geographical science. A considerable part of the east coast of Greenland explored by him, was seen in the preceding year by Captain Scoresby; but, from his distance from the land, that able navigator had not the same means of laying it down correctly to the north of Cape Parry which he had to the south of that headland, when he was close in with the land. In the chart the discoveries of both navigators are laid down, and form an actual survey of the coast from Lat. 69° to Lat. 76°; for, although Captain Clavering did not reach farther north than Shannon Island, yet the positions of the bluff head lands to the north of Roseneath Inlet, and the islands named, from their appearance, Haystack and Ailsa, were determined by astronomical bearings from two hills, one on the outermost, and the other on the innermost, of the Pendulum Islands; and the distance between the two stations was ascertained by a trigonometrical operation.

Although the principal object of the voyage was to convey Captain Sabine to the different stations, Captain Clavering did not consider it necessary to give any of the results of his observations in his account, as they were already published, and well known to the scientific world.

I. *Voyage from the Thames to Hammerfest in Norway.*

1823, March 1.—This day I received my commission to command the Griper Sloop-of-war, then lying at Deptford, and immediately commenced fitting her out for the intended voyage; and, in consequence of her having been already strengthened for an Arctic voyage, little delay took place in the equipment. I had the vessel fitted with a patent capstan, which afterwards proved of essential service in warping amongst the ice.

The Griper was originally a gun-brig of 180 tons; but having been raised upon six feet, when the coals, water, and provisions were on board, the buttocks and the whole of the dead work were completely immersed in the water. Under these circumstances, swiftness in sailing was not to be expected. To aid us in exploring the coasts of Greenland, I applied for a cutter to accompany us; but this the Lords of the Admiralty did not think fit to grant.

We were ready for sea by the beginning of May, and on Saturday the 3d, cast off from the Hulk at Deptford. We tided it down to Galleor's Reach, where we took on board our guns and powder. In the evening received Admiralty orders to proceed to the Nore.

May 4.—On the following day weighed with the tide, and worked down, with a strong easterly wind, a few miles below Woolwich, where we anchored. Soon after, a collier came athwart our hawse, and I feared would have carried away our masts; we, however, cleared without any material damage.

Monday, May 5.—The wind still easterly, weighed and worked down with the ebb as far as Gravesend. I found the ship to stay and work well. We anchored at the Nore on the 7th; and, as this was a fair trial in smooth water, I considered her to stand tolerably well up under her canvass. The three following days were employed in repairing the damages we had sustained, and in preparing for sea.

My attention was also directed to ascertain the local attraction of the ship, by swinging her round to every point of the compass, and taking the bearing of a distant object, and then ascertaining the true variation of the place. The difference is the deviation caused by the attraction of the ship, which we found here to be 26° when the ship's head was at right angles with the magnetic meridian, and diminishing till the line of the ship coincided with it, when there was no deviation. To correct this, Mr Barlow's plate was applied, at such a distance behind the compass as to compensate for the attraction of the ship. This was ascertained by taking the compass on shore, and placing the plate at such a distance as produced the same effect which the iron did on board. At that distance it is then placed abaft the compass. With us it was placed with its centre $7\frac{5}{8}$ inches below the horizontal plane of the compass card, and $8\frac{1}{4}$ inches from the perpendicular line which passes through its point of support.

Our compass, with its plate affixed, is placed on a three-legged stand, so high that the distant bearings can be taken from it. This, of course, the helmsman cannot see. We have therefore another, or steering compass; the courses are, however, to be registered from the one with the plate. It will be seen how completely successful this plan proved. It had not hitherto been tried in high latitudes, where, however, it is of most essential consequence. In these experiments I was principally assisted by Mr Henry Foster, one of my midshipmen, who had formerly made trials by Mr Barlow's desire, but being in low latitudes the results were less remarkable.

May 9.—This day I received my instructions, which were to the following effect:—

"You will put to sea with the sloop you command, and proceed to Norway, about the latitude of 70°, where Captain Sabine will make observations upon the pendulum. Upon his having completed them at that station, you will make the best of your way along the west coast of Spitzbergen, and in the best part you can find, about the parallel of 80°, he will again make farther observations. He is to have every assistance afforded him that he can require, or you can give. Upon their being completed, you will proceed, if the ice will permit, to endeavour to make the eastern coast of Greenland, along which you will proceed northerly, as far as the season will allow, consistent with the safety of the vessel, in order to afford Captain Sabine opportunity of repeating his experiments on that coast in the highest latitude which can be safely reached; and, when the obstructions you may meet with from ice shall induce you to return, you are to make the best of your way to Deptford, and report your arrival to us.

"Although it is our intention and desire that you should return to England at the close of this season, yet, as it is possible that unforeseen circumstances may occasion your being caught in the ice, and unable to extricate yourself, we have thought it prudent to order the sloop you command to be fitted and stored in such a manner as will enable her to winter in those high latitudes, if you should find yourself obliged by the circumstances before alluded to, to do so. In such an event you will choose the safest and most convenient port you can find, using every possible precaution for the preservation of the ship's company from the effects of cold, and by proper exercise and diet, and the use of the means with which you are furnished, prevent those diseases most prevalent in cold climates.

"On the supposition of your having wintered on the coast of Greenland, you are, in the succeeding summer, as soon as the navigation shall be open, to make the best of your way to England. If, however, on your return, either in the present or following year, Captain Sabine should be desirous of visiting Cape Farewell, or any other part of Iceland, for the sake of repeating his observations at either of those places, you are at liberty to do so."

We weighed anchor early in the morning of the 11th, and made sail, running through the King's Channel, and proceeded without any material occurrence till Saturday 17th, when we descried the coast of Norway, distant about thirty or forty miles. From this time, till our arrival at Hammerfest, we had a good sight of the land, having ran along it for upwards of 300 miles. It is from 1500 to 2000 feet high, rising abruptly from the sea. The mountains are caped with snow, without the least appearance of vegetation. The coast is indented with numerous fiords, or arms of the sea, that run forty or fifty miles inland, and, from the similarity of the head-points, are difficult to be made out, and easily mistaken by those who are not cautious and correct in their reckoning. It seems but little known to most navigators, and apprehended as dangerous; but, although it is an iron-bound coast, without soundings, it lulls in-shore, and, even should the gale blow home, situations for shelter will generally be found among some of the numerous openings. Anchorage may not always be obtained, but, in general, will be found pointed out by that land which terminates in a level. Whatever dangers there may be on the coast, will, with a very few exceptions, show themselves, particularly in bad weather, when the sea breaks high.

We had favourable winds as far as the Laffoden Islands, and I was in hopes of reaching Hammerfest by the 22d; but a succession of calms and contrary winds lengthened our passage till the 2d June. By speaking with fishing-boats, we were enabled to grope our way along a coast so difficult to distinguish, and on the charts of which we could place no dependence. I was particularly unwilling to commit any error by running into a wrong inlet, as the Griper's sailing would hardly have compensated for the time we must necessarily have lost.

On the 18th, in taking azimuths, found a variation of 16°

between N.E. and N., which was attributed to the local attraction of the ship, agreeing nearly with that found at the Nore. The true variation was considered to be 25° W.

Till the 26th we had a succession of calms and light winds, which, though accompanied with delightful weather, was extremely irksome, as we all anxiously looked forward to the more distant objects of the voyage, and considered we had but little time to spare.

May 31.—A boat came alongside and informed us, as nearly as we could understand, that we were about fifty miles from Hammerfest. Bore up and made all sail along the land. Next day we hoisted out a boat, which was sent ashore for a pilot. In rounding the north end of the Island of Soroe, we experienced heavy squalls off the land, which reduced us to double-reefed topsails. On Monday the 2d June, entered Hammerfest harbour, and anchored in sixteen fathoms, clay bottom.

No time was lost in disembarking the instruments, and erecting the observatory, tents, &c., the whole of which were found to answer exceedingly well, and Captain Sabine was ready to commence his observations the third day afterwards, had the weather continued clear. We saluted the fort with eleven guns, which were returned.

The natives here are kind and hospitable, and pleased at the idea of a visit from even such a man-of-war as the Griper. The women are fair and pretty, and dress much like our own. Remote from the civilized world, they are untainted by either its vices or its wants. Morality and religion strictly predominate, and deviations from either are rare. Mr Crowe, an English merchant, who also acts as consul, resides here, and paid us much attention. By a vessel of his which had been at Cherry Island early in March, we learn that the sea was more than usually open, and clear from ice, which generally extends in a compact body from thence to Cape Look-Out. We may therefore expect an open season, and hope to reach Magdalene Bay without any obstruction.

This place, built on a small island, named Qualoën or Whale Island, consists of about a dozen of houses. The bay is small, but the anchorage good and safe. There are no provisions to be got here, with the exception of reindeer, which were cheap, and afforded a seasonable supply, as the parties which had been sent out in search of game were by no means successful, killing but a few brace of grouse, and some wild ducks.

The trade of the place is entirely in fish and oil. On the 14th I dispatched the boats, with four days provisions, in search of whales, but a gale of wind coming on, with sleet, prevented them from being successful. A short time before our arrival one was found stranded in a bay. When the tide left it, the fishermen who found it immediately began to flench it, and had actually cut a quantity of blubber off the back, when a person who resided near the spot, persuaded them it would be more profitable if it was towed into Hammerfest. They accordingly fixed two grapnels through its nostrils, and a hawser round its tail, with which they hauled it off at high water, and made it fast to two boats. It had not been long in deep water before it began to evince evident signs of life, and soon after made a start off with the boats, which it dragged for twenty miles, although there was a smart breeze at the time, and the fishermen, in order to obstruct its progress, hoisted the sails, and laid them flat a-back to the mast. They were in the end compelled to cut the rope, being in danger of swamping, and thus lost the fish. They were so much enraged with the person who persuaded them to remove the whale, that they actually prosecuted him for the advice he had given them.

Captain Sabine having finished his observations, I sent a party on shore, on Monday the 23d, to strike the tents and observatory, and hoisted the launch in. The situation of the observatory, Lat. 70° 40′0″ N.; Long. 23° 45′ 45″ E. Variation 11° 26′ W. Dip 77° 40′.

This day I swung the ship round the points of the compass, to ascertain the amount of the local attraction, and noted the differences with a compass on the mast-head, as well as on the deck at the standard compass. The amount of deviation, which was at the Nore 26°, is here 50°; whilst the variation of the place, as found by Captain Sabine, is only 11° 26′.

During the whole of our run to this station, we had most satisfactory experience of the utility of Mr Barlow's plate. The course steered by it agreed very nearly with our astronomical observations; whereas that deduced from the compass without the plate, gave us sometimes an error of thirty miles even in a short run. The deviation of this ship is greater than any of those in the former voyages. We attribute this to the patent capstan, which stands but eight feet from the compass, and has an iron spindle. We have also two chain-cables, and both of them present a surface that is perpendicular, which is considered to have more effect than a horizontal one.

I am convinced upon serious reflection, that the loss of ships, particularly in the North Seas, is more to be ascribed to the deviation of the compass, than to currents, tides, or other unusual causes. All the Greenland traders acquire from experience the knowledge that the same course steered going out will not take them back again, and they therefore allow three-fourths, or a point more. How far Mr Barlow's invention may come into general use, I am not prepared to say; the utility of it on board this ship is incontestible, and must be proportionably so in all vessels having patent capstans, iron-tanks, and chain-cables. Within the tropics its effects are not so perceptible; but, in high latitudes, every man-of-war ought to be provided with one.

II. *From Hammerfest to Spitzbergen.*

We left Hammerfest on the evening of the 23d June, and had scarcely cleared the land before a favourable gale sprung up, and carried us rapidly towards Spitzbergen. We fell in with the first ice on the 27th, when abreast of Cherry Island, in Lat. 75° 5′ N., being then scudding under a close-reefed main topsail and foresail; but as the sea was smooth, owing, I presume, to a considerable body of ice lying to windward, I did not hesitate in continuing to run. It was principally a loose open stream, extending for a distance of about sixty miles. We were obliged, although the gale still continued, to set the close-reefed fore topsail, the ship requiring more head-sail, that she might better answer the helm, it being necessary to keep her under full command, to steer clear of the ice.

At this time the gale was at its height. This being the first introduction to the ice to most of us, the novelty of the scene rendered it intensely interesting. The ship received several severe shocks; but from the mode in which she was strengthened, did not seem to feel them. On one occasion, from bad steerage, we ran bump against the middle of a floe that completely stopped her way, and almost threw us off our legs; even this did not seem to affect her, though we were careful not to repeat the experiment: by making all snug, and getting the top-gallant-masts on deck, she went boldly through it at her extreme rate of seven knots, with the wind a-beam. Notwithstanding the severity of the gale, with the thermometer at 32°, not the slightest inconvenience was felt, but rather a cheerful bracing effect, as the weather had become clear, with the sun shining brilliantly, such as we have in the clear frosty mornings of October; splicing the main brace, and issuing the extra warm clothing, seemed to produce general good will and activity fore and aft. Had the weather been favourable for such a purpose, it was my intention to have made Cherry Island, and laid down its true position, but I did not consider it a matter of sufficient consequence to risk any delay, especially as the wind was now so favourable for our ulterior destination.

Towards the evening it became more moderate. At 7 P. M. we saw Spitzbergen, N. E. per compass, distant 50 or 60 miles; the land drift-ice completely surrounded the ship, but, by carrying sail, an hour's forcing brought us into a clear sea.

Our Greenland pilots considered it to be heavier, and in a greater quantity than usual in this latitude, and at this season. The following days the weather was moderate, and we met with no farther obstruction during our run along the coasts of Spitzbergen. On the 28th we hoisted out the jolly boat, to try if there was any current, but found none. Sounded in 65 fathoms, muddy bottom.

On the 29th we passed many pieces of land-ice, upon one of which we observed several walrusses, about twenty in number, and dispatched a boat to endeavour to capture some of them. They allowed the boat to approach quite close to them, only a few jumping into the water. The rocket-gun was fired, but missed. They were then attacked with rifles, apparently with more effect, as appeared from the blood flowing copiously from their wounds, and a harpoon was struck into one of them, which held but a few seconds. They were pursued for some distance, but being unaccustomed to behold these huge animals plunging around us, we were all more intent upon preparations to repel their attacks, than to think of reloading, and they finally escaped. We were more fortunate in the afternoon, and captured one. The animal, after it was harpooned, attacked the boat, and once struck its tusks so hard, as to start two of the planks; the others tamely looked on while their comrade was killed.

On other occasions, when, from experience, we learnt not to dread them, no accident occurred, and I consider that the circumstance of several uniting in attacking a boat is rare. They are extremely slow and unweildy in their actions, and may be easily boomed off with a boat-hook, when presence of mind is retained. Should they, however, succeed in getting their tusks over the gunnel of the boat, it must be capsized, as the weight of the crew on the opposite side would not be sufficient to retain the balance.

30th.—Moderate breezes, with a thick fog, through which we had occasional glimpses of the land. At 9, saw the North Foreland, distant four or five miles. We kept running along shore at the distance of about five miles. The land high, rugged and barren; the tops and valleys were covered and filled with snow. At 6 P. M. we braced up, rounding Hackluyt's Head, until which period we did not discover that we had passed Magdalene Bay, which we intended to have made the station for Captain Sabine's observations. I again made sail, with the intention of anchoring between Vogel Sang and Cloven Cliff. At 8 the fog totally dispersed, and the sea, from the mast-head, perfectly clear of ice, from west northerly to north-east, and only loose land-ice in the eastern quarter, all of which appeared penetrable. I sent two boats to examine the islands, as well as to select the best station for the observatory.

Anchored at midnight in 17 fathoms. The following morning weighed and towed the ship, about 2½ miles farther in, and brought up in 7 fathoms, a-breast of a small island, one of the Inner Norways, the same upon which Captain Phipps made his observations in 1773, and steadied the vessel, with a warp to the shore. We immediately proceeded to disembark the tents and instruments, and sent parties on shore to erect them. Two reindeer and a walrus were killed on the Island of Vogel Sang. The weather was calm, and the air mild and agreeable. Temperature 45°.

On the 2d June, the parties on shore were employed in erecting the tents and observatory, and also two huts, for the greater convenience of the party I proposed to leave behind, to assist Captain Sabine during my absence,—having determined to employ the time requisite for completing the pendulum observations in endeavouring to push as far as I could towards the north. The favourable circumstances of our passage hither, and the open appearance of the ice, gave me flattering hopes of advancing as far as any former navigator.

On the two following days we were engaged in the necessary preparations for the party which was to remain behind. Our sportsmen were successful in procuring game. Much loose ice about the ship, which was occasionally so completely blocked up as to prevent communication with the shore, and one of the whale-boats, was severely crushed by its suddenly setting in upon the ship.

I left a party of six men to assist Captain Sabine, under the command of Mr Foster, with Mr Rowland, assistant-surgeon, with our largest boat (the launch), which could have carried them to Hammerfest had any accident happened to the ship, and six months' provisions and fuel. Mr Foster was instructed, in the event of the ship's not returning by the 20th, to prepare for sea, but not to quit the present station before the 15th of August, after which he was at liberty to act as might seem best for the safety of his party.

III. *Unsuccessful attempt to reach from Spitzbergen a high Northern Latitude.*

Every thing being ready by the evening of the 4th June, I sailed with a favourable breeze next morning. No ice was in sight from the mast-head. At 1 P. M. sounded in 16 fathoms, sand and shells, passing two small rocks even with the water's edge, the sea breaking over them. They bore from Cloven Cliffs per compass N. E. by E. ½ E. 4 miles. About 3 P. M. it became hazy, and we lost sight of the land. A thick fog came on when we had just cleared the islands; and when we had run due north 25 miles from Cloven Cliff, and were in the act of heaving the ship to, we found ourselves suddenly embayed amongst the ice, and, before we could wear, the ship struck: failing in backing her out, and the ice beginning to beat against the rudder, we forced her about two cables' length farther in, where she lay quiet from the influence of the swell for 24 hours. We attempted ineffectually to warp the head round to seaward. In the evening, however, we succeeded, and were ready to take advantage of the first opening. Sounded in 115 fathoms, fine sand.

On the 6th, after a light air from the N. W., the fog dispersed, and presented to our view packed ice, extending nearly east and west as far as the eye could reach, being apparently driven upon the main body by the late southerly gales. We observed this day in 80° 20′ N., which proved to be our highest latitude. A shift of the wind from the eastward enabled us to warp out, and we made all sail, ranging along the ice in a westerly direction. We skirted the margin in a line nearly east and west, for about 60 miles, but did not proceed farther to the west, as the ice began to trend towards the south. During this run, the ice was everywhere closely packed and cemented, without any appearance of an opening, and no signs of clear water beyond it from the mast-head. I have no doubt but northerly winds would have dispersed it, and, had the nature of the service admitted of a delay, no doubt but I would have reached as far as Captain Phipps or Captain Buchan. Had I reached the main body of ice, it was my intention to have attempted to proceed a degree or two nearer the pole, having, for this purpose, been provided with a light Portsmouth wherry, which could have been dragged over the ice.

On the morning of the 8th, finding we were led so much to the southward without any prospect of getting to the northward, we tacked and stood off to the east. Next day we again found the ice to trend to the S. E., and finally joining the land without any appearance of an opening. We fell in with the land 15 miles E. N. E. of Fair Haven, for which we made sail. On the night of the 10th, we passed close to some small rocks lying off the outer Norway, and bearing from Cloven Cliff E. N. E. from

3 to 4 miles; they are quite bold. The shoalest water we had was 7 fathoms, at the distance of 50 yards. They would be dangerous to strangers, as they would hardly be looked for at that distance from land; and without a good look-out they are not to be seen till close upon them.

11th.—We reached our former anchorage early this morning, and found our party well, and in good spirits.

The remainder of our stay in Spitzbergen was employed in overhauling the ship's rigging, and preparing for the further prosecution of our voyage. Our surveys of Fair Haven and the adjoining islands corroborated that of Captain Beechey, which was found, in every instance, to be remarkably correct; but we found them much at variance with that of Captain Phipps. Captain Sabine, besides completing the observations on the pendulum, measured the height of the nearest accessible hill, both barometrically and trigonometrically, the results agreeing within two feet.

During our stay our sportsmen were very successful, and we killed nearly fifty reindeer, which gave us an ample supply of fresh provisions. Fair Haven has been so often visited and described as to render any remarks of mine unnecessary.

IV. *From Spitzbergen to the East Coast of Old Greenland—Exploration from Cape Parry to Rosneath Inlet—Meeting with the Natives—Account of them—Finally quit the Coast and return to England.*

The observations * having been completed, every thing was re-embarked on the 22d June.

Wednesday 23d.—Although a considerable fall in the barometer indicated an approaching gale, upon opening the point of Hackluyts Head we experienced some heavy squalls, with a head sea; and finding we could not beat up to Smeerenberg, bore up for our former anchorage, where we remained till the 24th, when we again sailed with favourable weather, passing through Smeerenberg Sound. We sounded occasionally with the hand-lead, in the middle of the channel; no bottom. At a mile distant from the west shore, we had from 5 to 20 fathoms; at six rounded the S. E. point of Danes'

* Latitude of Observatory 79° 49′ 58″ N. Longitude 11° 40′ 30″ E.

Island in 5 fathoms, a shoal extending nearly half a-mile off the point. The leading mark for hauling round the Danes' Island is a small rock off Bluff-point, on with the middle of two others to the S.W. of Wolf Island. This clears the shoal off the point. At this time, though almost calm, the tide set up about $1\frac{1}{2}$ knots through the channel.

We passed through the south gut, which is a passage $\frac{3}{4}$ths of a mile broad. When passing Wolf Island, the soundings were various, being from 5 to 6 fathoms in the middle, and deeper on the sides. Very irregular, being from 3 to 30 fathoms; it is however, a good and safe channel, and no dangers but what the lead and eye may discern.

It being now our object to reach the coast of Greenland as expeditiously as possible, I resolved to steer a course that would take me clear of the ice, although, had I not been restricted in time, and by the heavy sailing of the ship, I should have deemed it desirable to have examined the margin of the main body of the ice to the S. W. Being, however, determined not to be detained by any researches however interesting, I made a S. W. by S. course (true) from Hackluyts Head. A Dutch chart, published at Amsterdam in 1664, placed Gael Hamke's Bay in Latitude 74°. This I considered the best authority, for Greenland being known so far to the north, and accordingly I made for that part of the coast.

We proceeded on our voyage with favourable winds, the weather moderate, but foggy. When it cleared away, we frequently saw the ice, and on the 29th passed much heavy ice which obliged us to luff and bear away; occasionally in the evening, a heavy swell from the S. E. often caused it to close the passages that but a few minutes before presented themselves as easy for the ship to pass through. We were obliged to tack and trace our way back for above a mile, when we hauled round a floe and stood to the S. E., which brought us, after some trouble, into a clear sea, when we found a heavy cross swell, as if it had recently been blowing a gale. The weather, however, continued to favour us. On the 2d July, upon the fog partially clearing, and the ice appearing to run into a deep bight to the westward, in the Latitude of 75° 10′, we hauled up with the intention to penetrate through the barrier, and endeavour to make the coast of Greenland. We now pushed due west, and soon found ourselves hampered amongst immense fields of ice. On the 3d, the light winds and fog continued, we found ourselves frequently in very narrow channels; and not being able to see our way we received some shocks, though not of great importance. The water being smooth, and the ship having but little way upon her, my anxiety to get forward made me continue to advance, when perhaps it would have been better to have made fast to a floe.

In the afternoon the sun began to appear, and the fog dispersed. We found ourselves close to an extensive field of ice, the termination of which we could not discover. Hauled up to the S.W. and S. The winds continuing light and favourable, set the studding-sails, and, by tying the tacks along the yards, were able to brace all round together when necessary, to alter our course for the ice. From the appearance of the sky, we concluded there was clear water beyond it to the westward.

On the 4th the weather was clear and favourable. Continued to advance along the edge of the ice, the termination of which we could not yet observe. Beyond it we discovered land N.W. by W. Estimated distance 50 miles. At noon hove-to, and sent a boat to a piece of ice to observe the latitude, which was found to be 74° 4′ 47″. At one, our course was impeded by a narrow channel; shortened sail and warped through it, and again made sail in the evening: it was foggy; but having observed the channel to lead in with the land, before it came on, we continued our way close along the edges of the fields of ice, making or shortening sail when necessary.

Tuesday 5th.—Impeded by the ice we shortened sail and cut our way into a narrow channel, when we made sail, but were again interrupted,—clewed up and furled with the yards at the mast-head, and were employed several hours in warping, tracking, and towing, the ice being close and heavy, with a few pools of water apparently leading in with the land, which appeared to be about 7 or 8 leagues distant. Latitude observed, 74° 4′. The three following days we were engaged in the same manner, forcing our way through the barrier from one lead to another; frequently stopped altogether for several hours at a time. During these four days we were engaged passing the barrier of ice, our patent capstan proved of signal service, heaving aside floes of ice which astonished every person on board, although we rarely put our whole strength to it, as we were sure to break any hauser we had on board, the largest being 7 inches. We gained the shore on the 8th: we found a channel of several miles in breadth within the barrier; there was much loose ice, but nothing to prevent navigation; sounded in 51 fathoms, brown sand. I went ashore at night to examine the land. Never was a more desolate spot seen; in many places not a vestige of vegetation; the land high, from 2000 to 3000 feet, near the coast; in the interior much higher. There was not so much snow as at Spitzbergen, nor did the mountains present the same angular and broken appearance, being rounder and flatter on the summits; but no reindeer, no birds, or whales—indeed we had not seen a whale since we left Hammerfest. Spitzbergen was, on the whole, a paradise to this place. The point on which we landed was named Cape Borlase Warren. The shore appeared bold and safe; some remains of the huts of the natives were found, and signs were observed of their having been recently in the neighbourhood. We returned to the ship early next morning. Soundings 11, 13, and 14 fathoms, sandy bottom, about 2½ miles off shore; the land too much obscured by the fog to admit of bearings being taken. It being nearly calm the ship drifted to the N. E. We observed, on landing, that the tide was going to the N. E.; and during the time we were ashore it had fallen 7 inches. About noon, made fast to a floe a-ground, the tide seeming to drift the ship in a contrary direction. When the tide turned, cast off and sent a boat a-head to tow.

As the whalers have dwelt much on a strong current invariably setting to the southward on the east coast of Greenland, I shall merely observe, that, with the exception of one day, in which the difference of latitude was 18 miles more than the reckoning gave us, we never had reason to think there was any strong current, and certainly none in-shore. The tides, too, were scarcely perceptible, the rise and fall not exceeding 3 feet.

The coast here trending to the N. E., we coasted along shore in that direction, working to windward amongst floes of ice. On the 10th, we discovered two islands which we afterwards named Pendulum Islands, having been the station on which the observations were made.

11th.—Strong breezes from the N. N. E.; the sky being perfectly clear we had a good view of the land; the interior at a considerable distance, very high. The nearest land seemed to consist of a group of islands with deep bays, between which there was no passage from the ice. At 10 A. M. shortened sail and made fast to an iceberg a-ground in 7 fathoms, off shore about half a-mile. Sent a boat on shore to make observations and to examine the state of ice round a point of land. Latitude observed 74° 55′ N. We again made sail in the afternoon, and proceeded to the northward with a fair wind; we were, however, impeded again by greater quantities round the ship than usual, the passage near the land becoming much confined. At 11 P. M. we shortened sail, and made fast to the level ice, the passage being completely obstructed, with no appearance of water to the northward or N. E. I sent a party on shore to ascend the hills, and to examine the state of the ice.

12th.—Next morning, the ice beginning to set in upon the ship, we cast off and made sail to the southward; at six hove-to and sent a boat for the party on shore, and fired a gun as a signal; at eight the boat returned, and reported that the ice to the north formed a solid and compact field, with no open water except by the way we came. However anxious I felt to explore the coast farther to the north, my instructions imperatively required me to land Captain Sabine for his observations. I therefore reluctantly bore up for a secure anchorage, which was not afforded in our present situation. We had now reached what I considered the N. E. point of Greenland, which is formed by an island in Latitude 75° 12′ N., and Longitude 17° 45′ E. We ascended the heights on shore, from which we plainly saw very high land due north, at least as far as 76°. The island we were on being low and lying off the main 30 or 40 miles, I named Shannon Island, and the cape at its S. E. extremity Cape Philip Broke, from the ship it was formerly my good fortune to serve on board, and her gallant commander. Two remarkable rocks or islands were named, from their resemblance, the Haystack and Ailsa, and an inlet within them Roseneath Inlet. An extensive opening which bore due west from Shannon Island was named Ardencaple Inlet, from the residence of my friend and relative Lord John Campbell. Having hoisted the boat on board, we made all sail to the S. W. In the afternoon the wind increased, with heavy squalls off the land, and the ship was reduced to close-reefed top-sails; hauled to the wind on the starboard tack, the ice having changed its former position; set the mainsail to prepare to weather a floe of ice. At four we ran through a narrow passage between the land and ice, in one place forming scarcely more than a ship's breadth off shore; we sounded a quarter less 4. At five sent a boat to sound, and stood off and on till her return. We anchored in $3\frac{3}{4}$ fathoms a quarter of mile from the shore, between two islands.

13th.—Strong gales, with heavy squalls off the land; the ship drove, but brought up by letting go the small bower. Upon the gale moderating, hove in the starboard cable, and found the best bower gone by the ring. I dispatched a party on shore to take distant bearings from the hills, and a boat to sound for a secure berth for the ship. In the afternoon we weighed, but the ship almost immediately grounded in $2\frac{1}{2}$ fathoms; and before the stream-anchor could be laid out to heave her off, the tide fell so much as to give a considerable heel to port. We landed several articles to lighten her; the night was fortunately calm; we laid out another warp to heave her off at high water.

14th.—We hove the ship off next morning, and towed her about a mile farther up the bay, where she was safely moored. We proceeded immediately to land the observatory and tents, and parties were employed on shore setting them up.

15th.—Next day was employed in landing the instruments, and in preparing the yawl and wherry for a distant excursion, to examine the coast whilst Captain Sabine was engaged in his observations.

16th.—I left the ship at noon, with two boats, provisioned for three weeks. Our party consisted of three of my officers and sixteen men. The weather being calm, we pulled along shore till 8 P. M., much impeded by the bay-ice, the sure companion of a calm in these latitudes. Having come a distance of eighteen miles, we landed at Cape Borlase Warren, which forms the northern entrance of a large bay, where we pitched our tents for the night. With a stove in each of them, and wrapped up in our boat-cloaks and a blanket, we lay down to sleep in our clothes, and found no inconvenience from the cold. The external temperature was 28° Fahrenheit. The same method was adopted for twelve nights, and we never found ourselves the least incommoded by the cold. The average temperature was 37°, the extremes 53° and 23°.

At this station, which was named Cape Borlase Warren, we found traces of the natives, and also several graves, and hoards of blubber, which are piled up all along the shores, and are marked by heaps of stones being placed over them, and which also keep the birds of prey from devouring them. Their graves did not remain free from our curiosity; we opened some of them, but nothing but a few mouldering bones was discovered.

August 17.—Next morning, after taking the necessary angles and making observations for our survey, we embarked at 9 in the morning, and proceeded westerly along the shores of the bay, still pulling. In the afternoon a fresh wind sprung up off the land, and the wherry coming in contact with some hard bay-ice, had her bows cut through, and the water rushed in so fast, that we had much difficulty in preventing our provisions from being spoiled. After an hour's constant bailing, we reached the first headland, where we hauled the boat on shore to repair, having made a distance this day of sixteen miles.

On examining the boat's bows, both were found to be much cut by yesterday's expedition. We took out the old planks and replaced them by others, doubling them, which we found to be the most effectual security against farther accidents. We found here more recent traces of the natives, so that we began to look anxiously for them; it rained and blew hard during the night, but as our tents were under the lee of some high rocks, we remained both dry and warm.

18th.—In the morning several whales were seen for the first time *. The weather moderating in the afternoon, we continued our voyage, still coasting along the shores of the bay, which will be better understood by reference to the chart. We reached

* I cannot but consider our having seen so few as somewhat remarkable. From the appearance of the sea and ice, the Greenland Pilots thought we were upon good ground, and were continually expressing their astonishment at the absence of these animals.

our third station at 11 P. M., a distance of seventeen miles, which was also found a convenient spot for encampment.

On the yawl's coming up, which had been left much behind, I was informed the natives had been seen about a mile from our present situation. I immediately proceeded to the spot, and found a small tent, made up of seal-skin, pitched upon the beach, within a few yards of the high water. There was nobody in it; the inhabitants, having become alarmed on seeing us, had retreated to some high rocks at a short distance. We observed two of them watching our motions. Accompanied by one of my officers, I advanced towards them, making such signs of goodwill and friendship as occurred to us. They allowed us to approach the base of the rocks, which were about fifteen feet high. We deposited a looking-glass and pair of worsted mittens, and retired a few steps, upon which they immediately came down and took them up, withdrawing immediately to the top of the rock. After allowing them a few minutes to examine them, we again approached, when they permitted us to come close to them and shake hands,—a ceremony they by no means seemed to comprehend, trembling violently the whole time, in spite of our best endeavours to inspire them with confidence. We now led them to their tent, which we examined more minutely, and which we gave them to understand we greatly admired.

The tent was small, occupying a space about twelve feet in circumference, and about five in the highest point in the middle; the frame-work was composed of wood and whalebone; the former they must have picked up along the shore.

There was a small canoe, capable of containing but one person at a time, which was also of seal-skin, and in no respect different from those described by Crantz or Egedé. Their harpoons and spear, were lying at the side of it; the handles were of wood, the points tipped with bone, and some of them with iron, which had all the appearance of being of meteoric origin. We now shewed them our boat, which they were unwilling to get into from fear. Leaving them for the present, we returned to our tents for the night.

19th.—Next morning we were very anxious to renew our intercourse with our Esquimaux friends, and were happy to find that we had been successful in inspiring them with confidence. In the course of the day, men, women, and children found their way to our tent. They brought with them large pieces of blubber, being the flesh of the seal and the walrus, which they offered for our acceptance, tearing off large pieces with their hands and teeth in the most disgusting manner. We gave them in return biscuit and salt meat: the latter they immediately spat out. They were much surprised at my ordering one of the children to be washed, for they were so stained with dirt and oil, it was impossible, without this proceeding, to know what was their real colour, which now exhibited a tawny coppery appearance. They had black hair and round visages; their hands and feet very fleshy, and much swelled. The expression of their countenances was extremely stupid and unmeaning; but this was in all probability much increased by their astonishment at every thing they saw. They were clothed in seal-skin, with the hair inwards.

Knowing that we should again meet them on our return, and being desirous not to lose farther time, which, from the lateness of the season, was now becoming valuable, we left them about 4 in the afternoon. We were at this time considerably advanced up the extensive bay or inlet, which, as it agrees exactly in latitude with that laid down in the contemporary chart, formerly mentioned, I am convinced is the same which was discovered by Gael Hamkes in 1654 *. At this point it opened into an extensive basin, the circumference of which could not be less than fifty miles. Into this basin we now entered, and found it perfectly free of ice; not a piece of it could be seen in this immense sheet of water. We pulled along the northern shore for a distance of twenty miles, and pitched our tents at night on a low sandy beach, being the worst station we had yet occupied.

* *Note by the Editor.*—The Dutch chart referred to is in my possession, and is entitled "De Custen van Noorwegen, Finmarken, Laplandit, Spitzbergen, Jan Mayen, Englandt, Ysland, als mede Hitland," engraved at Amsterdam by Peter Goos, 1666, being only twelve years subsequent to the voyage of Gael Hamkes, and forms an inlet corresponding so well both in latitude and in the general trending of the coast, from Cape Broer Ruys to Cape Desbrowe, that there can be no doubt of its being the same with that explored by Captain Clavering. The entrance of this inlet was seen the preceding summer by Captain Scoresby, and by him named Scott's Inlet; and Gael Hamkes's Inlet, laid down in Latitude 75°, to which it had been shifted by the caprice of modern chart makers.

August 20.—Next morning I walked about six miles up an inlet trending to the E.N.E., which I have little doubt leads again into the opening between Cape Borlase Warren and Cape Mary, making the land. We were now upon an island, as will be best seen from the chart. Our time not permitting us to explore every opening, we again started in the afternoon, and pulled for a high rocky island, about eight miles distant. The mountains here were of great height, ending in immense glaciers on both sides. I determined to ascend the highest of them, hoping to have an extensive view of the different openings and arms of the sea that surrounded us on all sides. I accordingly started next morning, and reached to the height of 4500 feet by barometrical measurement, but was at least 500 feet from the top of the mountain. Several openings were observed to the west, and one of greater extent to the south, which I determined to explore. I returned to the tents, after a fatiguing walk of sixteen hours. Some foxes and white hares were seen, and two of the latter shot; innumerable traces of grouse were seen, but only one bird, which was perfectly grey. I named this island Jordanhill, after the residence of my friend James Smith, Esq., and named the capes, which form the southern and northern extremities of this extensive bay, Cape James and Cape Mary, in honour of the same gentleman and his lady.

August 21.—We now pushed for the Fiord or opening to the south, which I expected would lead us again to the coast. After pulling a distance of sixteen miles, we encamped at our sixth station. The inlet was from a quarter of a mile to a mile and a half in breadth, but of a sufficient depth of water for a vessel drawing 14 feet; the sides were more level than the shores we had hitherto passed—the mountains not rising so abruptly from the sea, and the face of the country presenting a less barren and heath-like appearance. We shot some swans, which we found excellent eating.

August 22.—Proceeded up the inlet, the head of which we soon reached: it terminated in low marshy land, about eighteen miles from its entrance from the bay; named it Loch Fine.

Up to this period, with the exception of the gale on the night of the 17th, we had had a constant calm, accompanied with the most beautiful and serene weather, so that the whole distance we had hitherto come, we had always occasion to make use of our oars. After refreshing ourselves at our seventh station, we started on our return, with a fine breeze from the southward, and made such progress, that we were enabled to reach our Esquimaux friends the same evening, although it had again fallen calm, and we were obliged to ply our oars for the last seven miles.

August 23. and 24.—These two days were spent with the natives, whom we found to consist of twelve in number, including women and children. We were well received by them, but our attempts at making ourselves understood were very unsuccessful. They are evidently the same race as the Esquimaux in the other parts of Greenland and the northern parts of America. Our intercourse was of too short duration to acquire any of their language; but the descriptions given by Captains Parry and Lyons of the natives at Igluleik, in many particulars resembled those of our friends. I observed particularly the same superstitious ceremony of sprinkling water over a seal or walrus before they commence skinning it.

Their amazement at seeing one of the seamen shoot a seal was quite unbounded. They heard for the first time the report of a musket, and turning round in the direction in which the animal was killed, and floating on the water, one of them was desired to go in his canoe and fetch it. Before landing it he turned it round and round, till he observed where the ball had penetrated, and, putting his finger into the hole, set up a most extraordinary shout of astonishment, dancing and capering in the most absurd manner. He was afterwards desired to skin it, which he did expeditiously and well.

Wishing to give them farther proofs of our skill in shooting, several muskets were fired at a mark, but without permitting them to see us load. A pistol was afterwards put into their hands, and one of them fired into the water; the recoil startled him so much, that he immediately slunk away into his tent. The following morning we found they had all left us, leaving their tents and every thing behind, which I have no doubt was occasioned by their alarm at the firing.

August 26.—We now pursued our way towards the ship, and took up our 9th station at Cape Mary, near the same spot which we had occupied on the 17th, after a most fatiguing row, our progress having been much impeded by the bay ice. Some whales were again seen this day.

August 27.—Made for an inlet leading to the WNW. into which we entered, and after pulling fifteen miles encamped at our 10th station. I walked a few miles farther, where it turned to the westward, and I have little doubt but that it joins the inlet formerly mentioned as leading from the basin up Gael Hamkes's bay. As the ascertaining of this point could lead to no important result, and as the short period of an Arctic summer was fast elapsing, I reluctantly gave up any farther examination of it, though I may truly say that there was none of the party that was the least tired of the expedition; on the contrary, the whole party were as fresh, and in as good spirits, as the first day they started. A large bear was seen at a distance upon a hill which we all eagerly pursued; the animal, however, as soon as he saw us, set off at a gallop much exceeding our ideas of his speed, having imagined these animals to be slow and unweildy; this was the first bear we had seen.

August 28.—Made a distance of seventeen miles, and encamped at the same place we had halted the first night.

August 29.—After a fatiguing pull of eighteen miles, our progress being much impeded by bay ice, we reached the ship, after an absence of thirteen days. We were happy to rejoin our friends whom we found all well. The fine weather had been favourable for Captain Sabine's observations, which were about completed.

August 30.—The observations were this day concluded, and we lost no time in re-embarking the tents and instruments. Latitude of the Observatory on Pendulum Island, 74° 32′ 19″ N. Longitude 18° 50′ 00″ W.

Sunday, August 31.—After performing divine service, we got under weigh: the light winds still continuing, worked out of the harbour, which we named Griper Roads after the ship; and the group of islands on which the observations were made, received the name of the Pendulum Islands. A bold headland, rising almost perpendicularly from the sea to the height of 3000 feet, marks the outermost of the Pendulum Islands. This cape it was my wish to have named after my friend Captain Sabine, but on his particular request it was named Cape Desbrowe in honour of the late Edward Desbrowe, Esq. M.P. We proceeded along the coast to the SW., occasionally making fast to the land ice. The calms and light winds continued for several days. Had there been a fresh wind it was my intention to have run again to the northward, and endeavoured to have got sixty or a hundred miles farther if the ice would have permitted. This I have reason to think would have been the case, because in our absence the sea towards the north had been observed from the hills to be quite clear of ice as far as the eye could reach, close in with the main, though the channel towards it was still obstructed. I have no doubt, however, but the heavy equinoctial gales we soon after experienced would have broken up the barrier, and I think that as long as there is a continuance of land, perseverance will get along it, but the land must be kept on board. We could not have made the attempt without wintering, and however pleased I would have been to have done so, I saw no adequate motive to bear me out in breaking the tenor of my instructions.

It was now the 4th of September, and the reappearance of the stars warned us how rapidly the days shortened at this season. A breeze springing up from the north we pursued our course slowly to the southward, working our way amongst a quantity of loose ice. At noon this day the boat was sent on shore to observe the latitude on a small island lying off Cape James, and which was found to be in 73° 56′.

September 5.—The light winds and favourable weather still continued; the land high and much distorted by refraction; that part of the coast lying between Cape James and Cape Broer Ruys I consider the most northerly seen by Hudson, and named by him "*Hold-with-Hope* *."

* That Hudson gave this quaint name to the most northerly of his discoveries there can be no doubt. I apprehend, however, that it would more properly have been given to the land running west of Cape Broer Ruys, and forming the north side of Foster's Bay, than to that assigned to it by Captain Clavering. Hudson was evidently in Foster's Bay when he discovered it, and he thus describes his situation,—"The two-and-twentieth in the morning it cleared up, being calm about two or three of the clocke, after we had a prettie gale, and we steered away E. and by N. three leagues, our

September 6.—Light airs still continued with clear weather. Advancing slowly to the south, I landed in the morning with Captain Sabine, at a headland which we considered to be the Cape Broer Ruys of the old charts. We ascended the mountain, which we ascertained by barometrical measurement to be nearly 3000 feet high. Having observed for the latitude we returned on board.

September 7.—Still calm, we stood into a large bay to the south of Cape Broer Ruys, which, in compliment to Mr Henry Foster, I named Foster's Bay; at the bottom of it several inlets or fiords were observed. Passed within an island which answers to the situation of the Bontekoe Island of the Dutch charts. We passed several icebergs fifty or sixty feet in height.

September 8.—Kept running along the edge of the land-ice, which extended from the shore five or six miles; at noon sent a boat to observe for the latitude on the ice, and to take bearings of the land. Latitude observed 72° 31′ N. In the afternoon we kept working up towards Cape Parry, discovered by Mr Scoresby last summer, in a narrow line of water, the floes being much closer than usual. At seven, when between two floes which were about 100 yards asunder, they suddenly closed together before the ship could be backed out; she was pressed by the tongues that projected underneath from each, and lifted abaft considerably out of the water. Her weight immediately broke the tongues with an immense crash, we then backed her out, and made her fast to the land-ice for the night. The fine weather

observation was in 72 degrees 38 minutes, and changing our course, the wind at SE. a prettie gale. This morning, when it cleared up, we saw land trending neere hand ENE. and WNW. esteeming ourselves from it twelve leagues: it was a mayne high land, nothing at all covered with snow, and the north part of that mayne high land was very high mountains, but we could see no snow upon them. We accounted by our observation the part of the mayne land lay neerest hand in 73 degrees. * * * * *

"On the one-and-twentieth day in the morning while we steered our course NNE. we thought we had embayed ourselves, finding land upon our larboard and ice upon it, and many great pieces of drift-ice. We steered away NE. with diligent look out every cleare day for land, having a desire to know whether it would leave us to the east, both to know the breadth of the sea and also to shape a more northerly course. And considering we knew no name given to this land, we thought good to name it *Hold-with-Hope*, lying in 73 degrees of latitude."—Editor.

continued till the 13th; constantly engaged through the day in warping and heaving through the ice which seemed to hang about Cape Parry, and forced us off the land. We now finally quitted the coast of Greenland. The whole line along which we had sailed is high, averaging from 2000 to 3000 feet, with mountains in the interior of perhaps double that height. The soundings partook of the character of the land, being deep close to, excepting when it slopes gradually towards the sea. It may almost be said there are no dangers whatever in the whole extent of our survey. It was now dark at night, for about eight hours, during which time we always made fast to a floe. On the 12th we observed three bears, an old one and two cubs, on a floe of ice; two of them we shot and captured the third alive, being taken whilst swimming in the water, which he jumped into on the death of his comrades. This animal lived till after our arrival at Drontheim, when, in endeavouring to remove him from the long boat where he had got loose, he was unfortunately strangled. He was an amazingly strong and powerful animal, and, without being well secured, there was no possibility of approaching him.

September 13.—The weather which had been so fine during the whole period of our stay upon this coast now broke, and we had this day a strong gale from the NNE. The weather being very thick with sleet, we secured the ship to a piece of ice, along with which she drove and received several severe shocks, and caused a heavy strain on the hawsers and stream-cables, which frequently broke. We then got out both chain cables and two large hawsers. During the night large floes were continually coming in contact with that to which we were fastened. Towards the morning the pressure became so violent that one of the chains and both hawsers snapped. The ship rode by the remaining chain for about two hours longer, when it also parted about an hour before day-light. Our situation was now a most anxious one, the gale continued with unabated violence, and the ship drove to the southward amongst loose ice and heavy floes, which, from the darkness of the night, we could neither see nor avoid. We received many severe shocks, but, from the admirable manner in which our little vessel was strengthened, without any serious injury. At day-break the gale moderated in some degree, and we set the storm staysails to sheer her clear of the floes. Upon heaving up the chains and hawsers, found we had lost three ice-anchors and the kedge. We now continued our course to the SE. and southward, frequently interrupted by streams of closely packed ice. At ten we were able to carry close-reefed topsails and foresail. In the course of the day we experienced one of the heaviest shocks we had experienced, and such as must have knocked a Greenlandman to pieces. I now determined to penetrate the barrier, and attempt to bore the ship through. We accordingly entered it about three in the afternoon, and by alternately backing and filling and forcing the ship against the floes, we opened a passage for ourselves, and in less than two hours succeeded in gaining the open sea. From this period till the 20th we had a succession of heavy gales. On the 23d, in Latitude 63° 55′, we made the coast of Norway; the breakers were observed a considerable distance off the land. Having fired several guns for a pilot, without success, we tacked and stood out to sea.

September 24.—At day-light land in sight, consisting of numerous small islands with breakers off them. We observed a fishing-boat standing off; we received a pilot, and, hoisting up his boat, proceeded along the coast. The following days the weather was moderate. On the 1st October, in running amongst a number of small islets, the pilot ran the ship upon a sunk rock, on which she struck hard and remained fast till the tide rose, when we backed her off. We discharged our pilot and anchored till the 3d, when we got another and made sail. The following day we entered Drontheim Fiord, and worked up against easterly winds; at length, on the 6th, we anchored in the harbour.

The attentions we here received from Count Trampe, Governor of the Province, Mr Schnitler, the British Consul, and other respectable inhabitants of this place, under any circumstances could not have failed to excite the most grateful sentiments; but the contrast between the difficulties and fatigues we had undergone with the comforts and indulgencies of civilized life, rendered them doubly so. Through the kindness of the Consul, a villa belonging to Mr Wensel, his father-in-law, was allotted to Captain Sabine and myself, and here we experienced all the comforts which kindness and hospitality could bestow, and I could not help feeling a degree of thankfulness and contentment on reaching this point, when I looked back at the success of two years' labour without an accident of any sort, particularly when there are so many nice and valuable instruments, the breaking or injuring any one of which would have tended so materially to destroy our confidence in the accuracy of the whole series.

Captain Sabine having completed his observations, the instruments were re-embarked, and we were ready for sea on the 10th of November, on which day the Governor visited us on board, and was saluted with 13 guns. Latitude of the Cathedral of Drontheim, 63° 25′ 50″ N.; Longitude 10° 24′ 50″ E.

The weather proving unfavourable, we were detained till the 13th, when we weighed anchor and worked down the Fiord. In the evening we anchored in a narrow part of the Fiord, and were detained by fresh gales till the 19th, when we again made the attempt, but were shortly obliged to bear up for the nearest anchorage. The westerly winds setting in strong, we continued wind-bound till the 3d December, when we again got under weigh with a fair wind, and ran down the Fiord. On the following day we were clear of the Fiord, and discharged the pilot. The favourable winds continued till the 5th, and gave us an offing of about 30 miles to the west of Stadtland. The wind now shifted to the westward, and soon after began to blow with great violence. The gale lasted without intermission for the three following days. On the 8th, we found ourselves much nearer land than we expected from our reckoning, and were obliged to keep the ship under a press of canvass to carry us off a lee-shore. From this time till we passed the Naze of Norway our situation was very critical, we had no room for drift, and the ship, under the reefed courses, was so much pressed down, and shipped so much water to leeward, as to be at times nearly water-logged. We, however, made good our course till we had the entrance to the Baltic under our lee. We had, during this gale, much lightning and frequent fire-balls at the mast heads and yard-arms, and it was remarkable how little effect it had on the barometer, indicating that the cause of it was entirely electric. We now proceeded on our voyage without farther incidents worthy of being recorded, and reached Deptford on the 19th December.

Analysis of the Vegetable Milk of the Hya-hya Tree of Demerara. By Robert Christison, M. D., Professor of Medical Jurisprudence in the University of Edinburgh. Communicated by the Author.

In a paper lately read before the Wernerian Society, and published in The Edinburgh New Philosophical Journal for January last, Mr Smith has given an interesting account of a new kind of vegetable milk procured from a tree in Demerara, which the natives term the *hya-hya;* and which, according to Mr Arnott's examination of the specimens sent to this country, is a species of *Tabernæmontana*, a genus of the natural order *Apocyneæ.* A portion of this vegetable milk having been sent by Mr Smith to Professor Jameson, the chemical analysis of it was entrusted to me, for the purpose of determining whether any similarity exists between it and the singular vegetable milk of Caraccas, lately made known to European chemists by Humboldt, and analyzed by Bousingault and Mariano de Rivero. The following is an account of the observations I have made on its properties and composition, which, it will be seen, are totally different from those of the vegetable milk of Caraccas, and such as render its nutritive quality doubtful.

In the state in which the juice arrived in this country, it consisted of a small portion of a clear watery-like fluid, and a white, concrete, cellulated substance, not unlike pressed curd, which filled nearly the whole bottle. It had an odour somewhat like that of Dunlop cheese, with a slight peculiar aroma, and scarcely any taste.

The watery portion reddens litmus paper, and appears to contain a little acetic acid; for the fluid procured from it by distillation has the odour of vinegar, and an acid reaction. But the quantity of fluid was too small to allow me to determine its contents more positively.

The concrete matter is of snowy whiteness, brittle and pulverizable when cold, but easily softened by an increase of temperature. At 100° F. it becomes ductile and viscid, and does not recover its original firmness and hardness for more than a day. At higher temperatures, it gradually becomes softer and softer; and at 212° its consistence is soft enough to allow it to flow, like very thick mucilage. A greater heat adds little to its fluidity, but produces brisk effervescence, during which acid vapours are discharged, and the whole mass becomes translucent and yellowish, like a resin. When allowed to cool after this change has taken place, it retains its translucency, and for some days is soft and extremely viscid; but at length it acquires the consistence and firmness of bees-wax. A still higher temperature applied to it in a tube, causes the usual decomposition which vegetable substances in general undergo, and a large quantity of pyro-acetic acid is formed. When a light is applied to it, it catches fire, and burns entirely away, with a large white flame, and much black smoke.

Water, cold or boiling, has no action on this substance. It merely fuses and rises to the surface of the water. Alcohol acts slightly on it, and only with the aid of heat: a small portion is dissolved by boiling alcohol, and the greater part separates in the form of a white cloud, when the spirit cools. Sulphuric ether acts on it with rapidity, dissolving the greater part of it, and leaving about four per cent. of a soft viscid mass.

It is unnecessary to mention any of the other chemical properties of the compound substance, as they are almost entirely the same with those I shall presently relate, as characterizing that part of it which is soluble in ether.

The portion insoluble in ether, when left exposed to the air for some hours till the adhering ether had evaporated, became a greyish, viscid, elastic, ductile substance, which, when heated to 212°, so as to remove the whole ether, and then left for some days exposed to the air, lost its viscidity, became brownish black, and acquired the external appearance and all the chemical and physical properties of caoutchouc. It is ductile and elastic, insoluble in water, alcohol, or caustic potass; is merely softened and swelled up in sulphuric ether; is easily dissolved by oil of turpentine; has a density of 934; undergoes imperfect fusion at a temperature above 212°, and does not after that recover its solidity on cooling; and when held to the flame of a candle, it takes fire and burns with a bright white flame, and much smoke.

The portion of the concrete juice which is dissolved by the ether, is deposited by spontaneous evaporation in the form of a white powder, which, as I have already remarked, differs little in chemical properties from the original juice.

It has neither smell nor taste; but it softens in the mouth, and becomes very adhesive. Its density is about 955. When heated in a tube, it softens into a thick fluid at 140°, retaining, however, its whiteness and opacity. At 160° it becomes greyish, more fluid, and translucent. At 212° it is greyish brown; and if it be kept some time at this temperature, and then redissolved in sulphuric ether, a black powder is separated, which possesses the properties of charcoal. The temperature of boiling water, therefore, evidently effects a slight decomposition. When it has been heated to this degree, and then allowed to cool, it is no longer brittle, but soft, ductile, and extremely viscid. It recovers its brittleness and white powdery appearance, however, on being redissolved in ether, and separated by spontaneous evaporation.

Water does not act on the white powder in the cold. At 212° the powder merely fuses into greyish globules, which rise to the surface of the water, and form a stratum of a substance precisely the same in nature with that procured by the same degree of heat without the contact of water.

Alcohol scarcely acts on it in the cold. In boiling alcohol, it fuses into an opaque white mass, which, on cooling, concretes into a white brittle solid, presenting a resinous fracture, and retaining its original properties. At the same time that it fuses, however, the alcohol dissolves about a 250th of its weight, which is recovered partly by refrigeration, and entirely by spontaneous evaporation, without having undergone any sensible change.

Sulphuric ether, at the temperature of 60° Fahr., dissolves between a sixth and seventh of its weight, and rather more when boiled on it. A colourless, transparent solution is thus procured, from which the powder separates unchanged, while the ether is evaporated spontaneously.

Oil of turpentine dissolves it in large quantity. I have not examined the changes which then take place.

A strong solution of caustic potass, even when boiled on it, dissolves only a trace, which is thrown down unaltered on the alkalki being neutralized. The portion not dissolved by the boiling potass undergoes no farther change than what occurs in boiling water. Ammonia does not act on it.

Muriatic acid has no effect on it. Strong nitric acid, either cold, or aided by heat, has also hardly any effect; it merely imparts a yellowish tint, and a slight increase in hardness, but does not alter any other property. Strong sulphuric acid dissolves it readily, and acquires a dark brownish-black colour.

The preceding experiments show that the concrete juice of the Hya-hya tree consists of a small proportion of caoutchouc, and a large proportion of a substance possessing in some respects peculiar properties, which appear to place it intermediate between caoutchouc and the resins, to the latter of which it bears the greatest resemblance. It differs, however, from the resins in being more easily fusible, in undergoing partial decomposition at 212°, in being very sparingly soluble in hot alcohol and caustic potass, and in resisting the action of strong nitric acid.

The information thus obtained from the chemical analysis of the juice, will naturally raise considerable doubts with regard to its possessing any nutritive quality. There is every reason to believe that caoutchouc, wax, resin, oil, and other vegetable principles, which resemble these in containing a large proportion of carbon, and in being insoluble in water or acidulous fluids aided by the action of heat, are very slightly nutritive, because the stomach can digest but a small quantity of them, and that only with great difficulty. The concrete juice of the Hya-hya evidently belongs to this class of substances. It is soluble in fewer menstrua than any of them, except caoutchouc; and it evidently contains a large proportion of carbon, as it burns with a dense white flame and much smoke. There is great reason to suspect, therefore, that it is not nutritive, and that, as an article of food, it can be useful only by rendering other aliments agreeable.

I need scarcely add, that the juice of the Hya-hya differs totally from that of the *Palo di Vaca*, the plant described by Humboldt as supplying the vegetable milk of the province of Caraccas, in South America *, as well as from the juice of the

* Ann. de Chim. et de Phys. vii. 1827.

papaw tree. The former, the vegetable milk of Caraccas, is said by Humboldt to be an agreeable beverage when taken alone, and to be so nutritive that the inhabitants fatten sensibly while it is in season. It has been lately analyzed by MM. Boussingault and Mariano de Rivero *, who found its solid contents to be wax, with a little sugar, and a large proportion of a substance analogous to fibrine. Hence, they remark, when it is heated in a vessel over the fire, the fibrine separates in a solid mass from the wax, which liquefies; and, at a higher temperature, the fibrin is fried in the wax, exhaling the odour of fried meat. As to the juice of the papaw tree, it appears, from the researches of Vauquelin, to contain two principles analogous to albumen and casëin †. It is easy to perceive, from their chemical nature, how these two vegetable juices are nutritive. They contain, in fact, principles analogous to the most nutritive of those belonging to the animal kingdom.

On the Physiognomy of the Vegetable Kingdom in the Brazils. By Dr C. F. Phil. Von Martius, Knight of the Royal Bavarian Order of Merit, &c.

Accounts have been transmitted in dark traditions, and in songs, of a happy Island which, in ancient times, arose, far to the west, out of the ocean, and appeared even to later antiquity, only in the uncertain light of a glory then unknown. Atlantis, thus runs the story, unfolded, in near alliance with the sun, whatever there is great or dignified in the productions of our planet. Incalculable was the quantity of precious metals and gems brought to light from its bowels, in wonderful variety; thousands of the most fragrant plants flourished and bloomed there; the animal creation arose powerful, lively and gigantic; while a noble race of men enjoyed the happy riches of such a country, under the blessings of wise laws, and well regulated institutions. Once, however, as the tradition goes on to say, the Earth being convulsed by internal commotions, the foundations

* Ann. de Chim. et de Phys. xxiii. 219.

† Ann. de Chim. xliii. 275, and xlix. 250 and 304.

of the happy isle gave way, and it was swallowed up in the awful depths of the ocean by which it was surrounded.

The auspicious genius and undaunted resolution of Columbus have, in modern times, restored the long lost region; but the history of the long period which America passed in seclusion from the old continent is involved in obscurity. The accounts of its ancient and mighty kingdoms, of its religion, philosophy, and poetry, cannot be connected with our history by any certain documents. The scanty monuments of these early epochs stand like enigmas before the contemplative eye of the inquirer, of which, in the present state of this quarter of the world, he labours in vain to find the solution. America, such as it has been opened up to us by the experience of three centuries, represents, in its state of savage wildness, the complete victory of the elements over the race of men who inhabit it, and the suppression of history by the rude productive powers of a luxuriant nature. Thus here, as every where else, man and his domestic history is less intelligible to man than the other parts of nature, which, always remaining the same, readily present themselves for examination; and the inquirer dwells with double satisfaction upon the investigation of the many great natural phenomena which fairly entitle America to pass under the designation of the New World. There the history of the formation of mountains is delineated in huge characters. The summit of the chain of the Andes, towering above the clouds, and undermined by subterraneous fires—the wide extended ramifications of the Brazilian mountain range, in whose bosom the sparkling diamond and immensely rich veins of gold are concealed—and the wonderful coal-strata of North America—open to the naturalist an extensive prospect into the early history of our globe. The animals, too, at present existing, present us with a very peculiar and strange assemblage of extraordinary forms of living beings; while the remains which attest the early formative powers of the new world are beheld with astonishment, of which we have specimens in the colossal elephant-like sloth of the La Plata, or in another found by us in the caves on the Rio de St Francisco, and in the innumerable mammoths on the Ohio, or in the mountains of the district of Bahia, which the Rio de Contas rolls to the sea. But the peculiar character of this continent seems to manifest itself in the vegetable kingdom; and if plants, as indicative of a general relation to the sun, be of importance in the history of the earth, of its climates and countries, this is peculiarly the case with America, where they are found either undisturbed by the influence of man, or triumphing over it. The various circumstances affecting the vegetation in a great part of South America, viewed under this aspect, may be an object not unworthy of the attention of this naturalist; and I venture, in consequence, to draw a sketch of the physiognomy of the plants in that part of Brazil which we ourselves had an opportunity of visiting.

The flourishing kingdom of Brazil comprehends almost a third part of the whole South American continent. Washed by the ocean for a length of many hundred miles, it opens, in this wide space, numerous havens to friendly Europe. On the south and north, two seas, as it were, of fresh water, the La Plata and Amazons, form its boundaries. On the west it is surrounded by the mighty tributary branches of these two streams, the Paraguay and Madeira, the sources of which approach very near to each other. This yet unmeasured land presents, in an extent from 4° 18′ north to 34° 55′ south latitude, and from the ocean to the meridian of 67° west longitude from Paris, a wonderful variety of surface, being at one time elevated to stately mountains, at another stretching out either as a level or hilly country, covered with woods and fields—intersected by innumerable streams and branching rivers —watered by large lakes, or changed into immense marshes by the overflowing of the waters. It enjoys, however, everywhere the blessings of a happy climate; everywhere the riches of the tropics abound, and the salutary abundance of milder latitudes. There the earth is never benumbed by the breath of winter; with the continual vigour of youth, it sends forth, at the same time, from its bosom, the products of the autumn and of spring, and the vegetable kingdom celebrates, as it were, in a perpetual hymn, the creative power of the sun, by a thousand living forms, colours and odours.

Whoever approaches Brazil from the sea, receives almost every where these impressions of the majesty and grandeur of the vegetation. Barren wastes of sand bound the ocean only along a comparatively small part of the northern provinces, especially the Lançôes Grandes of Ceará, between the 2° and 3° of south latitude; and in the south, principally between Porto Alegre and Monte Video, from the 29° to the 34° of south latitude. Frequent sheets of salt water within the land, and a succession of lakes parallel to the sea, indicate a gradual recession of the latter; and, in consequence, large tracts present nothing but dry sand, upon which are a few plants of scanty growth, peculiar to the sea-shore. But, with these exceptions, a luxuriant vegetation covers the confines of this quarter of the globe, either immediately on the margin of the sea where the shore rises abruptly, or separated from it by small intervening banks of sand. When the shore ascends precipitously, it is crowned by a dark green wood, whose overtopping palms already salute the stranger from afar. Where, on the contrary, the beach slopes gently, or, in the deep slimy bays, there appears a vegetation quite peculiar to the shores of the tropics, consisting of those trees which propagate themselves by the branches, forming thick bushes, which spread themselves far over the often unfathomable deep mud. Their succulent foliage surrounds the low shore with a wreath, whose cheerful green is frequently heightened by the red plumage of the ibis reposing on it *.

Advancing into the interior, we come to the foot of a moderately elevated chain of mountains, which, at one time, only a little removed, at another from 150 to 190 miles distant, from the coast, and almost always parallel to it, run through a great part of the country; on which account they nearly every where go under the name of the Serra do Mar, or Sea Cordilleras. This chain, consisting for the most part of granite and gneiss, begins in the southern part of the province of Pernambuco; sinking considerably, and often continued only in the form of swells, it proceeds through the eastern part of Bahia, whose hot and parched plains it supplies very sparingly with fountains, and again appears in a much higher and grander scale to the south of the Rio Peruaguaçu, in the Comarca dos Ilheos. From this latitude onward, only occasionally interrupted by the Rios de Contas, Patype, Belmonte, Doce, Pariba, &c., it stretches south through the provinces of Porto Seguro, Espiritu Santo, Rio de Janeiro, and St Paulo, in an extent of more than twelve

* Tantalus ruber.

degrees. Its conical rocky summits, seldom terminating in plains of any extent, sometimes reach a height of more than 3000 feet, and are distinguished by a character of wildness, in evident contrast with the usual contour of the primitive mountains. To the south they become low, part branching off to the west, under the name of Serra Geral, divides the waters of the Panama from those of the Uruguay; while the southern radiations are lost in the sandy plains north of Monte Video. The soil which covers the rocky masses of the Serra do Mar is either dark rich vegetable mould, or a heavy reddish loam containing gold. Large tracts in the valleys are frequently filled with marshes. The ground, however, here never becomes so dry as in our pine forests, because it is watered by many fountains, and moistened by the exhalations of the overhanging woods. This entire chain, the bulwark of the land towards the sea, is almost in its whole extent clothed with a thick tall forest, as old as the rocks on which it spreads its roots, and which, as it were, exhibits the creative power and luxuriancy of this continent.

It would be a vain attempt for the traveller to endeavour to excite in others, even in the faintest manner, the impressions which here overpower him. The magnitude of the heaven-towering trees; the fulness of the variegated foliage; the splendid display of colours, from an innumerable variety of flowers; the luxurious entanglement of dense bushes and entwining *Lianes*, or climbing plants*; and the singular forms of parasites which establish around the old stems their youthful empire. What a great, rich, and sublime scene! The wanderer finds himself here at once elevated and struck with awe. The horror of the solitude of the woods and dark shade, is associated with the sweet delight of such a novel scene, and with the most reverential admiration of that Almighty power which here conjures up a new world to the view, and speaks to us in a language that never before reached our ears; and, even in the unobtrusive life of the vegetable kingdom, unfolds the power and the majesty of its creation.

These woods occupy in a continuous tract, in the eastern provinces of Brazil, many thousand square miles, and are designated by the name of Matta Geral, or Universal Forest. They afford shelter to those wild hordes of Indians who, never hitherto sub-

* Chiefly of the genera Bignonia, Banisteria, and Aristolochia.

jected to the Portuguese yoke, roam about in them as unsettled wanderers. This is the abode of the sluggish Coroado, of the wild Puri, of the cannibal Botocudo, and other less numerous tribes, who live by hunting and fishing, upon nuts and other fruits, or from an inconsiderable cultivation of maize, mandioca, and bananas. Large portions on the borders of this enormous forest, as well towards the side of the sea as towards the districts inhabited by the Portuguese in the interior, in the direction of Minas Geraës, are already brought under cultivation; but, in the depths of it, colonists have only settled here and there along the large rivers. The fertility is incredible of such virgin woods (*matto virgem*), in which the stroke of an axe was never heard before. When the trunks have been burnt, and the cleared ground planted with French beans, maize, mandioca, coffee, cotton, or sugar-canes, a return of from 150 to 500 fold is calculated on. If the cleared wood be again left to itself, it returns, in a few years, to a state of wildness, and is covered with a thick growth of rapid growing trees and bushes, in Brazil called *capoeira.*

These primitive woods, according to the accounts of the natives, are not prevalent in the northern provinces of Pernambuco, Paraiba do Norte, and Ceara, to an equal extent, as upon the mountains, hills, and valleys of the Serra do Mar, in the middle part of Brazil. The soil of these parched districts, consisting of granite or limestone, appears to be less favourable to such majestic woods, which are here more insulated, and alternate frequently with the Catingas, or woods which periodically shed their leaves. The nearer, however, we approach to the equator, on the north of the rapid river Parnahyha, the more frequently are the primitive forests to be met with. It seems as if the vertical sun lent here double strength to the earth, to send forth from her bosom the largest and most enormous products. Dark as night, and intricate as chaos, an impenetrable wood of gigantic stems extends from the mouth of the Amazons, till far beyond the Portuguese territory on the west. The same exuberance, greatness, and majesty of forms as in the more southern provinces prevails also here; but the vegetation, under the influence of the most intense heat, of heavy and almost daily rains, and of the wide inundations of rivers, seems to be involved in perpetual change and fermentation. Forthwith the lofty trees, as well as the tender plants, solemnize, by the unfolding of their majestic tops, and by the innumerable flowers with which they array themselves, the returning season of their development. At the time of their maturity, the most extraordinary forms of seeds and fruits fall off, and cover the earth, teeming with life, in various places, almost a foot deep. Huge columns of carbonic acid gas then ascend from the sprouting or corrupting germs, and a thick heavy atmosphere hangs in vapour over the woods. The succulent glittering foliage, and the tillandsia, like a beard hanging down from the boughs, drop rain continually; the bushes of the bromelia stand like pitchers filled with water; and warm intervals of sunshine speedily dry up the moisture of the wilderness, so that decomposition and corruption follow immediately on the most violent vital excitement. The sober nature of the vegetable kingdom seems all at once to indulge in an inordinate desire to assume strange and grotesque forms. Bushes with thorns that cause malignant sores; palms, armed with dreadful prickles; closely-entangled lianes, yielding a milky juice*, confound the senses of the wanderer, who, being seized by the stunning exhalations of the osassacu, anxiously longs to escape from this noxious chaos into the peaceful majesty of the primitive woods on the Serra do Mar. No wonder if, in these regions, a gloom be cast over the spirit of the wandering Indian, who, awed by the horror of the dark lonely woods, sees, or thinks he sees, every where the ghostly phantoms which his own wild fancy has conjured up.

Lectures on the Natural History of the Sciences. By Baron Cuvier.

Conclusion of Lecture IV. *from page* 349 *of former Volume.*

The oldest, the Ionian school, was founded by Thales, about the year 600 before Christ. It possessed a great number of adherents in the cities of Asia Minor, Ephesus, Miletum, &c. The most celebrated of all was Anaxagoras, who modified its principles, and introduced them at Athens, about the year 500 before Christ.

* Such as Allamanda cathartica.

The second school is that of Pythagoras, who was born in 584, and flourished about the year 550 before our era. He also had received his doctrine from the Egyptian priests, and separated less from them than Thales had done. He even tried to establish their constitution; for, having gone from Samos to Crotone, he there founded secret societies, which soon caused disturbances, in which most of his partisans were massacred.

The third, or Elean school, derived its name from a small town of Lucania, where it was first established. It had for its founder Xenophanes, who was born at Colophon, in Asia Minor, but who afterwards passed over to Italy. This philosopher does not appear to have borrowed any thing of the Egyptians. His doctrine, which was that of pure idealism, rather resembled that of the Indians.

The fourth, or Atomistic school, founded by Leucippus, embraced a system entirely opposed to that of the Eleans. It saw nothing in the universe but matter and motion.

Along with these four purely speculative sects subsisted the family of the Asclepiades, who cultivated the sciences solely with a practical object. They attached themselves chiefly to facts, and their method served, at a later period, as a model, and contributed greatly to the progress of the positive sciences.

Lecture Fifth.—*Schools of Philosophy before Socrates.*

We have seen that there were instituted in Greece, or rather in the Greek colonies, four great sects or schools of philosophy, which, in consequence of political events, were eventually concentrated at Athens. There was established among them a useful emulation; and at length their labours being resumed by Socrates, gave rise to a new school, which, by the judicious method adopted in it, opened a way to the sciences, in which it was not possible afterwards to retrograde. But, before coming to that remarkable period, we must return to the four primitive schools, which as yet we have only mentioned.

Ionian School.—The Ionian sect, the most ancient of all of them, is that whose dogmas approximate nearest to the domains of the natural sciences. Its philosophy was at first almost entirely material; which proves, we may observe, that, at the time when Thales went to study in Egypt, the priests of that country had already forgotten in a great degree the metaphysical doctrines, which in former times were kept up in their colleges. At that time the experimental method being entirely unknown, the philosophers of the Ionian school devoted their attention to the discovery of a principle,—that is to say, a thing pre-existent to every thing. Thales thought he had found it in water. This was an idea which, without doubt, he had borrowed from the Egyptians, but which he so modified as to suit his views.* According to him, water is the original matter from which the world was formed. But this water could exist in different states of density, and in every one of these states it formed a secondary principle, an element. These elements combining with one another in different proportions, gave rise to all bodies. Thales gave a soul to the world, to animals, to plants; but by this word *soul* he means nothing more than an internal cause of motion.

Anaximander considered water only as a second principle; the first, in his system, was *infinity*. It is not easy in our day to know precisely what he meant by that term. Did he mean to say, that infinite space was pre-existent to matter? That is scarcely probable, since the ancient philosophers have, all of them, regarded matter as eternal. Be it as it may, Anaximander, having placed his second principle in water, maintained, that, originally, men were fish, and that they had arrived at their last state only by a series of transformations. This singular idea was many times revived, and has been so even in our days.

Anaximenes, a disciple, it is thought, of Anaximander, placed his principle in air, which, by different degrees of condensation, and by means of various combinations, gave rise to all beings, and even to the gods.

Finally, Heraclitus, who may be regarded as belonging also to the Ionian school, placed his principle in fire; but perhaps he considered it rather as the source of animation and motion, than as forming the real matter of bodies. There is a perceptible resemblance between his system and that of the physiologists, who have placed their principle of life, in all animals, in the heat produced by the act of respiration.

Italic School.—The second school, the Italic School, was founded by Pythagoras. This philosopher was born at Samos, about 584 years before Christ. He was contemporary with Anaximander, Anaximenes, and Heraclitus. It is even said that he was, like them, a disciple of Thales; of this, however, there is no positive proof. After having travelled into Egypt, into Magna Græcia, and perhaps into India, he returned to his native country, which he found governed by the tyrant Polycrates. Discontented with the changes this chief had introduced, he went into Italy, and settled at Crotona, a city built about 120 years before by a colony of Achaians.

He very soon founded secret societies there, to which he annexed institutions, of the same plan with those of the Egyptian sacerdotal tribe. He received none as disciples until they had submitted to a long noviciate.

He imposed on them fastings, and different modes of abstinence, and singular practices, with the design of which we are utterly unacquainted. The societies which he founded were soon dispersed, because they were charged by the people with ambitious views; they were not revived till long after his death.

Pythagoras left no work of any kind; and it is not even known whether he ever wrote any thing. He had learnt in Egypt the first elements of geometry; and tried, it is said, to discover the principle of things in the powers of numbers. Every thing relating to this part of his doctrine has been so disfigured by those who revived his school, after the time of the persecutions, that it is difficult to judge of his real opinions. Perhaps he wished to inculcate, that it is possible to estimate by numbers all powers, all dimensions, and of thus rendering them comparable, and susceptible of being reduced to calculation. In this case, his idea would be the same with that which serves, in our day, as the basis of all physical mathematics.

Pythagoras divided all beings into equal and unequal: the last were composed of *monades*, or unites; the other of *diades*, or dualites. He extended the language of arithmetic even to morals, and said that justice was always divisible by two. It is impossible not to consider this as an allegorical expression; and, with equal justice, it may be said, that, in many instances, ideas have been attributed to this philosopher which he never entertained, and just in consequence of taking in a literal sense what he said figuratively. In other respects, even through all these singularities, a progress in science cannot fail to be discovered. The Ionian school placed every thing in matter; the Italic school sought it elsewhere, and thought it had found it in the power of numbers.

According to Pythagoras, the Universe was a harmonious whole, and on this account the number of the planets was equal to that of the notes of the gamut. In the centre of this harmony was the sun, the soul of the world, and the principle of motion. The souls of men and of animals participated in the nature of this celestial fire; and also those of the gods, who were themselves only animals of a superior order.

This pantheism, which admits of beings of different degrees, became also a part of the system of Empedocles. This philosopher, born at Agrigentum 442 years before Christ, was contemporary with Socrates. He wrote a poem on Nature, in six books. He speaks in it of the four elements. He does not, like the other Ionian philosophers, regard any of them in particular as a principle.

It is a confused mixture of all things; it is their chaos, which, according to him, is the pre-existent substance.

Empedocles did not confine himself to speculations; he was just such an observer as Alcmeon had been. He established an analogy between the eggs of animals and the seed of plants; he discovered the *amnios;* and one would even suppose, from a verse of his which has been preserved, that he had a knowledge of the labyrinth of the ear. He applied his learning to the good of the people in general; he improved his country by draining of the waters; he purified the air by fires, and put a stop, as is said, to an epidemic, by closing a hole in a rock, whence unwholesome vapours were exhaled.

These were nearly all the philosophers of the Italic School, who engaged in the sciences. The Pythagoreans, by the form of their associations, and the mystery which enveloped them, almost always inspired the people with inquietude. On this account the propagation of their doctrine was far from being extensive. It became extinct, but was taken up again by Plato, who adopted a part of it.

Eleatic School.—Besides the Pythagorean school, another was established, that of Eea, founded by Xenophon, who, about 500 years before Christ, came from Colophon, his native country, and settled in Sicily. This philosopher is the first who combated the anthropomorphism of the Greeks. The divinity was, according to him, *unity*, every thing; but his pantheism, instead of being of a material sort, like that of the Ionians, was purely spiritual. Parmenides, his scholar, went much farther, and maintained that the whole of nature was a sensible illusion. This is precisely the system which, in the present day, we find among the Indians.

Parmenides and Zeno came to Athens about 460 years before Christ. Anaxagoras came thither about the same time. Socrates was then ten years old, and thus had the opportunity of receiving instructions from all the three.

Atomistic School.—Leucippus, founder of the atomistic sect, was cotemporary with the two eleatics we have just mentioned, and a declared antagonist of their doctrine. Disgusted with idealism, by the abuse he saw made of it, he ran precipitately into the opposite excess, and was a complete materialist. He rejected alike the intelligent unity of the eleatic school, the *whole* neither material nor immaterial, and the numbers with the harmonic proportions of the school of Pythagoras. He allowed nothing beyond a vacuum and atoms; these very atoms he deprived of the properties which other philosophers admitted they possessed, and assigned to them only figure and motion. The different properties of bodies, their colour, consistence, heat, and cold, depended at once on the figure and arrangement of these molecules; the external alternation of the destruction and reproduction of beings resulted from their motion; the soul itself was only an aggregation of atoms in a particular mode of combination.

Alcmeon had studied the anatomy of many animals, but Democritus of Abdera was certainly the first who practised comparative anatomy. He observed differences of organization in a great number of species, and tried to deduce from them differences also in their manner and habits. He was acquainted with the *biliary* process, and investigated the causes of madness, which he placed in an alteration of the viscera of the belly.

The character of the atomistic sect is peculiar and decided, whereas the other three being only derivations of the school of Thales, bear in many points a resemblance to each other.

Medical School.—Besides these four, there was the Medical School, and it was the most ancient of all. It continued in one single family, that of Asclepiades, from time immemorial. The two principal branches of it were those established at Cnidus and Cos. Most of the temples of Esculapius were served with priests out of this family. In these temples they received invalids, made them observe certain religious practices, administered remedies to them, and carefully attended to the effects they produced. Moreover, those who had been cured of any disease, even at great distances from these places, often sent thither, as if, *ex voto*, an account of their illness. One of these collections, continued nearly for 800 years, was examined by Hippocrates, and his works give as it were a summary of the enquiries of the Asclepiades. But, all the works which bear the name of this illustrious physician, do not belong to him. This fact is discernible from the difference of style, and the contradictions which occur, in the different treatises. It appears that three men of the same name and family contributed to them. The first lived about the time of Miltiades; to him is attributed the book of fractures, or of articulations. The second and most celebrated was cotemporary with Socrates.

Anaxagoras unites the school of Thales with that of Socrates, of which he was made master. When the Persians subdued Asia Minor, he came from Clazomènæ, his native place, and settled at Athens. He was the friend of Pericles, and shared the hatred which was entertained against him. Accused of atheism by the enemies of this great man, he was obliged to retire to Lampsacus, where he died at the age of 72, 428 years before Christ. It was he who first made a clear distinction between mind and matter. After his time philosophers regarded motion as inherent in bodies, or rather regarded bodies themselves as mere illusions. Anaxagoras maintained the reality of matter, and at the same time that of mind, which rules and directs it. The principle we see is like that of natural theology, which, in our day, serves as the basis of all religions. Nothing, therefore, was more unjust than the charge of atheism, directed against a man who was the first theist that ever existed among the Greeks.

Anaxagoras does not at all admit as a principle, either fire or water, or even the reunion of the four elements. According to him there was diversity in matter; every sort of matter was composed of corpuscules like to itself, and by consequence like to one another. From the singular objections made by the ancients against the system of homœomérias, the name given to those composing molecules, it appears they have not understood it. They ask, for example, if a man is composed of small men; as if Anaxagoras had ever admitted this mode of composition in any other case than in that of simple bodies.

None of the works of Anaxagoras has reached us; a few of his apophthegms are however preserved. He said that nothing comes out of nothing; that every thing is in every thing, and can produce every thing; thereby meaning, undoubtedly, that every composed body contains all the species of simple molecules, which, combined in different proportions, would produce different mixed beings.

This philosopher traced the reason of things in observation. It is told, that the people having considered as a horrible prodigy, a ram which was born with only one horn, Anaxagoras dissected the animal, and explained the cause of this monstrosity. He was far from being sufficiently strict in the examination of facts, if it is true that he believed that weasels, storks and crows produced their young by the mouth. In his time a very large stone fell from the air, near Aegos-Potamus. He tried to explain this fact, and it is pretended that the conclusion to which he came was, that the heaven was a vault of stones. He believed the moon to be inhabited, and regarded the sun as an inflamed metallic mass; this constituted one of the chief accusations which the Athenians urged against him.

Anaxagoras was the precursor of Socrates, whose opinions will be considered in our next lecture.

Lecture Sixth—*Socrates and his Epoch—State of the Sciences up to the time of Aristotle.*

Socrates—Plato; analysis of the Timæus—Herodotus—Xenophon; his treatise on Hunting—Hippocrates; his errors in Anatomy and Physiology—Ctesias.

We have seen the origin and development of the philosophic spirit among the Greeks, and the separation of the Grecian philosophers into several sects. In the most ancient of these sects or schools, gross physical ideas formed the basis of all their speculations. In the second, something beyond matter was already sought for; some of the laws which govern it were discovered; the power of numbers and of harmony was invoked. In the third, metaphysical ideas obtained the ascendency. Matter was no longer thought worthy of consideration, its very existence was denied: bodies were but illusions, and the whole world was in the intellect. The fourth, disgusted with these abstractions, went into the opposite extreme, and refused to admit any thing but matter and motion. Lastly, Anaxagoras raised himself to the idea of an intelligence which arranged matter.

Of the disciples of Anaxagoras, the most celebrated was Socrates. The history of this sage is too well known to render it necessary for us to speak particularly of it. Selecting from the doctrines of his master all that was elevated and useful in them, he tried to establish a more complete reform, and to force philosophy into a path from which it should never afterwards deviate. Rejecting all *a priori* positions, he endeavoured to subject metaphysics to logical reasoning, and physics to common sense and observation.

Socrates, after presenting during his whole life a model of virtue, afforded by his death an example of the respect that ought to be paid to the laws, by refusing to withdraw himself from the unjust sentence by which he had been condemned. He had been accused of impiety, and although no one had ever before formed a more sublime idea of the Divinity, he fell under the weight of the accusation. Perhaps his death was less the work of religious fanaticism than of political animosity. After the expulsion of the thirty tyrants, it was remembered that he had been the friend of one of them, of Critias. This connection, however, which the love of science alone had formed, never induced the philosopher to deviate from the rule of conduct which he had traced to himself, and at all times he had been as impregnable to the suggestions of friendship as to threats or violence.

Socrates did not cultivate the physical sciences; yet he contributed more than any person to give them the direction which they presently assumed, and it may be said that he paved the way for Aristotle. The Eleatic School introduced at Athens had there by its degeneration produced the sophists, who, by dint of subtleties, had succeeded in throwing uncertainty over the clearest notions. It was to combat them that Socrates chiefly laboured. To force them to relinquish the subterfuges to which they habitually had recourse, one of his chief means was defining precisely the value of terms. In this manner he created a rigorous language, and thus rendered an important service to the positive sciences, by furnishing them with the instrument which was indispensable to them.

It is to Socrates that we owe the introduction of a very broad principle, by which the natural sciences have greatly benefited, the principle of *final causes*, or, as it is now called, *conditions of existence.* He tells us himself that this idea was suggested to him by the reading of a work of Anaxagoras, *on the intelligence which has arranged the world.* If the universe, thought he, is the work of an intelligent being, all its parts must be in accordance, and disposed so as to concur to a common end. There results from this, that every organized being must be connected with all the others by necessary relations, and, moreover, that it must contain in itself all the conditions which may enable it to perform the part assigned to it.

The principle of final causes has sometimes led into error speculative minds who have too easily believed themselves, by means of this rule, to be freed from the necessity of direct observation; yet, it must be allowed that it has still more frequently led to useful discoveries; and that, in all cases, it has thrown interest upon researches which, without it, would have been very dry. Socrates was the first who explained this principle, and he even declares his regret that he was not sufficiently versed in the natural sciences to have frequent occasion of applying it.

Socrates was born in 469, and died in 399, three years after the war of the Peloponnesus. He was contemporary with Pericles, Alcibiades, Xenophon, and Hippocrates.

The pupils of Socrates, after the death of their master, left Athens, where their residence was not without danger, and retired to Megara, and some other cities, to continue the philosophical labours in which they were engaged. They founded different schools. Of these, the best known are the Cyrenaic School, the School of Megara, the Cynic School, and, especially, the Academic School, whose influence has been so powerful.

Antisthenes, the founder of the Cynic sect, asserted that the object of philosophy was to teach man to find the true good, which he placed in virtue; and maintained that it could only be acquired by overcoming all the propensities.

The Cyrenaic sect, founded by Aristippus, also engaged in the search of the chief good; but held that it was by moderately indulging the natural propensities that man could obtain it.

The Megaric sect trode in the steps of the Eleatic school, and lost itself in the subtleties of dialectics.

The Academic sect was founded by Plato, the youngest of the disciples of Socrates. Plato was only twenty-nine years old when his master died. After in vain attempting to defend him, he retired to Megara, and then to Cyrene. Anxious to apply the time of his exile to the best purpose, he resolved to travel. He went first to Egypt, and there became a pupil of the priests; who, notwithstanding the state of degradation to which they had been reduced in the reign of Cambyses, still retained traces of their ancient science. He passed from thence to Magna Græcia, and studied at the school of the Pythagoreans under Timœus of Locris and Archytas of Tarentum. Before leaving Megara, he had exercised himself in dialectics under Euclid, who had been like himself a pupil of Socrates, but at an earlier period. Thus when, on his return to Athens, he opened a new school, he had derived from those which already existed, all that could be useful to him for arranging his doctrine, and presenting it under the most advantageous form.

The natural bias of Plato's mind inclined him to poetry and fiction more than the sciences of observation and calculation. Yet he retained, in consequence of his connexion with the Pythagoreans, a great respect for geometry, and intended that it should form an introduction to philosophy. It is not always easy to determine what are his peculiar doctrines, for he has not explained them in a didactic manner. It may, however, be supposed that in his Dialogues, in which he generally introduces Socrates as interlocutor, the opinions he places in the mouth of his master were, for the most part, his own.

Plato, in most of his writings, speaks of the human faculties, the formation of ideas, and the nature of the soul. Although he borrowed many metaphysical ideas from Anaxagoras, the Pythagoreans, and even from the Elean School, yet the greater part of his doctrine is new. He admits, for example, that the general ideas in man are not formed by the method of abstraction, but that they are a recollection of those our mind had when it was united to the Divine mind, of which it is an emanation. The general ideas, therefore, pre-exist in the Divinity. At a certain period, they penetrate matter, which was itself eternal, and from this impregnation results the soul of the world, and the soul of the different organized beings.

It will easily be seen that, with bases like these for his philosophy, Plato would necessarily be led to an *a priori* system of physics and natural history, which would consequently be very far from the truth. The results of his speculations on these matters are given in the *Timæus*, a treatise which, although somewhat obscure, is interesting, because it is the oldest that remains to us of all those written by the Greek philosophers on the natural sciences.

The Dialogue commences with a recital which Critias supposes to have been made to Solon, by an old priest of Sais, a city of Lower Egypt, considered in Greece as the country of Cecrops. This priest, therefore, relates, that Sais had been founded 10,000 years before by a colony which had issued from Athica. Since this time, said he, numerous deluges had supervened and destroyed all the monuments of men; but, in the midst of these disasters, Egypt alone had been spared and still preserved her annals. It is not necessary to shew all the absurdity which there is in supposing that a country scarcely elevated above the level of the sea, could have been preserved during an inundation which covered higher countries. All that can be admitted is, that there was a confused tradition of great geological revolutions, a tradition which has been found in all countries. Other traditions are seen in the history of the Atlantis submerged by the waters, and no doubt still more would have been found, had not Plato disfigured the original account, by adding to it ornaments suggested by his own fancy. Assuredly, when he speaks of the wars of the inhabitants of that island, their constitution, &c., he merely yields himself up to his imagination, and does not express his actual belief.

After Critias finished his recital, Timæus speaks, and enters on a still higher cosmogony. The world, he says, was arranged by the Divinity. It proceeds at once from the Son, who formed it, and the Father, who furnished the model of it. When intelligence, which existed from all eternity, penetrated matter, which itself had no beginning, there resulted from the mixture the soul of the universe. The world has thus in itself its principle of motion. It has besides all the conditions of existence of organized beings. It is a true animal.

Timæus, therefore, admits matter as pre-existent to creation, and this opinion was in general that of all the ancient philosophers, even of those who did not believe in a distinct divinity of the universe.

The substance of all bodies, adds the Pythagorean, is composed of four elements, air, earth, fire and water. Each of these elements owes the properties which it possesses to the form of its molecules, which are pyramidal in fire, cubical in earth, octahedral in water, icosihedral in air. Each of these solids resolves itself into tetrahedrons, so that the universe is definitively composed of triangular pyramids.

These ideas, it will be seen, bear a great resemblance to those which at the present day furnish the basis of crystallography; nor is there a fundamental principle of science that has not thus been guessed by the ancients. At the same time these principles have aided the advancement of science only when they were deduced from experiment and observation. Whenever they were established *a priori*, they have been found completely sterile.

Timæus at length comes to the psychological and physiological part of his doctrine, for he establishes no distinction between these two orders of phenomena, which we now think widely separated. It is to be recollected here, that previously to Aristotle the greatest confusion prevailed in science. It was that wonderful man who first devised a classification of human attainments, and gave an example of it in his works.

God created the soul of the world by introducing into the formless material substance the ideas which existed by themselves. From the mixture were formed the souls of organized beings, which are in relation to the universal soul as the drops attached to the side of a vessel are to the fluid contained in it, the human souls were distributed in the different planets. Those which had the earth for their habitation were there in a kind of state of trial. The infernal gods were charged with providing bodies for them, of which previously they had no need.

Man has received three souls: the reasonable soul, the sensitive or passionate soul, and the coarse or vegetative soul. The reasonable soul resides in the highest part of the body, in order to be nearer Heaven, from which it derives its origin: The head, which is its place of abode, is rounded after the form of the world. The passionate soul is placed in the breast, the heart being its principal seat. By its impetuosity, it would tend to prevail over the reasonable soul. To prevent this disorder, their communications with each other have been rendered difficult, by the contraction of the neck. The coarse soul, occupied with material objects, resides in the lower belly. These two latter souls have each their moderator. The lungs, cooled by the air which they receive, are placed near the heart. The liver is placed in the neighbourhood of the stomach, the principal seat of the coarse soul, and has near it the spleen, which is destined to receive the impurities that hinder it from properly performing its functions.

After this singular system of physiology, comes what might be called the zoological part of the treatise. Timæus seeks the cause of the diversity of the form of animals, and explains the system of the Pythagoreans respecting metempsychosis. At the first transformation, trifling and unjust men are changed into women; at the second, they are metamorphosed into animals; and, according to their degre of culpability, become birds or quadrupeds; the most depraved, those which are no longer worthy of respiring pure air, are transformed into fishes. By means of successive transformations, Timæus explains the resemblance which is observed between animals of different classes. This resemblance does not come solely from the circumstance that all have a similar soul, but from the circumstance that each of them retains in its present state something of the former state.

The soul of plants (and it must be remembered that, in its general acceptation, this word signifies nothing more than an internal principle of motion) superintends their preservation, their growth, and their reproduction. Besides this vegetative soul, animals have the sensitive or passionate soul; man alone has a reasonable soul.

We thus find very clearly expressed in the Timæus these three principles of motion, which correspond to what have since been named organic life, animal life, and intellectual life. This, however, is not, properly speaking, science, or at least it is a science *a priori*, and such as might have been expected from a system of metaphysics like that of Plato. If, in fact, human knowledge be nothing but reminiscences, it is by retiring from the external world that there would be the best chance of obtaining them; and, in the search of truth, it is to meditation, and not to observation, that we ought to give ourselves up. It will be imagined, that, with such a mode of procedure, the Platonic School could not have greatly benefited the natural sciences. It may even be said that it injured them, by opposing to a certain degree the propagation of the doctrines of Aristotle.

In the Timæus, Plato explains his own doctrine, which is easily gathered from the Dialogue. Thus, the words which he puts in the mouth of various interlocutors, are to be considered as the true expression of his sentiments, excepting in some evidently allegorical parts.

The fictions which are met with in various treatises of this philosopher, are owing partly to the poetical turn of his mind, and partly to the necessity of veiling certain doctrines, which it would have been dangerous to divulge more clearly. Notwithstanding this precaution, Plato was accused of impiety, as Anaxagoras and Socrates had been before him; but he was treated more favourably, and continued to teach at Athens to an advanced age. He died at the age of eighty-one, in the 348th year before Christ.

Aristotle, the disciple of Plato, was his successor in philosophy. Before undertaking the history of the labours of this great man, which form so remarkable an epoch in science, it is necessary to advert to those of some of his predecessors, of which we have not yet had occasion to speak. Some of them belong to no sect of philosophy in particular; others are of the school of the Asclepiades, who, as we have said, cultivated the sciences only with a practical object. Among the first, we must in particular notice Herodotus and Xenophon.

Herodotus, the oldest prose writer whose works have come down to us, was born at Halycarnassus in Caria, about the year 484. He was a great traveller, having visited successively a part of the East, Egypt and Greece, and it is in his writings that we find the first positive facts in natural history. He has given a tolerable description of the crocodile of Egypt, and of several other animals of the same country. He also speaks of the hippopotamus, but what he says of it is less correct. Aristotle took advantage of these descriptions, and even copied some of them almost verbatim.

Xenophon engaged more particularly in natural history. He was born in 445, that is to say fifteen years later than Socrates, whose pupil he was, and whose apology he published. He devoted only a part of his time to the study of philosophy. He was a soldier and a statesman. He was present in that famous expedition of the Ten Thousand Greeks, which the young Cyrus had called to his aid, and, after the death of the principal officers, it was he who commanded the little band in its retreat towards Greece. Besides the account which he has left us of this expedition, we have various moral and historical works of his; but the most interesting in reference to science is his Treatise on Hunting (the Cynegetics), which he composed with the view of inspiring the Grecian youth with a taste for that exercise, as calculated to form them, during peace, to the labours of war.

Xenophon, in this treatise, gives us accounts respecting certain animals, which we in vain search for elsewhere. He treats of the different races of dogs which were employed in hunting, and of the two species of hares which occurred in the Peloponnesus. He makes known the various kinds of game, points out the habitual retreats of wild beasts, describes their stratagems to escape pursuit, and, lastly, their means of defence. Without this book, we could only conjecture a very important fact in zoology, which is, that certain races of wild animals have lived in climates very different from those in which they are now observed. In his time, in fact, Macedonia and the northern provinces of Greece had lions, panthers, jackals, and some other species which at present are to be found only in Africa.

We have yet two writers whose labours might have been useful to Aristotle, and who both belonged to the family of Asclepiades: the one is Hippocrates, the other Ctesias.

Hippocrates, as we have already said, is not the author of all the treatises which bear his name; but he is certainly the author who has most contributed to that admirable collection, which must be considered as a general view of the researches of the Asclepiades. He was born at Cos, in the 460th year before Christ, and died in Thessaly, at the age of nearly a hundred years. During this long life, he might have known Socrates, Plato, and even Aristotle, who lived at the Court of the King of Macedonia, when he was himself called there on account of the illness of Perdiccas. We have very few authentic facts respecting the life of this great physician. It is seen by his works that he had travelled much, but it does not appear that he had ever been in Egypt. It is related that he resisted the splendid offers made to him by the King of Persia, and that he wished to devote himself entirely to his country. It is also said that he delivered the Athenians from a very cruel epidemic disease; but it is to be supposed that this was not the great plague of 430, for Thucydides, who had traced the history of that disastrous period, makes no mention of Hippocrates, who was then living in all the vigour of his intellect.

Hippocrates is too well known to require any eulogium from us. It is known how skilful he was in the knowledge of diseases,—how he could distinguish them by their signs, and deduce indications of treatment from the consideration of their symptoms. In what relates to medicine properly so called, he is almost always admirable; but, on the other hand, in all that relates to anatomical knowledge, he is feeble in a surprising degree. His ignorance in this respect appears still greater than that of Plato; at least it shews itself more, from his being obliged to enter more into details.

Some of his errors are evidently the result of imperfect observation; but there are others which are absolutely founded upon nothing. His description of the veins, for example, is altogether imaginary. He speaks of a vein which goes from the forehead to the anterior face of the arm, and of another which goes to the posterior part, and rises upon the lateral parts of the head. From end to end there is the same inaccuracy; and yet it is according to this imaginary distribution of the bloodvessels that he is guided in prescribing the different bleedings; for, according to him, the place to be selected varies according to the symptoms of diseases.

Hippocrates considered the brain as a spongy organ, destined to absorb the moisture of the body. He had no knowledge of the nerves; and when the word *nerve* occurred in his writings, it designates the tendons, ligaments, and, in general, the various white tissues. In his time, it was almost impossible to acquire in Greece any accurate ideas respecting the internal organization of man. To touch a dead body with any other intention than that of rendering the last duties to it, was considered as a horrible profanation. It is true that, in Egypt, the practice of embalming bodies was in a certain degree favourable to the study of anatomy; but we have said that Hippocrates did not travel in that country. He did not, however, neglect to study all that could be known without the aid of dissections. The practice of surgical operations, and the treatment of diseases of the bones, would have pretty frequently afforded him opportunities of making observations in osteology; and of all the departments of anatomy, it is in this that he has made the nearest approach to truth.

The physiology of Hippocrates is by no means better than his anatomy. It is founded in a great measure upon the theory of the four elements, and upon their properties, heat, cold, dryness, moisture. It is a system formed entirely *a priori*, a mere production of the imagination. But the moment we arrive at the medical treatment, then the great observer appears again, and we find reflections as just as profound on the influence of climates, seasons, and kinds of food.

Ctesias was, like Hippocrates, one of the Asclepiades, but he belonged to a family that had settled at Rhodes. He had followed the army of the Ten Thousand, and after being made prisoner in that expedition, had become physician to Artaxerxes, at whose court he resided seventeen years. On his return to Greece, he published a history of Persia and Assyria, which he said he had taken from the archives of Ecbatan, and an account of India, which was also borrowed from Persian writers.

In the latter work, of which there remain only a few fragments preserved by Photius, we find several facts in natural history. Mention is made of the elephant, an animal with which the Greeks were not acquainted until after the conquests of Alexander; the parrot, and the facility which that bird had for pronouncing words. Lastly, the bamboo is spoken of, which the author describes as a reed so thick that two men could scarcely clasp it.

Ctesias does not confine himself to such exaggerations as this, but is full of absurd stories. However, we should not consider as entirely false all the extraordinary recitals which are met with in his book, many of them being founded on distorted traditions, or on erroneous figures. As an example of the latter, we may mention the history of the mauticore, an animal with the head of a lion, three rows of teeth, and the tail of a scorpion. It is evident that Ctesias, in this case, had described as a real animal the symbolical one whose figure he had seen represented on the monuments of Persepolis. His description of the unicorn is in like manner founded on the rhinoceros' figures which occur often in these sculptures. As to disfigured natural facts, they also may be pretty frequently recognised. Thus, it is judged that it is not with oil, but with naphtha, that the surface of certain lakes is covered; that it is not gum-lac but amber, that certain rivers carry in their waters at determinate periods. In a similar manner may be explained the history of insects and flowers that dye purple; that of white and horned wild asses, &c. But we also meet with fables which are entirely without foundation, and which it were useless here to repeat. These fables, perhaps, more eagerly received than the true descriptions given by Ctesias, infect almost all the works that have since appeared.

LECTURE SEVENTH—*Aristotle—His Opinions and Writings.*

ARISTOTLE was born at Stagyra, in the year 384 before Christ. His father Nicomachus being physician to Amyntas III, king of Macedonia, he was brought up among the young princes, and was in some measure the companion of Philip, who, shortly after ascending the throne, appointed him preceptor to his son Alexander. The philosopher was then only twenty-eight years of age, and was still in the number of Plato's disciples; so it may be supposed that he owed this distinction as much to the early connexion which had existed between him and Philip as to his merit, which could not at that period have been sufficiently appreciated. It would appear that at this time he had not yet opened school, and it is even doubted if he taught publicly before the death of his master, which happened in 348.

Aristotle remained at Athens until the period when war broke out between the king of Macedonia and the Athenians. He then retired into Mysia near his friend Hermias, the sovereign of Atarne, and, after the death of that prince, to Mytilene, whence Philip brought him in the year 348 to take charge of the education of his son Alexander, then thirteen years of age.

Philip died in 336, and, shortly after, Aristotle returned to Athens. It has been alleged, it is true, that he accompanied Alexander as far as Egypt; but this does not seem probable, as the descriptions of the animals of that country which are found in his works are borrowed from Herodotus, and contain the same errors. Aristotle opened his school at the Lyceum; he went there twice every day, exposing in his morning lectures the elements of philosophy and the matters that did not require preliminary study, and in his evening lectures developing the higher parts of his doctrine. He thus taught publicly for twelve or thirteen years, and during the whole of this time did not cease to correspond with Alexander. It would appear however, that, towards the end of his life, that prince grew cool towards him. In some of his letters he seems to endeavour to pique him by exalting the merit of Xenocrates. Some writers have even advanced that, after putting Callisthenes to death, he reserved the same fate for Aristotle, but that Antipater, to whom he sent the order, refused to execute it.

Notwithstanding this coldness, Aristotle continued to enjoy an appearance of protection which ensured his tranquillity; but scarcely was Alexander dead when the Athenians made amends for the constraint which fear had imposed upon them. The demagogues, who confounded in one common feeling hatred to the king of Macedonia and to his preceptor; the sophists, whose miserable quirks he had refuted, the platonists whom he had deserted, and whose doctrines he had afterwards combated; all leagued against him, and excited a priest named Eurymedon, who accused him of impiety. Aristotle, warned by the example of Socrates, withdrew, wishing, he said, to spare the Athenians a new attempt against philosophy. He retired to Chalcis in Eubœa, and there died very soon after, at the age of 63, in the year 322 before Christ.

Before speaking of the labours of Aristotle, it was necessary for us to mention the principal events of his life, as it is certain that the position of this great man in society was wonderfully favourable to his genius. He had inspired his pupil with a love of the natural sciences, and thus each victory of the conqueror enlarged the field of observation to the philosopher. It appears that, in the course of his expedition, Alexander sent to Aristotle all the most remarkable productions of the countries which he visited. He did not even confine himself to assisting him in this manner, but, in order to facilitate the means of collecting the materials of his History of Animals, gave him the enormous sum of 800 talents. Pliny adds, that he placed at his disposal more than a thousand persons for hunting, fishing, and collecting the observations which he required.

Such resources are no doubt immense, and yet the account to which Aristotle turned them, is still infinitely above all that could have been expected. Not only did he give to the natural sciences a method which could alone ensure their advancement, but he also, in a life which was not long, collected more particular observations, and deduced more general laws, than all his successors together did in the space of several centuries. Let it be added, that we can only yet judge imperfectly of the whole extent of his knowledge, as a part of his works is entirely lost to us, and the other we have received only in an altered state. Strabo, in the third book of his Geography, informs us what was the destiny of these books. Aristotle, when dying, had bequeathed them to Theophrastus, his favourite pupil, and his successor in the school. Theophrastus, in his turn, left them to Neleus, who carried them to Lepsis, a city of Asia Minor, then dependent upon the kingdom of Pergamos. The heirs of Neleus fearing that they should be carried off by Attalus, who, at this period, was forming a library on the plan of the Alexandrian, concealed them in a vault, where the damp destroyed a part of them. Appelicon, who afterwards became possessor of them, had the gaps filled up; but unfortunately the persons whom he employed in this work were not very well qualified for it, and their inappropriate restitutions have been more injurious than useful. Appelicon carried these books to Athens, where Sylla found them, when he took possession of that city. They were then transported to Rome, and a grammarian named Pyrranion had numerous copies made of them. Andromicus, the Rhodian, superintended the publication, and divided the work into chapters. This division was very ill done, and the titles have frequently no relation to the subject, or are derived from the most frivolous circumstance.

Of the two hundred and sixty works of Aristotle of which Diogenes Laertius has preserved the titles, many are only known to us by their names. Among the latter, we have especially to regret a series of anatomical descriptions in eight books, accompanied with painted figures, which corresponded to the text by references, and a collection of *natural things* arranged in an alphabetical order,—a real dictionary of natural history, which, without doubt, contained nearly all the matters of which Aristotle gave a brief account in his other works. It consisted of thirty-eight rolls, and would form a large quarto volume. Another great loss to those who are interested in the history of the Greek republics, is that of a collection of the constitutions of a hundred and fifty-eight independent states. It was a kind of preparatory work of the author to his book on politics.

Aristotle, in his works, embraces nearly the whole range of human knowledge; but he does not, like his predecessors, confound its different departments. He assigns their precise limits to the sciences; and the manner in which he classes them is so judicious, so accordant with nature, that the labours of twenty centuries have not improved upon it. We must confine ourselves to the examination of such of his works as have reference to natural history; but we cannot dispense with mentioning the others, to give an idea of the prodigious extent of the acquirements of this man of truly universal genius.

His first works relate to Logic or Psychology; and it was natural in fact that the study of the human mind should precede every other study. It is in these books that we find for the first time exposed the rules of syllogism, an art, by means of which it may easily be discovered, if a reasoning be deficient in some points, by giving it certain determinate forms. Plato, it is true, in his Dialogues, has made use of the syllogism, but it is in a manner instinctively. Aristotle, on the contrary, treats of it in a didactic manner.

Next come the works on Rhetoric and Poetry. Aristotle here gives rules which he derives from observation, and which, for this reason, have not yet become obsolete; while all those which have been since laid down in an arbitrary manner, have been found false or insufficient, and have been successively abandoned.

It is also by the method of observation that the author proceeds in his works on Morals and Politics. In the latter, we find some ideas which would not be admitted now, especially those which refer to slavery. But these ideas were so much those of the period, that to render more humane sentiments prevalent, it cost Christianity several centuries of continued efforts.

In Metaphysics, Aristotle treats of the being considered as existing by itself. Here we do not find the same clearness of expression as in his other works, which partly depends upon the circumstance of the subjects being more abstract, and is partly caused by the author's ideas being less precise. However, in this matter also, we do not find that Aristotle has been surpassed by those who have come after him; and it is even to be remarked, that of all the parts of his works, it is this which most contributed to extend his influence, and to make it prevail in the schools during the middle ages.

We now come to the part which more especially requires our attention, the books which treat of the Physical Sciences. These are numerous and varied; there being, 1st, Eight books *on physics, properly so called*; four books *on meteorology*, in which mention is also made of *mineralogy;* one book *on colours*; 2dly, Two books *on the generation and the corruption of bodies;* that is to say, on the motions of decomposition and recomposition of organised bodies; *ten on the history of animals*, four *on their parts*, one *on their means of progression*, two on their generation, and various treatises on *waking and sleeping.*

In all these works, Aristotle follows the same course as in his poetics, ethics and politics; that is, he lays down no rule *a priori*, but deduces them all from the observation of particular facts, and from their comparison. This method, besides, is only the application of his theory respecting the origin of general ideas, a theory which is the opposite of Plato's. That philosopher, as we mentioned, in analysing his *Timæus*, admitted that general ideas exist by themselves, and maintained that they are innate in man, that is to say, that his soul possessed them when it was united to the divinity, and that when it recovers them, it is by a true reminiscence. The evident consequence of this system is to condemn the senses to inactivity, in order to favour by contemplation the return of the mind towards its original state. Aristotle justly opposes this doctrine. With him there are no *innate ideas.* If the divinity has in itself all the general ideas, it is because this belongs to its nature; but, as to man, he can only acquire them by means of abstraction, and, as nothing is found in his mind which has not first passed through his senses, all his knowledge necessarily takes its source in observation and experiment. From the single fact of having laid down this principle in logic, there results a peculiar character which his whole philosophy possesses, and a mode of proceeding which is always the same in the moral sciences and in the physical sciences. When, for example, he has to speak on politics, in place of first creating to himself an ideal republic, which serves him as a type, a term of comparison for judging of the goodness of the different existing governments, he begins with bringing together a great number of constitutions, compares them with each other, examines their influence upon the nations such as history has disclosed it, and finally arrives at general views of the effects of social institutions, and the springs of states. This is the general course followed by Aristotle. It was necessary that we should digress a little from our subject to make it known, and we now return to the examination of the particular treatises on the natural sciences.

Of those which we have enumerated, the first, which relates to *general physics*, is the weakest of all, and such it ought to be. In fact, in that science great progress cannot be made, if the attention be confined to the facts which naturally present themselves. It is necessary to make new facts arise, in other words, to experiment. Now, in the time of Aristotle, this could not possibly be done, for the arts were not sufficiently advanced to furnish the means. There were only some observations in unconnected groups, and it was therefore impossible to rise to very high generalities. Many principles laid down by our philosopher have been found false or imperfect, but then they were truly the general expression of the phenomena then known. He saw, for example, solid or fluid bodies fall towards the ground when they ceased to be supported, gaseous bodies rise from the bottom towards the surface of water, and flame direct itself toward the sky; and he concluded that air and fire had a tendency to ascend, earth and water to descend. We now know that these motions, although inverse, are the result of a single power; but we have arrived at this discovery after the insufficiency of the first explanations were rendered manifest by new facts. The same remark applies to the so-much vituperated principle of the *horror of a vacuum*. Aristotle did not establish it *a priori*, he only announced it as the general expression of the facts then known. If he had seen water stopping in pumps at a height of 32 feet, and mercury rising to 28 inches in the Toricellian tube, perhaps, on comparing the specific weights, the heights of the two columns, he would have been led to discover the true cause of the phenomenon. We may remark, that so long as experiment had not shewn the contrary, it was just as rational to suppose that bodies had a disposition to carry themselves wherever a vacuum tended to form, as to admit that they attract each other, as is now believed. The principle of the *horror of a vacuum* is found false; but it has nothing absurd in itself, and can only seem so to persons who take in the literal sense a figurative expression, an expression perfectly similar to twenty others which we employ without scruple, because language does not furnish us with any that are perfectly rigorous.

Aristotle made a much happier application of his method to the study of living beings. His *History of Animals* in particular, is a true master-piece.

Lecture Eighth.—*Aristotle's History of Animals.*

The *History of Animals* is a very remarkable performance. On reading this treatise, one can hardly comprehend how the author could have found in his own observations so many general rules, so many perfectly accurate aphorisms, of which his predecessors had not the slightest idea. This book is not, properly speaking, a treatise on zoology: it is a general work on that department of natural science, similar to what the Philosophia Botanica of Linnæus is in another department.

The first book treats of the parts which compose the body of animals, describing them not by species, but by natural groups, and making known what belongs to each group. An essay of this kind could not have been written without the author having had very precise ideas respecting the classification of animals. However, as he did not judge it necessary to trace a zoological system, some persons have alleged that the book is deficient in method. Such a reproach manifests a very superficial mind in those who offer it.

The commencement of this first book is in a manner detached from the rest, and is intended to serve as an introduction. A great part of it consists of general propositions offered without details, but in a manner sufficiently clear to enable any one to comprehend it, and make application of it to the natural objects which he knows. The object of the author was evidently to fix the attention, by thus bringing together within a small space a great number of remarkable results, and to give beforehand an idea of the interest which must be found in the study of nature. Most of these aphorisms suppose the observation of an immense number of particular facts, as may be judged of from those which we proceed to quote.

All animals, without exception, are furnished with a mouth and possess the sense of touch; but these two characters are the only ones that are indispensable, and one cannot find a third that is not wanting in some species.

Of the land animals, there is none that is fixed to the ground; of the aquatic animals, on the contrary, several are known.

Every animal which has wings has also feet. The author, on the faith of this general observation, denies the existence of the dragon, which was represented as a winged serpent.

Of the winged insects, several are furnished with stings. Those which bear that organ at the anterior part never have more than two wings; those which bear it at the posterior part have four.

Propositions like these, it is well known, cannot be laid down *a priori:* they are necessarily founded upon the minute observation of facts, and suppose a very general observation of animals.

In this introduction, Aristotle lays the foundation of his classification. He divides animals into those which have blood, and those which are destitute of it: in other words, he separates the red-blooded animals from the white-blooded. The red-blooded animals are quadrupeds, serpents, birds, fishes, and the cetacea. Although the last two classes live equally in the water, and resemble each other a little in their external structure, Aristotle is far from confounding them, when he places them near each other. He was as well acquainted with the nature of the cetacea as we are at the present day. He knew that they are warm-blooded animals, which bring forth living young, and nourish them with milk from their mammæ. He also proposes a very distinct separation among the quadrupeds, between the viviparous and oviparous. The latter, he says, have a great resemblance to serpents, in the internal organization and tegumentary system. In this method, the different groups are formed in a very natural manner, and it is only in their arrangement that some improvement is to be made.

The white-blooded animals are the mollusca, crustacea, testacea, and insects. This division is certainly not without fault; but no better one was proposed until the time of Linnæus. Of the mollusca, Aristotle designates in particular the cuttle-fish, the octopus, the loligo, and the argonaut; and remarks, that the latter is not attached to its shell. He briefly describes all the parts of these animals, and even speaks of their brain, which is a very remarkable circumstance, as the existence of such an organ in the mollusca has only been demonstrated within these few years.

The subdivisions which he proposes among the white-blooded animals, are still better than his principal divisions. In the class of Insects, for example, it is precisely the same as that of Linnæus. He distinguishes insects according as they have wings, or are destitute of these organs, and forms of those which are winged, three sub-orders, according as their wings are two or four, or are covered with horny plates. After this, he explains what he means by *genus* in zoology, and gives, as an example, that of the Solipeda, which consists of the horse, the ass, and the wild mule of Syria (*Hemionus*). This is, in fact, a perfectly distinct genus, and one of those which we should at the present day adduce in preference.

Aristotle, after this introduction, which, as he himself says, is presented as an excitement to the study of natural history, passes to the description of the different parts of animals, taking as a point of departure the human body, which he uses as a term of comparison, and as a basis for his nomenclature. He first treats of the great regions, and of all that can be seen at the exterior; and then passes to the examination of the internal parts. Here his observations are not so correct as before. The great features of the organization, however, are pretty well known to him; and it would even appear that, with respect to certain points of detail, he knew more than most of his successors. He knew, for example, the Eustachian tube, and speaks of it in the passage in which he refutes Alcmeon, who maintained, as we have already said, that goats respire by the ears. He commences his description with that of the brain, and says, that that organ occurs in all the red-blooded animals, without exception; but that among the white-blooded animals, the mollusca are the only ones in which it is found. Man, he adds, has of all animals the largest brain. He gives a pretty good description of the two membranes which envelope that organ, and the different nerves which issue from it to be distributed to the eye. His neurological observations go no farther, however;

and he is ignorant of the distribution and uses of the nerves. Herophilus was the first who had any correct ideas on this subject. Aristotle speaks of the veins, of which the principal trunks have their origin in the heart. He distinguishes correctly between the venæ cavæ and the pulmonary vein, and describes the aorta from its origin to its division at the lower part of the trunk. He did not know that the arteries contain blood, and seems to think that the air penetrates into the heart, which he describes as only presenting three cavities. He treats of the stomach, omentum, liver, spleen, bladder, kidneys, and the parts connected with them, and says that the right kidney is placed higher than the left. All the descriptions, although incomplete, and even false in several points, prove, at least, that he had seen the viscera of which he speaks.

He then treats more particularly of animals, and first speaks of their limbs. Describing those of the elephant, he remarks how difficult the length of the fore-legs and the disposition of their joints render in that animal the actions of drinking and laying hold of its food on the ground. He shews that the proboscis makes up for this disadvantage, and forms a convenient organ of prehension. He also knew that the proboscis is a true nasal organ. In continuing, he gives very interesting details respecting the mode of reproduction of that quadruped, the difference of the sexes, &c. Buffon has contradicted him in several instances, but almost always erroneously, as has been shewn by observations recently made in India.

Aristotle then considers animals with reference to the distribution of their hair. Of those which are furnished with a mane he mentions the bonassus, which is the *aurochs*, and then three Indian animals, the *hippelaphus*, the *hippardium*, and the *buffalo.* The hippelaphus, or deer-horse, has lately been observed by MM. Diard and Duvaucel; the hippardium (the hunting tiger) has only been known within these few years. It existed in the Royal Menagerie, but Buffon did not see it. As to the buffalo, it is well known that it was introduced into Europe at the time of the crusades. Aristotle describes it so as that he cannot be misunderstood. He speaks of its colour, and of the direction of its horns, and says that it differs as much from the domestic bull as the wild boar differs from the hog. In speaking of the camel, he designates the two species, the one peculiar to Arabia, the other to Bactria. The latter could only be known to the Greeks through the conquests of Alexander.

After finishing what relates to the hair, he speaks of the horns, and, on this occasion, exposes general rules, the accuracy of which has been confirmed by all subsequent observations. We shall mention some of them.

No animal has horns unless it has the foot bisulcated, but the reverse is not true, and thus the camel, which has the foot cleft, does not bear horns.

The animals with bisulcated feet, which have horns, and have no teeth in the upper jaw, all ruminate; and, on the other hand, there is not a single ruminating animal that does not present all these characters.

Horns are hollow or solid. The former are persistent, the others are cast and renewed every year.

After this, he speaks of the teeth, the manner in which they are renewed in man and animals, the different forms which they assume in the different species according to their kind of food, being sharp and pointed in the carnivorous animals, flat and grinding in the herbivorous. In some animals, certain teeth protrude, and form weapons; but no animal is armed with horns and tusks at the same time. In the elephant, the tusks of the female are small, and directed towards the ground. This, also, is one of the propositions of Aristotle which has been attacked as erroneous. The Indian elephants, in fact, present in this respect no difference with respect to sex; but the African elephant, which was the species described by our philosopher, has actually the disposition described.

Then follows the description of the hippopotamus, which agrees indifferently with the rest. It is probable enough that it is only the description of Herodotus, which had first been written in the margin by one of the possessors of the book, and afterwards inserted in the text by an indiscriminating copyer. We have many examples of similar interpolations.

Before concluding what relates to the viviparous quadrupeds, Aristotle speaks of monkeys, which he considers as intermediate between these animals and man. He gives a very good account of the principal features of their organization, the structure of their hands, and designates several species, some of which have a tail, and others have none. He then passes to the oviparous quadrupeds, gives the characters which are common to all, speaks of the nature of their teguments, and, on this occasion, describes the crocodile of Egypt, remarks the hardness of its scales, the length of its teeth, their form, the disposition of the organ of hearing, and lastly describes the principal habits of that animal.

The classification which Aristotle proposes for birds is excellent, with reference to the principal sections, and is precisely that of Brisson. He shews the analogy between their wings and the fore feet of quadrupeds. He then speaks of the form of their feet, and the differences which are observed in them, of their third eye-lid, and of the faculty which several of these animals, especially those which have a fleshy tongue, possess of pronouncing words. He remarks that no bird has at the same time spurs and hooked claws. This is another of those general propositions which one is surprised to find in the infancy of science.

He at length arrives at the fishes; and here he is truly admirable, his knowledge being, on some points, superior to what we possess at the present day. He makes known, in various parts of his book, 117 fishes, although his object is not to enumerate species, but only to present general views. Of the facts which he relates, several are still considered as doubtful. New observations, however, have from time to time made known the accuracy of some of his assertions, even of those which seemed the least accurate. He says, for example, that a fish named *phycis* makes a nest like birds. This was long considered as a fable, but M. Olivi has lately found a fish, named *gou* or *gau* (*Gobius niger*), which has similar habits. The male, at the period of impregnation, digs a hole in the mud, surrounds it with fuci, forming a nest of it, near which he meets the female, and from which he does not stir until the eggs that have been deposited in it are hatched*.

Aristotle, in the part where he speaks of the sensations, takes care to point out the animals which are destitute of some organ of sense, or those in which these organs present certain peculia-

* Fishes nests built of fuci have been observed in this country, as mentioned in a former number of this Journal.—Edit.

rities. Thus, on the subject of vision, he speaks of the eye of the mole, which is concealed beneath the skin, but which is similar in its conformation to that of other animals, and equally furnished with a nerve, which is evidently that of the fifth pair. In treating of taste, he speaks of the fleshy palate of the carp. He speaks of the organ of hearing of fishes, and shews that the skin may serve for the transmission of sounds. He shews that insects also possess the faculty of hearing, and even that they have the sense of smell, as they are driven off by certain smells, and attracted by others. In speaking of the voice, he distinguishes correctly between the true voice, which is produced by air expelled from the lungs, and the various noises which some animals emit. He describes, on this occasion, the musical apparatus of the cicadæ and grasshoppers, which consists of quite a different mechanism. He then speaks of the voice of the parrot, and the disposition of the tongue in frogs, which, instead of being, as in most animals, free anteriorly and fixed behind, has its base attached to the fore part of the jaws, and the point directed towards the palate.

In treating of waking and sleep, Aristotle speaks of the hybernation of several animals, and the sleep of fishes; and, on this point, gives details which it would be very difficult for us at the present day to verify. But he was placed in very favourable circumstances for obtaining information respecting these animals. Greece abounds in gulfs and straits full of fishes, and the inhabitants of the coasts must therefore have engaged at an early period in fishing. It would indeed appear from some passages in Homer, that this profession was anciently held in disesteem, but the prejudice did not last long. Extensive fisheries were established, and salt fish became an important article of commerce. It was on account of the riches which this occupation procured to the inhabitants of Byzantium that their port received the name of the *golden horn.*

In the part in which generation is spoken of, we find very extensive and accurate observations. Aristotle there speaks of the membranes in which several mollusca envelope their eggs, and describes them in the octopus and loligo. He explains the metamorphoses of insects, which, before acquiring their last form, pass through the larva and chrysalis states. He also knew the incomplete metamorphoses, in which the larva differs from the perfect insect only in the absence of wings, and only undergoes a single transformation. He speaks of the insects which occur in snow; and, in short, enters into a multitude of very interesting and perfectly accurate details. He admits spontaneous generation, however, in these animals, and thinks, that, when the constituent elements present themselves in the necessary proportions, and in favourable circumstances, they are capable of giving rise to living beings; but, at this period, such an error was almost inevitable, and it was not until the invention of the microscope that the truth could be known. He speaks of the economy of bees, and says that some persons consider the *king* as a female. He describes the kind of cell constructed for these privileged individuals, which shews that he had observed the interior of their hives, although he certainly could not have had the use of glass, which greatly facilitates an examination of this kind. He also treats of the domestic economy of wasps, hornets, mason-bees, and drones; describes the singular covering in which the larva of the Phryganea is enveloped, and speaks of spiders which carry under their belly the bag which contains their eggs. In speaking of animals of a higher order, he makes a very accurate distinction between the eggs which have a hard envelope, as those of crocodiles and tortoises, and those with a soft envelope, as in serpents. He says that serpents which bring forth their young alive, have yet eggs, but that these eggs are hatched within them. He was perfectly acquainted with the development of the chick during incubation, describes it day after day, speaks of the heart as the first point that appears, of the veins which afterwards stretch towards the upper and lower parts of the body, and, lastly, of the alantoid membrane which presently envelopes the whole egg. It ought to be remarked, that all these observations were made with the unaided eye, and that the slight errors which may be marked in them depend solely upon the circumstance that Aristotle had no magnifying glasses. He remarks, in speaking of the eggs of fishes, that the alantoid membrane does not exist in them, nor in those of any other animal that respires by branchiæ. He admits spontaneous generation in fishes, as he had done in insects; and, in support of this opinion, adduces facts which appear conclusive such as those sudden appearances of an immense quantity of small fishes, which the Greeks, on account of their supposed origin, named *aphia*, and to which, in the south of France, a name is still given which originates from the same idea, they being there called *nonnats*, that is *non nati*. What he says of eels is certainly incorrect; but we ourselves, in respect to the reproduction of that animal, have still much to learn, notwithstanding the labours of Spallanzani.

Aristotle examines the changes produced by age in animals and in man, and on this occasion gives excellent advice to mothers. He then passes to the actions of animals, and endeavours to explain the influence of their kind of life, that of the external circumstances, climate and seasons, in the midst of which the different species live. He also points out the food that agrees with each. What he says of fishes is particularly interesting, and might be very useful to us, were it not that in consulting it we are frequently put to a stop, his nomenclature being different from ours. He treats of the influence of temperature on the migrations of birds, speaks of those which travel, the time at which they set out, and the order which they follow in their flight. He also speaks of the migrations of fishes, of that of the tunny, the mackerel and sardine, and says, that shoals of fishes come from the Black Sea and enter the Bosphorus. He follows them in their route through the Propontis and into the Archipelago. It appears that he had observed them on the coasts of Thrace, and especially at Byzantium. He says that the same fish receives different names at different periods; for example that the fish which is known in the Euxine Sea by the name of *cordylus* takes in spring the name of *pelamis*, and lastly that of *thon* when it has arrived in the Archipelago. He treats of the fishes which in winter do not shew themselves, and of other animals which appear at certain seasons of the year, as the *boback* or Pontus rat. He speaks of the diseases of fishes, and on this subject he appears to be better informed than we are at the present day. In describing the different acts of animals, he makes known the means by which the frog-fish attracts small fishes in order to devour them, and speaks of the commotions which the torpedo causes when one lays hold of it, and of the manner in which the cuttlefish escapes the pursuit of its enemies by darkening the water with its ink. He pursues this examination into the class of insects, and speaks particularly of some of them, and especially of the spiders. Then, passing to birds, he points out the different ways in which they construct their nests; says that there are species which make no nests; and, finally, gives the history of the cuckoo, which lays its eggs in the nest of another bird.

From the above account it will be seen how rich and abundant in matter is the History of Animals. There is a defect in it, however, which renders it much less useful to us than it might otherwise be, for Aristotle, like all the ancient naturalists, seems to have thought that the language which he spoke was never to change, and generally contents himself with naming the species. He gives no descriptions properly so called, excepting in reference to the elephant, the camel, the crocodile, and the cameleon. Some other animals, it is true, are indicated by characteristic traits, and cannot be misunderstood; but in most cases we are reduced to conjectures founded on some circumstances in the history of the animal, or the properties which the author assigns to it. We have to bring together the different passages which refer to it, to compare them with each other, and with those which occur in contemporary authors, and even to confront them with passages that occur in authors of an after date. But, in the latter case, great caution is necessary, the signification of words being liable to vary with time. In fact, it is evident that names have changed from the time of Aristotle to that of Athenæus, and the changes which they have since undergone must necessarily be still greater. The zoological nomenclature of the modern Greeks may, however, assist us in retracing the animal of the ancients.

Scaliger has published a good edition of the History of Animals, but the best of all is the one published in 1811 by Mr Schneider. The Latin translation of Theodore of Gaza is often quoted, but it is very inaccurate. This translator was a Greek, who went to Italy when Constantinople was taken by the Turks. He was a bad Latin scholar, so that, whenever he found a passage in Pliny that had been borrowed from Aristotle, he transcribed it literally. It also appears that he had only a bad copy of the Greek text.

There is a French translation by M. Camus, of which the text is nearly the same as that of Scaliger. The translation is as good as might be expected of a man who was not a naturalist; but the volume of notes which is added to it only renders the subject more obscure.

The other books of Aristotle, relating to natural history, are much less perspicuous than that of which we have been speaking. They are more mingled with discussions respecting technical terms. The Greek language encourages these discussions, and the same inconvenience is attendant upon all languages that are faithful to etymology. Each word, in fact, presenting as it were an abridged definition of the thing, necessarily bears the impress of the false ideas which were entertained when it was formed. Whence arises the necessity of defining each expression. Accordingly, the Greek writers are continually explaining their terms, distinguishing and subdividing without end. They carry the thing to excess, and Aristotle himself, as we have said, sometimes falls into this error. Those of his works against which this charge is to be made, appear to be much anterior to the History of Animals, and probably are merely a preparatory undertaking. This applies especially to the *Wonderful Recitals*, which are merely a collection of notes put together without order, but which are interesting on account of their containing extracts from lost books. There is a good edition by Beckmann.

A book on plants has been attributed to Aristotle, but it appears to be apocryphal.

Lecture Ninth.—*Theophrastus.*

Aristotle died, as we have already said, 322 years before Christ, in the same year with Demosthenes, who committed suicide that he might not fall into the hands of Antipater. After this period, the Macedonian yoke became still more oppressive to Greece than it had been even in the time of Alexander. Athens, though retaining its own laws and internal administration, was, in reality, subjugated. But so long as the turbulence of the times allowed, the Athenian schools continued to flourish. These were, the Portico, which was a separate branch of the Cynic sect; the Academy, where the doctrines of Plato, somewhat modified, were professed; and, finally, the Lyceum, in which were continued the labours of Aristotle. Among the philosophers of the Lyceum, the most famous was Theophrastus. He was born at Evesus, in the island of Lesbos, 370 years before Christ, and 22 before the death of Plato, whose pupil he is supposed for some time to have been before entering the school of Aristotle. His eloquence, from which he took the name of Theophrastus, for he was at first called Tyrtamus, gained him a number of disciples, and he had, at one time, more than two hundred. It is said, that when Aristotle was about to leave Eubœa, his pupils insisted on his appointing one among them, who should succeed him in the school. The philosopher, without speaking openly, said enough to let them know the man of his choice, for, having produced some wine from Rhodes, and some from Lesbos, the first sort, he said, was stronger, but the other was sweeter, and appeared to him preferable; making thus an illusion to the two persons, between whom the choice might appear doubtful, namely, to Theophrastus, who, as we have already said, was born in the island of Lesbos, and to Menedemus, who was born in that of Rhodes.

Theophrastus, like his master, was subject to some persecutions. Attacked by Sophocles, he, along with other philosophers, was driven into exile, about 306 years before Christ; but he was soon recalled, and the person who had accused him, was himself banished. Ptolemy Lagus endeavoured to attract him to Alexandria, but he preferred remaining at Athens. Eloquent, mild, beneficent, upright in his conduct, and neat in his external appearance, he gained the good will and respect of every body. He died at the age of 85 years, according to some, and of more than 100, according to others. The whole body of the people attended his funeral. His house, he bequeathed to his friends, on the conditions that they should not sell it, and that they should meet in it for the prosecution of the study of letters and philosophy. This is the first legacy which was left to the sciences by a private man. He left them also his garden, in which he had reared a great many native and foreign plants, such, at least, as would grow in the climate of Greece; for, as glass was not in use at that time, there were no hot-houses. Thus the descriptions which Theophrastus has given of the plants of warm countries, lie under a disadvantage, from this want of the means of observation. His botanic garden, however, notwithstanding this imperfection, was still a very useful institution to science: it was the first of the kind that had been established.

Theophrastus wrote on different subjects, on general philosophical questions, on manners, and on natural history. He left, it is said, more than two hundred treatises, the titles of which have been partly preserved to us by Diogenes Laertius. The most considerable of these, as well as some inferior ones, are still extant. In all these works, there is a good deal of spirit, much justness and elegance of expression, and great clearness of method.

The most important work of Theophrastus is his History of Plants, a work somewhat similar in design to Aristotle's History of Animals. Thus, according to his model, he begins by treating of the parts of plants, which, first of all, he divides into roots, stems, branches, and shoots. He remarks, and with propriety, that there is not one of these parts which is common to every plant—a circumstance which is very true, if truffles and mushrooms be excluded, as it is proper they should be. In every part, he distinguishes the bark, the wood, and the pith. He goes on to shew the exterior organs of the vegetables, the leaves, the flower, the peduncle, the tendrils,—and, on this subject, he speaks of *gall-nuts*. Then, he treats of the interior parts of the flesh, that is to say, of the *parenchyma*, veins, and juices.

After these preliminary observations, he divides plants, and forms a sort of method, similar to that of Aristotle in treating of animals. But his task was a more difficult one to accomplish, as the characters necessary for establishing, to a classification, are less easily met with in vegetable than in animated beings. Theophrastus contents himself, therefore, with dividing plants, according to their size and consistence, into trees, shrubs, plants, and herbs. This mode of division has been of very long continuance.

He speaks of the different qualities of wood and pith, and of the different forms assumed by the root, namely, the fusiform, the ramous, the tuberculous, or bulbous; and illustrates his definitions by examples. He says, that the root goes no farther into the earth than the point to which the heat penetrates from the surface.

In treating of leaves, he, first of all, makes the very just remark, that the inferior face of these organs is more absorbent than the superior. He divides them, according to their size, situation, and form. He speaks of the organs of fructification, and makes a distinction between the upper and lower flowers, and points out the different sorts of seed. He proceeds to examine the means of reproduction in vegetables, which are perpetuated not only by seeds, but often also by suckers, roots, and slips. He next considers wild and cultivated plants; says that the latter are not the produce of a degenerescence caused by the culture; and that, therefore, it is false that barley can be transformed to oats. He speaks of the effects which the sun, climate, and various other circumstances have upon the fecundity of plants; and, on this subject, relates many curious facts. Thus, he speaks of caprification, an operation, by means of which the bulk and richness of the fruit of the fig-tree are increased, and which consists in breeding upon it very small insects, which introduce themselves into the hollow of the nascent fruit. He describes also the way in which female date-trees were made to bear fruits, namely, by putting them near enough to receive the influence of the male dates. He does not, however, look upon this as a real fecundation. In this place, he speaks of different palm-trees in warm countries; and, among others, of a palm-tree having a forked, or dichotomous stem, which belongs to upper Egypt. He tells by what means forest-trees are propagated at a distance, namely, by the aid of winds, inundations, &c. He next considers trees as they inhabit plains or mountains, as they remain always green, or are divested of foliage; and, in this last case, he points out many sorts which lose their foliage at certain periods, and mentions these periods. He speaks also of the time of the sap, and of that of fructification. Finally, he considers the slowness or the rapidity with which plants grow.

Theophrastus, in speaking of trees, often distinguishes them as male and female; but these terms, as used by him, do not convey the idea of sexes. He describes different species: in speaking of the trees in warm countries, he describes the real acacia, which is a mimosa, a sensitive plant, different from that small species which is cultivated in our greenhouses; the lemon-tree (the thorny apple-tree of the Medes), the fruit of which was used at that time for perfuming clothes; the banana-tree, the large leaves of which resemble a bunch of ostrich feathers; finally, the fig-tree of the Brahmins, the branches of which, descending to the earth, take root in it, and send forth new shoots. He speaks also of the ebony and cotton-tree, a shrub which was known from the time of the expedition of Alexander, but which had not yet been transported into Greece.

Theophrastus speaks of plants which grow in water, such as the fucus and sponge. He remarks, that in these last there is something approaching to animals. In treating of vegetables which grow in rivers, he describes the papyrus, a plant so important during the time when parchment was undiscovered; and of the lotus, a sort of nymphæa, very common in every Egyptian canal.

He treats of the length of the life of plants, their diseases, and, among others, of those which attack wood; also of the insects that gnaw it. On this subject, he describes the *larva* of the horn-beetle. He shews the places in which forest-trees attain the greatest height, and mentions Corsica in particular.

These are nearly all the subjects treated of in the first five books. The sixth treats of shrubs, bushes, and garden flowers; the seventh, of culinary vegetables, and also of some field plants; the eighth, of the cerealia, and of leguminous plants; and, in the ninth and last book, he treats of the juices which are extracted from plants, namely, pitch, tar, rosin, frankincense, and myrrh. In this book, he treats also of certain aromatics, particularly of cinnamon, and of several medicinal plants, of hellebore, for example, which was much more in use among the ancients than it is among the moderns. From what has been said, it is obvious, that the history of plants is a sort of counterpart of the history of animals. But Theophrastus, though he had a good deal of talent and information, was far from having the genius of Aristotle. Nor do we find in his works those enlarged views, and that abundance of general rules, which we admire in the other.

Theophrastus has noticed in his work about 360 plants. There are mentioned in it a good many forest-trees, and fruit-trees, most of the culinary vegetables, the cerealia, and, lastly, a great many Indian plants, which have been discovered again only since the fifteenth or sixteenth centuries.

Theophrastus wrote another work relating to botany. It is his treatise on the *Causes of Plants.* In it he treats of some questions in vegetable physiology, but principally on the influence of external circumstances on plants. He proposes a certain number of questions, which it is not always easy to answer. He asks, for example, why the best fruit does not always contain the best seed?—why the fruit of wild trees has not so sweet a relish as that of cultivated trees? He puts other physical questions. He would have it explained, for instance, why animals have not in general a pleasant odour; while many plants diffuse a very agreeable fragrance? It is, says he, because animals, being of a hot, dry constitution, and having a thin breath, throw off by evaporation the superfluous parts of their aliment.

The physics of Theophrastus are worse than those of Aristotle.

Theophrastus, like his master, studied almost all the branches of natural history. He wrote some small treatises on different points in zoology.

There is one of them which treats of fish which live without water, in which he gives proof of extensive knowledge of the productions of India.

He speaks of flying-fish; of those which the sea in ebbing leaves upon the rocks; of those which lie buried in the mud of lakes, as the loach, and comitis fossilis, which is sometimes found in slime when thickened and dried. He speaks of an Indian fish that comes out of the water. This fish, which was unknown to us till about twenty years ago, when we were made acquainted with it through the account of M. Hamilton Buchanan, is the ophicephalus. It lives in the Ganges; but it is found sometimes at so great a distance from every appearance of water, that it has even been thought to have fallen from heaven. Theophrastus gives a pretty good description of it, and says that it resembles the mullet, in the round form of the head, in its colour, and the disposition of its scales.

Theophrastus wrote also a small treatise on animals that change their colour. In this treatise, he speaks of the various colours assumed by the cameleon, and the change of tint which takes place in the hair of the reindeer,—a change which he considers as dependent upon the will of the animal, but which, in reality, is only an effect of the seasons. In another little work upon animals of sudden appearance, he seems not much disposed to admit spontaneous generation; and if he does not altogether reject it, at least he limits it a good deal more than his master did.

The most important of the works of Theophrastus, next to his two books upon botany, is his treatise on stones, a work valuable on account of the number of mineral species that are pointed out in it. Theophrastus wrote also a treatise on metals, but this treatise is lost. He considers metals as deriving their origin from water, and stones as produced by the earth. He makes a division among stones, distinguishing them as fusible and infusible; and these last, again, as calcinable stones, and stones which are unalterable by fire. He groups all the mineral substances which have a common property, as amber and the loadstone, both of which have a power of attraction. He shews the uses of the touchstone, speaks of the different kinds of petrifaction, and of petrifying waters.

From these general considerations, he goes to particular descriptions. He speaks of different marbles, of the Parian marble, pentelic marble, alabaster, and a good many others that are used by architects and sculptors. He treats of the stones which are reduced for extracting metals, of pit-coal and its different species. He compares amber with a variety of this mineral which is found in Liguria, and it is a very just comparison.

He mentions also pumice-stones; he knew their volcanic origin, and gives to one of the species the name of Lipari-stone. He gives a description of the amianthus, which is indestructible by fire; and of another substance, like rotten wood, which, when soaked in oil, burns with a flame.

Next came the stones fit for engraving; the carnelian, the jasper, &c. Mention is made of a sapphire, which has a blue ground, with veins of gold. It is therefore not the gem which is now designated sapphire, but the lapis-lazuli. Theophrastus speaks of emeralds, and, in doing so, relates, that an Egyptian king had received emeralds from a prince of Ethiopia, which were not less than four cubits in height, and that four of them would have served to erect an obelisk. The thing, though strange, is not altogether incredible; for it is known that, near Limoges, emeralds are found of very large dimensions, but without either brightness or transparency.* Besides the ancients confounded, under the name of emeralds, tourmalines and many other greenstones. Theophrastus speaks also of the hyacinth; of the amethyst, which is called the Heraclean-stone; of rock-crystal; of the onyx, which is found on breaking certain rocks; of the Agate, which takes its name from the river Achates; of the jasper of Bactriana, which is met with among sand. He speaks of the magnetic stone; and by this name he designates, not what has since been designated by it, the loadstone, but a stone which has no attractive power, of a silvery lustre, and which was then used for making cups.

In treating of precious stones, Theophrastus speaks also of pearls, but without confounding them with mineral productions. He says that they are got from a shell-fish which is fished in the Indian seas. He speaks of the remains of organized bodies which are found in the earth, of petrified reeds, of fossil ivory, of Armenian blue, &c.

In treating of the use of mineral substances, he describes the process of the manufactory of glass. He mentions the different colours that painters obtain from minerals; natural ochre, burned ochre, white lead, verdigris, vermilion, cinnabar, which the Phœnicians brought from Spain; it was brought also from Colchis, and was found, it was said, on the top of certain steep rocks, from which it was separated by the shots of arrows. This was undoubtedly a story invented by the merchants, to warrant their raising its price. Finally, Theophrastus speaks of marl, and its uses; and of plaster, which, even in his time, was used as it is now, for moulding ornaments for the interior of houses.

* In North America beryls weighing 240 pounds have been met with.—Edit.

A Monograph of the Family of Plants called Cunoniaceæ.

By Mr David Don, Librarian to the Linnean Society; Member of the Imperial Academy Naturæ Curiosorum; of the Royal Botanical Society of Ratisbon; and of the Wernerian Society of Edinburgh, &c.

The *Cunoniaceæ* were first proposed as a separate family by Mr Brown from the *Saxifrageæ*, to which they had been referred by Jussieu, and to which they are intimately related, being chiefly distinguished by habit alone. M. Kunth considers them merely as a section of the *Saxifrageæ*, but it appears to me preferable to regard them as a separate family; for the advantages arising from dividing extensive families and genera, are, that the individuals composing them become better understood, and their characters more accurately investigated. In Willdenow's *Species Plantarum*, there are only two species of true *Weinmannia;* while in the present monograph they amount to nearly thirty. The *Saxifrageæ* are almost exclusively confined to the northern, as the *Cunoniaceæ* are to the southern hemisphere. Some pass beyond these limits, but their number is very small. Both families agree in having entire and divided petals, and a superior and inferior ovarium. I have occasionally met with instances in *Saxifraga decipiens* of trifid petals. In the series of natural affinities, the *Philadelpheæ* clearly follow the *Cunoniaceæ*, with which they correspond in habit; and in *Bauera* and *Polystemon* the stamens are indefinite; and the seeds of *Caldcluvia* have a striking analogy to those of *Philadelphus*. The styles, both in *Saxifrageæ* and *Cunoniaceæ*, are often three; and in *Cornidia* of the *Flora Peruviana*, a genus closely related to *Hydrangea*, that number is always constant. The leaves of *Bauera*, Mr Salisbury, who established the genus, and referred it to the *Saxifrageæ*, regarded as ternate, with an abbreviated axis; but they appear to me to be more properly simple, and that the two lateral leaves are really modified stipules,—an opinion which is confirmed by the presence in *Caldcluvia* of a pair of stipules to each leaf; and, were they more developed, we should have precisely the same structure as in *Bauera*. M. Kunth, who first suggested the propriety of separating *Caldcluvia* from *Weinmannia*, states the seeds to amount to 50 in each cell; but in all the specimens I have examined, both from Cavanilles himself, and also from Ruiz and Pavon, I have never found them to exceed 10. I regret that I have not had an opportunity of seeing authentic specimens of the species described in the *Nova Genera*, &c. by M. Kunth, but I could not omit inserting the characters of them in the present monograph, as the greater part of them are evidently distinct from those of the *Flora Peruviana*.

CUNONIACEÆ, *Brown.*

CALYX pluridivisus, æstivatione valvatus.

PETALA laciniis calycinis numero æqualia, iisdemque alterna, æstivatione imbricata; quandoque nulla.

STAMINA disco perigyno inserta, raró indefinita. *Antheræ* peltatæ, biloculares, fissurâ duplici longitudinaliter dehiscentes.

PISTILLUM: *ovarium* biloculare, ovulis sæpiùs indefinitis: *styli* 2, raró connati: *stigmata* 2, simplicia, obtusa, pruinosa.

CAPSULA (e folliculis duobus, facie applicatis, v. raró confluentibus, conflata) bilocularis, bivalvis, plerumque birostris et polysperma: *septo* e duplici valvarum margine introflexo constituto. *Placenta* centralis, e fasciculis vasorum umbilicalium omninò composita.

SEMINA pendula, quandoque alata: *testa* crustacea v. membranacea: *albumen* copiosum, carnosum.

EMBRYO dicotyledoneus, axilis, rectus: *radicula* umbilico obversa, sæpiùs longiuscula.

Arbores v. frutices (plerumque hemisphærii australis!). Folia opposita, nunc verticillata, simplicia v. composita. Stipulæ interpetiolares, v. raró nullæ. Flores sæpiùs spicato-racemosi v. paniculati.

SYNOPSIS GENERUM ET SPECIERUM.

* STAMINIBUS DEFINITIS, OVARIO LIBERO.

WEINMANNIA, *Linn. Kunth.*

Calyx 4-partitus, persistens. *Petala* 4. *Stamina* 8. *Discus hypogynus* urceolatus. *Capsula* ab apice septicido-dehiscens: *loculis* polyspermis. *Semina* subrotundo-reniformia, hirsuta!

Arbores (Amer. Æquin. et Insul. Maurit.!).

Folia *composita* v. *simplicia*: petiolis *articulatis*. Stipulæ *indivisæ*, *caducæ*. Flores *hermaphroditi*, *racemosi*: pedicellis *fasciculatis*.

* *Foliis simplicibus.*

1. W. *ovata*, foliis elliptico-oblongis obtusiusculis crenatis utrinque ramulisque glabris basi acutis, fasciculis paucifloris remotis.

Weinmannia ovata, *Cav. Ic.* 6. p. 45. t. 566.

Hab. In Peruviâ ad oppidum San Buenaventura.—*Ludovicus Née.* ♄.

Arbor triorgyalis. *Folia* elliptico-oblonga, obtusiuscula, basi acuta, 2–3-pollicaria, pollicem v. sesquipollicem lata. *Petioli* 2–3 lineas longi. *Racemi* 3-pollicares, laxissimi. *Discus hypogynus* 8-glandulosus !

2. W. *Kunthiana*, foliis ellipticis crenatis basi cuneatis membranaceis glabris, racemis elongatis, fasciculis plurifloris.

Weinmannia ovata, *Kunth in Humb. et Bonpl. Nov. Gen. et Sp. Pl.* 6. p. 52. (excl. synon. *Cav.*)

Hab. Prope Santa Fé de Bogota Novo-Granatensium.—*Humboldt et Bonpland.* ♄.

Folia elliptica v. ovata, obtusa, aut acuta, crenata, membranacea, suprà glabra, subtùs in nervo venisque pilosiuscula, basi cuneata, 3–5-pollicaria, sesqui- v. bi-pollicem lata. *Petioli* 2–3 lineas longi. *Racemi* spithamæi. *Fasciculi* 3–10-flori.

3. W. *Balbisiana*, foliis subsessilibus ovato-lanceolatis subacuminatis serratis glabris basi attenuatis, fasciculis paucifloris.

Weinmannia Balbisiana, *Kunth* in l. c. 6. p. 51. t. 520.

Hab. In sylvis prope Loxam Quitensium.—*Humboldt et Bonpland.* ♄.

Folia sesqui v. tripollicaria. *Racemi* laxi, bipollicares. *Capsulæ* ovatæ, glabræ.

4. W. *laurina*, foliis oblongis acutis crenatis glabris basi attenuatis, fasciculis multifloris.

Weinmannia laurina, *Kunth* in l. c. 6. p. 51.

Hab. .... ♄.

Folia tripollicaria v. ultra, subtùs ad venas puberula. *Racemi* bipollicares.

5. W. *macrophylla*, foliis subsessilibus ovatis acuminatis serratis utrinque ramulisque glabris basi rotundatis, fasciculis paucifloris.

Weinmannia macrophylla, *Kunth* in l. c. 6. p. 52. t. 521.

Hab. In Andibus Quitensibus inter Loxam et Pagum Nabon.—*Humboldt et Bonpland.* ♄.

Folia 3–5-uncialia, 2–3 pollices lata, utrinque glabra, suprà nitida. *Racemi* laxiusculi. *Fasciculi* pauciflori, distincti. *Capsulæ* tereti-oblongæ, glabræ.

6. W. *elliptica*, foliis petiolatis ellipticis obtusis crenatis utrinque glabris basi acutiusculis, racemis laxis.

Weinmannia elliptica, *Kunth* in l. c. 6. p. 50.

Hab. In Peruviâ prope Loxam.—*Humboldt et Bonpland.* ♄.

Folia pollicaria, v. ferè sesquipollicaria, coriacea. *Racemi* sesqui- v. bi-pollicares. *Capsulæ* ovatæ, glabræ.

7. W. *ovalis*, foliis petiolatis ovalibus crenatis utrinque ramulisque glaberrimis lucidis basi acutis, fasciculis paucifloris.

Weinmannia ovalis, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 333. f. *a.*

Hab. In Peruviæ Andium nemoribus ad Pillao.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Ruiz et Pavon, nunc in Mus. Lamb.)

Folia ovalia v. subrotundo-ovalia, obtusissima, substantiâ crassa, coriacea, utrinque glaberrima, basi acuta, bi- v. tri-pollicaria. *Petioli* pollicares. *Racemi* laxi, palmares. *Capsulæ* ovatæ, lævissimæ.

Obs. Forsitan eadem cum præcedente.

8. W. *crassifolia*, foliis subsessilibus ovalibus grossè crenatis subtùs ramulisque pilosiusculis basi rotundatis, fasciculis paucifloris.

Weinmannia crassifolia, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 331. f. *a.*

Hab. In Peruviâ—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Folia bipollicaria, substantiâ crassa, coriacea, subtùs ad costam venasque pilosa. *Racemi* bi- v. tri-pollicares. *Capsulæ* ovato-oblongæ, lævigatæ.

** *Foliis simplicibus ternatisque.*

9. W. *heterophylla*, foliis simplicibus ternatisve ovato-oblongis acutis grossè serratis subtùs pilosiusculis, fasciculis multifloris.

Weinmannia heterophylla, *Kunth* in l. c. 6. p. 52. t. 522.

Hab. Prope Santa Fé de Bogota Novo-Granatensium.—*Humboldt et Bonpland.* ♄.

Folia plerumque simplicia, ovato-oblonga, acuta, grossè serrata, suprà glabra, subtùs præsertìm ad costam pilosa, 3–5 pollicaria, sesqui- v. bi-pollicem lata. *Petioli* semunciales. *Racemi* laxi, 4-unciales. *Fasciculi* multiflori. *Capsulæ* ovatæ, lævigatæ.

10. W. *cordata*, foliis subsessilibus cordato-ovatis obtusiusculis grossè serratis subtùs ramulisque subpilosis, fasciculis multifloris.

Weinmannia heterophylla, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 331. f. *b.*

Hab. In Peruviâ.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Folia subsessilia, cordato-ovata v. ovalia, obtusiuscula, simplicia v. ternata, bipollicaria. *Racemi* laxi, tripollicares.

11. W. *auriculata*, foliis ellipticis margine revolutis serratis basi rotundatis subtùs ramulisque hirsutis, fasciculis confertis.

Weinmannia ovata, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 333. f. *b.*

Hab. In Peruviæ nemoribus ad Pillao.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Folia elliptica v. elliptico-oblonga, obtusa, suprà glabra, nitida, subtùs copiosè fulvo-hirsuta, pollicaria v. sesqui-pollicaria, basi unilobata v. quandoque ternata! *Racemi* densi, spicati, bi- v. tri-pollicares. *Capsulæ* subrotundo-ovatæ, stylisque hirsutiusculæ.

*** *Foliis ternatis quinatisque.*

12. W. *pentaphylla*, foliis ternatis quinatisve: foliolis ovato-lanceolatis acutis serratis utrinque glabris, racemis laxis.

Weinmannia pentaphylla, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 330. f. *a.*

Hab. In Peruviâ.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Ramuli pubescentes. *Foliola* 3–5, elliptico-oblonga, acuta, serrata, coriacea, utrinque glaberrima, suprà nitida, 2–3-uncialia; *lateralia* basi inæquilatera. *Racemi* laxi, palmares. *Pedicelli* longiusculi. *Capsulæ* ovatæ, lævigatæ. *Styli* nunc 3, et subinde capsulæ triloculares!

13. W. *Mauritiana*, foliis ternatis quinatisque: foliolis obovatis ellipticisve obtusis crenatis glabriusculis, racemis laxis.

Weinmannia trifoliata, *Lam. Encycl.* 7. p. 579.—*Illustr.* t. 313. f. 2. (excl. synon.)—*Smith in Rees's Cyclop.* in loco (excl. synon. *Linn. Thunb.* et *Willd.*)

Hab. In Insulâ Mauritianâ.—*Michaux.* ♄. (V. s. sp. in Herb. Lamb.)

Foliola 3 v. 5, coriacea, subtùs leviter pubescentia, semi v. pollicaria. *Racheos articuli* cuneato-oblongi. *Racemi* laxi, bipollicares. *Fasciculi* pauciflori. *Capsulæ* oblongæ, lævigatæ: *loculis* 10-spermis.

Obs. Toto cœlo diversa est a W. trifoliatâ Linnæi.

14. W. *microphylla*, foliis ternatis quinatisve: foliolis obovatis crenatis glabris, racemis brevissimis subcorymbosis.

Weinmannia microphylla, *Kunth* in l. c. 6. p. 54. t. 523.

Hab. Prope Loxam Quitensium.—*Humboldt et Bonpland.* ♄.

Foliola 3 v. 5, nunc binata! parvula, cuneato-obovata, crenata, glaberrima, nitida, 3 lineas longa. *Racheos articuli* cuneati. *Capsulæ* ovatæ, glabræ.

**** *Foliis pinnatis.*

15. W. *glabra*, foliis multijugis: foliolis obovatis oblongisve crenatis subtùs pilosiusculis, racheos articulis rhomboideis, racemis laxis.

Weinmannia glabra, *Linn. Suppl.* p. 228.—*Swartz Obs.* p. 151.—*Willd. Sp. Pl.* 2. p. 436. (excl. synon. *Lam.*)—*Smith in Rees's Cycl.* in loco.—W. pinnata, *Linn. Sp. Pl.* 1. p. 515. (excl. synon. *Browne Jam.*)

Hab. In Insulâ Sanctæ Crucis (*Swartz*); in Martinicâ (*Sieber, De Ponthieu*); in Mexico prope San Salvador et Chiconquiera.—*Schiede.* ♄. (V. s. sp. in Herb. Linn. Smith. et Lamb.)

16. W. *trichosperma*, foliis multijugis: foliolis oblongis acutè dentatis subtùs pilosiusculis, racheos articulis exactè rhombeis.

Weinmannia trichosperma, *Cav. Ic.* 6. p. 45. t. 567.

W. dentata, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 334. f. *c.*

W. pinnata, Linn. *Cav.* MSS.

Hab. In Insulâ San Carlos de Chiloe (*Ludovicus Née*)? in Peruviâ.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Foliola magnitudine præcedentis, basi obliquè cuneata, suprà nuda, nitida, subtus in nervo venisque pilosiuscula. *Racemi* laxi. *Capsulæ* subrotundo-ovatæ, costatæ, glabræ.

17. W. *hirta*, foliis subtrijugis: foliolis ellipticis serratis subtùs ramisque hirsutis, racheos articulis cuneatis.

Weinmannia hirsuta, *Swartz Prod.* p. 63.; *Fl. Ind. Occid.* 2. p. 691.—*Willd. Sp. Pl.* 2. p. 437.—*Smith* in loco cit.

Windmannia fruticosa, foliis subrotundis serratis, per pinnas cordato-alatas, racemis terminalibus, pinnis et ramis oppositis.—*Browne Jam.* p. 212.

Hab. In Jamaicâ.—*Browne, Swartz, Dancer.* ♄. (V. s. sp. in Herb. Smith. et Lamb.)

Foliola subtùs copiosè hirsuta, suprà demùm glabriuscula, coriacea, majora quàm in præcidente. *Racemi* laxi, copiosissimi, 2-pollicares.

18. W. *nitida*, foliis subtrijugis: foliolis obovatis crenatis utrinque glabris nitidis, racheos articulis cuneatis.

Weinmannia hirta, var.?—*Herb. Smith.*

Hab. In Jamaicâ.—*D. Wiles.* ♄. (V. s. sp. in Herb. Smith. et Lamb.)

Obs. Præcedenti admodùm affinis, sed glabritie primo intuitu distinguitur.

19. W. *tinctoria*, foliis multijugis: foliolis oblongis serratis glabriusculis, racheos articulis spathulatis, fasciculis multifloris.

Weinmannia tinctoria, *Smith in Rees's Cycl.* in loco.

W. glabra, *Lam. Encycl.* 7. p. 578.—*Illust.* t. 313. f. 1. (excl. synon.)

Hab. In Insulâ Borbonicâ.—*Commerson, Michaux, Bory St Vincent.* ♄. Tan-rouge, *colonis.* (V. s. sp. in Herb. Smith. et Lamb.)

20. W. *fagaroides*, foliis multijugis: foliolis obovatis ellipticisve crenatis utrinque glabris suprà nitidissimis, racheos articulis obcordatis.

Weinmannia fagaroides, *Kunth,* in l. c. 6. p. 54. t. 524.

Hab. In Peruviâ ad Pillao (*Ruiz et Pavon*); ad Loxam.—*Humboldt et Bonpland.* ♄. (V. s. sp. in Herb. Lamb.)

Ramuli sæpè annulari-rimosi, pubescentes. *Foliola* 5–15, obovata v. ovalia, obtusissima, crenata, coriacea, suprà nitidissima, subtùs in articulis pilosa, 3 lineas longa. *Racemi* bipollicares. *Fasciculi* multiflori. *Capsulæ* ovato-oblongæ, glabræ.

Obs. Cum sequente a Ruizio confusa.

21. W. *parvifolia*, foliis multijugis: foliolis oblongis serratis subtùs pilosis, racheos articulis obovatis, racemis abbreviatis.

Weinmannia microphylla, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 334. f. *a.*

W. parvifolia, *Ruiz,* MSS.

Hab. In Peruviâ ad Pillao.—*Ruiz et Pavon.* ♄. *Vulgò* Muchi et Arbol del Peregil. (V. s. sp. in Herb. Lamb.)

Ramuli densè pilosi. *Foliola* numerosa (9–15), elliptica v. oblonga, serrata, contigua, suprà nuda et opaca, subtùs copiosè pilosa, 3–5 lineas longa. *Racemi* densi, cylindrici, vix pollicares. *Fasciculi* multiflori, conferti. *Capsulæ* subrotunda-ovatæ, glabræ.

22. W. *reticulata*, foliis multijugis: foliolis ellipticis crenatis subtùs ferrugineo-tomentosis, racheos articulis obovato-oblongis, fasciculis confertis.

Weinmannia reticulata, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 332. f. *a.*

W. pubescens, *Ruiz* MSS.

Hab. In Peruviâ ad Pillao et Acomaya.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Ramuli densè ferrugineo-tomentosi, sæpè annulari-rimosi. *Foliola* 9–17, elliptica v. elliptico-oblonga, obtusissima, crenata, suprà pilosa, nitida, reticulato-venosissima, subtùs ferrugineo-tomentosa, semuncialia. *Racemi* densi, cylindrici, 2–3-pollicares. *Fasciculi* multiflori, conferti, pilosissimi. *Styli* basi pilosiusculi. *Capsulæ* ovatæ, lævigatæ.

23. W. *tomentosa*, foliis multijugis: foliolis ovalibus margine revolutis integerrimis! subtùs cano-tomentosis, spicâ cylindricâ confertissimâ.

Weinmannia tomentosa, *Linn. Suppl.* p. 227.—*Willd. Sp. Pl.* 2. p. 437 —*Smith*, in loco cit.—*Kunth* in l. c. 6. p. 55. t. 525.

Hab. In Novâ Granadâ.—*Mutis.* ♄. (V. s. sp. in Herb. Linn. nunc in Mus. Soc. Linn.)

Foliola magnitudine *Buxi*, 9–15, approximata, elliptica, obtusissima, margine revoluta et integerrima, coriacea, suprà convexa, pubescentia, demùm viridia, subtùs densè niveo-tomentosa. *Racheos articuli* obovati, margine revoluti. *Spica* cylindrica, obtusa, pollicaris. *Fasciculi* multiflori confertissimi. *Pedunculus* teres, densè tomentosus, brevissimus.

24. W. *cinerea*, foliis subtrijugis: foliolis ellipticis serratis reticulatis glabriusculis, racheos articulis cuneato-oblongis, racemis laxis.

Weinmannia cinerea, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 332. f. *b.*

W. sambucina, *Ruiz* MSS.

Hab. In Peruviæ Andium nemoribus ad Pillao.—*Ruiz et Pavon.* ♄. *Vulgò* Arbol del Peregil. (V. s. sp. in Herb. Lamb.)

Foliola 7 v. 9, elliptica, coriacea, rigida, pollicaria. *Pedunculus* hirsutissimus. *Racemus* laxus, 2–3-pollicares. *Fasciculi* pauciflori. *Capsulæ* ovatæ, glabræ.

25. W. *subsessiliflora*, foliis multijugis: foliolis ovalibus oblongisve serratis glabriusculis, spicis elongatis cylindricis, stylis puberulis, capsulis sericeis.

Weinmannia subsessiliflora, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 334. f. *b.*

W. polystachia, *Ruiz* MSS.

Hab. In Peruviæ Andium nemoribus ad Pillao.—*Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

Foliola 11 v. 15, semi v. pollicaria; *juniora* utrinque leviter canescentia. *Racheos articuli* obovati. *Spicæ* angustæ, 3–4-unciales. *Fasciculi* conferti, multiflori. *Flores* brevissimè pedicellati. *Pedicelli* et *calyces* incani. *Capsulæ* subrotundæ, sericeæ.

26. W. *hirtella*, foliis multijugis: foliolis oblongis serrulatis subtùs pubescentibus, racemis laxis.

Weinmannia hirtella, *Kunth* in l. c. 6. p. 56.

Hab. Prope Santa Fé de Bogota Novo-Granatensium.—*Humboldt et Bonpland.* ♄.

Ramuli tomentosi. *Foliola* 4–7-juga, oblonga v. ovato-oblonga, 8–9 lineas longa. *Racemi* laxi, 2–3-unciales. *Ovarium* ovatum, glabrum.

27. W. *pubescens*, foliis multijugis: foliolis elliptico-oblongis serratis utrinque pilosis, capsulis ovatis tomentosis.

Weinmannia pubescens, *Kunth* in l. c. 6. p. 56.

Hab. In Monte Avila prope Caraccas.—*Humboldt et Bonpland.* ♄.

Foliola 4- v. 6-juga, cum impari, 6–13 lineas longa. *Racemi* laxi, 3–4-unciales.

28. W. *sorbifolia*, foliis sub-4-jugis: foliolis oblongis acutiusculis serratis subtùs pilosiusculis, racemis laxis, ovariis glabris.

Weinmannia sorbifolia, *Kunth* in l. c. 6. p. 57.

Hab. In Novâ Granadâ.—*Humboldt et Bonpland.* ♄.

Ramuli glabri. *Foliola* oblonga acutiuscula, suprà glabra, subtùs in costam præcipuè pilosiuscula, 19–20 lineas longa, 6–7 lata, basi obliquè cuneata. *Racemi* laxi, 3–5-unciales. *Fasciculi* remoti. *Calyx* et *ovarium* glabrum.

Obs. Differt a sequente nonnisi: foliolis majoribus subcoriaceis et ramulis glabris. An verè species distincta?—*Kunth* l. c.

29. W. *caripensis*, foliis sub-5-jugis: foliolis oblongis obtusiusculis serratis membranaceis glabris.

Weinmannia caripensis, *Kunth* in l. c. 6. p. 58.

Hab. In Novâ Andalusiâ prope Cænobium Caripe.—*Humb. et Bonpl.* ♄.

Ramuli pubescentes. *Foliola* 10–15 lineas longa, 4–5 lata, membranacea, utrinque glabra. *Racemi* laxi, 4–5-unciales. *Ovarium* ovatum, glabrum.

Obs. Dubito anne has duas species esse distinctas. W. glabræ, *Linn.* sunt evidenter affines.

LEIOSPERMUM.

WEINMANNIÆ sp. *Linn. Forst.*

Calyx 4-fidus, deciduus. *Petala* 4. *Stamina* 8. *Discus hypogynus* planus, integer. *Capsula* ab apice septicido-dehiscens: *loculis* polyspermis. *Semina* oblonga, glabra.

Arbores (Nov. Zel.). Folia *simplicia, crenata.* Petioli *articulati.* Stipulæ *caducæ.* Flores *racemosi.* Pedicelli *sparsi, nec fasciculati.*

Obs. Nomen Semina lævia significat, et ex λειος, *lævis*, et σπερμα, *semen.*

1. L. *racemosum*, petiolis apice articulatis, racemis subsolitariis.

Weinmannia racemosa, *Murr. Syst. Veg.* p. 376.—*Linn. Suppl.* p. 227. —*Forst. Prod.* p. 29.—*Willd. Sp. Pl.* 2. p. 438.—*Smith, in Rees's Cycl.* in loco.

Hab. In Novâ Zelandiâ.—*Georgius Forster, Menzies.* ♄. (V. s. sp. in Herb. Lamb.

Folia elliptica v. elliptico-oblonga, subtùs pulchrè venulosa, 2–3-pollicaria. *Racemi* terminales, plerumque bini, 3–4-unciales.

2. L. *parviflorum*, petiolis basi articulatis, racemis corymbosis.

Weinmannia parviflora, *Forst. Prod.* p. 29.—*Willd. Sp. Pl.* 2. p. 438. —*Smith*, in loco cit.

Hab. In Novâ Zelandiâ.—*Georgius Forster.* ♄. (V. s. sp. in Herb. Geo. Forster, nunc in Mus. Lamb.)

Folia elliptica, apice recurva, sesquipollicaria. *Racemi* plures, sesqui v. bipollicares. *Flores* triplò minores.

CALDCLUVIA.

WEINMANNIÆ sp. *Cav.*

Calyx membranaceus, 4-partitus, deciduus. *Petala* 4, unguiculata. *Stamina* 8. *Glandulæ hypogynæ* 8, staminibus alterna. *Ovarii loculis* multi- (20–30) ovulatis. *Styli* crassiusculi. *Capsula* ab apice septicido-dehiscens: *loculis* poly- (5–10) spermis. *Placenta* tetragona. *Semina* fusiformia, glabra, testâ nucleo ampliore, membranaceâ laxâ, basi elongatâ, subarillata!

Arbor (Chilensis). Folia *simplicia, serrata, glabra.* Petioli *inarticulati.* Stipulæ *geminatæ! subfalcatæ, dentatæ, caducæ.* Flores *terminales, paniculati.* Capsula *sublignosa.* Semina *ferè ut in* Philadelpho.

Obs. Amicissimo D. Alexandro Caldcleugh, Soc. Reg. et Linn. Lond. Sodali, botanices peritissimo, cui plurimas novas plantas Chilenses exsiccatas debemus, hocce novum distinctissimumque genus dicatum.

1. C. *paniculata.*

Weinmannia paniculata, *Cav. Ic.* 6. p. 44. t. 565.—*Pers. Syn.* 1. p. 438. —*Smith in Rees's Cycl.* in loco.

W. corymbosa, *Ruiz et Pavon Fl. Peruv. et Chil.* tom. 4. ined. t. 330. f. *b.*

Hab. In Chili, prope Talcahuano urbem.—*Ludovicus Née, Ruiz et Pavon.* ♄. (V. s. sp. in Herb. Lamb.)

PLATYLOPHUS.

WEINMANNIÆ sp. *L.*

Calyx 4-fidus, nunc 5-fidus, persistens. *Petala* 4 (rarò 5), persistentia, trifida! *laciniis* linearibus, acutis, nunc unidentatis. *Stamina* 8 v. 10. *Discus hypogynus* urceolatus, integer. *Ovarii loculis* biovulatis. *Styli* brevissimi. *Capsula* membranacea, reticulata, apice in alam complanatam, bifidam confluens, basi ventricosâ, biloculari: *loculis* monospermis! *Semina* magna, arcuata: *testâ* coriaceâ, lævi.

Arbor (Capensis) *elegans.* Folia *petiolata, ternata:* foliolis *sessilibus, lanceolatis, acuminatis, argutè serratis, coriaceis, glabris, reticulato-venosissimis.* Flores *terminales, paniculati.*

Obs. Nomen ex πλατυς, *latus*, et λοφος, *crista*, atque ab eo capsulam apice compresso-alatam designare volui.

1. P. *trifoliatus.*

Weinmannia trifoliata, *Linn. Suppl.* p. 227.—*Thunb. Prod.* p. 77.—*Willd. Sp. Pl.* 2. p. 438. (excl. synon. *Lam.*)

Hab. Ad Promontorium Bonæ Spei.—*Thunberg, Niven.* ♄. (V. s. sp. in Herb. Lamb.) White Ash *colonis Anglicis*, ex D. Niven.

CUNONIA, *L.*

Calyx 5-fidus: *laciniis* deciduis. *Petala* 5, integra. *Stamina* 10. *Discus hypogynus* parvus. *Capsula* a basi septicido-dehiscens: *loculis* polyspermis. *Semina* oblonga, compressa, lævia, hinc alata! *testâ* laxiusculâ, membranaceâ. *Cotyledones* subfoliaceæ.

Arbor (Capensis). Folia *impari-pinnata:* foliolis *lanceolatis, acutis, serratis,* *coriaceis, glabris.* Stipulæ *cordato-ovales, maximæ, caducæ.* Flores *spicato-racemosi.* Pedicelli *fasciculati.* Capsula *lignosa.*

1. C. *capensis*, L.

Hab. Ad Promontorium Bonæ Spei.—*Thunberg, Masson, Roxburgh, Niven.* ♄. (V. v. c. et s. sp. in Herb. Smith. et Lamb.)

PTEROPHYLLA.

Calyx 4-fidus, deciduus. *Petala* 4. *Stamina* 8. *Styli* brevissimi, incurvati. *Ovarium* biloculare. *Capsula*............

Arbor (Mollucana). Folia *impari-pinnata:* foliolis *lanceolatis, obtusè acuminatis, crenatis, glabris, subtùs glaucis, basi obliquis, tripollicaribus;* impari *longiùs stipitato.* Stipulæ *foliaceæ, maximæ, reniformes, integerrimæ, deciduæ.* Flores *minuti, polygami, spicato-racemosi.* Racemi *erecti, terminales, aggregati, subpaniculati, palmares.* Ovarium *densè lanatum.*

Obs. Nomen ex *πτερον, ala*, et *φυλλον, folium*, atque ad stipulas maximas foliaceas refert.

1. *P. fraxinea.*

Weinmannia? fraxinea, *Herb. Smith.*

Hab. In Insulâ Honimao.—*D. Christophorus Smith.* ♄. (V. s. sp. in Herb. Smith. nunc in Mus. Soc. Linn.)

Obs. Fructûs structura mihi ignota, character generis adeò valdè incompletus, sed planta vix cum Weinmanniâ associata.

CALYCOMIS, *Brown.*

Calyx 5-partitus, persistens. *Petala* 5. *Stamina* 10. *Discus hypogynus* minimus. *Styli* setacei. *Capsula* globosa, bilocularis, apice dehiscens: *loculis* polyspermis. *Semina* minuta, lævia.

Frutex (Australasicus) *erectus, ramosus, sempervirens.* Folia *simplicia, terna, subsessilia, oblongo-cordata, acuta, grossè serrata, coriacea, glabra, subtùs glauca.* Stipulæ *paleaceæ, persistentes.* Flores *parvi, albi, copiosi, verticillati, pedicellati.* Capsula *membranacea, apice hians, ferè* Heucheræ.

1. C. *verticillata.*

Hab. In Novæ Hollandiæ montium rupibus scaturiginosis, sed rarissimè.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

CALLICOMA, *Andr. Rep.*

Calyx 4-partitus (rarò 5-partitus), persistens. *Petala* 0. *Stamina* 8, rarò 10. *Discus hypogynus* minimus. *Ovarium* liberum: *loculis* pluri-ovulatis. *Styli* setacei. *Capsula* calyce persistente inclusa, septicido-dehiscens: *loculis* ventricosis, abortu 1–2-spermis. *Semina* ovata, undique minutè papilloso-scabra (ut in *Saxifragâ*): *testâ* crustaceâ.

Arbores (Australasicæ). Folia *simplicia, petiolata, serrata.* Petioli *inarticulati.* Stipulæ *membranaceæ, bidentatæ, caducæ.* Flores *capitati:* capitulis *in apice ramulorum terminalibus, pedunculatis, globosis.*

1. C. *serratifolia*, foliis lanceolatis acuminatis subtùs canis basi attenuatis.

Callicoma serratifolia, *Andr. Rep.* 9. t. 566.

Hab. In Novâ Hollandiâ.—*Georgius Caley.* ♄. Black Wattle, *colonis.* (V. s. sp. in Herb. Lamb.)

Obs. Ad corbes conficiendos magni est usus, monente D. Caley. Anne flores dioici ?

2. C. *ferruginea*, foliis oblongis acutis subtùs ramulisque ferrugineo-tomentosis basi cuneatis.

Hab. In Novâ Hollandiâ ad fluviorum ripas.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

3. C. *Billardieri*, foliis ternis subsessilibus ellipticis retusis crenulatis glabris.

Codia montana, *Labill.* MSS.

Hab............. ♄. (V. s. in Herb. Lamb. à D. Labillardière commun.)

CERATOPETALUM, *Smith.*

Calyx limbo 5-partitus, persistens, in fructu auctus! *Petala* 5, lineari-multifida, rigentia, persistentia! v. nulla. *Stamina* 10. *Antheræ* cordatæ, processu rostelliformi terminatæ! *Ovarium* semi-inferum, biloculare: *ovulis* paucis. *Capsula* abortu monosperma, apice dehiscens. *Semen* rotundum: *testâ* crassâ, crustaceâ.

Arbores (Nov. Holl.) Folia *ternata v. simplicia, serrata, glabra:* petiolis *apice articulatis.* Stipulæ *indivisæ, subfoliaceæ, caducæ.* Flores *terminales, paniculati.*

* *Foliis ternatis, floribus petallatis.*

1. C. *gummiferum.*

Ceratopetalum gummiferum, *Smith N. Holl.* t. 3.

Hab. In Novâ Hollandiâ.—*White.* ♄. (V. s. sp. in Herb. Lamb.) Red Gum-tree, *colonis.*

** *Foliis simplicibus, floribus apetalis.*—Meridema.

2. C. *apetalum*, foliis lanceolatis.

Ceratopetalum monopetalum, *Caley* MSS.

Hab. In Novâ Hollandiâ.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

Obs. An flores quandoque petalo unico instructi ?

3. C. *montanum*, foliis lineari-lanceolatis.

Hab. In Novæ Hollandiæ montibus.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

SCHIZOMERIA.

Calyx 5-fidus, persistens, immutatus. *Petala* 5, laciniata, decidua. *Stamina* 10. *Antheræ* cordatæ, muticæ. *Ovarium* superum, biloculare: *ovulis* pluribus. *Styli* brevissimi, recurvati. *Capsula* baccata? apice clausa. *Semina*...............

Arbor (Nov. Holl.) Folia *simplicia, petiolata, elliptico-oblonga, acuta, serrata, coriacea, glabra, reticulato-venosissima.* Petioli *basi articulati.* Stipulæ *indivisæ, caducæ.* Flores *parvi, albi, paniculati.* Panicula *terminalis, ramosissima.*

Obs. Nomen ex σχιζω, *findo*, et μερις, *pars*, atque ad petala laciniata refert.

1. S. *ovata.*

Ceratopetalum ovatum, *Caley* MSS.

Hab. In Novâ Hollandiâ.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

** STAMINIBUS DEFINITIS, OVARIO INFERO.

CODIA, *Forst.*

Calyx limbo 4–5-partitus, persistens. *Petala* 4–5. *Stamina* 8 v. 10. *Ovarium* biloculare? calycis tubo adhærens. *Styli* densè pubescentes! *Capsula* apice clausa, sæpiùs abortu monosperma. *Semina* subrotunda, lævia: *testâ* osseâ: *albumen* parcissimum? *cotyledones* subfoliaceæ. *Radicula* brevissima.

Frutex (Nov. Caled.) Folia *simplicia, elliptica, obtusa, integerrima! coriacea, glabra.* Petioli *inarticulati.* Stipulæ *caducæ.* Flores *parvi, albi, capitati:* capitulis *globosis, pedunculatis, axillaribus:* ovarium *densè lanatum.* Stigmata *simplicia, obtusa.*

1. C. *montana.*

Codia montana, *Forst. Gen.* p. 59. t. 50.—*Icon.* ined. t. 35.—*Prod.* p. 29. —*Linn. Suppl.* p. 228.—*Labill. Sert. Caled.* p. 45. t. 46.

Hab. In Novâ Caledoniâ.—*Forster, Labillardière.* ♄. (V. s. sp. in Herb. Lamb.)

*** STAMINIBUS INDEFINITIS, OVARIO LIBERO.

POLYSTEMON.

Calyx altè 6-partitus: *segmentis* deciduis, in æstivatione valvatis. *Petala* 0. *Stamina* multiplici ordine numerosissima! *filamenta* subulata, glabra: *antheræ* subrotundæ, biloculares, longitudinaliter dehiscentes. *Ovarium* (e duobus folliculis conflatum) biloculare. *Styli* 2, distincti, teretes, glabri. *Stigmata* simplicia, obtusa, pruinosa. *Capsula* supera, bilocularis, bivalvis, birostris, septicido-dehiscens: *loculis* polyspermis. *Placenta* axilis, tetragona. *Semina* compressa, apice alata! samaroidea.

Arbores (Brasilienses). Folia *opposita, petiolata, digitata:* foliolis *serratis.* Stipulæ *interpetiolares, foliaceæ, deciduæ.* Flores *racemosi.* Ovarium *densè tomentosum.* Capsula *coriacea.*

Obs. Nomen ex *πολυς, multus,* et *ϛημων, stamen.*

1. P. *pentaphyllus,* foliis quinatis: foliolis lanceolatis glabriusculis.
   Hab. In Brasiliâ.—*Sello.* ♄. (V. s. sp. in Herb. Lamb.)
   Arbor habitu *Viticis.*

2. P. *triphyllus,* foliis ternatis: foliolis elliptico-oblongis subtùs tomentosis.
   Hab. In Brasiliâ.—*Sello.* ♄. (V. s. sp. in Herb. Lamb.)

BAUERA, *Salisb.*

Calyx 6–10-partitus. *Petala* 6–10. *Stamina* duplici ordine numerosa. *Antheræ* peltatæ: *loculis* connatis, longitudinaliter dehiscentibus. *Styli* 2, glabri. *Stigmata* simplicia, obtusa. *Capsula* supera, bilocularis, bivalvis, apice rimâ transversali dehiscens: *loculis* oligospermis: *septo* placentifero. *Semina* oblongo-cylindrica, atomis resinosis scabriuscula.

Suffrutices (Nov. Holl.) *erecti, ramosissimi, foliosi.* Folia *sena, verticillata, per tria approximata, subinde oppositè ternata, exstipulata.* Flores *rosacei, axillares, solitarii, pedunculati.*

1. B. *rubiæfolia*, foliis lanceolatis crenatis, floribus polypetalis.
   Bauera rubiæfolia, *Salisb. in Ann. Bot.* 1. p. 514. t. 10.—*Brown in Hort. Kew.* 3. p. 317.
   B. rubioides, *Andr. Rep.* t. 198.—*Bot. Mag.* t. 715.—*Vent. Malm.* t. 96.
   Hab. In Novâ Hollandiâ. ♄. (V. v. c. et s. sp. in Herb. Lamb.)

   Calyx 8–10-fidus. *Corolla* 8–10-petala.

2. B. *Billardieri*, foliis lanceolatis subintegerrimis, floribus hexapetalis.
   Baueria rubioides, *Labill.* MSS.
   Hab. In capite de Dieman.—*Labillardière.* ♄. (V. s. sp. in Herb. Lamb.)

   Habitu omninò *præcedentis.* *Folia* semipollicaria, margine subintegerrima.

3. B. *microphylla*, foliis elliptico-oblongis integerrimis, floribus hexapetalis.
   Hab. In Novâ Hollandiâ.—*Georgius Caley.* ♄. (V. s. sp. in Herb. Lamb.)

   Folia ferè *Thymi Serpylli.* *Flores* minores.

**** STAMINIBUS DEFINITIS, OVARIO LIBERO, STYLIS CONNATIS!

GEISSOIS, *Labill.*

Calyx 4-partitus, deciduus. *Petala* 0. *Stamina* 8. *Stylus* 1, basi remanente. *Stigmata* 2, simplicia. *Capsula* compressa, bilocularis, bivalvis: *loculis* polyspermis. *Semina* compressa, alata: *testâ* membranaceâ.

Arbor (Nov. Caled.) Folia *opposita, petiolata, quinata:* foliolis *ellipticis, obtusis, integerrimis, subtùs pubescentibus.* Stipulæ *oblongæ, costatæ, indivisæ, caducæ.* Racemi *axillares, multiflori, solitarii v. terni.*

1. G. racemosa, *Labill. Sert. Caled.* p. 50. t. 50.
   Hab. In Novâ Caledoniâ.—*Labillardière.* ♄.

NOTE.

Since the preceding monograph was prepared, I have learned from Baron Fèrussac's very useful Journal, the *Bulletin des Sciences Naturelles*, that *Polystemon* has been already proposed as a new genus, under the name of *Belangera*, by M. Cambessedes, whose appellation I willingly adopt. His *Belangera tomentosa* is evidently the same with my *P. triphyllus*, and *P. pentaphyllus* appears to be identical with *B. speciosa* of the same distinguished botanist.

Discourse delivered by Baron Alexander Humboldt *at the Extraordinary Meeting of the Imperial Academy of Sciences of St Petersburg, held on the 28th November* 1829.

Gentlemen,

If, on this occasion, when there is manifested a noble ardour for honouring the labours of human intellect, I venture to crave your indulgence, I do so only in discharging a duty which you have imposed upon me. On returning to my native country, after traversing the icy ridges of the Cordilleras, and the great forests of the equinoctial regions, and on being restored to Europe, then agitated by wars, after long enjoying the peacefulness of nature, and the imposing aspect of wild luxuriance, I received from this illustrious Academy, as a public mark of its good will, the honour of being associated with it. I still love to turn my thoughts toward the period of my life when the same eloquent voice which you have heard at the opening of this meeting, called me into the midst of you, and, by ingenious fictions, almost persuaded me that I had merited the palm which you conferred upon me. How far was I then from thinking that I should not sit at a meeting over which you, Sir *, preside, until I had returned from the banks of the Irtisch, the confines of Chinese Songarie, and the shores of the Caspian Sea! By the fortunate concatenation of events in the course of a restless and sometimes laborious life, I have been enabled to compare the auriferous deposits of the Uralian Mountains and New Grenada—the porphyry and trachyte formations of Mexico and the Altai—the savannas of the Orinoco, and the steppes of Southern Siberia, which offer a vast field to the peaceful conquests of agriculture, and to those arts which, while they add to the riches of nations, soften their manners, and progressively improve the condition of society.

I have been enabled to carry, in part, the same instruments, or those of similar but improved construction, to the shores of the Obi and the River of Amazons. In the long interval between my two journeys, the physical sciences, and especially geognosy, chemistry, and the electro-magnetic theory, have

* M. Ouvaroff, President of the Imperial Russian Academy of Sciences.

undergone considerable changes. New instruments, I might almost say new organs, have been invented to bring man into more immediate contact with the mysterious powers which animate the works of creation, and of which the apparent disturbances and irregularities are subject to eternal laws. If modern travellers can submit to their observations, in a brief period of time, a larger portion of the earth's surface, it is to the improvements effected in the mathematical and physical sciences, to the precision of our instruments, the perfection of our methods, and the art of grouping facts and rising to general considerations, that they owe the advantages which they possess. The traveller applies to use what, through the beneficial influence of societies, and the studies of sedentary life, has been prepared in the silence of the cabinet. To judge with equity and justice the merit of travellers of different times, we must be acquainted with the degree of development which practical astronomy, geognosy, meteorology, and descriptive natural history, had simultaneously acquired. It is thus that the degree of culture of the great domain of the sciences must be reflected in the traveller who would raise himself to the level of his times; and, in this manner, travels undertaken for the extension of the physical knowledge of the globe, must at different ages present an individual character—the physiognomy of a given epoch. They exhibit a picture of the state of cultivation through which the sciences have progressively passed.

In thus tracing the duties of those who have gone through the same career as myself, and whose example has often rekindled my ardour in moments of difficulty, I have pointed out the source of the feeble success of a devotion, which your generous indulgence has condescended to magnify by public testimonials of your approbation.

Finishing under happy auspices a long journey, undertaken by the order of a magnanimous monarch, powerfully aided by the knowledge of two philosphers, whose labours Europe has appreciated, MM. Ehrenberg and Rose, I might here confine myself to laying before you the homage of my lively and respectful gratitude;—I might solicit him who, young as he still is, has ventured to penetrate into those ancient *mysteries*, the memorable sources of the religious and political civilization of Greece, to lend the aid of his eloquence to enable me to express more worthily the sentiments by which I am animated. But I am aware, Gentlemen, that the charm of eloquence, were it even in accordance with the vivacity of feeling, is not sufficient in this assembly. You have been charged in this vast empire with the grand and noble mission of giving a general impulse to the cultivation of science and literature—of encouraging the labours which are in harmony with the present state of human knowledge—of vivifying and enlarging the mind in the domain of the higher mathematics, the physical history of the globe, and the history of the nations as illustrated by the monuments of different ages. Your view is directed forwards to the career which remains to be run, and the tribute of gratitude which I offer you—the only tribute worthy of your Institution—is the solemn engagement by which I now bind myself to remain faithful to the cultivation of the sciences to the last moment of an already advanced career, to explore nature unceasingly, and to pursue a course which has been traced by you and your illustrious predecessors.

This community of action in the higher studies, the aid which the different branches of human acquirement lend to each other, and the efforts that have been made at the same time in the two continents, and in the wide expanse of the seas, have impressed a rapid movement upon the physical sciences, as, after ages of barbarism, the simultaneousness of efforts similarly affected the progress of reason. Happy the country whose government accords an august protection to literature and the arts, which do not merely delight the imagination of man, but also increase his intellectual power and enlarge his conceptions;—to the physical sciences and the mathematics, which have so beneficial an influence upon the development of industry and public prosperity;—to the zeal of travellers, who force their way into unknown regions, or explore the riches of their native soil, and determine by accurate measurements the nature of its configuration! In here recalling to mind a small part of what has been done in the year now about to close, I am rendering to the Prince a homage which, by its very simplicity, cannot be displeasing to him.

While MM. Rose and Ehrenberg and myself have, between the Ural, the Altai, and the Caspian Sea, examined the geognostical constitution of the ground—the relations of its heights and depressions, indicated by barometrical measurements—the variations of the earth's magnetism in different latitudes (especially the augmentations of the inclination and intensity of the magnetic forces)—the temperature of the interior of the globe—the state of humidity of the atmosphere, by means of a psychrometric instrument, which had not previously been employed on a long journey—and, lastly, the astronomical position of some places, the geographical distribution of vegetables, and of several groups of the animal kingdom hitherto little known; philosophers and intrepid travellers have confronted the dangers presented by the snow-clad summits of Elborouz and Ararat.

I feel happy in seeing safely restored to the bosom of the Academy him whose valuable ideas respecting the hororary variations of the magnetic needle we have just received, and to whom the sciences are indebted (along with ingenious and delicate researches in crystallography) for the discovery of the influence of temperature upon the intensity of the electro-magnetic powers. M. Kupfer has recently returned from the Caucasian Alps, among which, after long migrations of the human race, in the great shipwreck of nations and tongues, so many different tribes have found refuge. To the name of this traveller, our learned associate, is joined, by similarity of labours, the name of the philosopher who, with a noble perseverance, has struggled on the ridges of Ararat, regarded as the classic soil of the earliest and most venerable recollections of history, with the obstacles which the depth and softness of the eternal snows presented to him. I am almost afraid of wounding the modesty of the father, by adding, that M. Parrot, the traveller of Ararat, worthily sustains in the sciences the lustre of a hereditary celebrity.

In the more eastern regions of the empire, which have received illustration from the immortal labours of my countryman Pallas, (pardon me, Gentlemen, if I claim for Prussia part of the glory of which two nations at once may be proud), in the Uralian and Kolyvan mountains, we have followed the still recent traces of the scientific expeditions of MM. Ledebour, Meyer and Bunge, and of MM. Hoffmann and Helmersen. The beautiful Flora of the Altai has already enriched the botanical establishment with which this capital is honoured, and which has risen, as by enchantment, thanks to the indefatigable and enlightened zeal of its director, to the rank of the first botanical gardens of Europe. The scientific world waits with impatience the publication of the Flora of the Altai, of which Dr Bunge himself, in the neighbourhood of Zmeinogorsk, shewed my friend M. Ehrenberg some interesting productions. It was unquestionably the first time that a traveller from Abyssinia, Dongola, Sinai and Palestine, ascended the mountains of Riddersky, covered with perpetual snows.

The geognostical description of the southern part of the Ural has been confided to two young naturalists, MM. Hoffmann and Helmerssen, one of whom was the first who gave an accurate account of the volcanoes of the South Sea. This choice is due to an enlightened minister, a friend of science and its cultivators, the Count Cancrin, whose kind attention, activity and foresight, have impressed my fellow-labourers and myself with a gratitude not to be effaced. MM. Helmerssen and Hoffmann, pupils of the celebrated school of Dorpat, have studied for two years with success the different ramifications of the Ural Mountains, from the great Taganai, and the granites of Iremel, to beyond the plain of Gouberlinsk, which is connected, more to the south, with the Mougodjares Mountains, and to the east between Lake Aral and the basin of the Caspian Sea. It was there that M. Lemm, in spite of the severity of the winter, made the first accurate astronomical observations that have been obtained of this arid yet inhabited country. We had the great satisfaction of being accompanied for a month by MM. Hoffmann and Helmerssen, and it was by them that we were first shewn a formation of volcanic amygdaloids, near Grasnuschinskaia, the only ones that have as yet been discovered in the long chain of the Ural which separates Europe and Asia, which presents the most abundant eruptions of metals on its eastern slope, and which contains, in veins or in alluvium, gold, platina, osmiuret of iridium, diamonds, discovered by Count Polier in alluvia to the west of the lofty mountain of Catschcanar, zircon, sapphire, amethyst, ruby, topaz, beryl, garnet, anatase, found by M. Rose, the celylanite, and other valuable productions of India and Brazil.

I might extend the list of important labours performed in the present year of his Majesty's reign, by speaking of the trigonometrical observations of the west, which, by the union of the labours of Generals Schubert and Tenner, and of M. Struve, the great astronomer of Dorpat, will elucidate the figure of the Earth on a great scale;—of the geological constitution of Lake Baikal, which has been examined by M. Hess;—of the magnetic expedition of MM. Hansteen, Erman and Dowe, justly celebrated over all Europe, the most extensive and adventurous that has ever been undertaken by land (from Berlin and Christiania to Kamtchatka, where it connects itself with the great labours of Captains Wrangell and Anjou);—lastly, of the circumnavigation of the globe, which, by the command of the Sovereign, Captain Luethe has performed, and which, through the co-operation of three excellent naturalists, Dr Mertens, Baron Kittliz, and M. Postels, has been productive of important results in Astronomy, Physics, Botany and Anatomy.

I have undertaken to point out this community of efforts by which several portions of the empire have been explored, by the aid of modern science, by that of new instruments, and new methods, founded upon the analogy of facts formerly unknown. It is also by a community of interests that, having once more ventured upon a new journey, I have found pleasure in adorning my discourse with names which have become dear to science. After having admired the richness of the mineral productions, the wonders of physical nature, one loves to point out (and it is a pleasant duty to perform in a strange land, in the midst of the assembly which listens to me) the intellectual richness of a nation, the labours of those useful men, disinterested in their devotion to science, who traverse their country, or, in solitude, prepare by study, by calculation and experiment, the discoveries of future generations.

If, as we have proved by recent examples, the vast extent of the Russian Empire, which surpasses that of the visible part of the moon, requires the concurrence of numerous observers, this very extent also presents advantages of another kind, which have long been known to you, Gentlemen, but which, in their relation to the present state of our knowledge of the physical history of the earth, do not appear to me to have been sufficiently appreciated; I would not speak of that immense scale, from Livonia and Finland to the South Sea, which washes the shores of eastern Asia and Russian America, on which the position and formation of rocks of all ages may be studied, within the limits of the same empire; the remains of those pelagic animals which the ancient revolutions of our planet have buried in the bowels of the earth; the gigantic bones of land quadrupeds now lost, or whose kindred species live only in the tropical regions;—I would not draw the attention of this assembly to the aids which the geography of plants and animals (a science only commencing its existence) will one day derive from a more profound specific knowledge of the climatic distribution of organized beings, from the happy regions of the Chersonesus and Mingrelia, from the frontiers of Persia and Asia Minor, to the melancholy shores of the Frozen Ocean;—I prefer confining myself to those variable phenomena whose regular periodicity, determined with the rigorous precision of astronomical observations, would lead directly to the discovery of the great laws of nature.

If, in the school of Alexandria, and at the splendid epoch of the Arabians (the first masters in the art of observing and interrogating nature by means of experiment), the instruments which we owe to the great age of Galileo, Huygens and Fermat, had been known, we should now know, by comparative observations, if the height of the atmosphere, the quantity of water which it contains and precipitates, and the mean temperature of places, have diminished in the course of ages; we should know the secular changes of the electro-magnetic charge of our planet, and the modifications which the temperature of the different strata of the globe, increasing in the ratio of the depth, may have undergone, whether through an augmentation of radiation, or from internal volcanic motions; lastly, we should know the variations of the level of the ocean, the partial disturbances caused by the barometrical pressure in the equilibrium of the seas, and the relative frequency of certain winds, depending upon the form and surfaces of the continents. M. Ostrogradsky would submit to his profound calculations these data, that had accumulated through ages, as he has recently solved with success one of the most difficult problems of the propagation of vibrations.

Unfortunately, in the physical sciences, the civilization of Europe did not commence at so early a period. We are, as the priests of Sais said of the Hellenes, a new people. The almost simultaneous invention of those organs by which we are brought into contact with the external world,—the telescope, the thermometer, the barometer, the pendulum, and that other instrument, the most general and the most powerful of all, the infinitesimal calculus,—hardly dates thirty lustrums back. In this conflict of the powers of nature, which yet does not destroy her stability, the periodical variations do not seem to surpass certain limits; they make the entire system oscillate round a mean state of equilibrium,—at least such is the case in the present state of things, since the great cataclysms which swallowed up so many generations of animals and plants. Now the value of the periodical change is determined with so much the more precision, the greater the interval between the extreme observations.

It is the duty of the scientific bodies which are continually forming and renovating themselves,—the academies, the universities, the many learned societies scattered over Europe, in the two Americas, at the southern extremity of Africa, in India, and even in New Holland, which, although but of late so wild, already possesses an observatory,—to observe, to measure, and, as it were, to watch over, what is variable in the economy of nature. The illustrious author of the Mecanique Celeste, has often verbally expressed the same thought in the midst of the Institute, where I have had the honour of sitting with him for eighteen years.

The western nations have carried into the different parts of the world those forms of civilization, that development of the human intellect, whose origin ascends to the epoch of the intellectual greatness of the Greeks, and to the gentle influence of Christianity. Divided in languages and manners, and in political and religious institutions, the enlightened nations form in our days but a single family (and this is one of the most beautiful results of modern civilization), when the object in view is the great interests of science, literature, and art, all that, springing from an internal source, the depths of thought and feeling, elevates man above the vulgar cares of society.

In this noble community of interests and action, most of the important problems which have reference to the physics of the globe, and which I have pointed out above, may, without doubt, become the object of simultaneous researches; but the immense extent of the Russian Empire in Europe, Asia, and America, presents peculiar and local advantages, well worthy of occupying, for one day, the thoughts of this illustrious society. An impulse given from so high a source would produce a happy activity among the observers with which your country is honoured. I would venture to point out here, and to recommend to your notice, three objects which are not (as was once said under a misapprehension of the concatenation of human acquirements) merely speculative and theoretical, but which have intimate reference to the ordinary wants of life.

The nautical art, the teaching of which, encouraged by the highest patronage, has, under the direction of a great navigator *, assumed so happy a development in this country, has, for centuries back, required a precise knowledge of the variations of the earth's magnetism in declination, inclination, and intensity of forces, for the declination of the needle in different seas, the appreciation of which is more exclusively required by mariners, is intimately connected in theory with two other elements, the inclination and the intensity measured by oscillations. At no former period did the knowledge of the variations of the terrestrial magnetism make so rapid advances as within the last thirty years. The angles which the needle forms with the vertical and the meridian of the place,—the intensity of forces, of which I have had the good fortune to ascertain the increase from the equator to the magnetic pole,—the horary variations of inclination, declination, and intensity, often modified by the aurora borealis, earthquakes, and mysterious motions in the interior of the earth, —the irregular disturbances of the needle, which I have designated, in a long course of observations, by the name of magnetic tempests,—have, in their turn, become objects of the most laborious researches. The great discoveries of Oerstedt, Arago, Ampere, Seebeck, Morichini, and Mrs Somerville, have revealed to us the mutual relations of magnetism with electricity, heat and solar light. There are only three metals, Iron, Nickel, and Cobalt, that become magnetic. The surprising phenomenon of rotatory magnetism, which my illustrious friend M. Arago first made

* Admiral Krusenstern.

known, shews us that nearly all the bodies in nature are transitorily susceptible of electro-magnetic actions. The Russian empire is the only country on earth traversed by two lines without declination, or along which the needle is directed towards the poles of the earth. One of these two lines, whose position and periodical motion of translation from east to west, are the principal elements of a future theory of the terrestrial magnetism, passes, according to the last researches of MM. Hansteen and Erman, between Mourom and Nijni-Novogorod; the second, some degrees to the east of Irkoutsk between Parchnikaia and Jarbinsk. Their prolongation northwards, and the rapidity of their motion westward, are not yet known. The physics of the globe require the complete tracing of the two lines without declination, at equi-distant periods, for example, every ten years,—the precise determination of the absolute variations of inclination and intensity at all the points where MM. Hansteen, Erman, and myself, have observed in Europe, between St Petersburg, Cazan and Astracan, in Northern Asia between Jekaterinburg, Miask, Oust-Kamenogorsk, Obdorsk, and Jakoutsk. These results cannot be obtained by strangers who traverse the country in a single direction, and at a single period. There is required a system of combined observations, carried on during a long period of time, and confided to observers established in the different countries. St Petersburg, Moscow, and Cazan, are fortunately situated very near the first line of no declination, which traverses European Russia. Kiachta and Verkhné-Oudinsk present advantages for the second or Siberian line. When we reflect on the comparative precision of observations made at sea and on land, with the aid of the instruments of Borda, Bessel, and Gambey, we may easily be persuaded that Russia, by its position, is capable of forwarding the theory of magnetism in a very great degree, in the space of twenty years. In speaking of these matters, I am only, gentlemen, in a manner, the interpreter of your desires. The manner in which you received the request which I addressed to you, seven months ago, relative to the correspondent observations of horary variations made at Paris, at Berlin, in a mine at Freyberg, and at Cazan, by the learned and laborious astronomer M. Simonoff, has proved that the Imperial Academy will worthily second the other academies of Europe in the thorny, but useful, research into the periodicity of all the magnetic phenomena.

If the resolution of the problem which I have just pointed out, is equally important for the physical history of our planet and the improvement of the art of navigation, the second object which I have to lay before you, and for which the extent of the empire presents immense advantages, is more immediately connected with general wants,—the cultivation of the soil, the examination of the configuration of the ground, the exact knowledge of the humidity of the air, which visibly decreases with the destruction of the forests and the diminution of the water of lakes and rivers. The first and noblest object of science resides undoubtedly in themselves, in the enlargement of the sphere of ideas, and of the intellectual power of man. It is not in the bosom of an academy like yours, under the monarch who regulates the destinies of the empire, that the research of great physical truths requires the support of a material and external interest, of an immediate application to the wants of social life; but when the sciences, without deviating from their noble primary object, are capable of exercising a direct influence upon agriculture and the arts (which are too exclusively called useful), it is the duty of the philosopher to point out these relations between the scientific investigation of countries, and the increase of territorial riches.

A country which extends over more than 135 degrees of longitude, from the happy zone of the olive to the climates in which the ground is only covered with lichens, is more than any other capable of advancing the study of the atmosphere, the knowledge of the mean temperatures of the year, and, what is much more important for the cycle of vegetation, that of the distribution of the annual heat among the different seasons. Add to these data for obtaining a group of facts intimately connected with each other, the variable pressure of the air, and the relation of this pressure to the predominant winds and the temperature, the extent of the horary variations of the barometer (which under the tropics, transform a tube filled with mercury into a kind of time-piece of most imperturbable regularity in its progress), the hygrometric state of the air, and the annual quantity of rain, which it is of so much importance to the agriculturist to know. When the varied inflections of the isothermal lines, or lines of equal heat, shall be traced by accurate observations, and continued at least five years, in European Russia and Siberia; when they shall have been prolonged to the western coasts of America, where an excellent navigator Captain Wrangel, is soon to reside,—the science of the distribution of heat at the surface of the globe, and in the strata accessible to our researches, will be established upon solid foundations.

The government of the United States of North America, keenly interested in the progress of population, and of an extensive cultivation of useful plants, has long been sensible of the advantages afforded by the great extent of its possessions from the Atlantic to the Rocky Mountains, from Louisiana and Florida, where the sugar-cane is cultivated, to the Canadian lakes. Meteorological instruments, after being compared with each other, have been distributed over a great number of places, the selection of which has been submitted to minute discussion, and the annual results, reduced to a small number of figures, are published by a central committee, which watches over the uniformity of the observations and calculations. I have already pointed out in a memoir, in which I have discussed the general causes upon which the differences of climate in the same latitude depend, on how great a scale this beautiful example of the United States might be followed in the Russian Empire*.

We are happily far removed from the period when philosophers thought they knew the climate of a place, when they knew the extremes of temperature attained by the thermometer in winter and summer. A uniform method, founded upon the choice of hours, and up to the level of our recently acquired knowledge of the true means of the days, months, and whole year, will replace the old and defective methods. By this investigation, various prejudices respecting the selection of objects of cultivation, the possibility of planting the vine, the mulberry, the chesnut, or the oak, will disappear in certain provinces of the empire. To extend it to the most remote parts, we may reckon upon the enlightened co-operation of many well-educated young officers, with whom the Corps des Mines is honoured, that of physicians animated by zeal for the physical sciences,

* This beautiful memoir was published in vol. iv. of the New Series of this Journal.

and upon the pupils of that excellent institution, the School of Canals, Bridges, and Roads, in which mathematical studies of a high order give rise to a kind of instinctive taste for order and precision.

Along with the two objects of research which we have just examined in their relation to the extent of the empire (the earth's magnetism and the study of the atmosphere, which leads at the same time, by the aid of the mean heights of the barometer, to the improved knowledge of the configuration of the ground), I would mention, in concluding, a third kind of inquiry of a more local interest, although connected with the great questions of physical geography. A considerable part of the earth's surface around the Caspian Sea, is inferior to the level of the Black Sea and the Baltic. This depression, which had been supposed for more than a century, and which has been measured by the laborious efforts of MM. Parrot and Engelhardt, may be ranked among the most surprising geognostical phenomena. The exact determination of the mean annual barometric height of the city of Orenburg, which we owe to MM. Hoffmann and Helmerssen; a levelling *(nivellement par station ?)* made by the aid of the barometer, by the same observers, from Orenburg to Gourief, the eastern port of the Caspian Sea; corresponding measures taken during several months in these two places; and, lastly, observations recently made by us at Astracan and at the mouth of the Volga, corresponding at once to Sarepta, Orenburg, Cazan, and Moscow, will serve, when all the data are brought together and rigorously calculated, to verify the absolute height of this internal basin.

On the northern side of the Caspian Sea, every thing appears to indicate at the present day a progressive diminution of the level of the waters; but without giving too much credit to the report of Hanway (an old English traveller, of otherwise respectable character), about the periodical risings and fallings, we cannot deny the encroachments of the Caspian Sea near the ancient city of Terek *(perhaps the old town of Terek or Old Terek)* and to the south of the mouth of the Cyrus, where scattered trunks of trees, the remains of a forest, are seen always inundated. The islet of Pogorelaia Plita, on the contrary, seems to be progressively extending and rising above the waves, which, not many years ago covered it, previous to the flames which were perceived by navigators at a distance.

To solve in a satisfactory manner the great problems relative to the depression, which is perhaps variable, of the level of the waters, and of that of the continental basin of the Caspian Sea, it were desirable that there should be traced a *soundings line* around this basin, in the plains of Sarepta, Ouralsk, and Orenburg, by uniting the points which are precisely at the level of the Baltic and Black Seas; that it should be determined by marks placed on the coasts all round the Caspian Sea (like the marks placed nearly a century ago on the coasts of Sweden, by the directions of the Stockholm Academy), whether there be a general or partial, a continuous or periodical, fall of the waters, or whether (as the great geologist M. Leopold de Buch supposes in respect to Scandinavia) a part of the neighbouring land is elevated or depressed by volcanic causes acting at immense depths in the interior of the globe. The mountainous isthmus of Caucasus, partly composed of trachyte and other rocks, which undoubtedly owe their origin to volcanic fires, margins the Caspian Sea to the west, while it is surrounded to the east by tertiary and secondary formations, which extend towards those countries of ancient celebrity, for the knowledge of which Europe is indebted to the important work of Baron Meyendorf. . . . .

In these general views, which I submit to your enlightened consideration, I have attempted to point out some of the advantages which the physical history of the globe might derive from the position and extent of this empire. I have exposed the views which vividly presented themselves to me, in sight of the regions from which I have just returned. It has appeared to me more suitable to render a public testimony of approbation to those who, under the auspices of the government, have pursued the same career as myself, and to direct the attention to what remains to be done for the advancement of science, and for the glory of your country, than to speak of my own efforts, and compress within a narrow compass the results of observations which have still to be compared with the great mass of partial data which you have collected.

I have alluded in this discourse to the extent of country which separates the line of no magnetic variation, to the east of Lake Baikal from the basin of the Caspian Sea, the valleys of the Cyrus, and the frozen summits of Caucasus. At these names the mind involuntarily reverts to that recent struggle, in which the moderation of the conqueror has increased the glory of his arms, which has opened up new paths to commerce, and has ensured the deliverance of Greece, the long abandoned cradle of the civilization of our ancestors. But it is not in this peaceful assembly that I ought to celebrate the glory of arms. The august monarch, who has deigned to call me to this country, and to smile upon my labours, presents himself to my imagination as a peace-making genius. Vivifying by his example all that is true, great, and generous, he has delighted, since the dawn of his reign, in protecting the study of the sciences which nourish and strengthen the understanding, and that of literature and the arts, which embellish life, and add to the comfort of society.

On Artesian or Overflowing Wells.

In some districts of France, England, and North America, the want of good spring-water is supplied very successfully by boring to a considerable depth into the ground, when a great quantity of very pure water rises to the surface, and, in many cases, is even projected to a considerable height above the surface of the earth. Wells of this description are called in England Overflowing Wells, and in France *Fontaines jaillissantes, Puits forés,* or *Puits Artesiens.* The latter name is derived from the circumstance of their having been long in very extensive use in the district of *Artois.* From thence these wells were introduced into other parts of France, yet, in general, much more sparingly than might have been expected from their acknowledged utility, and the peculiarly favourable nature of these districts for their employment. For this reason, for these ten years past, several scientific societies, as the *Societé d'Encouragement pour l'Industrie nationale,* and the *Societé royale et centrale d'Agriculture,* have offered prizes, to diffuse this useful discovery throughout France; and in consequence of these endeavours, several treatises and publications have of late drawn our attention to this interesting and important circumstance. It will not, therefore, be misplaced, to give a short exposition of the scientific information which we may derive from artesian wells; at the same time, it will perhaps be in our power to correct some of the erroneous notions upon the mode of origin of subterranean waters, and upon the possibility of discovering them.

We owe the most complete and authentic information on Artesian wells to M. F. Garnier. His work, *De l'Art du Fontainier sondeur et des Puits Artesiens*, which was crowned, in the year 1821, with the prize of 3000 francs, by the *Societé d'Encouragement*, and has been printed at the expense of the French Government, and of which a second edition has since appeared in 1826*, contains not only clear directions for boring these wells, with plans of the requisite instruments, but also such sound views regarding the origin of subterranean aqueous reservoirs, and so well founded on facts, that we cannot be far wrong in supposing everywhere the same, or similar relations, wherever we have hitherto succeeded in conducting to the surface these collections of water. We therefore think that the subject cannot be better introduced to the attention of those who are yet quite unacquainted with it, than by shortly communicating the substance of the above-mentioned essay, apart from all technicalities.

The observations of M. Garnier were especially directed to the department of the Pas-de-Calais. The constitution of this district, with the exception of some primitive ridges in the vicinity of Boulogne, consists essentially of two portions, of a limestone plateau, called the High Land, intersected by many small valleys,—and of alluvial deposites, which extend in an immense plain as far as Holland and the north of Germany. The limestone, only very thinly covered with soil, is stratified, full of fissures, and the same with that which forms the basis of Picardy, Normandy, and Champaigne. The line of junction of the limestone and alluvial deposites is principally directed from SE. to

* A German translation of the first edition, by Waldauf V. Waldenstein, appeared at Vienna in 1824.

NW., from between Arras and Lille to Calais: a little to the south of the last of which, the Cap-blanc-nez consists of this limestone.

By far the greater part of the Artesian wells, which are bored in this district, lie to the north of this line, where the newer cover of beds of sand and clay have yet attained no great thickness; and experience teaches us that water is not found till the borer reaches as far as the limestone, or has penetrated into it. Few wells lie to the south of this line, in the limestone formation itself. But the relations of these last are quite the same as those of the others; they are found, for example, in valleys of the formation, the bottoms of which are covered with the same masses which form the greater plain; we even here do not meet with water, till the waterproof stratum of clay, resting on the limestone, has been penetrated. When, which is not unfrequently the case, water is met with before this, in the beds of sand and loam, its impurity, and the feebleness of its propulsion upwards, shew that it is derived from quite another source than the pure water of the Artesian wells.

From these relations, which are elucidated in Garnier's work by the profiles of several boring works, it is sufficiently evident, that the water, which ascends through the shafts, is always derived from the deep-lying points of the limestone strata, from the subterranean slope of the mass of the rock. A farther proof of the Artesian wells deriving their supplies only from this source, is derived from the observation made in several places, as, for example, at Lillers and Bethune, that, when one of two adjoining wells, lying in the same line of direction as that of the limestone formation, is rendered muddy by the piston of the pump, the water of the other is simultaneously milky, from the suspension of minute particles of lime. The origin of the Artesian wells can therefore hardly be doubted. It is well known how numerous and extensive are the fissures, often miles in length, contained in the limestone of this part of France, how quickly the rain-water is absorbed on the high grounds, and how abundantly it re-appears, in the form of springs, at the foot of these hills.* If any proof of this was required from the

* One of the most instructive instances of the passage of water through

work of Garnier, it only requires to be mentioned that, among the many streams of water which issue forth with much violence from the fissures in the limestone rock of the steep declivity of Cap-blanc-nez, and which are constantly undermining it, also another proof of the existence of more extensive excavations in this district, and which are continually becoming larger, is in the sinking of the ground,—for example, in the *arrondissement* of S. Paul, being a not unfrequent occurrence. If we now reflect, the limestone strata have a position inclined to the horizon, and that their outgoing often forms the highest point of the district, there can be no doubt that the Artesian wells are only supplied by the atmospheric water, which falls on the upper part of the limestone strata, and sinks down through the various canals which they contain: in a word, that they represent the shorter legs of a syphon, the longer of which

subterranean canals in limestone mountains, is certainly that described by Saussure (*Voyages dans les Alpes*, ed. 4. t. i. p. 309), at the *Lac de Joux*. This little lake, in the Jura, receives the water of the larger lake of Rouss, and of several rivulets, without its having any other outlet, on account of its being situate in a valley surrounded by heights, than by the numerous crevices between the nearly vertical strata of limestone. On the north-west side, the lake has made for itself a way to them, and has formed a deep hollow, by the bottom of which the water is soon absorbed. The inhabitants of the valley have also formed similar outlets. As it is very important for them that the water maintain a nearly uniform level, they lead the lake, when it overflows, into little reservoirs, which they have dug down to the limestone rock, and are eight or ten feet broad, by fifteen to twenty deep, and which they carefully clear from the mud which collects in it. One could hardly have believed that these reservoirs, or, as they are called there, funnels (*entonnoirs*), both natural and artificial, gave rise to the springs of Orbe, lying 680 feet lower, and three-fourths of a league from the north end of the lake, if an accidental occurrence, in the year 1776, had not set it beyond a doubt. At that time, the inhabitants, in order to lay dry the little lake, and to clear out its outlets by the *entonnoirs*, dammed up the lake of Rouss, which empties into it; but this lake became at one time so much swollen, that it burst the embankment, and rushed downwards with great violence into the lesser one, which by that means became very turbid. The consequence of this was, that the usually pure spring of Orbe became shortly after dirty and impure. Yet the connexion of the lake of Joux with the springs of Orbe seems to have been suspected from a very early period, as the stream which connects the two lakes above has also the name of Orbe; therefore it has been clearly marked for a portion of the river which discharges itself into the lake of Neufchatel.

is buried in the rock. M. Garnier is so convinced of the truth of this principle, that he only advises the boring of wells in the valleys of those districts whose elevations contain the outgoing of a cavernous limestone.

Besides, upon a review of the appearances observed in Artesian wells, it is evidently sufficient, that an inclined stratum of a fissured or porous limestone be included between two waterproof beds of clay, one of which sets a limit to the sinking of the water downwards, and the other which keeps it back from above. The existence of such a cover is evinced by all boring works: a waterproof stratum of clay must always be penetrated, before reaching the spring-water. But also, it can easily be conceived, that the undermost layer is never wanting; and although, for the most part, some thinner strata of limestone supply its place, yet the strata, which conduct the water, always contain it in crevices, which are much more numerous on the surface than in the centre of the beds: thus there is a demonstration, as in a boring-work at Blengel, that, even in the limestone itself, beds of clay occur. From these circumstances, it is easily explained how we can never hope to sink Artesian wells in granite, gneiss, porphyry, serpentine, &c. Even in schistose mountains, it would not be advisable to sink these wells, because, even if found, it would be very easily impregnated with sulphuretted hydrogen, from the abundance of pyrites occurring in these strata, and thus be unfitted for many uses. Limestone, on the contrary, which is very insoluble, experience teaches us, yields a very pure water.

Other districts, where water has been bored for, shew a similar geognostic constitution to the Pas de Calais. M. Garnier notices this, with regard to Boston, in America, and Sheerness *, in England. London, where many sugar-works, distilleries, and breweries, have, for a long time, been principally supplied with water from Artesian wells, lies in the middle of a basin-shaped hollow, the fundamental rock of which is a limestone belonging to the chalk formation; which also forms the heights

* Very pure and clear water was here found at a depth of 550 feet, under the clay in a chalky limestone, which sprung at first 344 feet high, then sunk, and now remains 120 feet under the surface of the ground.

in the vicinity, and which is covered, though at times not immediately, by a waterproof clay. The wells, which are not sunk to this, the *London clay*, give abundance of clear, but mostly very hard, water; while those which penetrate through the London clay, into the subjacent *plastic clay*, a formation immediately covering the chalk, and consisting of alternating beds of sand, clay and boulders, yields a very soft and pure water *, which, on piercing this clay, often ascends with such violence, that the workmen have scarcely time to escape †. Here the plastic clay seems to be either the conducting medium, or the reservior of the water yielded by the chalk. Paris is known to be situate in a district whose geognostic relations are almost identical with those of London, and therefore we cannot wonder that there, as well as in many other parts of the north and east of France, Artesian wells may everywhere be sunk; nor can we doubt of the extension of this very useful discovery ‡. The soil of Vienna seems also to be well adapted for the purpose, as partly appears from a geognostic description of Prevost ||, and partly from the details given by Popowitch § of one of these springs in a suburb of Vienna, if new bores do not lead to unsatisfactory results ¶. In the environs of Modena, Rammazini

* It contains some carbonate of soda, about 4 grains per quart.—*Journ. of Science*, vol. xiv. p. 145.

† Conybeare and Philips, *Outlines of the Geology of England*, &c. pt. i. p. 34.

‡ Most of those which have been bored in the town and its immediate vicinity, remain under the surface of the ground, although they are often several feet above the surface of the Seine and the common wells. Among a considerable number of those which are enumerated by M. Hericart de Thury, in the *Annal. de l'Industrie*, t. ii. p. 58, there are several from which the water is projected, at least at first, with great force, and not without danger, far above the heads of the workmen. This, for instance, was the case with one, which, in the year 1780, was bored in the Vauxhall Gardens, and the level of the water of which has ever since been as high as the surface. This water comes from a depth of forty yards; but on account of the stoney character of the soil and the consequent expense, they are usually only about half as deep; and this may perhaps be one of the causes that permanent spring-wells have not yet been sunk.

|| *Journ. de Physique*, t. 91. p. 347, & t. 92. p. 428.

§ *Observations of the Physico-Economical Society of the Palatinate for* 1770 pt. 2. p. 169.

¶ Riepl, in an appendix to the German translation of M. Garnier's work, p. 162.

has already made us acquainted with one of the oldest spring-wells of this kind*; and from Shaw, we learn, that, even at Algiers, in the village Wad-Reag, appearances exactly similar to those in the Comté d'Artois are to be seen †.

The number of these examples might certainly be increased; only the few which are already adduced, and the frequency of the geognostic relations, which we have seen to be conditions to the boring of Artesian wells, will sufficiently justify the conclusion, that wherever these relations occur, we may calculate on meeting with a spring of water. By no means, however, ought the vain hope to be indulged, which has been published within this short time in a very uncritical essay in the Bibliotheque Universelle, t. xxxix. p. 193 and 204, that, in every part of the earth where we bore skilfully, a fortunate result may be expected.

Even in a district of the proper constitution, the meeting with these springs depends, in some measure, on accident. Where, for example, we must sink into the limestone itself, the result is naturally dependent on our meeting in time with a vein of water or not. Thus Garnier mentions, that an inhabitant of Bethune, after he had penetrated through 70 feet of alluvium, and 30 feet of limestone, met with a spring which ascended to the surface; while a neighbour, whose shaft almost touched that of the former, met with no water, although he had penetrated 70 feet of sand and clay, and then 105 feet into the limestone, so that he was altogether 75 feet deeper than his neighbour. In the citadel of Calais, they were obliged to carry the shaft to the depth of 110·5 yards before pure water was found; what was met with before this, was saline and brackish. The same is the case in England, where, at least near London, they are not sunk to the chalk; the depth of the stratum which leads the water is very different. Mile-end is 36, Tottenham 70, Epping 340, and Hunter's-hole 410 feet above the level of the Thames; and, in the first place, water was found 70, in the second 60, and, in the third, 80 feet above the same level; but in the last situation, 130 feet above it.—(*Conybeare*, n. a. p. 36.)

* *De Fontium Mutinensium admiranda scaturignic*, of which an abridgment is given in the *Act. Erudit.* of 1692, p. 505. Also Leibnitz, in his *Protogæa*, p. 75, expressly speaks of it.

† Delametherie, *Theorie de la Terre*, t. iv. p. 216.

It is not unfrequent, again, to cut across several veins of water with one boring-shaft. This was the case in a well at the brewery of Messrs Liptrap and Smith, a mile east of London, where, partly by digging, partly by boring, a depth of 370 feet was reached. The first spring was found above the London clay, the three following under it in the plastic clay, and the last in the limestone, 123 feet below its upper margin. The springs which rose from the plastic clay, all ascended to the same height, namely, to high water-mark on the Thames, which is there 36 feet under the surface of the surrounding country.—(*Conybeare*, n. a. p. 45.) * Likewise, in sinking a well in St Owen (as mentioned in the Globe, No. 54, for this year), five different veins of water were intersected.

Of the last case, M. Hericart de Thury mentions the curious circumstance, that an already existing Artesian well, in the vicinity of which the new one was sunk, was not at all affected by it†. Both together yield about 700 cubic yards of water in 24 hours. A similar case, where two adjoining springs do not appear to have disturbed one another, is mentioned by the same author, in the *Annal. de l'Industrie*, t. ii. p. 63. At Epinay, near St Denis, in one of the highest points of the park of the Countess Grollier, 16·5 yards above the mean level of the Seine, two wells were bored at the distance of a yard from one another, each of which yielded from 35 to 40 cubic yards, or from 38 to 39,000 litres of water in 24 hours. The source of the first was at a depth of 54·4 yards, and its surface remained 4·55 yards under the surface of the ground. The same was the case with the second, when it was sunk to an equal depth; but after the boring was carried to 67·3 yards, the water rose 0·33 yards above the surface of the ground. In London, phenomena have even occurred that indicate very distant wells to stand in a certain connexion with one another. Neither is it striking, that on the sea seast, where ordinary springs are often regulated by the ebb and flow of the sea, wells of this descrip-

* The water thus in no way rose 36 feet above the surface of the ground, as stated in the appendix to the German translation of Garnier's work.

† It is not strange that, as was here the case, the boring-iron was strongly magnetic. Even rods of iron at rest, in a perpendicular position, become magnetic; how much more must it be the case in an operation, when, in this position, it is subjected to violent shocks? This magnetic property of the boring-iron is a very common appearance.

tion should be subject to a similar disturbance. M. Hericart de Thury mentions this of a well bored to the depth of 17 yards at Noyelle-sur-Mer.—(*Annal. de l'Industrie*, t. ii. p. 66). At time of ebb, its level is 2 yards under ground, while at flood, it is on a level with it: a very ingenious valve has, therefore, been constructed, to maintain the well even during ebb at the higher level. Similar oscillations also occur in the Artesian wells at Abbeville, besides others at Dieppe, Montreuil, Department of Calvades, and the United States.

What extensive fissures the water here and there must fill, is not only demonstrated by the magnitude of many of these springs, but also by a circumstance mentioned by M. Garnier, on the authority of M. Hericart de Thury. In a brewery at Paris, near the barrier towards Fontainbleau, a well, 20 yards deep, ceased to yield any more water. They, therefore, resolved to sink the shaft deeper. But a depth of 19 yards was scarcely reached, when suddenly the borer sunk down into a crevice for more than 7 yards, and would have been inevitably lost, as even then it did not reach the ground, if fortunately a cross bar of wood had not been passed through the eye at the top of the instrument. The boring machine was tossed too and fro, as if it was moved by a large body of water, and, when after much difficulty, it was drawn up to the opening, the water suddenly sprung 10 yards above the heads of the workmen, so that they could scarcely escape quickly enough, and were obliged to leave all their implements in the well. Ever since, the water has stood 12 yards above the circle, which serves as a foundation to the wall of the well.

This irruption of the water, on first piercing these subterranean reservoirs, is often very violent, and is no small proof of the copiousness of many of these wells. Some striking examples of this are quoted from England in the Bibliotheque Universelle, t. xxxix. p. 199. A Mr Brook had sunk a bore in his garden 360 feet deep, and 4·5 inches in diameter, from which the water was discharged so copiously, that it not only overflowed the whole yard round the house, but also submerged the adjoining cellars. The damage was so great that the neighbours lodged a complaint, and the police were required to interpose. Two men now tried to close the bore with a wooden peg, but they were constantly driven back by the violence of the water, even when a third came to their assistance. They were equally incapable of restraining the water by an iron-stopper. At last they took the advice of a mason, and planted several tubes of small diameter over the bore, and thus succeeded at last in mastering the water.

At a Mr Lord's, in Tooting, where a bore had been closed, the water worked with such violence under the ground, that it burst forth in a space 15 yards in circumference, and certainly the walls would have been brought down if free vent had not been given to it. This spring, say the informants, on account of the height of its jet, and the quantity of water (600 litres per minute), is worthy of being in a public square.

The stream of a well belonging to a neighbour of Mr Lord, drove a water-wheel of 5 feet in diameter, and this again set a pump in motion which carried the water to the top of a three-storied house.

Even in the north east of France these overflowing and springing wells are by no means rare, as is seen from M. Hericart de Thury's notice in the *Annal. de l'Industrie.* At Kreutzwald, in the department of the Moselle, one has been sunk 60 metres; at St Quentin, in the department of the Aisne, there are two similar ones which flow over their brinks; further, at Prix, near Mezieres, there is one 143 yards deep, which rises about 0·5 of a yard above the ground. At St Amand, in the department of the north, were three wells, bored to a depth of 45 yards, the water of which sprang a yard out of the ground, and has never diminished since*.

At Rieulay, in the valley of Scarpe, towards the end of last century, in searching for coal, they came on a stream of water,

* A remarkable circumstance, although not immediately connected with Artesian wells, is related by Hericart de Thury, of the sulphureous spring of Bouillon, near St Amand. In the year 1697, when they began to repair the reservoir of this spring for receiving the fresh water, such a sudden disengagement of sulphuretted hydrogen took place, probably from another direction being given to it by the masonry, that an immense mass of water, mud, and sand was projected. It was curious enough, too, that several coins of different Roman emperors appeared at the surface, and more than 200 images, sculptured in wood. Most of these were much defaced by lying long in the water, yet M. Bottin believes, from his memoir in the *Memoires de la Societé Royale des Antiquaries de France*, that, at the time of the introduction of Christianity into these places, they were thrown into the well from fear of the zeal of the holy Amand, Bishop of Tougres.

which sprang to the height of a yard above the ground, as thick as a man's arm, and yielded enough of water to drive an adjoining mill.

Also, at Gonnehem, near Bethune, in the department of Pas-du-Calais, a mill-wheel, 3 yards in diameter, was driven by the united water of four wells, bored to a depth of 45 yards, and thus 200 kilogrammes of meal were ground in 24 hours. The water of these wells rose 3·57 yards out of the ground.

Equally noted for their abundance, as for their utility, are those at Roubaix, near Arras. This little town was in danger of losing, from want of water, its principal support, the silk-spinning and dye-works, when M. Hallette succeeded, after much difficulty, in boring several very copious wells, one of which even yields 288 cubic yards of water in a day, or double the power of a steam-engine of 20 horse power. The *Societé de l'Encouragement* in Paris has rewarded the meritorious M. Hallette with the prize of 3000 francs.

Lastly, the overflowing or spouting wells, those which have been lately discovered at Amalienbad, near Laugenbruck, in the county of Baden, are worthy of notice. They are bored 58 feet deep, and yet ascend 8 feet above the surface of the ground. Their water, which amounts to 460 tierces a day, is very free from salts, as are the most of the Artesian wells, but is distinguished from them by containing sulphuretted hydrogen, evidently from the bituminous pyritous slaty coal from which this spring seems to rise. The temperature of this artificial natural sulphureous water is 55°—56°½ F.—*(Berlin Nachricht, v. 9, Oct. of this year.)*

Agreeably to the design of this review, we have hitherto spoken chiefly of those appearances which relate to the boring of fresh water springs. The same phenomena, however, are afforded by salt springs, and often in a very marked manner.

We shall here only notice one of the most striking examples of this description, an event which marked the opening of the salt shaft at Dürrenberg. By the perseverance of the superintendant of the salt works, the Counsellor of Mines Borlach, the shaft had already reached a depth of 113 fathoms, when, on the 15th September 1763, the salt water suddenly burst through a layer of gypsum 23 inches thick, which formed the floor of the shaft; and notwithstanding the most active working of the machinery, within three hours and a half it had filled the whole depth of the shaft, which was 791 feet, and 5 ells square, and overflowed its margin. One of the workmen was caught by the salt water, and, wonderfully enough, raised 252 feet high in the shaft without being hurt. After more than 40 years, in the years 1802–1805, the salt spring still exerted such a pressure, that, according to the calculation of the Inspector of Salt-works, Bischof, it could rise 5 ells above the highest margin of the shaft. Also at Kösen the salt water reaches the surface from a depth of 86 fathoms (516 feet)*. Similar overflowing wells have also been lately bored at Nauheim, in the Wetterau, at Unna, in Westphalia, and in several other places.

This cannot be the place to prove the advantages of bored wells over dug ones, in an economical point of view, nor in what way they may be most advantageously employed; this must be left to technological treatises; besides, complete information on every thing which is important, in a practical point of view, may be obtained from the work of M. Garnier, which we have so often quoted†. Yet a few historical points regarding the boring of fresh water wells still remain to be mentioned. It is unknown who first turned the miner's boring-iron to this use ‡. Ramazzini's work, which was published in the year

* Geognostische Arbeiten, v. J. C. Freiesleben. Baud. ii. S. 208.—Bischof in Karsten Archis. Baud. xx. S. 17.

† *R. F. Selbman*, on the Use of Miner's Boring-irons, Leipzig 1823, contains a very particular detail of every kind of boring apparatus, as well as an enumeration of the principal works from which further information may be derived.

‡ Possibly the spontaneous irruption of these waters first attracted attention to overflowing wells. So it happened, in the year 1821, at Bishop Monckton, near Ripon, England, after a rattling noise of the ground, the water burst forth, and immediately excavated a shaft for itself, which, on the evening of the same day, had several feet in circumference, and, on sounding, shewed a depth of 58 feet.—(*Jour. of Science*, v. xi. p. 406.) Similar appearances have also occurred in the sandy soil of the Marck of Brandenburg. Thus, for example, in 1756, not far from Ziesar, at the foot of the sandy ridge which lies on the left bank of the Bukan, a spring burst forth with an immense noise, which the old people still remember perfectly. It has since flowed with undiminished violence, and its quantity of water is very great, as is the case with all those of this region. By the continual washing of the loose sand, a large excavation has been made, and the spring itself has retreated considerably, and has formed a basin of more than 500 paces long, which sufficiently shews that the source of the water is very deep in the sandy ridge.

1691, gives ample proof of the art having been practised from the earliest period in the environs of Modena. From thence it spread to France, and, as mentioned in the late programme of the Royal Society of Agriculture of Paris, the merit of their introduction is due to Domenico Cassini, who was invited from Italy to the court of Louis XIV, and was shortly after elected a member of the Academy of Sciences. The earliest information that we possess of any well being bored in the Comté d'Artois, is, perhaps, that given by Belidor in his *Science de l'Ingenieur*, liv. iv. chap. 12. He saw, in the year 1729, in the church of St Andre, a well of this description, which gave 20 yards of water in an hour, and rose a yard above the surface of the ground. Near Paris, according to M. Hericart de Thury, the first Artesian well was sunk at Clicky, in the middle of the last century. It reached the depth of 98 feet, and rose four feet above the level of the Seine. In Germany, where the art of boring mines has been known for more than a century, and where Leopold (Schauplatz der Wasserbaukunst, Leipzig 1724), has applied them to the boring of fresh water springs, this use has been made of them, but not so much as to the finding of salt springs; yet it may be expected, from the zeal with which the search for Artesian wells is carried on in France, that similar works will be carried on in other countries.

POGGENDORF.

On the Botany of India, and the Facilities afforded for its investigation by the East India Company.

THE natural sciences are not in the number of those which can be advanced by meditation alone. The logician and the mathematician may forward their studies by solitary reflection, and the chemist may make brilliant discoveries with a very limited apparatus; but the naturalist is continually obliged to have recourse to the ocular inspection of numerous and diversified objects. At the time when Europe was as yet little explored, he had only to make little excursions around his dwelling to extend the field of science; but now Europe and the countries in its vicinity may be looked upon as explored countries, and science has risen to considerations of so high an order, that the productions of the whole globe must be brought together to afford confirmations of its theories. These difficult and expensive researches are beyond the efforts of even the richest and most active individuals; and the governments, friendly to science, have perceived that their aid was necessary for the encouragement of these efforts, and have in various ways afforded their assistance. Confining ourselves here to botany alone, we have within the last fifty years seen numerous journeys performed by the orders of various governments for the extension of the knowledge of vegetables, not only with reference to agriculture and medicine, but even for eliciting the mere theoretical knowledge of the laws of vegetable nature. But the best conducted journeys commonly make known but a small portion of distant countries, and results much more satisfactory are obtained by the prolonged residences which naturalists may be appointed to make in them. The European nations which have distant colonies might in this respect render the greatest service to natural history, and several of them have taken advantage of their position so as to merit the gratitude of the scientific world. We intend to exhibit in a series of articles the principal services which have thus been rendered by France, Spain, Germany, Russia, and other countries; at present, we shall confine ourselves to those by which the English East India Company has acquired so many honourable titles to public gratitude.

Since the period when that company saw its sovereignty established in India with any degree of security, it has directed its attention, both with reference to its own interests, and to those of humanity in general, to the study and cultivation of the plants of that vast country. In March 1768, a botanic garden was established by it at Calcutta, under the direction of Colonel R. Kydd. This garden was quickly enriched with valuable plants, by means of a correspondence with all the Europeans that had settled in India. There were about three hundred species in it, when, in the autumn of 1793, Dr Roxburgh was charged with its superintendence. That botanist established a more active correspondence, and visited himself the coast of Coromandel, and some other provinces of British India. He succeeded in bringing together 3500 species of plants in the Company's garden, and of this number 1510 were previously unknown, and were named and described by him. This we learn from the catalogue of the garden printed at Serampore in 1814*, under the direction of Dr W. Carey, Dr Roxburgh's friend. This catalogue, which is written on a very contracted scale, makes known the botanical name, the Indian denomination, the native place, and the periods of introduction, flowering and maturity of each plant. It concludes with an appendix containing the Indian species not yet introduced into the garden but known to Dr Roxburgh.

That gentleman, however, did not confine himself to this brief indication of his labours, but successively sent to the East India Company numerous drawings and descriptions of the vegetables of India; and the Company made a selection of them, which was published, under the direction of Sir Joseph Banks, under the title of *Plants of Coromandel* †. This magnificent work contains descriptions and coloured figures of 300 species of Indian plants, selected from among those pre-eminent for beauty or utility.

But the very magnificence of this publication rendered it impossible to extend it to the whole of the vegetation of India, and Dr Roxburgh conceived the project of publishing a Flora of that country in a simpler form. Unfortunately, however, his health did not permit him to carry into effect this plan. He retired from India in 1814, and died in England. The Flora of India, however, was not lost to science, for his friend Dr Carey published two volumes of it at Serampore‡, and inserted in it, besides the plants described by Roxburgh, all those which had been successively discovered by himself, Messrs Wallich, Jack, and other botanists. This work is arranged according to the Linnean system, and contains the first five classes.

After Dr Roxburgh's death, the superintendence of the Calcutta garden was confided to Dr Wallich, whose talents and ac-

* *Hortus Benghalensis*, or a Catalogue of the Plants growing in the Honourable East India Company's Garden at Calcutta. 1 vol. 8vo. Serampore, 1814.

† Plants of the Coast of Coromandel selected from drawings and descriptions, presented to the Honourable Court of Directors of the East India Company, by W. Roxburgh, 3 vols. folio. London I. 1795, II. 1798, III. 1819.

‡ *Flora Indica*, or Description of Indian plants by the late W. Roxburgh, edited by W. Carey, to which are added descriptions of plants more recently discovered by Nat. Wallich, &c., 8vo. Serampore. Vol. I. 1820, vol II. 1824.

tivity, seconded by the protection of the Company, have raised the establishment to a high degree of prosperity. More than *three hundred gardeners* or workmen are attached to it, and the objects more particularly held in view are the naturalization and diffusion of useful plants, and the preservation of the rarer vegetables of the different parts of India for study. Numerous travellers, sent out at the expense of the Company, traverse all the countries subject to its domination, and, in concert with the English dispersed over that vast empire, are continually adding to the riches of the Company's garden and collections. Dr Wallich himself travelled in 1820 through the country of Nepal*, which, being situated at the base of the great Himalayan Mountains, presents a vegetation entirely different from that of Bengal. After this, although labouring under severe diseases caused by fatigue, he visited Penang, Singapore, the kingdom of Ava, and some other parts of India. Besides this, he sent collectors into the districts to which he could not go in person, and by these various means collected a great mass of vegetables, living and dried.

These collections have already enriched the science of botany with numerous discoveries. Several of the plants collected by Dr Wallich have been inserted in the *Prodromus Floræ Nepalensis* of Don†, and in various general works published in Europe. Dr Wallich himself has, as has been said above, inserted a great number of them in the *Flora Indica*, and has commenced the publication of two works intended to make known the principal discoveries in a more complete manner.

The first of these is his *Tentamen Floræ Nepalensis*‡, which contains the full description, accompanied with a lithographic figure, of the principal vegetables of that country. Two numbers have already appeared, each containing twenty-five plates. Besides its botanical importance, this work deserves notice from

* It is also written Nipal, Nepaul or Napaul, but Dr Wallich states that *Nepal* answers best to the original name.

† *Prodromus Floræ Nepalensis, sive Enumeratio Vegetabilium, quæ in itinere per Nepaliam detexit Fr. Hamilton; Accedunt Plantæ a D. Wallich missæ Auct. D. Don*, 1 vol. 8vo. *Londini*, 1825.

‡ *Tentamen Floræ Nepalensis Illustratæ*, consisting of botanical descriptions and lithographic figures of select Nepal plants, by Nat. Wallich, Calcutta and Serampore. Fol. Fasc. I. 1824, II. 1826.

the circumstance of its being the first containing botanical figures lithographed in India, and drawn by native painters.

Dr Wallich's second work, which is much more magnificent than the other, is intended to give descriptions and coloured figures of the rarest plants of Asia *. It is to consist of three volumes. The first number, which has just made its appearance, announces that this collection will be one of the most valuable of which the science has to boast, and will rival the great works of Rheede, Rumphius, and Roxburgh.

Besides the capital works of Roxburgh and Wallich, there are others which the East India Company has encouraged or protected. MM. Kœnich, Heyne †, Carey, Patrick, Russel, Rottler, Klein, Wight, Finlayson, &c. have traversed various parts of India for the purpose of examining its vegetation. For about fifty years back, all the collections of dried plants made by these zealous travellers have been sent to London, and are preserved in the Company's Museum. The very immensity of these materials has shewn the Honourable Directors of that Institution the impossibility of rendering them useful without the co-operation of a great number of observers. By a decision remarkable for its bounty and liberality, the Court of Directors has instructed Dr Wallich, who is now in London, to distribute these valuable collections among the principal botanists of Europe, at the same time taking suitable measures to ensure their publication. This liberal distribution has already commenced, and it is likely, that, through the generosity of the Company, the whole of the plants collected in India will soon be added to the mass of known vegetables. Their number is estimated at seven or eight thousand species; and it may easily be conceived how many new facts, ideas, and connections will arise from this immense addition to our botanical knowledge. The East India Company has thus acquired the most honourable right to the gratitude of the learned of all countries; and we are certain, that all the friends of science will applaud this great act of liberality, and will join us in expressing their gratitude.

* *Plantæ Asiaticæ Rariores.* Fol. London and Paris, 1829. Treuttel and Wurtz.

† Some of the plants collected by Mr Heyne, and sent by him to his friend Mr Roth, have been published by the latter under the title of *Novæ Plantarum Species, præsertim Indiæ Orientalis, ex collectione Doct. Benj. Heynii.* 1 vol. 8vo. Halberstedii, 1821.

The very manner in which this great operation is performed adds to its utility, and deserves being made known.

All the species of the different collections are arranged under their families and genera by Dr Wallich, and the principal English botanists Messrs Brown, Lindley, Bentham, &c. Each has a number attached to it, and receives a provisory name. Lithographic copies are printed of the lists of these names, accompanied with the designation of the different localities in which the plant has been gathered. All the specimens furnished with one number, refer to these lists, and in this manner, those who may see them in the different collections in Europe, will be certain of their identity with those which are described. By this very simple process, all the uncertainties to which the sight of isolated specimens frequently give rise, will be removed

Each family of plants is sent to the botanist who has given proof of his peculiar fitness for its examination, by the monographs which he has published, commenced, or projected on it. Thus, to confine ourselves to a few examples which have come to our knowledge, Mr Brown has got the Rubiaceæ, &c.; Mr G. Bentham the Caryophylleæ, Labiatæ, &c.; Mr Lindley the Rosaceæ, &c.; M. De Candolle the Umbelliferæ, Caprifoliaceæ, Loranthеæ, &c.; Mr Adolphe de Candolle the Campanulaceæ; Mr Choisy the Convolvuli, &c. Each of these monographists receive the first disposable duplicates in the part confided to him, and is to make them known to the public. The other specimens are distributed in such a manner as to be divided into collections destined for different countries, and thus contribute, in the most efficient manner, to extend a knowledge of the botany of India.

If the gratitude of naturalists is first due to the Honourable East India Company, it is also due to Dr Wallich, who superintends this distribution. So far from taking advantage of his situation for reserving to himself the publication of these riches, he only occupies himself in distributing them among his colleagues in the manner most useful for the advancement of Natural History. He employs, for the purpose of facilitating the labours of botanists in general, the valuable time which he might employ in his own private labours, and by this, proves that he sees glory where it really is, in usefulness. How widely different is this liberal manner of seeing the interests of science, from the narrow and despicable jealousies of which the history of literature and science presents but too many examples! If we have thought it our duty to mention this event as an honourable fact in the history of botany, we also love to make it known as a fact honourable to the human heart,—as a proof of the progress of civilization, and of the intimate connection which is every day becoming more firmly established among enlightened nations.

On the Subtropical Zone. By Baron Leopold Von Buch.

The *Tropical Zone* of the earth is, in a physical point of view, characterized by the *tropical rains.* These rains follow the course of the sun, and always occur where the sun is in the zenith of the place. During the time of the greatest declination no rain falls.

In *temperate climates*, on the contrary, the weather is clear and bright when the sun stands highest, but it rains when he has removed to a considerable distance. These latter rains appear with winds, which blow from the equator or from low latitudes towards the poles, probably by reason of the cooling of the upper equatorial trade-winds, which, in higher latitudes, touch from above the earth, and flow over it for a considerable length. I have endeavoured to prove these conjectures by an appeal to facts *. The transition from the one zone into the other, is made by an intermediate one, which can be accurately distinguished from the two formed by physical phenomena. I believe it deserves the name of *Subtropical Zone.* Humboldt, after making known the observations of Boussingault, in Santa Fé de Bogota, remarked, that the progressive decrease and increase of the medium heights of the barometer in different months, which Boussingault was inclined to derive from the greater or lesser distance of the sun, occurs again not only on a greater scale at Rio Janeiro, but also only in opposite months at the Havannah and Macao. It is, in truth, a general phenomenon, which depends on general causes, from those, namely, that occasion the trade-winds. The following Table shews the phenomena.

* In my observations on the climate of the Canaries, in the Memoirs of the Berlin Academy for the year 1820.

MEAN BAROMETRIC HEIGHTS in different Months (all the Heights are expressed in Paris Lines, and reduced to the Freezing Point).

Place and Period of Observation.	Latitude.	January.	Febuary.	March.	April.	May.	June.	July.	August.	Septem.	October.	Novem.	Decem.	Difference of highest and lowest Mean.	Mean Bar. height from all the Obs.
Cape-town, 9 years,	33° 15′ S. Lat. .	337,084	337,24	337,42	338,15	338,84	338,946	339,652	339,153	338,693	338,69	337,534	337,515	2,672	
Rio Janeiro, 1 year,	22° 15′ S. Lat. .	336,06	336,09	337,225	338,00	338,98	339,35	338,957	339,27	338,445	336,69	335,81	335,36	3,91	
Sta. Fé de Bogota, 1 year, . . .	4° 35′ 50″ N. Lat. 8,196 feet high,	248,445	248,458	248,516	248,746	248,578	248,795	248,840	248,738	248,662	248,561	248,445	248,303	0,503	
Havannah, 3 years,	23° 8′ N. Lat. .	339,235	336,97	337,34	336,72	336,10	337,204	337,200	335,717	335,780	336,101	337,46	338,51	3,581	337,009
Natchez Missisippi, 5 years, . . .	31° 20′ N. Lat., 91° 30′ L. W. Green.	336,64	336,857	335,83	335,85	334,11	334,65	335,82	335,09	334,60	335,08	336,68	338,16	4,07	335,96
Seringapatam, 1 yr.	12° 25′ N. L. 2,264 feet elevation,	311,01	310,046	309,557	308,654	308,336	308,109	308,294	308,303	308,517	309,314	309,554	309,69	2,901	
Bangalore, 1 year,	12° 55′ N. Lat. 2,997 feet high, .	305.764	305,68	305,065	304.61	304,186	303,751	303,673	303,188	303,43	303,585	304,078	304,327	2,576	304,46
Madras, . . .	13° 5′ N. Lat. .	338,77	337,95	338,00	335,44	334,85	334,96	...	...	...	...	...	...	3,92	
Calcutta, 8 years,	22° 40′ N. Lat. .	338,93	336,40	335,24	334,17	332,83	331,63	331,38	331,82	333,29	334,80	336,18	337,30	7,55	334,5
Benares, 4 years,	25° 18′ N. Lat. .	334,87	333,76	333,000	331,29	330,26	328,54	328,33	329,51	330,69	332,63	333,83	334,94	6,63	330,02
Khatmandu, 1 yr.	27° 42′ N. Lat., 4,355 feet high,	284,61	283,73	...	...,	284,84	282,45	281,69	280,83	280,73	282,97	283,97	284,61	3,88	
Macao, 1 year.	22° 50′ N. Lat. .	340,417	340,007	339,597	337,757	337,627	335,71	335,976	335,976	337,889	338,399	339,642	340,74	5,03	338,908
Cairo, ...	30° 2′ N. Lat. .	337,975	wanting	336,65	336,95	339,12	334,43	334,20	334,27	335,44	366,77	337,24	337,71	3,775	336,45
Paramatta, 1 year,	33° 30′ N. Lat. .	335,39	338,08	335,78	334,61	336,47	336,81	335,12	336,95	337,76	335,55	338,54	337,45	3,95	336,54
Palermo, 20 years,	38° 5′ N. Lat. .	334,48	334,95	334,10	333,95	334,57	335,17	334,67	334,77	335,07	334,87	334,69	334,15	1,22	334,52
Isle de Leon, 1 yr.,	36° 35′ N. Lat. .	335,34	336,78	331,47	335,03	334,73	336,09	335,32	335,39	336,09	336,23	336,00	331,69	5,31	335,44
Mafra, ...	38° 27′ N. Lat. 681 feet high, .	329,92	329,90	327,6	328,58	326,7	328,5	328,29	328,42	...	327,58	328,04	326,48	3,42	
Paris, 11 years,	48° 50′ N. Lat. .	336,4	336,5	335,28	334,77	334,96	335,7	335,36	335,46	335,4	334,43	335,02	334,73	2,07	
Berlin, 5 years,	52° 31′ N. Lat. .	334,56	334,83	333,30	335,60	335,41	335,77	335,11	335,3	335,1	335,96	335,27	335,37	2,66	

A law distinctly follows from these observations, according to which the mean barometric heights, for single months, regularly decrease from winter to summer, and this the more the farther they are distant from the equator. Irregularities, which appear in these statements, will probably disappear by a mean of many years. When we consider that this law is revealed in Louisiana, Cairo, Benares, and in Macao, we cannot doubt that it will also be observed in Owaihi, and hence be general over the earth. Rio Janeiro and the Cape-town are already so far removed in longitude, and even in meteorological situation, from each other, that we may expect a similar character for the southern hemisphere.

But this phenomenon has determinate limits. It disappears, not gradually, but in a sharp transition; and in the apparent inequalities, towards the pole, of the mean barometric heights, there is revealed the *temperate zone.* In Palermo, Cadiz, Mafra, we find no longer the deepest mean heights in the summer, and still less in places having a higher geographical latitude. As it appears to be proved, that the different barometric heights and their irregularities depend on the nature of the prevailing winds, it is probable, also, that the regular course of decreasing mean barometric heights also depends on changes of the wind; and this is proved by phenomena in India. For there it is that the rainy south-west monsoons cause the sinking of the mercury, and this in proportion as they touch from above downwards the surface of the earth. The north-east wind raises, with equal uniformity, the mercury in the barometer. It is also observed, where the law of the barometric heights no longer appears, that, in summer, the trade, or the regular north-east or north wind, is sometimes overcome by the south or south-west wind. But these are the upper equatorial currents, which in high latitudes come from above. As they ascend everywhere in the torrid zone, and flow towards the poles, they will be forced, the farther they come, from great circles of the earth's surface, into circles of smaller diameter, and so the farther they go into smaller and narrower limits. They will therefore increase in height, as also in velocity. Lastly, they will force the north-east wind to yield; and, in place of flowing perpendicularly over one another, flow alongside each other. The shape of the land and of the sea, different temperatures of the soil, different velocities of the wind, and frequently their crossing one another, change these polar and equatorial streams in very short periods, and the barometer continues in a constant state of agitation. The law of these vibrations will no longer be general, but belong to every individual part of the surface of the earth in which they occur. The limits of the *subtropical zone*, on the side towards the equator, will be determined by the tropical rains, which is, at the same time, the farthest limit which the upper equatorial current flowing towards the pole, in the winter, touches the surface of the earth. The boundary of the zone, on the side turned from the equator, is determined by the disappearance of the law of the regular decrease and increase of the mean barometrical heights. In summer, they would be where the upper equatorial current sometimes descends down, but, in winter, dispute the place with the north-east wind to the surface, and flow with it, for the most part, alongside each other, but in opposite directions. These limits may be determined, in the northern hemisphere, in the following manner. The southern limit will fall somewhat to the north of the Cape de Verd Islands, about the 20° of latitude; in the interior of Africa somewhat more to the south; for Denham expressly remarks, that the tropical rains begin on the west coast, in the 16° of latitude. In Nubia, also, according to Ehrenberg, they first begin in north latitude 16°. The northern limit will be placed over Cairo, yet not directly by Algiers; therefore in the 32° of north latitude. In the southern hemisphere, this boundary extends nearer to the pole, as is sufficiently proved by observations made at the Cape, in south latitude 33°. But it does not extend much farther, for the few observations made at Buenos Ayres appear to assign that place a situation beyond the boundary of the effect of the law of the medium barometrical heights. That Santa Fe' de Bogota, although in the northern hemisphere, yet follows in the mean barometrical heights the curve of southern places, is a beautiful confirmation of the encroachment of southern climatic relations beyond the equator. The boundary of the southern trade wind passes, in summer, from 7° to 8° beyond the equator; and in the estuary of the river Amazon, and in French Guiana, the tropical rains are conformable with those on the south side of the equator, not those on the north side, notwithstanding their northern latitude.

The *subtropical zone* is admirably characterized in the northern part of the old world by the date-tree (*Phœnix dactylifera*). If this tree were also found on the opposite side of the Atlantic sea, the whole zone might well be named the *Date Zone.* For on the opposite side of its northern limit, the date-tree no longer ripens its fruit; and the tropical rains prevent a single date-tree ripening its fruit beyond its southern limit. Hence this palm does not occur in India, and therefore is not met with in Mosambique or Melide. It first appears again in Mekran, in the 27° of latitude, where the south-west monsoon ceases; and before the north-east wind has obtained the ascendancy, at the end of August and the beginning of September, there occurs a time of very continued heat, which is called the Date Ripening (*Khoormu Puz*), without which the fruit does not acquire its full ripeness. The caravans, in the interior of Africa, provide themselves with dates for many weeks, when they travel from the south to Bilma, in the 18° of latitude. The soil does not prevent the farther spread of the date, but the tropical rains soon appear. Browne found the Date but rarely in the Darfur, and only with bad fruit. On the Senegal, in Guinea, in the Congo, it is never seen. The Date is as peculiar to this zone, as the Cocoa is rare in it. It is truly remarkable how the cocoa trees no longer thrive when the tropical rains cease. Even in Mekran they are no longer met with, and neither on the coasts of the Arabian nor Persian Gulfs.—Another distinguished production of this zone is *Ceratonia siliqua*, the Carob-tree. It oversteps in its distribution the northern and southern boundaries, but only in a small degree, and only as a shoot from the zone itself. The tropical rain also prevents its ripening its fruit. Hence we in vain look for it in India. And probably many other trees will be found and determined, which require for the growing and ripening of their fruit the intensity and uniform increase of the subtropical heat, and therefore will be characteristic for this zone.

On Milk, and its Adulterations, in Paris.

By the extension of the use of coffee, the quantity of milk now consumed is at least double that which was used eighteen or twenty years ago.

But the number of milch cows in the vicinity of Paris has not increased in any thing like the same proportion. Much of the milk sold by certain milkmen at the corners of streets, has none of the properties of common milk, except the whiteness.

The quantity of milk which proceeds from the same cow, is very different at different times; and that of different cows varies also in quality. Some of the more wealthy inhabitants, who obtain their milk directly from the dairies, at a good price, have it pure; but the mass of milk sold in Paris is more or less altered.

The most common adulteration is that of water. But as this can be detected by the taste and colour, brown sugar is added to restore the sweetness, and wheat or some other kind of flour the whiteness and consistency.

Hence the areometer, which merely determines the specific gravity of the fluid, is of no use in detecting these impurities;—and besides, milk which is rich in butyraceous matters, is much lighter than that which is less rich in butter, but more rich in caseous ingredients. To prevent the flour which is used in thickening the skimmed and watered milk from settling to the bottom, it is previously mixed with water and boiled, which renders it, when cold, soluble in milk. Thus, flour is easily detected by the tincture of iodine, which gives it a wine or violet colour.

More especially, if this floured milk be treated with a little sulphuric acid, and the coagulum separated by a filter, the serum acquires a fine blue colour by the tincture of iodine.

Thus detected, the milk sellers sought for some substance which would not produce the blue colour with iodine, in which they doubtless obtained the aid of some chemists. They resorted to an emulsion of sweet almonds, with which, for the cost of about one franc, they can give a milk white to 30 pints of water, and communicate no unpleasant taste.

Some of these pretended milk dealers, less scrupulous, employ hemp seed in lieu of almonds, because of its greater cheapness. They thus dilute the milk of cows to almost any extent they please, without altering its colour or opacity, and correct its taste by a little coarse sugar.

This fictitious milk may be detected, however, by the oily nature of its curd. When the latter is pressed between the fingers, or on paper, the oil exudes from it, which is not the case with the curd of pure milk.

That portion or part of the milk which is least influenced by variation of food, &c. in the cow, is the caseous portion, or curd.

Four specimens of milk were obtained by the author from dairies on different sides of Paris, and one other was taken from a cow, and immediately brought to him. Three hundred grammes of each of these were warmed, and treated with equal quantities of vinegar. The curd of each being drained, and equally pressed between folds of soft paper, afforded, those from the dairies, each twenty-nine grammes of cheese, and that from the cow, thirty grammes.

A second experiment, gave within a small fraction, the same result. Taking the quantity of this caseous matter as a type of the purity of milk, other equal proportions of milk were mixed, each with an equal weight of water, and treated in the same manner, when it was found that the quantity of cheese was exactly one-half.

In a third experiment, the milk was diluted with twice its weight of water, and the cheese was precisely one-third.

The last experiment was repeated, with the addition of sugar tothe milk and water. When the cheese was extracted, the whey cautiously evaporated to the consistency of extract, treated with boiling alcohol, filtered and evaporated, the sugar which had been added was recovered.

To distinguish the milk which is adulterated with emulsion of almonds or of hemp-seed, 150 grammes of pure milk were united with 150 grammes of emulsion of sweet almonds, and the curd was separated by vinegar, with the aid of heat. Being well pressed, it weighed 16 grammes $\frac{5}{10}$. Then another mixture was made, in the proportion of 100 grains of milk to 200 of emulsion, and this furnished 10 grammes and 18 decigrammes of curd, which, it will be observed, is proportionate to the prior quantity. Besides, the curd or caseum of pure milk can be easily distinguished from that with the emulsion, by its consistency, and by the grease which the latter yields when exposed for some time to white paper.

To prevent the milk from turning sour and curdling, as it is so apt to do in the heat of summer, the milkmen add a small quantity of sub-carbonate of potash, or soda, which, saturating the acetic acid as it forms, prevents coagulation or separation of the curd; and some of them practise this with so much success, as to gain the reputation of selling milk that never turns. Often when coagulation has taken place, they restore the fluidity by a greater or less addition of one or other of the fixed alkalies. The acetate which is thus formed has no injurious effects; and, besides, milk contains naturally a small quantity of acetate of potash, but not an atom of free or carbonated alkali.

It is proposed from the result of these investigations, that the authorities should ordain, 1*st*, That no milk should be sold except in sealed measures; and, 2*dly*, That, in each quarter of the city, one or two pharmaceutists should be charged with the duty of examining from time to time the quality of the milk offered for sale, and that penalties should be exacted for every fraudulent alteration of quantity or quality.—*Annales d'Hygiene Publique et de Medecine Legale*, July 1829.

Remarks on Sir Humphrey Davy's Opinions respecting Volcanic Phenomena. By Mr W. J. Girardin.

After presenting a succinct account of Sir H. Davy's ideas on the subject of volcanoes, M. Girardin makes the following remarks.

In the first place, is it indeed demonstrated that the sea communicates with the volcanic foci? Geologists of all ages have attributed a great degree of importance to the circumstance, that volcanoes are situated near the sea, or in islands. It is difficult to give a satisfactory reason for this fact, and still more difficult to account for the manner in which the communication may take place. There is every reason to believe, that the infiltrations of the sea advance but a very short distance into the interior of the land, and in general, what has been said on this subject has been exaggerated. Besides, were it true that this communication of the waters of the sea with volcanoes was one of the causes of their eruptions, how should the present state of rest of certain of them, although always placed in the same circumstances, be accounted for? The islands of Ischia, of Procida, and the Pumice Isles, are always surrounded by the sea; the bases of the craters of Averne, Gauro, Astroni, &c. are still bathed by it; and yet none of these places at present exhibit any signs of action. Will it be said, that the subterranean canals by which the waters introduced themselves into the volcanic abysses are now closed, or that the masses of alkaline and earthy metals which existed in these different localities are exhausted? It would be difficult, indeed, to conceive such reasons. Besides, a great number of volcanoes are situated in the interior of continents: we may mention, for example, those of the Andes of Quito, Sanguay, Pichincha, Cotopaxi, &c. What means of communication can be supposed to exist over a space of more than 40 leagues? It is true, that the waters of the sea are supplied by great subterranean lakes, whose existence is attested by immense mud eruptions, great inundations, and especially by the fishes (*pimelodes cyclopum*) sometimes ejected in prodigious quantity; but many circumstances prove that these lakes have no communication with the volcanic focus itself. Many of these fishes are found alive at the moment of their ejection, and almost all of them are in so entire a state, notwithstanding the great softness of their flesh, that it is impossible to admit their having been exposed to the action of heat. The water ejected along with them is commonly cold. It is easy to account for these extraordinary facts, the first knowledge of which we owe to M. de Humboldt, by the formation of subterranean lakes which are peopled by fishes ejected during eruptions, the latter, besides, only taking place at long intervals.

It therefore remains highly probable, that the alleged communication of the sea or of subterranean lakes with the foci of volcanoes, is altogether imaginary. And besides, were it admitted, it would remain as difficult to explain certain facts, to the discussion of which we now proceed. One of the most important consequences of the action of water upon the alkaline and earthy metals, would be the production of an enormous quantity of hydrogen, and, in consequence of the combustion of that gas on coming into contact with the air, the disengagement by the volcanic crater of a prodigious mass of aqueous vapour. Abundance of such vapour is, in fact, observed during all eruptions; but it is difficult to conceive that all the hydrogen rendered free is burnt; for, however large the subterranean cavities may be which Sir H. Davy admits under the ignivomous mountains, it is more than probable that there does not exist in them a quantity of air sufficient to produce the combustion of the enormous volume of hydrogen which must be disengaged. Besides, it is impossible, supposing the two gases to be in suitable proportions, that a part of the hydrogen should not escape ignition, being carried away by the aqueous vapours, the acid gases and the saline sublimations, which are formed at the same moment. From these circumstances, there ought to be found a pretty large quantity of hydrogen among the aeriform products which issue from the craters. Now, observation proves that the disengagement of this gas is very rare in eruptions. It might then be supposed that this gas, at the moment when it is about to issue from the volcanic caverns, combines with some other combustible body. Of all the hydrogenous compounds with which we are acquainted, the only ones observed in volcanic places are ammoniacal salts, sometimes sulphuretted hydrogen, and always hydrochloric acid. The ammoniacal salts, whose base would be derived from the combination of hydrogen with the azote of the decomposed air, and the sulphuretted hydrogen, are in too small quantity for us to calculate upon a great absorption of hydrogen by these compounds. It would, therefore, be with the chlorine that nearly the whole of the hydrogen would unite; but then it would be necessary to admit that the metals are partly in the state of chlorurets in the interior of the earth, as has also been advanced by some chemists. In the first place, according to this supposition, the quantity of hydrochloric acid produced ought to be considerable. This is not the case, however. All the naturalists who have observed the phenomena of volcanoes on the spot, have been sensible, that, at the moment of the eruptions, this acid was produced, but none of them have stated it to have been in extraordinary proportions. Moreover, the metallic chlorurets of the two first sections, when placed in contact with water at a high temperature, powerfully unite with it, but do not decompose it. The chloruret of iron alone presents this fact; so that of all the oxides that occur in lavas, iron is the only one that could be originally in the state of a chloruret. In the neighbourhood of burning craters, there are found a considerable number of metallic chlorurets. These compounds, so far from existing previous to the eruptions, are, on the contrary, formed under our eyes by the reaction of the free hydrochloric acid upon the volcanic rocks. It is true, that Sir H. Davy has discovered that the white fumes which are disengaged from lavas in a state of fusion, are in a great measure composed of chloruret of sodium, and a little chloruret of potassium and iron; but the quantity of these chlorurets is so small in proportion to the mass of the ejected matters, that they cannot be supposed to exist in very large proportions in the interior of volcanoes. Besides, they ought to form the greater part of the substance of lavas, in which, however, only traces of them are found. From this discussion, there results, that water has not been satisfactorily demonstrated to perform the part in volcanic reactions which Sir H. Davy attributes to it.

Another consequence of the theory of the English chemist is, that the internal parts of the globe would have a very small specific gravity, it being known that the earthy and alkaline metals are generally lighter than water. Now, this great lightness is contrary to all the opinions and all the experiments of natural philosophers, who are generally agreed in attributing to the internal rocks of our planet, a density superior to that of the earth and rocks which compose its surface. According to the calculations of Clairaut, Boscowich, Laplace, and Maskelyne, and the experiments of Cavendish, it may be established that the mean density of the internal nucleus of the earth, compared with that of water, is as 5 to 1. Consequently, it may be admitted that this nucleus is formed by substances whose specific gravity is inferior to that of water.

From all these facts and reasonings, to which we could add many others, it appears to us evident that Sir H. Davy's ingenious theory is insufficient for the explanation of those natural phenomena, whose magnitude and periodical occurrence present something so surprising. The recent investigations of the most celebrated geologists, tend to prove that the phenomena of volcanoes are intimately connected with the state of fusion and incandescence of the internal nucleus of the globe; nor does their explanation present any difficulties. The hypothesis of central heat, at first so keenly contested by the greater number of naturalists, now rests on so great a number of facts, collected by men entertaining such different opinions, in countries so remote from each other, and under such diversified circumstances, that it is very difficult to combat it with success. Sir H. Davy himself, at the end of his memoir, admits that this theory possesses much probability. Such is almost always the fate of great truths, moral as well as natural. After exciting the contempt, frequently the sarcasms and persecutions, of party-spirit (for the sciences, unfortunately, are not free of it), they always end, after a greater or less period, with triumphing even over the most exaggerated; and often he whom it has been found most difficult to convince, becomes one of the most ardent enthusiasts in the cause which he formerly repelled with so much obstinacy *.

On Changes of Temperature in Plants.

In a thesis sustained at the University of Tubingen, Dr W. Neuffer has presented the results of a number of interesting researches into the changes of temperature which plants undergo. In a thesis presented by M. Halder in 1826, on the same subject, the author asserted that trees are in winter at a lower temperature than the freezing point, and even pass to the state of congelation, without injury to their life. The winter of 1827 and 1828 being very severe, the necessary observations were made at Tubingen for confirming those of M. Halder. The temperature of a poplar was observed during the whole of the year 1828, and the results of this examination differ little from those obtained in the Botanic Garden of Geneva, and published in the first volume of the Bibliotheque Britannique. The temperature of the air and that of the tree were about equal in Fe-

* In the former Number of the Journal, we gave Sir H. Davy's own account of his desertion of the metalloidal theory of volcanoes, and his tracing volcanoes to the action of the central heat.—Ed.

bruary; that of the tree was higher in March, April, and May, and again the temperature of the air was higher during the other months of the year. At the beginning of January, the temperature of the tree was higher by 10° than that of the external air, which would appear to announce a great disengagement of heat at the time when the aqueous juices of trees congeal. When it thawed, the heat of the tree was 4°, and even 8° above that of the air. It is to the greater evaporation of trees in summer, that the author attributes the less elevated degree of their temperature. The reason of their heat being greater in spring is, that they then lose very little by evaporation, and retain the mean temperature of the earth, which at that season is a little higher than that of the air. The observations made during two successive winters have shewn that the thermometer, in the interior of trees, may descend below zero, without the vegetation suffering. It even descended so low as + 5° Fah., and + 1½ Fah. in some young trees. On the 26th January 1828, the thermometer indicated + 1½ Fah.; the day after, it suddenly rose to + 34½ F.; the change was not so sudden in the tree, which, the second day, was still below 32° Fah. Several trees were cut, and they were found frozen in concentric circles to a certain depth. The frozen wood was easily known by the greater resistance which it offered to cutting instruments. In the six trees that were cut, the wood was frozen to the following mean depths :—*Æsculus Hippocastanum*, 8.2 lines; *Pinus Abies*, 12.5 lines; *Acer Pseudo-platanus*, 15.2 lines; *Fraxinus excelsior*, 16.8 lines; *Corylus Avellana*, 16.9 lines; *Salix fragilis*, 17.3 lines. The water in a pool near these trees was frozen to the depth of 8.8 inches.

Experiments made with care prove, that the cold had penetrated into the trees partly in direct proportion to the quantity of water which their wood contained. But much more certain results were obtained by the examination of the concentric layers of different trees, and the result was, that the cold had penetrated least into the trees whose layers were closest.

In spring, the cold often causes trees to perish, without their having been injured by it in winter. On this subject, the author apprises us that nearly all trees contain, at the beginning of April, 8 per cent. more of aqueous parts than at the end of January. Water being a better conductor of heat than dry wood, the deleterious action of cold upon trees will easily be accounted for by its greater abundance. The young branches, containing a much greater quantity of water, suffer more from cold.

The results of experiments made upon a great number of plants, with the view of discovering the quantity of water which their leaves contain, are then detailed. Trees and shrubs have much less water than herbaceous plants. If the former contain from 54 to 65 parts in the hundred, the latter contain from 65 to 70, and even 88 parts. Succulent plants present from 90 to 95 per cent. The floral leaves generally contain more watery parts than the stem leaves. The quantities of water contained in the leaves of a great number of plants are presented in a table. Another table shews a certain number of vegetables, on which observations have been made for determining the velocity with which their leaves emit their aqueous parts. The species which present the most rapid evaporation, are those which require the greatest quantity of water in vegetating. If the carices, the gramineæ, and the aquatic plants, evaporate in a short time, the large quantity of water which they contain; the succulent plants, on the contrary, give it out but very slowly, for which reason they vegetate easily in the warmest countries. The coniferæ, and shrubs with coriaceous leaves, resemble the succulent plants in respect to the slowness of their evaporation. Very interesting researches by the author have proved that the quantity of water given out by evaporation in the gramineæ, is, in a given space, in some cases, two or three times more than that evaporated by an equal surface of water. *Sedum album*, on the contrary, submitted to the same experiment, did not evaporate more than half the quantity given off by water.

In three tables, there are given inquiries respecting the thickness of the concentric layers, in 24 species of trees of the forests of Esslingen, where M. Neuffer examined them; the weight of newly cut wood, compared with that of wood carefully dried; and the specific weight of each kind of wood. The treatise concludes with a table, indicating the degree of cold which a considerable number of plants can support in our climates. Professor Schubler has made most of these experiments, and has compared them with those made in different botanic gardens. This treatise has afforded us the greatest pleasure, and we think it deserving of the attention, not only of physiological botanists, but also of agriculturists.

Naturgeschichtliche Reisen durch Nord Africa, &c. Natural History Travels in Northern Africa and Western Asia, from 1820 *to* 1825; *by* Drs Hemprich *and* Ehrenberg, *published by the latter. Historical part, with maps and views.*

In the preface, the author gives an account of the preparations for the journey, and of the persons who were useful to him. The height of Mount Sinai, as determined by thermometrical observations, is also given. The monastery is 5400 feet above the Red Sea; the summit of Mount Sinai 7400 feet; and the highest summit of the chain, St. Catherine's Mount, 8400 feet. It is to be regretted that the travellers had no barometer with them. The expedition occasioned the death of nine Europeans.

In the first chapter, the author states that, in the Adriatic and Mediterranean seas, their vessel was covered with insects carried off by the wind. Blasts of this kind might account for the winged insects discovered in an isolated state in secondary formations, as at Solenhofen. Around Castelnuovo and Cattara in Dalmatia, the mountains, of about 3000 feet high, or the Monte Negro, are composed of grey compact limestone, with veins of calcareous spar, and without fossils. M. Partsch considered them as Jura limestone, while M. Ehrenberg thinks they belong to the alpine limestone. At the base of these mountains, there are hills composed of marl and sandstone, sometimes containing impressions, and subordinate to the limestone. He does not agree with Partsch, in thinking that the islands of the Adriatic have been produced by the destruction of marly masses interposed between the limestone beds. At Trieste, a formation of breccia is at present going on under the sea. To the south of the Morea, the travellers felt an earthquake on the 29th August 1820, and afterwards saw at a distance the snowy summit of Ida in Crete. In Dongola, there is a bed of iron-ore capable of being worked.

At the cisterns of El Matar, the coast is formed of low hills of white limestone. The plain of El Matar is bordered to the south by a chain of horizontal secondary limestone, which sometimes attains a height of about 500 feet. Hills come off from them which descend to the west, towards the sea, and under the sand of the coast. The Katabathmus Minor, or Akabetes Sghire, is one of the largest of these branches. From Bir-el, Ghorallant to the S. W., they traversed an undulated plain, covered with a thin layer of sand and limestone debris, and reached the foot of the Katabathmus Major, or El Akaba el Kebire. This plain is the boundary of Egypt and the country of Cyrene ; it is 300 feet above the sea, extends to the west and south to a great distance, and is composed of strata of the same whitish secondary limestone. In passing from thence to Siwa, they had opportunities of examining the sand, which covers the plain, but is not deep, and is sometimes replaced by remains of silicified shells; among which, however, they did not find nummulites. The descent from the plain to the basis of Siwa is over seven terraces, and among grotesque rocks.

The slopes of this plain present specimens of siliceous woods near the plain of El Gatara, and in the part called Gebel Schatar, the ground is covered with a saline crust in an oasis not far from this. At Bir-Haie, there are also fossil woods and aëtites with quartz crystals at the foot of the slope of the plain. They followed the route from Siwa to Alexandria, where the ground is saline as far as Wadi Lebuk, where the sandy or rocky ground recommences. Farther on, the author found many petrified trunks of palms and of dicotyledonous plants, some of them from five to six feet long. The bark was preserved in the dicotyledones, but not in the palms. A coloured geological map gives an idea of the geological constitution of the country traversed. There are first seen the alluvia of the Delta of the Nile between Alexandria, Cairo, and Damietta. To the east, between the two last cities, the Delta is bordered with sandy and pebbly hillocks. Between the pyramids of Cairo and the Lake Mareotis, they point out to the south the dried up bed of ancient streams.

Farther to the south, between Lake Mœris and Karb-Schamamel el Scharkie, the lower desert is covered with an alluvial formation, characterized by pebbles of Egyptian jasper, siliceous woods, and nummulites, which have come from the higher limestone mountains of Egypt, and perhaps even from Mokattam. The high plain of the desert, between Bir-Lebuk, Katabathmus Parvus, the other promontory called by the ancients Catabathmus Magnus or Kasreschdacbi, Siwa and Bir-Haie, is tertiary, and composed of horizontal strata of shelly limestone, slaty clay, and gypsum. The fossils which are observed in it are different from those of the nummulitic limestones of the Pyramids and Mokattam. There are found polyparia, echinodermata, bivalve and univalve shells, but no nummulites. There is no Egyptian jasper, and little sand, unless in crevices. The Nile is bordered, from Siout or Lycopolis to Cairo, at least on its western banks, by nummulitic limestone, which there forms the eastern slope of the desert, and rises to the height of 50 or 150 feet above the river. From Siout to Kineh, Dendera, and Esne or Latopolis, the same bank of the Nile presents only Jura limestone, without fossils, and rising to the height of about 300 feet. It is well known that these heights have the appearance of having once formed an island between Farschiout, Dendera, and Luxor, at a time when the waters of the Nile were higher. Opposite Dendera, on the other bank of the Nile, the same limestone forms the heights of Birambar and Legeta, and farther on, there rise mountains of breccia and greenstone, around Maksur-el-Benat and Bir-Hamamat. To the east of Cairo, the nummulitic limestone constitutes the heights of Mokattam; and on the eastern bank of the Nile, red sandstone occurs near Cairo, not far from the town, at Gebel-Achmar, in the mountain of Gebel-Chesche on the route to Suez; and, before that city, the Jura limestone predominates in the heights, around Emschsalis-el-Bahhara, in the oase of Actahka, Touerik, and Wadi Amfuone. The Gulf of Suez is bordered to the west, from Buko to the promontory opposite the island of Jubal, by dolomitic limestone, which forms prominences of 500 or 600 feet. Limestone exists in Gebel Goaebe, Gebel Saferane, and Gebel Setie; but between the two last groups, along the coast, rises behind, to a height of 6000 or 8000 feet, the porphyritic group of Gebel Ghareb. On the eastern shore of the Gulf of Suez, there are mentioned as occurring near the sea only mountains of limestone and marl, and tertiary deposits, excepting between Scheratihb and Tor, where there is red sandstone again at the foot of the porphyritic group of Sinai. The tertiary hills rise to the height of from 300 to 500 feet. The red sandstone forms the shores of the point of Ras Muhamed, in the peninsula of Sinai. The same colour is given to the shore of Machmud to beyond Scherm el Moie. The porphyry colour occupies all the mountains between Wadi Firan, Scherm-es-Scheech, and far to the north of Wadi Bedda. The same formation reappears in Arabia, between Magne and Moile in the high Gebel Schar, a chain estimated at from 6000 to 8000 feet. The islands of the Gulf of Akaba and that of Schedoan are tertiary. Petroleum and mineral pitch are indicated at the eastern base of Gebel Setie in Egypt. Between Ras Muse and Suez is marked the passage of the Jews through the Red Sea. It is still frequented at low water, and is called Dorb el Jahudi, or the Jews' Road. This map is accompanied with profiles of the two shores of the Gulf of Suez, the islands of Sanafer, Remahn, Schusche, Maksure, Jobe, Wale, Schedoan, Jobal, and Barcan. The latter is a coral bank, while all the others are composed of a limestone which the author doubtfully refers to the tertiary class, probably on account of their recent characters. That of Tiran differs from the above, in having its principal mass composed of a tertiary marl, associated with tertiary sandstone and limestone.

On the Irritability of the Stamina of the Barberry.

M. Goeppert of Breslau, has published, in the Linnæa, July 1829, a memoir on the irritability of the filaments of Berberis vulgaris, in which he first gives an historical account of the observations made on the phenomenon in question by Linnæus, Covolo, Kælreuter, Smith, Schkuhr, Humboldt, Rafn, J. W. Ritter, and Nasse. Linnæus was first informed of it by a gardener of Montpelier, named Baal, of whom little else is known. M. Goeppert, after confirming most of the observations of authors, made three series of experiments, with the view of determining the influence of various poisonous and other substances upon the irritability of the stamina.

1. In the first experiments, he deposited clusters of barberry flowers in different substances; he then observed that prussic acid, and other concentrated acids, aromatic waters, alcohol, and ethers, destroy the irritability of the stamina more or less rapidly. Metallic salts produce the same effect, whereas the property

is in no degree altered in flowers immersed in concentrated infusions of narcotic poisons, such as nux vomica, opium, &c. This last fact is in perfect accordance with all that M. Goeppert had previously observed as to the innocuousness of narcotics with respect to vegetation.

2. In the second series of experiments, M. Goeppert brought the substances, whose influence he wished to determine, into direct contact with the stamina only. He found that pure water does not hurt the irritability of the stamina, and that the narcotic infusions already mentioned have no prejudicial effect, provided they be deprived of extractive principles. Phosphorus, dissolved in almond oil, was equally harmless. A drop of prussic acid deposited upon the flower, caused, in ten seconds, a motion of contraction in the stamina towards the pistil. Some hours after, the chemical action of the acid began to manifest itself in the plant by a more or less complete destruction of its parts. The same phenomenon is produced under the influence of alcohol, ethers, essential oils, aromatic waters, some concentrated acids, &c. None of these substances, however, stimulate the stamina with so much rapidity as prussic acid. It is hardly necessary to add, that these organs lose all irritability in this last act of contraction, and, soon after, are decomposed like the rest of the plant.

3. Lastly, M. Goeppert exposed barberry flowers to the vapours of several volatile substances. Those of the narcotic principles had no action as infusions. The vapours of hydrocyanic acid, those of mercury in the metallic state, and those of the volatile substances mentioned in the preceding experiments, by destroying the vegetable tissue, also put a stop to the phenomena of irritability.

Chronological Series of the more important Changes made upon the Coasts by the Sea, from the Eighth Century to the present day.

Year.

800.—About this period the sea carried off a large portion of the island of Heligoland, which is situated between the mouths of the Weser and the Elbe.

800–900.—In the course of this century, the coasts of Brittany were considerably altered by storms; valleys and villages were swallowed up.

800–950.—Violent storms agitated the lagoons of Venice, and destroyed the islands of Ammiano and Constanziaco, mentioned in the old chronicles.

1044–1309.—Dreadful irruptions of the Baltic sea on the coasts of Pomerania; produced great ravages there, and gave rise to the popular tales respecting the submersion of the pretended city of Vineta, the existence of which is merely hypothetical, notwithstanding the imposing authority of Kant and other celebrated philosophers.

1106.—Old Malamocco, a large city on the lagoons of Venice, was overwhelmed by the sea.

1218.—A great inundation formed the Gulf of Jahde, so named from the small river which watered the fertile country destroyed by this catastrophe.

1219, 1220, 1221, 1246, and 1251.—Dreadful hurricanes separated the present island of Wieringen from the continent, and made preparation for the subsequent disrupture of the isthmus which connected North Holland of the present day with the country of Staveren, which is at present in Friesland.

1277, 1278, 1280, 1287.—Inundations swallowed up the fertile district of Reiderland, destroyed the city of Torum, fifty towns, villages and monasteries, and formed the Dollart. The Tiam and the Eche, which watered this little country, disappeared.

1282.—Violent tempests broke down the isthmus by which North Holland was united to Friesland, and formed the Zuiderzee.

1240.—An irruption of the sea produced a considerable change in the western coast of Schleswig; many fertile tracts were swallowed up, and the arm of the sea, which separated the island of Nordstrand from the continent, was greatly widened.

1300, 1500, 1649.—Violent tempests carried off three-fourths of the island of Heligoland.

1300.—This year, according to Fortis, the city of Eiparum, in Istria, was destroyed by the sea.

1303.—According to Kant, the sea carried off a great part of the island of Rugen, and covered several villages on the shores of Pomerania.

1337.—An inundation carried off fourteen villages in the island of Kadzand in Zealand.

1421.—An inundation covered the Bergseweld, destroyed twenty-two villages upon it, and formed the Biesbosch, which extends from Gertruidenberg to the island of Dordrecht.

1475.—The sea carried off a large piece of ground situated at the mouth of the Humber: several villages were destroyed.

1510.—The Baltic Sea formed the opening of the Frisch-Haff, near Pillau, 1800 fathoms in width, and from 12 to 15 in depth.

1530–1532.—The sea swallowed up the town of Kortgene in the island of North Beweland in Zealand. In the last mentioned year, it also carried off the eastern part of the island of South Beweland, with several villages, and the towns of Borselen ad Remerswalde.

1570.—A violent tempest carried off half of the village of Scheveningen to the north-east of the Haye.

1625.—The sea detached a portion of the peninsula of Dars, in former Swedish Pomerania, and formed of it the island of Zuigst, to the north of Barth.

1634.—An irruption of the sea covered the whole island of Nordstrand; 1338 houses, churches, and towers were destroyed; 6408 persons, and 50,000 head of cattle perished. Of this island, once so fertile and flourishing, there only remained the three islets named Pelworm, Nordstrand, and Lütze-Moor.

1703–1746.—During this period the sea carried off, from the island of Kadzand, more than 100 fathoms of its dikes.

1726.—A violent tempest changed the salt-marsh of Araya, in the province of Cumana, a part of Colombia, into a gulf several leagues in breadth.

1770–1785.—The currents and storms formed a canal between the high part and the low part of the island of Heligoland, and converted that island, which, before the eighth century, was so extensive, into two islets.

1784.—According to M. Hoff, a violent tempest formed the lake of Aboukir in Lower Egypt.

1791–1793.—New irruptions of the sea destroyed the dikes and carried off other parts of the already so reduced island of Nordstrand.

1803.—The sea carried off the last ruins of the priory of Crail in Scotland.

Notice of a Memoir read by Dr Hibbert *to the Scottish Society of Antiquaries, on the Caves occupied by the early Inhabitants of the West of Europe; with illustrations of some still remaining in France and Italy.*

Dr Hibbert commenced by stating that his paper had for its object, to prove that natural caves were the temporary resort of the earliest and rudest inhabitants of Europe; that even at a more advanced stage of civilization, caves had been used for human habitations; that, in certain localities, they had afforded protection to the chiefs and vassals of the feudal times; and that even at the present day, whole villages of Troglodytes might be found in the civilized countries of the Continent. The subject of caves had lately attracted considerable notice on the Continent; but more on the part of the geologist than of the antiquarian. It had been incontrovertibly established, that, in the caves in the South of France, human remains had been found along with bones of different mammiferæ. As the particular species of animals found in this juxtaposition were now no longer to be met with, they had been assumed to be antediluvian, but upon insufficient evidence. The destruction of the forest in which they found shelter, the drying up of the lakes on the borders of which they found their food, and partial convulsions of nature, sufficiently accounted for their extinction. In this view the investigation of the caves in which human bones had been found, was as much the province of the antiquary as of the geologist. Dr Hibbert assumed as an hypothesis, that the tribes inhabiting Europe, previous to the historical times, were in a state similar to that of the Fins described by Tacitus, as leading an almost brutish life, destitute even of the earliest rudiments of the arts. Such beings might well be conceived to contend with the beasts, above whom they were so little elevated, for places of shelter they knew not how to construct; or, at all events, they might crawl like the beasts into holes, to conceal their dying agonies. At this period the bones could scarcely have been deposited in caves for the purpose of inhumation —the idea of sepulture belonging to a more advanced state. The rude fragments of earthenware found in the same caves, strengthen the conjecture that the bones belonged to an extremely rude and early period. The Celtic and Gothic tribes who supplanted the aborigines of Europe, seem to have reached the agricultural state. The Germans are described as inhabiting houses built of gross and unhewn materials, constructed without the aid of mortar, and also caves, into which they retired for shelter from the inclemency of the winter, or from the attacks of a powerful enemy. Traces of these ancient subterraneous habitations are still to be met with in Germany, but much more frequently in France and Italy, where the nature of the rock is in general more favourable to the task of excavation. They are most numerous in the south of France. Each cave appears to have been entered by a low chink or fissure, situated almost half way between the floor of the cave and its roof, and differing as little as possible from the level of the avenue by which it was approached. The entrance seems intended to have been closed, from the invariable presence of a narrow opening, reaching the external air in an oblique direction for the purpose of ventilation. Sometimes these caves are insolated, sometimes they are found in groups. It has been conjectured by French antiquaries that these are the *latebræ* of the Roman historians, in which the Gauls so often eluded pursuit, and re-appeared as suddenly to harass the enemy. Dr Hibbert next proceeded to remark that these caves continued to be used even during the feudal period. At Ceyssac, in the province of Velay in France, the castle of the lord crowned the summit of a hill, all of which was excavated into caves, that seemed either to have been used as chambers, or to have contained regular stalls for horses, and one has evidently been employed as a chapel. The entrance and lower apartments of a castle which flanks Mont Perrier, in Auvergne, has been scooped out of the solid rock; and on the opposite eminence is a system of grottoes, which served for the abodes of the retainers. At Conteaux, in Velay, is a system of caves, one of which, apparently the baron's hall, is twenty yards long, by six and a half broad. Attached to it is a kitchen, opening to the top of a superjacent terrace, and almost as spacious as the famous one of the Abbot of Glastonbury. Among the caves of Roche Robert is a hall twenty yards by five, lighted by a well-shaped window. The period when these caves were abandoned by their feudal proprietors cannot be ascertained. They became subsequently the haunts of banditti.

The next portion of the memoir was intended to shew that, even in the present day, whole villages of Troglodytes were to be found even in the civilized countries of Europe. In the neighbourhood of Bagnovea, in the Pope's territories, is a village, of which an Italian traveller has observed, that a few stones for the purpose of closing the entrance of the cavern, a hole for the smock to go out of, and an aperture to admit the light, suffice to complete each habitation. In the Island of Ponza, near the Bay of Naples, is another town of the same kind, the inhabitants preferring to reside in caves, although the island abounds with the best materials for building. The caves are described as being refreshing in summer, warm in winter, and without the least humidity. In France, many villages of inhabited caverns still exist, as at Cuzolo in the Cantal, at Mount Perrier in Auvergne, and many other places. Swinburne has described a village of the same kind, which occurs in the provinee of Andalusia in Spain. In Transylvannia, the places which the nomadic gipsies inhabit during the winter, ought to be called holes or burrows, rather than caves, which, for farther security from the weather, are covered over with branches of trees, with moss and turf. Dr Hibbert concluded his memoir by recommending the history of European, and particularly of Scottish caves, to the attention of the Society; and by describing the geological formation in which the search for them was most likely to be attended with success.

NEW SOCIETIES.

1. *Geographical Society of London.* 2. *Geological Society of France.* 3. *Statistical Societies in France.*

1. *Geographical Society of London.*

We are happy in having an opportunity to lay before our readers, the following interesting document, in regard to a projected Geographical Society in London. Such an institution will, we feel confident, assist in raising the scientific character of Geography in this country, where at present it is too much in the hands of popular and unscientific writers. It will also excite a more decided taste for geographical researches among geologists, zoologists, botanists, and also those travellers who visit countries, not with the view of gossip, or the sheer greed of the little money which may be extracted from a publisher, or for the purpose of personal exhibition, but with the desire of enlarging our knowledge of the physical, statistical, and moral condition of different and distant lands.

"At a numerous meeting of the Members of the Raleigh Travellers' Club, and several other gentlemen, held at the Thatched House, on Monday the 24th May, John Barrow, Esq. in the Chair, it was submitted, that, among the numerous literary and scientific societies established in the British metropolis, one was still wanting to complete the circle of scientific institutions, whose sole object should be the promotion and diffusion of that most important, useful, and interesting branch of knowledge, Geography: That a new Society might therefore be formed under the name of The Geographical Society of London: That the interest excited by this department of science is universally felt; that its advantages are of the first importance to mankind in general, and paramount to the welfare of a maritime nation, like Great Britain, with its numerous and extensive foreign possessions: That its decided utility in conferring just and distinct notions of the physical and political relations of our globe must be obvious to every one; and is the more enhanced by this species of knowledge being attainable without much difficulty, while at the same time it affords a copious source of rational amusement: That, although there is a vast store of geographical information existing, yet it is so scattered and dispersed, either in large books that are not generally accessible, or in the bureaus of the public departments, or in the possession of private individuals, as to be nearly unavailable to the public.

The object, then, of such a Society as is now suggested would be, 1. To collect, register, and digest, and to print for the use of the members, and the public at large, in a cheap form and at certain intervals, such new, interesting, and useful facts and discoveries, as the Society may have in its possession, and may from time to time acquire. 2. To accumulate gradually a library of the best books on Geography—a selection of the best Voyages and Travels—a complete collection of Maps and Charts, from the earliest period of rude geographical delineations, to the most improved of the present time; as well as all such documents and materials as may convey the best information to persons intending to visit foreign countries; it being of the greatest utility to a traveller to be aware, previous to his setting out, of what has been already done, and what is still wanting, in the countries he may intend to visit. 3. To procure specimens of such instruments as experience has shewn to be most useful, and best adapted to the compendious stock of a traveller, by consulting which, he may make himself familiar with their use. 4. To prepare brief instructions for such as are setting out on their travels; pointing out the parts most desirable to be visited; the best and most practicable means of proceeding thither; the researches most essential to make; phenomena to be observed; the subjects of natural history most desirable to be procured; and to obtain all such information as may tend to the extension of our geographical knowledge. And it is hoped that the Society may ultimately be enabled, from its funds, to render pecuniary assistance to such travellers as may require it, in order to facilitate the attainment of some particular object of research. 5. To correspond with similar societies that may be established in different parts of the world; with foreign individuals engaged in geographical pursuits, and with the most intelligent British residents in the various remote settlements of the Empire. 6. To open a communication with all those philosophical and literary societies with which Geography is connected; for as all are fellow-labourers in the different departments of the same vineyard, their united efforts cannot fail mutually to assist each other. 7. And lastly, in order to induce men of eminence and ability in every branch of Science, Literature, and the Arts, and in particular those who have travelled by sea and by land, and all such as are skilled in geographical knowledge, and likely to become useful and efficient members, it was suggested that the admission fee and annual contribution should be on as moderate a scale, as, with the number of subscribers calculated upon, would be sufficient to enable the Society to fulfil the important objects herein alluded to.

The meeting then proceeded to nominate the following gentlemen as a *Provisional Committee*, to draw up certain leading principles, as the groundwork on which such a society may be established.

The Hon. Mountstuart Elphinstone.
Lieut-General Sir Thomas Macdougal Brisbane, K. C. B.
Sir Arthur De Capell Brooke, Bart.
John Cam Hobhouse, Esq., M. P.
Robert William Hay, Esq.
Colonel Leake,
Robert Brown, Esq.
Captain Beaufort, R. N.
Captain Basil Hall, R. N.
Major The Hon. George Keppell.
Henry Ward, Esq.
Lieut.-Col. Colby, R. E.
Thomas Murdoch, Esq.
Commander Mangles, R. N.
Roderick Impey Murchison, Esq.
Captain Sir John Franklin, R. N.
Captain Smyth, R. N.
John Barrow, Esq.
George Bellas Greenough, Esq.
Commander M'Konochie, *Provisional Secretary.*

At a meeting of the above-mentioned Committee, held on the

26th May, the following resolutions were agreed to. 1. That the Society be called the Geographical Society of London: 2. That the number of ordinary members be not limited; but the number of honorary foreign members to be limited as hereafter shall be determined. 3. That, as soon as the number of Subscribers shall amount to three hundred, a general meeting be called to appoint a President, two Vice-Presidents, a Treasurer, Secretaries, and a Council, to conduct the affairs of the Society; and for approving, altering, and, if necessary, establishing such other regulations, in addition to those herein recommended, as may appear to be necessary to the well-being of the Society. 4. That the election of the Council and Officers of the Society be annual. 5. That the office of President be not held by the same individual for a longer period than two consecutive years; but that he be eligible for re-election after the lapse of one year. 6. That the two Vice-Presidents be subject to the same regulation as regards the President; but the Treasurer and the Secretaries may be re-elected. 7. That the officers above mentioned, with fifteen other members, constitute the Council, and that five of the fifteen are to go out annually at the period of the general election of the officers of the Society. 8. That the admission fee of members be L. 3, and the annual subscription L. 2; or, both may be compounded on for the payment of L. 20. 9. That all admission fees and compositions be placed in the public securities, to be hereafter applied as the Society may direct. 10. That the funds and property of the Society be vested in the names of three Trustees. 11. That these three Trustees be supernumerary Members of the Council. 12. That so soon as five hundred members shall be entered on the list, a second general meeting will be called to decide upon such further regulations and by-laws as shall appear beneficial and useful for the management of the Society. 13. That Commander M'Konochie, R. N., be appointed *Provisional* Secretary to the Society. ARTHUR DE CAPELL BROOKE, *Chairman.* Those who may be desirous of becoming Members of the Geographical Society of London are requested to send their names to any of the gentlemen of the Provisional Committee, or to the Secretary, No. 99. Quadrant, Regent Street."

2. *Geological Society of France.*

A Geological Society has just been established in Paris, under the name of the Geological Society of France. Cordier is President; Vice-Presidents are Brongniart, Blainville, Prevot, and Brochant; Secretaries, A. Boué and El. de Beaumont; Vice-Secretaries, Desnoyers and Dufresnoy; Treasurer, Michelin; and Archivist, De Roissy. Already one hundred members have been enrolled. Among these many Frenchmen, also geologists of Prussia, England, Holland, Italy, South America, &c. The following laws or regulations of the Society have been ordered for circulation :—1. The Society assumes the title of "Geological Society of France." 2. Its object is to aid in the advancement of geology in general, and in particular to make known the geology of France, and its relations with the arts and agriculture. 3. The number of members not limited; foreigners as well as Frenchmen admitted: no distinction of members into honorary, &c. 4. The administration of the Society committed to a Board and Council. 5. The Board consists of the President and four Vice-Presidents, two Secretaries, two Vice-Secretaries, Treasurer, and Keeper of Archives. 6. The President and Vice-President chosen annually; Secretaries every two years; Treasurer every third year, and the Archivist every fourth year. 7. The Council consists of twelve members; of these four go out annually. 8. The Members of Council and Board, with exception of President, are chosen by a majority. 9. The President is elected by a plurality among the four Vice-Presidents of the preceding year. 10. The Meetings to be held in Paris from November to July. 11. Extraordinary Meetings from July to November. 12. Society to contribute to the advancement of geology by its publication and its bounties. 13. A periodical bulletin of the labours of the Society to be delivered gratuitously to each member. 14. The Society to form a Library and Museum. 15. The gifts to the Society to be inserted in the Bulletin, with names of the donors. 16. Each member to pay as entrance-money 20 francs; annual contribution 30 francs: any member may compound by paying 300 francs.

We are informed, that during the meetings a general view is taken of the geological labours of other Societies during the previous fortnight (the Society to meet every fortnight). On particular days geological subjects proposed by the members are discussed, and memoirs are read. A publishing Committee is entrusted with the charge of publishing speedily extensive memoirs and maps, and separately. Each memoir will have two paginations, one for the memoir, and the other for the volume: by this arrangement memoirs cannot remain long unpublished, and the memoirs will form a series of volumes.

3. *Statistical Societies in France.*

Two Statistical Societies have lately been established in France, one by the celebrated Cæsar Moreau, in which we find as members many of the higher ranks in Paris; the other under the direction and auspices of that active, enterprising, and accomplished person the Baron Ferrusac. The Society of Ferrusac is divided into seven sections. 1. Civil Arithmetic. 2. Physical Geography, and Natural Resources of the Soil. 3. Political Geography, Public Works, &c. 4. Medical Topography, Public Salubrity, Charitable Institutions. 5. Agriculture and Rural Economy. 6. Manufactural Industry. 7. Commerce. The central commission is composed of 65 members, and the whole Society already consists of 100 members. The Society has had already six meetings.

Observations on the Cause of the Spouting of Overflowing Wells or Artesian Fountains.

According to some philosophers, the theory of the spouting waters of Artesian springs has been referred, sometimes to that of *jets d'eau*, and sometimes to that of syphons, a bored well being, as they say, only the second branch of a large syphon, of which the first branch is the subterranean course, between impermeable strata, followed by the compressed waters coming from a higher country than that in which the bored well has been formed.

According to others, such a well can only be considered as a tube, which shows the pressure of water upon an earthy or stony stratum, at which the bored well terminates.

Mr Dickson of New Brunswick, after showing that, by means of bored wells, water may be procured in any place whatever, and that it will rise to the surface of the earth, independently of all gravitating pressure, says, that masses of water, precipitated into the abysses of the interior of the earth, are thrown out to its surface by an innate expansive force, through the action of the central fire; and again admits, as a second cause for the ascent of water, the effect of capillarity,—forgetting that, if this action could bring subterranean waters to the surface, it yet could not make them spring beyond it.

According to M. Azais, the springing of the water of bored wells seems to be unamenable to any common law, and can only be accounted for by the universal principle of expansion: "For," says he, "every body which contains in its central parts an expansive focus surrounded by envelopes of greater or less thickness or condensation, is a body in *a state of resilience*, that is, in a state of continued effort against the resistance of these envelopes. It incessantly labours to drive them outwards, to break and dissolve them; and not being able to do this, it at least exercises its expansive action upon the internal substances, agitates them, divides them, attenuates them, and projects them as much as it is possible for it through the pores of the external envelopes. This action of *resilience* and *transpiration* is in nature the first and essential *vital action*." After distinguishing three kinds of transpiration, viz. 1*st*, the *vital transpiration*, which emanates from the central regions of our planet, and projects outwards by radiation the subtile fluids, such as *caloric*, the *magnetic fluid*, *electricity*, &c.; *2dly*, the *middle transpiration*, which emanates from the intermediate regions, and projects, under a vague and semi-impetuous form, the various gases of which the mass of the atmosphere is composed; and, *3dly*, the *weak* or *indolent transpiration*, which emanates from the layers nearest the envelope, a *soft transudation* like *sweat*, and under an *aqueous* form, M. Azais says, that, like the blood, which, through the impulsion of the central focus, is continually making an effort to exhale, by supplying our habitual transpiration, and which springs out the moment the lancet has burst the envelope which retained it, the central water springs out under the borer in obedience to the universal principle of expansion *.

In his *Recueil Industriee Manufacturier*, M. Moleon has inserted an article on the Essay published at New Brunswick by Dickson, which had been communicated to him by one of his London correspondents. This correspondent says, that, without profoundly examining the question, he ventures to assert, that, in his opinion, the waters which spring from a depth of 400 or 500 feet (of which there are examples in England, in parts at a great distance from any hills of a similar height), are not the product of infiltrations from above, which feed small springs and wells, but that these wonderful and inexhaustible jets are projected by great subterranean arteries, which are acted upon by great reservoirs of air which the earth contains, and which are often met with in boring. The author of this article rests his opinion, 1*st*, on the disengagement of hydrogen gas which took place during a boring in America †; 2*dly*, on the vacuities which are often met with in forming wells; and,

* On this subject, M. Azais, after observing that in the globe, taken as a whole, each of the three modes of transpiration always preserving the same measure, there always emanate from it the same quantities of subtile fluid, gases and water; whence it follows, that, wherever the aqueous transpiration is precipitated, by the aid of a bored well or a bleeding, a local intensity is given to it, by which there is drawn off a more or less extensive mass of the aqueous transpiration, which, in ordinary cases, makes its way slowly, with difficulty, and under a very divided form by the pores of the envelope. Thus there is substituted a small, but rapid and continued torrent, for a vague and confused fumigation, occupying much more time and space. Now, it is extremely probable that this fumigation through the pores of the envelope is the principal food of plants. The large trees especially, the magnificent forests, which no external drought can wither, have, without doubt, the mouths of their roots open towards the aqueous transpiration, which ascends towards them from the interior of the earth. This vital source of vegetation would be cut off, or at least greatly diminished, were too many vertical fountains opened in their neighbourhood, and in the ground which bears them.—*Unpublished Memoir on Artesian Wells, by M. Azais.*

† This boring was made at the bottom of a dry well in the brewery of Messrs Bord and Collok, at Albany. This well was in depth ...... 30 feet.

The sound passed through gravel and clay, ...	11
Black slate,...	41
Carry over,...	82

3dly, on the circumstance that the quantity of spouting water is not diminished, when several wells have been bored quite close to each other, which induces him to think that the pressure of the air must there be the cause of motion.

The workings of mines and quarries have shown, that, in certain kinds of ground, the waters spread out into veins, stripes, brooks, and even sometimes torrents, running through the cracks, fissures, and natural perforations of the interior of the rocky strata *; while, in other kinds of ground, they form sheets or expanses of various extent, in beds of sand, earth or permeable stones,—and the moment the upper stratum is perforated, they rise and spring out with greater or less rapidity, until they have attained the level from which they come.

Such is the basis of our theory of the spouting of subterranean waters: it is merely the result of what we daily see in the workings of mines. It is the application of the theory of *jets d'eau* and syphons. It is, in fine, so simple, and so natural, that it is hardly possible to offer one more satisfactory.

The thermal waters which rise to the surface from the interior of primitive formations, owe their springing to the disengagement of compressed gases which react upon the surface of these waters, in the same manner as vapour acts upon the water in the Eolypile.

Brought over,...	82 feet.
At this depth of 82 feet water was found; but as it was not abundant, the boring was continued.	
Black slate, ...	168
	250
At the depth of 250 feet there was a plentiful disengagement of hydrogen gas in the black slate, ...	32
	282

At the depth of 282 feet the water sprung up to the height of four feet above the surface of the ground.

* The quarries of Paris, and, in general, all large quarries, present frequent examples of vestiges of subterranean brooks or currents now dry, which must formerly have traversed the limestone mass at different heights, by means of the fissures and tortuous cavities which intersect it in all directions.

The springing of cold mineral gaseous waters may be assimilated to that of the compression fountain.

The circumstances of springs which flow out upon the declivities of hills, nearly at a constant height in stratified countries, and particularly in those composed of alternate layers of sand and clay, establish and characterize that disposition of water which we have said to be in sheets, and whose origin is due either to subterranean effusions coming from higher countries, or to infiltrations of snow and rain water arrested by these claybeds.

This sheet of water has been likened by Professor Hachette * to a layer of ice of a similar form to a layer of clay, sand, or chalk. If the water is considered as occurring there between two curved surfaces, such as two sections or basins of different diameters, whose upper edges are in a plane, or irregularly indented, or partly closed, the liquidity of the water is the cause of the pressure which the tube of the bored well measures; but if, in place of a sheet of fluid water, there be supposed a layer of ice, the pressure would resist, and would not be indicated by the tube, and it would be changed in its power of cohesion.

Whatever be the manner in which water spreads under ground, in descending from higher to lower grounds, whether in sheets or in veins, stripes or torrents, when it happens to meet with an issue of any kind in the ground, it insinuates itself into it, and rises to a height corresponding to the level of its point of departure, or rather to a height which balances the pressure which the water exercises against the walls of the canal which contain it †. Hence arise the spouting fountains or natural jets-d'eau, which occur in secondary formations.

Whence it follows, that, to obtain a spouting fountain, we must, 1st, Try, according to the nature of the ground, at a greater or less depth, to reach a flow of water coming from higher basins, and passing along, in the bosom of the earth,

* M. Hachette, Considerations sur l'ecoulement des liquides.

† Memoir by M. Barrois, on Bored Wells: *Societé des Sciences de Lille*, 1825.

between compact and impermeable rocks; 2dly, Afford this water, by means of a well artificially bored, the possibility of rising to a height proportional to that of the level from which it comes; and, 3dly, Prevent, by tubes inserted into the bored well, the spreading of the ascending water in the surrounding sand, or in the cracks and fissures of the rocks traversed by the bore.

From this it will be seen, that spouting springs may be obtained by means of boring, in almost every country that presents in its interior subterranean sheets of water, between the alternating and continuous beds of permeable and impermeable deposits, extending to the country or mountains which contain the reservoirs of these water-sheets, and whose bases or slopes are covered by these beds.

But it is essential to repeat here, that we must not expect to find wells of this description everywhere, as has been thoughtlessly asserted; for, on the one hand, the nature of the ground sometimes absolutely prevents it, as in granite districts; and, on the other hand, it is possible that a perforation, made even at a very small distance from a bored well affording water, may not yield any, should the latter, for example, be fed by a subterranean current, in place of being supplied by a sheet of water, or should the perforation be made upon the extremity of a basin with inclined strata resting upon a formation of a different nature.

We shall not here enter upon any details respecting the art of boring artesian wells, such not being our object. M. Garnier's *Manuel du fontenier-sondeur* contains all that can be desired on the subject.

Taking a general view of what we have said, we deduce the following consequences, which we believe to have been sufficiently demonstrated.

There exist great subterranean sheets of water at various depths. These sheets are more commonly met with in the plane of superposition of strata of different formations. They however frequently occur at various heights in the great masses, such as those of clay, chalk, and even marine limestone containing cerithia, when these masses are entire, and of great thickness.

According to the slope, the undulations, or the declivity which are presented by the plane of superposition of the permeable deposits in which the waters flow between impermeable strata, these great sheets of water are met with at all depths; but it is impossible to lay down any constant rule with respect to them.

In order that these waters be capable of ascending, it is necessary that the formations among which they occur be entire, in the state in which they were originally deposited, and that they be not intersected by large valleys, or deep ravines, in which the waters would find a free and easy exit.

It would be in vain to search for springs in deposits which, at no great distance from the place of boring, are intersected by deep valleys, or when the formations are internally cracked, filled with tortuous separations, and greatly disturbed, whether by the contraction attending the desiccation of the mass, or by internal shocks, swellings or earthquakes; or, lastly, when these neptunian formations, such as plastic clay, chalk, oolite and shell-limestone, are raised up, and present precipices at the surface, as is the case, for example, with the plastic clay at Issy, Vauvres, Auteuil and Passy, and with the chalk at Meudon, Sevres, Auteuil, Bongival, &c.

In these different localities, we need not expect success in boring for springs, unless by penetrating deeply into the mass of the chalk, in search of the sheets of water in its lower part, or even by traversing it entirely, in order to come upon those in the clays, oolites, and shell-limestones; or, lastly, unless by penetrating deeply into the latter, when they happen to be raised to the surface, and present cliffs, or are intersected by valleys of greater or less depth.

On this subject it is necessary to observe, 1st, That if in a country composed of elevated plains, such as those of Champagne, Normandy, Picardy and Beauce, or any other of the same nature, or of similar formation, in place of boring to the necessary depths for reaching the different water-sheets which are commonly the most abundant, and, at the same time, those which rise highest, the boring is stopped at higher levels less distant from the surface, it is more than probable that, in that case, the ascending waters would stop more or less *beneath* the surface of the ground, according to the depth of the borings.

Then also, so far from considering the operations as having failed, because in this case the water does not rise above the surface, we are of opinion that, according to the localities and the nature of the ground, steps might be taken to remedy the deficiency.

Thus, for example, when the water of a boring only rises to within a certain number of yards from the surface, but in sufficient quantity, it might be conducted from the point to which it reaches, by a small gallery, into some neighbouring well, or into one dug on purpose, and there might thus be produced a kind of artificial fall, which might be employed to make the water ascend to the surface of the ground, and even beyond it, by employing for this purpose either a hydraulic engine (belier hydraulique), which would always give a third of the volume of water, or a wheel, which might be placed at the point of the fall, and which, working a pump suitably placed, might raise the third, or perhaps even the half of the volume of water, or, in short, any other hydraulic machine of the kind. But these means would be practicable, only in so far as the wells into which the waters should be precipitated, might not allow them to run off into strata of permeable deposits.

In concluding these considerations, and the consequences which we have deduced from them, we shall mention the circumstances which it is necessary to examine and appreciate before resolving upon boring a well.

1st, It is necessary to examine the physical constitution, or the nature of the ground, and the disposition of the surface of the country, with reference to the mountains which overlook it, the valleys by which it is intersected, and the springs which rise in these valleys. The latter it is particularly necessary to examine, before deciding upon boring a well, as many of them are real natural wells.

2dly, It is of importance to select a fit person for boring, the art not being merely mechanical, and such as can be practised by any borer *.

* A borer who has no experience may entirely fail in the operation confided to him; and such an occurrence may suffice to prejudice a whole country against bored wells, if it be the first time that they have been tried in it. Too frequently the borers are nothing but common labourers, who follow a

Lastly, Besides attending to these circumstances, it is necessary to be possessed of perseverance and courage, which will lead us to disregard the delays and difficulties often unavoidably connected with the operations of boring.—*Hericart de Thury.*

Observations on the Snake called Yellow Tail (Coluber flavicolis, Linn., *belonging to the division of Cerberus of* Cuvier*), and on the supposed power of Fascination in Serpents.* By Dr J. Hancock, Corresponding Member of the Zoological Society, and of the Society of Arts for Scotland, &c. &c. (Communicated by the Author.)

I have examined several specimens of this serpent, and the following are some of the results of my observations.

The head is rather small, oblong, angular, and pointed, and has large scales; two rows of fine teeth on each side the upper jaw, and one row on each side the lower. It has 211 abdominal

blind routine, and are apt to be discouraged, when in a different country they do not see the sound bringing up the kinds of earth and stone to which they have been accustomed. The levels of water, and the manner of determining their rise, are often unknown to them. Sometimes by their haste to sink the tubes, they prevent the sheets of water from ascending to the surface; and they are frequently discouraged, because they do not find succeeding each other the formations in which they have been accustomed to see water springing. Lastly, some of them having no knowledge of the art, have been seen exposing their workmen, without any precaution, in the bottom of deep wells, where they run the greatest risk when they approach impermeable beds covering the sheets of compressed water. These waters sometimes coming from distant and very elevated reservoirs, often rise at the very moment of boring, in such quantity and with such impetuosity, that the workmen scarcely have time to ascend to the surface, and have even perished before they were able to give any signal of distress. Frequently the irruption of the compressed waters is accompanied with a disengagement of air, which escapes with such noise and impetuosity, that the workmen are thrown over, and others have compared the effect of this disengagement of air to a violent blow upon the body or arms. It is this disengagement of air which has led some persons to think that the ascent or springing of the water of bored wells is owing to the pressure of the atmospheric air in great subterranean cavities. If this cause be admitted for the rising of water at the very moment when the impermeable stratum is perforated, it remains to be examined why, the air once disengaged, the water continues to spring, although it no longer undergoes pressure from the air.

scuta, and 69 pair of subcaudal scutella; the back is dark grey, and the hind part yellow. It grows to 7 or 8 feet in length.

One of these serpents had 204 abdominal scuta, 68 pair of subcaudal scutella, and two longitudinal cavities behind the vent, probably the receptacles of the ovaries?

Another had 206 abdominal scuta, with 2 whole scuta, and 76 pair of half scuta under the tail, which was yellow, long, and tapering, one-fifth of the whole length, the snake being 5 feet long.

The tail, being constantly of a deep yellow colour, forms the most distinctive character and appropriate name possible for this serpent.

I have, in several instances, observed both whole and half scuta behind the vent in this serpent (as occurs in the kind with 206 abdominal scuta), as also in some individuals of the rattlesnake. In the boas, also, we find this variation occurs not unfrequently. I, therefore, consider the *modern* distinction of "Pythons," so far as depends on this character, as altogether nugatory, and an affectation of novelty only calculated to augment the confusion of an almost unintelligible jargon. This character I find to be common in serpents of the most opposite and contrary natures possible *.

Being told, in 1815, by Captain Mackenzie of Demerara, that he had killed a snake on the shore of the Orinoko, of the kind mentioned by Mr Bunting of Pomeroon, with horns or ears, as Mackenzie called them, the horns being contractile, and projecting about an inch and a half, having a long tapering yellow tail, and brown body; and having had a similar account from Mr John Brumwell, of a serpent approximating very nearly in appearance to the snake called Yellow Tail in Demerara, with the

* Since my stay in London, I have examined some living Pythons, so called, from Java and Ceylon, and I find them to approximate very nearly to the Boa Constrictor, or *Conluconaru* of Guiana. The Conluconaru and Camudi have each a pair of nails or claws, *i. e.* one on each side of the anus, and so have all the other species of Boa, so far as I have had opportunities of observing. It appears, however, that in the female these claws are much less developed than in the male, and in some are scarcely visible without dissection. This appendage appears to be the most certain and constant characteristic of the Boa kind, and we know of no poisonous serpent, I believe, possessing this character.

exception of the peculiar appendage above mentioned, I was led to investigate it further, and took the opportunity, for this purpose, of examining one of these serpents killed at St Ann of the Orinoko.

Observing then that the eyes were sunk so deep in their sockets as to impede the animals seeing in a direct line before, the idea occurred to me that it must possess the power of pushing them out at pleasure, and that it might be this circumstance which had given rise to the idea of the horned snake.

To ascertain whether the animal had this supposed faculty, I passed an instrument through the arch of the jaw into the orbit, and, with much facility, pushed forward the eyeball about an inch from the head, without using any force. I then observed a muscular coat, or strong membrane, attached laterally to the tunic, which envelopes the globe of the eye, and on withdrawing the instrument, the eye again retired into the head by the retraction of the muscle; their eyes being, by this mechanism, rendered both protractile and versatile, enabling them to see at once in every direction, and especially to escape the fangs of the rattle-snake, which is said to be their mortal enemy.

I feel strongly persuaded, therefore, that it is identically the yellow tail, or, at least, a variety of it, with *pedunculated* eyes, which has been taken for a horned serpent, or with moveable horns, all of them agreeing that it carries the horns in and out of its head occasionally. Finally, it seems to me a construction of sight in this serpent similar to that of crabs, and that that which has been taken for horns is no other than the organs of sight, thus formed by the allwise Author of Nature for some particular purpose unknown to us.

I intended to have made further inquiries, after my return to Demerara from the Orinoko, respecting the peculiarities of this *horned* or *stylephorus* serpent, but have hitherto neglected it.

An old friend of mine (Mr Thomas of the Kitty Estate, Pomeroon) having killed a yellow tail, on going out to see it, I observed all the fowls, Guinea birds, and turkeys in the yard, assembled around, and approaching close to the dead snake to examine it, timidly chirping in a low feeble note, the nictitating membrane drawn over their eyes, and seeming, as it were, half deprived of animation. Had the animal been alive at the time, it might easily have made a prey of one of these birds at least.

It appears to me that that property of serpents which has obtained the name of *fascination*, does not exclusively belong to any certain species, but that it is in some measure common to all the serpent race; and that there are a few of the more subtile and cunning ones, who know how to improve by their natural endowments, and to turn those powers to advantage in their predatory pursuits.

I am decidedly of opinion, from the observations I have been able to make, as well as from the testimony of others, that there is in reality no such property as fascination in serpents. It is not a faculty of charming or of fascinating, in the usual acceptation of the term, which enables certain serpents to take birds; but, on the contrary, their hideous form and gestures, which strikes the timid animals with impressions of horror, stupifying them with terror, and depriving them of their proper sensations, which renders them unfit for any exertion.

How, indeed, is it possible that a form so terrific and forbidding as that of the crotalus, should be possessed of a power to render itself agreeable or inviting. It is, on the contrary, natural to suppose that it is the *terrifying*, not the *charming*, principle by which serpents of the most disgusting or hideous forms are most successful in taking birds; and this we find to be actually the case, for those serpents to which has been ascribed the power of fascinating, are among the most terrific of the tribe.

The torpedo benumbs its prey with an electrical shock; but the serpent disables the more timid birds by the mere presentation of its horrible front. The one hurtful or destructive agent is communicated by the touch, or some conducting medium, as water, and acts with energy upon the muscular fibre; the other finds its way by the organ of vision, and exerts its influence upon the sensorium commune or brain, and thence paralyzing the whole nervous and muscular system. No wonder than these small birds, so feebly constituted, and the most sensible perhaps of all animals to impressions of fear, should fall insensibly into the devouring jaws of their terrific adversary.

Thus the fascinating power attributed to serpents, if properly viewed, falls entirely to the ground. It is not the timid little bird or rabbit alone which are thus overcome, but the larger animals also, and even man in some instances. An occurrence of this kind is related of a Negro, belonging to Mr John Henley, who, in the swamp of Pomeroon, fell in with a serpent of great magnitude, as the Negroes asserted, and was so dreadfully terrified that he fainted away, and was picked up for dead by his companion. The serpent was said to be a camudi (Boa Scytale), and might have made an easy prey of the man, but was over-gorged. They rarely, however, attack man, unless much provoked.

Providence has so mercifully ordered it, that serpents of mortal venom are very slow to bite; they must first be much irritated. It is a rare occurrence that an Indian is bitten by the bush-master or rattlesnake; when this happens, however, they seldom attempt a cure, as they consider it absolutely impossible, and the unfortunate patient dies in a short time.

Some of the inland tribes, however, have a method of obviating the fatal effects of their bite, by scarifying the wound, immediately applying the mouth, and diligently sucking it, squeezing the bitten part from the bottom, so that both the force of suction and pressure are exerted at the same time. Some use withal, salt, honey, juice of the aristolochias, &c.; however, without the scarifying and suction, nothing would avail in these cases.

There is also a spinose species of solanum, called Burabara, which is reputed at Demerara, and among the Indians living near, to be an antidote; as also the root of the arum, called Labaria Plant *, the stem of which is spotted like the snake of that name, and there are many other reputed remedies of this sort.

I was informed at Angostura, that the bark of the Chapara Manteca (*Malpighia crassifolia*), the bark of which is very thick and astringent, is among the best or most certain remedies as an antidote, bruised and applied to the wound, and the decoction or infusion taken inwardly. M. Machan said the cascabel or rattlesnake was very numerous on his estate, to the southward of the Orinoko, and very frequently bit and killed animals, and

* This appears to be the *Dracontium polyphyllum* of Linn.

that the remedy there is the bark of the chapara*. He also said that the bark of the alcornoco is a good remedy.

In the Orinoko, cats are said to be a mortal enemy to the serpent tribe; that they kill the crotalus, and even the coral snake, which is considered by the Spaniards to be very poisonous, though, I believe, it is harmless; and it is said are not unfrequently killed in a conflict with the former. I was told that, on some of the Llanos, where rattlesnakes abound, cats are frequently kept for this purpose by the inhabitants.

* He added at the same time, that this bark, as well as that of the Alcornoco, is esteemed a *grand remedy* for abscesses in the lungs. They are both powerful astringents.

Description of several New or Rare Plants which have lately flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden. By Dr Graham, Professor of Botany in the University of Edinburgh.

10*th June* 1830.

Brachystelma crispum.

B. *crispum;* foliis elliptico-lanceolatis; corollæ laciniis tubo duplo longioribus, pedunculis sæpius aggregatis.

Description.—*Tuber* (4 inches in diameter) round, flattened, slightly depressed; in the centre is a rugged crown or neck, divided at top, and permanent, about ½ or ¾ of an inch high, from which the stems spring when the plant begins to vegetate. *Stems* several, slightly flattened, ascending, much branched, forming a dense round tuft (in the specimen described 6 inches high and 10 inches broad), covered with short glandular pubescence. *Leaves* opposite, decussating, elliptico-lanceolate, dark green in front, paler behind, covered on both sides with glandular pubescence, crisped, on short petioles, with a strong middle rib and few veins prominent behind; at the flowers, the pairs occasionally approach, so as to give the appearance of a 4-leaved verticel. *Peduncles* (nearly ¾ths of an inch long), simple, rarely solitary, generally aggregated, situate on the side of the stem between the leaves, 2 or more frequently agglutinated together in the luxuriant specimen described. *Bracteæ* small, awl-shaped, at the base of the peduncles. *Calyx* small, 5-parted, pubescent, segments awl-shaped, and very much resembling the bracteæ. *Corolla* monopetalous, pubescent within, naked without; limb 5-parted, plicate, occasionally twisted, forming to the bud an angular blunt beak (about an inch long), of the same colour as the back of the leaves, segments afterwards spreading wide, their edges revolute, upper surface of dark olive-green; faux devoid of pubescence, yellow, especially on the inside, crowded with deep purplish-brown, oblong, transverse spots, which, on the outside, are fewer and more rounded; tube campanulate; crown deep purple, included, monophyllous, with five teeth, which are connivent over the stigma. There is an emarginate erect border on the outside of each, and between them five pits, over which are placed the truncated *stamens*, each having two distinct pollen-masses, and a depending, central, double beak. *Germen* of two smooth, green, conical follicles, each with many *ovules* attached to their inner side. *Stigma* common to both follicles, large, flat, white.

Several bulbs of this plant were collected in Southern Africa, by Mr Bowie, and sent, with many other roots, in spring 1829 to Mr Neill, in whose stove at Canonmills it flowered last month. It approaches *Brachystelma spathulatum*, Bot. Reg. t. 1113, but it seems to me to be evidently distinct. Mr Neill has received another plant, which has not yet flowered, from the same quarter. The leaves are flat, elliptico-spathulate, and the bulb is somewhat elevated in the centre. It seems probable that it will turn out to be the *B. spathulatum.*

In the natural group of plants to which *Brachystelma* belongs, there are many fetid species, but I am not acquainted with any whose smell is so decidedly stercoraceous, as that of B. *crispum.*

Calceolariæ hybridæ.

It is with no slight feelings of disappointment that I have lately seen sent to the Botanic Garden some very fine hybrid varieties of *Calceolariæ.* The species lately introduced into cultivation in this country seemed so well marked, and so entirely agreed with native specimens which have accompanied the seeds, that I did not fear a confusion of species in this genus; a confusion which in other genera seems to have rendered a distinction of species impossible, and has given colour to the opinion that natural genera form the ultimate divisions of plants with permanent characters.

Mr Morrison, gardener to Lord President Hope at Granton, being aware that several of the finest species of *Calceolaria* were shy in producing seed, suspected that this defect might be corrected, by applying the pollen of certain kinds to the stigmata of others; and he first has had the merit of presenting to the florist, hybrids thus produced, which equal, if they do not surpass, in beauty, any of the species of this handsome genus. Mr Morrison's experiments have been confined to four species, all herbaceous, viz. C. *corymbosa*, C. *arachnoidea*, C. *plantaginea*, and C. *Fothergillii.* He has succeeded in crossing the whole of these. C. *plantaginea* he finds most apt to produce seeds of itself, and most readily to fertilize others. The hybrids which Mr Morrison has sent to the Botanic Garden are the following:

1. C. *plantaginea-corymbosa*, raised from seed of C. *corymbosa*; produced by the pollen of C. *plantaginea.*

This is an exceedingly handsome plant, with the foliage of C. *plantaginea*, and the outline of its flowers, but they are larger than these, and with fewer spots externally; the mouth is open, as in C. *corymbosa*, but smaller, and the dark marks on the inside of the throat are round, not in streaks; in its flowering stem there is the mode of branching of C. *corymbosa.* Looking at it only with a florist's eye, it is really a splendid plant. A specimen of this hybrid having been sent by Mr Morrison to the meeting of the Caledonian Horticultural Society on 3d June 1830, the Society's Silver Medal was voted for it.

2. C. *plantaginea-arachnoidea*; raised from seed of C. *arachnoidea*, produced by the pollen of C. *plantaginea.*

This is a large healthy plant, having acquired little from C. *arachnoidea*, except a dirty brown colour in the corolla, the mode of branching in the flower-stalk, and the number of its flowers. There is very little woolliness upon the plant, but there is none of the polished surface of C. *plantaginea*, and the leaves are much smaller, and very much resemble those of C. *purpurea.*

3. C. *arachnoidea-plantaginea;* raised from seed of C. *plantaginea*, produced by the pollen of C. *arachnoidea.*

This plant is almost identical in appearance with the last, the parents being only transposed. The flower is rather smaller, its colours darker, more decided, more speckled, and, on the whole, certainly handsomer.

4. C. *corymbosa-Fothergillii;* raised from seed of C. *Fothergillii*, produced by the pollen of C. *corymbosa.*

This plant being produced by a cross between species much more dissimilar, is quite unlike any of the others, has little of the family features of either of its parents, and apparently the delicate health of a badly organized mule. The leaves are like those of C. *Fothergillii*, but they are more numerous, and extend farther, upon a more robust stem. The form of the flowers considerably resembles those of C. *Fothergillii*, but they are larger, and yellow. Its habit is such that I thought it was probably a mule between C. *Fothergillii* and C. *integrifolia*, before I was informed by Mr Morrison of its origin.

Eutoca sericea.

E. *sericea;* suberecta, foliis utrinque sericeis pinnatifidis, laciniis extrorsum incisis, superioribus linearibus integerrimis; ovulis placentæ singulæ numerosis, multis abortientibus; staminibus corolla triplo longioribus.

Description.—*Root* perennial. *Stem* (10 inches high) herbaceous, suberect, angular, red, hoary, leafy, branched at the bottom. *Leaves* very numerous, spreading in a stellate manner from the crown of the root and lower part of the stem, or scattered along the stem, smaller and more entire upwards, the lower with their petioles 5 inches long, the upper linear, entire, and about 1 inch long, pinnatifid, covered on both sides with subadpressed white hairs, channelled, subdecurrent along the petiole; segments incised on their outer edges, and each section has a strong central nerve, prominent below, and channelled above. *Spike* terminal, solitary, compound, dense, about half the height of the whole plant. *Spikelets* erect, gradually elongating, hairy. *Flowers* erect on the upper side of the spikelets, expanding from below upwards. *Calyx* 5-parted, segments linear, nearly smooth on the inner side, on the outer, covered like the pedicels with long, spreading, somewhat matted white hairs. *Corolla* (about 3 lines long, 4½ across), inferior, subcampanulate, bluish purple, equal to the length of the calyx, segments 3-nerved, blunt, entire, smooth, paler towards the base, and there on the inside somewhat hairy, and each having two overlapping membranous, nectariferous wings. *Stamens* 5, nearly thrice the length of the corolla, connected with its base, and alternating with its segments; filaments straight, distant, tapering, purple, slightly hairy at their origin, every where else smooth; anthers yellow, placed transversely, attached by their middle, bilobular, lobes somewhat crescent-shaped, furrowed in the centre. *Germen* green, ovate, subcompressed, covered with loose white simple hairs, unilocular; style erect, subangular, purple, nearly as long as the stamens, bifid at its apex; stigmas 2, small, 3-angled, green. *Ovules*, attached to each parietal receptacle, numerous. *Seeds* ovate, compressed into a keel along one side, dark brown, and covered with many round depressions, placed in longitudinal rows.

This pretty and perfectly hardy alpine was raised at the Botanic Garden, Edinburgh, in 1828, from seeds collected in Captain Franklin's second expedition to the arctic coasts of America, and presented by Mr Drummond. It flowered for the first time in spring 1829. This year it is much stronger, and was in full flower in the open border in May.

Ferraria elongata.

F. *elongata;* caule simplice; laciniis corollæ interioribus maculatis.

Description.—*Bulb* large, smooth, shining red, flattened on the sides, and tapering at both extremities. *Stem* (above 2 feet high in the specimen described, which, however, was probably drawn up from its situation) erect, simple, round, flexuose, pruinose, as is every other part of the plant except the peduncle, germen, and flower. *Stem leaves* few (about 3 inches long), lanceolate, strongly nerved and plicate, erect, green or scarcely pruinose; *sheaths* very long but variable, devoid of leafy expansion at the top and bottom of the stem. *Spathe* (1½ inch long) elliptical, coriaceous, bivalvular, many flowered, closed at the apex, where the valves are thin, transparent, membranous, blunt. *Flowers* expanding in succession, one expanded at a time. *Peduncles* (projecting half an inch above the membranous apices of the spathe) round, pale-green, naked. *Corolla* (fully ¾ of an inch long, 1¼ inch across) bright-blue, yellow at its origin, white immediately above, the white spot drawn to a point near the middle of each segment, and ornamented on the inside with numerous rather oblong spots of deep-blue, subrotate, 6-parted, segments elliptical, slightly undulated, nearly equal, the inner rather the narrowest and slightly pointed, the outer blunt. *Stamens* united, shorter than the corolla. *Filaments* pale-blue, with 3 prominent angles, short, toothed on the outside, teeth curved, erect between the base of the anther-lobes; *anthers* erect, twice as long as the filaments, sagittate at the base, slightly twisted, bilocular, bursting along their outer surface. *Pistil* shorter than the stamens; germen green, naked, cylindrical, tapering a little near the pedicel, 3-locular; ovules very numerous, attached to a central receptacle, which is double, in each loculament, and continued from the extremities of the dissepiments; style deep-blue, enlarging upwards; stigmata slightly dilated, projecting a little way between the anthers, hairy on their upper surface.

A single bulb of this very pretty plant was sent to Mr Neill from Buenos Ayres by Mr Tweedie, in a ball of clay, in 1828. It was planted in the open border in spring 1829, and stood till the middle of winter without having flowered. It was then taken up and put into the stove, where it flowered in June. The flowers expand about 6 o'clock in the morning, and become involute and decay about 3 in the afternoon. It may probably be found sufficiently hardy to bear the same treatment as Tigridia pavonia.

Habenaria obtusata?

H. *obtusata?* labello lineare, integerrimo, germen æquanti, cornu breviore; folio unico radicale elliptico, undulato.

Habenaria obtusata? *Goldie,* MS.

Orchis obtusata; *Pursh,* Flor. Americ. Sept. ii. 588?

Description.—*Root* consisting of a few strong, simple, fleshy fibres. *Leaf* (2½ inches long, 1¼ broad) radical, solitary, elliptical, undulate, keeled, many nerved. *Scape* (5 inches high) erect, angular, 15-flowered in the specimen described. *Bracteæ* green, linear-subulate, smaller upwards, the lower longer, the upper shorter than the flowers. *Flowers* small, cernuous. *Perianth* 5-parted, 3 outer segments green, the upper cordato-suborbicular, slightly pointed, cucullate, the lateral spreading, linear, somewhat tapering, slightly twisted, inner segments smaller, distant, lateral, 1-nerved, greenish, linear with a dilated white margin on their lower side, for above half their length. *Labellum* linear, entire, green, pendulous, dilated and white at its base, shorter than the *Spur,* which is white, tapering, green, and blunt at the apex. *Column* emarginate, green in the centre, with an expanded wing projecting forward on each side, along the edges of which the anther-case is placed. *Anther-case* nearly globular, with a prominent edge in front. *Pollen masses* yellow, granular, stipitate, arising from small brown glands, pollen granules course, angular, elongated. *Stigma* small, round, green, placed on the inside of the column, and connected to the glands from which the pollen masses arise by the uppermost of two parallel green ribs, which pass forward to the edges of the column. *Germen* green, curved, furrowed, scarcely twisted, about as long as the lip, and rather shorter than the spur.

The specimen described flowered in a cold frame in the collection of P. Neill, Esq. of Canonmills, in May last. The flowers have been expanded about six weeks, and will not immediately fade. It was received by Mr Goldie from the neighbourhood of Montreal in autumn 1829, and communicated by him to Mr Neill in March last, under the name of *Habenaria obtusata*? the specific name being given with some hesitation; and I have the same plant, under the same name, with the same uncertainty, from my liberal friend Dr Boott, gathered in woods on the White Mountains, North America. I have some doubts as to its being the species mentioned by Pursh, but having no means of certainly determining this, I do not feel myself at liberty to act with more decision than Dr Boott and Mr Goldie, the last of whom, if not both, I believe, examined the plant in its native stations. My doubts arise from the form of the leaf, the number of the flowers, and the comparative length of the segments of the perianth, to none of which the expressions of Pursh apply. On the specimen of Dr Boott, however, there are but 7 flowers, and the leaf is more attenuated at the base, than in Mr Neill's plant.

Halenia Fischerii.

H. *Fischerii;* corolla 4-partita, calcaribus rectis, patulis; laciniis calycinis subulatis; caule ramoso-erecto; foliis subsessilibus, trinervibus, inferioribus obovatis, superioribus ovato-lanceolatis, carinatis; pedunculis solitariis, terminalibus.

Descripiton.—*Root* annual. *Stem* (3 inches high) erect, enlarging upwards, purple below, green above, with 4 sides of unequal breadth, which alternate at the joints. *Leaves* opposite, decussating, and at the top of the stem, four in a verticel, from approximation, and therefore imbricated at their base, subpetioled, decurrent, 3-nerved, glabrous on both sides, the lower obovate, blunt and nearly flat, the upper ($\frac{3}{4}$th of an inch long, $\frac{1}{4}$th of an inch broad) ovato-lanceolate, acute, keeled. *Peduncles* ($4\frac{1}{2}$ lines long) solitary, one rising from the apex of a minute branch in the axil of each leaf, and one terminating the stem, therefore five at the top, always single-flowered, shorter than the leaves. *Calyx* 4-parted, segments awl-shaped, imbricated, sparingly provided with minute glandular pubescence (every other part of the plant being glabrous), spreading, shorter than the peduncles along which they are decurrent. *Corolla* yellow or brownish-yellow, ovate, equal in length to the peduncle, 4-cleft, 4-spurred; segments broadly ovate, acute, always connivent, at least I have never observed them to expand in any weather, or at any hour of the day; spurs rather shorter than the calyx, straight, spreading, conical, compressed laterally. *Stamens* 4, arising from the corolla at the base of the fissures, and therefore alternating with the segments, occasionally an abortive fifth stamen rises from below the middle of one of the segments at the mouth of the spur; filaments awl-shaped, shorter than the spurs, approximating at their bases, the upper part being erect; anthers 2-lobed, bursting early along their fronts. *Germen* elliptical, subtetragonous, unilocular, bivalvular, and empty at the apex. *Stigmata* 2, diverging, sessile. *Ovules* large, round, attached to the sides of linear, parietal receptacles.

The plant was raised from seed transmitted through Mr Hunneman in March 1829 to the Botanic Garden by Dr Fisher, as a species of *Halenia* gathered in Dahurica. It flowered very freely in the open border in June, and probably will ripen its seeds.

Hibiscus splendens.

H. *splendens;* frutex, aculeis rectis, base tuberculatis; corolla expansa, extrorsum costis pluribus flexuosis tomentosis; calyce 5-fido, laciniis acutis, 3-nervibus, carinatis; involucro multipartito, laciniis lineari-subulatis, interdum ramosis, calyce paulo brevioribus; pedunculo supra medium oblique articulato; foliis palmatis, 3–5-lobatis, lobis lanceolatis.

H. splendens, *Fraser*, MS.

Description.—*Stem* woody (in our flowering specimen 10 feet high), erect, round. *Bark* every where green, covered with short stellate pubescence, interspersed with short, spreading, nearly straight aculei, arising from large callous bases, which are red on the young parts of the plant. *Branches* axillary, woody, scattered, ascending, round. *Leaves* (6–7 inches long, 6 broad,) spreading, palmate, 3–5-lobed, light green, reticulated, thickly covered with rather harsh, stellate, unbranched pubescence on both sides; lobes lanceolate, unequally serrated; ribs and veins prominent, and aculeate below. *Petioles* (3–5 inches long) nearly as long as the leaves, slightly flattened above, filled with pith, which is continued into the ribs of the leaves. *Stipules* (1 inch long) green, subulate, linear, unconnected with the petioles, pubescent on the outside. *Peduncle* solitary, single-flowered, longer than the petiole from the axil of which it springs, and resembling it, filled with pith, obliquely articulated and bent about three-fourths of an inch from the calyx. *Involucrum* (about 1 inch long) green, divided to its base into many linear-subulate segments which are occasionally branched, smooth on the inside, covered on the outside with long, harsh, simple, spreading hairs, arising from glandular bases. *Calyx* yellow, deeply 5-cleft, rather longer than the involucre, densely covered with softer shorter hairs on the outside, smooth within; segments tapering, 3-nerved, two of the nerves lateral, the other forming a strong keel. *Corolla* (in our flowers 3½ inches long by 6 inches across when expanded) rose coloured; petals with many colourless flexuose nerves prominent on the outside, and there especially pubescent, connected to each other and to the lower part of the united filaments near their base, white towards their lower part, each having two dense tufts of dark red wool on the inside of its callous base, within a large obcordate, slightly orange coloured spot, having a dark rose coloured margin. In the entire flower, the margin forms a continuous line round the centre, inclosing a space about half an inch in diameter, and 5 tufts of red wool produced by the confluence in pairs of the tufts on the petals. *Stamens* numerous, united filaments at the lower part pale, above rose coloured; anthers dark crimson, arranged in a pyramidal form; pollen granules very large and spherical. *Style* projecting beyond the stamens, as is usual in the genus, but much shorter than the petals, supporting 5 deep red hairy round stigmas. *Germen* covered with erect silky hairs, quinquelocular; ovules numerous, attached to the central receptacle, and arranged in two rows in each loculament. *Seeds* ash coloured, wrinkled, warted, and angular.

This noble plant was raised, I believe, in various collections, from New Holland seeds sent by Mr Fraser in November 1828; but I am not aware that it has flowered anywhere before the present month (May 1830), when it blossomed in the stove of the Royal Botanic Garden, Edinburgh. Its only fault, as a cultivated plant, is its great size; but in its native situation, it must present a most brilliant appearance. Mr Fraser writes of it, "This I consider the king of all the Australian plants which I have seen. I have it 22½ feet in height. The flowers this season measured 9 inches across, were of the most delicate pink and crimson, and literally covered the plant."

Salvia rhombifolia.

S. *rhombifolia;* caule herbaceo, bifariam piloso, erecto, ramoso; foliis subrhomboideo-cordatis, subacutis, rugosis, subtus præcipue pubescentibus, crenato-serratis; racemis terminalibus, solitariis, verticillatis, subcapitatis; corollæ labio inferiore ampliato, patente, bilobato. Staminibus longe exsertis. Bracteis ovatis, acuminatis, deciduis.

Salvia rhombifolia, *Ruiz et Pavon,* Flor. Peruv. et Chil. i. p. 26. t. 36. fig. *b.*

Description.—*Stem* herbaceous, branched, 4-sided, pubescent; hairs short recurved, and most numerous in two broad lines along two sides, alternating at the joints; hairs with several joints. *Branches* green, spreading. *Leaves* petioled, veined, rugose, subacute, pubescent on both sides, but especially on the under, crenato-serrated, the serratures mucronulate, in the more luxuriant plants (which are 1½ foot high, 1¼ across) of dark green, the larger ones (4 inches long, 3½ broad) being subrhomboideo-cordate, and often unequal at the base, in the smaller plants (where they are 1½ inch long, and rather more than 1 inch broad,) pale green and cordate. *Petioles* spreading, channelled, ciliated, shorter upwards. *Racemes* terminal, solitary, verticillate; peduncle without flowers for a considerable way above its origin, and resembling the stem in shape and the bifarious arrangement of its hairs; verticels 2–6-flowered, according to the luxuriance of the plant, collected into a lax capitulum; pedicels slightly hairy, spreading on all sides. *Calyx* with three mucronate erect teeth, and eleven primary nerves, three running along each of the lower teeth, and five along the upper, hairy, especially along the ribs, and sprinkled, as well as the stem, and both sides of the leaves, but more abundantly, than these, with minute, shining, subviscid glands; tube subcylindrical; limb, after the corolla falls compressed laterally, closing the throat. *Corolla* azure-blue, the tube only and two parallel linear streaks in the centre of the lower lip being white; tube glabrous, nearly filling the calyx, and equal to it in length, compressed laterally, curved; limb pubescent on the outside, upper lip shorter than the tube, nearly straight, lower lip spreading, twice as long as the upper, 4-lobed, lobes obtuse, spreading. *Stamens* closely enveloped by the upper lip, but double its length; filaments smooth, rather paler than the corolla; anthers darker, bursting along their lower sides, pollen yellow. *Style* similar to the filaments, but more slender, and rather shorter, bifid at the apex, the lower segment revolute, and by much the broadest and longest, the stigmatic surface being arranged along its edges, and awanting altogether on the small, subulate, upper segment. *Lobes of the germen* pale yellow, obovate, slightly mutually impressed, veined, obscurely dotted, placed around the base of the style on a large fleshy yellowish-white *receptacle.*

The plant was raised from seed communicated by my valuable correspondent Mr Cruckshanks from Lima this season, and flowered in the stove of the Botanic Garden in May and June.

I do not hesitate to refer this species to *S. rhombifolia* of Ruiz and Pavon, though the upper leaves are less sessile than in their figure, the branches and calyx always green, the peduncles always solitary in our specimens, which are in every degree of luxuriance, and the verticels fewer and more capitate.

Schizanthus Hookerii.

S. *Hookerii;* corollæ tubo limbum æquante, labio inferiore longe bicornuto, labii superioris lobo medio longe acuminato.

Schizanthus Hookerii, *Gillies,* MS.

Description.—Biennial? *Stem* herbaceous, stout, branched. *Branches* diffused, whole surface covered with glandular pubescence. *Leaves* variable, once or twice pinnatifid, laciniæ incised. *Pedicels* (¾ths of an inch long) both in flower and in fruit secund, erect. *Flowers* in large branching, terminal, bracteated panicles. *Calyx* persistent, 5-parted, 4 of the segments suberect, the two upper rather shorter than the next, and the lowest, which is closely applied to the under side of the tube of the corolla, is considerably longer than any of the others, at least in the cultivated specimens. *Corolla* fully an inch across in both directions, slightly pubescent on the outside, bilabiate; upper lip, as in the other species, 3-lobed, of which the central is much narrower than in S. porrigens, or S. pinnatus of our gardens (which is certainly different from S. pinnatus of Ruiz and Pavon), entire, with prominent edges forming the throat, revolute in its sides towards the apex, and drawn out to a long erect point, which, as well as its base, and the whole of the remainder of the corolla, is of uniform pale rose-lilac, rather darker and somewhat streaked on the outside, the centre being orange coloured, with a few dark purple streaks; lateral lobes biparted, and each segment bifid: lower lip tripartite, lateral segments linear, very narrow, spreading, and half the length of the central, which is notched, and each segment is drawn out into a long beak: tube slightly curved, compressed laterally, and longer than the limb. *Stamens* four, filaments pubescent at the base, the two upper very short, abortive, and projecting forwards from the edge of the central lobe of the upper lip at its base, the two others rising from the base of the lower lip, nearly reaching to the fissure in its central lobe, and, as in the other species, retained within this till the pollen is ripe, after which they advance, and pass forward in straight parallel lines from the centre of the flower; anthers large, green, broadly elliptical, notched at their base, bilobular, bursting along their inner surface; pollen greenish-yellow. *Stigma* very minute, terminal. *Style* rather longer than the stamens, ascending at its extremity, lilac. *Germen* small, conical, yellow, bilocular. *Ovules* numerous, attached to a central receptacle in each loculament; capsule ovate, longer than the calyx, bivalvular, valves bifid. *Seeds* brown, dotted, somewhat scaly, reniform, or so much bent round that their extremities meet.

This remarkably distinct species of *Schizanthus* was raised by James Boog, Esq. in his garden at Portobello, from seed brought to this country by my excellent friend Dr Gillies, having been gathered by him in various places on the Chilian side of the Cordillera of the Andes, at an elevation of 8000 or 9000 feet above the level of the sea. The seed was sown in May 1829 in the open border, and the plants not having flowered, were taken into the house during winter, but planted out again in March. They began to flower in the beginning of June, and I doubt not will produce abundance of blossoms during the summer. The plant, when thus treated, has therefore proved to be biennial at least; whether it may be longer lived, or whether, if raised in a greater degree of heat, it might not have flowered during the first year, and died, I cannot say. Dr Gillies obligingly wrote to me when the plant came into flower, expressed his conviction that it was a nondescript species, narrated its most characteristic features, and inclosed a specimen.

Scilla pumila.

S. *pumila;* corolla patente; folio solitario vaginante, apice calloso; racemo erecto; bracteis pedicello multo brevioribus.

Scilla pumilla, *Broter*, Flora Lusitanica, i. 527.

Description.—*Leaf* (2 inches long, ½ inch broad) generally or always, as in the specimen described, solitary, involute, ovato-acuminate, with a callous subcylindrical apex, subcarinate, waved, glabrous. *Scape* about the same length as the leaves, erect, filiform, glabrous, green, racemose (5-flowered in the specimen described), pedicels purplish, gradually elongating (to about half an inch), springing from the axil of a small sheathing bractea, which is occasionally drawn out into a point, projecting from some part of a truncated ragged extremity. *Corolla* bright lilac (half an inch across), segments spreading, subunguiculate, ovate, slightly undulate, having a blue thickened middle rib, and an inflected mucro. *Stamens* inserted into the base of the corolla, and rather more than half the length of its segments; filaments light lilac, dilated towards their base, but contracted immediately above their insertion; anthers erect, blue, pollen greenish. *Germen* blue, ovate, 3-lobed, with a distinct light coloured suture along the front of each lobe. *Style* furrowed.

This pretty little species flowered in the garden of David Falconar, Esq. of Carlowrie, near Edinburgh, in May 1830. It is a native of Portugal, and is said rarely to vary with white flowers.

Celestial Phenomena from July 1. *to October* 1. 1830, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Astronomical Calculator, 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.	′	″	
2.	1	27	45	☌ ☽ γ ♎
3.	4	15	19	☌ ☽ φ Oph.
4.	12	34	41	Em. III. sat. ♃
4.	20	13	10	Em. IV. sat. ♃
4.	23	51	20	☌ ☿ ζ ♉
5.	12	–	–	☍ ☉ ♃
6.	1	11	52	☌ ☽ ♃
6.	2	15	52	○ Full Moon.
6.	7	6	9	☌ ☽ d ♐
7.	18	5	18	☌ ☽ ♅
8.	11	15	48	☌ ♃ o ♐
8.	15	24	7	☌ ♀ ε ♉
8.	23	25	23	Im. I. sat. ♃
9.	.	.	.	☿ greatest elong.
19.	5	44	35	☌ ☽ λ ♒
10.	15	29	26	☌ ☽ φ ♒
11.	5	19	8	☌ ☽ ♂
11.	13	20	50	Im. III. sat. ♃
13.	3	28	44	☾ Last Quarter.
13.	22	28	38	☌ ☿ η ♊
14.	12	53	8	☌ ☽ μ Ceti.
15.	6	40	8	☌ ☿ μ ♊
15.	8	21	10	☌ ☽ f ♉
1 .	18	0	11	☌ ♀ ν ♉
16.	1	20	16	Im. I. sat. ♃
16.	4	38	20	☌ ☽ γ ♉
16.	5	52	37	☌ ☽ 1 δ ♉
16.	6	21	27	☌ ☽ 2 δ ♉
16.	11	14	57	☌ ☽ α ♉
17.	1	26	18	☌ ☽ ♀
18.	15	5	–	☌ ☽ ☿
18.	17	20	43	Im. III. sat. ♃
20.	0	6	54	● New Moon.
21.	11	32	3	Im. IV. sat. ♃
21.	15	46	2	☌ ☽ ♄
22.	17	53	22	☌ ♀ ζ ♉
22.	21	18	34	☌ ☽ ρ ♌
23.	5	4	48	☌ ☿ δ ♊
23.	10	18	29	☉ enters ♌
24.	9	44	3	Im. I. sat. ♃
24.	12	36	9	☌ ☽ β ♍
25.	2	56	20	☌ ☽ η ♍
25.	15	26	35	☌ ☽ 1 γ ♍
25.	20	48	41	Em. II. sat. ♃
25.	21	20	39	Im. III. sat. ♃
27.	7	14	6	☌ ♃ 1 ν ♐
27.	15	25	30	☌ ☽ κ ♍
27.	20	29	1	☽ First Quarter.
29.	9	31	47	☌ ☽ γ ♎
30.	2	47	22	☌ ♀ ν ♉
30.	12	32	22	☌ ☽ φ Oph.
30.	20	44	21	☌ ☽ Ψ Δ ♎
31.	4	53	20	☌ ♀ μ ♉
31.	23	39	12	Im. I. sat. ♃

AUGUST.

D.	H.	′	″	
1.	22	2	45	☌ ♀ ν ♊
1.	23	23	35	Em. II. sat. ♃
2.	1	21	14	Im. III. sat. ♃
2.	3	51	59	☌ ☽ ♃
2.	6	45	–	☍ ☉ ♅
4.	15	35	7	☌ ☽ d ♐
4.	7	31	2	☌ ☽ ♅
4.	12	49	50	○ Full Moon.
4.	20	24	–	Sup. ☌ ☉ ☿
6.	12	32	29	☌ ☽ λ ♒
6.	22	3	1	☌ ☽ φ ♒
8.	3	18	54	☌ ☽ ♂
8.	19	8	5	☌ ♀ ζ ♊
9.	5	21	19	Im. III. sat. ♃
9.	5	57	–	☌ ☿ ♄
9.	14	49	23	☌ ☽ ν ♓
10.	18	10	29	☌ ☽ μ Ceti.
11.	8	0	21	☾ Last Quarter.
11.	13	45	5	☌ ☽ f ♉
11.	21	45	5	☌ ♀ δ ♊
12.	10	17	29	☌ ☽ γ ♉
12.	10	53	–	☌ ☿ α ♌
12.	11	33	16	☌ ☽ 1 δ ♉
12.	12	2	23	☌ ☽ 2 δ ♉
12.	17	0	45	☌ ☽ α ♉
15.	2	48	–	☌ ☉ ♄
15.	22	13	22	☌ ☽ ♀
16.	6	41	0	☌ ☿ ρ ♌
16.	21	58	29	Im. I. sat. ♃
18.	6	10	58	☌ ☽ ♄
18.	11	44	32	● New Moon.
19.	5	25	4	☌ ☽ ρ ♌
19.	15	45	–	☌ ☽ ☿
20.	5	33	57	☌ ☽ σ ♌
20.	20	37	17	☌ ☽ β ♍
21.	11	51	57	☌ ☽ η ♍
21.	23	18	39	☌ ☽ 1 γ ♍
23.	15	46	56	☌ ☿ σ ♌
23.	16	56	38	☉ enters ♍
24.	19	49	30	☌ ♀ τ ♌
25.	.	.	. .	☍ ☉ ⚵
25.	17	30	9	☌ ☽ γ ♎
26.	4	49	1	☌ ☽ ψ ♎
26.	13	51	0	☽ First Quarter.
26.	20	27	29	Em. II. sat. ♃
26.	20	57	30	☌ ☽ φ Oph.
28.	17	52	50	☌ ♀ δ ♋
28.	20	7	50	☌ ♀ β ♍
30.	1	1	24	☌ ☽ d ♐
30.	20	40	5	Em. III. sat. ♃
31.	14	58	6	☌ ☽ ♅

SEPTEMBER.

D.	H.	′	″	
1.	20	18	12	Em. I. sat. ♃
2.	21	35	53	☌ ☽ λ ♒
2.	22	24	19	○ Full Moon.
3.	6	53	56	☌ ☽ φ ♒
4.	8	47	42	☌ ☽ ♂
5.	21	45	56	☌ ☽ ν ♓
6.	21	22	8	Im. III. sat. ♃
7.	0	28	42	☌ ☽ μ Ceti.
7.	19	38	14	☌ ☽ f ♉
8.	15	51	50	☌ ☽ γ ♉
8.	17	35	46	☌ ☽ 2 δ ♉
8.	22	31	7	☌ ☽ α ♉
9.	20	56	42	Em. IV. sat. ♃
10.	13	42	40	☾ Last Quarter.
13.	6	56	38	♀ near ♄
14.	19	34	3	☌ ☽ ♄
14.	21	2	39	☌ ☽ α ♌
14.	22	52	15	☌ ☽ ♀
15.	12	19	29	☌ ☽ ρ ♌
17.	.	.	.	☿ greatest elong.
17.	2	10	0	● New Moon.
17.	19	5	15	☌ ☽ η ♍
18.	6	32	34	☌ ☽ γ ♍
18.	23	13	51	☌ ☿ α ♍
19.	9	54	36	☌ ☿ i ♍
19.	11	30	–	☌ ☽ ☿
19.	15	5	–	☍ ☉ ♂
20.	1	20	11	☌ ♀ ρ ♌
22.	0	47	53	☌ ☽ γ ♎
22.	12	11	41	☌ ☽ ψ ♎
23.	4	23	51	☌ ☽ φ Oph.
23.	13	31	8	☉ enters ♎
24.	20	33	31	Em. I. sat. ♃
25.	6	31	30	☽ First Quarter.
25.	19	58	7	☌ ☽ ♃
26.	10	3	26	☌ ☽ d ♐
27.	20	9	44	Em. II. sat. ♃
27.	23	42	50	☌ ☽ ♅
29.	8	10	51	☌ ☽ λ ♒
30.	11	15	5	☌ ♀ σ ♌
30.	17	28	55	☌ ☽ φ ♒

Times of the Planets passing the Meridian, and their Declinations.

JULY.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	10 38	18 52 N.	9 8	17 28 N.	4 49	7 57 S.	0 24	22 54 S.	14 39	17 1 N.	2 12	18 30 S.
5	10 37	19 44	9 12	18 30	4 40	7 22	0 6	22 57	14 26	16 53	1 59	18 31
10	10 35	20 41	9 16	19 39	4 31	6 40	23 39	23 2	14 9	16 42	1 39	18 34
15	10 42	21 50	9 20	20 38	4 16	6 4	23 18	23 6	13 52	16 31	1 18	18 37
20	10 57	22 39	9 25	21 24	4 5	5 31	22 54	23 9	13 33	16 20	0 58	18 41
25	11 18	22 39	9 30	21 56	3 51	5 4	22 33	23 12	13 16	16 9	0 37	18 44

AUGUST.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	11 52	20 57 N.	9 38	22 18 N.	3 31	4 36 S.	22 2	23 17 S.	12 53	15 53 N.	0 8	18 48 S.
5	12 11	18 30	9 41	22 17	3 19	4 25	21 45	23 19	12 39	15 43	23 48	18 51
10	12 31	15 25	9 48	22 2	3 1	4 17	21 23	23 21	12 20	15 32	23 27	18 54
15	12 47	11 54	9 54	21 31	2 43	4 16	21 2	23 23	12 3	15 19	23 7	18 57
20	13 1	8 11	10 0	20 45	2 24	4 21	20 41	23 25	11 48	15 7	22 46	19 0
25	13 11	4 27	10 7	19 44	2 4	4 33	20 21	23 26	11 30	14 55	22 26	19 3

SEPTEMBER.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	13 21	0 37 S.	10 13	17 55 N.	1 34	4 57 S.	19 53	23 27 S.	11 6	14 38 N.	21 57	19 6 S.
5	13 25	3 22	10 17	16 42	1 17	5 15	19 37	23 28	10 51	14 29	21 41	19 8
10	13 28	6 32	10 22	15 0	0 50	5 38	19 17	23 28	10 35	14 17	21 21	19 10
15	13 28	9 23	10 26	13 6	0 26	6 1	18 58	23 28	10 18	14 5	21 1	19 12
20	13 26	11 45	10 30	11 3	0 0	6 22	18 40	23 27	10 1	13 54	20 40	19 14
25	13 19	13 29	10 34	8 58	23 30	6 39	18 22	23 26	9 43	13 43	20 20	19 15

On the 16th of July, there will be an Occultation of *Aldebaran* by the Moon:

	D.	H. ′ ″
Immersion,..................................	16.	11 46 4 at 193°
Emersion,..................................		12 13 30 at 244

The *angle* denotes the point of the Moon's limb where the phenomenon will take place, reckoning from the *vertex* of the limb towards the right hand round the circumference, as seen with a telescope which inverts.

On the 2d and 3d of September there will be a total Eclipse of the Moon:

	D.	H. ′ ″
The Eclipse begins,..........................	Sept. 2.	20 36 32
Beginning of total darkness, ...		21 34 26
End of total darkness,.......................		23 15 14
End of the Eclipse,..........................	3.	0 13 8

Proceedings of the Wernerian Natural History Society.

(Continued from preceding volume, p. 385.)

1830, *March* 6.—Henry Witham, Esq. Vice-President, in the chair.—The Secretary read a notice concerning the Hya-hya or Milk-tree of Demerara, contained in a letter from James Smith, Esq. to Professor Jameson. (See No. 16. of this Journal, p. 315. *et seq.*) After which the Rev. Dr David Scot read an essay on the question, Whether Domestic Poultry were known among the ancient Jews?

March 20.—Dr R. K. Greville, V. P. in the chair.—There was read an essay on the origin of our Domestic Poultry, communicated by James Wilson, Esq.; and specimens of several kinds of the wild poultry were placed on the table. The Rev. Dr Scot then read an essay, shewing that the Hyæna of naturalists is most probably alluded to in three different passages of the Sacred Writings, although this has been denied by critics.

April 3.—Robert Jameson, Esq. Pres. in the chair.—There was read by David Craigie, Esq. surgeon, an interesting account of the internal structure of the Sturgeon, *Acipenser*

Sturio, particularly of the organs of digestion; the description being illustrated by preparations and drawings.

April 17.—G. A. Walker Arnott, Esq., formerly V. P. in the chair.—The Secretary read notices regarding the appearances and probable effects of the Aurora borealis in Scotland, in August and September 1829, communicated by Mr Blackader. The Rev. Dr Scot read an essay on the Copher of the Song of Solomon, or Henna of the Arabians, the Camphire of the English translation; Lawsonia inermis of botanists.—Dr John Gillies then read an account of an eruption of fine ashes from the Volcano of Penquenes in the Andes of Chile, which he witnessed during his travels.

May 1.—Robert Jameson, Esq. Pres. in the chair.—The Secretary read a communication from the Rev. Dr John Fleming of Flisk, on the Superposition of the Strata on the banks of the Tay, and on the occurrence of Scales of vertebrated animals in the old red sandstone of that district.—Dr Walter Adam then read a paper on the different forms of the Human Skull, and illustrated his remarks by the exhibition of specimens.—There was then read an account of a new species of Arvicola, found in the eastern parts of the middle division of Scotland, by Mr William Macgillivray; and, lastly, an Analysis of the Milk of the Hya-hya tree of Demerara, by Professor Christison. (For a detailed account of this analysis, see p. 31. *et seq.* of the present number of this Journal.)—After which the Society adjourned for the season, having completed its twenty-third session.

SCIENTIFIC INTELLIGENCE.

METEOROLOGY.

1. *Professor Hansteen's Journey to Siberia.*—Professor Hansteen, in a letter to Professor Shumacher, dated *Irktuz, 11th April*, states, that " it is difficult to find a sky more favourable to astronomical observations than that of eastern Siberia. It is

constantly serene from the moment when the River Angara, which flows out of Lake Baikal, is covered with ice, to the month of April. In a cold of from 30° to 35° of Reaumur, the sun rises and sets clear, free from the red mist in which its disk appears enveloped to us, when near the horizon, during the winter. Moreover, its action is so powerful, in spite of the intense cold, that the roofs of the houses are often seen dripping in a temperature of from 20° to 30° below zero. The latter degree of cold is more supportable here than that of 15° with us, seeing that the air is always calm and dry. When we left Tobolzk, on the 12th December, the cold was constantly from 20 to 30 to 34°. We are obliged to cover our instruments with thin leather, otherwise, on touching them, a pain was felt like that from a burn, and a white blister was produced on the skin."

HYDROGRAPHY.

2. *Colour of Water and Ice.*—Not only the water, but also the ice of different rivers, has a peculiar colour; and this appears to depend not on accidental causes, as conjectured by Davy, because, if so, it could not be the same every year. "I have," says Ritter von Wurzer, in Karsten's Archives, b. xviii. p. 103, "often observed this in the ice of the Rhine, which is always *bluish;* while, on the other hand, the ice of the Moselle is always *greenish.* The ice of the small rivers that pour into the Lower Rhine, for example the Ruhe, &c. is either *white*, or only *pale greenish.* More than seventy years ago, Leidenfrost first remarked this circumstance. This difference of colour is so striking, that the boatmen guide themselves by it, as they know by it whether it is Rhine or Moselle ice they have to do with. That decaying vegetable matter is the cause of the green colour is by no means evident, for the clear and transparent ice of the Rhine is *sky-blue*, the clear and transparent ice of the Moselle is *green*; and why is this appearance the same, year after year? Why is the water of streams in woods in general not green? Why is the sea-waters green, even in places hundreds of miles from the land? I am not of opinion that iodine and bromine give to sea-water its colour, for those sea-plants which, by their decomposition, afford these substances, does not contain them in

an uncombined state. The truth is, we have not hitherto discovered the cause of the colour of ice and water.—*Karsten's Archiv.* b. xviii.

3. *Quantity of Water in the River Clyde.*—The breadth of the Clyde, at the new bridge, Glasgow, is 410 feet, and its mean depth $3\frac{1}{2}$ feet. The velocity of the water at the surface is 1·23 inch, and the mean velocity of the whole water is 0·558,132 inch per second. From these data it may be inferred that the quantity of water discharged per second is $76\frac{2}{3}$ cubic feet. This amounts to 2,417,760,000 cubic feet, or 473,017,448 imperial gallons, or 1,877,053 tons. The river Clyde drains about $\frac{1}{30}$th of Scotland, or about $\frac{1}{83}$d part of Great Britain. Hence, if the water discharged into the sea by the Clyde afforded a fair average of the whole island, the total amount of the water discharged annually by all the rivers in Great Britain would be only 155,795,399 tons, which does not amount to one-hundredth part of the excess of the rain above the evaporation.—*Thomson on Heat and Electricity*, p. 268.

CHEMISTRY.

4. *Freezing Point of Spirit of Wine.*—The following statement on this curious topic is given by Muncke and Gmelin :—1. Good Coniac Brandy froze or sustained in Melville Island, according to Captain Parry, a temperature of — 48°.5 cent. 2. Alcohol of 801 sp. gr. at 20° cent., had its point of greatest density, according to first experiments, at — 56°.6 cent., consequently the conjectural freezing point was — 58° cent. 3. Nearly pure alcohol of specific gravity 789, froze at — 79° cent. 4. According to second experiments, alcohol of 791 sp. gr. attained its point of greatest density at — 89°.4 cent. Therefore the conjectural freezing point was — 92° cent.—*Poggendorf's Annalen, No.* ix. 1829.

5. *Note on Robert Brown's Microscopical Observations on the Particles of Bodies.*—Muncke of Heidelberg finds the following a simple and easy mode of shewing the motions of the particles. If we triturate a piece of gummi guttæ, the size of a pin-head, in a large drop of water on a glass-plate, take as much of this solution as will hang on the head of a pin, dilute it again with a drop of water, and then bring under the microscope

as much as amounts to half a millet-seed; we observe in the fluid small brownish yellow, generally round (but also of other forms) points, from the size of a small grain of gunpowder, in distances from one another of 0.25 to 1 line. These points are in perpetual slower or quicker motion, so that they move through an apparent space of 1 line, in from 0.5 to 2 or 4 seconds. If we employ fine oil of almonds in place of water, no motion of the particles takes place, while in spirit of wine it is so rapid as scarcely to be followed by the eye. This motion certainly bears some resemblance to that we observe in infusory animals, but the latter shew more of voluntary action. The idea of vitality is entirely out of the question. On the contrary, we are disposed to view the motions as of a mechanical nature, caused by the unequal temperature of the strongly illuminated water, its evaporation, currents of air, and heated currents, &c. If the diameter of a drop is placed at 0.5 of a line, we obtain, by magnifying it 500 times, an apparent mass of water of more than a foot and half the side, with small particles swimming in it, and if we consider their motions magnified in an equal degree, the phenomenon ceases to be wonderful, without, however, losing any thing of its interest.

6. *Brewsterite.*—Since my former notice on the constitution of Brewsterite, I have completed an analysis of a portion of one of the specimens mentioned in that notice, consisting of a concretion of Brewsterite partly crystallized, and partly amorphous; and have found it to contain, besides silica, alumina and water, 7.709 per cent. of strontia, 5.27 of baryta, and 1.007 of lime, the strontia and baryta being in the proportion of two atoms of the former to one of the latter. Before, however, publishing a statement of the proportions of all the constituents, I wish to repeat the analysis, which different avocations have prevented me from as yet accomplishing.—*Arthur Connell.*

GEOLOGY.

7. *A Village lighted by Natural Gas.*—The village of Fredonia, in the western part of the State of New York, presents this singular phenomenon. I was detained there a day in October of last year, and had an opportunity of examining it at leisure. The village is forty miles from Buffalo, and about two

from Lake Erie; a small but rapid stream called the Canadaway passes through it, and, after turning several miles, discharges itself into the lake below; near the mouth is a small harbour with a light-house. While removing an old mill, which stood partly over this stream in Fredonia, three years since, some bubbles were observed to break frequently from the water, and on trial were found to be inflammable. A company was formed, and a hole, an inch and a half in diameter, being bored through the rock, a soft fetid limestone, the gas left its natural channel, and ascended through this. A gasometer was then constructed, with a small house for its protection, and the pipes being laid, the gas is conveyed through the whole village. One hundred lights are fed from it; more or less at an expense of one dollar and a-half yearly for each. The flame is large, but not so strong or brilliant as that from gas in our cities; it is, however, in high favour with the inhabitants. The gasometer, on measurement, collected 80 cubic feet in 12 hours during the day; but the man who has charge of it told me, that more might be procured with a larger apparatus. About a mile from the village, and in the same stream, it comes up in quantities four or five times as great. The contractor for the light-house purchased the right to it, and laid pipes to the lake, but found it impossible to make it descend, the difference in elevation being very great. It preferred its old natural channels, and bubbled up beyond the reach of his gasometer. The gas is carburetted hydrogen, and is supposed to come from beds of bituminous coal. The only rock visible, however, both here and to a great extent on both sides, along the southern shore of the lake, is fetid limestone.

8. *Diluvial Furrows and Scratches.*—In a late number of the *American Journal of Science*, there is a notice of information laid before the New York Lyceum, relative to the worn appearance of rocks *in situ*, with parallel scratches (such as heavy harrows might make in soft clay), and the writer speaks of them as being in a south-easterly direction. Appearances precisely similar occurred in excavating the Erie Canal above Lockport, on hard limestone, with a direction of the lines about north 15° east. Similar marks were found on uncovering hard sandstone in the Erie Canal, not far from Brockport, and nearly

80 feet below the former level. At my request Dr Whippo, the resident engineer, ascertained the direction of the lines north 80° east. Nearly on the same level with the last, on the east side of the Genessee River, and also on the line of the Erie Canal, similar scratches occurred on the hard limestone; but I know not the direction. I have also found similar traces on the Montrose and Milford turnpike, south of the Great Bend of the Susquehanna in Pennsylvania, probably 1000 feet above any of the before-mentioned localities, and in all cases on hard rock *in situ*. I see no difficulty in referring this attrition of the surface of rocky strata to the Deluge,—a period when all the loose matter of the globe appears to have been in violent commotion; but on the cause of lines so regular, and so deeply engraved, I have nothing to offer.

9. *Origin of the Air of Air-Volcanoes.*—An account has been lately published of a salt named *Kniester Salz*, brought from Wieliczka by Dr Boué, which contains much carburetted hydrogen. When dissolved in water, the carburetted hydrogen escapes; hence it is inferred that the gas evolved in many salt-mines, and also in salses in air-volcanoes, may have this origin.

10. *Origin of Diluvium.*—Rozet maintains, in a memoir just published, that the diluvium of geologists was produced by the rising through the earth from below of vast quantities of water and carbonic acid.

11. *Overflowing or Spouting Springs.*—M. Mallat, by an ingenious contrivance, is enabled to make use separately of two kinds of water, sometimes found in a single boring, such as hard and soft water.

12. *New Work on Geology.*—That excellent man Omalius will soon publish a work on geology, which cannot fail to prove highly interesting and instructive.

13. *Humboldt's New Journey.*—This distinguished philosopher and traveller, will, we are informed, undertake a new scientific journey to the southern parts of Russia, with the Emperor of Russia.

14. *Works on Petrifactions.*—Mr Witham of Lartington is preparing a work on the *structure* of the fossil trees found in our secondary strata, to be illustrated by numerous engravings, illustrative of the various structures exhibited by these fossil

organic remains.—Major Zieten has begun the publication of a work on the Fossils of Wurtemberg, (über die Versteinerungen Wurtembergs), to be in 12 numbers. The first number contains the Ammonites. Each will cost about 6s. in black.—Deshayes of Paris continues his excellent work on the fossils, shells, &c. of France.—Goldfuss of Bonn is advancing with his interesting series of plates of Fossil Organic Remains.—Children's work on Fossils does not appear.

15. *Memoirs of the Society of Strasburg.*—The first volume of the new memoirs of the Society of Strasburg has just appeared. It contains, 1. An extensive paper on Belemnites, with plates by Voltz. 2. On the Jura Limestone, and caves of the Haute Saone, by Thirria. 3. On the fresh-water gypsum of Hegau (Baden) by Dr Althaus. 4. On the pea iron-ore of Randern by Walchner. 5. On the fibrous boracite found in keuper-gypsum. 6. On vertical strata. 7. On the mineral waters of Sulz. 8. On the primitive floras of the earth, by Voltz; it is an answer to Brongniart's observations on the subject.

16. *On the Alluvium of the Nile.*—It is mentioned by authors, that the tract of country between Damietta and the sea, a distance of about two leagues, is a work of the Nile: that Damietta, during the first crusade of St Louis, was on the border of the sea, hence that this alluvial formation must have been the produce of at least 600 years.—The work of Mr Reinaud, entitled, "*Extraits des Historiens Arabes, relatifs aux guerres des Croisades,*" shews that the influence of these alluvia has been exaggerated; for in that work it is said, in conformity with the testimony of oriental writers, that immediately after the departure of St Louis, the Egyptian Emirs, wishing to prevent a new invasion on the same side, razed Damietta, and founded a new city in the interior of this district. This is the present city of Damietta.

ZOOLOGY.

17. *Mortality among Leeches during Storms.*—That atmospheric changes have a remarkable influence upon leeches, is a well-established fact. In 1825, M. Derheims of St Omer, ascribes the almost sudden death of them at the approach of, or during storms, to the coagulation of the blood of these creatures, caused by the impression of the atmospheric electricity. This

opinion, which at that time was the result of theory, he confirmed by direct experiments.

BOTANY.

18. *Notice respecting the existence of Fraxinus excelsior, as an Indigenous Tree in Scotland.*—As the occurrence of the ash and beech in Scotland, in a truly indigenous state, has been considered doubtful, I have been induced to consult the notes which I have been accustomed to write during excursions made into various parts of the country, for the purpose of examining its natural productions. If the subject be considered of any importance, perhaps the following facts, extracted from the notes of three journeys, may be found worthy of a place in the Journal. The beech I have no where seen wild in Scotland; but the ash I find marked as frequently as most of our native trees, excepting the birch, the alder, the oak, and the hazel. The passages that refer to it I extract without alteration. For two miles above Upper Banchory, there were considerable quantities of Betula alba, Alnus glutinosa, Fraxinus excelsior, Quercus robur, and Ilex aquifolium. In the space between Charlestown and the Pass of Tulloch, there is very little wood by the river; but at the upper end of the valley, a considerable quantity along the hills: Betula alba, Quercus Robur, and Fraxinus excelsior, are the species which occur here. In Glen-Nevis, the trees seen were Alnus glutinosa, Fraxinus excelsior, Pinus sylvestris, the latter to appearance planted. Between Fort-William and Ballachulish, the trees and shrubs were Alnus glutinosa, Betula alba, Pyrus Aucuparia, Quercus Robur, Corylus Avellana, Fraxinus excelsior, Prunus spinosa, Mespilus oxyacantha, Hypericum Androsæmum, Hedera Helix, Lonicera Periclymenum, &c. At Cladach, on Lochawe: Corylus Avellana, Quercus Robur, Fraxinus excelsior, Prunus Padus, Betula alba, Mespilus oxyacantha. In the Forest of Aray: Quercus Robur, Corylus Avellana, Fraxinus excelsior, &c. The woods on Lochlomond consist chiefly of Quercus Robur, the other species which I observed, are Pyrus Aucuparia, Alnus glutinosa, Pyrus Malus, Prunus spinosa, Ilex Aquifolium, Mespilus oxyacantha, Fraxinus excelsior, Betula alba, and these undoubtedly wild. Specimens of some of them also appeared planted, particularly the ash, which is a very beautiful tree, and

here grows to a great size. Between Dunbarton and Glasgow: Prunus Padus, Quercus Robur, Fraxinus excelsior, &c. In Glenappe on Loch Ryan, the woods consisted of the following species: Betula alba, Corylus Avellana, Fraxinus excelsior, Alnus glutinosa, Mespilus oxyacantha, Prunus spinosa. At the fall of Foyers, Pinus sylvestris, Betula alba, and Fraxinus excelsior, grow upon the brinks, and along the precipices. The country between this (Pollewe) and Inverness is but thinly wooded. In the higher or central parts between the two seas there is no wood at all; but the moors every where bear evidence of the former existence of very large trees. In common the Betula Alnus grows along the rivers and lakes, the B. alba on the sides of the mountains, and the Pinus sylvestris in a similar situation. I have seen the Ilex Aquifolium on the face of a rock; Quercus Robur, Fraxinus excelsior, Populus tremula and Pyrus Aucuparia thinly scattered along the sides of the hills. At Ord in Skye, the woods, which are pretty extensive, are composed of Corylus Avellana, Betula alba, Betula Alnus, Fraxinus excelsior, Prunus Padus, Prunus Cerasus, Mespilus oxyacantha, and perhaps some others. From Inverary to Cairndu, there was a good deal of natural wood, consisting chiefly of Quercus Robur, Corylus Avellana, Prunus spinosa, Fraxinus excelsior, Populus tremula, and several willows. Among the plants observed here (at Aberfoyl) were Quercus Robur, Alnus glutinosa, Fraxinus excelsior, Betula alba, Populus tremula, Sorbus Aucuparia, &c. To these fourteen stations might be added as many more, but perhaps more than enough has already been said on the subject.—W. M'G.

STATISTICS.

19. *Religious toleration in Russia.*—Independently of the people who profess the orthodox religion in Russia, there are in the country, Roman Catholics, Unitarians, Lutherans, Calvinists, Armenians, Mennonists, Mahomedans, Jews, worshippers of the Grand Lama, and Idolaters. The number of Roman Catholics may be estimated at seven millions, and of other Christians rather more than two millions and a-half. The Mahomedans of Kasan, Astracan, Siberia, Orenburg, the Crimea, Caucasus, Lithuania, and other places, have mosques in the places where they have fixed their abode. Their number amounts to more than three

millions. Synagogues have long existed in the cantons and cities inhabited by the Jews, the total of whom is about five hundred thousand. With respect to Paganism, we must add to the gross idolaters who wander in the deserts of Siberia, and the steppes of Kirgius-Kaissaks, the worshippers of the Grand Lama, and those of Fetishes and Schahmans. We should not omit either the heretics and schismatics of the different sects, whose religion seems limited to vain prejudices and superstitious practices. *In the midst of such a variety of worship, religious toleration has always been maintained in Russia. During the ten centuries of the existence of the Empire, its history does not produce a single instance of persecution by the Russian government against a foreign religion, and the bloody name of religious wars is not found in its annals.* It would seem that, in its ancient attachment to the spirit of the Eastern Church, it has learned the moderation which characterized true Christians in the origin of Christianity.

20. *Annual Quantity of Sugar consumed in Britain.*—The quantity of sugar at present consumed in Great Britain may be estimated at 160,000 tons, or about 360,000,000 lb.; which, taking the population at 16 millions, gives, at an average, 22½ lb. for each individual. In work-houses, the customary allowance for each individual is about 34 lb.; and in private families the smallest separate allowance for domestics is 1 lb. a-week, or 52 lb. a-year.

21. *Foundling Hospitals.*—"In Catholic countries, numerous asylums have been opened to all new-born children, legitimate or illegitimate, which it may please the public to abandon, or to place in them. Austria has many such institutions: Spain reckons 67; Tuscany 12; Belgium 18: but France, in this respect, excels other countries; she has no less than 362. Protestant countries, on the contrary, have suppressed the greater part of those which had been specially founded for this purpose."—To form an idea of the advantage of the Protestant system over that of Catholic countries, Mr Gouroff states *, "That, in London, the population of which amounts to 1,250,000, there were, in the five years from 1819 to 1823,

* From prospectus of a projected work on the History of Foundling Hospitals, in 3 vols. by M. Gouroff, Rector of the University of St Petersburg.

only 151 children exposed; and that the number of illegitimate received into the 44 work-houses of that city, of which he visited a large number in 1825, amounted, during the same period, to 4,668, or 933 per annum; and that about one-fifth of these are supported at the expense of their fathers. By a striking contrast, Paris, which has but two-thirds of the population of London, enumerated, in the same five years, 25,277 *enfants trouvés*, all supported at the expense of the state."—To ascertain the contagious influence of these houses on the abandonment of new-born children, Mayence had no establishment of this kind, and, from 1799 to 1811, there were exposed there 30 children. Napoleon, who imagined that, in multiplying foundling hospitals, he would multiply soldiers and sailors, opened one in that town on the 17th of November 1811, which remained until *March* 1815, when it was suppressed by the Grand Duke of Hesse Darmstadt. During this period of three years and four months, the house received 516 foundlings. Once suppressed, as the habit of exposure had not become rooted in the people, order was again restored; and in the nine succeeding years but 7 children were exposed.

22. *Scottish Societies.*—The publishing Literary and Philosophical Societies, in this part of the United Kingdom, are the following: 1. *Royal Society*, instituted in 1739, and incorporated by Royal Charter in 1783, and which has published ten and a-half volumes 4to. of Memoirs. 2. *Antiquarian Society*, instituted in 1780, and has published two and a-half volumes 4to. of Transactions. 3. *Wernerian Natural History Society*, instituted in 1808, and has published five volumes of Memoirs in 8vo. 4. *Edinburgh Medico-Chirurgical Society*, instituted in 1821, and has published three volumes of Transactions in 8vo. 5. *Highland Society*, founded in 1784, and has published eight volumes in 8vo. 6. *Caledonian Horticultural Society*, founded in 1809,and has published four volumes of Memoirs, in 8vo.

23. *Early Discovery of America by the Scandinavians.*—"It is known," says M. Rafn, in a letter to Dr Silliman, in the American Journal of Science, "that the inhabitants of the north of Europe visited, long before Columbus's time, the countries on the coasts of North America. The greatest part of the information on this subject has not hitherto been published. At

a time when the researches concerning the former times of America have gained a greater interest, I hope the effort to extend this information will meet the approbation of the American antiquarians. I have now gone through all the old MSS. on this subject, and have made a complete collection of several pieces, showing the knowledge which the old Scandinavians had of America. I intend now to publish this collection, with a Latin translation. The accounts of the voyage of the old Scandinavians to America have lately gained a new confirmation, by a Runic stone, which, in the year 1824, was found under 73° N. Lat., on the western coast of Greenland; translated, it is as follows:—'Erling Sigvalson, and Biorne Hordeson, and Endride Addson, Saturday before Gagnday (25. April), erected these heaps of stone, and cleared the place in the year 1135.'"

ARTS.

24. *Invention of Stereotyping.*—The honour of this important invention is at present claimed by Holland, apparently with justice. Baron Van Westreemen Van Tiellandt, encouraged by the government, has made very active researches on this subject, and has received from the booksellers Luchtmans of Leyden, a stereotype form of a Bible, in 4to, from which impressions have been taken since 1711. At Haarlem also, the booksellers Enschedé have furnished him with another stereotype form of a Dutch Bible, which dates from the first years of the 18th century. These are two substantial proofs of stereotyping in Holland before it was thought of in France. It is well known that, in a note annexed to No. 1316. of the catalogue of Alexander Barbier, a note extracted from the papers of Prosper Marchand, it is affirmed that John Muller, minister of a German church at Leyden, contrived, about 1701, a new method of printing, similar to stereotyping as now practised. The method of John Muller consisted in composing the letters in the common way, correcting these forms very exactly, binding them in a very solid manner in frames of iron, then inverting the letters, and riveting them with metal, or, still better, with mastic. The first essay of this method was a small prayer-book, entitled Gebeede-Bookjen, Van Johan Haverman, printed in 1701, by

J. Muller, son of the inventor. This method of printing was afterwards transported to Halle. In a letter of the 28th of June 1709, Muller acknowledges that he had printed in this manner, a Syriac New Testament, with a Lexicon.—*Ferrusac.*

In June 1801, the Messrs Luchtmans addressed the following letter to M. Renouard of Paris, which has been published by M. Camus, in his History of Stereotyping:—"We have sent you a copy of our stereotype Bible, which we take the liberty of offering you as a work truly interesting in regard to the history of the art. All the plates of it are now in our possession, and notwithstanding that many thousand copies have been printed from them, they are still in very good condition. They are formed by soldering the bottoms of common types together, with some melted substance, to the thickness of about three quires of writing paper. The plates were made about the beginning of the last century, by an artist named Van der Mey, at the cost of our late grandfather, Samuel Luchtmans, bookseller. The same artist, at the same time, and in the same manner, also prepared for our grandfather the stereotype plates of a folio Dutch Bible; these plates are at present in possession of the bookseller Elwe; and afterwards of a Greek New Testament, on Brevier, and of 24mo size, the plates of which are still preserved by us. The last work which this artist executed in this manner, was the *Novum Testamentum Syriacum et Lexicon Syriacum*, by Schauff, 2 volumes 4to; a work sufficiently known. The plates of this last work have been destroyed. These instances comprise, as far as our knowledge extends, all the attempts of this kind which have yet been made in this country.' The plan of stereotyping here described,—"by soldering the bottoms of common types together by some melted substance,"—is very different from that now in use. A mould of plaster of Paris is formed from a page of common type, in which a thin plate is cast, containing a *fac simile* of the face only of the page, and which is afterwards mounted on wood to the necessary height for the press. There is no means of accurately ascertaining by whom this important improvement in the art was first effected. Our neighbours across the Channel claim it upon the authority of some old plates of a Calendar to a Prayer-Book, very rudely and imperfectly formed of *copper*, and without a date, but supposed to have been made about 1735. We cannot think, however, of yielding on such proof the merit of the improvement in the invention, when on this side the water we have positive names and dates of about the same period, to shew that the art was then practised in this and the sister kingdom; by Mr Ged of Edinburgh, in 1725, and by Mr Fenner and Mr James of London, who absolutely cast plates for Bibles and Prayer-books in the University of Cambridge, in the year 1729-30.—Edit.

25. *Important Experiments.*—We have received the following account of the experiments made with the new marine boiler on Messrs Braithwaite and Ericsson's construction. It is a low pressure boiler; and, from these experiments, it is evident that the following important advantages will arise to steam naviga-

tion by the introduction of this principle: 1. The total absence of all smoke; 2. The dispensing with the chimney; 3. A saving of at least 120 per cent. in the cost of fuel, and 30 per cent. in the space to stow it; 4. A saving of about 400 per cent. in the space occupied by the boilers. The same principle is now applying, by Messrs Braithwaite and Ericsson, to the new locomotive engines constructing for the Liverpool and Manchester railway, which are to be delivered at mid-summer; and a similar combination of vast power, in a small space, with a great saving of fuel, will be applied to them.

Memoranda relative to the Experiments made at Mr Laird's works at North Birkenhead, with the new Low Pressure Boiler, on the exhausting principle of Messrs Braithwaite and Ericsson, by Alexander Nimmo, C.E. Dublin, and Charles B. Vignoles, C. E. London.—The exhausting apparatus consisted of a fan-wheel, with broad radial leaves, revolving within a close box or chamber, placed a little apart from the boiler, but connected with it by a passage leading from the flues traversing the boiler: a short tube above the exhausting chamber passed out to the atmosphere. The furnace was attached to and placed at the end of the boiler, opposite to the exhausting apparatus, which latter being put to work, drew through all the turns of the boiler the hot air from the fire, which passed over the throat of the furnace through the bridge flue, and then successively through the other five turns of the flue arranged through the boiler, and finally was drawn through the exhausting chamber and passed into the atmosphere. The heat, which in the furnace was extremely intense, was absorbed by the water in the boiler as the air rushed through the flues, and, when passing up the tube or funnel from the exhausting chamber, was so far cooled that the hand or arm might be placed with impunity down the tube, the temperature probably not exceeding 180° of Fahrenheit. Not the slightest smoke was perceptible. The following are the principal dimensions measured:

	Ft.	In.			Ft.	In.		
Furnace	2	0	deep	Ash Pit	1	0	deep	The openings of the fire bear equal to about half the area of the bottom.
	2	6	long		2	6	long	
	2	6	wide		2	6	wide	

	Ft.	In.				Ft.	In.
Exhausting Chamber	2	6	high	Outside Dimensions	Diameter of Exhausting Wheel,	3	0
	3	6	wide		Breadth of the same,	0	10
	3	6	long				

Bridge flue or throat from the furnace 2 feet 6 inches broad, 4 inches wide, 2 feet deep. 5–16th inch iron plate.

First turn of the flue 4 inches wide, 2 feet deep,
2d, 3d, 4th, and 5th turns, 3 inches wide, 2 feet deep, } ¼th inch iron plates.

Whole length of the flues through the boiler, ...	45 feet.
Superficial area of the heating surface, ...	247 square feet.
The contents of the water in the boiler when filled were from	85 to 90 cubic feet.
The superficial area of the evaporating surface in the boiler,	33 square feet.

The proportion of the heating to the evaporating surface nearly 7½ to 1

	Ft.	In.			
Steam Chamber	3	0	wide	containing about	65 cubic feet.
	4	10	average depth		
	4	6	long		

Diameter of the safety valve very nearly 5 inches, being 19 square inch area, which was loaded for a pressure on the square inch of 4 lb.
Giving 76 for the load.

Of this, 66 lb. of iron were placed in the boiler, and 10 lb. allowed as the weight of the valve, rod, hook, handle, &c. The water used was the salt water from Wallasey Pool, and filled into a large iron tank, the area of the surface of which measured 32½ superficial feet. The boiler was placed under an open shed; the day was very cold, with thick rain. No engine being attached to the boiler, the exhausting apparatus was worked by a wheel and band from Mr Laird's turning engine. The velocity of the circle of percussion of the leaves of the exhausting wheel was determined to be about 77 feet per second, or upwards of 52 miles an hour. Mr Laird's engine is stated to be a four-horse power. No determinate measurement was made, but the engineers present computed that the power applied to turn the exhausting wheel was equal to that of two horses. The fire being lighted, the steam was got up to 4 lb. pressure in 45 minutes, with a consumption of 2½ cwt. of coke. The expenditure at first was 8 lb. per minute, and gradually decreased to 5 lb., averaging about 6¼ lb. per minute for getting up the steam. The steam began to rise in 27 minutes, after which the consumption of coke was little more than 5 lb. per minute; and at this period there would have been a sufficient supply of steam to work the cylinders of an engine. The coke employed was gas-coke of very bad quality, of which 3½ cubic feet weighed 105 lb., giving 30 lb. for the weight of a cubic foot, or 3000 lb. as the weight of 100 cubic feet. The same weight of St Helen's coal (that principally used in steam-boats) measures 63 cubic feet. The cost of the coke used was 8s. 6d. per ton, delivered in Liverpool; the cost of smithy coke being 25s. per ton, of which 3½ cubic feet weighs 115 lb., giving very nearly 33 lb. for the weight of a cubic foot. When the steam was up, the water in the thick glass gauge attached to the boiler standing at 7½ inches, the two men stationed for the purpose began to pump, a fresh supply of weighed fuel was placed on the floor, and the following observations were made:—At 3h. 32m. began to pump; at 3h. 54m. 16 cubic feet of water were evaporated; at 4h. 12m. 27 cubic feet of water were evaporated; at 4h. 19m. 38 cubic feet of water were evaporated, and 2 cwt. of coke consumed; at 4h. 32m. 41¼ cubic feet of water were evaporated, with a consumption of 252 lb. coke. From which it appears, that only 6 lb. of coke per cubic foot of water per hour was consumed; and the evaporation of a cubic foot of water per hour being generally considered the measure of a horse power, the conclusion is, that the boiler was a forty-horse boiler, and that the quantity of fuel requisite to work it is 2¼ cwt. per hour, the expense of which is 12¾d.; and as the consumption diminishes after the first hour, the expense of fuel will probably not exceed 1s. per hour for the forty-horse boiler. (Signed) Alexander Nimmo, C. E. Charles B. Vignoles, C. E.—*Waterloo Hotel, Liverpool, 29th May* 1830.

NEW PUBLICATIONS.

1. *An Outline of the Sciences of Heat and Electricity.* By Dr THOMSON, Regius Professor of Chemistry, Glasgow, &c. &c. 1 vol. 8vo. 600 pages.—This excellent treatise is an abridgment of the Author's Lectures on Heat and Electricity, which he annually delivers in the College of Glasgow. No English work with which we are acquainted contains so beautiful, at the same time so luminous and interesting, an exposition of the important doctrines of heat and electricity.

2. *A Treatise on Poisons in relation to Medical Jurisprudence, Physiology, and the Practice of Medicine.* By ROBERT CHRISTISON, M. D. Professor of Medical Jurisprudence in the University of Edinburgh, &c. 1 vol. 8vo. 700 pages.—On the continent, particularly in Germany and France, Medical Jurisprudence has long occupied the attention of medical men; while, in Britain, a few years only have elapsed since this important branch of medicine was held in any esteem. Now, however, it is viewed otherwise, for no practitioner can be said to have had a thorough education, without an acquaintance with medical jurisprudence. The work of the Edinburgh Professor is just what we expected from him, being throughout distinguished by extent of information, accuracy of detail, luminousness of arrangement, and soundness of judgment. We have, therefore, no hesitation in recommending it to the particular attention of the medical student and practitioner. We would even venture to hint, that our legal practitioners might be benefitted by an acquaintance with the facts and reasonings in Dr Christison's work.

3. *The influence of Climate in the Prevention and Cure of Chronic Diseases, &c.; comprising an account of the principal places resorted to by Invalids in England, the South of Europe, &c.* By JAMES CLARK, M. D. &c. Second edition, 400 pages. —This edition of Dr Clarke's valuable work is much improved, and considerably enlarged. The article on the climate of England is rewritten. The climate of the Canaries, the Azores, the Bahamas, the Bermudas, and also of the West Indies, are here given for the first time. Much additional important informa-

tion will be found dispersed through this volume, now become one of our standard works on climate.

4. *The Teignmouth, Dawlish, and Torquay Guide.* By N. T. Carrington. *The Natural History by* W. Turton, M. D., and J. F. Kingston. In 2 vols. Published at Teignmouth.—We have lately examined several of the guides to different districts in England, and consider this as one of the best. The first volume contains full and accurate accounts of the antiquities and descriptions of the scenery; the second volume, which is entitled Natural History of the District, contains full, and we think very interesting lists and notices in regard to the animals, vegetables, minerals, and geological appearances. We can safely recommend these volumes to the attention of our travelling friends.

5. *Elements of Practical Chemistry.* By David Boswell Reid, Chemical Assistant to Dr Hope. 1 vol. 8vo. 500 pages, with numerous Wooden Cuts.—From the style and execution of Mr Reid's former work, we were entitled to expect that the present one would sustain the reputation he had obtained as an active and skilful chemist. That he stands equally high in our estimation as formerly, may be inferred from our recommending the present volume of practical instructions to the student of chemistry, and also to those who may wish to become practically acquainted with this all-engrossing and delightful branch of science.

List of Patents granted in England from 26th November 1829, *to 6th February* 1830.

1829.

Nov. 26. To F. Westby, Leicester, cutler, for his "improved apparatus for the purpose of whetting or sharpening razors, penknives, or other cutting instruments."

Dec. 10. To J. Marshall, Southampton Street, Strand, Middlesex, tea-dealer, for his "method of preparing or making an extract from cocoa, which he denominates Marshall's Extract of Cocoa."

14. To B. Coulson, Pendleton, Lancashire, surgeon, for his "improvements in the manufacturing of farina and sugar from vegetable productions."

To C. Derosne, Leicester Square, Middlesex, gentleman, for "certain improvements, communicated from abroad, in ex-

tracting sugar or syrups from cane-juice and other substances
1830. containing sugar, and in refining sugar and syrups."

Jan. 12. To W. HALE, Colchester, Essex, mechanist, for his "method of raising or forcing water for propelling vessels."

18. To J. CARPENTER, Willenhall, Wolverhampton, Stafford, and J. Young, Wolverhampton, locksmiths, for their "improvements on locks and other securities applicable to doors and other purposes."

Jan. 18. To W. PARR, Union Place, City-road, Middlesex, gentleman, for his "method of producing a reciprocating action to be applied to the working of pumps, mangles, and all other machinery to which reciprocating action is required or may be applied."

21. To E. Dakeyne, and J. Dakeyne, Darley Dale, Derby, merchants, for their "machine or hydraulic engine for applying the power or pressure of water, steam, and other elastic fluids to the purpose of working machinery, and other uses requiring power, and applicable to that of raising or forcing of fluids.

26. To J. YATES, Hyde, Chester, calico-printer, for his "method or process of giving a metallic surface to cotton, silk, linen, and other fabrics."

To G. STOCKER and A. STOCKER, Somerset, for a "cock for drawing liquor from casks, which produces a stop superior to that which is effected by common cocks, and will continue in use for a longer time."

To J. ARNOLD, Sheffield, for "an improved spring-latch or fastening for doors."

To G. F. Johnson, Canterbury, for "a machine which is intended as a substitute for drags for carriage-wheels, and other purposes."

To Dr T. Bulkely, Richmond, Surrey, for "a method of making candles."

To J. COBBING, Bury St Edmunds, for "certain improvements in skaits."

To J. WEIGHT, Shelton, Staffordshire Potteries, for "a manufacture of ornamental tiles, bricks, and pan-tiles for floors, pavements, and other purposes."

To R. Busk, Esq. Leeds, for "improvements in apparatus for distilling and rectifying.

28. To Dr T. Revere, New York, America, for "a new alloy applicable to the sheathing of ships, and various other useful purposes."

Feb. 4. To J. LAMBERT, Esq. London, for an "improvement in the process of making iron applicable ta the smelting of ore, and at various stages of the process, up to the completion of the rods or bars, and a new process for the improving of the quality of inferior iron."

To G. POCOCK, Esq. Bristol, for "improvements in constructing globes for astronomical, geographical, and other purposes."

1830.

Feb. 4. To J. Gray, Beaumoris, Anglesea, for "a new and improved method of preparing and putting on copper-sheathing for shipping."

To C. T. Miller, Middlesex, for "certain improvements in manufacturing candles."

To T. J. C. Daniel of Limphley Stoke, in the parish of Bradford, Wilts, clothier, for "certain improvements in the machinery applicable to the manufacturing of woollen cloths."

List of Patents granted in Scotland from 16*th March to* 14*th June* 1830.

1830.

Mar. 16. To Andrew Smith of Prince's Street, Leicester Square, in the Parish of Saint Martin in the Fields, in the County of Middlesex, machinist, for "certain improvements in the construction of window frames, sashes or casements, sun-blinds, shutters, and doors, designed to afford security against burglars, as well as to exclude the weather."

To Thomas Affleck of the town of Dumfries, in the county of Dumfries in Scotland, Gent., for "certain improvements in apparatus and machinery for cleansing and deepening rivers, and in the method of applying the same."

Apr. 13. To James Carrick of Mossley Vale, near Liverpool, in the county-palatine of Lancaster, Esq. for "certain improvements in machinery for spinning cotton, silk, linen, and other fibrous substances," communicated to him by a certain foreigner residing abroad.

29. To Samuel Brown of Billeter Square in the City of London, Esq. for "certain improvements in making or manufacturing bolts or chains."

To William Aitken of Carron Vale in Scotland, Esq. for "certain improvements in the means of keeping or preserving beer, ale, and other fermenting liquors."

May 3. To Richard Witty of Basford, in the Parish of Wolstanton, in the county of Stafford, engineer, for "certain improvements in apparatus for making and supplying coal-gas for useful purposes."

12. To James Viney of Piccadilly, Colonel of Artillery, for "certain improvements on steam-boilers, and in carriages or apparatus connected therewith."

June 14. To Edward Turner of Gower Street, in the county of Middlesex, M. D., and William Shand of the Burn, in the county of Kincardine in Scotland, Esq. for "a new method of purifying and whitening sugar, or other saccharine matter."

THE

EDINBURGH NEW PHILOSOPHICAL JOURNAL.

Biographical Memoir of M. Claude Louis Richard. By Baron Cuvier.

M. Richard presents one of the few examples of an agreement of the inclinations with the circumstances of birth. The condition of his relations and his natural genius seemed alike to destine him for becoming a great botanist; and no obstacle could prevent him from obeying this twofold impulse. For more than a century his family had been, in some measure, devoted to the service of natural history. The name of his great-grandfather, who had charge of the Menagerie of Versailles under Louis XIV., had acquired a certain celebrity from the humorous pleasantries of the Count de Grammont. The reputation of Anthony Richard, his grandfather, was of a better kind. He it was who, under the orders of Bernard de Jussieu, had charge of the beautiful botanic garden of Trianon, to which Louis XV. daily resorted, to forget for a moment the pomp of his court and the cares of state. The governors of the colonies and naval men made it a duty to offer, as a tribute to the monarch, the rarest vegetables of distant countries; and the prince in his turn made it his duty to distribute these treasures among the most celebrated botanists. It was thus that Richard the gardener corresponded with the Linnæuses, the Hallers, and the Jacquins, and all the men of genius and talent whom science at that time possessed. His sons also were engaged in this scientific commerce. The youngest, who was named Anthony after his father, was one of the travellers whom Louis

XV. employed to augment his collection of live plants. He visited Auvergne and the Island of Minorca, where he made rich acquisitions. Botany owes to him some valuable species. His eldest son Claude Richard, the father of our academician, was placed at the head of a garden which the king had purchased at Auteuil, and which was a kind of auxiliary to that of Trianon. At this garden was born M. Claude Louis Richard, the subject of our present memoir. He was therefore born in the midst of plants; he learnt to know them sooner than the letters of the alphabet; and before he was able to write correctly, he could draw flowers, or plans of gardens. Thus it may be literally said of him that he sucked in botany with his mother's milk; he did not recollect a moment of his life in which he had not been a botanist; and if he ever engaged in other studies, botany was always the object of them. It was for botany that he improved himself in drawing, and almost for it alone that he gave himself the trouble of attending his classes, and learning Latin and Greek. Yet his progress was scarcely less backward than that of children who learnt these things only for their own sake. At the age of twelve he had the Georgics by heart. The delicacy and correctness of his drawings were surprising.

But this early display of talent, which ought to have attached his parents to him, and secured for him a happy childhood, were the very causes of the first misfortunes which he experienced, and which, perhaps, by altering his disposition and his health, led to those of his future life. The archbishop of Paris, M. de Beaumont, sometimes visited the garden of Anteuil, and was fond of its director. The intelligence and proficiency of the child excited his interest, and he promised advancement should he devote himself to the church. This was opening to him the only career in which talent, without birth or fortune, could then expect to arrive at honours and independence, and opening it, too, with the most favourable prospects. There was nothing that he might not have hoped from the bounty of the prelate, seconded by the protection which the king extended to his family; and M. Richard, the father, who had nine other children, and who was not rich, even for a gardener, could not fail to seize such hopes with ardour; but his son had determined otherwise. Nothing could bend the inflexible resolution of the child·

He unhesitatingly and unvaryingly declared that he would be a botanist; that he would be a gardener at all hazards, and nothing else. Neither entreaties nor threats had any effect on him; and his father's anger rose to such a pitch, that he banished him from his house, allowing him only ten francs a-month for his support.

Young Richard was then not quite fourteen, and how many children of that age would not such a treatment have led to the most degrading irregularities, or perhaps to a miserable death! He, however, showed the courage and prudence of a grown up person. He betook himself quietly to Paris, hired a corner of a garret, went through the town in search of an architect, who gave him plans of gardens to copy, devoted to this labour a part of his nights; and after having thus secured the means of subsistence, occupied himself through the day in regularly attending the lectures in the College of France and the King's Garden. But he did not confine himself to these first precautions. The beauty of his drawings, and the punctuality with which he fulfilled his engagements, obtained him a great deal of work. By degrees he was entrusted to direct by himself the execution of the plans which he had traced; and while he was thus gaining considerable profits, he established so much order and economy in his manner of living, that, at the end of a few years, not even asking of his father the miserable aid that had been promised him, he not only supported himself with decency, but had accumulated upwards of 80,000 livres.

But his savings had the same object as his studies, and always referred to botany. Like most men captivated with a love of nature, he wished to enlarge the sphere of his observations, and to visit distant countries in quest of plants. It was for the purpose of attaining this end, without the help of any one, that, from the age of fifteen to that of eighteen, he lived in the midst of Paris like an anchorite, giving himself no other relaxation than mere change of labour. He was, in particular, constant in his attendance on the lectures and botanical walks of Bernard de Jussieu, the most modest, and perhaps the most profound botanist of the eighteenth century, who, although he scarcely published any thing, is, nevertheless, the inspiring genius of modern botanists, like those legislators of old whose laws were but the more religiously observed that they were not written.

Bernard de Jussieu was not a great man only, he was also a benevolent man, adored by his pupils, because he loved them, and interested himself in their welfare not less than in their instruction. A young man so devoted to science as M. Richard, and who showed at the same time so much judgment, could not escape his notice. He admitted him to his intimacy, initiated him in his views, and even directed the first researches which his able pupil ventured to make into the numerous families of the vegetable kingdom, whose organization was not yet entirely known.

The encouragements of so great a master, at length emboldened our young gardener *to shew that he also was a botanist.* He ventured to read to the Academy a memoir on one of the most difficult questions in the science, and by this fortunate temerity, placed himself in some measure, all at once, in the first ranks of its cultivators.

The genera Cynanchum and Asclepias, in the family of Apocyneæ, were, at that time, the subject of the keenest discussions. The interior of their flowers presents, around the pistil, various circles of organs, none which has very decidedly the ordinary form of an anther. Those of the outer row exhibit each a small horn, from the bottom of which rises a bent thread. Between them is a pentagonal body formed by the union of five vertical scales, which open, each at its upper part, into two small cells. This body is surmounted by a kind of pentagonal capital, hollowed above, with five small fissures, and on the sides with five small fossæ, tallying with an equal number of small black bodies, divided and prolonged each into two yellow and granulated filaments, resembling two clubs or two small spatulæ, and which sink into the cells of the vertical scales which correspond to them. The problem was to determine which of these complicated organs are the true anthers; and so much the more importance was attached to it, that the sexual system founded upon the stamina and pistils was then exclusively received in botany. There had been almost as many opinions on the subject as there were celebrated botanists. Linnæus considered the scales as the stamina; according to Adanson, the scales were only the anthers, and the small horns were their filaments. Jacquin regarded the anthers as placed in the interior of the cells of the scales. According to M. Desfontaines, the black corpuscules were the true anthers; and the slits of the pistil, opposite which they are placed, performed the office of stigmata. Amid these different opinions of the most celebrated men, M. Richard fearlessly brought forward his own. He endeavoured to shew that the capital is the stigma; that the little black bodies which adhere to it are parts or divisions of it; that the cells of the pentagonal body are the anthers, and that it is their agglutinated powder that forms the small masses of threads which terminate the little black bodies. If all botanists have not yet considered these determinations as demonstrated, most of them at least admit that they are the most probable that have been proposed.

An opportunity now presented itself to M. Richard of realizing the scheme which he had nourished from his childhood. M. Necker and M. de Castries were desirous of sending, to our American colonies, a man qualified to propagate there the productions of India, which Poivre and Sonnerat had obtained for them at the risk of their lives, as well as to make known such of their own native productions as it might be possible to convert to some use. The Academy, on being requested to point out to them such a man, made choice of M. Richard; and Louis XVI., who had seen him when quite a child, and was personally acquainted with most of the individuals of his family, approved, with pleasure, of his nomination. It is well known that that unfortunate prince was fond of and cultivated geography. He did M. Richard the honour of several times sending for him to his cabinet, and shewing him on a map of Guyana, the districts whose examination seemed to him likely to present the greatest interest; the rivers whose course he wished to be better laid down, and other objects, to the knowledge of which he attached importance. These audiences, these directions, given by the king himself, together with the promises of the ministry, could not fail to raise, to a still higher pitch, the natural ardour of our young naturalist. Full of courage and hope, and without caring, in the smallest degree, about the precautions and formalities which would have rendered the engagements entered into with him more positive, he did not hesitate to draw upon his small capital for the purpose of fitting himself out for his travels; and during them, he was not more attentive to his interest: what occupied his attention least was what was taking place in France during this interval, and the influence which these events might have on his circumstances.

He was soon however to learn, that neither the personal protection of a king, nor the orders of his ministers, are always sufficient guarantees against the caprices of personages of a much lower rank. It is related that a pasha, on being threatened by one whom he had oppressed, with the wrath of the sultan and of God, replied, " The sultan is very far off, God is very high, and here I am master." The Governor of Cayenne, although he did not make use of the same language, conducted himself according to the same principle—the most sordid interest was his only motive. He had filled with pulse, for his own use, the royal garden intended for the culture of spices; and M. Richard, whose principal office at Cayenne was to be the direction of this garden, and who had caused himself to be conducted there on his arrival, could not so much as obtain entrance into it. What he experienced with respect to the clove-trees did not less excite his surprise and indignation. The governor, thinking he might imitate, for his own advantage, the tyrannical proceedings for which the Dutch have been so much reproached, had pretended that the colonists neglected too much the cultivation of these trees, and in consequence had ordered all the single trees dispersed over their estates to be removed to a distant and solitary place, where, in the king's name, he assumed monopoly of them to himself. So absurd a command had incensed the proprietors to such a degree, that the greater number had chosen rather to destroy their trees than to give them up. But at length the governor was become master of all that remained. He guarded them like the dragon of the Hesperides, and M. Richard, who had been sent by the King of France into a French colony, for the express purpose of propagating clove-trees, and distributing them through our other islands, could not even get near the place where they were confined. He was obliged, in order to get some seeds of them, to do at Cayenne as Poivre and Sonnerat had done in the Moluccas; and it cost him nearly as much trouble to give the clove-tree to Martinique, as it had cost these courageous citizens to procure it for the Isle of France. It even happened that a ship coming from the Isle of France, having brought over a certain number of plants, which were supposed to be the true pepper-tree, this governor was not ashamed to make it be understood, that if they were to be propagated, it should be for himself, and on his own estate. He even avowed, that he had already caused a piece of ground to be prepared for this purpose by the king's negroes. I need not say how such an insinuation was received by a young man, who at the age of thirteen had shown so much firmness of character. Every day something new occurred to thwart him; but he resolved to do good in spite of his superiors, as he had made himself a botanist in spite of his relations; and his activity prevailed so much over the obstacles opposed to him, as to enable him eventually to be of great service to the colony. He was at least permitted to cultivate and distribute some vegetables which the governor had not thought worthy of his exclusive solicitude. The litchi *(Scytalia litchi)*, the sago-tree *(Sagus palma-pinus)*, the rose-apple *(Eugenia jambos)*, and the mangrove *(Mangifera indica)*, required for their propagation only that the indolence natural to the colonists should be overcome. The bamboo, whose utility was more readily appreciated, was generally cultivated, and is now abundant, and of enormous size. In 1785, finding an opportunity of going to Brazil, M. Richard brought from it to Cayenne the talin, or pourpier du Para *(Talinum oleraceum)*, a fleshy, tender, somewhat acidulous and cooling plant, which yields a pleasant salad. He afterwards went to the Antilles, where he remained from February 1786 to November 1787. He succeeded in procuring in the island of St Croix the *Eugenia expetita*, a delicious fruit, which now forms the ornament of the finest desserts.

Better times at length arrived. Another Governor, M. de Villebois, turned out to be a benevolent and enlightened man. Scarcely had M. Richard spoken to him, when he abrogated the odious restrictions laid upon cultivation by his predecessor; and during the short time that our botanist remained under his orders, no restraint was put on his operations. Even before, when he was so much harassed by the vexations which he experienced under the former governor, he consoled himself by researches in pure natural history. The rural habits of his old trade enabled him to make excursions which would have frightened cabinet naturalists. An excellent hunter and marksman, he dreaded neither the thickest forests nor the most unhealthy marshes. Twice his dogs were devoured by those enormous serpents which from the trees lie in wait for animals, and even sometimes cast themselves upon men. He had, in particular, a talent for gaining the friendship and confidence of the savages. They assisted him in his huntings, admitted him into their dwellings, and did not conceal from him their most secret practices. He thus discovered, that if they had long been considered beardless, and if numerous and absurd theories have been founded on this error, it is merely because they pluck out, with superstitious care, the slightest germ of hair as soon as it makes its appearance. For this purpose, instead of pincers, they employ the valves of a particular kind of mussel.

These prolonged excursions, together with those which he made to Brazil and the Antilles, procured for M. Richard extensive collections in the three kingdoms of nature. His herbarium was remarkable, not only for its beautiful preservation, but for the care which he had taken to join to it drawings from nature of all the details of the flower and of the fruit. Nothing could be more valuable, nor even at the present day is any thing more so, than this series of drawings. Travelling botanists had too long given only superficial descriptions of plants. Since the time of Linnæus, more attention had been paid to the sexual organs; but the relative position of the parts, the attachment of the seed in the interior of the fruit, and the interior of the seed itself, were neglected; and in plants which could not easily be procured in Europe, there was no means of supplying the deficiency. Herbaria and dried fruits afforded but uncertain or insufficient information. Of this deficiency in the science, M. Richard had been sensible, since he had attended the lectures of Bernard de Jussieu, and he had determined to supply it. Thus, at the same time when Gærtner was with so much assiduity labouring in his cabinet, at his celebrated Carpology, our botanist, in a more favourable situation, was describing and drawing in the woods and savannahs of Cayenne the fresh fruits, in which the most delicate parts were distinctly seen, in which each tegument, pulp, and seed, retained its colour and consistence.

But in the midst of these wild scenes, so rich and so new to him, the plants were not the only objects which were calculated to arrest his attention. The singular birds, the fishes and reptiles of strange and extravagant forms, which presented themselves to his view, rendered him, almost in spite of himself, a zoologist, and even an anatomist. In that climate, at once moist and scorching, in which the lapse of a few hours changes a dead body into an infectious carcass, he collected skins and skeletons of animals, and made drawings and descriptions of their viscera. Among his papers we have seen observations, new for the time, on the organs of voice in birds, and on those of generation and digestion in various quadrupeds. The sea and rivers had supplied him with the most singular mollusca. He had especially observed with much care, and in the living state, the animals which form and inhabit shells, a class which had until then been almost always neglected, attention having been paid only to their brilliant integuments.

With these treasures he returned to France, after an absence of eight years, and landed at Havre in the spring of 1789.

Unacquainted as he had remained in the midst of his woods, with all that had taken place during his absence, he doubted not that the most honourable reception would be the reward of his labours: philosophers and ministers, he imagined, would be equally eager to throng around him, the former to learn his discoveries, the latter to repay the debt of the public. But, as we have just said, this was in 1789. M. de Buffon had died the year before; his place had been given to a courtier of a gentle and upright character, but without energy, and entirely destitute of the knowledge essential to the discharge of such important duties. Thus natural history had no longer a protector; and, besides, of what importance could the most powerful protection have been in the midst of the embarrassments which on all sides crowded on a government as unskilful as it was unfortunate? Our poor traveller, with a report from the Academy in his hand, setting forth the extent and importance of his labours, knocked at every gate; but the ministers, and even the functionaries down to the lowest degree, were all changed: no one remembered that any promises had been made to him. It was a light matter to men whose lives were daily in jeopardy, that a few more cloves had been grown at Cayenne, or that litchis and eugeniæ had been propagated there. Scientific discoveries affected them still less. Thus M. Richard found that he had spent his time, impaired his health, and sacrificed the small fortune which he had so laboriously acquired, without any one deigning even to hold out to him any future prospects. There only remained for him to begin again the kind of life to which he had devoted himself at the age of fourteen.

Natural history perhaps requires in him who gives himself up to it, more study than any other kind of study, not only for confronting the hidden and continual dangers which menace him in his researches, but also for supporting reverses of fortune or neglect. Amid the material equipage without which he can do nothing, the naturalist is in a manner attached to the soil. That the genius of the poet, the metaphysician, and geometrician, may support itself, and even rise to a higher pitch in solitude and poverty, is easily conceived: their thoughts are independent of the things of this lower world; but in a science which is founded on the inspection and comparison of so many thousands of beings and parts of beings,—in a science whose general propositions are elicited only from the approximation of thousands of particular facts, the finest genius, without numerous subjects of observation, without all that can render observation easy and of daily occurrence, would either be annihilated, or would lose itself in fantastic and idle theories. Who, then, can be surprised that M. Richard, restrained in his inclinations in childhood by his relatives,—overburdened with labour in his youth,—thwarted at Cayenne by a petty despot in all his projects, in the very exercise of the duties which had been prescribed to him,—neglected and repelled at Paris by those who ought to have nobly recompensed his services,—should have harboured a misanthropy which only rendered the rest of his career more painful, and deprived him of the little aid which, with patience and gentleness, he might still have hoped to obtain?

The more faults men in power commit, the less must be spoken about these faults, if the reparation of them be desired. But all oppressed persons are not of a character to bend themselves to this maxim, and M. Richard was less so than any one. After some unsuccessful attempts to obtain his due, he shut himself up in his retreat, living and studying only for himself, communicating the objects which he had collected, and the observations which he had made, only to a few persons, and by preference to strangers. It might be said that each of his fellow countrymen whom he saw better treated than himself, appeared to him to have usurped his rights. This much is certain, that the obstinate silence in which he persevered, has been an immense loss to all the branches of natural history. A foreign botanist, M. Kunth, perfectly qualified to judge, and who has published a biographical notice of M. Richard, calls him one of the greatest botanists of Europe. It was from his manuscripts that he had formed this opinion of him. M. de Jussieu, one of his old masters, and almost the only member of the Academy who retained any portion of his confidence, often admired the numerous analyses of flowers and fruits displayed in his drawings.

Zoology has not suffered less than botany from this peevish humour. His labours, with respect to shells, were of the greatest importance; no collection of this kind was better laid out, or more correctly named, than his. It is asserted that several of his ideas on the testacea, their relations, and the principles according to which they ought to be distributed, communicated in conversation, passed into the works of writers who have not acknowledged them; but these plagiarisms did not alter his resolution.

Part of his collections has, since his death, been obtained for the King's cabinet; and in them were found fishes and mollusca, which, if they had been made known at the time when he brought them home, would have prevented several mistakes made by the most able naturalists. Science not only loses by such delays, it is obscured by them. In thirty years works multiply; the errors, which a word would have dispersed, are repeated, and end with becoming so firmly rooted, that they can only be refuted by long dissertations.

M. Richard, however, emerged from the painful condition which had led him to adopt the unfortunate resolutions. Fourcroy, when he established the School of Medicine in 1795, had named him professor of botany. He there found an opportunity of planting a beautiful garden; and, entering upon this new duty with much zeal, he formed several excellent pupils. But his habits were fixed, both with respect to his manner of living, and the difficulty of arranging his labours for publication. It was with difficulty that, towards the end of his life, he was prevailed on to give a few specimens of his researches in scientific journals, and perhaps even this he regretted. Botany is commonly represented as a science, as gentle and peaceable as the objects which it studies. Unfortunately it does not change the character of botanists, or impress its own upon their discussions. M. Richard, like most secluded persons who have long cherished certain opinions without contradiction, was keenly hurt by the objections offered to some of those which he had published, and answered in a tone which well proved in how great a degree he had become a stranger to the world and its forms. The replies elicited by these answers were perhaps too acrimonious also. His quiet was disturbed by these altercations, and his bad health rendered still worse. On the whole, however, these dissertations astonished by the depth and sagacity of the views, and by the extensive observations which they shewed. One of them, entitled, *Analyse du Fruit**, and which did not even come from his pen, but was written at his lectures by one of his pupils, is so full and so concise as to be equivalent to a great work; and the learned botanist whom we have already mentioned, regrets that Gærtner could not have seen it before composing his own, as from it, he says, he would have gained much. This little production was immediately translated into several languages. The observations which it contains on the embryos of the plants, which the author names *endorhizes*, or which are commonly called Monocotyledones, were in particular as new as important, and he enlarged on them in a Memoir on the Germination of the Gramineæ, accompanied with figures of unexampled accuracy. He has left another in manuscript on

* Demonstrations Botaniques, &c. Botanical Demonstrations, or Analysis of the Fruit, considered in general, by M. Louis Claude Richard. Published by H. A. Duval. 1 vol. 12mo. Paris, 1808.

the Coniferæ and Cycades, the execution of which is said to be still more perfect. His Memoirs on the Lygeum Spartum, on the Families of the Butomeæ, Calycereæ, and Balanophoreæ, present the same kind of merit, and in the same degree *. In all these are contained numerous new facts, reduced to laws with a precision and regularity altogether unexpected. There is everywhere seen in them the work of a man, who, before writing, was thoroughly imbued with his subject by long studies, and had possessed numberless opportunities of studying it. If he may be blamed for any thing, it is that he did not render himself sufficiently accessible to the generality of readers, and that he added too much to the difficulties with which botany was already crowded, from attempts to employ a rigorous terminology. But, like Linnæus, he wished that each form, each shade, each relation, should be expressed by a proper and unvarying term; and the prodigious number of ideas and new facts which had sprung from his observations, necessarily engendered that multiplicity of words with which he enriched, or, as some may think, overloaded the science. All his labours were even directed to a common object, the formation of a new Botanical Philosophy, like that of Linnæus, which was to include a new botanical terminology, proportioned in extent and depth to the improvements of the science, and especially to those which M. Richard himself had made in it, and of which a great part are still concealed in his portfolios.

Time did not permit him to terminate this great undertaking. His health, which had been long enfeebled by his travels and

* Commentatio de Convallaria Japonica novum genus constituente, præmissis nonnullis circa plantas liliaceas observationibus. (Schrader's New Journal of Botany, t. ii. p. 1. 1807.)

Description of the Lygée Sparte. (Mem. de la Soc. d'Hist. Nat. de Paris, 1799.)

Memoirs on the Hydrocharideæ. (Mem. de l'Inst. 1811.)

Botanical Analysis of the Endorhizal or Monocotyledonous Embryos, and particularly of that of the Gramineæ. (Annales du Muséum d'Hist. Nat. t. xvii.)

Proposal of a New Family of Plants, the Butomeæ. (Mem. du Muséum d'Hist. Nat. t. i.)

Annotationes de Orchideis Europæis. (Ibid. t. iv.)

Memoir on the New Family of Calycereæ. (Ibid. t. vi.)

Memoir on the New Family of Balanophoreæ. (Posth. Ibid. t. viii.)

vexations, at length assumed an alarming character. A disease of the bladder, from which he had long suffered, obliged him to keep his room, and, after several months of severe sufferings, he died on the 7th June 1821, at the age of 67. His death would be an immense and irreparable loss to botany, had he not left a son, who, formed in his school, and imbued with all his doctrines, will not only render to his memory the devotion which he owes to him, by publishing his works, but will extend them, and add what may still be wanting for their completion. We also hope that his researches in comparative anatomy, which were very considerable, but of which nothing is known, excepting through the medium of some verbal communications, will not be lost to science.

Description of Luminous Bodies which were observed attached to the Vane-Staff at the Mast-head and Yard-arm of H.M.S. Cadmus, while cruizing in the River Plate. By Lieut. ALEXANDER MILNE, R. N. Communicated by the Author.

THE first time I observed this luminous appearance was in the month of September 1827, in Lat. 34°40′ S. and Long. 54°50′ W. The weather for some days had been unsettled, and there was every indication of an approaching pampero, or hurricane, which blows from the pampas or plains of Buenos Ayres, and extends for many hundred miles along the coast of Brazil. During the day it had been exceedingly sultry, and heavily charged clouds had been collecting in the south-west. As the evening approached it became very dark, and the darkness was rendered still more striking by the continued flashes of lightning, followed by heavy peals of distant thunder. About 10 o'clock, while the lightning continued to rage and extend itself around the horizon, I observed a light on the extremity of the vane-staff at the mast-head, and shortly afterwards another on the weather-side of the foretopsail-yard. One of the midshipmen, struck with so curious a phenomenon, went aloft to discover its position. He found it attached to an iron-bolt on the yard-arm, its size rather exceeding that of a walnut, and having a faint yellow cast in the centre, approaching to blue on the exterior edge. He applied his hand to it, on which it burnt with a hissing noise resembling the burning of a portfire, at the same time emitting a dense smoke, without any sensible smell. On taking away his hand it resumed its former appearance; but, when he applied the sleeve of his wet jacket, it run up it and immediately went out, and never again appeared. The one on the vane-staff retained its position for upwards of an hour, but, on account of the heavy rain, and probably also from having been struck by the vane attached to the staff, it went out; but resumed its position after the rain had ceased, although with a less degree of brightness.

The second time I observed the same phenomenon was in the month of December of the same year, while off the coast of Patagonia, in Lat. 36° 40′ S., and Long. 54° 40′ W., a little to the southward of the River Plate. The night on which it was observed was exceedingly dark, but rendered as light as day by the continued flashes of lightning, which spread over the sky and around the whole horizon, so much so indeed that the firmament presented a complete mass of fire. At this time I observed the same luminous appearance, and attached to the same staff as before mentioned. It retained its situation for some hours, but when the lightning subsided it became gradually fainter, and at last entirely disappeared.

I may here remark, that the above lights were not attached to any kind of metal in particular; for the one on the yard-arm, and the other on the vane-staff, were both attracted by metal, the former to an iron-bolt, the latter to a spindle of copper; while the one seen in the month of December was attached to a spindle of hard-wood, the copper having been removed to guard against lightning.

After any of the above phenomena having been seen, we always had very bad weather, commencing with heavy and sudden squalls, generally from the south-west, but varying a few points each way, and settling in a few hours to a steady gale.

In addition to these remarks, I may mention, that, on the coast of South America, the barometer is very sensible of any change in the weather, particularly with regard to the pamperos. Its general height in fine weather is 30.10, varying very little from that point; but, on the approach of the pampeso, the mercury sinks to 29.70, and even as low as 29.35 *. Should the mercury become stationary between these intermediate points, it will most certainly blow from the south-west (which is the pampeso wind); and during the period I served in the River Plate, I never knew this instrument err. But the most remarkable phenomenon which it presents, is the rapidity with which it rises on the squall reaching the ship. I have often observed the mercury rise upwards of a tenth of an inch in less than five minutes after the gust had reached us. It will then rise very gradually, if the weather is to continue fine; or should it rise to 29.90, and again fall, the weather will continue boisterous for some days. Whenever the mercury is below 29.94, the weather becomes unsettled; and when between that point and 29.80, it generally prognosticates lightning, with little or no wind.

With an easterly wind the mercury rises to 30.20 and 30.28; when it obtains that height it generally blows strong, and varying from NE. to SE.

A northerly and north-west wind has the least effect upon the mercury, and I have often observed it to blow with great violence without its being materially changed.

Private Journal of a Voyage to the Western Coast of Africa, including Observations on the Preservation of the Health on that station. Communicated by the Author.

Dear Sir, *November* 1829.

In conversing with you some time ago upon the unhealthy climate of the Western Coast of Africa, and the precautions I used to adopt in preserving the health of my ship's crew when on that station, you requested me to favour you with my private journal kept at that period. I send you, therefore, the following extract, which will sufficiently point out the method I followed, and the success with which it was attended. It may afford a few useful hints, derived from experience and observa-

* The lowest range of barometer I observed while in the River Plate was 29.35, and these remarks relate entirely to that place.

tion on the spot, to those who may have occasion to serve upon that station, and may not be uninteresting generally, on account of the colony at Fernando Po and other parts of the Western Coast of Africa. I remain, &c.

To Professsor Jameson,
College, Edinburgh.

On the 2d September 1799, His Majesty's frigate ——— was ordered to proceed to the coast of Africa from England, with a store-ship and convoy bound to Cape Coast Castle. We had previously been supplied with provisions for six months, and I now received instructions to take on board as much more as we could conveniently stow. The store-ship not having yet arrived at Spithead, I took this opportunity of obtaining various other supplies, which I conceived might be useful to the health and comforts of my crew in the unhealthy climate to which we were ordered. Besides two months more of the ordinary provisions, I also procured from the agent-victualler 24 lb. of bark, and a due proportion of sugar and lime-juice. About the end of September, and some little time before we sailed, I happened to observe a number of maggots crawling out of the chinks of the wood in my cabin. I at first attributed their appearance to dead rats, which were very numerous in the ship, and which means had been employed shortly before to destroy; but I now found that they proceeded from the two months additional supply of bread which had been last sent on board. I immediately applied for a survey: it was found to be totally unserviceable, and I returned the whole to the agent-victualler. He at first refused to receive it, but on requesting Admiral Milbank, who then commanded at Portsmouth, to report his conduct to the Admiralty, in two days after the unwholesome bread was removed, and a supply sent back of a better description. As there was no accommodation in the store-rooms, we were obliged to put this additional quantity of bread between decks, a circumstance which was so far fortunate, that our largest supply was thus saved from the vermin brought with the bread which we sent back.

After being delayed for some weeks longer by prevailing westerly winds, we at length left England upon the 31st October.

Lat. 46° 53′.—From the 1st to the 7th November we had a great deal of wet and blowing weather. We were obliged to have stoves as frequently as possible in the lower decks to keep them dry, and otherwise attend to the comforts of the people. Our number of sick was considerable, being nineteen, a third of whom were unwell from severe colds, and the rest of various other complaints, of which they had not been completely cured when they came from the Haslar Hospital. During this period the barometer varied from $28\frac{9}{10}$ to 50; the thermometer from 58° to 60°.

Lat. 44° 40′.—During the 8th, 9th, and 10th of November, we had fine pleasant weather. I took this opportunity of getting up all the casks, chests, and men's bags upon deck, and washed thoroughly the lower parts of the ship. The stoves were then kept down for several hours, and the crew were not allowed to go below till all was perfectly dry. I ordered their clothes to be regularly washed every Monday and Friday, with fresh water, and a list or account taken of them by divisions. By means of these precautions, I hope to keep the ship's company in a healthy condition. The sick-list is already reduced to ten. The barometer varied between $29\frac{9}{10}$ and $30\frac{3}{10}$; the thermometer 56° and 58°. Lat. 42° 40′.

Lat. 42° 16′.—From the 11th to the 17th November, we had much variable weather, chiefly strong gales of wind, and a great deal of rain, by which the people were kept constantly wet. However, by the constant use of stoves below decks, there have been no new complaints. I now began to serve out lime-juice and sugar for a crew of 284 men. I found 6 oz. of the former and 12 lb. of the latter to each man per week a sufficient quantity. Instead of the butter and cheese, which were expended, they received rice and sugar, the rice being boiled for their breakfast on the days when no oatmeal is allowed. Barometer varied from $30\frac{5}{10}$ to $29\frac{6}{10}$; thermometer from 58° to 62°. Lat. 38° 27′.

Lat. 37° 40′.—From the 18th to the 24th November, we had almost constantly heavy rains and blowing weather, accompanied with thunder. One night our masts were struck with lightning, and the light at the mast-head was extinguished; but no other damage was sustained by us. A ship in company was also struck, and a man killed. The sick-list varies from 14 to 18; the chief complaints are colds, with slight feverish symptoms, arising from the constant exposure to wet. The lower decks are constantly aired with stoves, which serve to ventilate the berths, and keep the people's clothes and beds dry and warm. The usual allowance of rum is served out in the forenoon, and wine in the afternoon. The salt meat is placed upon an iron-grating in the coppers, which is raised a little over the boiling salt-water. It has thus the advantage of being dressed in steam; and, by this means, I find that it is rendered much fresher, and more palatable to the taste, than by the common method of steeping in the salt-water. Rice is still boiled for the crew's breakfasts, on the days when oatmeal is not allowed. They eat it with molasses and sugar, and are very fond of it. I still continue the supply of lime-juice. Barometer varies from $29\frac{5}{10}$ to $29\frac{8}{10}$; the thermometer from 62° to 64°. Lat. 34° 7′.

Lat. 32° 10′.—From the 24th to the 30th November, the weather continued moderate and clear. On the 24th we made the Island of Madeira, and remained at anchor a few hours in Funchal Roads. Some fruit and vegetables were purchased by the officers, but none of the shore-boats brought sufficient to supply the ship's company. The same precautions were still followed for keeping the lower decks dry and clean, and a circulation of air preserved by means of wind-sails. Lime-juice and sugar were now given only to the people, as the petty officers have plenty of tea and sugar of their own, and various other articles of refreshment. The sick-list is at present reduced to seven, consisting chiefly of colds, or other trifling complaints. The barometer varied from $29\frac{8}{10}$° to 30°; the thermometer from 64° to 70°. Lat, 21° 36′.

Lat. 19° 35′.—From the 1st to the 7th December. On the 1st we crossed the Tropic of Cancer; and the ceremony of ducking, shaving, &c. usual on this occasion, was performed on those who had not crossed The Line before. Sailors are, in all situations, like children. Unless placed under control of the strictest discipline, they run into every sort of excess, heedless alike of their professional duties, and the injurious consequences which may happen to themselves. I was willing to indulge the people in this practice, which they look upon in some measure as a birthright, and allowed them to throw the water about, and to amuse themselves in whatever way they pleased. I had given strict orders, however, that no liquor should be offered by the petty officers to be exempted from the ceremony of being ducked and shaved, but only half-a-crown in money; and I myself gave four bottles of old rum to Neptune and his attendants, which I calculated would yield about a glass of grog to each. In spite of all my precautions, they continued to procure more spirits, either privately from the petty officers, or by having saved so much out of their own daily allowance. In consequence, many of them were intoxicated, and unable to do duty in the first watch, being found lying in their wet clothes asleep in the open air. On the next and second day afterwards, several applied to the surgeon, complaining of colds and slight fevers.

On the 3d, we anchored in Port Praya Bay, at the Island of St Jago, and immediately sent ashore as many empty casks for water as it was possible to fill and bring back to the ship before dark: for I had resolved that no person should be on shore late in the evening. Those who went ashore with the empty casks early in the morning, always received bark and wine before leaving the ship; and, after breakfast, at the usual hour, the rest of the party followed. In this way, one raft of casks always reached the ship by 12 o'clock, in time for dinner. I took care that every attention should be given to the cooking of their provisions. Their soup, besides the common ingredients, always contained slices of pumpkin, onions, some pepper-pods, and rice, which rendered it excellent. In about half an hour afterwards, grog was served out, and strict orders were given that the officer who superintended should allow none to be given to any man who had not dry clothes on. This was a precaution which I am satisfied was attended with the best possible effects, as it caused the people to throw off their wet dress whenever they came on board, and thus rendered them less liable to catch cold or fever. In the course of an hour and a quarter after dinner, the watering party again left the ship, and before six o'clock they always came back with the second raft. The usual allowance of grog was then served out, with the same precaution that every man had on dry clothes; shortly after which hammocks were piped down.

Such was the method I followed in watering the ship. It might perhaps have taken up more time, than if we had adopted the general practice of continuing this duty throughout the whole night. But any advantage which the greater expedition of the latter method may afford, is infinitely less than the benefits resulting from the system we adopted: for the men were thus protected from the dangerous effects of the night-air on shore, which have often proved fatal to European constitutions, and, at the same time they were never kept away from their regular meals or rest at the usual hours. The first object of an officer, in the internal management of a ship, should be the health and comforts of his crew; and certainly, by the method which I followed at this unhealthy place, that object was completely attained; for out of the 50 men who were occupied on this duty, only one person complained of any illness, and he, after the third day, was seized with a slight fever, in consequence of drinking some of the country rum. The party was always attended by a lieutenant and three petty officers, each of whom had charge of a certain number, and for whom he was made responsible. The utmost vigilance was necessary, to prevent the men from straggling and stealing away in quest of the spirits sold by the natives, who are anxious to entice them, in order to make them drunk and then strip them of their clothes.

About this period, a very remarkable instance of infection occurred on board, which had very nearly been attended with the most fatal consequences. The sail-maker and several of the seamen had been employed in repairing the wind sails and making awnings. For this purpose, some old canvass was brought up from the boatswain's store-room, with which we had been supplied from the dock-yard at home. Two of the people at work were taken suddenly ill with a nausea, followed by fever. The next day the old canvass was again brought upon deck for the same purpose, and two or three others who were at work on it were also taken ill in the same manner. This circumstance struck me as something very particular, and on examining the canvass, I observed the appearance of blood and matter on it in many places. I sent for the surgeon, and pointed it out to him, and he agreed with me, that there was no doubt this canvass had been used in some other ship for laying the sick or wounded men in, and that the matter and blood had been allowed to become putrid. It was now quite evident to us what was the cause of the people having been seized with fever while working at the canvass, and I immediately ordered the worst to be cut out and thrown overboard, and the rest to be well scoured with hot salt water and sand. Every man who was employed on this canvass was taken unwell, and some had the fever very severely, with a yellow effusion over the body. After the canvass was scrubbed, the people worked on it without any injurious effects ; but had this canvass been made into wind sails without the blood and putrid matter being observed, it might have spread contagion through the whole ship, without a possibility of detecting the cause of it *.

During this period, the barometer varied only from 30 to $30\frac{1}{10}$, the thermometer from 70° to 79°.

Lat. 16° 54′—A part of the next seven days, from the 8th to the 15th December, we still remained in Praya Bay, watering the ship. The same precautions were still employed, and the same unremitting attention observed in keeping the decks clean and dry with stoves. On the 11th, departed this life Thomas Connor, seaman. He was one of those who had been working on the old canvass, and had caught the yellow fever in consequence. He had previously been in a weak state of health. On the day we crossed the Tropic, he had got drunk and slept in his wet clothes in the night air. The sick-list now amounts to eight, three of which consist only of hurts and accidental injuries. I have not been giving the people their usual allowance of sugar and lime-juice lately, as they have abundance of oranges and other fruit from the shore ; and I am desirous of saving as much as possible for our homeward voyage, or when we are using much of salt provisions.

The weather being fine and moderate, I took the opportunity of bringing all the stores from below upon the quarter-deck, in order to air them, and clean the rooms thoroughly where they

* I mentioned this case some years ago to Dr Trotter, who has taken notice of it in his "Medicina Nautica," an excellent work on "the diseases of seamen," vol. iii. 262.

are stored. Every evening, also, water is allowed to flow into the ship's well, and it is pumped out again by the morning watch. By this practice the hold, which is generally so offensive by its effluvia, is kept clean and wholesome.

The seamen have now been provided with a light duck jacket and blue cuffs, and the marines have a similar jacket with scarlet cuffs. This forms at once a cool and agreeable dress in the hot and sultry weather which now prevails. The barometer varies from $30\frac{1}{10}$ to 30; the thermometer from 79° to 74°.

Lat. 9° 40′.—Between the 16th and 22d December, the weather has been generally very warm and nearly calm. On the 20th we struck sounding off Sierra Leone, but did not see the land. The crew are healthy, the sick list consisting only of five, all of them trifling complaints. One of them, R. Roswell, has been in the list ever since we sailed; his complaint is a pain in the loin, from a hurt received two years ago in a former ship, and there is no appearance of his recovering. We have had a partial supply of fish caught with the hook. The usual attention is always paid to keep the lower decks well aired with windsails and stoves every day. Several of the crew have been flogged lately for getting drunk; but I have now fallen upon an expedient which I think will be an effectual remedy. A large wooden collar is made, painted red, white, and blue; this is put about the neck of the person who is found drunk, and he is obliged to wear it until he find another person in the same condition. This is an excellent plan for detecting any one in liquor, as the punishment is severely felt from the ridicule and shame to which the person is subjected who wears it, and, of course, he is induced to look out sharply among the rest in order to be himself relieved. The thermometer, since we arrived on the coast, has always been highest after sunset. When at 82° during the day, about eight or nine o'clock in the evening it has risen to 84°. This does not arise from any heat in the ship, as it hangs in a draft of air in the cabin, where all the windows are continually kept up. I have likewise observed for some days a variation in the barometer. About noon it falls $\frac{1}{10}$th of an inch under 30, and always rises again in the evening. This cannot be from the rarefaction and expansion of any small particle of air that may be above the mercury in the tube, as the thermometer is highest in the evening, when the barometer again rises. (Query, may not the rise of the tide have some effect on the barometer, as, since we have come to the coast, it has generally fallen at high water ?)

Lime-juice and sugar are not now served, as from the good health of the people it seems to be unnecessary. Indeed, I never saw a crew in better health and spirits. The water we got at St Jago becomes very bad; it tastes of decayed vegetables, and has a disagreeable smell, though the ventilator is used to sweeten it. Barometer varied from 30 to $29\frac{9}{10}$; thermometer from 78° to 80°. Lat. 7° 35'.

From the 23d to 29th December, the weather has been extremely sultry, being for the most part calm, with thunder and lightning in the night, with heavy torrents of rain. The people are thus generally drenched; however, in the morning, their wet clothes are ordered to be hung up, on lines between the masts, and dried. The sick-list consists of five; none seriously ill except Roswell, and another man, who slept one night on shore at St Jago; he has been attacked with a severe fever, and is very much reduced. Stoves are uniformly hung between decks every forenoon, and all afternoon, and although the climate is so hot, yet I think this practice is even more necessary than in the English Channel; for I observe, when any drop of water happens to be spilt, it will remain for days without being dried up, and this, too, in my own cabin, where there is a constant current of air. A few of the young people in the ship have been attacked with boils about the face and joints; but they generally get well in a day or two. From the great heat of the weather, the people allow their thick clothes to be lying about the decks. I have in consequence ordered them to be collected, and after being dried, put into bags, and deposited in one of the store-rooms: they will be given back to the owners when we again come into a cold climate;—if this precaution is not taken, they would be lost or sold, and the people would want proper clothes on the home-passage, as I have often before experienced. Barometer from 30 to $29\frac{9}{10}$; the thermometer from 81° to 82°. Lat. 5° 11'.

From the 30th December to the 5th January 1800, we had almost constant calm, with thunder, lightning, and heavy rain in the night. No fresh complaints have appeared. The store-rooms are excessively hot, holes are bored in the doors to allow some circulation of air, and the doors kept open in the daytime, and the windsail introduced; this is likewise done to the spirit-room and after-hold. The usual regulations about keeping stoves between decks are constantly continued. A number of canoes come from the shore, but bring nothing on board. For several days past, immense flocks of swallows have settled about the mast-heads and rigging about 8 o'clock in the morning, the ship seeming to attract their attention; but after flying about for half an hour, they rise to a great height in the air, and then go to the southward. This week I have been obliged to put the crew to an allowance of water, as it is difficult to be got on the coast,—two quarts per man, exclusive of their pease-soup and burgoo. The officers have the same allowance. This is found to be quite sufficient, and saves nearly a ton per day. Barometer $29\frac{9}{10}$ to $29\frac{8}{10}$; thermometer from 8° to 83°. Lat. 4° 21′.

During these eight days, from the 3d to the 13th January, we have had extremely thick weather (being what is called the Harmattan season), so that we were unable to see the land at two miles distance. The air is very moist, and a heavy dew falls in the night. Iron rusts on the least exposure to the air, and leather of every description is covered with mould. The sick-list consists of five, all very slight complaints, except Roswell, who still continues the same. Every attention is paid to keep the ship well ventilated between decks, by stoves and windsails. The 12th of the month I had the misfortune to put the barometer out of order. I had screwed the mercury to the top of the tube, to remove the instrument out of the way of the people washing the cabin, but it would not descend again, owing probably to the aperture in the lower end of the tube being too small. But the want of a barometer is less severely felt here than in higher latitudes, where the variation is more considerable, for some weeks past the change having been no more than $\frac{9}{10}$. The thermometer stands generally at 82°. Lat. 4° 51′.

Between the 13th and 20th January we were principally at anchor on the coast, and at Cape Coast Castle. The thermometer in the morning is generally 79°, and at noon 83°. The sick-list consists of five; but in clearing the hold to water the ship at Cape Coast, two of the men at work there, after coming on deck in a violent perspiration, inadvertently bathing themselves with cold water, they were immediately after attacked with fevers; after two days confinement, however, they recovered. Other two, likewise, were attacked with slight flux, which I think arose from their having slept on deck in the land-wind; but they also are again doing duty. This week we found a good deal of water had lodged in the spirit-room, and had become very offensive. We hoisted up all the casks, and found the limbers stopt; this we cleared, and got down stoves to purify the air.

We attempted to water the ship at Cape Coast Castle, but found the pond and well so full of mud and filth, from not having been recently cleaned, that we could not procure more than ten tons, though, if due attention was paid to keep the pond in proper order, there would, I am certain, be sufficient for a line-of-battle ship. The pond is offensive in the highest degree, from the quantity of filth mixed with the water, and the well is only separated from it by a wall. I hope that this evil will be remedied, from the representation I mean to make upon the subject to the Admiralty; for, were an enemy to appear or be expected on the coast, our ships could not possibly remain on the spot for want of water, and I am certain that, were this pond and well to be kept clean, and deepened a little, there would be abundance of water for several men-of-war; at present, when they require a supply, they must leave the coast unprotected, in order to seek for water at St Thomas's or Prince's Island. I have ordered about a pound of lime to be put in each cask filled with this water, which I hope will rectify it a little, for, in its present state, it is quite unwholesome to drink. Since we came on the coast, we have had very little fruit or other refreshments, and I have again ordered the lime-juice and sugar to be served out to the people. Thermometer from 80° to 83°. Lat. 5° 7′.

From the 20th to the 31st January.—During our stay at Cape Coast we had very few complaints, those we had were slight fevers and diarrhœas; but when the people applied to the surgeon on the first attack, they seldom remained off duty above a day or two; the people who were on shore getting off the water, and cutting copse for brooms, were none of them taken ill, though much exposed to the heat of the sun. Indeed I always have observed that, in tropical climates, there is far less risk in exposing the people to the heat of the sun, than in sending them away early in the morning, before the damps collected in the night are dissipated. Whenever they had occasion to go ashore before their breakfast, they had always wine and bark given to them.

On the 23d, John English (S.) was attacked with fever. He died on the 29th. As boatswain's yeoman, he was almost constantly employed in the store-room, and as he exhibited exactly the same symptoms as Connor, I do not think it improbable, that this man had also caught the infection from the store-room, or the old canvass above described.

On the 23d we left Cape Coast, and next day anchored at Accra, where we remained till the 30th, when we sailed for Prince's Island to wood and water. During our stay at Accra, we were supplied with fresh beef, and the people purchased a considerable quantity of vegetables and fruit in exchange for their bread. The sick list consisted of a few diarrhœas, but none very ill. Since we arrived at Cape Coast we have had no rain; there is generally a fine sea-breeze during the day, and land-wind at night. Thermometer from 80° to 83°. Lat. 3° 40′.

From the 1st to the 4th February, we were running down to Prince's Island; on arrival there, we found that the French squadron had been here a month, and only left it on the 30th *ultimo*, and had plundered the island of all their stock, and made them pay 500 ounces of gold to ransom the town. We immediately set about filling our water and cutting wood, which we completed on the 8th. This island is nearly in a state of nature, and entirely covered with trees. We anchored in a deep bay, almost surrounded with high hills, and only about 200 yards from the shore on each side. We watered abreast of the ship, at a small rivulet which runs down from the hills. The watering and wooding party were sent away always as soon as they had got their breakfast (eight o'clock), and were brought off to their dinner at twelve; the wooding party took their dinner with them, as they had farther to go; but they were always brought on board at sunset, then their afternoon's grog was served, and the hammocks piped down. The people on shore duty were a good deal exposed to the sun, and at times we had excessive heavy squalls, with a great deal of rain. During our stay here we had no complaint; but the day we left it, (the 9th), we had eight or nine of those who had been on shore attacked with fever, which I attributed to their having overheated themselves in climbing the cocoa-nut trees, and immediately going into the water to cool themselves. All of them had the yellow effusion over their skin, which remained for some days, and then gradually disappeared.

But I am persuaded, that if we had staid much longer at this island, we should have lost some men. The French squadron lost a great many; but that is not to be wondered at, as, from the account the inhabitants gave us, their ships were in a most filthy state, and most of their crew constantly on shore all night, without any kind of discipline being observed among them. We got here plenty of fruit, but no fresh meat for the people, except fish, which we caught in great abundance with the line. Thermometer 83° at Prince's Island.

On the 10th February we left Prince's Island. Those who were attacked with fevers are all recovering; and by the 20th all had returned to their duty except two, who are still weakly.

On the 16th, Richard Roswell, who had been so long ill, died of consumption, and it was the surgeon's opinion that he would not have lived so long in any other climate.

To the 24th we were working up to Cape Coast, when, instead of anchoring, I kept under sail, and stood off and on within two or three miles of the coast. I took the opportunity of getting every chest up from between decks, and whitewashed them thoroughly with two coats of lime, which I had brought from England for the purpose, and employed all the carpenters in making and fitting up a folding-table for each mess between decks. This makes the people extremely comfortable. The crew are at present very healthy. There is no one in the ship who is not doing duty. On the 27th we again anchored at Cape Coast. Thermometer at 84°.

On the 6th of March we sailed with a convoy for the West Indies, to touch at Prince's Island in our way, to wood and water. On running down to that island, we had at times strong squalls or tornadoes, with very heavy rains, thunder and lightning. However, the ship's company were all in good health, except a few trifling complaints. Stoves are constantly kept the usual time between decks.

On the 11th we again anchored at Prince's Island, and as I attributed the people being taken ill on the last occasion we were here, to their going into the water when warm, I gave strict orders to the officer who was sent on the shore-duty, not to allow this in future.

We watered and wooded the ship as before, and remained till the 20th, waiting for the convoy. We had no sick at all during this stay, except a few slight colds, which did not keep a single man from his duty. The weather was as before, heavy squalls (tornadoes) with violent rains, at times accompanied by thunder and lightning; the thermometer standing generally at 84°. These tornadoes prevail during the Harmattan season, which generally lasts during the months of December, January and February. While off Cape Coast Castle, we were for some time almost daily exposed to them. About nine or ten o'clock in the morning, heavy black clouds were to be seen accumulating over the mountains in the interior of the country, and then gradually advancing towards the sea-coast. As the clouds approach the ship, torrents of rain are observed to be gushing from them, accompanied with the most vivid flashes of forked lightning, which dart down in continued sheets into the water. As soon as the squall had left the shore, I generally caused every stitch of canvass to be taken in, and sent the people below till the tornado passed away to leeward. It is a curious fact, that whenever the clouds approached about half a mile from the ship, the thunder and lightning uniformly ceased; the dense clouds passed over our masts silently and harmlessly; and when they were about half a mile to leeward, the same phenomena recommenced which were before observable. These phenomena generally continued for about half an hour longer in their progress out to sea, after which time the rain ceased, and the sky cleared up. To these circumstances I may add another curious fact, which was observed by us frequently, that when the lightning had discontinued darting down from the clouds into the sea, and the squall was beginning to dissipate, we distinctly perceived the electric matter to be rising upwards from the water. During the continuance of these tornadoes we never used our conductors; and it is worthy of consideration whether it would not be more safe for ships never to have recourse to them. When the conductor is fixed to the mast-head, a chain is attached to it, and brought down one of the back stays into the water; but if any accident were to break off the communication with the water, the conductor, so far from proving a protector, would only become a source of danger, by powerfully attracting the electric fluid, without affording any means for its escape. When, therefore, I discovered, that there existed some quality in the ship itself, perhaps the masts and yards, which caused the thunder and lightning to cease when it approached the ship, I considered it most expedient not to try what the effects of the conductor might be, and during all the period that we were exposed to these tornadoes, no accident ever occurred to us.

On making Artificial Pearls.

These are small globules, or pear-shaped bulbs, blown in thin glass, and each pierced with two opposite holes, by which it may be strung. These are afterwards prepared in such a manner as to greatly imitate the rounded and brilliant concretions, reflecting the iridescent colours, which are found in certain bivalve shells, such as the pearl-mussel, &c., and which bear the name of oriental pearls.

We can perfectly imitate the brilliancy and reflection of these natural pearls, by means of a liquid, termed Essence of Pearl, and which is prepared by throwing into liquid ammonia the brilliant particles which are separated by friction and washing from the scales of a small river fish named the Bleak (Cyprinus alburnus). These pearly particles, thus suspended in the ammonia, can be applied to the whole interior of these glass bulbs, by blowing it into them; after which, the ammonia is volatilized by gently heating them.

It is said that some manufacturers do not apply the ammonia;

but instead thereof, suspend the pearly particles in a solution of isinglas, well clarified, and which they drop into the bulbs, and then turn them in all directions, in order to spread it equally over the interior surfaces. There can be no doubt, that in this mode of applying the pearly mixture, the same success will be obtained as in the before mentioned process, and that it will afford a layer of the same thinness and brilliancy.

It is important, to succeed in the perfect imitation of pearls, that the glass bulbs or pearls employed should be of a slight bluish tint, opalized, and be also very thin; and likewise, that the glass should contain but little potash, or oxide of lead. In each manufactory of these artificial pearls, there are workmen exclusively employed in the blowing of these bulbs, and which requires a great dexterity to succeed well therein,—a dexterity, indeed, which can only be acquired by long practice.

The French manufacturers of these artificial pearls have at length attained a degree of perfection before unknown. We must add, that the bulbs are finally filled up with white wax.

On Improvements in Black Writing Ink. By JOHN BOSTOCK, M. D. F. R. S., &c.

WHEN the sulphate of iron, and the infusion of galls, are added together for the purpose of forming ink, we may presume that the metallic salt or oxide enters into combination with at least four proximate vegetable principles, viz. Gallic Acid, Tan, Mucilage, and Extractive Matter,—all of which appear to enter into the composition of the soluble parts of the gall-nut. It has been generally supposed, that two of these, gallic acid and the tan, are more especially necessary to the constitution of ink; and hence it is considered, by our best systematic writers, to be essentially a tanno-gallate of iron. It has been also supposed that the peroxide of iron alone possesses the property of forming the black compound which constitutes ink, and that the substance of ink is rather mechanically suspended in the fluid than dissolved in it.

Ink, as it is usually prepared, is disposed to undergo certain changes, which considerably impair its value. Of these, the three following are the most important: its tendency to moulding—the liability of the black matter to separate from the fluid, the ink then becoming what is termed ropy—and its loss of colour, the black first changing to brown, and at length entirely disappearing. Besides these, there are objects of minor importance to be attended to in the formation of ink. Its consistence should be such as to enable it to flow easily from the pen, without, on the one hand, its being so liquid as to blur the paper, or, on the other, so adhesive as to clog the pen and to be long in drying. The shade of colour is also not to be disregarded; a black, approaching to blue, is more agreeable to the eye than a browner ink; and a degree of lustre, or glossiness, if compatible with the due consistence of the fluid, tends to render the characters more legible and beautiful.

With respect to the chemical constitution of ink, I may remark, that although, as usually prepared, it is a combination of the metallic salt or oxide, with all the four vegetable principles mentioned above; yet I am inclined to believe that the last three of them, so far from being essential, are the principal cause of the difficulty which we meet with in the formation of a perfect and durable ink. I endeavoured to prove this point by a series of experiments, of which the following is a brief abstract. Having prepared a cold infusion of galls, I allowed a portion of it to remain exposed to the atmosphere, in a shallow capsule, until it was covered with a thick stratum of mould; the mould was removed by filtration, and the proper proportion of sulphate of iron being added to the clear fluid, a compound was formed of a deep black colour, which showed no farther tendency to mould, and which remained for a long time without experiencing any alteration.

Another portion of the same infusion of galls had solution of isinglas added to it, until it no longer produced a precipitate; by employing the sulphate of iron, a black compound was produced, which, although paler than that formed from the entire fluid, appeared to be a perfect and durable ink. Lastly, A portion of the infusion of galls was kept for some time at the boiling temperature, by means of which, a part of its contents became insoluble; this was removed by filtration, when, by the addition of the sulphate of iron, a very perfect and durable ink was produced. In the above three processes, I conceive that a considerable part of the mucilage, the tan, and the extract, were respectively removed from the infusion, while the greater part of the gallic acid would be left in solution.

The three causes of deterioration in ink, the moulding, the precipitation of the black matter, and the loss of colour, as they are distinct operations, so we may presume that they depend on the operation of different proximate principles. It is probable that the moulding more particularly depends on the mucilage, and the precipitation on the extract, from the property which extractive matter possesses of forming insoluble compounds with metallic oxides. As to the operation of the tan, from its affinity for metallic salts, we may conjecture that, in the first instance, it forms a triple compound with the gallic acid and the iron; and that, in consequence of the decomposition of the tan, this compound is afterwards destroyed. Owing to the difficulty, if not impossibility, of entirely depriving the infusion of galls of any one of its ingredients, without in some degree affecting the others, I was not able to obtain any results which can be regarded as decisive; but the general result of my experiments favours the above opinion, and leads me to conclude, that, in proportion as ink consists merely of the gallate of iron, it is less liable to decomposition, or to experience any kind of change.

The experiments to which I have alluded above, consisted in forming a standard infusion, by macerating the powder of galls in five times its weight in water, and comparing this with other infusions which had either been suffered to mould, from which the tan had been abstracted by gelatine, or which had been kept for some time at the boiling temperature; and by adding to each of these respectively, both the recent solution of the sulphate of iron, and a solution of it which had been for some time exposed to the atmosphere. The nature of the black compound produced was examined by putting portions of it into cylindrical jars, and observing the changes which they experienced with respect either to the formation of mould, the deposition of their contents, or any change of colour. The fluids were also compared by dropping portions of them upon white tissue paper, in which way both their colour and their consistence might be minutely ascertained. A third method was to add together the respective infusions, and the solutions of the sulphate of iron, in a very diluted state, by which I was enabled to form a more correct comparison of the quantity, and of the state of the colouring matter, and of the degree of its solubility.

The practical conclusions that I think myself warranted in drawing from these experiments, are as follows:—In order to procure an ink which may be little disposed either to mould or to deposit its contents, and which, at the same time, may possess a deep black colour, not liable to fade, the galls should be macerated for some hours in hot water, and the fluid be filtered; it should then be exposed for about sixteen days to a warm atmosphere, when any mould which may have been produced must be removed. A solution of sulphate of iron is to be employed, which has also been exposed for some time to the atmosphere, and which, consequently, contains a certain quantity of the red oxide of iron diffused through it. I should recommend the infusion of galls to be made of considerably greater strength than is generally directed; and I believe that an ink, formed in this manner, will not necessarily require the addition of any mucilaginous substance to render it of a proper consistence.

I have only further to add, that one of the best substances for diluting ink, if it be, in the first instance, too thick for use, or afterwards becomes so by evaporation, is a strong decoction of coffee, which appears in no respect to promote the decomposition of the ink, while it improves its colour, and gives it an additional lustre.—*Transactions of the Society of Arts of London*, vol. xlvii.

Additions to the Natural History of British Animals. By John Coldstream, M. D., M. W. S., &c. (Communicated by the Author).

Coryna Squamata, (Fleming, Brit. An. 553).—The tentacula vary in number from 5 to 25. There are generally five botryoidal groups of vesicles, sometimes only one. After having been kept in small vessels of sea-water for some hours, without renewal of the water, some of the animals protrude the inner surface of the mouth, so as to present a convex disc, with the tentacula ranged around it. Small individuals, possessing apparently the same structure as the larger ones, occur around the bases of the latter. The vesicles are distinctly seen even in these. The Coryna is very hardy; its tentacula scarcely contract when touched; and the body may be divided, and detached entirely from its base, without the head altering its form, or the tentacula shrinking. The specimens I examined were from the east coast of the Island of Bute, where they were found attached to fuci, near low water-mark *.

Valkeria, (Flem. Brit. An. 550.); *V. glomerata*, C. (Plate II., Fig. 1. & 2).—Stem simple, slightly branched, partly creeping, partly erect. Cells ovate, lengthened, with the mouths slightly compressed quadrangularly; scattered over the stem in irregular groups. Before the polype is evolved, the cell is closed at the distal extremity by a conical covering (This is represented at *a a*, Fig. 2.) Polypi with *ten* tentacula, finely ciliated. They extend considerably beyond the mouths of the cells, to the margins of which each is attached by a membrane, which is protruded before the tentacula, when the polype is about to expand itself. When alarmed, it contracts very rapidly.

Found attached to the stems of *Fucus nodosus*, in small pools, at low water, near Leith.

Note.—Notwithstanding the number of the tentacula, I have placed this species in the genus *Valkeria*, on account of its agreement in habit and general character with the *V. uva* and *cuscuta*. Perhaps it ought to form a separate genus. The termination of a branch, with a group of cells, is represented in Plate II, Fig. 1. of its natural size, and considerably magnified in Fig. 2. The protuberances on the stem, marked *b b*, seem to be the rudiments of future cells.

Halichondria suberica, (Flem. Brit. An. 522.) Plate II, Fig. 3, 4, & 5. I found two specimens of this sponge in Rothesay Bay, attached to old shells of *Turritella terebra*, each containing within its mass a spiral cavity of two turns, continuous with that of the shell. The cavity enlarges towards its mouth,

* This beautiful animal Professor Jameson met with among the Shetland Islands.—Vide Wernerian Memoirs, vol. i. p. 565.

so that the outline of the whole mass is conical, and resembles that of some *Buccina*. (Fig. 4. Plate II, is a sketch of a section of the mass, shewing the position of the *Turritella*, and the cavity in the sponge). This cavity was inhabited, in both specimens found, by the common hermit-crab. Externally, in one specimen, there are three fecal orifices, in the other only one. The surface of the spiral cavity is smooth; and, near the shell, it is perforated by numerous small holes. The spicula are slightly curved, pointed at one end, and terminated at the other by a round head. (Their outline is represented in Fig. 5.)

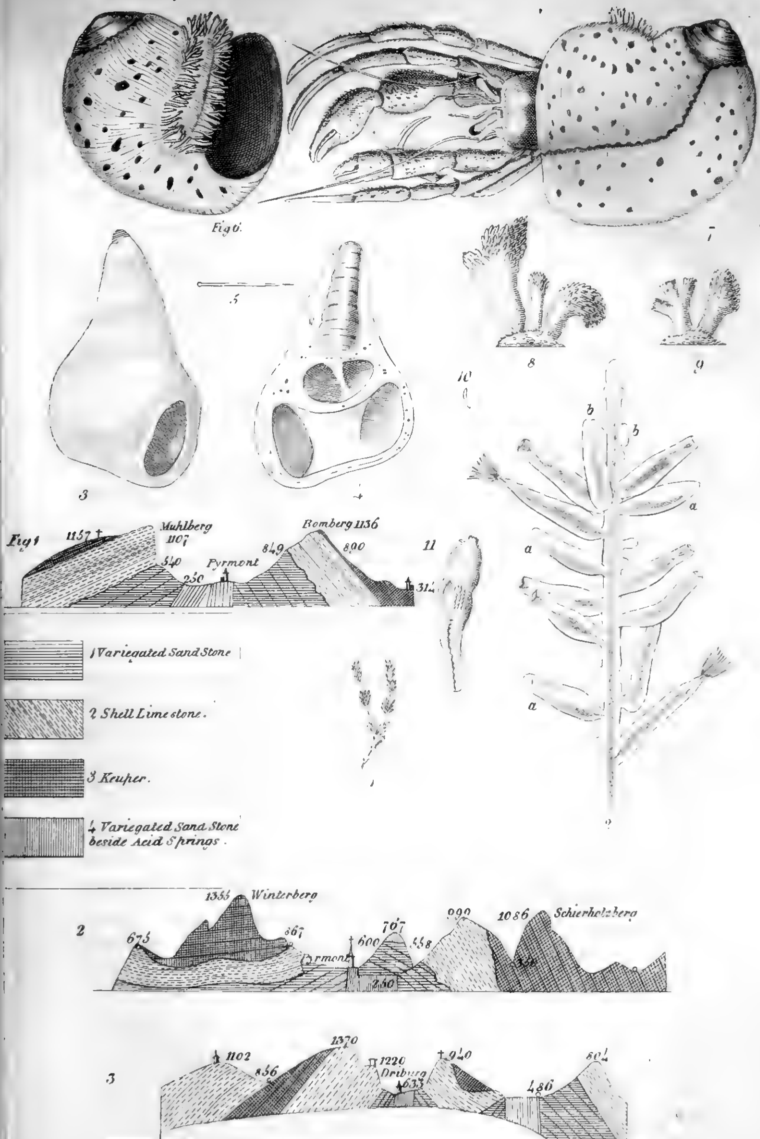
The history of these sponges I presume to be this. The crab takes possession of the *Turritella*, when young; the sponge then attaches itself to the shell, and, as it grows, is forced, by the motions of the crab, to assume a spiral form, with a cavity enlarging towards the mouth, corresponding to the progressive development of its crustaceous inhabitant.

Montagu, who first described this species, found it generally in the very same circumstances as those I have just described; but he says, that, in every specimen which he obtained, the sponge had spread within the aperture of the old shell to which it was attached; and that, in some cases, it seemed to have increased so much internally, notwithstanding the motions of the crab, as to force the latter to remove to another shell (Wern. Mem. ii. 102.). In my specimens, the sponge does not spread within the aperture of the shell.

Actinea maculata, (Adams, Linn. Trans. v. 8.) *. General mass of the animal flattened and extended; thickness at the oral disc three-tenths of an inch, diminishing towards the circumference of the base; longest diameter of the base about three inches; margin minutely crenated; colour of the body, near the

* This has been given as a synonyme of *A. sulcata*, (Flem. Brit. An. p. 498, and Dict. des Sciences Nat. lx. p. 294); but the characters of the species here described do not correspond with those assigned to *A. sulcata*, while they agree closely with the description of the *maculata* of Adams. In the *A. sulcata*, the tentacula are greenish, and longer than the body; in the *A. maculata*, they are white, with a faint streak of brown, and shorter than the body; the first has the oral disc dentated, the latter has it plain. Lamarck (An. sans Vert. iii. 69), gives the specific name of *maculata* to a species from the Red Sea, but neither the characters assigned to it, nor the figure in the Encyclopédie, (Pl. 72, f. 10), correspond with those of our animal.

Edinr. new Phil. Jour. Vol. IX. p. 235



Valleys of Elevation.

Published by A. Black Edinr. 1830.

E. Mitchell, sculpt.

base, reddish-brown, passing gradually into a light cream colour towards the oral disc; whole surface striated longitudinally with alternate opaque white, and translucent bluish lines, and marked irregularly with bright reddish-purple spots. These spots are confined to the outer coat, which is easily peeled off. That below it is of a pink colour, and is marked with the striæ, which shine through the outer coat. Oral disc of an elongated oval form, white, and bearing on its outer margin numerous rather short tentacula, arranged in three or four irregular rows; tentacula shorter than the body, acuminated, white, each marked with a faint streak of brown; mouth large, oval; lips white, contracted into folds; internal surface of the stomach marked with numerous white striæ. Base fixed to a thin horny expansion attached to the apertures of various dead shells, such as *Trochus cinerarius* and *T. Magus*.*, and forming, as it were, an extension of the body-whorl of the shell in a spiral form. Over this, the *Actinea* is spread entirely, and covers also more or less of the shell. Its oral disc is uniformly situated close to the inner lip of the horny case. The aperture of the case is accurately surrounded by its body, the margins of the opposite sides of which meet, and are closely applied to one another at the middle of the outer lip of the aperture, whence they run upwards towards the old shell, where they generally separate again, leaving its apex uncovered. This arrangement will perhaps be better understood by a reference to the figures, (Figs. 6 & 7, Pl. II.)

The horny membrane to which the *Actinea* is attached, covers, for the most part, nearly the whole external surface of the old shell to which it is fixed, and, from the circumference of its aperture, is prolonged into a large hollow expansion, resembling in form, and occupying, relatively to the shell, the place of, a ventricose body-whorl. Its substance is of uniform thickness throughout its whole extent, of a greenish-brown colour, translucent, having both surfaces irregularly wrinkled transversely. In a recent state it is quite flexible, but when dried it is brittle. It takes fire and burns readily, leaving a very small residuum, which does not effervesce with acids. It is insoluble in boiling water and in alcohol, but dissolves slowly in acids, and in solu-

* Adams found his specimens "surrounding the apertures of deserted shells of *Murex despectus*."

tions of the alkalies. Its general appearance may be compared to that of the cases of *Tubularia indivisa,* except in point of colour.

The case thus formed by the old shell and the horny membrane, and covered by the *Actinea,* I have *always* found inhabited by a variety of the hermit-crab (*Pagurus benhardus*), differing from the common one in having the distal extremities of the hands nearly smooth, and the margins of all the legs fringed with hairs. The crab is so imperfectly covered by the case, that the whole anterior half of the thorax remains exposed, even when the animal retires within it as much as possible.

This curious combination of animals occurred to me several times in Rothesay and Kames Bays, in Bute, either thrown ashore after easterly gales, or drawn in by flounder-nets. Its natural history is perhaps doubtful. Is the horny case secreted by the *Actinea?* Or is it the dead axis of some zoophyte, like that which covers old *Buccina* (*Alcyonium echinatum, Fl.*), and which I have found forming an extension of the body-whorl of the *Turbo littoreus,* also inhabited by the *Pagurus?* Or, is it likely that the old shell, with a young crab in it, may have been swallowed by the *Actinea;* that the crab may have forced its way through the walls of the stomach, and the integuments of the latter, and that, the *Actinea* then secreting a peculiar membrane to defend its base, the crab may have found itself provided with a habitation suited to its wants? To this last supposition an objection is found in the fact, that the full grown shell of *Trochus Magus* forms sometimes the base of the horny case, and this shell is too large to enter the mouth of the *Actinea.* It seems to me probable that the horny membrane is produced by the *Actinea;* and that its formation presents a striking instance of the operation of that beautiful law of Nature which makes the habits of one animal subservient to the wants of another *.

Asterias irregularis, (Flem. Brit. An. 486).—Diameter, including the rays, $3\frac{1}{2}$ inches; colour of the dorsal surface vermilion-red, with yellowish-white spots; tips of the rays white;

* British zoologists will feel indebted to Dr Coldstream for his description and figure of this, the most interesting of the Actinea tribe; if indeed this curious creature is really a true Actinea. We shall, in this Number of the Journal, make further mention of it.—EDIT.

ventral surface white; avenues of suckers yellowish; whole surface very smooth and soft. The yellowish-white spots on the dorsal surface are, when the animal is contracted, minute round depressions, from which, in a state of expansion, conical transparent tubercles are protruded. On the ventral surface, slightly elevated striæ extend between the marginal spines and the sucker canals. The dorso-marginal plates are not seen when the animal is alive. There are 88 suckers, arranged in two rows, in each canal. The suckers are moved about slowly, and adhere feebly.

Found under stones amongst sandstone cliffs, at Whiting Bay, Arran.

Synoïcum, (De Blainville, Man. de Malacol. p. 586, a genus in which several of Savigny's genera of compound *Ascidiæ* are united); *S. rubrum*, C. (Plate II, Figs. 8, 9, 10 & 11.)—Form of general mass various; base, for the most part, cylindrical; summit larger, more or less conical or convex, sometimes divided; height nearly an inch; base yellowish, translucent, somewhat cartilaginous; summit containing the animals imbedded in its substance, and coloured by them of a bright vermilion; animals very numerous in each lobe, and crowded together without any regular arrangement; orifices prominent, with their margins divided into eight or nine short tentacula. The size and outline of each animal, separated from the common mass, are represented in Fig. 10, and a magnified view of the same is given in Fig. 11.

Found in abundance on the north shore of Lamlash Bay, Arran, attached to the sides of boulders, generally under the shelter of fuci.

Sidnyum turbinatum, (Savigny, Mem. 238.); *Sydneum*, (Flem. Brit. An. 469).—In specimens from St Ninian's Point, on the west coast of Bute, I found from 5 to 20 animals set round the circumference of each lobe.

Ascidia Prunum, (Lamarck); *Pirena prunum*, (Flem. Brit. An. 468)*. Branchial orifice with nine short conical tentacula:

* I do not adopt the latter generic name, because Lamarck has already assigned it to a genus of fresh-water mollusca. (An. sans vert. vi. (2.) 169.)

The reddish lines, said to mark the orifices, do not always exist. Inner tunic very soft, transparent, and furnished with three or four longitudinal muscular bands. Branchial membrane dusky green, with a tinge of blue. It has been doubted (Cuvier, Mem. sur les Ascid. 7.), whether the *Ascidiæ*, in contracting their tunics, expel the water through their anal as well as through their branchial orifices. I have distinctly seen this species, as well as others (in particular the *A. intestinalis*), propel currents of water through both orifices, at every contraction of the tunics, that from the anal orifice being almost as strong as the one from the mouth of the branchial sac. When the *A. prunum* is in a state of rest, a slow and uniform current can be perceived flowing inwards through the opening into the branchial cavity, but none can be detected entering the anal orifice. The voluntary contractions for the expulsion of the inspired water, take place at irregular intervals of time; but, for the most part, not more frequently than once in a minute. The steady flow of the inward current through the branchial opening, seems to strengthen Cuvier's supposition with regard to the mechanism of respiration in the *Ascidiæ*, (Mem. 17.)

This species occurs sparingly in the Firth of Clyde, adhering to the under surfaces of slate boulders *.

Ascidia (Lamarck) *rugosa*, C.—General form somewhat conical, compressed; length upwards of two inches; surface of outer tunic greenish, irregularly wrinkled, rugose, harsh; substance almost cartilaginous, near the base very thick; orifices approximate, large, compressed, slit-like; branchial one terminal. The prolongations of the inner tunic, which unite it to the outer one, are attached nearly half an inch within each of the orifices of the latter; inner tunic whitish, transparent; branchial tube furnished with two layers of muscular fibres; external, transverse; internal, longitudinal; orifices studded with minute red spots arranged irregularly; branchial cavity, extending the whole length of the inner tunic, straight; branchial membrane greyish, reticulated. A fold, projecting into the branchial cavity, and continuous with the membrane lining its walls, is attached along its

* Professor Jameson, in his paper on Vermes, enumerates the *Ascidia prunum* among the marine animals of the Firth of Forth.—*Vide Wern. Mem.*

anal side, from the mouth (which it partly surrounds) towards the opening of the cavity, opposite the position of the anus. It is about one-sixth of an inch in breadth, and has its surface marked with transverse striæ only. The mouth is simple. The stomach and two first turns of the intestine are united together, and surrounded by, the liver, which has a spongy structure. Imbedded in its substance are several series of white granular bodies. A large column or rib projects into the cavity of the intestine, on the anal side, along the greater part of its course; its walls are coated with a dark orange-red matter, easily rubbed off. Ovary situated between the middle of the branchial membrane and the mass of the intestines.

The species being rare, I could not procure a sufficient number of specimens to enable me to prosecute farther the examination of its structure; but the details already given are sufficient to indicate its more striking peculiarities, and to point it out as differing, in several particulars, from the species already described.

It occurred in East Loch Tarbet, Argyleshire, adhering to dead branches of some land shrub.

Lima fragilis, (Flem. Brit. An. 388).—I mention this rare animal for the purpose of pointing out a locality where it may be found in some abundance. It is near Ardbeg Point, on the west side of Rothesay Bay, Bute. It seems to be an inhabitant of deep water, as I found it thrown ashore only after strong gales from the east.

On Polishing Metals.

Before proceeding to polish metals, they commence by preparing the surfaces they would polish; that is to say, it is of importance to remove all the marks left by the file, the turning tool, the scraper, &c. in order to render the surfaces uniform.

This preparation is effected on those metals which are not very hard, by means of pumice-stone, either used in substance, or reduced to powder, and water; and, when in powder, applied upon felt, or upon slips of soft wood, covered with buffalo or chamois skin, if the surfaces be flat; or with pieces of soft wood, properly shaped, so as to penetrate into the hollows, and act upon the raised parts. When the first coarse marks are thus removed, they then proceed to remove those left by the pumice-stone. In order to this, they employ finely powdered pumice-stone, which they grind up with olive-oil, and employ it upon felt, or upon small pieces of soft wood, such as that of the willow or sallow. It is important, in these manipulations, to observe an important rule, which is never to proceed from one operation to another, before previously washing the pieces of work well with soap and water, by means of a brush, in order entirely to remove the pumice-stone, used with water, before employing it with oil, and likewise never to use those tools for succeeding operations, which had been used in preceding ones; each stage of the operation requiring particular tools, and which should be kept in closed boxes, in order to prevent the powders from being diffused or scattered about when not in use. Without taking these precautions, which must be particularly and minutely attended to, we should be liable to make fresh scratches instead of removing them.

After removing the marks left by the coarse pumice-stone and water, by means of finely grounded pumice-stone and oil; to know which, we should wash it with soap and water, and dry it well with a linen cloth; we must then examine it with a lens or magnifying-glass, to see whether any scratches yet remain; if not, we may proceed to the polishing. The softer metals are polished in different manners, according to their size and uses; the larger gold works are, however, generally burnished, but the smaller gold works in jewellery, &c. and those in brass for watch-work, are not burnished, but polished. The following are the manipulations:—After having removed with oil-stone powder the marks of the file, &c. they smoothen them with blue and grey stones, and plenty of water: there are two kinds of these stones, the one soft and the other hard; the first is designated by Brongniart, under the name of Argillaceous Schistus, and is the kind in question; the second kind is named by the above mineralogist Schiste Coticule: this serves to sharpen tools upon. The pieces of watch-work are always smoothened in this manner, until all the marks disappear, and which is known by washing them in the manner above mentioned with soap and water.

They finally proceed to the polishing, by employing the tripoli from Venice, which is most to be preferred, and is either finely ground in water, or in olive-oil, according to the different cases, for pieces of gold work, or the larger kinds of jewellery articles, and until they perceive their surfaces are become perfectly brilliant; they then finish them with tripoli, reduced to an impalpable powder, and applied upon a very soft brush.

For polishing those pieces of watch-work which are not to be gilt; after smoothening them with the grey or blue stone and water, they polish them with rotten-stone well washed over, and consequently very fine, ground up with olive-oil, and finish with dry rotten-stone.

This rotten-stone is, according to M. Brongniart, a kind of very light tripoli, but finer and more friable than the other sorts. It comes from England, and is highly esteemed for polishing with; it is of an ashy-grey tint, and is found in thin layers, upon the compact carbonate of lime, near Bakewell, in Derbyshire. The polishing of steel is not executed in the same manner as in polishing the softer metals; the steel is not polished until it has been hardened, and the harder it is the more brilliant is its polish.

The substances we have above indicated for polishing other metals, are not powerful enough to attack a substance so hard as this. We must employ emery, a substance so well known as not to need describing here; it is used after having been ground in oil.

The hardened steel is either polished flat, like glass, or cut into facets, like a diamond, and, consequently, the lapidary's mill is used. They commence by smoothening the work with emery, rather coarse, then with finer emery, and finish with the finest. The smoothening being perfected, they polish it with English rouge, tritoxide of iron, and oil, and finally finish it with putty of tin (peroxide of tin) and water; but if upon mills, or laps of zinc, then without the use of water. When the steel articles consist of raised and hollow work, they are smoothened and polished with the same substance; but the instruments are, as in the case of less harder metals, pieces of wood, properly shaped, and employed in the same manner.

Gill's Repertory, Vol. vii. No. i. p. 27.

Of the Phenomena and Causes of Hail Storms. By DENISON OLMSTED, Professor of Mathematics and Natural Philosophy in Yale College *.

SHOWERS of hail present themselves to us under two very different forms. Sometimes they consist merely of frozen drops of rain, unaccompanied by any extraordinary appearances; and are easily accounted for, by supposing that the air happens at that time to be colder than the region of the clouds, and that the drops of rain are congealed in falling through it. But in those *storms*, whose mysterious causes we are now desirous of penetrating, the hailstones are of great and sometimes enormous size, and are associated with the most impressive and sublime phenomena of nature.

To pass over many statements on record of hailstones of a magnitude almost surpassing belief †, we have authentic statements of such as exceeded one foot in circumference ‡, and those larger than a hen's egg are of yearly occurrence.

To account for these extraordinary hail storms, is considered as one of the most difficult problems in meteorology. There is little to be found on this subject in systematic works; but the accounts of the facts lie scattered up and down in scientific journals, and in the transactions of learned societies. After comparing a great number of these descriptions of hail storms, the following propositions appear to me to embrace the most important facts.

1. HAIL STORMS, WHEN VIOLENT, ARE CHARACTERIZED BY THE MEETING OF ALL THE ELEMENTS OF STORMS; the clouds are very black; they are strongly agitated, and fly swiftly through the air, or more frequently rush towards each other, attended by high winds and terrific thunder and lightning §.

2. HAIL STORMS, OF THE FOREGOING CHARACTER, ARE CON-

* Silliman's American Journal of Science.

† It is related, that during the wars of Lewis the XII, in Italy, in 1510, there was for some time a horrible darkness, thicker than that of night; after which the clouds broke into thunder and lightning, and there fell hailstones of one hundred pounds weight. (Encyc. Perth. II, p. 14).

‡ Halley, Phil. Trans.

§ Phil. Trans. vols. iv. and v.

FINED CHIEFLY TO THE TEMPERATE ZONES. They rarely occur in any form in the torrid zone*; and when they do, it is chiefly on high mountains. Hail is indeed frequent in the polar regions; but it is of the ordinary kind before mentioned, and is therefore not the subject of our present inquiry. Of all places in the world, the South of France is most remarkable for frequent and violent hail storms. During the year 1829, an insurance company was formed in France for the special purpose of affording protection against their ravages.

3. THE MOST VIOLENT HAIL STORMS OCCUR CHIEFLY DURING THE WARMER HALF OE THE YEAR, AND MOST FREQUENTLY IN THE HOTTEST MONTHS.

4. THE HAIL STONES THAT FALL DURING THE SAME STORM, ARE FOUND TO BE MUCH SMALLER ON THE TOPS OF MOUNTAINS THAN IN THE NEIGHBOURING PLAINS.

5. Though hailstones are of various forms, yet THEY FREQUENTLY EXHIBIT IN THE CENTRE A NUCLEUS WHICH IS WHITE AND POROUS, while the other parts consist of concentric layers of ice, either transparent or of an opaque white, or alternately transparent and opaque.

6. A SHOWER OF HAIL DURING THE WARMER SEASON OF THE YEAR, IS OFTEN FOLLOWED BY COOLER WEATHER; in spring and autumn particularly, hail is a well known precursor of cold.

Whatever may be the remoter cause of this phenomenon, we can be at no loss for the immediate cause, namely, *a sudden and extraordinary cold in the region of the clouds, where the hailstones begin to form*: Nor can there be any doubt, that the degree of cold by which the nucleus is congealed, must be very intense,—far below 32°, or the freezing point of water,—since this nucleus, as there is every reason to believe, rolls up to the final size of the hailstone, by congealing upon itself the watery vapour which it meets with in its descent to the earth. But, although the presence of such an intense degree of cold is implied in the formation of hail, yet the great question before us is, *what is the origin of this cold itself?* Among the different suppositions which have been made, or which may be made, there are only two that are worthy of notice. One is, *that the cold is ge-*

* Rees says never; but the Ed. Encyc. Art. Phys. Geog. says, 'at an elevation not less than 1500 or 2000 feet.' V. Tilloch's Mag. vol. xliii, p. 191.

nerated by the immediate agency of electricity; the other, *that it is derived from the region of perpetual congelation.*

In the first place, *what reason have we to believe, that the cold which produces hail is generated by the agency of* ELECTRICITY? Were we to confine our attention to the whimsical reasons, or to the gratuitous assumptions, on which most writers upon electricity proceed, in ascribing to it the power of producing such an extraordinary degree of cold, we should conclude at once that the hypothesis was without foundation *. But it is still proper to inquire if we cannot discover a connexion between some known property of electricity, and the sudden production of an intense degree of cold. It is a known property of electricity, *to rarefy air*, and rarefaction produces cold. When we strongly electrify a Leyden jar, the air is frequently so much rarefied as to rush out from any opening in the cover with a hissing noise. In like manner, the air which supports and envelops thunder clouds, being strongly electrical, might be conceived to be powerfully rarefied, and the temperature proportionally reduced. The power of a sudden rarefaction of the air to precipitate in the form of hail, the moisture contained in it, is strikingly exemplified in the apparatus employed for raising water at the mines of Chemnitz in Hungary. The only point to be attended to at present is, that a quantity of air previously confined under the pressure of a column of water 136 feet in height, is suddenly permitted to escape, and has its temperature so much reduced by the enlargement of the volume, that the moisture present falls in a shower of hail †.

Another argument in favour of the supposition that hail owes its origin to electricity, is derived ftom the protection against hail-storms alleged to be afforded to vineyards in France, and the neighbouring countries, by erecting among them long pointed poles, or *hail-rods* (paragrêles) as they are called. Could the fact be fairly established that places furnished with

* See, especially, Priestly's History of Electricity, p. 371.—Malte Brun, Phys. Geogr. Vol. I.—Van Mons, in Nicholson's Phil. Jour. xxiv, 106.

† Lib. Useful Knowl. Art. 'Hydraulics,' p. 18. The same views with respect to the origin of the cold of hail storms are expressed in this Journal, vol. xv; Morveau also has the same idea. (Journal de Phys. ix, 64). Idem. xxi, 146.

such hail-rods are protected from the ravages of hail-storms, while other places in the midst of them, and all around them, are laid waste by these destructive visitations, it would go very far to prove that hail is produced by the agency of electricity. This point, therefore, requires to be considered with attention.

It is now more than fifty years since it was first proposed by men of science in France, to avert the calamities which that kingdom sustains in a very peculiar degree from hail-storms, by erecting conductors, with the view of drawing off the electricity that was supposed to generate the storms. The land proprietors, however, did not display the expected eagerness to avail themselves of the proposed security, and a writer complains that for thirty years afterwards, not a single landholder had put the experiment in practice *. But as late as the year 1821, the Linnæan Society of Paris † revived the interest in this subject, and caused numerous experiments to be made, which have inspired, it appears, much confidence in the efficacy of hail-rods. In a late number of the Annals of that Society, the subject is thus noticed. "The Paragrêle, or hail-rod, has for several years occasioned much inquiry on the continent, and has engaged the particular attention of the society. In many districts, which were formerly, year after year, devastated by hail, the instrument has been adopted with complete success, while in neighbouring districts, not protected by paragrêles, the crops have been damaged as usual; and the society are receiving from all quarters statements which fully confirm their opinion of the utility of the invention. The society have made a report to the Ministers of the Interior, recommending that measures be adopted by the general government, for protecting the country from hail; and it is estimated, from the result of experiments in numerous districts, that if paragrêles were established throughout the whole of France, it would occasion an annual saving to the revenue of fifty millions of francs ‡."

These statements are certainly favourable to the hypothesis in question; but since the experiments are in their infancy—

* Tilloch's Phil. Mag. vol. xxvi, p. 213. † Am. Jour. vol. x. p. 196.
‡ Am. Jour. vol. xii, p. 298.

since hail storms are often of very limited extent, and of places very near to each other, one is desolated, while another escapes uninjured—and since such apparent exceptions in favour of the utility of hail-rods would very naturally be exaggerated, I do not feel warranted in assuming the fact of their efficacy as fairly established *. With regard to the merits of the hypothesis in general, I would offer the following remarks.

1. Although we can conceive that a portion of the atmosphere, suddenly and highly rarefied by electricity, might produce the degree of cold requisite to form hail, yet the *possibility* of an event is but slight evidence of its reality; and we have here no independent evidence that such a rarefaction does in fact take place; but, on the contrary, we have certain evidence from the concourse of opposite winds, from the density and consequent blackness of the clouds, that a great condensation of air takes place in the region of the storm.

2. If hail be produced by electricity in the manner supposed, why is it not a *constant* associate of thunder-storms, since the same causes operate continually; yet the rare occurrence of hail-storms, as well as their desolating effects, mark them as out of the common course of nature. Why, especially, do not hail-storms occur in the torrid zone, where the electricity of the atmosphere is most abundant, and the phenomena of thunder storms the most violent and terrible? Not being able, therefore, to satisfy ourselves that hail storms are produced by the agency of electricity, let us inquire, in the second place, *what reason we have to believe that they owe their origin to the* COLD OF THE UPPER REGIONS OF THE ATMOSPHERE.

It is a well known fact, that the atmosphere grows continually colder as we recede from the earth, until, at a certain elevation, we reach the temperature of freezing water, called the *term of congelation*; that the height of the term of congelation above the surface of the earth varies with the latitude, being greatest at the equator, but coming very near to the earth at the pole; that its average height at the equator is about fifteen

* The establishment of Hail Insurance Companies, so late as the year 1829, indicates a want of confidence in this kind of protection. On account of the efficacy of lightning-rods, no such companies are needed to secure the public against damages by lightning.

thousand feet, at the latitude of 30° twelve thousand feet, and at the latitude of 50° six thousand *; that beyond this line of perpetual congelation, the reduction of temperature still proceeds until it shortly reaches a degree of cold the most intense that can be imagined. If we now contemplate a current of air, that is, a wind blowing horizontally first at the surface of the earth and afterwards at different elevations, we shall find that it will be subject to the following modifications. We will suppose it to blow first from the polar towards the equatorial regions. When it moves at the surface of the earth, it will rapidly imbibe the heat of the earth as it traverses the warmer latitudes; at the height of one thousand feet it will feel the influence of the earth much less, and grow warm much slower than before; and at the height of ten thousand feet, it will, for the most part, sweep quite clear of the mountains, and be a current of air blowing through the atmosphere alone. And since, as in the case of the Gulf Stream, a fluid does not readily change its temperature merely by flowing through a body of the same fluid of a different temperature, and especially air by flowing through air, a wind blowing from north to south at an elevation of ten thousand feet above the earth, will pass to a great distance without materially altering its temperature. What we have here supposed respecting the heating of a northerly wind as it blows southerly, will obviously apply to the cooling of a southerly wind as it blows northerly; and since a high wind frequently moves at the rate of sixty miles or about one degree an hour, especially where it passes without obstruction in the upper regions of the atmosphere, it would consequently pass over ten degrees in the short space of ten hours †.

These things being clearly understood, we assign as the cause of hail-storms, THE CONGELATION OF THE WATERY VAPOUR OF A BODY OF WARM AND HUMID AIR, BY ITS SUDDENLY MIXING WITH AN EXCEEDINGLY COLD WIND, IN THE HIGHER REGIONS OF THE ATMOSPHERE. Let us examine the effects which would result from the meeting of two opposite winds, at the height of ten thousand feet, during the heat of summer, the one blowing

* Ed. Encyc. 'Phys. Geography.' See figure, page 9.
† Daniel's Meteor. Ess. 113.

from the latitude of 30° or from the confines of the torrid zone, and the other from the latitude of 50° or the northern part of British America. If they had equal velocities, they would meet at the parallel of 40°, that is, at our own latitude, in ten hours from the time of setting out; and according to what has been premised, each current would retain nearly the original temperature. The southerly wind blowing from a point which is still two thousand feet below the line of perpetual congelation, is comparatively warm; while the northerly wind coming from a point which is four thousand feet above the same boundary of the empire of frost, will have a degree of cold probably surpassing any with which we are acquainted. We infer from our preliminary principles, that immediately on meeting, the watery vapour of the warmer current would be frozen with an intensity corresponding to the temperature of the colder current; that the minute hailstones thus formed, and endued with such excessive cold, would begin to descend, and accumulate to a size proportioned to the intensity of the cold of the original nucleus—to the space through which they descended—and to the humidity of the lower strata of the atmosphere; that is, the colder they were when they began to fall, the farther they fell, and the more humid the air, the larger they would become.

We have supposed a strong case, namely, that a wind from the torrid zone is suddenly brought into contact with a wind coming directly from a point far within the limits of perpetual frost, a concurrence of circumstances which appears to be not improbable, and which appears also sufficient to explain the most extraordinary phenomena of hail-storms. But since natural causes do not commonly operate in their greatest possible energy, it is probable that hail-storms usually result from these causes acting under circumstances less favourable in various degrees. We need not even suppose any thing more than that the cold current, instead of meeting with an opposite hot wind, merely mixes with the stationary air of the hotter climates, in order to precipitate their moisture in the form of hail. In every minute description of a violent hail-storm, however, we shall probably find mention made of this common circumstance, that *opposite and violent winds met* *, hurrying on

* Clark in Am. Jour. ii, 134. Beccaria on Elec. in Priestley, 341.

the clouds from opposite points of the compass. Thus a writer in the American Journal of Science, describing a violent storm that occurred in the state of New Jersey, adds, "I observed then, and have many times observed since, that hail is usually accompanied by contrary winds, which seem striving over our heads for the mastery." And Beccaria recognises the same feature of clouds congregated from opposite quarters. "While," says he, "these clouds are agitated with the most rapid motions, the rain generally falls in greatest plenty, and if the agitation be exceedingly great, it generally hails *."

We will now see how far the foregoing explanation corresponds to the facts before enumerated.

Why, then, are violent hail-storms attended by all the other elements of storms,—by clouds of intense blackness, and terrific thunder and lightning? Because the sudden concourse of a wind exceedingly cold with one comparatively hot, ought, in conformity with the known causes of these phenomena, to exhibit them in their most energetic forms. All these atmospheric phenomena are linked together, and the same causes, acting with different degrees of energy, produce each of them in its turn. The mixing of portions of air differing but little in temperature is sufficient to form clouds—if the temperature differs somewhat more, the watery vapour may fall in rain—if the one portion is hot and the other cold, more sudden and powerful rains are the consequence, and thunder and lightning result from the rapid condensation of watery vapour—and, finally, when a powerful wind from the regions of perpetual frost mixes with the heated and humid air of a warmer sky, the same watery vapour descends in hail.

Why are such violent hail-storms confined to the temperate climates, and why do they occur neither in the torrid nor in the frigid zone? This is a point of great difficulty, and the question has never to my knowledge been satisfactorily answered; but I think we perceive something in the foregoing principles, which may lead us to a correct understanding of it. We have considered the case of two opposite winds from points differing twenty degrees in latitude, one blowing north from the 30th,

* Priestley, 341, Nich. Jour. xxiv. 111.

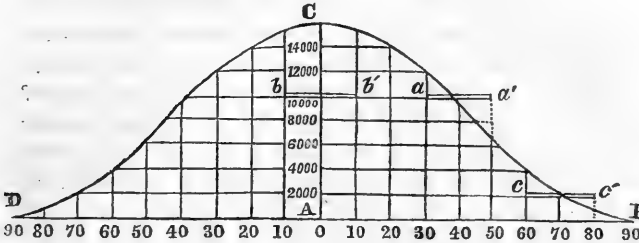
and the other south from the 50th degree of north latitude, each being at an elevation of 10,000 feet above the earth; and we have found them sufficient to explain the occurrence of violent hail-storms within the temperate zones, at least in our own latitude; other opposite points may be assumed for other latitudes. But suppose we transfer this reasoning to the equator, and consider the condition of two opposite winds blowing from ten degrees on either side, and meeting at the equator, each being at the same elevation of 10,000 feet above the earth. Now both of these winds would be warm, and almost equally so, and here of course would be wanting that intensely cold current which we have been able readily to summon to our aid to help in forming our hailstones in the temperate climate. If we take any other point within the torrid zone, the case would be indeed somewhat less unfavourable to the production of hail; the opposite currents might differ in temperature to a degree sufficient to account for the formation of clouds and rain, and thunder and lightning; but in this region we know not when to look for that *freezing current*, unless we ascend so high that there no hot air exists, holding watery vapour to be frozen by it. The case is plain, that if we ascend in the torrid zone for air that is cold enough to answer our purpose, we ascend above the region of the hot air, the watery vapour of which is necessary to afford the materials for hail; whereas, in our own latitude, on ascending to the region of congelation, we find the north and south currents differing in temperature, more than opposite winds in any other part of the globe. There is indeed one situation where we may imagine hail to be formed within the torrid zone, and that is in the vicinity of lofty mountains covered with snow; and there, in fact, it does sometimes hail *.

Next, if we attentively consider the circumstances of the frigid zone, we shall see that here there is no hot region on the one side to send its heated air to mix with the cold currents from the other; and that no meeting of very cold with warm winds could possibly take place. The rain, indeed, on account of the ordinary cold of this region, would frequently descend in the form of hail; but it would necessarily be of that small

* Edin. Encyc. vol. xv. Art. Phys. Geogr. at an elevation of 1500 or 2000 feet.

and ordinary kind, which is formed near the earth, before described as being common in the polar regions.

This will become obvious by inspecting the following figure.



The curve B, C, D, represents the *line of perpetual congelation*, as given in the Edinburgh Encyclopædia, under the article "Physical Geography," and is believed to be a very accurate delineation of it. Let then, *a a′* denote the path described by the opposite winds that are supposed to meet at the latitude of 40°; *b b′*, that of similar winds meeting at the equator, each being at the height of 10,000 feet above the earth; and *c c′*, the path of two currents at the height of 2000 feet, meeting at the latitude of 70°. These heights are taken arbitrarily, as affording a favourable view of the nature of our reasoning. The same mode of reasoning, however, may be applied to other points of elevation, at which any particular hail-storm may be supposed to be generated.

France is peculiarly exposed to hail storms, on account of its situation between the Alps and the Pyrenees. The country lying between these high mountains being heated by the summer's sun, the cold blasts from the regions of snow, and ice, mingling with the hot and humid air over the intervening country, ought, in conformity with our principles, to produce frequent hail-storms.

The most violent hail-storms occur in the warmer season of the year, and usually in the hottest months, because it is then that the heat of the sun contributes most to set the opposite currents in motion. Hailstones are smaller on the tops of mountains than in the neighbouring plains, because not falling so far, they have less opportunity to accumulate by the congelation of successive layers of watery vapour. The white, snowy nucleus which large hailstones frequently exhibit in the centre, indicates that the congelation began in highly rarefied air, such being precisely the appearance of a drop of water frozen under the exhausted receiver of an air pump *. And, finally, the sudden and severe cold weather which often immediately follows a hail-storm, only indicates that the cold blast which produced the hail, extends something of its influence even to the surface of the earth itself.

What is the cause of the small momentum of hailstones? Although hailstones, when large, do great damage to tender crops, and occasionally kill small animals, yet, it is on the whole surprising that they fall with no greater force than they do. A pebble of the same size falling from the mouth of a well, upon the head of a man at the bottom, would kill him; and the meteoric stones which fall from the sky, many of which do not exceed the size of some hailstones, bury themselves deep in the ground, and sometimes penetrate through the entire body of a house, and bury themselves in the cellar †. The small momentum of hailstones is partly to be ascribed to their low specific gravity, which is a little less than that of water; but still they are heavy enough to fall with a hundred times the momentum which they actually exhibit, descending as they do through many thousand feet. Their velocity is in fact very small, whereas we should expect to find it immensely great; the true reason of this I apprehend to be the following. We are to regard the largest hailstone as commencing its formation with a small nucleus, and as receiving continual accessions of matter in descending, until it reaches the ground. But the watery vapour of which these accessions are composed, is matter at rest to be put in motion by the falling body, which is therefore taking on a new load at every stage of its progress, and consequently has its speed continually retarded. The velocity which it acquires in falling each successive moment, is lost by communicating motion to so large a quantity of matter at rest, as that which composes its accretions.

* Leslie, Encyclo. Ed. Meteorology.

† See an amusing account of the force of falling hailstones by Fairfax, in the 1st volume of the Phil. Trans.

Ararat, Pison, and Jerusalem—a contribution to Biblical Geography. By Charles Von Raumer.

Ararat.

Ritter, in his excellent geography, assigns the following boundaries to Armenia: He draws a line from the mouth of the Kur, in the Caspian, to that of the Phasis (Poti), in the Black Sea; a second line, from the Phasis to the Bay of Issus (the NE. corner of the Mediterranean); a third, from this bay, back to the mouth of the Kur. The triangle comprised within these three lines forms his Armenia. "Armenia," says Ritter, "is principally a table-land, similar to those of Thibet, Quito, and Habesh. Arzeroom is elevated 7000 on this table-land, to which point the ten thousand Greeks under Xenophon ascended for five days' journey over the high mountains of Kurdistan, and descended again from the north declivity of the latter to Trapezus on the Black Sea. They found the plain of Armenia partly covered with snow, six feet deep; and as, from later observations, snow falls at Arzeroom even in the beginning of June, Upper Armenia should present a uniform snowy cover for six months, and the temperature in the plain of Ararat descends to 16°—18° Fahrenheit *; and as Armenia lies in the same latitude as Naples, this is a strong proof, independent of other circumstances, of the great elevation of the country. On this table-land rises Ararat, which, with Sinai, is a magnificent witness of ancient sacred history.

Sir Robert Kerr Porter approached Armenia on the northern side from Teflis. "When," says he, "we left our resting place, the great plateau of Ararat gradually unfolded before our eyes, and the colossal mountain itself seemed, in all its majesty, to touch the clouds." † When on our descent (from a height in the plain of Ararat), the valley opened below us, my whole attention was attracted from the prospect before us; an immense plain, covered with innumerable villages; the minarets and spires of Eitch-mai-adzen, which towered above the rest; the

* Kerr Porter's Travels, from the English. Weimar, 1823. P. 213.

† Ibid. p. 212—214.

silvery waters of the Araxes flowing through the verdant herbage of the valley, and the lower mountain chain, which formed the basis of that tremendous monument of the antediluvian world, which seemed as it were to stand like an immense link in the chain of man's history, uniting the antediluvian with the postdiluvian world: Not until we reached the level of the plain did I see all the gigantic proportions of Ararat. From the spot on which I stood, it seemed as if the greatest mountains of the world had here been piled upon each other, to form this single colossal mass of earth, rock, and snow. Its double icy summit was majestically outlined on the clear expanse of ether, and reflected the rays of the sun with a radiance nearly equal to other suns. From this point, the mind felt the grandest impressions which mountains and extensive plains are calculated to give; but I am inadequate to describe the feelings which rushed upon my mind on the aspect of the mountain. My eye, incapable of dwelling for any time on the resplendent brightness of its summit, descended along its seemingly boundless declivities, till their gigantic outline could no longer be traced in the obscurity of the horizon, so that they were irresistibly thrown back on the sublime splendour of the peaks of Ararat. "The name which the Turks give to this high mountain is Agridagh, the Armenians call it Macis; all, however, revere it as the haven of the great vessel, which saved the father of the human race from the waters of the deluge. Since the days of Noah, its inaccessible summit has been trodden by no mortal foot. Attempts have been made at different times to ascend its enormous cone, but in vain. Insurmountable obstacles exist in its form, its snow, and its glaciers; and the distance from the commencement of its icy region to its summit is so great, that the cold would prove fatal to whoever had the resolution to persevere in the attempt."—"A wide valley," Sir R. Porter continues, "separates the two snowy peaks of Ararat." In another passage, he describes how, in the midst of this beautiful landscape, Ararat stands unrivalled in majesty, and clothed with the light of heaven*. Onwards from Erivan, he sees before him many monuments of antiquity † round the base of this immense mountain. "We really," says he, "here come into converse with the earliest periods of the world. Some

* Sir R. K. Porter, p. 225. † Ibid. p. 231.

of our oldest towns of Europe seem to date only, as it were, from yesterday, when compared with the ages which have rolled over the magnificent ruins with which these countries are still covered."

The descriptions of the English traveller Morier are in entire accordance with those of Porter. I will only select one of them, as Morier viewed the mountain from the opposite, the southern side *. "After," says he, "we had traversed the plain from Abbas-Abad to Nackchivan, we enjoyed a beautiful view of Ararat. Its form is extremely elegant, its gigantic proportions extraordinary; compared with it, all the adjoining mountains sink into insignificance; its form is complete in all its parts; its contour is bold, but without any irregular prominence; all is harmony, all appears so connected, as to form the most elevating natural object. It is raised on an immense base; the slope to its summit is gentle, except the portion covered with snow, which is more abrupt. A little hill rises as an ornament on the same base as this wonder of nature, which, from its form and proportions, would in any other situation be called a high mountain. No man seems to have reached its summit since the deluge, and the steep ascent of its snowy peaks seems to mock all attempts to reach them. We may be sure that in modern times it has continued quite inaccessible."

To these pictures of Porter and Morier I may add the following from Ritter's Geography †. "None ever appears to have reached the summit of Ararat. Haithon, Prince of Armenia (about A. D. 1300), says of it, that no man, on account of its eternal snows, will attempt to ascend it. It is so high as to appear quite isolated when seen from Derbend on the Caspian, behind the snowy ridges of Caucasus ‡. The Armenians believe that it still contains remains of Noah's ark; they throw themselves on the ground, make the sign of the cross, and pay their adorations whenever they see its summits free from clouds. Shah Abbas sent people to search for the remains of the ark, but it was told him that it was inaccessible. The Persians call

* Morier's Second Journey, French translation, Part ii. p. 237.

† Ritter, Part ii. p. 747—750.

‡ This would give an immense height to Ararat, as Derbend is fully 270 miles distant. Ritter cites for this fact, P. H. Bruce's Memoirs, London, 1723, 4to. p. 283, 266.

the mountain Noah's Hill, other Oriental nations the Mountain of the Deluge. At its base, at Erivan, the spot is pointed out where Noah is said to have planted the first vine. The Armenians trace their origin to Haik, Noah's grandson, and from him they call their land *Haik*.

Having now given these descriptions of Ararat and its immediate environs,—of this mountain from which the Earth, cleared of its living inhabitants by the deluge, again derived its population of men and animals, I shall now view its position in relation to the whole of the old world.

1. Ritter * calls Armenia, figuratively, an airy, humid, cold, mountain isle. No point of the old continent is so much in the interior of *terra firma*, and yet, with comparatively few exceptions, so surrounded by great masses of water. If we draw a circle with a radius, extending from Ararat, a little to the south of Erivan, to the south of Suez, the circumference of this circle intersects the Red Sea, the Persian Gulf, comprehends the great lakes Van, Urmia, Aral, the Caspian, the Seas of Azof and Marmora, the Euxine, and, lastly, intersects the eastern part of the Mediterranean. Does it not appear as if Noah had descended on Ararat as on a true mountain isle of antiquity, from whose immense heights the waters descended in all directions.

2. A great desert extends through the whole of the old world from W. SW. to E. NE. †. It commences on the west coast of Africa, between Cape Verd and the Empire of Morocco, extends, under the names of the deserts of Sahara and Lybia, into Egypt, where the rich valley of the Nile forms a narrow belt of cultivation in the broad expanse of sand; beyond the Straits of Suez and the Red Sea, it forms the Syrio-Arabic deserts, which extend, with slight interruption, into Persia. From the left bank of the river Sihon, it encircles in Lower Bucharia, and Persia, to Guzurat ‡ on the western coast of Hindostan, the western extremity of the immense mountain chain of Central Asia, the alpine sources of the Gihon, Indus, and Ganges. When we

* Ritter, part ii. p. 710.

† Compare Humboldt's Views of Nature, Part I. on steppes and deserts.

‡ With slight interruption, we can trace, in succession, the deserts of Guz, Gasnak, Deschtkowar, Naubendan, Kerman, Multan, Guzurat. See in Stieler's Atlas, Richard's excellent Map of Upper Asia, No. 43.

surmount these Alps we reach the great desert wastes of Cobi, which extend to the north of Pekin nearly as far as the Pacific.

The superficial extent of these vast deserts is immense. The Sahara alone, including its Oases, amounts to 324,000 square miles, which is six times larger than Germany. The Indian Desert is about the same size as Germany. Cobi extends for 1800 miles in length, from W. SW. to E. NE., with a breadth of from 135 to 450 miles *. The superficies of all these deserts may exceed that of Europe. They have all essentially the same character, principally sand and gravel, then clay, here and there solid rock. Water fit for drinking is in these desert expanses extremely rare; those lakes, morasses, and wells which exist, are usually brackish and saline; crusts of salt cover the soil; and rock-salt is found at a trifling depth. The desert of Kerman (Persia) †, seems to be the dried up bed of a Mediterranean Sea like the Caspian. The lake of Zareh may be regarded as the remains of this ancient water which receives the large river Hirmend. If the high desert of Cobi seems now a great basin, surrounded by the highest mountains in the world, from the walls of which flow the largest rivers into the various quarters of the globe, in former times it may have been a great inland sea, of which the lake Lop is still the remains, which receives the large river Yerken, as well as several other lakes of smaller importance. Besides which, there are 68 rivers and streams delineated in the Jesuits' Map of Eastern Cobi, which mostly lose themselves in shallow lakes on the sand, and 115 steppe streams on the southern boundaries of Tartary.

Thus, all these wastes seem to be the bottom of a former salt sea ‡. But what opinion shall we form of this range of deserts? Let the reader take the compass, and he will find on the globe, that Ararat is situate nearly in the midst of the range, at an equal distance from the mouth of the Senegal, and the termination of the chain to the NE. of Pekin.

3. Parallel to this chain of deserts, there ranges on the north a chain of inland seas from W. SW. to E. NE., from the west

* Humboldt calculates the extent of these deserts, without the Oases, the Bucharian or Cobi deserts, at 504,000 square miles.

† Ritter, ii. 63.

‡ Ritter. i. 515, first edition. Humboldt MS. p. 20.

end of the Mediterranean to the sea of Marmora *, Euxine, Sea of Azof, Caspian ; farther on, to the lakes of Aral, Aksakal, Tchan, to which we may reckon the lakes of Baikal and Saisan, which stand in connexion with the Icy Sea †. Ararat here again lies in the middle of this great chain of lakes, half-way between Gibraltar and the lake of Baikal.

I refrain from drawing any conclusions, wishing to confine myself to facts which prove that Mount Ararat (even all Armenia, the source of the Euphrates, Tigris, and Araxes), has a very elevated site: 1. From the waters surrounding the mountain; 2. Because it is situate nearly in the centre of the great Africo-Asiatic chain of deserts, probably at some former period the bottom of the sea; 3. From the continuous range of inland lakes from Gibraltar to the sea of Baikal; hence it follows, 4. That it is nearly the centre of the great axis or backbone of the old world, extending from the Cape of Good Hope to the Straits of Behring. I draw, I say, no conclusions. May it, however, suffice, to cause the reader to reflect, that no chance but "Wisdom, which governed the just on the waters ‡," could have landed that preacher of righteousness, the second progenitor of the human race, on the mountain of Ararat.

Pison.

Mr Buckland has most distinctly shewn in his profound work *Reliquiæ Diluvianæ*, that the most prominent features of the physiognomy of the Earth's surface were not altered by the Deluge. What was dry land before the irruption of the waters, again became so after their retreat. England, which is not very much elevated above the level of the sea, was, even before the Deluge, peopled by hyænas, elephants, &c.

* See Stieler's Atlas, No. 41.

† By the Irtisch and Jenisei. For the indubitable evidence of a former connexion of the Black Sea with the Caspian, of the latter with the Lake Aral, and the farther extension of these inland waters to the north and east, as well as for proofs of the continual drying up of these regions, see the following article, "Pison." Further, the Gihon seems to have mixed the character of the southern range of deserts with that of the northern range of lakes, being on the frontiers of both, and at a low level; here, amid arid sands, is great abundance of water. (Ritter, ii. 425.)

‡ Wisdom, 10. 4.

From the Sacred Writings, the river-basins of the present rivers must have existed before the Deluge; all these valleys, therefore, cannot have been formed by this catastrophe; for the Scriptures enumerate the Hiddekel or Tigris and the Euphrates among the rivers of Paradise. These rivers are the measures with which we are furnished to determine the site of Paradise, and to guard us from arbitrary determinations. They lead us to the elevated table-land of Armenia,— to Ararat, whose singular position we have just been considering. This point seems to have been the one selected, for the first as well as the second peopling of the globe. The garden of Eden lay eastward from Moses, who was journeying from Egypt to Palestine; Armenia, the source of the Tigris and Euphrates, lay also in the same direction (more exactly, NE.). Reland, Calmet, Michaelis, Faber, &c. have therefore been in strict accordance with the Bible, when they placed Paradise in this region of Asia.

But the rivers Pison and Gihon gave much embarrassment to all interpreters.

Their eye must necessarily fall on the Araxes, which had its source in the same district with the Euphrates and Tigris. The Pison, says Rosenmüller *, seems to be the Phasis of the Greeks, which is identical with the Aras and Araxes. But how shall we explain the words †? It flows round the whole land of Hevilah, and in it we find gold. Rosenmüller quotes the following from G. F. Müller ‡:—"Foreign writers give us no information regarding the Chovalissi, a people related to the Slavonian stock; they are only noticed by the Russians, and by them but rarely. They are said to have dwelt on the banks of the Wolga, near the Caspian. Their name is derived from Chovala, which has the same meaning as Slawa." From this

* Rosenmüller Scholia in Vetus Test. p. 1. s. 50. See also Ritter, pt. ii. p. 787. Mannert first shewed that the Phasis of Xenophon was the Upper Araxes, not the Colchian Phasis.

† Genesis ii. 11.

‡ De Chovalissis, populo a plerisque ad Slavorum prosapiam relato, exteri scriptores nihil nos docent, sed soli Russici, ipsi quoque raro illorum mentionem facientes. Ad Volgam proxime a Caspio mare feruntur habitasse. Nomen eorum derivatur a Chovala, ejusdem cum Slawa significationis.

people the Caspian Sea is called by the Russians, " *Chevalin Skoye More.*"

Thus interpreters have pursued as far as possible the first correct trace. Yet it is puzzling how the Bible should say, the Pison encompasses the whole land of Hevilah. I shall endeavour to give an explanation of it. Ritter has depicted, in the second part of his excellent Geography *, the deep basin of Bucharia from the sources of the Oxus to the mouth of the Don. The level of the Caspian appears, from the careful measurements of Engelhardt and Parrot, to be from 300 to 350 feet lower than that of the Euxine, and about 380 lower than the Red Sea. The surface of the Lake Aral is probably quite as low as that of the Caspian.

Now, there are many proofs of the former union of the Caspian Sea with the Aral †. The ancients gave a much wider extent to the Caspian than what it now possesses. Pliny, for example, makes it nearly twice as large. Herodotus and Strabo both make the Oxus and Iaxartes fall into the Caspian ‡, not as now into the Lake Aral, which was not then a distinct sea; they give a much greater extent to the Caspian from east to west, than from north to south, which is exactly the reverse of its modern dimensions. It is almost certain that, so late as the year 1660, the Oxus sent a branch into the Caspian §, so that there thus existed even then a distinct water communication between this sea and the Aral.

To the north and east of the Aral are the great Kirghis Steppes ||, which extend as far as Tobolsk, " without a single relatively visible elevation." In these Steppes are inland rivers, bitter wells, saline lakes, marshy lagunes; no habitations for several hundred miles, no grass or wood; the horses soon die from the bitterness of the water, and even the shrubs; every where, on digging to the depth of two feet, we find a yellow putrid water, full of the ova of worms. One hundred years ago

* P. 470.

† V. Hoff Geschichte der Veränderungen der Erd oberfläche, Th. i. p. 116, 117. Ritter, ii. 670.

‡ But Reichardt makes the Iaxartes synonymous with the Aral, and the Sithon with the Iaxartes.

§ Ritter, ii. 667.

|| Ritter, ii. 648.

the Sarasu discharged itself into the Aral, now into the Teleghul, five days' journey from that Lake,—" a picture, on the small scale, of the Gihon, Caspian and Aral, on the large."—" Even now, the level of the lower Sihon, the Upper Irtisch, the Tobol, and the Ural rivers, is constantly changing, from the constant process of exsiccation." Every lake is becoming more and more covered with vegetation, and its surface daily diminishing, and the soil becoming more solid. This continual drying process is even very observable in the memory of the inhabitants; even the innumerable salt lakes, which are every where scattered in these wastes, and the extensive saline Steppes of Ischym and Barnaul, covered with a layer two feet deep of saliferous clay and sand, seem to be the bottom of an ancient sea, which has been laid dry in the memory of man,—and which, perhaps a thousand years ago, was intermediate between the Ocean and the Continent, and belonged to the ancient basin of the Caspian." Who can refuse his assent to the same conclusion, after the facts quoted from Ritter? He even traces a water-communication between the Aral and the Irtisch *, and by the latter with the Icy Sea.

If we trace now the coast of the Icy Sea westwards to the mouth of the Petschora, where a moorish steppe of several thousand square miles is said to exist, as a proof of its former covering of water, how near is the Kama to the great river Wolga. If there is found here any higher water-shed, it is certainly very inconsiderable between the western Dwina and the Wolga, because both rivers are now united by canals. If the level of the Caspian should rise 500 feet, it would be united to the Euxine, according to Ritter.

That such a union did exist at some former period, appears both from the testimony of the ancients and the present aspect of nature †. Scymnæs of Chios notices a connexion between the Tanais and Araxes. Valerius Flaccus extended the Black Sea far to the north, and made it equal in size to the Mediterranean. Salt and shells are found to the north of the Caspian as far as Sarpa, and the shells are exactly the same with those in the Caspian. The union of the Caspian and Euxine was, ac-

* The Steppes of Barnaul are even to the east of the Irtisch.

† V. Hoff. i. 106, &c.

cording to Pallas, in the direction of the Manytsch, and the water-shed between the two seas, at the source of the latter river, was 71 toises, about 400 or 500 feet above the sea of Azof.

But if we suppose with Pallas, that, in former times, the Caspian stood 600 feet higher than at present, it is very probable that the following arrangement of the waters must have existed.

From the high lands of Armenia the Pison or Araxes flowed into the Caspian, which was united with the Aral lake; but the latter communicated with the river-basin of the Irtisch, as well as the low-lying steppes, which are still interspersed with chains of salt lakes, the remnants of a sea formerly extensive and still drying up. The Irtisch leads us to the Icy sea, from which we retrace our steps by the Petschora and the Dwina to the Wolga*, and so on back to the Caspian; the lowest water-shed now intersected by the canals between the Wolga and Dwina, would, on this supposition of a higher level of the waters, be completely overflowed.

But this union of waters would have at one period surrounded the Uralian chain, on whose western side, near the Wolga, we have placed the nation of the Chovalissi, who, from the early interpreters, were the inhabitants of the land of Hevilah†.

Diodorus Siculus asserts that the Black Sea and that of Azof were formerly in connexion with the Caspian. They were bounded on the west by Byzantium, till the waters burst through the barrier of the Bosphorus, flowed out into the Mediterranean, and thus separated the Black from the Caspian Sea. At that time this Uralian island, this encompassed land of Hevilah, would have become one continent with the rest of Asia.

Moses gives the following characteristic of the land of Hevilah, that "there we find gold, and the gold of that land is precious, and there is found bedellion and the onyx stone."

It is not very easy to divine what is to be understood by Bedellion‡, yet it agrees with the views of Galen and Ætius, who say that one kind of bedellion was Arabic, another *Scythian* §. Our idea of the onyx is just as ill defined, but the

* The source of the Wolga is only 800 feet above the level of the sea.

† See V. Hoff. l. 105.

‡ Rosenmuller u. s. Nil certi de hoc nomine definiri potest.

§ Travels in the Interior of Russia, undertaken by Erdmann.

idea of gold has been coëval with the human race. Does gold then characterize the land of Hevilah, the Uralian Island of antiquity? The following facts may answer this question. At Beresowsk (on the Urals) are 70 gold mines; in 1803, 12 new ones were discovered on their western side. In 1814, an auriferous sand was discovered, which fulfilled the most sanguine hopes; in 1824, it was hoped to yield a million of ducats *.

The following is the result of an inquiry into the state of the Eastern Urals by a Russian commission in the year 1823:—

"The auriferous sand is not, as was believed, the local product of a few of the torrents from the Urals; but it is the product of a great mass of weathered rock, extending for 1000 versts on the eastern declivity of the chain, and which contains every where to a certain depth more or less gold." And in a letter of Mr Tschbotaref, it is mentioned that "the Uralian range is perhaps as rich in gold as Mexico, Peru, and Chili †."

Thus have I endeavoured to identify the Pison and the golden land of Havilah which it encompassed ‡. Probably, in the antediluvian ages, this land had not the severity of the Urals, but a milder and more genial climate; one fitted for the production and preservation of elephants, rhinoceri, hippopotami, and other now tropical animals. This is proved by the vestiges of these quadrupeds in Siberia.

Jerusalem

As we have cast a retrospective glance from the deluge upon Paradise, we shall take a prospective view of Jerusalem.

If we take the Armenian mountain isle in the above extended signification, and suppose the former union of the eastern Mediterranean with the Red Sea, the Gulf of Persia, the lakes of Var and Urmia, the Caspian, Euxine, and then back to the Me-

* Schweigger Jahrbuch der Ch. u. Phys. N. R. b. 16, heft 2, p. 229, partly by Leonhard.

† Engelhardt has given some recent intelligence regarding the gold of the Urals, in a little treatise which appeared after a more exact inquiry into these mountains. The public eagerly look for the results of the previous journey of Humboldt to the Urals.

‡ I shall communicate my views with regard to the fourth river of Paradise, the Gihon, as soon as I shall succeed in basing them on a proper collection of facts.

diterranean; then Palestine, and especially Jerusalem, is situate in this great peninsula in the midst of the old continent.

The table-land of Armenia was the chosen cradle and starting point of the first (the Adamitic) as well as the second (the Noachian) peopling of the earth, from whose heights men gradually advanced on the progressive retiring of the waters. But when the earth was peopled, the Deity selected for the dwelling of his people, Palestine, situate on *that* sea whose shores were inhabited by the mightiest nations of the world, and by means of which they were brought into universal contact with one another. However near Jerusalem lay to the great nursery of the nations of the old world, yet it was almost separated from the heathen by deserts on every side. From this position it was much easier for the Jews to insulate themselves, and we can understand why, even from Zion, "the word of the Lord and the sound of God's messenger went forth into every land," why here the Shepherd appeared, whose flocks were to pasture over the whole earth.

We can now understand why Abraham was ordered to withdraw from Mesopotamia into Canaan.

NOTES.

1. *Visit to the Graphite or Black-Lead Mine in Glen Farrer, in Inverness-shire.* 2. *Walk from Aberdeen to Castleton of Braemar—Country around Castleton—From Castleton to Spittal of Glen Shee and Blair Gowrie.* 3. *Blair Gowrie—Craighall—Forneth—Linn of Campsie—Perth.*

1. *Visit to the Graphite or Black-Lead Mine in Glen Farrer, in Inverness-shire.*

This mine lies in Glen Farrer, above Beauly. We visited it from Inverness, following in our route the Beauly road, along the firth of that name.

The red sandstone and conglomerate of Inverness accompanies us on the Beauly road, until it is succeeded by red and grey gneiss, which is traversed by several broad veins of red granite: in some of the veins the granite is very coarse granular, the concretions of quartz and felspar being occasionally five or six inches square. Gneiss, with imbedded precious garnets, and associated with *serpentine*, continues to Beauly. About two miles from Beauly we visited the falls of Kilmorack. Here the river Beauly forces its way through and over rocks of conglomerate of the red sandstone formation. The conglomerate, which is of a reddish-brown colour, contains fragments of various sizes, from that of a pea to several feet in diameter, more or less angular or rounded, of quartz, quartz-rock, gneiss and granite. From the falls, upwards to the house of Mr Fraser of Eskdale ?, where the conglomerate appears to terminate, the river is bounded by high perpendicular cliffs of conglomerate, thus presenting a scene resembling that at Baron Clerk Rattray's, near to Blair-Gowrie. At Eskdale the river divides into two branches, both of which are observed cutting through the conglomerate. Immediately above this barrier, the valley of the Beauly widens, and the bounding hills increase in height. The hills are no longer roundish, and green to the summits, like those composed of the conglomerate rocks, but are rugged and marked by numerous grey-coloured cliffs, the whole being principally composed of gneiss and quartz rocks, traversed by numerous veins of granite. At Struey, about nine or ten miles from Beauly, there is a fine bridge across the river. Nearly opposite to Struey, beautiful veins of red granite are to be seen traversing the gneiss strata, which range from NE. to SE. and dip to the S., and generally at a pretty high angle. The glen to the black-lead mine, appears, as far as we had an opportunity of examining it, in our rapid journey, to be principally composed of gneiss, which is often waved in its structure and in its strata, and frequently, when the quartz predominates, passes into mica-slate. It is sometimes *grooved*, with projections fitting into these grooves, as we have observed to be the case with quartz-rock, sandstone, and even trap-rock. The principal imbedded mineral we noticed was *precious* garnet, a gem of all others the most widely distributed over the earth, it having been traced from the Equator to North Lat. 81½°. Veins of granite are of frequent occurrence, and also beds of red and grey granite alternating with the gneiss. These beds, in some instances, are true beds contemporaneous in formation with the gneiss; in other instances, are portions of veins running parallel with the gneiss strata.

Besides the gneiss, quartz-rock also occurs, and, in some places, in considerable quantity. It always contains mica, and hence frequently passes into mica-slate.

We did not reach the Black-Lead Mine until 12 o'clock, the distance being greater from Beauly than we had calculated on, it proving to be twenty or twenty-two miles. The excessive heat of the day, and the torment of the midges, was intolerable. My face, lips, and eyes were speedily distorted by them, and one of my eyes fairly closed up. Since a similar attack, during a very hot season in Sutherland, I had experienced nothing like this. The rock in which the graphite or black-lead occurs is gneiss, in which the direction is a little to the E. of N. and dip W. 80°. The gneiss in some places is very micaceous, contains garnets, and here and there is traversed by veins of granite. The graphite is not in beds or veins, but in *masses imbedded* in the gneiss. The *first mass*, or bed, as it is called, is fully three feet thick where broadest. The whole mass appeared to be scaly foliated; no regular crystals were observed, although, judging from the crystalline nature of the deposit, I think it probable that in cavities, varieties of its regular form, which is rhomboidal, will be met with. It is not throughout pure, but is occasionally mixed with the gneiss, which occurs either in apparent fragments, or its ingredients, especially felspar, are disseminated in grains or crystals. The precious garnets, already mentioned as imbedded in the gneiss, also occurs abundantly in some kinds of the black-lead, and thus deteriorates it. The *second mass* (according to the manager of the mine, John Young of Beauly, who first made the locality known in the month of March of the year preceding that of our visit in 1817), is about a foot wide: the *third mass* the same width. Besides these masses, which were observed extending several yards, we noticed several smaller masses imbedded in other parts of the gneiss near to the mine, and indeed more or less interruptedly to the summit of the gneiss mountain, which rises from the mine. The working we found carried on in a very paltry and slovenly way: three or four men only were employed digging out the graphite, in the style of an open quarry. This district, I doubt not, if thoroughly examined, will be found to afford larger and pure masses of this valuable mineral, than those already mentioned; but its working will, as is the case with all minerals occurring in imbedded masses, be less certain than when it occurs in regular beds or veins.

The occurrence of graphite in gneiss has been observed in other countries, as in Spain, where its mode of distribution is the same as in this glen. It is also one of the minerals mentioned in my Account of the Rocks of the Arctic Regions, published with the Voyages of Captain Parry, as having been met with in the arctic regions of America. In Scotland it is not confined to Glen Farrer, as there are two localities of it in the county of Ayr, where it is associated with rocks of the coal formation, viz. near New Cumnock, and at Stair, on the water of Ayr.

This interesting mineral is generally considered as a chemical compound of carbon and iron, and as such it figures in chemical works under the name of *native carburet of iron.* The experiments of Karsten, however, shew, that the pure varieties of graphite contain not an atom of iron, and that it is only the impure kinds that contain oxide of iron, and occasionally also oxide of titanium, silica, and alumina. Graphite, therefore, is a pure carbon.

Having finished our rapid glance of this interesting spot, we returned in the evening to Beauly. In our walk down the glen we noticed more particularly the narrowings and widenings that occur in its course to the Falls of Kilmorack. Of these we reckoned five. These alternate widenings and narrowings of the valley, the richness of its wooded banks and mountains, and the tumult and noise of the river, as it forced its way through the narrow rugged rocky passes, contrasted with its quiet and almost still course through the wider parts of the valley, formed altogether a scene not exceeded in natural beauty or geological interest by any other glen in Scotland.

2. *Walk from Aberdeen to the Castleton of Braemar—country around Castleton—from Castleton to the Spittal of Glen Shee and Blair-Gowrie.*—The country around Aberdeen is almost entirely composed of primitive rocks. Of these there are two sets, the Neptunian and Plutonian. The Neptunian are certain varieties of granite subordinate to gneiss, gneiss, mica-slate, hornblende-rock, hornblende-slate, hornblendic gneiss, &c.;

the Plutonian rocks are granite, with felspar, or granitic porphyry. Besides these old rocks, there are also, although in small quantity, members of the secondary class, viz. augite-greenstone or dolerite, and sandstone conglomerate. The Neptunian primitive rocks exhibit numerous very interesting geognostical relations, all of which go to prove their chemical and contemporaneous formation; while the great bodies of Plutonian granite, as those exposed in the celebrated granite quarries, render it probable that the stratified Neptunian rocks owe much of their contorted and broken aspect, and also, in some degree, their position, to the action of this igneous rock. The most important of these primitive rocks, in an economical point of view, is the granite, which is quarried very extensively, and shipped for many and distant parts of the island. The very coarse granular varieties of this rock form an indifferent building stone; while those varieties in which the granular concretions are of a medium size, and well crystallized, and which resist a strong pressure, are the most valuable. The resistance which the different varieties around Aberdeen oppose to pressure is exceedingly various; the most esteemed kinds will bear, without being crushed, on the square foot, a weight of 169,000 pounds; while the best granite of Cornwall yields to a pressure of about 114,000 pounds. The only secondary Neptunian stratified rock we observed at Aberdeen, is the conglomerate at the old bridge over the Don. This conglomerate rests over the outgoings of the inclined subjacent gneiss strata. It is composed of roundish boulders, from the size of a musket-ball to that of a man's head and upwards, held together by a paste of a coarse and loosely aggregated sandstone. The boulders are of granite, gneiss, mica-slate, porphyry, hornblende-rock, quartz-rock inclining to rock-crystal, with imbedded grains of felspar. The sandstone forming the paste of the conglomerate consists of grains of quartz, mica, and earthy felspar, which latter sometimes serves as a basis for the other two ingredients. Thin layers of red-coloured sandstone are visible in the conglomerate. The only Plutonian secondary rock was augite-greenstone, or dolerite, which occurs in veins or dikes cutting across the primitive rocks.

The river Dee, along whose banks we strolled in our walk to its source, rises in a terribly wild region in the very bosom of the Cairngorm group of granite mountains, and, after a course of fully 90 miles, flows into the sea at Aberdeen. The road to the Castleton of Braemar, a distance of 58 miles, although excellent, affords in many places much insight into the geognostical nature of the bounding hills and mountains. In the first part of the road that leads from Aberdeen to Braemar, gneiss and granite continued onwards to Banchory Ternan. The granite is grey and red; the red occurs most frequently in veins. The gneiss, as is the case at Aberdeen, is grey and red, and often traversed by granite veins. The banks of the Dee to Banchory Ternan, as far as we had an opportunity of examining them, are tame and unpicturesque; the hills lumpish and heath-covered, and presenting but few cliffs. The sides of the river exhibit deep deposites of alluvium. At a bridge across the Dee, about a mile before reaching Kincardine O'Neil, there is a magnificent vein of red felspar porphyry (eurite porphyry) traversing the gneiss; in breadth it varies from six to twenty feet.—From Kincardine O'Neil to Charleton, a distance of six miles, the whole road nearly passes over alluvium; the only fixed rocks we observed were of gneiss. The alluvium is composed of rolled masses of coarse and fine granular, grey and red granite, gneiss, porphyry, primitive greenstone, porphyritic hornblende-rock, and hornblende-slate. In the primitive greenstone (diorite), iron-pyrites is disseminated, and also iserine.—From Charleton, the road for several miles is over alluvium, the same through which the river here forces its way. All the way abundant rolled masses of red granite, hornblende rocks of various kinds, &c. Granite in mass begins to appear at the *37th mile-stone* from Aberdeen. It is red and grey, and coarse or fine granular, sometimes porphyritic, and traversed by contemporaneous veins of small granular granite. The granite here crosses the Dee, and ranges upwards among the bounding mountains, from both sides of the river. In this quarter there are examples of *natural cairns*; these are heaps of masses of granite formed by the weathering and washing away of the softer granite, the harder parts remaining, forming heaps resembling artificial cairns or tumuli. This granite continues upwards to the Bridge of Tulloch. Here we noticed in this rivulet, rolled masses from the mountains; these were principally of coarse granular red granite, masses of various hornblende-rocks, traversed by granite veins, also fragments of quartz-rock and gneiss. The granite appears to cross the Dee in a south-west direction. The road leads to the short but steep and rugged Pass of Ballater. The cliffs of this pass are of coarse granular red granite, which is disposed in tabular masses, and these are traversed by natural seams, in such a manner as to give the granite an indistinct columnar structure. In some places noticed small granular granite in the coarse granular.

Below the pass is the village of Ballater, always crowded during the summer months with invalids and other visitors, brought together by the fame of the chalybeate wells of Pananich, and the magnificence and beauty of the surrounding scenery. I am not aware of the existence of any thoroughly scientific analysis ever having been made of this mineral water. Indeed it is a fact, that, with exception of the mineral springs of Dunblane, examined by the late Dr Murray, we have no good analysis of any of our mineral waters. This is much to be regretted, when we recollect that a knowledge of the chemical nature of spring waters is eminently important when viewed in connexion with many geognostical phenomena and interesting geological speculations.

Although the geognostical *notes* are from journals of an old date, I could not refrain from enlivening them by some extracts from the recently published highly interesting and popular work of my accomplished friend, Sir Thomas D. Lauder.

" The view of Ballater from the lower extremity of the plain," says Sir T. D. Lauder, " is something quite exquisite. I do not speak of the village itself, which, at that distance, presents little more than the indication of a town, with a steeple rising from it; but I allude to the grand features of nature by which it is surrounded. The very smallness of the town adds to the altitude of the mountains; for, when seen from the point I mean, it might be a city for aught the traveller knows to the contrary. It stands, half hidden among trees, in the rich and diversified vale. On the north rises the mountainous rock of Craigdarroch, luxuriantly wooded with birch, and divided off from the bounding mountains of that side of the valley by the wild and anciently impregnable Pass of Ballater. Beyond the river, amidst an infinite variety of slopes and wood, is seen the tall old hunting-tower of Knock; and, behind it, distance rises over distance, till the prospect is terminated by the long and shivered front, and (when I saw it on the 15th of October last) the snow-covered ridge of Loch-na-gar—the nurse of the sublime genius of Byron, who, in his beautiful little poem, so entitled, still

'Sighs for the valley of the dark Loch-na-gar.'"

At the *Bridge of Gairden*, over the water of Gairden, a short distance from the granite pass and hill of Ballater, observed strata of hornblende-slate, hornblende-rock, micaceous gneiss, quartz-rock, more or less traversed by granite veins; and near to this, Dr Macknight discovered a fine junction of the great central granite with the neighbouring strata. From Gairden Bridge, by Abergeldy, to *Crathie*, the rocks are red and grey granite, syenite, primitive greenstone (diorite), hornblende-rock and slate, also micaceous gneiss, hornblendic gneiss, and quartz-rock, with much disseminated felspar. The granite at Crathie appears to extend onwards to Loch-na-gar. At and near the kirk of Crathie there is a fine display of syenite and hornblende rocks, and in the syenite there are numerous imbedded contemporaneous masses of hornblende, which at first sight might be confounded with fragments. Near to Crathie, at Monaltrie, there are veins of fluor-spar in granite. Beyond Crathie, towards an inn, called, I think, *Inver*, the rocks are still quartz-rock, with gneiss, hornblende-rock, bluish-grey granular foliated limestone, and granite, alternating in beds. Beyond Inver Inn a great body of red granite makes its appearance, which continues in a line parallel with one of the boundaries of Loch-na-gar. It is to be seen crossing the highway, and forming a continuation with the granite of the mountain just mentioned. This granite is succeeded by a series of strata of quartz-rock, gneiss, mica-slate, hornblende-rocks of various kinds, granite, and limestone, which form the Lion's Head and other hills onwards to the *Castleton of Braemar*. At Castleton there is a good inn, which is a great convenience to the geologist who may wish to remain here some weeks studying the numerous very interesting geognostical phenomena, so abundantly exhibited in this magnificent highland district.

Sir T. D. Lauder, describing this part of the country, says, "The magnitude of the features of Braemar, where the immense extent of the pine forests, and the huge bulk of its timber, give quite a Swiss character to the country—the rapidity and wildness of many of the streams—their craggy channels—the infinite variety displayed in the grouping of their birches, and picturesque firs, often partially interposing their deep green mantles before the white foam of the water-falls—and the accidental glimpses of the misty mountain-tops caught between them—combine to form an endless variety of pictures, such as are to be met with among the upper alpine regions; whilst, about upper Mar Lodge, Invercauld, and Ballater, we have the wide and cultivated valley—the sublime outline of bounding mountains, their bold and rocky fronts starting forward into individually prominent masses, hung with woods—their deep and shadowing recesses, and their levels and slopes, and varied knolls, where even the very buildings are found calculated to bring back the recollection of many a lovely Swiss valley."

Castleton.—To give a detailed account of our numerous observations in this part of Scotland, and to point out how the great mass of granite of the Cairngorm group, Loch-na-gar, &c., is distributed in regard to the neighbouring gneiss and other strata, would require many plates, a good map, and much more space than can be afforded in a periodical work. We must therefore rest satisfied by mentioning a few of the arrangements that occur around the Castleton. The rocks immediately beside the inn in the Clunie, or Cluanadh Water, are the following:

The uppermost rock is a *granite*, composed of ash-grey felspar and quartz, with a little mica. It forms a bed varying in thickness from a few feet to several yards. It rests upon strata of *gneiss, hornblende-rock and slate*, and *quartz rock;* and these latter rest upon, and alternate with, bluish-grey *granular foliated limestone.* This limestone is in some places mixed with contemporaneous portions of hornblende slate, just as the granite is found intermixed with portions of hornblende-slate, and the slate with portions of granite. In several places veins and imbedded masses of granite are observed mingled with the other strata, and again portions or fragments of these strata in the granite.

Lion's-Head.—This hill occurs on the road between the Castleton and the bridge over the Dee, near Invercauld. At the bridge the strata of gneiss and hornblende rock in the bed of the river are traversed by veins of granite; and, both above and below the bridge, the slaty rocks in the bed of the river exhibit interesting displays of the granite veins traversing them. The base of the Lion's-Head exhibits an alternation of granite and quartz. A road cut in the hill winds round it, and leads down into a valley which brings us again to the Castleton Inn. In the direction of this road, the structure and materials of the hill are well seen: they are alternating beds of granite, quartz-rock, gneiss, and limestone. The beds of quartz are frequently several yards thick: they exhibit, by their intermixture with mica and felspar, a gradual transition into granite, and frequently are traversed by contemporaneous veins of red felspar and of red granite. The granite, which alternates in beds with the quartz-rock, is either red or grey, and is composed of felspar, quartz, and mica. It is sometimes so intermixed with the quartz-rock, that it is difficult to say which is the predominating rock. Veins of it shoot through and across the quartz, and also the gneiss. The gneiss alternates with the quartz and the granite, is often intermixed with them, and veins of both traverse it. Portions of gneiss occur imbedded in the granite, and of granite in the gneiss. The limestone is bluish-grey in colour, composed of large and small granular concretions, and occurs in beds several feet in thickness, that alternate with the granite, gneiss, and quartz rocks. In the road leading through and down the glen to the inn, the same rocks and arrangements occur.

Loch-na-gar. Lake of the Precipice.—On a delightful morning in August, we started early from the Castleton, for the top of this mountain. After a long and fatiguing ascent through a fir wood, we gained the open brow of the mountain, from whence we ascended with more ease and less annoyance to the summit. The view from this elevated point is striking and extensive. In one direction our view extended to the sea at Aberdeen; in another the vast granite group of Cairngorm, with its well-known summits, viz. Bin-na-muick-dui, Cairngorm, Bin-na-buird, Bin Aven, rose before us in massive magnificence: to the south, in the distance, rose the trap-hill named Dundee Law, the trap cones of the Lommonds in Fifeshire, and the beautiful porphyry range of the Pentlands near Edinburgh; and, towards the west, the wild and rugged alpine country of Athole and Badenoch added to the interest of this varied scene. Around the mountain, we observed several frightful *cories*, bounded by dreadfully rugged precipices. We descended into one of them in order to examine the snow which it contained,—snow which remains all the year round. The mass of snow was thirty yards square, several feet thick; at the surface its texture was loose, but below was hard and composed of granular concretions, and had much of the glacier character. We met with parties of *topaz diggers* in search of the *topaz*, *beryl*, and *rock-crystal*, which occur in this and other granite mountains of the district, in the granite, either in drusy cavities or as disseminated crystals. The topaz diggers find the gems only in the alluvium, or broken granite, and generally in that covering the bottoms of cories, or spread round the foot of the higher granite summits*. It is interesting to observe the various modes of weathering of the granite here and in other parts of the granite mountains of this district. Some kinds, on exposure to the air, display the globular, others the columnar, and frequently the great tabular concretions exhibit a tendency to the slaty arrangement. All of them break down in a longer or shorter time into gravels, sands, and clays. The phenomena exhibited during the weathering of

* Those, Dr Macknight remarks, who employ themselves in searching for the gems, pay the proprietors a small rent for the liberty of searching. The part of the Cairngorm group which lies to the east, and is called Ben-Aven, is at present reckoned the most productive, yielding the proprietor about L. 150 or L. 200 a-year. The field is said now to be nearly exhausted.—Vide Wernerian Memoirs, vol. iii. pp. 117, 118.

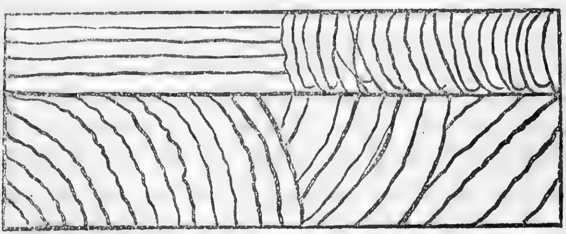
the rock depend partly on the original texture and composition of the mass, partly on the action of the atmosphere and of the subterranean water and gases. When the felspar of the granite contains little alkali or calcareous earth, and the mass is compact, it is a very durable stone; but when either the felspar contains much alkaline matter, or the mica much protoxide of iron, the action of the atmosphere and water containing oxygen and carbonic acid, on the ferruginous and alkaline ingredients, tends to produce the disintegration of the stone. As the nature of the gaseous matters that rise through the fissures of the granite rocks in this quarter have not been examined, we cannot say how far these may assist in breaking down the granite *.

Glen Callader.—The granite continued to accompany us, without any intermixture of other rock, until we reached an eminence named Muckle Cairn-taggert, when large loose blocks, and even fixed rocks of hornblende-rock and slate made their appearance. These were traversed by veins of granite, often of considerable size. These rocks are probably ranged alongside the granite, and may be a continuation of the slate-rock observed at the bridge over the Dee, at the foot of the Lion's-Head. We now descended into the wild Glen Callader, and walked by the river which flows through it to the mouth of the glen, where Callader water flows into the Clunie water. The bed of the river exhibits numerous displays of the phenomena that occur where granite is associated with slaty primitive rocks, and, for its extent, no glen in Scotland is more remarkable, not even the famous Glen Tilt. We examined with great care a succession of alternations of slate rocks, as common hornblende-slate, micaceous hornblende-slate, mica-slate, and gneiss with *apparent beds* of

* It is worthy of notice, that the proportion of carbonic acid in the atmosphere, according to the observations of Saussure, the son, are not always the same. Over a wet soil, the atmosphere contains less carbonic acid than over a dry one; more carbonic acid exists in the air during the night than during the day; the superior strata of the atmosphere contains more carbonic acid than the inferior; and, lastly, a violent wind generally augments the carbonic acid in the lower strata of the atmosphere, during the day, by the intermixture of the lower and upper aërial strata, and sometimes by the wind blowing from a dry quarter.

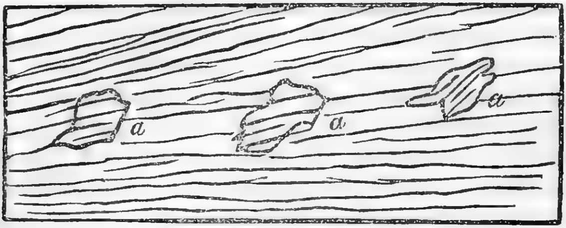
granite, some of these several hundred feet thick. From these beds of granite, veins of the same rock shoot out on both sides into the bounding slaty strata. In other parts, distinct veins of granite were observed waving through the hornblende-slate. We also examined particularly the effects of the granite-rock on the substance of the slaty strata, and their different positions, as connected with the intrusion of the granite. It is worthy of remark, that, in some veins, one part of the rock was quartz-rock, like that of the Lion's-Head, while other parts were composed of red or grey granite. The micaceous hornblende-slate is used as a roofing material, clay or roofing slate not occurring in this district *.

Having reached the mouth of the glen, we continued our examination along the course of the Clunie water, and the hills that bound it, to the Castleton. The stratified rocks in this direction we found to be mica-slate, quartz-rock, gneiss, and hornblende rock and slate. Among these, in the form of veins, or in apparent beds, that is, in branches of veins, and varying in size from a few feet to many yards in breadth, and many fathoms in extent, we noticed granite, felspar-porphyry, granite-porphyry, and hornstone-porphyry. The slaty rocks exhibit many interesting varieties of structure, which our limits will not allow us to describe. In some places the gneiss was disposed as represented by this figure.



* Shell-marl is met with in the glen in small quantity on the side of Loch Callader, consequently at a very considerable height above the sea, although not so high as the shell-marl on the mountain of Ben-i-gloe in Glen Tilt. Sir T. D. Lauder mentions shell-marl, in which, as is often the case, lacustrine and land helices, &c. are intermixed, at a great height, in the farm of Inchrory, in Glen Aven.

In the gneiss, observed, cotemporaneous masses of gneiss as represented in the figure at *a a a*, which might be mistaken for fragments.



From Castleton to Mar Lodge—Fall of the Dee—Across the Mountains to Aviemore.—The country from Castleton to Mar Lodge abounds in stratified quartz-rock, which is often micaceous, thus passing into mica-slate, always with imbedded grains and crystals of felspar, and passes into gneiss. These strata, as is the case in the Lion's-Head, Glen Callader, and Clunie Water, range from NE. to SW. and dip under various angles, 45° and upwards, to the SE., and are traversed by veins of granite and of felspar-porphyry. We visited from this the cascade called the Linn, or fall of the Dee where the river flows through a deep and narrow chasm in mica-slate rocks, over which an alpine wooden bridge is thrown at a height of 30 feet above the stream. From this point up the course of the Dee to its head, there is a path which leads to the rugged tract that strikes across the Cairngorm group to Rothiemurchus. The same slaty quartz-rock, mica-slate and gneiss, with alternating and intersecting felspar porphyries and granite, prevail here as lower down the river. The path across the mountain is wild in the extreme, and difficult to travel, being encumbered, or rather blocked up, by enormous masses of granite, which have fallen from the neighbouring granite cliffs. On descending from the summit-level towards Rothiemurchus, through remnants of the great central forest of Scotland, we at length leave the granite, which is replaced by gneiss strata, that accompany us onwards to Aviemore.

Ben-na-buird, or Table-mountain.—On visiting this wild massive granite mountain, we walked in the direction of Mar

Lodge, and crossed a bridge over the Cuach or Quoich* water, at which latter place the strata are the usual gneiss and quartz-rock, but here in nearly horizontal strata. From this, walked across the hills to the base of Ben-na-buird, the strata the whole way proving to be gneiss, frequently passing into quartz-rock. For a considerable distance the strata were but little inclined, but as we approached the granite of Ben-na-buird the inclination became considerable, and the dip, not as in the case of the lower parts of this district to the SE., but to the NW.—the direction SW. and NE. Near the head of Quoich water examined the gneiss strata, where nearly in contact with the granite, and found them dipping NW., that is, towards the body of the mountain. The scenery around the upper part of this stream is overpoweringly dreary and desolate: on the one hand lofty, rugged, and bare granite cliffs and precipices; on the other, grey roundish hills, sparingly clothed with a meagre-looking heather. The granite continues to the summit of the mountain, exhibiting the usual characters of the Cairngorm granite.

During the tremendous days of the 3d, 4th, and 27th of August 1829, the whole of the wild granite region of Cairngorm was violently assaulted by the flood and the storm, and exhibited scenes of fearful atmospherical agitation, and of the mighty power of the waters let loose on its magnificent summits—ridges—cliffs and glens—far exceeding in violence any thing remembered by the oldest inhabitant of those regions, where indeed every season these powers of nature are exerted with an energy unknown in the lower parts of the country. Sir Thomas Dick Lauder informs us, that during these storms the *subterranean water frequently burst out with great violence.* "The red granite hill of the *Muckle Glashault*, nine miles to the north-west of Invercauld, is about 3000 feet high, and of steep ascent on all sides, the surface being covered with immense masses of rock and granitic sand. On the north side, and at

* "Cuach is a drinking cup, and the river is so called from the circular holes worn in the slaty rocks near where the bridge stood. Tradition says that the Earl of Mar, and his followers, used to rest here, as they returned from the chase, and to drink, mixing their liquors with the pellucid water, for which this river is remarkable. One of these holes is still called The *Earl of Mar's Punch-bowl.*"

about a third of the way from the summit, no less than from fifteen to sixteen of these openings have been made, varying in breadth from thirty to forty yards. Each of these appears to have had an immense column of water issuing from it, which has cut a tract for itself to the very base of the mountain, into the Glashault burn. The ravines are all of them of very peculiar formation. Their margins or sides are completely defined by a fence of stones, raised considerably above the surface, something like that presented by the track of an avalanche. Dr Robertson of Crathie concludes, from the appearances, that the water burst from the bowels of the mountain in repeated jets, rather than in one continued stream; and such we know to have been the case at Tomanurd. Some of the stones on the sides are of great size, and must have required a powerful force to have placed them there. None of these appearances existed previous to the 3d and 4th of August, but were noticed immediately afterwards. They are by no means confined to the *Muckle Glashault*, being observed of greater or lesser magnitude by Dr Robertson in all the hills he had an opportunity of examining. To have stood in the midst of a solitary amphitheatre of these wildernesses, with all the elements warring around, and to have beheld the mountain sides heaving, and these 'fountains of the great deep broken up,' and their streams sent forth as messengers of Almighty power, would have been inconceivably grand." At page 206 of the same work is the following account of another burst of subterranean water: "Before leaving the district of Abernethy, I have to notice a wonderful ravine formed in the side of Bein-a-chavirin, near the Dhu-Lochan, above the bridle-road from Strathspey to Braemar, and a quarter of a mile from the march of that country. It extends a mile in length down the steep slope of the mountain, is from forty to fifty yards wide, and of proportionable depth. Its former contents are now spread all over the base of the hill, covering an immense surface. The mountain side was formerly an entire and beautiful green sward, and there was no stream or spring there; but the new channel is now occupied by a rill, the remains of the tremendous burst of subterranean water that occasioned it. Soon after it took place, a man passing on horseback, who was not aware of the water-charged and unstable nature of the debris that had fallen from it, got so entangled in it that his horse broke its leg, and soon afterwards died."

To this mode of action of water, we have always referred the frightful ravines, that commence not at the top, but on the acclivities of hills, in many parts of Scotland; and of which there are examples near to Edinburgh, in the mountains between Noble House and Moffat. But not only water bursts out from the rocks in the manner already mentioned, but air also rushes forth with incredible violence through the rents and fissures of the mountains. The strange and fearful noises heard during the raging and howling of the tempest, may at times be in part traced to these emanations from below.

The tumult and noise of the flood and storm in our Highlands, are thus forcibly pourtrayed in the "Account of the Great Floods of 1829:"

"On the evening of Monday the 3d of August, we were roused, while at dinner, by the accounts the servants gave us of the swollen state of the rivers, and, in defiance of the badness of the night, the whole party sallied forth. We took our way through the garden, towards our favourite Mill Island. 'John,' said I, to the gardener, as he was opening the gate that led to it, 'I fear our temple may be in some danger if this goes on. 'Ou, Sir, it's awa' else!' replied he, to my no small dismay; and the instant we had passed out at the gate, the Divie (river) appalled us!

"Looking up its course to where it burst from the rocks, it resembled the outlet to some great inland sea, that had suddenly broken from its bounds. It was already 8 or 10 feet higher than any one had ever seen it, and setting directly down against the sloping terrace under the offices, where we were standing, it washed up over the shrubs and strawberry-beds, with a strange and alarming flux and reflux, dashing out over the ground 10 or 15 yards at a time,—covering the knees of some of the party, standing, as they thought, far beyond its reach,—and, retreating with a suction, which it required great exertion to resist. The whirlpool produced by the turn of the river, was in some places elevated 10 or 12 feet above other parts of it. The flood filled the whole space from the rocks of the right bank on the east, to the base of the wooded slope, forming the western boundary of the Mill Island, thus covering the whole of that beautiful spot, except where two rocky wooded knolls, and the Otter's Rock beyond them, appeared from its eastern side. The temple was indeed gone, as well as its bridges, and four other rustic bridges in the island. Already its tall ornamental trees had begun to yield, one by one, to the pressure and undermining of the water, and to the shocks they received from the beams of the Dunphail wooden bridges. The noise was a distinct combination of two kinds of sound; one, an uniformly continued roar, the other like rapidly repeated discharges of many cannons at once. The first of these proceeded from the violence of the water; the other, which was heard through it, and, as it were, muffled by it, came from the enormous stones which the stream was hurling over its uneven bed of rock. Above all this was heard the fiend-like shriek of the wind, yelling as if the demon of desolation had been riding upon its blast. The leaves of the trees were stript off and whirled into the air, and their thick boughs and stems were bending and cracking beneath the tempest, and groaning like terrified creatures, impatient to escape from the coils of the watery serpent. There was something heart-sickening in the aspect of the atmosphere. The rain was descending in sheets, not in drops, and there was a peculiar and indescribable lurid, or rather bronze-like hue, that pervaded the whole face of nature, as if poison had been abroad in the air. The flood went on augmenting every moment, and it became difficult to resist the idea of the recurrence of a general deluge. We could not prevent ourselves from following it out, and we fancied the waters going on rising, till first the houses, and then the hills of the glen, where we had so long happily lived, should be covered; and all this in spite of our reason, which was continually prompting us to stifle such dreams. But, indeed, even reason was listened to with doubt, where we saw before our eyes what was so far beyond any thing that experience had ever taught us to believe possible."

We ascended from Quoich Water, and clambered and walked over a dreary and stony heath-covered wilderness, to the road leading to Invercald. The prevailing rock was gneiss, often alternating with quartz, and in which the strata were still dipping to the NW. The road down to the Dee opposite to Castleton, was across gneiss, in several places alternating with felspar-porphyry, and also traversed by it in the form of veins.

Walk from Castleton to Spittal of Glen-Shee and Blair-Gowrie.

In our walk from the Castleton to Blair-Gowrie, we travelled parallel with the Clunie water to its source. About five miles and a-half on the way, there is an inn named Newbigging, a convenient halting place for those who may wish to explore the mountains in this quarter. The gneiss, and other primitive slaty rocks, appeared to form the mountains on both sides of the valley. In many places veins of porphyry and granite were observed traversing them, or branches running parallel with the strata thus appearing like beds. At a place named Goats'-craig, we observed a vein of porphyritic granite, 40 feet wide, traversing the strata. In the neighbourhood of the inn the prevailing rocks are quartz-rock, hornblende-slate, hornblende-rock, porphyritic hornblende-rock. Of these, the quartz-rock, with subordinate mica-slate, was the most abundant. Of this rock it may be remarked, that here, as in many other places, it has disseminated through it iron-pyrites, which, by decomposition, communicates to the surface of the rock a yellowish-brown colour. Beds of bluish-grey granular foliated limestone, alternating with the other stratified rocks, were observed. All these rocks are more or less intersected and alternated with felspar-porphyry; and this porphyry, where in contact with the mica-slate, has a blackish colour, and the slate is changed in its nature.

In our course onward, before reaching the summit of the mountain on which is the *water-shed* (divortia aquarum) that separates Aberdeenshire from Perthshire, we noticed several beds of bluish-grey granular foliated limestone, with mica-slate, chlorite-slate, and hornblende-rocks, traversed by veins of felspar porphyry, and also alternating in beds with that rock. Having reached the highest part of the pass, the line of demarcation of the two counties, we now descended a rapid acclivity into the valley named Glen-beg. The strata were mica-slate, with the usual SW. and NE. direction. Near the foot of this acclivity we observed, at a little distance, several large beds of felspar-porphyry, and also of bluish-grey granular foliated limestone. The country, which had been hitherto bleak, improved in appearance as we approached Tombey, the inn of the Spittal of Glen-Shee. The situation of the Spittal is beautiful,—the surrounding hills green, the valley wide and ornamented with cultivated fields and wood *. After leaving Tombey the hills become gradually lower, the valley wider; but, in some places, the sides of the hills are extremely rough, owing to the vast number of blocks of mica-slate spread around. In the mica-slate there are beds of chlorite-slate and bluish-grey granular foliated limestone; also beds of hornblende-rocks and hornblende-slate, the outgoings of which frequently project above the mica-slate, forming rough and picturesque cliffs in this and in the neighbouring Strath Ardle. The mica-slate, as we walked onwards, is at length succeeded by clay-slate, which, like the mica-slate, ranges NE. and SW., and dips to N. 25° to 40°. At the bridge of Caley, conglomerate and old red sandstone make their appearance in nearly horizontal strata, resting upon the outgoings or upper ends of the strata of clay-slate, which latter rocks are inclined to the south at an angle of 70°. The conglomerate is composed of rolled pieces of porphyry, amygdaloid, quartz, mica-slate, clay-slate, and hornblende-rock. The masses are frequently the size of a man's head, even, as is the case with the amygdaloid, several feet in length. At the line of junction of the clay-slate and red sandstone, we observed fissures in the slate filled with sandstone, and at times are disposed in such a manner as to give the masses of slate somewhat the appearance of conglomerate. These secondary sandstone and conglomerate rocks extend down to Blair-Gowrie.

The water of Ardle passes Blair-Gowrie, and in its course displays good sections of the strata of the district, which are red sandstone and conglomerate. The masses in the conglomerate vary in size from that of a pea to a man's head, and larger; are principally porphyry, with amygdaloid, quartz, and mica-slate. The strata dip to the SW. and direction NE. and SW. The finest display of the conglomerate is at Craig-Hall, at the time we visited it in the possession of a particularly interesting and delightful old lady, Miss Rattray, but now the seat of Baron Clerk Rattray. The residence is perched on a tre-

* Dr Macknight met with a bed of an impure graphite, in mica-slate, half a mile south of the inn of Tombey.—*Vide Wern. Mem.* vol. iii. p. 121.

mendous precipice, from which are seen the stupendous walls of conglomerate, that bound this part of the water of Ardle. In the conglomerate we observed large *masses* and *veins* of amygdaloid; but here, as at Blair-Gowrie, the predominating masses are of porphyry.

We now turned westwards and visited Forneth, the seat of the Very Rev. Principal Baird, delightfully situated on the side of the Loch of Clunie. In this route we passed several lakes, on the banks of which we observed shell-marl of various interesting kinds, and also different species of lacustrine shells. The strata are conglomerate and old red sandstone, ranging NE. and SW., as is the case with the clay-slate on which these deposites rest. To the south of Forneth, we visited the limestone quarries of Gourdie, which are particularly interesting on account of the change of the compact limestone into granular, by the action of the trap-rocks which are intermingled with it. From these quarries we walked to the *Craig of Clunie*, which we found to be the outgoing of a great mass of trap, in some parts greenstone, in others porphyritic. It is said to be about 600 feet high. It rises through the red sandstone, and probably is disposed partly as a vein, partly as a bed. To the westward of this Plutonian mass, on the property of Sir Alexander Muir Mackenzie of Delvin, we observed in the red sandstone a conglomerated limestone, resembling some varieties met with in the red sandstone at the bottom of the Mid-Lothian coal-field. From this point to the *Craig of Stenton*, on the river Tay, some miles below Dunkeld, the red sandstone and conglomerate were the prevailing rocks. The Craig of Stenton is a Plutonian mass, resembling that of the Craig of Clunie. Near the Craig we examined some beds of conglomerate, in which the porphyry is still the predominating rock. From this we went on towards *Caputh*, where we crossed the Tay by a boat ferry, and at some distance visited *Gilly-burn sandstone quarry*. The sandstone is of a grey colour, horizontally stratified, and the strata from two to six feet thick. The bridge at Dunkeld is built of this sandstone. We next visited the *Linn of Campsie*. Here the river Tay forces its way through and over rocks of a vein of basaltic greenstone. Direction of the vein E. and W. It is 14 feet wide, and cuts across strata of red sandstone. It appears intersected by a vein of newer greenstone. Some miles lower down the Tay, at *Thistle Bridge*, we noticed another linn or fall of the river, caused by a vein of greenstone crossing the river. The sandstone all around red, with beds of red marly slate, which, like the sandstone, exhibits green streaks, and circular green and grey spots. This old red sandstone continues onwards to Perth, being in its course variously intersected and disturbed by veins of dolerite and other trap-rocks.

In this line of walk, as in that from Aberdeen to the head of the Dee, the zoologist and botanist will find much to interest them :—the lover of insects will ramble in a country, the entomology of which is nearly unknown—the botanist will not go unrewarded : if he has merely a passion for rare plants, he will be gratified ; if he aspires higher—if he is desirous of tracing plants from the sea-coast to the summits of the most lofty land in Britain (Cairngorm), and from thence down to the low land leading to the Firth of Forth ; and if he endeavour to connect their aspect and distribution, with rock, soil, exposure, climate, and height above the sea, he will procure for himself the most varied and multiplied enjoyment, and will be doing what has not been done before, in this or in any other district in Scotland. In this tract the ornithologist and the ichthyologist will not travel in vain ; and even the conchologist will, if he is disposed to collect and determine the species of land, river, and lake shells, return home with a store of facts of a very interesting nature.

Descriptive Memoir of the Imperial Forest of Bialowieza. By the Baron de Brincken, Conservator in Chief.

One of the most important and singular remnants of the primeval forests of Lithuania is that of *Bialowieza*, formerly the private domain of the kings of Poland, and now the imperial property, in the district of Pruzany, in the government of Grodno. It comprises the immense forest which extends from the River Bog to the heights, near the town of Osla, from north to south, at the southern extremity of which is the hamlet of *Haynowezyna*. The forest forms an uninterrupted mass, 31.5 miles long, 27 broad, and 112 in circuit, situate from Lat. 52° 29′ to 52° 51′ N., Long. 41° 10′ to 42° W. By the most correct measurements, its superficial extent amounts to 102.01 square miles, or 489,103,187 Prussian acres; the portion which is private property amounts to 33.75 square miles; so that the whole forest may in round numbers be estimated at 135 square (Eng.) miles—an uninterrupted expanse, except by a few cultivated spots. The cold and dry east and north winds, in conjunction with the great extent of the forest, give to the climate much greater severity than under the same parallels in Germany and England. The mean temperature of Lithuania does not exceed 5° 4′ R., although it has been much ameliorated by the progress of culture; the mean temperature of the forest of *Bialowieza* may be 5°. The three regions into which Count Plater divides the kingdom of Poland have respectively a temperature of 5° 5′, 6°, and 6° 5′ R. Compared with the north of Germany, their spring is late and short; summer is rather early, often cloudy and stormy, at one time cold, at another of intolerable heat. Autumn partly supplies the want of summer, for it is serene, dry, warm during the day, cold only at night. Most of the grains and fruits of northern Germany, however, thrive very well when properly cultivated; they only ripen slower, and the later varieties often do not ripen at all. In the immediate proximity of the forest the temperature is lower, and harvest from eight to fourteen days later. Innumerable streams take their rise in its interior; the river Narew has its source there, and the Narewska flows through it: both are navigable for boats in the forest, the former nearly to its origin. The soil is level without any elevations, and consists principally of sand, and was evidently, from the lakes and other geognostic characters, at some former period either the bottom of the sea, or constantly exposed to frequent and extensive inundations. In the forest the sand is more or less mixed with clay; in the lower parts, and particularly by the sides of the streams, there is found a black friable soil, but which is not true peat; the only true peat-bog is that from which the Narew takes its rise, and which extends for several miles exterior to the forest. The more elevated portions of ground are covered with a thick layer of vegetable earth, and may be compared to very fruitful oases, interspersed in the uniform expanse of sand, and only bear a proportion to the latter of 1 to 4. A ferruginous earth is the only mineral deposit which is explored by the natives. Amber has not yet been discovered, but it probably exists. According to the statistics of Count Plater, amber is found in Poland, of remarkable beauty, and considerable quantity, in the deposits of brown-coal.

The chief place is the village of Bialowieza, situate nearly in the centre of the forest. It consists of a church, fifty-six dwelling-houses, and an inn. Augustus III. of Poland built on the height at this village a hunting seat, which was enlarged by Stanislaus Augustus. Besides this, there are in the forest two hamlets, which have been lately erected. On the other hand, round its exterior, there are twenty-four villages and hamlets, which are all connected in some way or other to the forest, and are under its local jurisdiction. All the houses consist of logs of wood piled upon one another, and the roofs are covered with boards or shingles. The inmates are as unpretending as the dwellings, and as rude and uncultivated as the surrounding wilds. They are of Russo-Polish descent, and are simply clothed; the only covering for their feet, for example, are sandals of the wood of the lime-tree. They prefer to the agricultural occupations, which are followed by their neighbours, a wandering forest life, which furnishes them with honey, wild fruits, edible mushrooms, and pasture for their cattle; they are, consequently, very expert as foresters and hunters, on which account all the imperial huntsmen and foresters are chosen from among them. Five villages are exclusively set apart for the service of the forest; their inhabitants must fell the wood, collect winter fodder for the wild animals, cultivate the fields of the foresters, and employ themselves in hunting. The inhabitants of the other forest villages must also do service in the chase, so that 2000 individuals can be brought together for this purpose. None of these people have any property in the forest itself; the fields from which they get their bread are the property of the crown, but they have pasturage in abundance, and can make use of the wood for fire and building free of expense. In the whole district there is no manufacture, nor process for the better working of the timber: there is no saw-mill nor glass-house; seldom is any man met with on the road; and in the innermost recesses of the forest not even the art of the wood-cutter is put in practice. There is even a district of 15,000 acres, or nearly two square miles, which bears the name of "*Niezeanow*," that is the "*Unknown region*," because it is rendered quite impassable from the multitude of trunks of trees rooted up and crossing one another in all directions. These wilds are peopled by a great variety of wild animals, such as the aurochs, elks, boars, roes, beavers, bears, lynxes, and wolves.

European culture and rational forestry have had no influence on this forest. The Scotch pine (*Pinus sylvestris*), which in the north of Europe extends from Lat. 51° to 70°, covers four-fifths of the surface of the wood, where the sand predominates; it is the principal tree, as in all the Sarmatian plains. Next to it is the silver-fir (*P. picea*, Duroi), which principally thrives on cold, heavy, and marshy soil, where it attains to the most advanced age, without becoming sickly or porous, and differs in this from what is observed in southern Europe. The silver-fir in the forest of Bialowieza only grows in these its favourite soils, and by the sides of streams. The entire absence of larches and common spruce firs (*P. Larix* & *Abies*, Duroi) is the more extraordinary, as these two species are not only found in other parts of Poland on a soil with exactly the same constitution, but also in 60° and 70° North Lat., in the governments of Archangel and Tobolsk. The larch, which is now seldom seen in Poland intermixed with the Scotch pine, was formerly much more abundant. The common spruce is still pretty frequent, and now and then forms whole forests; but in Poland the larch and spruce do not reach higher than the 52° of Lat., which is in accordance with the statements of Count Plater. According to this author, in the middle region of Poland, there occur either isolated, or collected into small groups, the *Pinus Larix*, *P. Abies* (Duroi.), *Fagus sylvatica*, *Quercus pedunculata*, *Acer platanoides*, *Fraxinus excelsior*, and *Tilia grandifolia*. In the wild districts, all these species are to be met with, partly in families, and partly mixed with one another, as oaks and beeches in patches of considerable extent. The spruce fir is common on the Jura limestone; the silver-fir on clay-slate in the mountains, in marshy places, between hard-wood, on the plains; larches on *quadersandstein*. 360,000 Prussian acres, in lease, in Poland are covered by the common spruce, generally alone, at times mixed with red beech and oaks, and often rising up in gloomy shades, in which are aspens and birches.

The tree most worthy of the notice of the botanist is the yew, *Taxus baccata*, in Polish *Cis*. On account of the utility of its wood it has become very scarce, but was formerly very common in Poland and Lithuania. Not only are there many villages whose names are derived from *Cis*, but in the great forests there are well preserved roots of this tree, which bear out the supposition that the trunks to which they belonged must have possessed great height and thickness. Even in the vegetable earth of the forest of Bialowieza there are old roots of the yew, although neither so numerous nor large. Among the hard-wood trees there are two common species of oak, the *Quercus Robur* and *pedunculata*, in tolerable numbers, and furnishing magnificent specimens; the former is the most common. The beech (*Fagus sylvatica*) is more abundant, and generally in the vicinity of the oak. This species bears the same relation to this district as the red beech (*F. atro-rubus*, Duroi) to Germany, and both are distinguished from those of south Europe by their beauty and height. The entire absence of the red beech in this forest, is another proof that geographic latitude does not invariably determine the limits of plants; as in Poland, where this tree is rare, we see some specimens on the northern frontiers of the kingdom; in Lat. 53° 3′, and in Lat. 51′, there are woods of it, extending even to some thousand acres. In the same latitude in Lithuania there is no trace of this tree. According to Count Plater, the beeches in the whole kingdom of Poland cover a space of 45,000 Prussian acres. The common birch (*Betula alba*), is scattered through the whole forest. Elder, both the black (*Alnus glutinosa*) and the white (*Al. incana*), with a great variety of grasses, grow along the sides of the streams, and especially in the lower situations.

The small-leaved lime (*Tilia parvifolia*) is very common in the Sarmatian plains; it was formerly more abundant, but even still forms large groups. The month of July is known in Poland by its flowering at that period. It is very common in the forest of Bialowieza, and there attains a very great age and a vast size. The large-leaved lime (*T. grandifolia*), on the contrary, is rare, not only in this forest, but in all the Sclavonian territory under this degree of latitude. The Bialowieza wood contains three species of poplar, the *Populus nigra, alba,* and *tremula.* Two species of *Pyrus,* viz. the *P. Malus* and *sylvestris,* the wild apple-tree, and *P. pyraster,* the wild apple-tree, are pretty common. The wild cherry-tree, *Prunus Padus,* is rare. We meet with field maple *(Acer campestre),* and the sycamore *(A. pseudo-platanus);* the pointed-leaved maple *(A. platanoides)* is wanting here, and is very rare in Poland. Of the elms there is only the *Ulmus campestris,* and of the ashes only the *Fraxinus excelsior.* The service-tree (*Sorbus Aucuparia*), so common in the north, is neither found in this forest nor in Lithuania.

Among the shrubs there are wanting many of central Europe. The principal which do occur are found on the stations of the hard-wood trees: the hazel (*Corylus Avellana*) is the most common; several species of *Salix*; three species of ivy and honeysuckle; three species of *Rhamnus,* among which is the *alpinus,* an unusual phenomenon; the common privet is very frequent; dog-wood; the sloe; barberry; hawthorn; and common Guelder rose; different species of *Eunymus,* as the *verrucosus,* which, in the south of Europe, is only seen on high mountains, is found in Poland and Lithuania. There are several species of *Rosa, Ribes,* and *Alnus*; the common juniper in abundance; mezereon, and wild rosemary, in abundance; common ononis; and several species of bilberry. Round the stems and stumps are ivy and osier; the misletoe also is not wanting; lastly, the heath (*Erica,* principally the *vulgaris* and *Tetralix*), forms the principal turf on the wide expanse of the forest.

Although Gillibert* has described a great number of plants, yet the botanist will find many others not mentioned by that author; as, for instance, several rare species of *Campanula,* the *C. pyramidales, thyrsiflora, lilifolia.* We observe also here the *Veronica sibirica, alpina,* and *maritima,* which do not occur in the woods of Poland. We may further enumerate the *Dracocephalum moldavica, Pedicularis sceptrum carolinum, Gentiana amarella, Saxifraga hirculus,* &c. and several of the less com-

* Flora Lithuanica, &c.

mon species of *Pyrola*. The grasses are richly intermixed with the *Anthoxanthum odoratum*, known in autumn by the rich fragrance which it diffuses. Several species of ferns, and similar plants, form large patches in the thickest recesses of the forest, and in the open spaces. There are also many varieties of mosses, *Hepaticæ*, *Algæ*, and *Fungi*; and in the districts with abundance of vegetable soil, there are both kinds of truffle, the *Tuber cibarium* and *album*.

As the soil is in general divided into two principal portions, that in which sand, and that in which vegetable earth, predominates, so there is this distinction between the kinds of timber; the former being principally covered with trees with linear leaves, as firs, the latter with broad-leaved trees. The space in which the fir predominates may amount to 81.612, and that of the broad-leaved trees to 20.373 square English miles.

In order to give an idea of the vegetation, and of the increase of single trees in this forest, we may subjoin the measurements of several trees, expressed in Prussian measure, which, though not the rarest, are perhaps the most remarkable in this forest.

Scotch Pine, 190 years old. Height of the whole tree 130 feet; of the trunk 56. Lower diameter 38″.5; of the last 30 years 1″.7. Present contents 453 cubic feet; 30 years ago 375. Annual increase 2.6 cubic feet.

Silver-fir, 190 years old. Height of whole tree 120 feet; of the trunk 62. Lower diameter 48″; of last 30 years 2. Present contents 781 cubic feet; 30 years before 652. Annual increase 4.3 cubic feet.

Oak, 230 years old. Height of whole tree 80 feet; of trunk 72 feet. Lower diameter 48″; of last 30 years 2″.5. Present contents 907 cubic feet; 30 years before 725. Annual increase 6.0 cubic feet.

Beech, 120 years old. Height of whole tree 80 feet; of trunk 45. Lower diameter 26″.7; of last 30 years 1″.7. Present contents 167 cubic feet: 30 years ago 126. Annual increase 1.4 cubic feet.

Birch, 120 years old. Height of whole tree 100 feet; of trunk 44. Lower diameter 26″.1; of last 30 years 1″.6. Present contents 163 cubic feet; 30 years ago 126 cubic feet. Annual increase 1.2 cubic feet.

Maple, 110 years old. Height of whole tree 92 feet; of the trunk 51. Lower diameter 24″.1; of last 30 years 3″.5. Present contents 162 cubic feet; 30 years ago 82. Annual increase 2.6 cubic feet *.

These measurements of oaks, beeches, and maples, shew that the climate and soil must here be favourable to these species of wood. No example is given of the lime-tree, as its age could not be certainly determined, and because the most remarkable lime trees are situate in inaccessible places. It rivals the oak in height, often exceeds it, and is then truly the colossus of the vegetable kingdom. A number of stems of pine trees (Scotch fir or pine) prove that this tree has a duration of 250 to 300 years: it seldom survives beyond 300 years. The silver-fir *(Pinus picea)* terminates its life sooner: the greatest age of this tree does not exceed 200 years, after which it soon dies. Internal decay is not the cause of the death of the pine, but it probably depends on the severity of the climate. The beech reaches 220 years; the birch 120, and the maple 250 years. The life of the oak appears in this forest to terminate between 500 and 600 years; we can trace a retrograde growth in this tree of a century. Of all the trees which have been enumerated, the lime attains to the greatest age. 815 annual circles were counted on the section of a stem of the lime tree.

* In Scotland, trees of all the above kinds are found of a large size. The Pine, the Oak, and the Birch are indigenous: the Silver-fir, the Beech, and the Maple were introduced towards the middle of the 16th century, or shortly before the Reformation, and are found of a large size only near old mansion-houses. Mr Macnab of our Botanic Garden, informs us, that, in the present autumn, he saw native *Pines* in Mar Forest, 12 feet in circumference at 3 feet from the ground, and from 50 to 60 feet in height, English measure. The *silver-fir* reaches from 50 to 100 feet high: very fine specimens exist at Woodhouselee near Edinburgh, and at Ramornie in Fife. Dr Walker (in the posthumous Essays in Natural History and Rural Economy) mentions an *oak* at Lockwood in Annandale, 230 years old, about 60 feet high, and at 6 feet above the ground 14 feet in girth. Many noble oaks exist in the Duke's Great Park near Hamilton, where some of the original white cattle of Scotland are still preserved. Some *beeches* more than 200 years old exist at Newbattle Abbey near Dalkeith, with trunks 16 feet in girth at breast-height. The *birch* is a most abundant native, and sometimes acquires a great size: one at Balbegie attained the height of 100 feet, with a clear stem of 50 feet. At Barnton, near Edinburgh, are two *maples* (Acer campestre) with stems between 8 and 9 feet in circumference, and perhaps the largest trees of the kind in Scotland.—Editor.

On the Development of the Vascular System in the Fœtus of Vertebrated Animals *. By Allen Thomson, M.D. late President of the Royal Medical Society.—Communicated by the Author.

Introduction.

In studying the various forms which the organs circulating the blood assume in the different orders of Vertebrated Animals, we are apt to consider the varieties which present themselves in these organs, from their simple state in Fishes, to their more complicated structure in Mammalia, as wholly unconnected with one another. The discoveries, however, that have lately been made respecting the development of the circulating organs in the earlier stages of fœtal life, appear to illustrate the relation which these varieties bear to one another, as well as to the other organs of the animals in which they occur, more fully than could previously have been done by the most extended comparison of their forms in adult animals.

From the ease with which observations may be made on the eggs of birds during incubation, many physiologists have availed themselves of the opportunity thus afforded of studying the development of the fœtus and of its different organs. By the earlier authors, accordingly, the production of the heart and bloodvessels was studied in the chick alone; and it was not till a very late period, that the observation of physiologists was extended to the formation or evolution of these organs in the other classes of vertebrated animals.

From this circumstance it has necessarily arisen, that we are at present much better acquainted with the mode of development of the organs of the chick than of any mammiferous animal, and that many facts, often regarded as ascertained by observation in the human embryo, have only been inferred by analogical reasoning, from what is known to take place in the eggs of birds. It might, at first sight, be supposed, that such a mode of reasoning is inadmissible in prosecuting researches of this nature; but the more the structure of the ova of the different classes of vertebrated animals has been studied, the more perfect

* This Essay was the subject of the author's Inaugural Dissertation on taking the degree of Doctor of Medicine in the University of Edinburgh, July 1830.

has the resemblance between them appeared to be. Since our acquaintance with the development of the ovum has increased, the mode in which the organs of the fœtus are produced, has been proved to be analogous in the different classes of vertebrated animals; and we are induced to believe, that a knowledge of the simpler forms of these animals must greatly facilitate our study of the more complicated.

For some time even after the development of the chick, as well as of the fœtus of several other animals, had attracted considerable attention, physiologists believed that the impregnated ovum, at the time it passes from the parent, and before the process of development has commenced, contained already formed, all the parts which are afterwards to be found in the perfect animal. They seemed to make a duty of conceiving that the successive appearance of the organs of the animal which is observed during the process of development, is owing simply to the evolution or coming into sight of parts, the transparency and small size of which had before rendered them invisible; and in no instance did they permit themselves to imagine, that the actual formation of an organ, or the union and arrangement of its parts, could be observed to proceed before their eyes. As their knowledge of development increased, it is true, many observations were made, which were with difficulty to be explained in accordance with the commonly received opinion; but still, the theory of preformation and simple evolution of parts was strenuously defended by some of the most distinguished physiologists, till it was opposed by C. F. Wolff, in a Thesis * which he published at Berlin in 1759.

This celebrated author endeavoured to show, by a reference to many accurate observations which he had made on the development of the fœtus of the bird, that the impregnated egg, before incubation has commenced, is very simple in its structure, that it does not, so far as we are able with the greatest attention to discover, contain any part that can be compared to the fœtal or adult animal, and that several of the organs of the chick can be seen gradually forming by the apposition of their parts. Wolff carefully avoided entering into any speculation on the causes of the phenomena which he observed, and affirmed that it

* Theoria Generationis. Republished 1774.

was by indulging in theory, without attention to facts, that the older authors were led into error; and he endeavoured to prove, that if we regard only the appearances which present themselves to us, we cannot refuse our assent to the conclusion to which they lead. He was aware that it would be impossible to disprove, by argument, the assertion which was made by the opposite party, that all the organs of the animal really exist, though circumstances render them invisible in the germ of the egg; but he endeavoured to establish his own opinion, without opposing their hypothesis, by recording those observations which seemed to him indisputably to prove the formation of a new part in the egg. The part which he first described was the vascular network which appears on the surface of the yolk about the 40th hour of incubation. He followed, with great minuteness, the changes by which the vessels of this network are formed, and afterwards extended his observations to the formation of the intestinal canal, amnios, and some other parts of the fœtus. By these observations he shewed very clearly, not only that the actual formation of parts may be observed to take place, but that after they are first formed, they undergo many important changes in their structure before arriving at their perfect state.

The observations of Wolff, and the conclusions to which they inevitably lead, viz. that during the development of the fœtus, its organs are actually formed, and not simply evolved, gave a new direction and increased interest to the study of this subject. This author has since been followed in his investigations by many other observers. The work of Pander *, especially, on the incubation of the egg, together with the observations of Meckel, Oken, Blumenbach, Baer, Rathke, Cuvier, Dutrochet, Serres, Rolando, Prevost, Dumas, and many others, have confirmed and greatly extended the system of which Wolff laid the foundation, and have, indeed, created a new branch of physiological science, from which our knowledge of the structure and functions of animals may be considerably increased.

The observations of the above mentioned physiologists tend to show that the Germinal Membrane of the ovum, in which the

* Beiträge zur Entwickelungsgeschichte des Hünchens im Eie, Wurtzburg, 1817; also, Journal des Progrès des Sciences et des Instit. Médic. tom. v. p. 30, and in the Journal des Physique, tom. 68.

rudimentary parts of the fœtus appear in vertebrated animals, is composed of a thin layer of granular substance situated on the surface of the yolk. This germinal membrane, or Blastoderma, as it has been called in the egg of the bird, is the first part which is seen to undergo a change: it becomes more distinct, and gradually separates itself into three layers, called by Pander the Serous, Mucous, and Vascular Layers of the Blastoderma, which, by the various folds they afterwards form, give rise to the Nervous and Tegumentary, the Vascular and the Intestinal Systems of the body. The layers into which the germinal membrane becomes divided, are placed closely under one another on the surface of the yolk. The outermost, called the Serous Layer, is situated immediately under the membrane of the yolk, and, by the changes which it undergoes in the progress of evolution, forms the rudimentary state of the brain and spinal cord, the parietes of the larger cavities of the fœtus, its muscular and osseous parts, its general integuments, and proper envelope or amnios. The layer next in order has been called Vascular, because in it the development of the principal parts of the vascular system appears to take place. The third, called the Mucous layer, situated next the substance of the yolk, is generally in intimate connexion with the vascular layer; and it is to the changes which these combined layers undergo, that the intestinal, the respiratory, and probably also the glandular systems owe their origin.

The knowledge of these rudimentary parts of the germinal membrane has, it is true, been obtained chiefly from the observation of the eggs of birds; but later investigations render it highly probable that they are also common to the ova of other orders of vertebrated animals, and that they form a very striking analogy among these animals from the earliest periods of their existence.

In the following pages we purpose to describe some of the changes which the middle, or vascular layer, undergoes in the ova of vertebrated animals during the formation and development of the more important organs which take their rise from it; but it will be necessary, first, to give a short account of the general phenomena of development of the germinal membrane, from the first signs of change, up to the period when the heart, or principal circulating organ, is formed. As the development of the bird is best known, we shall begin with it, and shall afterwards notice the analogous observations which have been made in other vertebrated animals.

1. *Changes of the Germinal Membrane in Birds.*

In the unincubated egg of the common fowl, the cicatricula, or germ spot, lying on the surface of the yolk, is of a round form, a whitish colour, and generally about one-sixth of an inch in diameter (Plate II. Fig. 1). The disk of the cicatricula is formed of different-sized granules united together, and is covered by the proper membrane of the yolk, (Fig. 3).

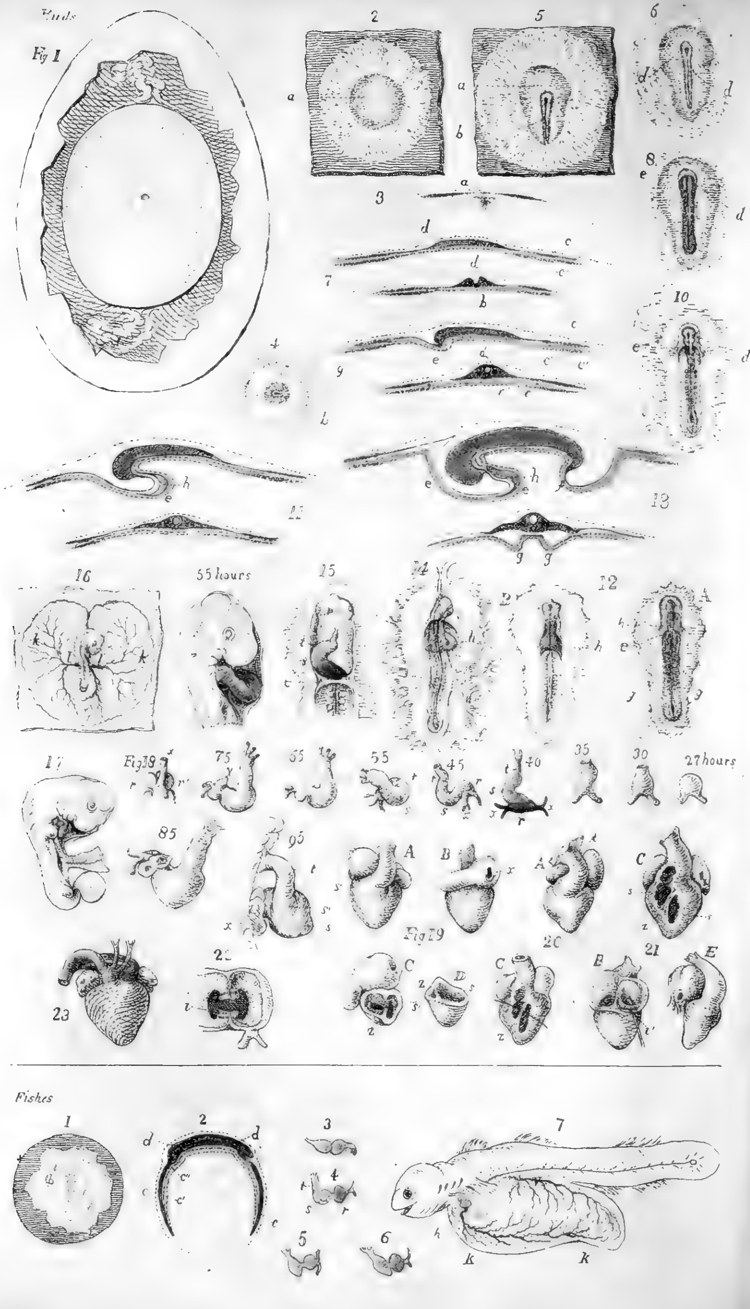
The central part of the disk (Figs. 2. and 3, *a*) is thinner and more transparent than the rest, and has been called the Colliquamentum, or Transparent Area. Observers differ as to whether any mark or trace of the embryo is to be found in the cicatricula before incubation has commenced: Some, as Rolando, Prevost, and Dumas, affirm that there always exists a linear trace of the embryo in the centre of the transparent area (Fig. 4. *b*); while others, as Pander and Baer, assert that they have never been able to discover such an appearance. However this may be, it seems now to be established, that after the egg has been incubated seven or eight hours, a small dark line may, with the aid of a magnifying lens, be discovered on the upper part of the cicatricula, towards the centre of the transparent area (Fig. 4. *b*).

This line, or primitive trace, is swollen at one extremity, and is placed in the direction of the transverse axis of the egg; its rounded extremity is situated towards the left, when the small end of the egg is turned from us, and indicates the place where the head of the fœtus is afterwards formed (Figs. 1. and 4). This large extremity occupies very nearly the centre of the transparent area, while the linear part of the primitive trace (Fig. 5, *b*), corresponding to the body and tail of the fœtus, approaches the margin of that area on the right side.

As incubation proceeds, the whole cicatricula, expanding, increases in size. The transparent area becomes larger, more pellucid and defined. We are indebted to Pander for the important discovery, that, towards the 12th or 14th hour, the germinal membrane becomes divided into two layers of granules—the serous and mucous layers of the cicatricula (Fig. 7. *c c′*) ; and that the rudimentary trace of the embryo, which has at this time become evident, is placed in the substance of the uppermost or serous layer (*b*). According to this observer, and to Baer, the part of this layer which surrounds the primitive trace soon becomes thicker ; and, on examining this part with care, towards the 18th hour, we observe that a long furrow has been formed in it, in the bottom of which the primitive trace is situated (Fig. 6. *d d*). About the 20th hour, this furrow is converted into a canal, open at the two ends, by the junction of its margins (Fig. 7. *d d*), (the *plicæ primitivæ* of Pander, the *laminæ dorsales* of Baer). The canal soon becomes closed at the cephalic or swollen extremity of the primitive trace, at which part it is of a pyriform shape, being wider here than at any other part, (Fig. 8. *d′*).

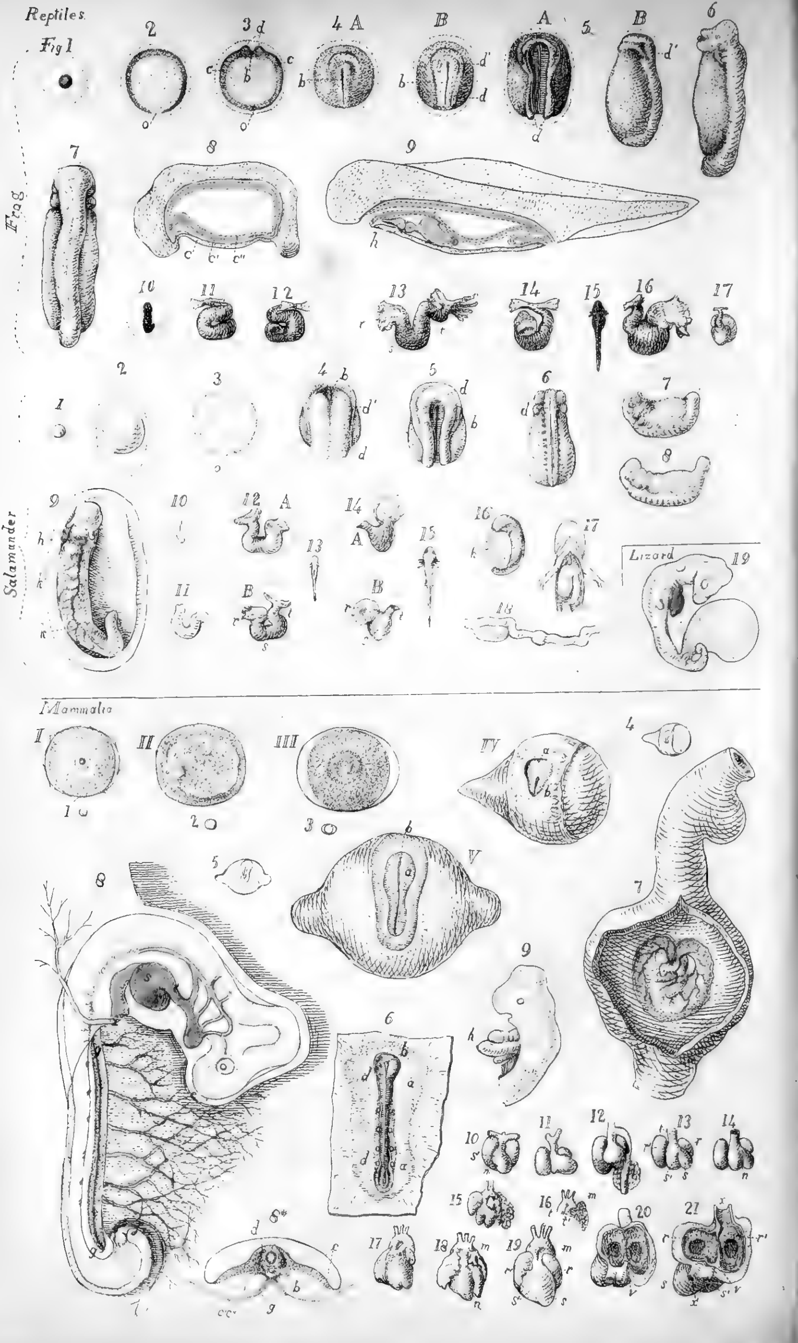
According to Baer and Serres, some time after the canal begins to close, a semifluid matter is deposited in it, which, on its acquiring greater consistence, becomes the rudiment of the spinal cord. The pyriform extremity or head is, soon after this, seen to be partially subdivided into three vesicles, which being also filled with a semi-fluid matter, give rise to the rudimentary state of the Encephalon (Fig. 10, *d′*). Rolando, Prevost, and Dumas, on the other hand, suppose that the rudimentary state of the brain and spinal cord is constituted by the primitive trace itself, which, it will be recollected, they affirm exists before incubation has commenced. The view given by Baer of this subject agrees best with my own observations, and I feel the more disposed to adopt it, that the opinion of Prevost and Dumas seems to be influenced by some hypothetical views which they entertain respecting impregnation.

As the formation of the spinal canal proceeds, the parts of the serous layer which surround it, especially towards the head, become thicker and more solid ; and, before the 24th hour, we observe on each side of this canal four or five small round opaque bodies. These bodies indicate the first formation of the dorsal vertebræ : in a few hours, several more appear, and those first produced become quadrilateral (Figs. 8. and 10). About the same time, or from the 20th to the 24th hour, the inner layer of the germinal membrane undergoes a further divi-



Thomson Sculpt.

PLATE III.



A. Thomson Sc

sion, and, by a peculiar change, is converted into the vascular and mucous layers (Fig. 9. *c′ c″*).

Towards the 25th hour, when the layers of the germinal membrane cover nearly a third of the circumference of the yolk, they no longer retain their flat and uniform position, but begin to exhibit various folds, which afterwards serve for the formation of the cavities of the body. That part of the germinal membrane which lies immediately before the cephalic extremity of the embryo is bent down into a fold, so as to make a depression on the surface of the yolk; and some time afterwards, a similar fold is formed behind the caudal extremity. As these folds of the germinal membrane increase, they gradually turn in below the fœtus at its head and tail, and their margins (*e f*, Figs. 8, 10, 12, 9, 11, 13), approach one another under the abdomen, which at this period always lies next the substance of the yolk. As the layers of the germinal membrane are bent down in a similar manner towards the sides also of the spinal canal (Fig. 13. *g*), there is formed under each end of the embryo a shut sac or cavity, which communicates with the yolk by an opening, common to both, left in the middle (Fig. 13. *e f*). The two shut sacs thus formed indicate the rudimentary state of the intestinal tube: the anterior corresponds to the œsophageal portion of the intestine, the posterior to the lower part of the large intestine.

The first rudiments of the heart appear, towards the 27th hour, on the lower side of the œsophageal canal (Figs. 12, 13, *h*), at the place where the layers of the germinal membrane are reflected from the edge of the anterior shut sac which they form in the embryo. In forming this fold, the mucous layer (Fig. 13, *e*), is reflected farthest inwards, the serous layer advances least, and the space between them, occupied by the vascular layer, is filled up by a dilated part of this layer, the rudiment of the heart (*h*).

About the same time that the development of these rudimentary parts of the embryo takes place, the surrounding disk of the cicatricula is also considerably changed. The whole cicatricula continues to expand, and to cover more of the surface of the yolk. That part of the mucous and vascular layers which surrounds the transparent area, becomes thicker and more spongy than the adjacent parts, and is soon studded with numerous irregular points and marks, of a dark yellow colour: as incubation proceeds, these points become more apparent, and are gradually elongated into small lines, which are united together, first in small groups, and then into one net-work, so as to form what is termed the Vascular Area.

The space occupied by this network is cordiform, and is surrounded by a vessel, gradually developed in the same manner as those of the rest of the area. The newly formed vessels of the space become more and more distinct as incubation advances, and the orange-coloured fluid they contain acquires a darker hue: the small branches of the network arrange themselves like the fibrils of a leaf, on each side of the embryo (Fig. 16, *k*), and terminate towards the embryo, in two vessels issuing from its sides, which are the omphalo-mesenteric arteries (Fig. 16, *l*.) Towards the circumference of the area, the smaller ramifications of these vessels open into the sinus or Vena terminalis which bounds the space.

This description of the changes which the germinal membrane undergoes in the common fowl, may be applied to most other birds, as no material difference has been perceived in any of their leading features, in the eggs of the different birds in which they have been observed.

2. *Changes of the Germinal Membrane in Mammalia.*

The very small size of the ova of Mammalia has rendered it difficult for physiologists at all times to observe the early signs of development in these animals. De Graaf, Cruikshanks, Haighton, and others, have described very small ova in the oviducts and cornua of the uterus of the rabbit; but little respecting the internal structure of the ovum is to be learned from the observations of these authors, before the time at which a considerable number of parts in the fœtus are formed, and the heart and bloodvessels have appeared. More lately, Baer, Prevost, and Dumas, from their intimate acquaintance with the phenomena and laws of development, have been more successful in their researches on this subject.

The older authors were aware that the ova found in the oviducts and uterus were derived from the Graafian vesicle of the ovarium, but they were quite at a loss to conceive what part of this vesicle the ova formed, as no direct observation had ever been made of their presence there. We are indebted to Professor Baer* for a solution of this difficulty, in the discovery which he recently made of the ovulum in the interior of the Graafian vesicle. Baer made this discovery first in the dog. The ovulum has since been found in the human species, and in all other mammiferous animals in which it has been sought for, by Baer and by my friend Dr Sharpey, through whose kindness I have had an opportunity of seeing it in the cow, sheep, pig and rabbit.

In the dog the ovulum, while in the Graafian vesicle, is so minute, that its structure cannot be easily examined. It appears to be only about the 200th part of an inch in diameter. As soon as it enters the oviduct it begins to enlarge, and it increases in size as it passes along that tube towards the uterus. In the uterus the growth of the ovum is proportionally more rapid than before; its structure may be examined with ease when it is about half a line in diameter. At this time the interior of the ovum is seen to be filled with a granular matter, frequently of a yellowish colour, which is probably the substance of the yolk: this matter is inclosed within a double covering, the internal layer of which appears to correspond to the proper membrane of the yolk, the external to the proper membrane of the ovum, or chorion. According to Baer, Prevost, and Dumas, the cicatricula or germinal membrane is visible at this time on the surface of the yolk (Figs. I. and II.), and bears some resemblance to the corresponding part in the egg of the bird; being a round opaque granular disk, with a dark spot in its centre. I have seen this spot very evident in the ova of the rabbit on the 6th day after impregnation, (Fig. III).

As development proceeds, the germinal membrane increases in size; its central part becomes thin and transparent; its peripheral part expands laterally, so as to form a cover for the yolk, the yolk bag, intestinal sac, or what in mammalia has been called the Umbilical Vesicle.

According to Baer, and to Prevost and Dumas†, the two last

* Epistola de Ovi Mammal. et Hom. Genesi, Lipsiæ, 1827; also in the Repertoire Génér. d'Anat. et de Physiol. tom. vii.

† Annales des Scien. Natur., tom. iii.

of whom have investigated more particularly the changes in the germinal membrane subsequent to the period when the parts of the fœtus begin to be visible, the first trace of the embryo appears like a dark line near the middle of the central transparent part, exactly in the same manner as the primitive trace shows itself in the transparent area of birds (Fig. IV. *b*). In comparing, indeed, the drawings which these observers have given of the development of the rudimentary parts of the fœtus of the dog and rabbit, with those at a corresponding period in the eggs of the common fowl or duck, we cannot fail immediately to perceive the singular resemblance which exists between them.

The spinal canal and cerebral cavity, the vertebræ, the integuments, and the amnios, are most probably, therefore, formed, as in the chick, by the extension and folding of the serous layer of the germinal membrane. The intestine takes its origin in the same way as in the chick, by the inflection of the mucous and vascular layers on the anterior or abdominal side of the embryo (Fig. 8. *g g*), and is there connected in a similar manner with the sac of the yolk. In the dog and rabbit the peripheral part of the germinal membrane undergoes changes also very similar to those described in the chick : there is formed on its surface a vascular network which receives its blood from the omphalo-mesenteric arteries; this network is smaller, relatively to the size of the fœtus, in these animals than in the bird, and its vessels are more numerous (Figs. 7, 8. *k k*). Unfortunately, the first appearance of the heart has not been investigated.

3. *Changes in the Germinal Membrane in Reptiles.*

The ova of the Saurian and Ophidian reptiles resemble much more than those of the Batrachian, the eggs of birds. Baer has represented the cicatricula or germinal disk in the ova of the Coluber natrix, the Lacerta agilis, and the L. crocea ; and he informs us that he has ascertained by observation, that the changes which this part undergoes during the development of the embryo in these animals, do not differ in any important points from those which takes place in the bird.

The ova of Batrachian reptiles differ very much in structure and appearance from those of the Lizard and Serpent tribe, as well as from those of birds and mammalia. In the ova or spawn of the common frog, the yolk, occupying the central part, is small and of a dark brown or blackish colour. At the time the egg is laid, the yolk consists of a soft grey substance in its centre, surrounded by a film of black granular matter, in which the parts of the embryo first become developed (Fig. 2. *c*). This layer of black matter, corresponding to the germinal membrane, has not, in the ova of Batrachia, the appearance of a flat disk, which it commonly presents in other animals, but is nearly spherical in its form, and covers almost the whole of the proper substance of the yolk, leaving uncovered only a small greyish spot on the side of the egg opposite to that on which the fœtus begins to be developed (Fig. 2. *o*).

We are indebted to the observations of Prevost and Dumas *, Sir E. Home †, and Baer ‡, for our knowledge of the mode in which the rudimentary organs of the tadpole are developed. According to these authors, whose observations have been repeated and confirmed by Dr Sharpey and myself, the first change which the germinal membrane undergoes is in its lateral expansion; it thus very soon fills up the vacant space previously left on the surface of the yolk. The spinal canal begins to be formed about a day after development has commenced. A long dark eminence, bulged at one extremity, makes its appearance on the upper surface of the germinal membrane. This part is the primitive trace of the embryo, on each side of which, a short time after, the germinal membrane becomes thickened and raised, so as to form the primitive folds or dorsal plates of the spinal canal (*d d*, Figs. 3, 4, 5). These folds are broader in proportion to the size of the egg in the Batrachia than in other animals; they are thickest and most abrupt towards the primitive trace. The yolk, at the same time, loses its spherical form, and the germinal membrane is bulged out at the places where the head and tail are afterwards formed. The primitive folds are soon after united together behind, so as to close the spinal canal; and the rudiments of the vertebræ now appear on each side of it (Figs. 6, 7).

We have already remarked that the germinal membrane

* Annal. des Scien. Natur., tom. ii. 1824.

† Phil. Trans. 1825. Part i.

‡ In Burdach's Physiologie als Ehrfahrungsgeswischenshaft, vol. ii. p. 222.

covers the whole of the yolk at a very early period; but in the frog no new fold of the germinal membrane takes place for the formation of the intestinal tube (Fig. 8, *e f*). We may therefore regard the embryo of the frog as destitute of any proper intestinal appendage or yolk-bag, as the whole of the mucous layer of the germinal membrane is employed in the formation of the rudimentary intestine; or, perhaps, it may more correctly be said, that the sac of the yolk constitutes or is converted into the intestine itself. As development proceeds, the embryo becomes of an oval and then of a long shape. The spinal canal is lengthened by the sprouting out of the tail from the serous layer, and the intestine becomes more tubular in its form. I have found the heart on the fifth day while the embryo is yet enclosed in the egg, but I have not been able to follow the production of the bloodvessels at the same time, owing to the dark colour of the animal, and the transparency of the blood.

The ova of the Aquatic Salamander, in which changes occur very similar, in the early stages, to those in the frog, are much more suitable to the observation of the phenomena of development, as the germinal membrane is of a light colour, and the coverings of the egg quite transparent. The excellent memoir of Rusconi* has made known many facts relating to the development of the larva of this animal. In the spring of the present year, Dr Sharpey and I investigated the formation of its rudimentary parts, and it appears, from our observations, that the mode of development of the water newt resembles very closely that of the frog. See Figs. of this. We have observed the production of the heart and bloodvessels at a very early period. Some days before the little fœtus quits the egg, there is seen on the abdomen an irregular sort of network, the branches of which, in a day or two, becoming more distinct, assume a more regular disposition, and are collected into one trunk near the heart (Fig. 9, *k*). At this time the heart, of a very simple form, is distinctly seen contracting on the fore part of the neck, but I have not yet succeeded in tracing this organ to its first formation (*h*).

* Amours des Salamandres Aquatiques, et développement du Tétard, &c. Milan, 1821; of which an account is given by Daniel Ellis, Esq., in Edinburgh Philosophical Journal, vol. ix. 1823.

A German author, Funk*, who has written an interesting memoir on the structure and development of the Land Salamander (an ovo-viviparous animal), has made in it an observation corresponding with that related above on the development of the bloodvessels in the water newt. "Permulta vasicula tenuia," says this author, "inter se complicata, a parte dorsali exorta in vitello evanescentia in conspectum veniunt;" showing in this respect the analogy subsisting between the salamander and other animals (Fig. 17, *k*). It may be remarked, however, that this animal possesses a distinct yolk-bag.

4. *Changes of the Germinal Membrane in Fishes.*

In the ova of cartilaginous fishes, such as the skate and shark, the yolk is of a large size, and is filled with a white granular and oily matter. The cicatricula, lying on the surface, is small, and resembles considerably the same part in the egg of the bird.

The ova of osseous fishes are generally small and transparent. From the observations of Cavolini †, on the development of the Syngnathus ophidion, the Cyprinus barbus, and some other osseous fishes, and of Forchhammer ‡ and Rathke § on that of the Blennius viviparus, it appears that the elements of the germinal membrane in the ova of osseous fishes are the same as those we have described in the egg of the bird, and that the changes by which the organs are formed from these parts are, in many respects, analogous.

The germinal membrane, which, even before development has commenced, appears to occupy a considerable space on the surface of the yolk, first increases in size and expands laterally, (Fig. 2 *c*). It then becomes thicker in the centre, and the primitive trace appearing in the serous layer (Fig. 1, *b*), is surrounded by the spinal canal. The head, tail, and vertebral column are soon distinguishable, as well as the rudiments of the intestinal canal communicating with the sac of the yolk. The rudiment of the heart is first perceived between the anterior or œsophageal por-

* De Salamand. terrest. Vita evolutione, &c. Berolini, 1827.
† Die Erzeugung der hartgrätigen Fische. Berolini, 1792.
‡ De Blennii Vivip. formatione et evolutione, &c. Kiliæ, 1819.
§ Geschichte des Embryo der Fische, in Burdach's Work, vol. ii.

tion of the intestine and the sac of the yolk. About the same time that the heart can be perceived, the vascular network of the yolk-bag begins to be formed. This network differs, however, entirely in its relations from the corresponding part in birds or mammalia, as the mesenteric arteries do not reach it, and veins alone are distributed on its surface (Fig. 7, *k k**).

Having thus shortly pointed out the changes which take place in the germinal membrane of the ovum in the earlier stages of development, I shall next describe the mode in which the heart and bloodvessels are formed and evolved. It will be necessary to divide this description into two parts: the *first* comprehending an account of the formation and development of the heart; the *second* that of the larger bloodvessels, more especially those connected with the respiratory organs of the fœtus.

I. The heart, at the period of its first formation, in all vertebrated animals which have been examined, is very similar in its structure and in the situation which it occupies. The Rudimentary parts of this organ are situated on the lower side of the œsophageal portion of the intestine. Its primitive form is that of a tube more or less bent, but equally simple in all vertebrated animals. In these animals, therefore, the adult heart, however varied its form, must be produced by some change in this tube; and from the facts I am about to relate, it will appear that these changes are more or less complicated, according as the animal in which they occur is higher or lower in the scale, or according as its structure is more or less nearly allied to that of man.

In treating this subject, we shall find it advantageous to begin with the simpler class of animals, and then to proceed with the more complicated.

1. *Development of the Heart in Osseous Fishes.*

According to the observations of Rathke on the Blennius, the heart of the fœtus of this fish appears, at the commencement of its formation, like a small reniform body of a granular

* Since writing the above, I have seen the Memoir of M. Prevost, on the Development of the Mulus gobio, in which the observations of Rathke are confirmed in most particulars.

gelatinous consistence. As evolution proceeds, its texture becomes more compact; it now takes the form of a sac, pointed at the two extremities: the posterior extremity becomes connected with the venous trunk which collects the blood from the anterior surface of the yolk. At a later period, the rudimentary heart is divided into two compartments by a knotch in the middle (Fig. 3). The posterior of these compartments (*r*, Fig. 4). communicating with the vena cava and veins from the yolk, is the auricle; its form is oval and more regular than that of the other compartment, and it is placed in the direction of the body of the fish. The anterior compartment (*s*), or ventricle, projects from the body of the fœtus, and communicates with the posterior auricular part by a short and narrow canal: the cavity of the ventricle is widest posteriorly: at its anterior extremity it is connected by a canal with an oval dilated part, which afterwards forms the bulb of the aorta (*t*). At first the cavities of the heart appear scarcely to differ from one another in their texture. Very soon, however, the parietes of the ventricle become perceptibly thicker, and this cavity in consequence assumes a white appearance during its contraction: the parietes of the auricle, on the other hand, remain very thin, so as to allow the red colour of the blood to shine through them (Fig. 5). As the development of the heart proceeds, the veins on the surface of the yolk become more apparent. The course of the blood can then be traced with ease. A branch springing from the vena cava inferior, about the middle of the abdomen, (Fig. 7, *v*), is ramified on the posterior surface of the yolk, and communicates, by its capillary vessels, with the small branches of another vein *k*′, which is ramified on the anterior surface of the yolk, and which, joining again the vena cava near the head, conveys the blood which has passed over the yolk into the auricle of the heart. Before entering the heart, the venæ cavæ form posteriorly, by their dilatation, two sacs, which afterwards become the venous sinuses or appendages to the auricle.

As development proceeds, the auricle increases principally in its width; the auricular canal shortens itself relatively; the ventricle increasing in size and strength acquires the form of a three-sided pyramid; the bulb of the aorta becomes stronger and wider than before. The relative position also of the auricle and ventricle is changed. As the sac of the yolk decreases, preparatory to its entering the abdomen, or disappearing altogether, the auricle advances forward so as to place itself between the ventricle and the vertebral column. In some fishes, this change of position takes place only in a slight degree, so that the auricle remains somewhat posterior to the ventricle; while in others it advances forward so as to lie immediately above the ventricle, or even to come into contact with the bulb of the aorta—a situation which it continues to occupy in the adult fish. After this has taken place, and the valves at the mouth of the aorta and auriculo-ventricular opening are formed, the heart suffers little alteration, except in the increased thickness of the ventricle and bulb of the aorta, and the dilatation of the auricle and venous sinuses.

2. *Development of the Heart in Reptiles.*

Though the dark colour of the embryo of the Frog and the transparency of its blood, do not permit us to examine this fluid circulating in the vessels, I have succeeded in separating the heart from the embryo at a very early period. About the 5th day, the heart of the tadpole, before it leaves the egg, consists of a tube, which is so closely rolled up on itself as to give it the appearance of a solid ball (Fig. 11). At this time there appears to be little difference between the auricular and ventricular parts of the tube. They are both composed of soft dark-coloured granules loosely connected, so that considerable care is necessary in unravelling them. The auricular part (*v.* Fig. 11), is situated towards the left side of the fœtus. The ventricular part (*s*), occupies the greater curvature of the tube, and stretches across the neck to the right side of the fœtus, where it is bent forwards, between the rudiments of the gills, so as to form the bulb of the aorta (*t*), from which the principal arterial vessels arise. About the 12th day, when the external gills are nearly perfectly formed, the auricular becomes wider than the ventricular part of the tube (Fig. 13). The ventricle is also slightly dilated in its middle, and is separated by a contracted part from the bulb of the aorta. Between the 2d and 3d week, the colour of the blood is changed to red, and the alterations in the form of the parts of the heart become more apparent. About the third or fourth week, the primitive tubular form of the heart can no longer be easily recognised (Fig. 16).

The auricle remains thin and membranous, becomes much dilated, and is placed behind the ventricle. The ventricle is now much widened at its middle, and, from the projection of the apex, begins to assume somewhat of a pyramidal shape. The bulb of the aorta, the diameter of which remains comparatively small, is now thrown forward on the neck, and we can easily distinguish the arterial branches coming off from it on each side. For some time before the tadpole leaves the water, its heart seems to resemble almost entirely that of the adult animal: after this period, the apex of the ventricle is still more prolonged, and the strength of its parietes increased; but no material change is known to take place when the animal begins to breathe air only.

The Heart of the Fœtal Salamander may be perceived about the same relative period as that of the frog. About the 5th or 6th day (Figs. 9, 10, 11), when the heart is first perceptible, this organ has the form of a semitransparent and slightly curved tube, lying across the body of the fœtus in a depression between the head and body (Fig. 9, *h*). At first, the contractions of the heart, though regular, are very slow, there being, in the ordinary temperature of the season at which they are developed (April and May) only 20 or 25 pulsations in a minute. The contraction begins at the end of the tube which is on the left side, and extends slowly and regularly through the whole tube till it reaches the right side. The blood is at this time of a milky colour, and can be seen best when the fœtus is placed on a dark ground. As the development of the animal proceeds, and the gills begin to sprout out from the sides of the neck, the fœtus leaves the egg and swims about in the water. The blood now becomes of a pinkish, and soon after of a red hue. The heart becomes more distinct, and its contractions more rapid. The tube of the heart is now altered in its form; the auricle and ventricle and bulb of the aorta become distinct from one another, and on laying the animal on its back and observing it with a moderately strong lens, the circulation of the blood may be followed in almost all its parts (Figs. 12, 13). It is unnecessary to describe more at length the changes which the heart of this animal undergoes before arriving at its perfect state, as these changes appear to resemble very closely those just described in the frog.

The contractions of the heart become gradually more rapid, amounting to 50 or 55, at the time when the animal is about four weeks old, and the external gills are nearly perfect. The colour of the blood deepens. The contraction of the heart is now no longer uniform from one end to another; for as the auricle contracts and discharges its contents, the ventricle is dilated, and when this cavity contracts, the auricle in its turn expands for the reception of a new supply of blood, which flows into it from the venæ cavæ. By comparing the slight sketches which are given in Plate III. of the heart of the Newt, at three separate periods,—before it comes out of the egg,—when it has just left it,—and when the external gills are nearly perfect, with those at the corresponding periods in the Frog, the great resemblance they bear to one another cannot fail to be apparent.

It is to be regretted that very few observations have been made on the development of the Ova of the Higher Orders of Reptiles, as, from the great variety in their forms, we might have hoped that the investigation of their evolution would have thrown considerable light on the mode in which this process is effected in other animals. According to the observations of Emmert and Hochstetter *, of Rathke †, and of Baer ‡, it has been shewn that in the Lizard tribe the surface of the yolk is covered with the ramifications of the omphalo-mesenteric arteries at a very early period. It has also been ascertained, that in these animals the heart, which in the adult generally consists of two auricles and a ventricle, divided by a septum into two compartments, has at first only a single auricle and ventricle; and that these cavities become divided by the gradual formation of partition walls between them. In the early periods there is only a single arterial vessel arising from the ventricle, the bulb of the aorta, which afterwards becomes divided so as to form the roots of the right and left aortæ with the other arterial vessels §.

* Untersuchungen über die Entwickelung der Eidechsen, &c. Reil's Archiv. x. p. 84.

† In his Memoir on the Development of the Respiratory Organs in the Isis, in the Répert. Génér. d'Anat. tom. vii., and Edin. Med. and Surg. Journ. January 1830.

‡ Loc. cit.

§ The division of these vessels will form one of the subjects treated of in the second part of this paper.

3. *Development of the Heart of Birds.*

The appearance of the heart of the Chick, at the earliest period at which it is visible, has not been described exactly in the same way by the different authors who have observed it. Baer * describes the rudimentary heart as having the appearance of a dilated vessel situated between the mucous and serous layers on the lower side of the œsophagus; while Pander †, Prevost, and Dumas ‡, compare it to a sac or pouch closed at the anterior extremity, situated between the mucous and vascular layers of the germinal membrane; and describe it as somewhat similar in its form to the œsophagus itself (Fig. 12, A and B.) From the drawings of it which Pander, Prevost, and Dumas have given, I am inclined to think that the view which they have taken of the subject is the more correct one, so far as regards the form and position of the heart; but I do not think it probable that the anterior extremity of this organ is shut or closed.

The heart of the chick retains the appearance of a sac for a short time only; its anterior part is soon produced forwards, while the middle part of the cavity of the organ is narrowed so as to reduce it to a tubular form (35th hour). The posterior part at the same time sends out a prolongation on each side of the fœtus into the transparent area; and these prolongations, formed at first only of globules loosely connected together, indicate the place where the veins afterwards enter the heart, (Fig. 12, A).

At first the tube of the heart can only be seen on looking at the abdominal side of the embryo, but towards the 30th or 33d hour, it is dilated in its middle, and is bent out towards the right side, so that part of it can be seen when the fœtus is viewed from above, as is the case when it lies on the surface of the yolk in the egg. The tube of the heart remains as yet simple and undivided; and so long as motion has not commenced, nothing remarkable distinguishes one part of it from another. We may state, however, that the posterior part, or that towards the tail,

* Entwickelungsgeschichte der Thiere. Königsberg. 1828, and in Burdach's work, vol. ii.

† Loc. citat.

‡ Sur la Formation du Coeur dans le Poulet. Annal. des Scien. Natur. tom. iii.; and, Sur le Développement du Poulet, ibid. tom. xii.

corresponds to the auricle, the anterior to the ventricle and bulb of the aorta.

Though the circulating apparatus of the heart and vascular area is apparently completed at the 35th hour, and a fluid resembling blood is contained in the vessels, motion is not observed till the 38th or 40th hour. When the heart first begins to move, it seems to contain only a colourless fluid and a few globules; a slow and regular contraction then takes place in the tube, commencing at the posterior, and extending gradually to the anterior part. Very soon afterwards, the orange-coloured fluid from the terminal sinus of the vascular area is carried into the posterior part of the heart by the two venous branches already alluded to, and the circulation of the blood is then established all over the vascular area. The vessels of the area now become more defined, the colour of the blood deeper than before, and the heart contracts with increased velocity.

From the 40th to the 50th hours, the fœtus makes a slight turn on its axis, so as to be placed with its left side towards the yolk. In consequence of this change of position, the heart, which before appeared to project from the right side of the fœtus when viewed from above, now hangs from the abdominal part of the body, to which it is attached at its two ends. About the same time, the simple tube, of which the heart has hitherto consisted, begins to be slightly divided into several compartments; the posterior part, or auricle (45th hour, *r*), with which the veins (*x x*) communicate, becomes dilated, and is separated from the anterior part as well as from the veins, by a constriction in the paries; the anterior part, or ventricle (*s*) becomes divided into two compartments by a similar constriction in its canal; the posterior compartment forms the ventricle itself, the anterior connects the ventricle with the arteries, and constitutes the bulb of the aorta (*t*).

Between the 50th and 60th hours, the circulation of the blood on the vascular area becomes more vigorous, and the action of the ventricle seems to succeed that of the auricle in a separate period. The auricle increases in width laterally, the capacity of the middle part or ventricle is also increased, and the bulb of the aorta, lengthening itself, is applied more closely to the fore part of the pharynx. The tube of the heart becomes more and more bent together till it is doubled; the auricle then passes below the ventricle, and the tube of the heart has the appearance of being coiled into a knot. The auricle, originally placed posteriorly, now lies between the ventricle and the body of the fœtus, (55th hour), and towards the 65th hour, is in a great part concealed behind the ventricle and bulb of the aorta.

Between the 60th and 70th hours, the convex part of the ventricle, afterwards becoming the apex, projects farther from the breast of the fœtus than before, and its concave part (75th hour, *y*) becomes less curved, so that the depth of the ventricle is increased. The passage from the auricle to the ventricle, the canalis auricularis of Haller, does not increase in the same ratio as these cavities, so that it now appears proportionally smaller than before. About the 60th hour, the texture of the auricle differs considerably from that of the ventricle; the auricle remains, as at first, composed of a thin and membranous paries, while the ventricle has now become stronger and thicker, and is rendered rough by the deposition of muscular fibres.

Before the 65th hour, the heart is quite single, consisting, like that of the fish, of one auricle, one ventricle, and the bulb of the aorta. Towards the 70th and 80th hours, the cavities of the heart begin to be divided for the formation of the right and left auricles and ventricles. Most late observers seem to be agreed with regard to the mode in which the division of the auricular cavity takes place; but that of the ventricle has been described very differently by those authors who have recently written on the subject. The earlier authors, such as Aldrovandus, Coiter, Fabricius, Vesling *, and even Harvey †, seem to have been altogether ignorant of this change; and Malpighi ‡ appears to have been the first who ascertained that the cavities of the heart are originally single, and afterwards become divided by septa. Malpighi has pointed out the time at which the auricle becomes divided, but Haller § first traced this division from its commencement; and little new has since been added to his observations.

Towards the 75th hour, the auricle has become considerably

* See the Anatome Animalium of Blasius.

† Anatomical Exercitations concerning Generation. London, 1653.

‡ De Formatione Pulli in Ovo. 1672.

§ Sur la Formation du Coeur dans le Poulet. Lausanne, 1758, and in his Opera Minora, vol. ii.

longer in its transverse than in its vertical diameter; at the same time, the canalis auricularis being farther shortened, the auricle is more closely applied to the upper part of the ventricle. About the 80th hour, the commencement of the division of the auricle is indicated externally by the appearance of a dark line on the upper part of its wall, towards the left side, and very near the entrance of the veins. In a few hours after this, we perceive that this dark line (Fig. 18), is produced by a crescentic contraction which has taken place on the upper and back part of the auricle, in a direction at right angles to its longest diameter. This contraction increasing, proceeds towards the ventricle, and soon divides the long-shaped common auricle into two nearly spherical sacs; of these, the right (Fig. 18 *r*) is at first much the largest, and receives the superior and inferior venæ cavæ (*x*); the left smaller, somewhat pointed at its free extremity, has at first the appearance of being a mere appendage of the right. Before the end of the 6th day, this left auricle, at first quite free, becomes connected with the pulmonary veins; but the mode in which this union is effected has not, so far as I know, been discovered. The contraction in the wall of the auricle, proceeding from above, continues to increase for more than a day after its first appearance, so as at last to form a septum between the auricles; the foramen ovale is left towards the lower part of this septum, so that the ventricle communicates freely with both cavities of the auricle for some time. This foramen is afterwards closed by the prolongation of a fold from behind forwards, in a direction nearly opposite to that of the septum auricularum. While the foramen ovale is yet quite open, there is seen at the lower and back part of the right auricle a fold, appearing to be a continuation of the septum, which is stretched across the right auricle nearly horizontally from left to right. This fold appears to correspond to the Tubercle of Lower and the Eustachian valve (Fig. 21, B, *v*). It is situated between the mouths of the upper and lower venæ cavæ, but does not appear, in the examples in which I have examined it, to be adapted to directing the flow of blood from the lower vena cava into the left auricle. About the end of the 5th day, the auricles appear slightly serrated on their edges, and, when emptied of blood, lose the vesicular appearance which they had hitherto presented. The anterior parts of both auricles now project more forward, and form the auricular appendages. Their parietes become covered with numerous small irregular marks, which appear to indicate the formation of the fleshy pillars, (Fig. 23).

From late observations, it would appear that the division of the ventricle commences some time before that of the auricle. Malpighi was also acquainted with this change in the ventricle; but as he had observed the bulb of the aorta, in immediate connexion with the great arteries, to become slightly swollen at its root on the fourth day, he was led to suppose that this cavity formed the left ventricle of the heart; and he erroneously concluded that the ventricle first produced must have been the right. Haller having with care investigated this subject, detected the error of Malpighi, and satisfied himself that no part of the bulb of the aorta was converted into the new ventricle, but that this part remained to form the roots of the great arteries springing from the heart. He thus describes the appearances of the right ventricle *: "Hora fere 96, sive die exeunte quarto, prima vestigia novi accrescentis ventriculi adparent. Sub bulbo nempe aortæ tuberculum nascitur, multo corde brevius, perinde rubellum, ovatum, quod in principio suo superius videtur, et vero ventriculo transversum insidet. Recte tamen adhibitis oculis adparet, eum ventriculum qui hactenus solus fuit, suo semper loco manere immutatum et sinisterius solum conspici, dexterius vero mucronem solum tenere, dum novus ventriculus ipsi imponi videtur, quia brevior est, nec attingit mucronem."

It will appear, however, from what we are going to relate, that Haller, though correct in his description of the appearances which presented themselves, had observed the right ventricle only when it was nearly completely formed. Professors Rolando and Baer have, since the time of Haller, investigated this subject, and have traced the commencement of the right ventricle to a much earlier period than any previous observers; but their accounts of the mode in which this cavity is produced differ considerably from one another.

According to Rolando †, the right ventricle is produced by

* Opera Minora, vol. ii. p. 376.

† Sur la Formation du Cœur, &c. Journ. Complément, tom. xv. & xvi.

the dilatation of a small vessel which adheres to the side of the primitive ventricle. Rolando informs us that this vessel may be perceived so early as at the 60th hour; that it is connected with the common auricle exactly opposite to the place where the veins enter that cavity, and that, winding round the side of the left ventricle, it reaches the bulb of the aorta, where it appears to terminate. According to Rolando, this vessel is quite transparent, and does not contain any blood at the 60th hour; but, towards the 68th or 70th hour, it is dilated in its middle part by the influx of blood from the auricle, and it is then easily seen applied closely to the base of the left ventricle, with which, soon afterwards, it becomes firmly united by muscular fibres that are deposited round both cavities.

Prevost and Dumas, in their account of the formation of the heart, not having been able to perceive the right ventricle before the end of the fourth day, have adopted the description of Rolando, while at the same time they state that they have not seen the appearances which he has described.

The observations of Baer, on the other hand, lead him to believe, that the right ventricle is produced by the growth of a partition in the interior of the primitive ventricle, by which it is separated into two compartments. This partition, according to Baer, commences at the apex or projecting part of the heart, and, gradually increasing in size, extends itself from thence to the upper or basilar part. The rudimentary partition may be seen on the third day, or about the 60th hour, when it presents the appearance of a dark stripe on the convex aspect of the heart. On the fourth day, owing to the more rapid deposition of muscular fibres, and the consequent opacity of the parietes of the heart, the ventricular part seems externally to consist of a single cavity only; but, on examining its interior with care, the division into right and left ventricles is sufficiently obvious: the partition appearing like a fold arising from the inner wall of the cavity. The same author has shewn that the partition between the right and left ventricle remains for some time incomplete, and allows these cavities to communicate with one another, as well as with each of the auricles, along its free edge. Baer has observed that the constriction of the paries of the auricle, by which its right and left cavities are formed, takes place considerably later than the production of the septum of the ventricles; and he, therefore, does not agree with Rolando, Prevost, and Dumas, in believing that the obstruction thus produced to the flow of blood from the right to the left auricle is to be regarded as the cause of the development of the right ventricle.

During last spring I was enabled to investigate this subject more carefully than had previously been done, by means of some very large goose's eggs, which, having been hatched for the proper time, presented to me hearts of such a size that their cavities could be distinguished with the naked eye alone. The observations I then made confirmed in the more important particulars the account which Baer gives of the separation of the right from the left ventricle, by the formation of a septum rising between them: they lead me to believe, however, that this septum is not produced exactly in the manner he has described. I can have no doubt, however, of the existence of a gradually increasing septum in the hearts of the fœtus of all birds, as I have examined the fœtus of the common fowl, the turkey, the duck, and the goose, and have found corresponding appearances in them all. According to my observations, the septum does not rise from the apex of the heart, but begins to be formed by imperceptible degrees towards the right and upper side of the common ventricle (Fig. 19. C, D, *z*). At and before the time at which the first traces of the interventricular septum appears, the internal paries of the ventricle is of a very spongy structure, being composed of numerous loose fleshy fibres, interwoven with one another. From part of these netted fibres, some of which, in a more advanced state, no doubt constitute the columnæ carneæ of the ventricle, the septum which divides the cavity springs; but, from the gradual manner in which it takes its origin, it is difficult to assign any very definite period for the commencement of the right ventricle. On the fifth day, in the goose (a period corresponding nearly to the 65th hour in the chick), the septum becomes more distinct. The right ventricle (Fig. 19. *s'*), now also appears as a distinct cavity, occupying the dilated part at the root of the bulb of the aorta, on the right side of the heart.

The septum of the ventricles (*z*), does not appear to be formed by any fold in the paries, like that of the auricle, but resembles rather some of the larger columnæ carneæ of the adult heart, except in the softness of the bundles of fibres of which it is composed. It forms a crescentic arch, the convexity of which looks downwards, and is attached on the lower and right side, and anterior and upper side, of the common ventricle. On the sixth day, in the goose, the septum increases in size, and can be displayed by making a vertical section of the ventricles, as in Fig. 20. *d*. C. The cavity of the right ventricle is now considerably increased, and the septum is found to occupy the apex, and whole anterior part of the ventricle, but is scarcely, if at all, attached to the posterior surface. Here, as well as at the openings of the auricles and bulb of the aorta, the septum is quite free, and a hair may with ease be introduced from the left into the right ventricle (Fig. 20. C). After six days and a half incubation, the septum is still stronger than before (*z*, Fig. 21. C), and rises higher up in the ventricle, till very soon it reaches the entrance of the bulb of the aorta. Under the mouth of the bulb, a communication continues to exist for about a day or more longer, until the roots of the aorta proper and pulmonary arteries, are formed by the junction of the opposite walls of this vessel. Before this takes place, however, the bulb is much shortened. At the back part of the ventricles, again, where they communicate with the auricles, the septum increases till it reaches the level of the opening of communication: here it becomes united with the anterior and posterior prolongations of the septum of the auricles; and some time after, the valve which closes the foramen ovale being formed, the whole heart is divided into two cavities, no longer communicating with one another. Before the union of these septa has taken place, while the four cavities of which the heart consists yet communicate freely with one another, the valves of the auriculo-ventricular orifices are partly formed (*i i*, Fig. 23). In the goose of the sixth day, these valves consist of two folds of the internal wall of the auricle, which hang down into the ventricle, one on the anterior, the other on the posterior edge of the opening. As development proceeds, and the union of the septa takes place, each of the depending plates is divided into two, leaving the half on each side for the formation of the valve.

After the direct observation which has been made by Professor Baer and myself of the formation of the septum, the opinion of Rolando, who denies that there can exist at any time a communication between the ventricles, cannot, I apprehend, be received as correct. Were farther proofs required of the accuracy of the statement given in this account, I think they are to be found, 1*st*, In the analogy which this mode of production bears to that of the auricles; 2*d*, In the similarity between these changes in the bird and those observed in mammiferous animals; 3*d*, In the existence of larger and smaller septa in the hearts of many adult reptiles; and, *lastly*, By the satisfactory explanation which it affords of the communication which continues to exist in many cases of malformation in the human as well as other species.

After the sixth day, little farther change takes place in the heart of the chick. The apex of the ventricles becomes more acute, and the parietes of the heart generally more muscular; but no alteration in its organization occurs till the approach of the termination of fœtal life, at which period the closure of the foramen ovale, and the obliteration of the ductus arteriosi, follow the inflation of the lungs by air.

4. *Development of the Heart in Mammalia.*

The heart of the dog, at the twenty-first day, represented by Baer (Fig 8. *r s t*), bears a great resemblance to that of the chick at the 55th or 60th hour. At this time, the heart of the dog consists of a membranous tube, twisted on itself, and slightly divided into an auricle, ventricle, and bulb of the aorta. It is thus described by Baer *: "Denudata corporis parte curvata optime in oculos cecidit cordis atrium (Fig. 8. *r*), venas recipiens, et ventriculus (*s*), a sinistro ad dextrum latus in spiram tortus et ita ac in pullis avium, deficiente pectore, a corporis lateribus non tectum. In nostro fetu præter cuticulam pectus tegentem jam tenerrimum pericardium adest, quod ante atrium et ventriculum distinguitur. Ex corde systema arteriosum emergere vidi."

Rathke † has described the heart of a pig at a period somewhat more advanced. In this animal he found the heart very

* In the Epistola de Ovi, &c. p. 3.

† Loc. citat.

large proportionally to the rest of the body, and projecting from the fore part of the breast. The ventricle, strong and thick, resembled somewhat in its form that of the adult. As yet it consisted of a single cavity, but the septum which divides the right from the left ventricle had begun to be formed (Fig. 9).

The farther changes which the heart of animals belonging to the class Mammalia undergoes have been investigated by Meckel*, principally in the human embryo; and by my friend Mr Owen †, in the embryo of the pig and sheep. From their observations, it appears, that, in the human embryo of about four weeks old, and at a corresponding period in other mammiferous animals, the septum begins to be formed between the ventricles, and the auricle is slightly divided into two cavities. The right ventricle (Fig. 10. *s'*), is at first very small, and is situated at the base, and on the right side of the left ventricle. The bulb of the aorta (*t'*), appears like a large vessel arising from the ventricle, and communicating with both its compartments. The auricles are proportionally very large, and are situated behind the ventricle (*r r'*).

Some time after the septum of the ventricles begins to be formed in the interior, there appears a corresponding notch on the exterior, which, as it gradually deepens, renders the apex of the heart double, (*n*, Figs. 11, 12, & 14). As development proceeds, the ventricular part of the heart becomes longer, and the capacity of its right compartment proportionally increases. The notch between the right and left ventricles continues to become deeper till about the eighth week, when the two ventricles are quite separated from one another, except at their bases, where they are attached (Fig. 15.), and where, by the deficiency of the internal septum, these cavities still communicate with one another, as in the chick on the fourth day. It is an interesting fact, that this state of separation is to be found permanent in some adult mammalia, as in the Dugong.

After the eighth week, the septum of the ventricle is completed, so that they no longer communicate with one another: the external walls of these cavities at the same time become at-

* Meckel's Archiv. b. ii. p. 402; and Journal Complement, tom. i.

† The Assistant Curator of the Hunterian Museum, London, who has kindly made me acquainted with the results of his observations.

tached to one another in a greater space towards their bases, and the notch between them is thus diminished. The apex of the heart still appears double at the tenth week, (Fig. 16); but at the end of the third month, the ventricles are very little separated from one another, though the place where the notch previously existed is still strongly marked (Fig. 17.)

We have already remarked, that there is at first only one vessel which arises from the ventricle of the heart; this is the bulb of the aorta, which joins with the ventricles immediately above the septum, and seems to communicate freely with both till the seventh week. About the seventh or eighth week, the bulb of the aorta becomes gradually divided into two vessels, for the formation of the ascending part of the aorta proper, and the root of the pulmonary arteries, (*tt'*, Figs. 16, 17). The division takes place first towards the ventricle, so that at first, when the lower part is divided, the higher still remains single. The division proceeding upwards does not separate the whole of the bulb of the aorta into two vessels; a communication is left at the upper part, (*m*, Fig. 16), by means of which the ductus arteriosus is afterwards formed.

The left auricle is at first much smaller than the right; and at the time of its first separation, as in that of the chick, we can discover no connexion between it and the pulmonary veins. In the seventh week, the anterior parts of the auricles are prolonged forwards, so as to place themselves at the base of the ventricles, and to cover anteriorly the bulb of the aorta, or origin of the pulmonary and aortic trunks. At this time the vena cava inferior appears to enter the left auricle (the superior vena cava leading into the right, as in the adult), as the back part of the septum of the auricle is at this time formed by the eustachian valve (Fig. 20). At the ninth week the proper septum of the auricles begins to appear a little to the left of the vena cava inferior, and the foramen ovale is seen quite open between this, the lower, and the upper part of the septum auricularum, which descends from above. The eustachian valve is still very large; at the end of the third month, it decreases in size, and the valve of the foramen ovale begins to be formed.

It appears to me to be unnecessary to continue to describe the farther changes which take place in the development of the heart of the fœtus of mammiferous animals, as the structure of the heart in the later stages of gestation has been made the subject of several treatises, and as a German work has lately appeared on this subject alone, in which all points connected with it receive a full discussion *.

Explanation of the Plates.

The individual parts of all the following figures are indicated by the letters of the alphabet, as follows:—

a, The transparent area of the cicatricula. *b*, The primitive trace of the fœtus. *c*, The serous layer of the germinal membrane. *c'*, The mucous do. *c''*, The vascular do. *d*, The primitive folds of the spinal canal. *d'*, Their cephalic part. *e*, The head sheath or fold of the intestine. *f*, The tail sheath or fold of the intestine. *gg*, The two lateral folds of the intestine joining the head and tail folds. *h*, The heart. *r*, The auricle. *r'*, The right auricle. *s*, The ventricle. *s'*, The right ventricle. *t*, The bulb of the aorta, or aorta. *t'*, The pulmonary artery. *x*, The veins entering the auricle. *i*, The auriculo-ventricular valves. *k*, The capillary vessels of the vascular area. *l*, The omphalo-mesenteric arteries. *m*, The ductus arteriosus. *n*, The notch between the right and left ventricles. *o*, The part of the yolk uncovered by the germinal membrane. *v*, The eustachian valve. *z*, The septum between the ventricles.

PLATE II.

1. Birds.

Fig. 1. The impregnated egg of the Common Fowl, with the cicatricula on the surface of the yolk.
2. The cicatricula magnified about five diameters.
3. Vertical section of the cicatricula.
4. The cicatricula with the primitive trace, shewing the position of this trace in relation to the yolk as represented in Fig. 1.
5. The primitive trace in the transparent area, and the commencing primitive folds, after 14 hours' incubation.
6. The same after 18 hours.
7. (From Baer) Vertical sections of the cicatricula in the longitudinal and transverse diameter of the fœtus.
8. The primitive folds of the spinal canal closed behind at the 24th hour.

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* Kilian. Ueber den Kreislauf des Blutes im Kinde welches noch nicht geathmet hat. Karlsruhe, 1826.

9. (From Baer) Longitudinal and transverse sections of the embryo and germinal membrane.
10. Appearance of the embryo at the 26th hour.
11. Sections of the same.
12. Embryo of the Chick, when the heart begins to appear, about the 30th hour. A (From Prevost and Dumas.) B (From Pander.)
13. (From Baer) Sections of the germinal membrane, about the 35th hour. The intestinal folds below the head and tail, and the commencing amnios, are seen.
14. (From Prevost and Dumas) The fœtus and heart from above, at the 36th hour.
15. Fœtus of the Turkey at a period corresponding to the 40th hour in the chick, seen on the abdominal side.
16. The vascular area about the 60th hour.
17. The fœtus of the Goose after five days and a half incubation.

The remaining figures represent the appearance of the heart at the different hours, indicated by the numbers attached to them, viz. at the 27th, 30th, 35th, 40th, 45th, 55th, 65th, 75th, 85th and 95th hours.

Fig. 18. The commencing fold of the septum of the auricles, seen from behind.
19. The heart of the Goose of five days and a-half, when the septum of the ventricle commences. A, The anterior side. B, The posterior. A section being made through the ventricles at the upper part, C represents the basilar part, D the part towards the apex.
20. Heart of the goose on the 6th day, when the right ventricle and septum are increased in size. A, Anterior view. C, The anterior part of the ventricles removed. A hair is passed behind the septum from one ventricle to the other.
21. Heart of the goose more advanced. In B, the upper part of the auricles is removed, so as to shew the septum between them. A probe is passed through the opening of the vena cava inferior, and the projecting fold corresponding to the tubercle of Lower, and the eustachian valve, is seen before it. E, The side view of the same heart.
22. The heart of the chick, when nearly completely formed, after six days and a half incubation. The fore parts of the auricles are drawn aside, so as to shew the aorta, innominatæ, pulmonary arteries and ductus arteriosi.
23. The folds forming the auriculo-ventricular valves, before the septa are complete.

2. Fishes.

Fig. 1. (From Prevost) The primitive trace of the fœtus of the Mulus gobio in the cicatricula.
2. (From Rathke) Section of the ovum of the Blennius, shewing the embryo and the layers of the germinal membrane.
3. The heart of the same animal, when divided into an auricle and ventricle.

4. 5. & 6. The heart of the same animal at more advanced periods.
7. The fœtus of the Salmon, with the yolk-bag and veins ramified on it (from Ellis).

PLATE III.

3. Reptiles.

Frog.

Fig. 1. The ovum of the Frog, natural size.
2. Section of the ovum, shewing the manner in which the germinal membrane surrounds the yolk, magnified 6 diameters.
3. (From Prevost and Dumas) Section of the ovum, and the furrow formed by the primitive folds of the spinal canal.
4. (From do.) A and B, The primitive trace and primitive folds.
5. (From do.) A, The spinal canal beginning to close. B, Side view more advanced.
6. (From do.) Side view of the fœtus more advanced.
7. (From do.) Posterior view, the spinal canal closed.
8. & 9. Sections of the tadpole, shewing the mode in which the layers of the germinal membrane are disposed.
10. Tadpole in the egg at the fifth day after being laid, natural size.
11. & 12. Anterior and posterior views of the tubular heart of this tadpole, magnified.
13. & 14. Hearts of tadpoles in which the external gills were nearly perfect.
15. Tadpole when the external gills begin to lessen.
16. The heart of this tadpole.
17. Heart of the tadpole a short time before the transformation takes place.

Salamander.

Fig. 1. Ovum of the Aquatic Salamander, natural size.
2. This ovum magnified.
3. Section of the ovum and germinal membrane.

The remaining figures indicate the development of the tadpole, and formation of the heart, corresponding with those in the Frog.

Fig. 16. (From Funk) Shews the yolk and vascular network of the land salamander.
17. & 18. (From the same) Shew the yolk-bag at an advanced period in this animal.

Lizard.

19. (From Rathke), The fœtus of the Lacerta agilis.

4. Mammalia.

Fig. I. (From Baer) Ovum of the dog (probably eight days after impregnation), with the cicatricula on its surface. Fig. 1. Natural size.
II. (From Prevost and Dumas) Ovum of the dog, eighth day. Fig. 2. Natural size.
III. Ovum which I found in the rabbit on the sixth day. The cicatricula is seen on the surface of the yolk, magnified 6 diameters. Fig. 3. Natural size.

IV. (From Prevost and Dumas) Ovum of the dog, twelfth day. The primitive trace of the embryo. Fig. 4. Natural size.

V. (From the same) Ovum of the same date farther advanced. Fig. 5. Natural size.

6. (From the same) Transparent area in the ovum of the Rabbit, with the primitive folds of the spinal canal, commencing vertebræ, &c.

7. (From the same) Part of the uterus of a rabbit opened eight days after impregnation. The fœtus seen lying on the vascular area of the yolk, or umbilical vesicle, natural size.

8. (From Baer) Fœtus of the dog three weeks, lying on the vascular area on its left side, magnified 10 diameters. Fig. 8 *. Section of the fœtus, shewing the folds of the spinal canal, intestine, &c.

9. (From Rathke) Fœtus of the pig three weeks, magnified 1 diameter.

10. to 19. (From Meckel) Represent the changes which the ventricles and auricles of the human heart undergo from the fourth week to the third month.

20. & 21. Are diagrams copied from those of Mr Owen, to shew the mode in which the upper and lower interauricular septa, and eustachian valve, are formed in the heart of mammiferous animals.

(To be continued.)

On Changes observed in the Colour of Fishes. By Mr James Stark. Communicated by the Author.

Having accidentally observed remarkable changes of colour in some minnows I had kept over last winter, I was induced to make a few experiments, with a view to discover the cause of these singular changes. As no observations of the same nature seem to have been recorded, so far as my reading extends, I take the liberty of transcribing from my notes a short detail of some of the experiments I have made upon the Minnow *(Leuciscus phoxinus)*; the Stickleback *(Gasterosteus aculeatus)*; the Loche *(Cobitis barbatula)*; and the Perch *(Perca fluviatilis.)*

My attention was first directed to this subject from having transferred the minnows above alluded to into a white basin, for the purpose of changing the water in the glass-vessel where they were usually kept. Having allowed them to remain in the basin for some time, it struck me, on going to replace them, that their colours were less vivid, and the dark spots and bands much paler than usual. As the white basin stood in the shade, it occurred to me, that, by putting the basin and the animals in the dark, I might be able, on the principle of blanching vegetables, by excluding them from the light, to render the loss of colour complete. I was not aware at the time that I could with equal ease restore the colours, and in a very short period, to their original brightness and beauty, by a process equally simple.

June 26. 1830.—I put two minnows which had lived with me over the winter into a white stone-ware ewer. They had at this period the usual vivid colours, back dark brown, and the bars on the upper part of the sides black, upon a silvery ground, with violet and golden reflections.

June 27.—Upon examining the minnows this morning, I found that they had nearly lost their colour. The back was now of a light sand colour: the bars on the sides had entirely disappeared, and the sides and belly were nearly of one colour, a silvery white, with a slight shade of blue.

June 28.—Same as yesterday, but the body seemed partly translucent, so that the layers of muscle on the back were distinctly seen, and the vessels between them ; the snout and top of the skull more transparent than usual.

June 29.—Replaced the minnows in the glass-vessel from which they were originally taken. Appearances same as yesterday. I wrapped a black silk handkerchief round the vessel.

June 30.—Colours were this morning but little altered from yesterday. Removed the handkerchief, and put them in sunshine for a few minutes, and placed the bottle upon a black cloth exposed to the light, but not within the rays of the sun. At 4 o'clock P. M. they had regained much of their original colours. I now transferred them again into the white ewer.

July 1.—The minnows have again lost their colour, and become totally of a pale sand colour. After examining them, I now placed the ewer in a dark corner of the room, and they were kept in this situation till the 17th July, their colour remaining uniformly pale, and without variation all that time.

July 17.—I now transferred the minnows to a black glazed earthen-ware jar. In five minutes, dark-coloured spots began to appear on the back; and in little more than a quarter of an hour they had lost their transparency. Five hours afterwards, the minnows appeared of a mottled grey and brown colour, with the fins of a bluish tinge.

July 18.—Colours on the back dark brown, approaching to black, so as to be with difficulty distinguished from the colour of the jar when looking down; fins purplish, inclining to blue.

The same minnows remained in the dark jar till the 21st. On that day, I covered the bottom and two slips on the side two inches high with tinfoil, leaving the minnows in the shade as before.

July 22.—One of the minnows which had kept at the bottom over the tinfoil, had this day lost much of its dark colours, the back appearing brownish-coloured, fading into silvery on the sides, with no appearances of the dark interrupted bars. The other minnow, which kept above, and by the side of the vessel where it was not covered with tinfoil, retained its original colours and markings.

July 24.—I removed the tinfoil this morning, and at night both minnows had assumed on the back, when looked down upon, the same dark colour as before, and nearly approaching that of the jar.

The minnows remained in this jar till the 3d of August, some time previous to which, I had put others of the same species into the jar; and they were now uniformly of the same dark colour on the back, with black variegations and golden reflections on the sides. The belly in all cases retained its silvery appearance.

All these experiments were conducted in a dark corner of the room. I repeated the same experiments in a perfectly light place of the room, but excluded from the sun's rays; and again by exposing the vessels and animals to the direct rays of the sun, with the same results;—that is, when placed in a dark vessel, the colours of the animals assumed much of the colour of the vessel they were placed in; and when transferred to a white basin, they uniformly became in a very short period of a light sandy colour, and their characteristic markings disappeared. In crystal vessels, when exposed to the light, little change of colour takes place, though I have often observed, at different periods of the day, and in different minnows in the same vessel, a change to a certain extent in the brightness of the colours and markings, for which I am unable satisfactorily to account.

On the 25th July, three minnows were put into a crystal decanter, rolled all round with black silk, and placed in a dark corner of the room. At this time they were brownish or sand coloured on the back, sides with golden, bluish and black variegations, belly and lower part of the sides silvery white. They remained in this situation till the 3d of August, during which time no change of colour took place.

I repeated the same experiments often, and varied in all ways I could think of, with the Stickleback. Its changes of colour were still more remarkable than those of the minnow, inasmuch as they took place much more rapidly; and even in a few minutes, and under the eye, the colours may be seen to fade or brighten according to the nature of the vessel they are placed in for the time. The fine vermilion colour of the breast almost disappears when placed in a white basin; and the vivid colours are as speedily recovered upon transferring the animals to a black glazed earthen jar.

As the same changes in colour take place in the Loche *(Cobitis barbatula)*, and in the Perch *(Perca fluviatilis)*, it is unnecessary to detail experiments which are in every one's power to make. The sudden change in colour which takes place in the course of a few hours, is so striking, that doubts of the identity of the animals might reasonably be entertained by one who witnessed the results, without being aware of the circumstances which led to them. Though I retained them at first for weeks in the various vessels, to ascertain the reality and permanency of the change, while circumstances remained the same, yet I afterwards experienced that a few hours was sufficient to display all the phenomena.

Into the causes of these changes of colour in fishes, and to what extent these may be explained on optical, chemical or physiological principles, I do not hazard an opinion. One principle is sufficiently obvious from these experiments, that these fishes, and perhaps all the other river and lake fish, possess the faculty of accommodating their colour to the ground or bottom of the waters in which they are found. The final reason for this may be traced to the protection which they thus secure from the attacks of their enemies; and it affords another beautiful instance of the care displayed by Nature in the preservation of all her species.

May not the changes of colour observed in these fishes depend much upon the same cause as the changes which take place in the colour of the chameleon, and for which no very satisfactory account has yet been given? When crawling on plants, the keenest eye cannot detect its presence, as being different in colour from the exact shade of the leaves.

Not having been on the sea-coast this summer, I have not yet had an opportunity of repeating these experiments on the sea-fishes, though, from analogy, I have no doubt that the same changes of colour will be found to take place in them. In fact, I have often observed on our flat sandy coasts, that the flounders were so very much the colour of the sand, that, unless they moved, it was impossible to distinguish them from the bottom on which they lay. I have noticed the same with regard to the eel in the muddy pools and places where these animals are usually found.

It may perhaps be worth while to mention, that the food of my minnows in winter consisted of fibres of beef or mutton; and this, with flies, generally formed their summer food. With this they were generally retained in health and activity; but I have never been able to keep them alive above three years, which I take to be about the average duration of life in the minnow.

In the stickleback, the loche, and the minnow, when full grown, and I suppose arrived at the extremity of age, I have often observed, some days previous to death, the tail extremity to lose its flexibility, and to become covered with a kind of mould or conferva-like substance to the height of two or three lines, and that this substance or growth gradually crept along towards the middle of the fish, the rigidity of the parts still increasing till they died. Is this the natural death of fishes?

15. Brown's Square,
23d August 1830.

Notice in regard to the Actinia maculata. By the Editor.

An actinea much resembling the species (if indeed not the same), of which our young friend Dr Coldstream has given a description and figure at page 236. of this volume, I find figured and described by Bohadsch, in his Anim. Marin. p. 135, &c., under the name *Medusa palliata.* That author says, the surface of the skin is white, and spotted with most elegant purple dots. In the month of August it is often taken in the fishermen's nets. It appears to move about in the sea, and also very frequently it occurs investing shells. Its mode of investing shells is given by Bohadsch in detail. The same species, apparently, is described by Otto, in t. ii. of the Nova Acta Physico-Medica Acad. Cæs. Leopoldina-Carolinæ Naturæ Curiosorum, p. 288, 9, 90, 1, 2; and in Plate 40. there are six coloured figures of it, under the name *Actinia carciniopoda.* He describes it as white, with many delicate pale bluish-grey stripes running from the centre to the circumference, and marked with numerous large roundish spots, of the most beautiful purplish colour. The habits and manners of the animal are mentioned, but our limited space will not allow us to state them here.

Notice respecting the Nervous System of the Crustacea.* By MM. V. Audouin and Milne Edwards.

Among the most curious and most important researches to which anatomists could devote themselves, are without contradiction to be reckoned those which tend to make known to us the course which nature has followed in the formation of each being, and in the creation of the different series which seem to be constituted by animals. This result may be attained in two different ways;—by the comparison of the modifications which the same organs present in a great number of different animals, and by the study of their mode of development, or of the kinds of metamorphoses which they undergo in the same individual at

* Read to the Natural History Society of Paris on the 2d April 1830.

the different periods of its life. The corollaries which are deduced from the facts elicited by each of these methods of investigation always facilitate the study of organization; but this advantage is not the only one that may be derived from researches directed toward this object: they sometimes lead us to general principles which seem to be so many laws that regulate the organic formations. It even happens, when these principles are the just expression of truth, that they cause us to anticipate the existence of facts still unknown, and that opinions drawn from deductions of this kind afterwards receive an entire confirmation from direct observation. What we are about to say of the nervous system of the Crustacea affords a striking example of this.

In a memoir which we presented to the Academie des Sciences in 1827 (*Annales des Sciences Naturelles*, t. xiv. p. 77), we endeavoured to make known the different modifications of the nervous system of the Crustacea, and we tried to apprehend the relations existing between the different forms under which it presents itself in that class of animals. We shewed that sometimes there exist two ganglionary chains distinct from each other, and similar to themselves in the whole length of the body; that, at other times there is but a single chain whose structure is equally uniform; that, in certain species, a cephalic ganglion and a medullary ring contained within the thorax are alone met with; and, lastly, that frequently this latter portion of the nervous system is replaced by a solid node. At first consideration, one would be led to suppose that the nervous system of each of these animals, having an aspect so different, is formed of elements, which cannot be strictly compared with each other; but, in pursuing the examination of these parts in a great number of Crustacea, we have met with intermediate states which have enabled us to understand that these dissimilarities depend only upon a series of modifications, consisting in the various degrees of approximations and of centralization, of certain similar parts, or in the want of development of some others.

This result is in perfect accordance with the principles which M. Serres deduced from his inquiries into the nervous system of other animals, and into embryogeny in general. He was led to conclude that this tendency to centralization was one of the laws of organization, and that the nervous system, in developing itself, would present modifications similar to those which are met with when it is observed in the series of animals. It therefore became probable that observations made on the same species of crustaceous animal, in its different periods of life, would shew that the nervous system, as it becomes developed, passes through several of the states which we have pointed out in the series of these animals.

The beautiful researches which M. Rathke has lately published in Germany respecting the generation of crabs, shew that this is really the case. In these animals, the thoracic nervous system examined in the egg, at first presents two series of ganglia perfectly distinct from each other, and the number of these pairs of medullary nuclei is then equal to that of the appendages, while, in the adult crab, the same ganglia are much less numerous, several having united to form a single nervous mass. Now, this first state of the nervous system of the crab, which in it is only transitory, has a great similarity to that which we have found, but in a permanent manner, in the adult Talitres, which occupy a very low place in the natural series of Crustacea. At a more advanced period of incubation, we find in the egg of the crab the same ganglia already approaching the median line, united together, and forming a single series. This arrangement, which is still but transitory, is then comparable to that which is presented by the nervous system of the adult Cymothoæ.

The medullary system of the crab afterwards undergoes modifications similar to those which we have met with in comparing together the Cymothoæ, Homards, Palemons, Langoustes, Carcins, and Majæ, that is, it undergoes a kind of longitudinal centralization, the ganglia which correspond to the appendages of the mouth approaching each other, and finally forming but a single nervous mass.

It is therefore seen that in the crab the central nervous system is developed from the circumference towards the centre, and that it presents, during the fœtal life, a series of modifications similar to those which we have found in examining the series of Crustacea in the adult state. On afterwards combining M. Rathke's observations with those made by ourselves, we arrive at this general conclusion, that the nervous system of the Crustacea is originally composed of two chains of medullary nuclei equal in number to that of the locomotory or other appendages, and that all the modifications which are met with in it, whether at different periods of incubation, or in the different species of the series, depend for the greater part upon the more or less complete approximation of these ganglia, an approximation which takes place in two different directions, viz. longitudinally and transversely *.—*Annales des Sc. Nat.*, June 1830.

Description of a Species of Salix found in Braemar. By W. Macgillivray, A. M. (Communicated by the Author.)

Having visited, in the beginning of August 1830, the beautiful circular valley or *corry* containing Loch Ceanndin, and forming one of the two terminal branches of Glen-Callader, near Castleton of Braemar, for the purpose of examining its geological phenomena, I happened to find, among the numerous alpine and other plants growing profusely among its cliffs, a small willow, which, after mature deliberation, I venture to offer to the consideration of botanists as a species distinct from any hitherto received as indigenous to the British isles. Mr Macnab, of the Edinburgh Botanic Garden, having been with me at the time, I presume that the difficulty of finding an appropriate name for this supposed species in any circumstance connected with its organization, will authorize me to name it after him.

Salix Macnabiana. Leaves elliptico-lanceolate, serrate, veiny, glossy on both sides; young twigs downy; catkins cylindrical, with lanceolate, hairy, scales; germens nearly sessile, awl-shaped, downy.

A stout, erect, bushy shrub, from two to three feet high. Stem smooth, brown; branches spreading, greenish-red, smooth and glossy; young twigs green and downy. Stipules unequally ovato-lanceolate, small, downy. Leaves elliptico-lanceolate (tapering nearly equally at both ends), acuminate, serrate, rigid, brittle, veiny, glossy on both sides, deep green above, a little paler (but not glaucous) beneath, with oblique parallel veins, which are rather prominent beneath, and reticularly connected by the venules at right angles. The

* M. Rathke does not appear to have been acquainted with our researches into the nervous system of the Crustacea, or with those of M. Serres, otherwise he would probably have been struck with the similarity which exists between his observations and ours, and would have made the general remarks which his work has suggested to us, and which we have just made.

lower leaves of the twigs are (as usual) much smaller, narrow-elliptical, more obscurely serrate; the young leaves slightly downy. Petioles short, smooth, reddish. Catkins lateral and terminal, cylindrical, obtuse, rather lax. Germens subulate, downy, tapering into a long, slightly downy style, their very short stalk downy. Stigmas obtuse, and with the style, rather deeply divided and separated. Scales of the catkin oblong, dark-brown, hairy, the terminal hairs nearly as long as the scales.

This supposed species, of which I have seen only a female plant, is closely allied to *Salices prunifolia*, *carinata*, and *myrsinites*.

The leaves are not carinate, recurved, nor glaucous beneath, as in *S. carinata*, and are more distinctly serrate. The germens also, are very different from those of that species, being much longer, with a more lengthened style, and not silky, but sparsely and rather coarsely downy.

From *prunifolia*, which has ovate leaves, glaucous beneath, it differs in the very different form of the leaves, the much greater elongation of the germens, and the comparative shortness of their down.

With *myrsinites* it agrees in general aspect, and the smoothness and reticulation of the leaves; but these organs are more elongated and acute, less rigid, thinner, and of a darker colour, while the catkins are longer, and the germens are not quite sessile; the leaves are more narrow and more acuminate than Fig. *f*, Pl. viii. of Flora Lapponica, which represents the narrow-leaved variety of S. myrsinites. With Fig. 6, Pl. vii. of Smith's edition of Flora Lapponica, which is said to represent *Salix myrsinites*, it agrees pretty well as to the form of the leaves, but the catkins and germens there represented are totally different. The figure of *S. myrsinites*, in Salictum Woburnense, which agrees with a specimen cultivated in the Edinburgh Royal Botanic Garden, is also very different from our plant, not less in the short, almost orbicular form of the leaves, than in the narrower catkins and broader germens.

The leaves are about an inch in length, and a quarter of an inch in breadth. When dried, they assume an olivaceous or brownish tint, and in their reticulations bear some resemblance to those of Arbutus alpina.

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*On the Lacustrine Basins of Baza and Alhama in the Province of Granada in Spain**. By Colonel Charles Silvertop, F. G. S. Communicated by the Author.

Basin of Baza.

Two basin-shaped tracts are met with in the province of Granada, and to the north of the primitive chain, which borders and runs parallel to the southern Mediterranean coast of Spain,

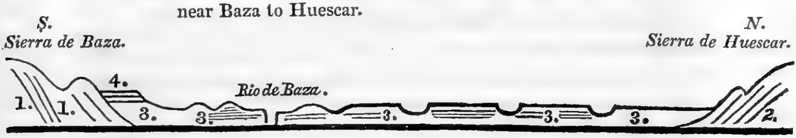
* A geological sketch communicated to Roderick Impey Murchison, Esq. Secretary to the Geological Society, and read before the Geological Society during the last season.

presenting in a portion of their respective areas, beds of the tertiary age, and of lacustrine origin. One of these lies between the towns of Baza and Huescar, the other between the city of Granada, capital of the province of the same name, and the large village of Alhama, celebrated for its mineral waters. I have further observed vestiges of similar beds in other parts of Spain, which will be subsequently noticed.

In order to facilitate the labours of future investigators, I shall point out a few circumstances connected with these two tracts, and offer such observations with respect to their geognostical relations, as a cursory inspection of them enabled me to make. I shall designate the basins by the names of the towns of Baza and Alhama, to which they are respectively contiguous, and commence with the former.

1. *Basin of Baza.*

Section across the Basin of Baza from south to north nearly, or from near Baza to Huescar.



1\. 1. Transition Limestone.
2\. Secondary Nummulite Limestone.
3\. Gypsiferous Marls.
4\. Compact Paludina Limestone.

Previous to entering into a detail of the beds in this basin, I beg leave to give the following rough sketch of the structure of the country between Granada and Baza. For the first eight leagues after leaving Granada, the road follows an irregular hollow along the northern base of the Sierra * Nevada, a magnificent mountain, composed of primitive rocks, and rising in two of its peaks, called La Veleta and Muleihassen, to the elevation

* Sierra Nevada. This name, in Spain, designates and is confined to one immense mountain mass, which extends longitudinally from near Granada to the vicinity of Guadiz, but which is only a portion of a chain of mountains bordering the Mediterranean from Gibraltar to the Cabo de Palos. I designate the whole of this nearly continuous range as the *Sierra Nevada Chain.*

of between 11,000 and 12,000 feet above the level of the sea. Contiguous to the line of road, lower hills of transition-slate and limestone are continually observed, and the latter, which lies upon the former, constitutes an irregular line of hills bordering the hollow towards the north, but these are immediately succeeded in the same direction by a continuous ridge of a secondary nummulite limestone. This ridge ceases near a village called Diesma, eight leagues from Granada.

Between Diesma and Guadiz, an ancient city ten leagues from Granada, the country begins to open out into that extensive area, surrounded by high ridges and lower ramifications, in a part of which, near Baza, I observed one of the beds in question, resting upon gypsiferous marl. To the left or north of the road in the intervening tract, a pretty even surface of table land extends from near Diesma, towards the central portion of this area, and often presents long slopes to different ravines which intersect it, and an abrupt high escarpment to the valley of Guadiz, exhibiting a mass of earthy calcareous marl, with frequent beds of gravel, and horizontal strata of indurated conglomerate, whose cement is also calcareous. On the approach to Guadiz, and between the road and the base of the primitive chain towards the south, the ground presents evident proofs of the overwhelming action of torrents, which at some remote period have rushed down from these elevated mountains, and furrowed it into ravines of great magnitude and depth. In the vicinity of Guadiz, argillaceous conical hillocks, at times insulated, at others in little groups, and often so numerous and thickly clustered as to resemble at a distance an immense encampment of tents, present views of most singular appearance. A deposit of a marly, gravelly, argillaceous nature, appears to have filled up all this portion of the area, upon which water in a state of violent agitation, and exerting its power according to the different resistances offered by such a heterogeneous mass, has given to its surface so curious a variety of form, and by a consequent great denudation, scooped out the Valley of Guadiz. The upper portion of this deposit, as may be seen near the end of the ridge or Sierra of Diesma, has the appearance of being the result of the destruction of calcareous rocks; whilst the lower part, constituting the Valley of Guadiz, is of an argillaceous character, and is charged with innumerable minute particles of mica, which give to the surface of the various pyramidal and columnar figures, into which it is worked, a shining and splendent aspect, and is evidently the result of the destruction of those older rocks of gneiss and mica-slate, predominating in the neighbouring primitive chain. At the distance of about three miles from the road which passes from Diesma to Guadiz, and intervening between the former and the Sierra Nevada, there is a singular little tract, surrounded on every side by the deposit which occupies this portion of the area, composed of a tufaceous yellow ochreous mass, with interspersed particles of laminated gypsum, in which the hot mineral waters, known by the name of Baños de Graena, take their origin.

From Guadiz to Baza a high ridge of transition * limestone, resting upon greywacke and clayslate, intersected by numerous quartz-veins, runs parallel to and at a short distance from the road on the south side, and throws out ramifications which extend beyond it in the opposite direction. These appearances continue as far as a public-house or venta, called La Venta de Gor, between which and Baza an inclined plane, exhibiting on its surface an indurated stratum of conglomerate, of little thickness and frequently broken up, extends from the immediate base of the ridge, or inosculates between its ramifications, towards the lower and central portions of the area. This conglomerate is formed of fragments of the rocks now existing in the adjoining ridge, imbedded in a reddish calc-argillaceous cement. It is covered with wild plants and evergreens; but the predominating shrub is the juniper. It therefore appears, that from Granada to Guadiz the road is bounded on the south by the primitive chain of Sierra Nevada, and between the latter city and Baza, by a ridge of transition limestone: it may be stated indeed in general terms, that the whole district between this line of road and the Mediterranean coast is composed of primary and transition rocks.

Towards the north of the same line of road as far as Diesma, the nummulite secondary limestone stated to constitute the ridge of the latter name, prevails for a considerable extent over a

* Lead-ore has been found and worked in various parts of this ridge.

broken barren-looking country. From Diesma to Baza, the road is within the limits I have assigned to the basin under consideration.

On approaching Baza by this line of road, or from the west, there is a long descent, the upper part of which exhibits on each side a series of horizontal strata of compact limestone, filled with paludinæ, which, at a short distance towards the left, forms a bold escarpment about seventy feet high, resting upon marl, and bordering the lower and more central portion of the basin. The same limestone, with its characteristic univalve, also forms a low escarpment contiguous to the road, for a short distance during the descent. The strata are from three inches to a foot thick, and as near as possible horizontal, but others were observed which had a thickness of four and six feet. The limestone is of a muddy-whitish colour, its fracture smooth and even, and in large fragments inclining to the conchoidal. During the descent, the road is at times confined on the right-hand side by an earthy marly embankment, in which large rolled masses are seen of the same limestone, remnants in all probability of an extensive bed of this rock which has now nearly disappeared.

This locality is interesting to the geologist, as it affords a proof of the superposition of the compact paludina limestone, on the deposit of gypsiferous marl, which occupies so large a portion of the basin of Baza, and which will be immediately the subject of consideration. It is, however, the only point in this basin where such limestone, as far as I have had an opportunity of observing, can be seen; but as a similar superposition will be shewn to exist in the basin of Alhama, where a compact limestone, characterised by the same paludinæ, rests upon a thick bed of gypsiferous marl, I am induced to consider the subjacent beds in each, although differing in some points, to be identical, and of similar origin.

The extensive basin near Baza, in which these beds have been deposited, is confined, towards the south, by the high ridge of the transition (?) limestone, called the Sierra de Baza, which has been stated to extend from Guadiz to the former town; towards the north it is bounded by the still more elevated mountains of Huescar, formed of secondary nummulite limestone; and towards the east and west, in a more irregular manner, by lower ramifications, from these two mountain ridges. Its breadth from south to north, or from Baza to Huescar, is about thirty miles; its length from east to west appears more difficult to determine, in consequence of the intrusion of minor ridges and ramifications, and of an immense deposit of transported materials which intervenes topographically between the gypsiferous beds occupying the lower and central portion of the basin, and the inward flanks of such ridges and ramifications. Including this deposit, whose geological relations I had not time to make out, it may be estimated at between forty and fifty miles.

The city of Baza is situated at a short distance from the northern base of the transition ridge, or Sierra de Baza, near its eastern termination, the continuation of which, in the latter direction, has been interrupted by a valley, which, extending southerly to a village called Caniles, in the opposite direction, passes by Baza, and forms the lowest part of the extensive undulating plain to its north. To the latter, from its amphitheatrical configuration, and the beds it contains, I have ventured to give the name of Basin, an appearance which it presents to the spectator, from the high mountains and lower ridges nearly surrounding it on every side. A description of the line of road from Baza to Huescar, traversing the entire breadth of this basin, will shew the nature of the predominating deposit it contains, which is immediately subjacent to the compact paludina limestone, observed in the descent to the former town, on approaching it from Guadiz. For the first three miles the road proceeds along cultivated ground, gradually sloping from the base of the escarpment of paludina limestone to the Rio de Baza, a stream which, rising in the high ridge of the same name, after watering the rich fruitful valley between Caniles and this town, runs nearly due north along the lower part of the basin. The soil consists of greyish-coloured argillaceous marl, and produces good crops of wheat and barley. Towards the left a low irregular escarpment, the continuation of that just alluded to, borders the higher part of this sloping ground, and, winding round towards the west, surrounds and abuts against an outlying insulated mountain of transition limestone, called Javalcal. The road proceeding along this cultivated slope for about four miles, by a line which is nearly equidistant from the escarpment and the stream, or Rio de Baza, subsequently descends to a horizontal tract, contiguous to the left bank of the latter. A white farinaceous efflorescence, which has a bitter taste, is often observed upon the surface of patches of ground, which have remained for a considerable time unploughed, or investing the banks of little channels of irrigations, as well as various wild maritime plants. Some projecting low eminences and hillocks, formed of horizontal strata of marl, with imbedded gypsum, the former in a semi-indurated state, and of a whitish-grey colour, the latter in separated pieces, and of a laminated structure, are observed rising to twenty or thirty feet above the level of the surrounding tract. Here, therefore, along the line of road which crosses the basin from Baza to Huescar, the gypsiferous marl is first distinctly seen, and hence to the latter town it continues almost without interruption.

About eight miles from Baza the road crosses the little stream of the same name, confined by low escarpments of marl, and, after a short gradual ascent, where numerous rolled fragments of red sandstone strew the ground, passes through an aperture in a sort of embankment, formed of alternating strata, of a gravelly conglomerate and marl. It then traverses a little hollow—a sort of a valley of denudation in the gypsiferous marls—and, after a subsequent ascent, whence onwards the nature of the deposit may be constantly observed, enters upon a table-land tract, which, varied or indented by frequent little hollows and denuded spaces, extends to a village called Benamaurel, about half-way between Baza and Huescar. One of these natural excavations of considerable magnitude, is crossed immediately before entering the last-named village, situated upon the summit of the opposite ascent. I may here observe, that, from the rivulet, or Rio de Baza, to Benamaurel, a distance of about eight miles, gypsum is continually seen in every little natural section of the horizontal marl strata over which the road proceeds. This tract consequently presents a general even surface, interrupted occasionally by little hollows of denudation, unwatered by any stream, and a scanty vegetation of wild plants and shrubs. But between Baza and the ford where the rivulet was crossed, the gypsiferous marls were only observed in a few projecting low eminences or hillocks, in the horizontal tract along its left bank.

In the preceding cultivated slope near to Baza, they were not noticed; in all probability, however, they constitute the under stratum. A powerful stream, called the Guardal, rising in mountains north of Huescar, passes close below Benamaurel, at the bottom of a high perpendicular escarpment of the horizontal beds of marl and gypsum, and joining subsequently the rivulet of Baza, which flows in an opposite direction, their united waters taking first a westerly, and afterwards a northerly course, finally enter the Guadalquivir *, in the neighbourhood of Uveda.

The Subterranean Village of Benamaurel.—The total number of inhabitants in Benamaurel, as I was informed, amounts to about three hundred, three-fourths of whom live in capacious caves excavated in the mass of gypsiferous marl, which constitutes the surrounding tract. I entered several of these, and was gratified to remark the neatness and cleanliness they exhibited. Their owners appeared to be perfectly content in these grotesque habitations, and assured me that they were not only extremely durable, but warm in winter, and, from the freshness and coolness pervading them in summer, much preferable to common built cottages. Those I visited indeed far surpassed the expectations I had formed from their external appearance. They were generally divided into three compartments; a large room in good proportion and of considerable height was the general rendezvous of the family, and adjoining to this, on one side was a small bed-room, and on the other, the kitchen. The greater number of these subterranean dwellings are situated on the acclivity we ascended after crossing the denuded hollows above mentioned, and the church and a few mud-built houses crown its summit. That in which I was lodged for the night I passed there, in part belonged to the latter class; but from the manner of its construction, in which art and nature mutually assisted each other, it might be said to possess a sort of amphibious character. It was two stories high, and consisted of various apartments excavated out of a considerable insulated projecting mass of gypsiferous marl; but in the second story there were joists and beams stretched from wall to wall, which gave greater strength to the natural

* This river, as every one knows, falls into the Atlantic Ocean, in the beautiful Bay of Cadiz.

partitions. The floors of the different rooms were formed by the natural surface of the strata, and a corresponding plane had been left after the excavation of each apartment, whose interior surface formed the ceiling as its exterior one did the roof of the house. The lower part of the house, on the ground floor, which consisted of more numerous apartments, was also excavated in the mass of these strata, and divided into compartments by thick walls of the latter left standing for this purpose, without any artificial support. Amongst the most curious pieces in the latter, a circular room, vaulted in the form of a low dome or half-orange, and called the Mazmorra, from its destination of a dungeon in the time of the Moors, is worthy of being noticed, affording, from the perfect state in which it is preserved, an incontestible proof of the durability of excavations made in these strata. The house occupied the whole of the insulated projecting mass of these strata, and a broad and high-arched gallery, excavated with nice precision, conducted through its central part, from the front to the rear of this singular edifice. It opened out on the latter side upon a platform along the summit of the high escarpment whose base is washed by the Guardal, and represented a delicious view of a little green cultivated valley fertilized by its waters, upon which the eye reposed with delight, fatigued by the monotonous, barren-looking prospect of this arid district.

Sulphur Mines of Benamaurel.—Benamaurel stands upon the left bank of the Guardal, and the sulphur mines known by the name of this village are situated about three miles towards the west on the opposite side of the rivulet, the intervening distance exhibiting perfect similarity in geological and physical character to the tract lately described. In one of the little hollows which characterize and indent the basin occupied by the gypsiferous marl strata, several perpendicular shafts have been sunk for the purpose of extracting the sulphur which in some places accompanies them. The principal bed of this substance occurs at about sixty feet below the surface; but before reaching this, two other strata are passed through, in which the mineral makes its appearance, but in small quantities, and so mixed up with marl and gypsum, as not to repay the expenses of extraction. The former, or workable stratum, has little thickness, rarely exceeding that of two or three inches, and preserving the horizontality of the gypsiferous marls between which it is enclosed. The sulphur is of a pale yellow colour, of a compact structure, and a few minute scales of laminated gypsum are occasionally disseminated in its mass. Amongst the debris resulting from excavation, and surrounding the aperture of one of the shafts, I observed fragments of the marl strata, studded with numerous minute organic bodies, with whose nature I was then unacquainted, but have since been informed that they belong to the genus Cypris, and are similar to those found in the weald clay of England. The stratum to which these belonged had a more arenaceous character—a greater proportion of fine sand—than the generality of those which constitute this formation. A few broken fragments of testacea were also observed, whose nature it would be difficult to determine, being principally converted into a crystalline substance in the form of minute concretions. The above organic remains are met with, as the workmen informed me, in the strata immediately overlying those in which sulphur is found. During the three hottest months of summer, it becomes necessary to suspend the workings for this mineral, as the exhalations are so powerful, that the lights attempted to be introduced are immediately extinguished.

The road from Benamaurel to Huescar proceeds up the little valley of the Guardal, on the right bank of, and at a variable but never considerable distance from, the rivulet. The opposite bank is formed by a high perpendicular escarpment, the continuation of that below Benamaurel, nearly the whole way to a village called Castillejos, several openings or entrances into caves being observed along its face, which tradition states to have been inhabited by the Moors. All the tract to the left of the line of road, as far as Castillejos, exhibits a succession of little escarpments, in the gypsiferous marl deposit, bordering table-formed flats of different dimensions, or surrounding denuded hollows; and from the summit of the high escarpment forming the left bank of the rivulet, the surface presents a similar character and configuration in the opposite direction, as far as the eye can reach.

Sulphur is also met with in this deposit, and worked by means of shafts, in the immediate neighbourhood of Castillejos.

The little valley of the Guardal, between Benamaurel and Castillejos, has a varying breadth and form. At times it is reduced to a narrow slip of land, confined on one side by a high escarpment, and on the other by step-like platforms of the marls successively becoming more elevated as they recede from the rivulet; at others it expands into little circular basins, from a quarter to half a mile broad. The course is nearly north and south; the distance between the two last-mentioned villages is about ten miles.

From Castillejos to Huescar, a distance of about twelve miles, the tract exhibits appearances identical with those lately described; but on approaching the latter town, the gypsiferous marl deposit is concealed under a gently inclined plane of alluvium, of a sandy character and reddish colour. This extends to the base of the first low ridge of secondary limestone, which has been stated to form the northern boundary of the basin, and which, a few miles still farther north, rises into a series of elevated chains and magnificent mountains, the highest of which is known by the name of La Sagra.

It appears, therefore, in crossing this basin from south to north, or from Baza to Huescar, that it is entirely occupied by a deposit of gypsiferous marl in horizontal strata, whose total thickness may perhaps be estimated at between 300 and 400 feet, judging from the height of the escarpment at Benamaurel, and the depth to which the sulphur workings have been carried in a hollow of denudation at a much lower level than the surface of this formation near the last named village.

The gypsum, so abundant in this deposit, is almost universally in wedge-shaped separate pieces, many of which are often joined together, and form irregular masses of the size of a large cannon-ball. These are imbedded in great profusion in the marl strata, which generally are from 3 to 4 inches thick, but vary from 1 to 6. In other places these strata are studded with small facettes of gypsum, and an instance rarely occurs where it is not visible in one form or the other. Its structure is universally laminated.

I shall now proceed to say a few words upon the appearances presented along the line of road which passes over the eastern portion of this basin. About sixteen miles from Baza, and on the road to Velez Rubio and to the more eastern province of Murcia, there is a village called Cullar, situated within the limits assigned to it. The first part of the intervening tract is occupied by the pretty cultivated valley immediately below Baza, the upper stratum of which consists of a greyish-coloured argillaceous marl, that is observed in the descent to a stream about four miles from the last-named city, to become very tenacious, and to be covered with gravel. Hence, for about six miles there is a long gradual ascent, varied by a succession of little horizontal flats and gentle hills. The road often passing along denuded spaces, or cut through little ridges and eminences, numerous escarpments of horizontal calcareous marl strata, from 3 to 6 inches thick, are exhibited, containing discontinuous beds of earthy marl, studded with separate pieces of laminated gypsum frequently grouped together, and presenting a boat-shaped form. Higher up the ascent a regular stratum of gypsum was observed, in two separate instances, about a yard thick, between horizontal strata of semi-indurated calcareous marl. Near the summit of the ascent the marl becomes more calcareous, and several strata, each about 4 inches, and altogether about 3 feet thick, were noticed, of a somewhat porous earthy limestone, containing a few crystalline facettes of the same substance. This point is nearly the highest level of the gypsiferous marl formation in this direction, and hence to Cullar is almost a horizontal plane. I am inclined, in consequence, to consider these latter and higher strata, which, nearer to Cullar, are observed at times to alternate with thin beds of a sandy marl, in which small grains of quartz and specks of mica are seen, as the equivalents of the compact paludina limestone, which, on the opposite side of the valley lately crossed, rests upon the gypsiferous marl deposit, as before noticed, on the descent to Baza by the Guadiz road.

As far as the eye can reach to the right and left of the road from the stream last mentioned to Cullar, this immense deposite extends over a greyish barren-looking tract; but shortly beyond the latter village, in the direction of Velez Rubio, it is succeeded by a mass of transported materials which extend to the base of

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the secondary limestone* and older rocks†, stated to form the geographical limits of the basin towards the east.

All the tract surrounding Caniles, a village situated in the upper part of the Valley of Baza, and about six miles from this city, towards the S. SE., is also formed of horizontal strata of marl, in which I did not observe any imbedded gypsum, nor, as I was informed when there, is it found in the neighbourhood. Intervening between this tract and the eastern flank of the Sierra de Baza‡, there is much conglomerate, composed, like that along the northern base of this ridge, of fragments of argillaceous schist, greywacke, and transition limestone, imbedded in a reddish calc-argillaceous cement; and, towards the east and south, at a few miles from Caniles, gravel is extensively spread over a considerable tract, called El Desierto de Jauca.

Other localities within the area of this basin, not visited by me, present phenomena interesting to the geologist, viz. the brine springs of Vacor, the mineral waters of Casablanca, and the neighbourhood of Zucar, where testaceous remains and a variety of lignites are found. These three little villages are situated to the north of the line of road between Guadiz and Baza.

In concluding, I beg to recall your attention to two facts which intimately connect this basin with that which will form the subject of my next communication. The *first* is the superposition of the compact limestone with paludinæ to the gypsiferous marls; the *second*, the superposition of the latter to the secondary nummulite limestone. I shall, however, show, in the description of the basin of Alhama, the existence of other intermediate strata between the gypsiferous marls and the nummulite limestone.

The valleys of denudation, along which the rivulets of Guadiz, Baza, the Guardal, and some minor streams now flow, as well as the numerous dry hollows which diversify the surface, afford many opportunities of observing sections of the gypsiferous marl. That near Baza proves that the upper beds, or those immediately under the compact paludina limestone, are com-

* Sierra de Maria. † Greywacké and argillaceous schists.

‡ A patch of snow still remained, on the 28th of May, near the summit of Sierra de Baza, opposite Caniles. A barometrical observation I made at this point gives an altitude of 4856 feet above the level of the Mediterranean.

posed of marl without gypsum, the succeeding ones, in a descending order, becoming more argillaceous, and containing some gypsum; whilst those below, to an unknown depth, are calcareous, sandy, and abound in that mineral. It also appears that, in the lowest beds penetrated, near the centre of the basin, the gypsiferous marls contain imbedded sulphur in sufficient abundance to be advantageously worked, associated with various organic remains, amongst which the existence of the Cypris seems to warrant the conclusion that the deposite has been lacustrine *.

(To be continued).

On Valleys of Elevation, and their Connexion with the Origin of Acidulous Springs. By M. Frederick Hoffmann †.

It is well known, that of late years MM. Keferstein, Bischoff, De Hoff, De Buch, Brongniart and Boué, have sought the origin of the carbonic acid of acidulous springs in the ancient foci of volcanic activity. M. Hoffmann's memoir is a happy combination of this idea with the formation of certain valleys by elevation, and its author connects these phenomena with the mutual crossing of different systems of mountains.

This memoir tends to prove, that the formation of the valleys of elevation was accompanied by the eruption of a great quantity of water containing carbonic acid, which had been expelled from the depths of the earth; and that the springs of

* It would probably be a difficult question of antiquarian investigation, to trace the origin of these subterranean dwellings, inhabited by a considerable population of the poorer class in various parts of the province of Granada. They may be observed in the outskirts of the cities of Granada, Guadiz, and Baza; but are most numerous in the villages of Benamaurel, Castillejos, Caniles, and Cullar, where they have been excavated in the marl strata so extensively deposited in this basin, and in those of Benabra, and another, whose name I forget, in the valley of Guadiz. In Benabra, the entire population lives in caves; the church, the curate's house, and the Venta, being the only edifices seen above ground. Many of the argillaceous conical hillocks, which give so singular a character to a small tract of ground in the immediate vicinity of Guadiz, and to which allusion has been made before, have been also partially excavated and converted into dwellings,—an aperture at the base of the cone serving for entrance, another higher up as a window, and a third, near its apex, as a chimney.

† From Journal de Geologie. Par M. Boué, &c. No. II.

this nature which still exist in several of these valleys, are only the last ramifications of this great phenomenon.

M. de Buch has also tried to show, that when hot springs issue at the bottom of crevices and hollows, the carbonic acid which accompanies their eruption escapes through the rents of the formations, and impregnates the cold springs in higher places. The observations of these two naturalists tend to support the opinions exposed by M. Rozet, in his memoir on the old alluvia of the valleys of the Rhine.

Of the phenomena which clearly indicates the elevation and fractured state of the chains of Westphalia, one of the most remarkable is the formation of certain valleys, which we shall name *circular valleys*, or *valleys* of *elevation*. Their principal character consists in their having been originally shut in on all sides by precipices, whose strata are circularly inclined. The most striking example of this formation is the valley of Pyrmont, as represented at Figs. 1. and 2., Plate IV.

The upper edges of the muschelkalk mountains, which form the surrounding precipices, are seen on the opposite declivities, and are sometimes half a mile distant from each other, and they rise above the bottom of the valley, equally on all sides, to a height of from 900 to 1000 feet. Upon this formation are seen, sometimes at greater heights, the edges of the keuper, which has also been pushed backwards, and the first mountain's form, in the ridges of the Winterberg, Arminiusburg, the Schwalenbergerwald, &c. a second girdle, much less entire, around the inner wall of the valley. In the bottom of this valley, the variegated sandstone is seen issuing beneath the cliffs of muschelkalk, and rising to a height of 400 feet. The upper limits of this last group do not attain the same elevation on the opposite slopes; on the contrary, they are seen rising much higher on the north and east sides than on the others; and, conformably with this arrangement, the inclination of the strata is greater on the two first sides than on the last. I found, for example, on the north side of the Bamberg, the upper limits of the variegated sandstone at an absolute height of 849 feet, and the inclination of the superimposed muschelkalk was from 20° to 24°. Right opposite, in the Muhlberg, on the contrary, the limit occurs at 540 feet, and the inclination of the limestone is very slight. In like manner, in the western part of the mountain of Hagen, the lower limit of the limestone is at an absolute height of 280 feet, and almost in the bottom of the valley, while it rises in the Kellerser-Feld to 560 feet. It appears, therefore, that the constant difference of the elevation of the two sides of the valley is 300 feet.

We shall not venture to decide whether it has been only accidentally that this peculiar formation of valley has taken place precisely at the place where the directions of the systems of mountains of the north-east of Germany and the banks of the Rhine, cross each other for the last time. On the other hand, it is not the less singular to find the head of a gypseous mass in the bottom of the valley, at the bridge named Emmerbrucke, near the saline. We cannot, however, attribute to an accidental association, the existence in the same valley of the largest acidulous springs in Westphalia, and of those emanations of carbonic acid which are met with everywhere at a small depth, and which have rendered the gaseous or sulphureous caves of Pyrmont so celebrated. In these places, the pipes are still open, which the subterraneous gases followed when they split and raised up the crust of the mountainous country of the north of Germany. Those substances which now issue quietly from the earth, and which man has turned to his advantage, at a former period existed in a heated and compressed state, and may have elevated and overthrown masses of mountains.

Those who are aware of the influence which the evolution of carbonic acid gas, and the mineral springs which are connected with them, have upon volcanic phenomena, will not find much to disapprove of in our idea respecting the formation of the Valley of Pyrmont. Who would not be agreeably surprised at finding the other acidulous springs in the same country existing in the same circumstances? The largest acidulous springs in the country, next to those of Pyrmont, issue on the left bank of the Weser, in the Valley of Driburg, which, in all its external relations, is but a miniature of the Valley of Pyrmont. We have, at Fig. 3. Plate IV., a section where we see the muschelkalk ridge, which extends from the edges of the plain of Paderborn, from Dringenberg to Horn, is split and open upon its summit in the direction of south and north, at the same time that the variegated sandstone appears in the bottom of the valley. The western escarpment is nearly 400 feet higher than the eastern side. The fact, that, precisely in this place, in the whole extent of the chain of the *Teutoburgerwald*, the muschelkalk, which is pushed aside, forms the summit of the ridge, occupying the place of the *quadersandstein*, does not appear to be the result of a mere accident.

Two miles to the north, the muschelkalk ridge is again seen split on its summit, in the Wulfeshärte, near Vinsebeck. A narrow wedge-shaped mass, of nearly vertical strata, of variegated sandstone, occurs situated in this fissure; and beside this rock there issue some acidulous springs of large size. Lastly, when the muschelkalk-ridge has attained its maximum of height from the effect of elevation, in the Bellenberge, near Horn, it sinks under the Keuper; and before it are seen the large acidulous springs of Meiniberg, which issue from the Keuper, and are met with precisely on the limits of the two systems of mountains of the banks of the Rhine and the north-east of Germany. Moreover, in the interior of the wedge-shaped platform of Paderborn, there exist numerous acidulous springs and great evolutions of carbonic acid. There may be mentioned as examples, Saatzen, Istrup and Schmechten, Schonenburg and Reelsen, near Driburg, and the north side of Brackel, at the foot of the Hinneburg. It is possible to demonstrate that all these points owe their present position to violent disruptions of the original surface.

In the bottom of the valley of Saatzen and Istrup, the variegated sandstone appears in large spaces between the edges of the surrounding muschelkalk mountains, and carbonic acid escapes from it, with great force, by thousands of canals. In the marshy meadows of Istrup, I have seen hillocks of mud from 15 to 20 feet high, and 100 feet in circumference, produced by the currents of gas; and at their surface there are numerous small reservoirs of water, whose surface is kept in a state of ebullition by gas-bubbles of the size of one's fist. Between Schonenberg and Reelsen, rises the Melsberg, which is composed of variegated sandstone, and is situated in the middle of a plain of muschelkalk. It is on the western slope of this mountain that the gaseous springs are situated. On the other hand, the ridge on which is placed the Hinneburg, near Brackel, presents a wedge-shaped mass of variegated sandstone, in a nearly vertical position, which has been pushed through the muschelkalk; and whose masses, which were formerly superimposed, present the remarkable circumstance of a distorted and broken stratification. The gaseous springs, on the southern slope, have thrown up rocks which almost indicate the vicinity of transition formations, and which occur nowhere else on this plain. More to the east, where this covering of muschelkalk gives place to the variegated sandstone, we still see here and there on its edges the traces of emanations of carbonic acid. This is the case with the mineral springs of Godelheim near Hoxter, in the valley of Weser, the salt springs of Carlshafen, and the acidulous springs of Hof-Geismar near Volkmarsen, &c. In like manner, at the place where the Keuper forms a thick covering over the muschelkalk, on the northern edge of the plain of Paderborn, we also find similar appearances, even to a great distance. Everywhere the carbonic acid makes its escape in the places where the muschelkalk has perforated in islets the covering of the Keuper. Thus we may mention the slopes of the muschelkalk mountain near Schieder, and of Wobel near Pyrmont, the environs of Calldorf to the south-west of Rindeln, where numerous slightly acidulous and saline springs issue on the declivities of a limestone islet. So also, near Vlotho in the Clusenberg, near Zalzuffeln, and in the upper valley of the Zalze, &c. We might, therefore, compare the great country situated on the left bank of the Weser, in the direction from Carlshafen to Vlotho, as far as the slope of the *Teutoburg-Wald*, to the surface of a sieve, the holes of which that still remain open, allow the gases to escape which are disengaged in the depths of the volcanic foci by unknown means.

Councillor Hausmann seems not to have had a clear idea of these singular circumstances, when he appears inclined to attribute the origin of the acidulous springs of Westphalia to a solution of the protocarbonate of iron, which is very sparsely disseminated in the marls of the variegated sandstone*. We cannot easily see how this explanation is applicable to other countries of Germany, which are distant from modern volcanic formations.

* See Bemerkungen in W. A. Ficker's Driburger Taschenbuch, 1816.

Besides the valuable remarks of M. Leopold de Buch * on the salt springs of Nauheim, and the acidulous springs of Wetteravia, we have still to direct attention to the remarkable observations of M. Stifft, which prove that, in the Duchy of Nassau, the numerous mineral springs, so rich in carbonic acid, issue almost always in places where the strata manifest remarkable changes in their direction and inclination, and in the places where in particular there are remarked saddle-shaped elevations, and also frequently rents on the summit of the saddle †. We have, therefore, here the same appearances as those which have been described above in Westphalia; and it would be difficult to find stronger proofs of the connexion of the lines of direction of our chains, and of the position of their beds, with the effects of still existing subterranean forces.

What we above deduced from observations on the formation of the circular valleys of elevation in the north of Germany, we find again proved by Mr Buckland's researches as to the origin of many valleys in the south of England. That distinguished geologist has represented these valleys, at the western extremity of the London basin, which he names the valleys of Kingsclere, Ham, and Pewsy, and which are, in the midst of the chalk and green sand formation, a perfect representation of the valleys of Pyrmont and Driburg. In the valley of Kingsclere, the south escarpement has been raised to double the height of the northern one, and the chalk of England here attains its maximum of elevation in the mountain of Inkpenhill, which rises to an absolute height of 1011 English feet.

As Mr Buckland attributes the formation of several less circumscribed valleys to raisings and breakings of the strata, we might place in this latter class the very wide valleys of Quedlinburg, Huyseburg, and Reitlinge near Elmwald. We recommend the inferences drawn from these observations to the geologists of the mountains of the north of Germany, who are little accustomed to consider, in a general point of view, the appearances of the position of the strata. It would, in like manner, be advantageous to compare the phenomena of this order which present themselves in these countries with those which might come to us from distant regions.

* Poggendorff's Annalen der Physik, xii.

† See Wiesbaden und seine Heilquellen, 1823, by Rullmam.

Arrangement of Rocks. By Dr K. C. Von Leonhard, Professor of Mineralogy and Geology, Heidelberg. Communicated by the Author.

The division of rocks into Primitive, Transition, and Secondary, does not answer the present state of science. In our opinion, the regular or stratified rocks (normale felsgebilde), may with justice be separated into a series of more or less characteristic groups. Certain analogies of character, a close connexion by means of reciprocal gradation, organic remains, and finally a constant, or at least a very frequent, appearance of various members of such groups, allow us to regard them as more or less well defined. The constant occurrence of one or more members of the series, and being always in the same position, decide as to the identity of the other members, thus affording light in many ambiguous cases. The nature of organic remains is, above all, of the greatest importance in the arrangement of such groups of regular rocks. The groups I have adopted in my system are the following :—

I. Postdiluvial.
II. Diluvial.
III. Fresh-water gypsum, with coarse limestone (grob kalk), and plastic clay.
IV. Chalk and green sand.
V. Jura and oolite limestone.
VI. Lias and keuper.
VII. Shell limestone (muschel kalk), and variegated sandstone.
VIII. Magnesian limestone (zechstein), and red sandstone (Tod-liegendes).
XI. Coal.
X. Transition limestone, greywacke, and clay-slate.

In judging of the relations of the absolute age of irregular rocks (abnorme felsenmassen), we meet with many difficulties. We want there the criterions that occur in the regular rocks, and the relative age is itself a problem whose solution is not admissible but within certain limits.

On the Geological relations of the South of Ireland. By Thomas Weaver, Esq. F.R.S., &c *.

This hilly and diversified region is chiefly composed of ridges, having generally a direction from east to west, and attaining their greatest elevation in the mountains of Kerry, where Gurrane Tual, one of Magillicuddy's Reeks, near Killarney (the highest land in Ireland), is 3410 feet above the sea.

The rocks in this elevated country are chiefly of the transition class; they decline gradually towards the north, and finally pass under the old red sandstone and carboniferous limestone of the midland counties.

1. *Transition Series.*

In Kerry there is a persistent series of transition rocks, having a general direction from east to west, and dipping to the north and south with vertical beds in the axes of the ridges; the strata, as they diminish in inclination on each side, form a succession of troughs.

The principal rock masses are composed of greywacke, slate, and limestone; but the general series is distinguished by the author, into simple and compound rocks: the simple being clay-slate, quartz-rock, hornstone, lydianstone, and limestone; the compound sandstone and conglomerate, with bases of clay-slate, quartz and sandstone, greywacke and greywacke-slate, sandstone and sandstone-slate, greenstone and hornstone porphyry. Roofing-slate, though comparatively rare, is found of an excellent quality in the island of Valentia.

Organic remains occur more frequently in the limestone of this series than in the slate and greywacke. In Kenmare, these remains consist of a few bivalves, and some crinoidal remains;

* The above is an abstract, published in the Annals of Philosophy for August 1830, of a Series of Observations, read to the London Geological Society, on the Geognosy of a large tract in the South of Ireland, comprising the counties of Cork, Kerry, and Clare, with part of those of Galway, Tipperary, and Waterford, thus connecting this portion of the island with the eastern part, formerly described by Mr Weaver, one of our best geognostical observers.

and these also are most numerous in the Muckruss and Killarney limestones. At the foot of the Slieve-meesh range, this limestone includes Asaphus caudatus, Calymene macrophthalma, and perhaps a third crustaceous animal, with Orthoceratites, Ellipsolites ovatus, an Ammonite, Euomphalites, Turbinites, Neritites, Melanites, and several species of Terebratula, Spirifer, and Producta. Other bivalves in this locality are referrible to species figured by Schlotheim, as from transition rocks on the continent.

Near Smerwick harbour, similar organic remains are abundant in slate, and fine grained greywacke, together with hysterolites, and many genera of Polyparia, the whole resembling, both in mineral and zoological characters, the rocks of Tortworth in Gloucestershire, formerly described by the author, as well as those of the Taunus in Nassau, more recently described by Sir Alexander Crichton. Again, the same fossils are found in the limestone of Cork, associated with impressions of vertebræ of fishes; and analogous remains are to be met with also in a portion of the slate of that neighbourhood.

Transition Coal.—All the coal of the province of Munster, except that of the county of Clare, is referrible to one of the earliest periods at which that mineral has been produced; the true coal overlying the mountain limestone being found in that county alone. At Knockasartnet, near Killarney, and on the north of Tralee, thin beds of glance-coal, inclined at various angles, from 70 degrees to verticality, are included in greywacke and slate. In the county of Cork, this old coal is more extensively developed, particularly near Kanturk, extending from the north of the Blackwater to the Allow. The gorges of the latter river, and various other neighbouring defiles, expose clay-slate, greywacke, shale, and sandstone, in nearly vertical beds, direct from west to east. This transition tract extends to the river Shannon on the north-west. As the systems range from west to east, in a series of parallel acutely-angled troughs, the beds have great diversity of inclination, dipping rapidly either to north or south, and bending horizontally between the ridges. This glance-coal or anthracite is raised in sufficient quantities for the purpose of burning the limestone of the adjoining districts; and the most considerable collieries, those of Dromagh, have yielded 25,000 tons per annum, at from 10s. to 15s. per ton.

The coal, and accompanying pyritiferous strata, are abundantly charged with the remains or impressions of plants belonging chiefly to Equiseta and Calamities, with some indications of Fucoides. Beds of transition coal occur also in the county of Limerick, on the left bank of the Shannon, not of Abbeyfeall, and at Longhill; and are seen, though in very small quantity, on the right bank of the river at Labasheada. Several other places where coal strata occur are mentioned by the author. The transition rocks of Kerry and Limerick are prolonged into Cork and Waterford, preserving with certain modifications an analogous character and composition. The carboniferous limestone reposing upon this tract, on the north, is usually unconformable to it, but is conformable to the old red sandstone, wherever that rock intervenes. In this system of strata, organic remains, such as polyparia, bivalves, trilobites, &c., occur near the Bonmahon river; the horizontal planes which they occupy crossing the vertical cleavage of the slaty grauwacke nearly at right angles. The series rests upon and passes into clay-slate, and is capped by old red sandstone and strata of the carboniferous order. Metalliferous veins, with indications of copper and lead, are seen in the cliffs of the transition series, east and west of the Bonmahon river.

2. *Metalliferous Relations of Kerry and Cork.*

The author having succeeded in restoring the copper-mines at Ross Island, on the Lake of Killarney, and in effectually draining off the water, was enabled to prove that the ore did not constitute a metalliferous bed, or any real vein, but was contemporaneous with the rock, in which it is irregularly distributed in the form of ribs, branches, strings, &c., analogous to those of calcareous spar in limestone. The rocks at Ross Island consist of blue limestone, and beneath it of siliceouslimestone, but the ore is confined exclusively to the former; and various trials have proved the non-existence of any vein communicating with the metalliferous deposit. Copper-ore is similarly distributed at Crow Island; but at the Muckruss mines the ore was obtained chiefly from a metalliferous bed. The author has ascertained exactly the extent of the limestone bearing lead in Kenmare, where most of the unsuccessful trials in search of ore have shewn that the mineral deposits are discontinuous and nearly parallel to the range and dip of the bed; and in Castlemaine mine, where lead-ore was formerly worked in a mass of calcareous spar and quartz, in thinned out in an unproductive pipe. Near Tralee and Ardford, and on the left bank of the Shannon, lead-ore has been unprofitably worked in limestone, sandstone, and slate.

In the county of Cork, the copper mines are those of Allihies, Audley, and Ballydehol; and those producing lead are situated at Doneen and Rinabley. The mine at Allihies is one of the richest mines in Ireland; it was discovered only in 1812, and has already yielded more than 2000 tons of copper-ore per annum. The ore occurs in a large quartz vein, which generally intersects the slaty rocks of the country from north to south, but in some places runs parallel to the stratification. It is remarked, that this portion of the county of Cork indicates a very general diffusion of cupreous particles; so much so, that, in the year of 1812, a cupriferous peat-bog on the east side of Glandore harbour, forty or fifty tons of the dried peat produced, when burnt, one ton of ashes, containing from ten to fifteen per cent. of copper. The lead mines of Doneen and Rinabelly are in slate. In concluding a long series of observations on the mines of the tracts described in this paper, the author remarks, that the diffusion of metallic substances throughout the mass of rocks is far from being an uncommon occurrence,—the metalliferous matter appearing in isolated particles, and in strings, veins, or filaments, more or less connected with each other, but not continuous or persistent, and therefore of contemporaneous origin with the rock itself.

3. *Carboniferous Series of Clare.*

The clay-slate in this county is bordered by a belt of red sandstone, to which succeed, in ascending order and conformable position, the mountain limestone and coal measures, both of which occupy flat and undulating hills, and the strata usually dip from the east of north to the west of south; but seldom at a greater angle than 5°. The best sections are seen in the cliffs of the west coast, where shale, sandstone, and sandy flag-stones overlie limestone. Coal, however, is there of very rare occurrence, and when disclosed is of a very indifferent quality; and the author infers, that the lower part of the series in the county of Clare is comparatively poor in this mineral; he, however, suggests that the best chances of discovering valuable seams must lie in the elevated regions of Mount Cullun, where, if coal be found, the beds being nearly horizontal, it might be worked with advantage.

The Memoir concludes with some observations on the distribution of diluvial matter in the south of Ireland.

1. Boulders, gravel and sand, derived from the transition series, are lodged along the borders and sides of the mountains in Kerry.

2. In a small district of Limerick and Tipperary, situated between the Gaultees and Slieve-na-much, the rolled debris consist not only of portions of the contiguous rocks, but contain also porphyry, which is not to be found in situations near the vicinity of Pallis hill.

3. In the peninsula of Renville, near Galway, the surface of the carboniferous limestone is strewed over with numerous boulders of red and grey granite, syenite, greenstone, and sandstone, which must apparently have been conveyed from the opposite side of the bay of Galway.

Notice of Plants observed in an Excursion made by Dr Graham *with part of his Botanical Pupils, accompanied by a few Friends, in August last.*

The party proceeded in two divisions to Castleton of Braemar; the one, landing at Aberdeen from the steam-boat, walked up the Dee; the other, proceeding by the coach to Blair Athole, walked through Glen Tilt. We met at Castleton on the 3d of August. From this point we walked to Ben-na-Buird, Ben-na-muic-dui, Glen Callader, Glen Candlich, and over Loch-nagar to Clova. From Clova we walked to the Glen of the Dole, and then the greater part returned to Edinburgh, others diverging in different directions with other pursuits. The whole time occupied, including the days of departure and return, was eleven days. The weather being wet, though, with exception of the 3d of August, calm, and the distances from our quarters being very considerable, we were able to examine the mountains which we visited only superficially, yet the excursion was productive, and left a very general desire with us all to visit the same country again. Of the plants met with, those chiefly worth notice were the following:

Alopecurus alpinus.—Original station on rocks in the stream leading into Loch Whorl, Clova.

Arabis hispida,—Ben-na-muic-dui.

Betula nana, var. with large pointed leaves, fewer larger indentations, and much longer petioles. I gathered this to the eastward of Ben-na-Buird, near the top of a low hill over which the path from the Dee leads, and was inclined to attribute the appearance to the luxuriance of young shoots springing from ground on which the heath had lately been burnt, but it was mixed with other plants having the usual appearance.

Caltha radicans.—I pulled this plant, but not in flower, one or two miles from Castleton, on the road to the Spittal of Glenshee. It seems to me to be distinguished from a plant very often mistaken for it, the creeping variety of Caltha palustris, by its far more divaricated lobes, and its much more acute serratures.

Carex atrata,—Corry at the top of Glen Callader.

Carex incurva,—Aberdeen Links.

Carex Vahlii.—This plant, new to the British Flora, was gathered on the same day by Dr Greville and Mr Balfour in the corry at the top of Glen Callader. I have since determined the species by comparison with authentic continental specimens. It differs from these only in the leaves being broader; but in this respect one specimen which I have from Gulbrandsdalia, through the Unio Itineraria, very nearly approaches it. The zeal of my friend Mr Balfour has carried him back to the station, and I hope he will return rewarded with a greater number of specimens.

Cetraria islandica,—in fruit on several mountains near Castleton. I found in this neighbourhood, in August 1821, the first British specimen which had ever been seen in fruit. My friends Drs Hooker, Greville and Mr Arnott, afterwards pulled it in abundance; but I am not aware that it has ever been found in fruit in any other district in Britain.

Cetraria nivalis,—near the summits of every mountain we visited.

Galium pusillum,—growing with Oxytropis campestris.

Goodyera repens.—Fir wood at Aboyne.

Hieracium alpinum,—on all the mountains which we visited, and in the corry at the top of Glen Callader especially, most abundant and luxuriant: also the variety of this which has been called H. Halleri. Between these, I can really see no distinction that is not obviously the result of situation,—the first growing on dry, the last in damp places.

Juncus castaneus.—Above the rocks in the corry at the head of Glen Callader.

Jungermannia Doniana, in fruit.—Ben-na-muic-dui.

Luzula arcuata.—Summit of Ben-na-muic-dui abundantly.

Lycopodium annotinum.—Very abundant on all the mountains in the Ben-na-muic-dui range, and on the ascent to Loch-na-gar from the north.

Oxytropis campestris.—In the old station near the Glen of the Dole in great abundance.

Phleum alpinum.—On Ben-na-Buird, most abundantly; in the corry at the head of Glen Callader; and on Loch-na-gar.

Poa alpina vivipara.—Ben-na-Buird.

Polytrichum hercynicum.—Ben-na-muic-dui, abundantly.

Polytrichum septentrionale.—In profusion, and in fine fruit, on Ben-na-Buird and Ben-na-muic-dui. Drs Hooker, Greville, and Mr Arnott found this species in fruit for the first time in Britain on the latter mountain in 1822, but very sparingly. It was never seen in Britain in such perfection and abundance as we now noticed it.

Pyrola rotundifolia,—very abundant in the woods on the Dee.

Pyrola secunda,—among the heath in the ascent to Loch-na-gar from the north.

Rubus suberectus.—Clova.

Salix arenaria,—in very considerable variety, head of Glen Callader; Loch-na-gar; banks of the Esk, Clova. Among the varieties we certainly have S. Stuartiana of Eng. Bot.; but it gives me pleasure to think that we have many memorials of the late excellent minister of Luss, less fleeting than the specific name of a willow.

Salix herbacea, var. *major.*—Corry at the head of Glen Callader. This variety is not generally known, but is not uncommon. We have it in the Botanic Garden, brought from mountains of Sutherlandshire in my excursion with the botanical pupils in 1827. Dr Hooker remarks most justly, that the common variety is not " so small as is generally supposed, for its stems divide and creep below the surface of the earth, scarcely rising an inch above;" but after cultivation in the Botanic Garden, this variety has acquired a woody stem, prostrate upon the surface of the ground, from 2 to 3 feet long, and nearly as thick as the little finger. We have in cultivation the common variety, and we have another also from the mountains of Sutherland, with upright shoots, but both are much smaller than the variety to which I now allude, and neither ever acquire the large prostrate stems.

Salix lanata.—Corry at the head of Glen Callader. This is the second station for this willow in Britain; but it is at no great distance from the first, in Clova.

Saxifraga rivularis,—in profusion on Loch-na-gar.

Saxifraga cæspitosa. A single tuft only, the first that has been found in Scotland, was picked by Mr Macnab on Ben-na-Buird.

Sonchus cœruleus.—Sparingly in the old situation on the White Water. Five of the party only reached the spot, and one specimen for each was all that was found. The plant maintains itself by its perennial roots, but shows no tendency to diffuse itself by seed.

Stellaria cerastoides.—Ben-na-Buird; Ben-na-muic-dui.

Subularia aquatica.—Loch in Glen Callader.

Veronica alpina.—Corry at the head of Glen Callader; Loch-na-gar; Ben-na-

Buird'; Glen of the Dole, Clova. From having a long while watched this and V. Wormskioldii in cultivation together, I am now satisfied that they are specifically distinct, as I shall endeavour to show hereafter.

In addition to the above enumeration of the more remarkable plants observed, I may mention, that we saw several *Salices*, which might be considered distinct, and new or scarce species, but confessing great ignorance of this genus, I dare not give names to very obvious differences of form. Among these was probably *S. rosmarinifòlia*, one bush of which, without catkins, was found by Dr Greville, scarcely rising above the heath, on the side of a bog near the base of Loch-na-gar, towards the Dee; and one which Mr Macgillivray first picked in the corry at the top of Glen Callader, which was afterwards found by several of the party there, and which he has described in this Journal under the name of *S. macnabiana*.

The few days of very hot weather in the end of July, after the long continued rains, seemed to have produced a fresh blossom of *Azalea procumbens*, for we found much more of it in flower than I had ever before seen in August.

The following list of plants observed in the excursion is inserted, as it may possibly interest those who are not well acquainted with the alpine vegetation of Scotland. They are found on almost every range of considerable elevation.

Aira alpina.
—— —— vivipara.
Arbutus uva-ursi.
Aspidium Lonchitis.
Asplenium viride.
Azalea procumbens.
Carex dioica.
—— rigida.
Cerastium latifolium.
Draba incana.
Cornus suecica.
Epilobium alpinum.
—— alsinifolium.
Gnaphalium supinum.
Juncus triglumis.
Luzula spicata.
—— trifida.
Oxyria reniformis.
Rhodiola rosea.
Saxifraga aizoides.
—— oppositifolia.
Saussurea alpina.
Sibbaldia procumbens.
Silene acaulis.
Thalictrum alpinum.
Vaccinium uliginosum.

R. G.

Description of a Species of Aira found on Loch-na-gar, in Aberdeenshire. By Mr W. Macgillivray.

A species of Aira, bearing some resemblance to *A. flexuosa* and *A. cæspitosa*, having attracted my attention while examining the granite of the Loch-na-gar group of mountains in August last, I have found it to be apparently *A. montana* of Linnæus, although from the slender means which a person thrown entirely upon his own resources can possess, I shall not be surprised to be informed that it is something else. It is, at all events, different from any species or variety hitherto admitted as British.

A. montana? Linn. Leaves involute; panicle close, with flexuous branches; florets longer than the calyx, somewhat abrupt and lacerated; awn from below the middle of the outer valve, shorter than the floret.

Root of numerous long, branched fibres. Stem about a foot high, oblique at the base, afterwards erect, two-jointed, striated, smooth, pale green, brown on the exposed knot. Leaves forming a tuft at the base, linear involute, acute, sheathing, the sheath of the uppermost, which is extremely short, reaching to near the panicle, smooth on the back, scabrous on the edges and the nine prominent ribs of the upper surface. Ligulæ obtuse, lacerated, white. Panicle close, four inches long, with angular roughish shaft, semiverticillate, quaternate, smoothish branches, which with the shaft are flexuous, and shining dark reddish-purple flowers, whitish at the tips. Florets longer than the calyx. Valves of the calyx unequal, ovate, keeled, the outer serrato-dentate towards the slightly cleft tip, the inner larger, lacerated toward the end and cleft. There are always three florets: the lower on a very short stalk, its outer valve ovato-lanceolate, with a tuft of erect hairs at the base, and denticulate on the keel, rather abrupt, with five tapering acute terminal segments, the inner elliptical, deeply cleft, sparsely ciliated, the awn denticulate, nearly straight, from below the middle of the outer valve, and almost as long as it. The second floret on a longish hairy stalk, which is suddenly bent at the top, where it bears a tuft of hairs, smaller than the first, sparsely denticulate on the keel, terminated by three tapering segments, and awned like the first, the awn shorter. The third floret on a similar stalk, rudimentary, denticulate on the keel, with a very minute awn not reaching beyond the middle of the outer valve, which is simply cleft, the inner valve acute. The two lower florets are perfect, the third abortive, sometimes antheriferous. The outer valve of all is pale-green at the base, reddish-brown in the middle, whitish at the tip, the inner valve white. Filaments short; anthers linear, bifid, yellow. Germen roundish; stigmas very short, feathery, recurved. Scales in the two lower florets only, lanceolate, very minute, scarcely longer than the germen.

With *A. cæspitosa* this species has little affinity in its general appearance, although the flowers, which are about 60, resemble those of that species, which has commonly more upon a single branch of its panicle. In *A. cæspitosa*, the calycine valves are nearly equal, and both rough on the keel; the outer valve of the corolla is quite abrupt, with several segments, each of which is abrupt and lacerated; the awns come off close to the base; and the scales are much longer than the germen. From *A.*

alpina it differs, in having three instead of two florets, a small and few-flowered panicle, and in many other characters. It agrees with *A. flexuosa* in the appearance of the panicle and colour of the florets, the former, however, not being triple-forked, and having more flowers, and the latter being smaller. It differs from it in many particulars; for example, the sheathed stem, the broader and longer leaves, the longer florets, shorter awns, &c. It is not Smith's var. β of *A flexuosa*. *A. bottnica* or *atro-purpurea* of Wahlenberg it cannot be. Smith says *A. montana* of Linnæus was not known to Hudson, whose *montana* he refers to his own pale-flowered *Aira flexuosa* β. It agrees sufficiently with Linnæus's *A. montana;* but before difficulties can be solved in a satisfactory manner, without the impracticable expedient of having recourse to the actual specimens of authors, descriptions must be more minutely accurate than those which we are accustomed to see. Even Smith, of British botanists *facillime princeps*, affords little aid in the present case. There is still ample field for enthusiasts in our own country. The Outer Hebrides, almost the whole of the mountainous districts of the north of Scotland, and numberless nooks in all parts of it, are untrodden soil. On the other hand, many plants are admitted as indigenous which are not so. Who ever saw the Bedford willow, for example, growing wild in Scotland? And as to geographical distribution, the connexion of rock with soil, and of soil with vegetation, the changes which plants undergo, the inferences deducible therefrom, and applicable to specific distinctions, the arithmetic of botany, the comparisons of climates and latitudes, the organization of plants, and the radiance which it is yet destined to throw on geology,—these are subjects unheeded, probably undreamt of, by persons who would risk their necks to get a rare plant from an alpine crag, and incur the danger of being drowned in a quagmire, for the purpose of gathering a new Scirpus; and who, moreover, smile at the idea of philosophizing in botany, which is in this country little better than a broken string of imperfect specific characters, and abortive attempts at grouping plants by means of latitudinarian criteria, by which varieties are confounded with species, and species receive common characters which do not exist in nature.

Description of several New or Rare Plants which have lately flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden. By Dr Graham, Professor of Botany in the University of Edinburgh.

10*th Sept.* 1830.

Calceolaria bicolor.

C. *bicolor;* foliis ovato-cordatis, venosissimis, rugosis, biserratis; pedunculis multifloris, dichotomo-umbellatis.—*Ruiz et Pavon.*

Calceolaria bicolor, *Ruiz et Pavon*, Flor. Peruv. et Chil. i. 16. t. 25. fig. *b.* —*Pers.* Synop. Pl. 1. 15.—*Sprengel*, Syst. Veget. i. 147.

Description.—*Plant* half shrubby, everywhere covered with short, soft, glandular pubescence. *Stem* (in our specimens, which are seedlings of this season, 2½ feet high) erect, purple at the base, green above, round, much branched. *Branches* nearly round, ascending, or suberect at the base, and above bent outwards at an obtuse angle. *Leaves* (3 inches long, 2½ broad,) opposite, very rarely ternate, petioled, spreading at right angles to the stem, ovato-cordate, acute, duplicato-serrate, much veined, undulate, wrinkled, the veins and middle rib prominent behind; petioles below nearly half the length of the leaves, shorter above, flattened on the upper side, connate. *Cymes* peduncled, axillary and terminal, dichotomously branched, two opposite small subsessile subentire ovato-acuminate leaves or bracteæ being placed at the primary division of the peduncle, and two flowers on simple pedicels in each cleft, the one ascending and first expanded, the other spreading or deflected. *Calyx* segments elliptical, the lowest the narrowest and most acute, the upmost the shortest. *Corolla* sulphur coloured, except the lower half of the lower lip, which is white; upper lip very small; lower large, many-nerved, linear, compressed, turned upwards, so as with its retuse extremity to touch the upper lip till fully expanded, when it is separated from it a little way, opening into the lower lip large; at its base, on the inside, there is a tuft of long hairs, every where else the pubescence on the corolla is very short, and at the extremity of the lower lip it is nearly awanting. *Stamens* erect, the lower lobes of the large yellow anthers projecting from the apex of the upper lip. *Style* rather longer than the stamens, slightly curved downwards at the apex, compressed laterally, withering.. *Stigma* small, 2-lipped. *Germen* pubescent, pyramidal, grooved on its four sides, bilocular; *ovules* numerous, on large undivided central placentæ.

Ruiz and Pavon state this species to be a native of rocky places in Canta, and we obtained the seeds from which our plants were raised by the kind attention of Mr Cruckshanks, from Cullnay, in the same province of Peru. They were sown in spring, and our first specimens came into flower towards the end of July. It is an extremely pretty addition to our cultivated species (now fifteen in all, exclusive of the hybrids, and of the narrow-leaved variety of *C. integrifolia*), resembling in colour the pleasing subdued tint of *C. scabiosæfolia.*

Commelina formosa.

C. *formosa;* caule ascendente, ramoso, repente, colorato, piloso, pilis reflexis; foliis sessilibus, lanceolatis, acuminatis, planis, utrinque glabris; spatha cordata, compressa; floribus pentandriis; petalis inæqualibus; staminibus inclusis, tribus fertilibus.

Description.—*Stem* ascending, rooting, branched, red, especially above the joints, hairy, hairs reflected. *Leaves* lanceolate, acuminate, flat, glabrous on both sides and shining, bright green above, whitish below, 7-nerved, the middle rib prominent behind, channelled above, sheaths striated, ciliated. *Peduncles* (2 inches long) straight, with a line of reflexed hairs along the inner side (the ciliæ of the adhering sheath of the spathe). *Spathe* heart-shaped, folded, compressed, several-flowered, glabrous. *Pedicels* of unequal length, slightly pubescent, erect, straight. *Calyx* white, glabrous, triphyllous, leafets unequal, the upper the smallest and most acute, the two lower rounded, and cohering towards their base. *Corolla* of beautiful rather pale blue, of three unequal petals, each concave, rounded, slightly and unequally crenate (the largest ¾ths of an inch long, and nearly as much broad), the two upper particularly unguiculate. *Stamens* (5?) inserted within the base of the corolla, and sometimes attached to this at their origin; filaments glabrous, pale blue, less than half the length of the petals. *Anthers*, 2 abortive, yellow, lobed, 3 fertile, white, linear, sagittate at the base; pollen white. *Germen* superior, ovato-acuminate, white. *Style* deflected upon the lower petal, otherwise like the filaments, and similar to them in length. *Stigma* small, 3-lobed. *Unripe capsule* 3-gonous, 3-celled.

The seeds of this very pretty species were gathered by Mr Cruckshanks in the valley of Lima, and communicated to me last spring. The plants flowered freely in the greenhouse in July.

Gentiana cæspitosa.

G. *cæspitosa;* caule repente, cæspitoso, ascendente, ramoso; foliis congestis, rotundato-ellipticis, subcarnosis, concavis, trinervibus, carinatis; floribus corymbosis, subterminalibus; calyce 5-fido, acuto, reflexo; corolla erecta, nuda, campanulata, 5-dentata, obtusa.

Description.—*Stem* slender, procumbent and rooting at the base, turf-like, ascending, 2 inches high, exclusive of the flower, angled, and stouter towards the top, much branched, branches short and crowded. *Leaves* sessile, in four rows, densely crowded, and not unlike in general effect to *Arenaria peploides*, but of much darker green, rotundato-elliptic, concave, 3-nerved, keeled, undulate, slightly wrinkled on the upper surface, somewhat fleshy, margins entire, and slightly reflexed. *Flowers* sessile, very rarely solitary and axillary, in general 3–4 together, forming a terminal corymb, expanding in succession, erect. *Calyx* green, 5-cleft, segments unequal, spreading or reflexed, subacute. *Corolla* (7½ lines long) naked, dark greenish-blue, yellowish-green at the base, campanulate, contracted somewhat towards the mouth, 15-nerved, 3 nerves passing into each of 5 blunt teeth. *Stamens* reaching to the base of the teeth, unconnected with each other; filaments arising from the base of the corolla, adhering to it by their backs for about half their length, dilated in the middle. *Anthers* pale yellow, arrow-shaped, bursting along their edges. *Pistil* equal in length to the stamens; stigmas sessile, nearly white, revolute, truncated; germen attenuated at both extremities, green; ovules green, numerous, irregular on the surface, attached to the parietes.

Raised at the Botanic Garden from seeds collected in Captain Franklin's last expedition to the arctic coasts of America, and flowered abundantly in the open border in June and July 1830.

Hibiscus divaricatus.

H. *divaricatus;* corolla campanulata; calyce 5-fido, cumque involucris brevioribus 10-partitis glanduloso-muricato; caule fruticoso, aculeato; ramis base patentissimis; foliis cordato-subrotundis, sublobatis, inæqualiter serrato-dentatis, concavis, rigidis, utrinque pubescentibus.

Description.—*Shrub* (2½ feet high) erect. *Stem* round, green, sprinkled with oblong red spots, beset with short, rigid, slightly recurved prickles, with tumid bases. *Branches* numerous, especially at the base, spreading wide at their origin, and afterwards ascending, surface similar to the stem. *Leaves* (2 inches broad) cordato-subrotund, irregularly angled, and deeply and unequally serrato-dentate, strongly 5–7 nerved, reticulate, somewhat wrinkled, rigid, concave, pubescent on both sides, lessening upwards into the form of *bracteæ*, which, at the apices of the stem and branches, are linear-lanceolate, entire, and subsessile, nerves prominent above, but more so below, with small aculei on both sides, projecting forwards. *Petioles* (3½ inches long) longer than the leaves, divaricated and curved forwards, rigid, aculeated, obscurely channelled above, containing pith. *Flowers* collected near the apices of the stem and branches, rising singly on short, robust, erect, hairy peduncles from the axils of the diminished leaves or bracteæ. *Involucre* 10 parted, segments subulate, somewhat spreading, rigid, covered with long simple harsh colourless hairs, which arise from large greenish glands. *Calyx* longer than the involucre, similar to it in texture and colour, 5-cleft, segments broad, acute, and each composed of three coarse connivent ribs, similar to the segments of the involucre, translucent at the glands, united by a green membrane. *Corolla* (2½ inches across when expanded) 3–4 times the length of the calyx, campanulate, revolute in its edges, many-nerved, sulphur coloured, with a deep and beautiful crimson heart; segments (1½ inch long, 1¼ broad) very sparingly pubescent, the crimson part having a considerable number of short erect glandular hairs, obovato-cuneate, thickened at the base, forming a short fleshy tube, along which their edges are decurrent. *Stamens* numerous, erect, as long as the dark centre of the corolla, arising from its tube of deep crimson, with glandular pubescence: anthers on short partial filaments, sometimes united in pairs, arising from the sides of the common sheath, kidney-shaped, bursting at a groove along the back, dotted, in the bud forming a dense orange coloured capitulum; pollen granules spherical, so large that they may be seen through the anther-case, and, when exposed and examined under the microscope, are found to be pubescent. *Style* scarcely longer than the stamen-sheath, purple, and slightly pubescent in its upper part. *Stigmas* 5, capitate, purple, angular, fringed. *Capsules* five, cohering into a cone, hard, hairy. *Seeds* angular, erect, several in each capsule, embryo central, bent, radicle straight, plume plicate.

This very handsome species, which was raised in spring 1829 at the Royal Botanic Garden, from seeds received from New Holland by Mr Goodsir, flowered in the stove last year, and again this season. We were not informed in what district of New Holland it was collected; but I learn from Mr Lambert, that a species which, from his account, I take to be the same, has flowered with him, having been obtained from Morton Bay.

Loasa hispida.

L. *hispida;* hispidissima, foliis alternis, bipinnatifidis, laciniis calycinis lateribus replicatis, corolla reflexa.

L. hispida, *Linn.* Syst. Nat. ed. 13. p. 364.—*Willd.* Sp. Pl. 2. p. 1176.

L. urens, *Jacq.* Observ. Bot. pars ii. p. 15. t. 38.—*Lam.* Encyclop. 3. 758.—*Sprengel,* Syst. Veg. 2. 601.

L. ambrosiæfolia, *Juss.* Annal. du Mus. 5. 26. t. 4. fig. 1.—*Persoon,* Synop. Pl. 2. 71.—*Sprengel,* Syst. Veg. 2. 601.

Description.—*Stem* round, rooting at the base, flexuose, branched, densely covered with innumerable short harsh hairs, which seem rough under the microscope, and are scarcely stinging: higher up there are a few deep green oblong spots on the stem, and the hairs are mixed with others which are twice or thrice as long, smooth, dark brown, arising from larger glandular bases, and are stinging; these increase in number upwards, and are much crowded near the top. *Leaves* (5 inches long, 3½ broad,) scattered, petioled, oblong, pinnatifid and incised, or oftener bipinnatifid, or almost pinnated, and the pinnæ pinnatifid, pubescent on both sides, but especially the under, which is paler, with prominent branching veins, which are a little reticulated, and channelled above. *Peduncles* scattered, opposite, but never immediately, sometimes at a considerable distance from the leaves, single-flowered, longer than the upper, but shorter than the larger leaves. *Flowers* nodding, rather powerfully, and, as some think, pleasantly perfumed. *Calyx* green, 5-parted, segments patent, cordato-ovate, acute, reflexed in their sides, submarcescent. *Petals* (1 inch long) reflexed, navicular-hatchet-shaped, cucullate, glandular-pubescent, but sparingly except at the claws, reticulated, ciliated along the keel, alternating with white, erect, truncated, obcordate scales, hollow, and opening longitudinally on their inner surface, flat at the apex, there transversely marked with elevated stripes, and each extended into two short rose-coloured points in the centre of the flower, the stripes reddish-brown on the outside, and more and more greenish-yellow towards the centre. *Stamens* very numerous, about half as long again as the claws of the petals, and lodged, as in the genus, in their cavities, and advancing in succession; filaments white, glabrous; anthers yellow, becoming brown, short, bilobular, bursting along their sides, pollen granular, small, pale yellow. Two abortive, subulate, hooked, pubescent filaments, shorter and broader than the others, are placed on the inside of each of the hollow scales, and are at all times erect. *Germen* unilocular, turbinate, inferior, covered with pungent hairs, its upper surface flat, becoming conical, and rising above the calyx, but there empty, trifid; ovules numerous, attached to three linear parietal placentæ. *Styles* 3, cohering, their lower half, as well as the upper surface of the germen, covered with hairs. *Stigmas* very small.

I cannot see the propriety of changing the specific name of Linnæus to the equally objectionable one of Jacquin, nor could I have thought the reason assigned by Jussieu for departing from this last sufficient, even though he had not taken a third, which in its turn may be considered inappropriate. It is very true, that all the species of *Loasa* are hispid, and all are stinging; but if such be considered a reason for changing a specific name, endless confusion would arise in almost every old genus in which we have lately become acquainted with many new species. I wish specific names, when once given, were considered mere arbitrary and immutable terms. Trattinnick, it appears, has considered *L. urens*, Jacq., and *L. ambrosiæfolia*, Juss. as distinct, and is followed by Sprengel; but as I am not acquainted with the reasons for this opinion, as Jussieu is perfectly explicit that they are the same, as his figure agrees sufficiently, and as the differences noticed in his description appear to me to be trifling, I must follow his opinion, supported as it is by Persoon and Lamarck.

The seeds of this most beautiful species were received at the Botanic Garden in spring last, from my invaluable correspondent Mr Cruckshanks, whose additions to our stock of cultivated plants I take delight in recording. They were gathered in the valley of Lima. The specimen described was raised in a hot-bed, and flowered in the greenhouse in the end of July. It has also flowered in the Royal Botanic Garden at Glasgow, and I understand also in the neighbourhood of London.

Palavia rhombifolia.

P. *rhombifolia;* foliis rhomboideis, lobato-crenatis, ad venas sparsim stellato-pilosis, pedunculo brevioribus; stipulis subulatis ciliatis viridibus; petalis obovato-cuneatis, oblique emarginatis; caule prostrato, ramoso, parce stellato-piloso.

Description.—Annual? *Stem* prostrate, branched, sprinkled very loosely with rather rigid hairs, which are single or stellate. *Leaves* ($1\frac{3}{4}$ inches long, $1\frac{1}{2}$ broad,) alternate, petioled, soft, bright green above, paler below; rhomboid, glabrous, sublobate, or deeply and unequally crenate, nearly entire at the base, 5-nerved, veined, the nerves and veins prominent below, channelled above, and both above and below, but especially below, loosely sprinkled with hairs similar to those on the stem. *Petioles* (1 inch long) rather shorter than the leaves, having a shallow groove along their upper surface, ciliated. *Stipulæ* subulate, ciliate, green, spreading, connivent at the apices. *Peduncles* (3 inches long) solitary, axillary, longer than the leaves, loosely provided with hairs like those on the other parts of the plant, slightly tapering, jointed near the calyx, but not swollen at the joint. *Flowers* large, inodorous. *Calyx* persisting, 5-cleft, green, more hairy both within and without than any other part of the plant, tube somewhat fleshy, and lighter coloured than the cordato-ovate, acute, more membranous segments, the edges of which are compressed and prominent in the bud. *Corolla* three times as long as the calyx, rose coloured, veined, flat (then 2 inches across) and becoming paler when fully expanded: petals 5, obovato-cuneate, obliquely emarginate, glabrous, ciliated at the base, æstivation contorted. *Stamens* monadelphous, numerous; sheath pale rose colour, bearing at or near the top the partial filaments, which, as well as the anthers, are darker, and orange-red; anthers kidney-shaped, dotted, bursting by a suture along the back; pollen globular, smooth, yellow. *Styles* numerous, cohering at their base, equal in length to the stamens, purple, under the microscope appearing rough. *Stigmas* flat, deep purple, villous. *Germens* numerous, each containing a single ovule, green, dotted, glabrous, collected irregularly into a head, inclosed within the calyx.

This is a very pretty plant, and if it will bear cultivation as an annual in the open border, will soon become common. The seeds were received from Mr Cruckshanks in spring last, having been collected near Lima. It bears a profusion of blossoms in a hot-bed at the Botanic Garden. It must come very near to *Palaua moschata* of Cav. Dissert. i. p. 41. t. 11. fig. 5., *Palavia moschata* of later writers, but that is described as tomentous, the stem erect, the leaves cordate, the petals subrotund and yellow, passing into purple, the stipules coloured, and the figure represents a tumefaction at the joint of the peduncle, which is quite awanting in our plant; nor can I perceive that any part of the plant is at all perfumed.

Rhododendron lapponicum.

R. *lapponicum;* frutex ramosus, procumbens; ramis divaricatis; floribus umbellatis, 5–8-andris, corollis rotato-infundibuliformis; foliis oblongis, obtusis, rigidis, foveolato-punctatis, subtus discoloribus, lepidotis, marginibus reflexis.

Azalea lapponica, *Linn.* Fl. Suecic. p. 64.; Sp. Pl. 1. 214.; Fl. Lapp. Ed. Smith. p. 59. t. 6, fig. 1.—*Willd.* Sp. Pl. 1. 832.—*Pers.* 1. 212.
Rhododendron lapponicum, *Wahl.* Fl. Suec. 249.—*Spreng.* Syst. Veg. 2. 293.

Description.—An evergreen procumbent *shrub* (about 6 inches long); branches at length divaricated, round, grey, when young red, obscurely pubescent, warted. *Leaves* (8 lines long, 4 broad) petioled, divaricated, elliptical, veinless, reflexed at the edges, dark green above, pale green and at last yellowish below, thickly sprinkled on both sides with hollow dots, which are covered with an umbilicated persisting yellowish scale, obscurely channelled along the middle rib, which is somewhat prominent behind. *Flowers* terminal, umbellate (about 5 or 6 in the umbel, of which 3 expand at a time), surrounded with large, concave, imbricated, brown, dotted scales or bracteæ. *Peduncles* the length of the bracteæ, round, dotted. *Calyx* small, 5-toothed, blunt, ciliated, thickly covered with yellow scales. *Corolla* (three-fourths of an inch across) crimson, rotato-funnel-shaped, 5-cleft, segments blunt, unequal, undulate, throat hairy, nectariferous, nectariferous pore very indistinct. *Stamens* 5–8, equal to the length of the corolla, scarcely declined; filaments adhering to the base of the germen, of the same colour as the corolla, hairy near their base;

anthers brown, attached by their backs, bilocular, each cell depressed in the middle as by a longitudinal suture, but bursting by a pore at its upper extremity; pollen yellow. *Stigma* red-brown, capitate, 5-lobed, lobes depressed. *Style* round, red, glabrous, longer than the stamens, once or twice kneed. *Germen* green, thickly covered with yellow scales, similar to those on the calyx, conical, obscurely 5-lobed, ciliated round the base of the style, 5-celled; placentæ linear, extending to the parietes, covered with innumerable *ovules.*

The enterprize of Mr Cunningham has been rewarded by having first in Britain brought into flower *Andromeda hypnoides* and *Rhododendron lapponicum.* They are still under the same hand-glass in the nursery at Comely Bank, near Edinburgh. This plant, as well as the other, was brought from Canada by Mr Blair in 1825. It flowered in July.

Celestial Phenomena from October 1. 1830 *to January* 1. 1831, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Astronomical Calculator, 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.	′	″	
2.	7	33	36	○ Full Moon.	15.	12	53	27	☌ ☽ γ ♍
3.	7	40	25	☌ ☽ ν ♓	16.	19	4	21	● New Moon.
4.	9	14	2	☌ ☽ μ Ceti.	16.	19	8	–	☌ ☽ ☿
5.	3	44	33	☌ ☽ f ♉	18.	1	39	0	☌ ♀ γ ♍
5.	23	17	13	☌ ☽ γ ♉	18.	7	14	41	☌ ☽ γ ♎
6.	0	29	42	☌ ☽ 1 δ ♉	19.	18	38	28	☌ ☽ ψ ♎
6.	0	57	42	☌ ☽ 2 δ ♉	20.	10	52	40	☌ ☽ φ Oph.
6.	5	43	30	☌ ☽ α ♉	21.	8	45	–	☿ near ♀
6.	9	0	59	☌ ♀ β ♍	23.	8	46	49	☌ ☽ ♃
8.	22	6	47	☾ Last Quarter.	23.	17	30	35	☌ ☽ d ♐
10.	15	40	26	☌ ☿ i ♍	23.	21	38	51	☉ enters ♏
10.	18	53	21	Em. I. sat. ♃	24.	4	20	14	☌ ♀ ϑ ♍
11.	0	50	38	☌ ☿ α ♍	24.	19	28	4	☌ ☽ ♅
11.	11	32	37	☌ ♃ 1 ν ♐	24.	19	28	51	☽ First Quarter.
12.	7	2	12	☌ ☽ ♄	27.	18	25	41	☌ ☽ λ ♒
12.	18	6	29	☌ ☽ ρ ♌	28.	.	.	.	☿ greatest elong.
13.	0	0	–	Inf. ☌ ☉ ☿	28.	1	38	–	☌ ☿ ϑ ♍
13.	3	38	25	☌ ♀ η ♍	28.	3	58	21	☌ ☽ φ ♒
13.	18	41	38	☌ ☽ σ ♌	28.	15	6	43	☌ ☽ ♂
14.	9	57	56	☌ ☽ β ♍	30.	18	33	2	☌ ☽ ν ♓
15.	1	22	4	☌ ☽ η ♍	31.	20	10	6	☌ ☽ μ Ceti.
15.	5	6	40	☌ ☽ ♀	31.	16	50	7	○ Full Moon.

NOVEMBER.

D.	H.	′	″	
1.	14	17	9	☌ ☽ f ♉
2.	9	16	27	☌ ☽ γ ♉
2.	10	26	40	☌ ☽ 1 δ ♉
2.	10	53	47	☌ ☽ 2 δ ♉
2.	15	30	15	☌ ☽ α ♉
7.	10	23	50	☾ Last Quarter.
7.	19	46	9	☌ ♀ λ ♍
8.	16	47	12	☌ ☽ ♄
8.	23	47	46	☌ ☽ ρ ♌
9.	12	5	9	☌ ☿ ϰ ♍
10.	0	20	55	☌ ☽ σ ♌
10.	12	13	21	☌ ☿ λ ♍
10.	15	39	29	☌ ☽ β ♍
11.	7	7	55	☌ ☽ η ♍
11.	18	43	28	☌ ☽ γ ♍
12.	12	0	–	☌ ⚳ ⚴
14.	7	55	39	☌ ♀ 2 α ♎
14.	12	43	–	☌ ☽ ☿
14.	17	16	56	☌ ☽ ♀
15.	13	27	16	● New Moon.
15.	17	55	32	Im. IV. sat. ♃
15.	18	36	12	☌ ☿ 2 α ♎
16.	16	49	36	☌ ☽ φ Oph.
18.	17	27	41	Em. I. sat. ♃
19.	23	22	59	☌ ☽ d ♐
19.	23	32	10	☌ ☽ ♃
21.	15	36	15	☌ ☽ ♅
22.	1	33	30	☌ ☿ ♀
22.	18	10	38	☉ enters ♐
23.	11	18	19	☽ First Quarter.
23.	17	6	45	Em. II. sat. ♃
23.	20	42	49	☌ ☿ ϰ ♎
24.	2	35	6	☌ ☽ λ ♒
24.	11	28	10	☌ ♀ ϰ ♎
24.	12	26	19	☌ ☽ φ ♒
24.	17	28	3	Im. III. sat. ♃
25.	12	26	37	☌ ☽ ♂
25.	15	6	19	☌ ☿ λ ♎
26.	15	21	18	☌ ♀ λ ♎
26.	22	56	26	☌ ☿ 1 β ♏
26.	22	58	21	☌ ☿ 2 β ♏
27.	5	13	33	☌ ☽ ν ♓
28.	7	22	54	☌ ☽ μ Ceti.
28.	11	24	53	☌ ♀ 1 β ♏
28.	11	44	5	☌ ♀ 2 β ♏
29.	1	40	45	☌ ☽ f ♉
29.	20	39	4	☌ ☽ γ ♉
29.	21	48	49	☌ ☽ 1 δ ♉
29.	22	15	45	☌ ☽ 2 δ ♉
30.	2	44	22	○ Full Moon.
30.	2	49	50	☌ ☽ α ♉

DECEMBER.

D.	H.	′	″	
1.	21	27	57	Im. III. sat. ♃
4.	3	30	–	Sup. ☌ ☉ ☿
5.	19	5	5	☌ ☽ α ♌
6.	2	33	16	☌ ☽ ♄
6.	6	49	38	☌ ☽ ρ ♌
7.	2	56	57	☾ Last Quarter.
7.	6	45	0	☌ ☽ σ ♌
7.	22	2	25	☌ ☽ β ♍
8.	13	23	52	☌ ☽ η ♍
8.	16	40	43	☌ ☿ ϑ Oph.
9.	0	56	34	☌ ☽ γ ♍
9.	1	27	57	Im. III. sat. ♃
9.	12	45	46	☌ ☿ B Oph.
12.	19	40	22	☌ ☽ γ ♎
13.	7	1	42	☌ ☽ ψ ♎
13.	23	9	26	☌ ☽ φ Oph.
14.	1	36	18	☌ ♀ B Oph.
15.	4	1	41	☌ ☽ ♀
15.	8	1	33	● New Moon.
15.	22	6	22	☌ ☽ ☿
16.	5	28	22	Im. III. sat. ♃
17.	5	0	39	☌ ☽ d ♐
17.	16	23	36	☌ ☽ ♃
18.	. .	. .	.	☌ ♀ ⚴
18.	8	39	12	☌ ☿ λ ♐
18.	23	6	34	☌ ☽ ♅
21.	. .	. .	.	☌ ♀ ⚳
21.	3	45	–	Sup. ☌ ☉ ♀
21.	8	19	14	☌ ☽ λ ♒
21.	18	26	6	☌ ☽ φ ♒
22.	5	25	23	☌ ☿ σ ♐
22.	6	51	0	☉ enters ♑
22.	22	28	35	☽ First Quarter.
23.	9	28	31	Im. III. sat. ♃
23.	17	21	48	☌ ☽ ♂
24.	13	25	12	☌ ☽ ν ♓
25.	3	51	56	☌ ☿ ψ ♐
25.	6	17	15	☌ ♀ λ ♐
25.	16	37	17	☌ ☽ μ Ceti.
26.	11	34	10	☌ ☽ f ♉
27.	7	5	37	☌ ☽ γ ♉
27.	8	17	6	☌ ☽ 1 δ ♉
27.	8	45	7	☌ ☽ 2 δ ♉
27.	13	25	11	☌ ☽ α ♉
29.	9	3	4	☌ ☽ ♊
29.	13	51	55	○ Full Moon.
29.	19	13	4	☌ ♂ ε ♓

Times of the Planets passing the Meridian, and their Declinations.

OCTOBER.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	13 0	14 10 S.	10 37	6 36 N.	23 1	6 51 S.	17 59	23 25 S.	9 23	13 32 N.	19 56	19 16 S.
5	12 40	13 26	10 40	4 43	22 41	6 52	17 45	23 24	9 9	13 22	19 40	19 17
10	12 4	10 50	10 46	2 18 N.	22 19	6 49	17 27	23 22	8 51	13 14	19 20	19 17
15	11 33	7 53	10 47	0 10 S.	21 57	6 36	17 10	23 20	8 34	13 5	19 1	19 17
20	11 0	4 42	10 50	2 38	21 36	6 18	16 53	23 17	8 15	12 56	18 41	19 17
25	10 42	3 42	10 53	5 6	21 17	5 52	16 36	23 14	7 55	12 48	18 21	19 16

NOVEMBER.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	10 38	5 36 S.	10 58	8 28 S.	20 52	5 4 S.	16 14	23 8 S.	7 32	12 38 N.	17 54	19 15 S.
5	10 43	7 44	11 2	10 20	20 38	4 32	15 57	23 5	7 17	12 32	17 38	19 14
10	10 51	10 45	11 6	12 34	20 22	3 50	15 44	22 59	6 58	12 27	17 19	19 12
15	11 1	13 49	11 10	14 42	20 8	2 59	15 30	22 54	6 40	12 22	17 0	19 10
20	11 12	16 41	11 15	16 39	19 53	2 6	15 13	22 47	6 21	12 18	16 41	19 8
25	11 24	19 17	11 21	18 25	19 40	1 10	14 58	22 40	6 2	12 15	16 21	19 6

DECEMBER.

D.	Mercury. H. ′	Mercury. ° ′	Venus. H. ′	Venus. ° ′	Mars. H. ′	Mars. ° ′	Jupiter. H. ′	Jupiter. ° ′	Saturn. H. ′	Saturn. ° ′	Georgian. H. ′	Georgian. ° ′
1	11 40	21 52 S.	11 28	20 17 S.	19 25	0 2 N.	14 39	22 31 S.	5 39	12 12 N.	15 59	19 2 S.
5	11 51	23 15	11 33	21 19	19 15	0 51	14 27	22 24	5 24	12 11	15 44	18 59
10	12 8	24 43	11 40	22 24	19 4	1 55	14 12	22 15	5 4	12 11	15 25	18 57
15	12 23	25 19	11 48	23 12	18 52	3 0	13 57	22 6	4 45	12 12	15 6	18 54
20	12 38	25 22	11 56	23 42	18 41	4 6	13 42	21 55	4 25	12 14	14 46	18 49
25	12 54	24 45	12 5	23 54	18 31	5 14	13 27	21 44	4 1	12 17	14 28	18 45

On the 15th of October there will be an Occultation of *Venus* by the Moon:

		D.	H. ′ ″	
Immersion,	Oct.	15.	16 31 17	at 61°
Emersion,			17 28 25	at 250

The Moon will be scarcely risen at the time of immersion.

On the 30th of November, there will be an Occultation of *Aldebaran* by the Moon:

	D.	H. ′ ″	
Immersion,	30.	15 9 23	at 161°
Emersion,		16 0 2	at 276

The *angle* denotes the point of the Moon's limb where the phenomenon will take place, reckoning from the *vertex* of the limb towards the right hand round the circumference, as seen with a telescope which inverts.

SCIENTIFIC INTELLIGENCE.

METEOROLOGY.

1. *Thunder-Storm at Inchkeith.*—Mr John Bonnyman, light-keeper at Inchkeith, in his report to Mr Stevenson, engineer, writes as follows:—" On the afternoon of 30th July 1830, we had a storm of thunder and lightning, accompanied with thick fog and rain, from 4 P. M. till past 11. Although it has done no harm, I was a good deal alarmed, as there was rain-water in the large circular tray in the inside of the roof of the light-room, and the lightning frequently *hissed in it like as if there had been hot iron put among water.* The flashes were quick in succession; sometimes only one minute, and rarely more than three minutes, betwixt them."

2. *On Sounds on the Peak of Teneriffe.*—" There is another observation," says Mr Allison, in his Narrative of an Expedition to the Summit of the Peak of Teneriffe, on the 23d and 24th of February 1829, " which I made, that may be worth mentioning. Soon after the sun went down, the wind became much louder, and had an acuter sound, although the force was very considerably less than in the day. It has been observed from the earliest antiquity, that the air becomes more sonorous at night than in the day; but I am not aware that

the cause of it is well ascertained. The general opinion, I believe, is, that the air becoming colder, is therefore denser and more susceptible of conveying the sonorous waves. This, to a certain extent, may be correct, as it has been well ascertained by Dr Priestley, that the force of the pulsations of sound depends considerably upon the degree of density or rarefaction of the air; and I think Captain, now Sir Edward Parry, mentions the surprising distance he was enabled to hear sound during the winter at the North Pole. From frequent observations which I have made in Teneriffe, I am inclined to attribute the intensity of sound at night to a certain increase of moisture, and to an equability of temperature in the different strata of the atmosphere; because, instead of becoming colder, it was four or five degrees warmer when the sound of the wind became more sonorous. Humboldt has made a similar remark; and, as many observations fully coincide with his opinion, I beg to quote it. He ascribes the diminution of sound during the day to the presence of the sun, which influences the propagation and intensity of sound, by opposing to them currents of air of different density, and partial undulations of the atmosphere, produced by unequal heating of different parts of the ground. In these cases a wave of sound, when it meets two portions of air of different density, is divided into two or more waves, a part of the primitive wave being propagated with more rapidity through the denser portions, than the parts that pass through air of less density. In this way the wave is broken down into different parts, which arrive at the ear at different times. These different portions of the wave passing again through succeeding portions of the atmosphere of different density, may be so wasted and frittered down, as to be incapable of affecting the tympanum. My observation respecting the intensity of sound is not confined to the Peak. At the town of Orotava, situated about two miles from the sea, the noise of the waves in the morning occasionally had a grave low sound: at the same time the air appeared to be particularly dry, and distant objects were very indistinct. Towards the middle of the day, or the beginning of the afternoon, the island of Palma, nearly sixty miles distant, could be seen distinctly; and the ridge of mountains that surround the valley of Orotava were apparently brought so close, that the vegetation upon them could be observed: at the same time the sound of the sea invariably passed from a grave to an acute sound. The natives prognosticate rain when this particular clearness of the atmosphere takes place, and I have generally found them correct."—*Annals of Philosophy.*

3. *Magnetizing Power of the Solar Rays.*—MM. Ries and Moser, after alluding to the doubts which many philosophers entertained as to the accuracy of M. Morichini's experiments, as to the magnetizing power of the solar rays, observe that the favourable results which Mrs Sommerville obtained, had dissipated the doubts of many persons, and consequently that the supposed discovery had given rise to various theories on the magnetism of the earth and its variations. The authors then detail the results of their own experiments, which seem to have been made with great care, and under varied circumstances: the conclusion at which they arrive, and which seems certainly warranted by their experiments, is, that they have a just title to reject totally a discovery, which, as they say, has disturbed science at various times during seventeen years. The slight variations which they observed in some of their experiments, and which they have not concealed, cannot, they conceive, arise from a real action of the nature of that described by MM. Morichini and Baumgartner, as being so evident and decided; added to which, these variations are not always favourable to the supposed discovery.

4. *Radiation from Trees.*—As a proof of the cold produced in solid substances by radiation, in a clear atmosphere, Dr Guerin has ascertained, as had been previously done by Wells, that the temperature of trees and shrubs is much inferior to that of the air. On the 24th January 1827, at 7 A. M., the air being —11°.3 cent., the snow adhering to the branches of a cypress and other plants and shrubs, was — 14°.5 and 15°, that is to say, 3°.5 lower than the air.

GEOLOGY.

5. *Eruptions of Water.*—During volcanic action, torrents of water sometimes flow from the craters, and sometimes from

fissures on the sides of the mountains. During the last eruption of Mont Idienne, a volcano in the east of the Island of Java, it vomited forth so great a body of water, that it inundated the country, extending from the mountain to the sea, for an extent of twenty leagues, and gave rise to two large rivers. The water was hot, and charged with sulphuric acid, and destroyed the whole vegetation of the country over which it passed. The river Pusanibio, also named Rio Vinagre, in Columbia, rushes from the foot of Puraci, an extinct volcano 2650 yards above the level of the sea. Its waters are charged with oxide of iron, sulphuric acid, and muriatic acid. Near to Beaune Cote d'Or, in France, there is a spring named Genet, which, during different periods of the year, throws out torrents of water, that inundate the country for several days. In the departments of Doubs and Haut Soane there are many springs of the same description. The most remarkable is that named Frais-Puits, at some distance from Vesoul. This fountain vomits forth, in intervals of two, three, four, and five years, sometimes after rains, sometimes without rains, water, in so great a quantity, as to inundate the whole valley, the Prairie of Vesoul, and even the lower part of the city. This aqueous eruption sometimes continues for three days, after which the torrent ceases to flow. The opening resembles a true crater, and the water, in rushing from it, is accompanied with a loud noise. Similar phenomena are presented by the Fontaine-Ronde, near to Pontarlier, the pits of Breme, to the north of the town of Dormans, and the spring situated near the bridge of Cleron.

6. *Eruptions of Gas.*—M. Fournet observed, in the neighbourhood of Pontgibaud, in Auvergne, a great eruption of free carbonic acid, which issues through fissures in the ancient rocks. The bursting forth of the gas is attended with a pretty loud noise. The temperature of the gas is so high, as to affect materially that of the cavities and galleries of the mines in which it collects: this temperature assimilates the phenomenon to that of hot springs, and proves that the gas comes from a great depth. This gas, he further notices, has acted on the veins in a singular manner, by dissolving the minerals that yield to its influence, and leaving untouched the quartz, heavy spar, serpentine, talc, galena, &c.; even these also are sometimes in a corroded and

disintegrated condition. It acts principally on the carbonates of iron and manganese: it converts them into bicarbonates, and thus renders them soluble in water.

7. *Fossil Trees in an erect position.*—In geological writings mention is frequently made of fossil trees being found in strata, in their natural erect position, and therefore still on the spot where they grew. We have always objected to this opinion, and maintained that those fossil trees only, in which the roots are spread through a soil different from that surrounding the trunk and branches, are to be considered as in their natural and unaltered position. In the sandstone quarries around Edinburgh, fossil trees are found in all positions, from the upright to the horizontal, and enveloped in the same general mass. These, therefore, are trees which have been moved from their original situation and position.

8. *Crustacites and Cidarites in Mountain-Limestone.*—Count Munster enumerates in Leonhard's Jahrbuch, Erst. Jahrg. 1. Heft. p. 60. et seq., fourteen species of the genus *Cytherina,* he found in the *tertiary sand-marl* of Astrupp near Osnabruck. They were collected from the interior of the Terebratula grandis of Blumenbach, the Terebratula gigantea of Schlotheim. Some of these species occur also in the *ferruginous sand* of the Welhelmshöhe at Cassel, in the *calcaire grossiere* at Paris, Bordeaux, Dax, Turin, and particularly at Castell'arquato. Besides these he also found eight species, but different from those already mentioned, in the *transition limestone* at Regnitzlosau near Hoff. These eight species, says Count Munster, "occur in the upper beds of the transition limestone, called *Mountain-Limestone.* The bed in which they occur is interesting in a geognostical point of view. There follows immediately to the transition limestone, abounding in species of *orthoceratite, nautilite, planulite,* &c., the newer transition limestone, or the so named Mountain-limestone, distinguished by the great number and the many species of *productus,* fossils which are characteristic for the mountain-limestone and magnesian limestone (zechstein), but which here never occur in the true transition limestone." In the midst of this mountain-limestone there occurs a marly bed, having an oolitic character, which oolite structure is occasioned by numberless remains of organic bodies, of which

but few could be determined; among these are the already mentioned species of Cytherina, in which both valves are generally united. Besides these, there also occurs in this bed, 1. Small corals, among which we could distinguish the *Ceriopora prisca*; 2. Remains of *cidarites* and *serpulites*; 3. Numberless fragments of *encrinites*; 4. Some new species of *Bellerophon*; 5. Among the bivalves numerous small *producti* and *terebratulæ*, further *cardia*, &c.; 6. Many species of small univalves, and among these, *Nerita, Trochus, Turritella, Melania? Cerithium?* &c. The uppermost bed of this mountain-limestone affords here, as at the Eifel, the most characteristic petrifactions of the zechstein of Gera, which at that place rests in part on this transition limestone, and in part on the dolomite belonging to the zechstein of Liebenstein and Glücksbrunn in the Thüringerwald.

9. *Connexion of Diseases with the Rock Formations of a Country.*—Amongst a great many of the communes of Calvados, in France, near to each other, and exposed to the same climatic influences, there is one which is particularly liable to fever. Nearly the whole of these communes are situated upon *lias* and *red marl*, and some other clayey formations, which retain at the surface a humidity favourable for the formation of fogs. On the contrary, the communes situated on rocks having a loose texture, and which permit the rain water to escape more easily, such as the *great oolite, chalk*, &c. or which do not present any beds capable of arresting the course of the water, as granite, and certain slates, appear less liable to fevers. It results from these general considerations, that the soil, by its greater or less hygroscopic quality, may have an effect on the state of health, by favouring more or less the development of certain diseases. M. de Caumont does not regard this observation as new, but communicates it with the view of ascertaining in what proportions (every thing being equal), the fevers and other maladies are developed in the principal geological regions of Calvados; for example in that of granite, slate, limestone, clay, &c.—*Journal de Geologie*, May 1830.

10. *Coprolite found in the Tyrol.*—"I have found in the black bituminous limestone, below the jura limestone of Seefeld, in the Alps of the Tyrol, *coprolites* resembling those figured at

Fig. 17. of Plate xxv. of the Memoir of Buckland, in the Geological Transactions. They occur in the same bed with fishes and marine plants."—*Boué in Journal de Geologie.*

11. *Fossil Fox.*—Last summer Mr Murchison purchased at Æningen, near Schaffhausen, the fossil skeleton of a quadruped said to be a common fox. The specimen was exhibited at the Geological Society in London, as a common fox? We are not, however, aware of any osteological characters by which we can distinguish the fox from the dog, nor the different species of fox from each other.

12. *Fossil Floras.*—Brongniart imagines that his different fossil floras are entirely different from each other. He supposes that a general marine inundation has always separated these floras from each other; consequently he is obliged to maintain that there are no vegetables or only marine plants in the deposites of rocks that separate his four periods. This opinion is advocated by some geologists, but rejected by others. Boué says, in the Journal de Geologie, t. i. p. 179. Note, " M. Voltz and I reply, that, in proceeding from what is known, it is in the nature of things that the arenaceous deposites or continental alluvium should contain only land plants, and that the opposite should be the case with the calcareous deposites, with exception of the modern fresh water deposites, since they are strictly marine deposites, and partly mechanical, partly chemical. Hence the absence of deposites of vegetables in the limestone, &c. does not by any means prove that the vegetation of the globe was destroyed during the period when these formations took place. On the contrary, this vegetation ought to exist in a more flourishing condition during a period when no revolution occurred to destroy it; which period of repose is indicated by the want of arenaceous deposites. If cataclysms had taken place, we would have found traces of them in these strata. The more or less considerable differences observed between the vegetation of the different deposites of land plants, may depend on the intermediate ones being awanting, or more probably to the moments of repose in the transport of the alluvium. The climates changed during the periods of the formations, although arenaceous or sandstone deposites did not take place, and this change is well indicated by a comparison of the fossil animal remains

of two neighbouring epochs, comparisons that shew the striking relations between the changes in the flora and the fauna of different periods. Hence we conclude that there has been a gradual succession of creatures, according as the circumstances proper for vegetable and animal life was modified on the surface of the earth; and, admitting local debacles, we do not see any proof of one or more cataclysms which could at once have destroyed the vegetation of the whole earth."

13. *Boué on the relative Age of the Secondary Deposites in the Alps and Carpathians.*—Boué, in the first and second numbers of the Journal de Geologie, has published a very interesting account of the secondary formations of the Alps and Carpathians, in which we observe he differs from Messrs Murchison and Sedgwick, as to the nature and geognostical situation of a particular deposite, viz. that of Gossau. Boué, in our opinion, demonstrates that the Gossau deposite *lies below chalk*, while Murchison and Sedgwick affirm, on less extensive and less accurate observation, and on rather loose reasoning, that it *rests upon chalk.*

14. *Journal de Geologie, par MM. A. Boué, Jobert, et Rozet.*—Of this very promising periodical, under the able guidance of our former pupil Boué, and Messrs Jobert and Rozet, both distinguished geologists, two numbers have appeared. Its merit, independent of any recommendation from us, will secure for it the approbation and support of geologists.

15. *Flint in Scotland.*—True flint, as is well known, is a rare mineral in the strata of this part of the island, because Chalk, the formation in which it most abounds, although widely distributed throughout England, has not hitherto been met with in Scotland. In the neighbourhood of Peterhead, however, loose flints of the chalk formation occur scattered over an extensive primitive tract, in some places considerably above the level of the sea. It is possible that, in some of the basin-shaped hollows in that part of Scotland, there may occur, under the alluvium, new rocks probably of the chalk formation. My friend Mr Christie of Banff, an active member of the Banff Institution, says, in a letter lately received from him,—" I see abundance of flints along the shore, but whether they are the flints of the chalk formation or not I cannot say, as I can find no impressions of organic remains in them. Perhaps they may have

come from a place below Elgin, called Stotfield, where a similar flint is found *in situ*, and the coast there is strewed with rolled blocks of a similar kind. The flints at Peterhead may have come from the same place."

16. *Blackpots Clay, near Banff.*—At Blackpots, a short distance from Banff, and on the sea-shore, there is a considerable bed of clay containing organic remains, resembling the organic groups that characterize geologically the Lias. Mr Christie, in a late communication to me on this subject, says,—" I mentioned to you, that I considered the bed to be of considerable extent; that I had traced it along the coast from the serpentine rock at Portsoy, eastward to Troup, a distance of upwards of 20 miles; and I considered it the same bed as is wrought into brick, tile, &c. at a place called Cairnhill, close by the church of the parish of Marnoch, at least 15 miles south from Blackpots. I have not found organic remains at any other point than at Blackpots; but as the clay is wrought at Cairnhill, I have little doubt but I will find them there when I have an opportunity of examining the spot."

MINERALOGY.

17. *Prunnerite.*—The violet-blue mineral found along with apophyllite, in the island of Hestoe, one of the Faroës, and hitherto arranged as a variety of cuboidal calcareous spar, has been, by Esmark, on account of its form and large proportion of silica, put forth as a new species, which he names Prunnerite, in honour of Prunner, the naturalist of Cagliari, in Sardinia.

18. *Pinguite.*—This is a mineral resembling bole, found in the mine of Neu Beschert Glück, in the Saxon Erzgebirge. It is not unlike green iron-earth. Its specific gravity = 2.315. Massive. Hardness = 1. Occurs in veins of heavy spar.

ZOOLOGY.

19. *Motions in Water caused by the process of Respiration in Animals* *.—As the function of respiration in the Unio picto-

* The motions in water caused by sea animals of various descriptions were noticed at an early period by observers, but it is only of late years that they have engaged the particular attention of zoologists. Carus, in his prize essay, published a good many years ago, illustrates these motions by figures; and the same has been done by Dr Unger.

rum is effected, on the one hand, by the branchiæ or gills, and, on the other, by the air contained in the water, the necessity of a constant contact of both is evident, and is shewn in a way which is deserving of particular notice. If we place a living mussel in a flat vessel filled with water, we will observe, after every thing is at rest, that the mantle-slit provided with tentacula, and the anus, will project; and suck in water by the first, and by the latter, after it plays round the floating gills, again throw it out. If we strew the surface of the water with light bodies, as dust, semen lycopodii, &c. we will observe this sucking in and throwing out of the water, by the continual circular motion of these floating particles. These circles vary much, according to the size and the elasticity of the vessels wherein the bodies are driven round by the currents of water, and suffer numerous bendings and alternations, all of which, however, can be referred back to the original current, as well represented in figure first in the plate accompanying Unger's memoir. It consists of a double whirl, in opposite directions, of which the diameter of each single whirl is several times that of the length of the animal, hence shews the force with which the water is thrown out or projected; even how changes of place, as the turning round of the animal, may be effected by the sudden and violent emptying of the inspired water on the application of a stimulus. The cause of this phenomenon is to be traced to the very particular formation of the parts by which the process is performed, viz. that the flowing water reaches its place of destination by one organ (the cleft in the mantle, the anterior tube of the mantle), and is thrown out by another organ (posterior mantle-tube or anus), which does not occur in those mollusca a little higher in the scale, viz. univalve shells, as in them there is but one passage for respiration. Secondly, to the alternate pressure of the upper and inner free edge of both gills on the foot, by which we can explain the continued stream of water from the anus. This explanation agrees with that given by Carus several years ago, in which he compares the operation here noticed to the mechanism of a double bellows. A very easy and simple experiment will convince any one, not only of the uniformity, but also of the velocity with which the water is projected by the above mentioned parts. If we drop a minute portion of solution of china-ink on the surface of the water in a vessel in which we have placed a mussel, and directly over the upper half of the mantle-slit, we will observe, as the particles sink towards the bottom, and pass across the mantle-slit, they will be visibly drawn by it into the interior of the animal, and, before a minute has elapsed, will stream out again, more violently, from the anus. If we now examine the animal, the course taken by the china-ink will be distinctly seen, by means of the colouring of the parts.—This subject has been taken up, in this country, by an ingenious observer, Dr Sharpey. His observations are well stated by himself in the Edinburgh Medical Journal.—For further details, vide *Unger über die Teichmuschel.* Wien, 1827.

20. *Migration of the Common Cockle* (Cardium edule) *and Donax anatinum.*—On the beach of Colleville, in Normandy, the fishers remarked, that, in 1823 and 1824, these shell-fish were so very abundant, that it was only necessary to stir the sand with the foot, to occasion them to rise all around: but, in March 1825, few or none were to be seen nearer this part of the beach than a distance of three miles.

21. *Nerita glaucina.*—M. Eudes-Delongchamps observed, the mantle of the animal of this species covering, and even hiding the shell, as in the Cypræa tribe.

22. *Proof that the Stomach is still the best Distinctive Character of Animals from Vegetables.*—It is generally believed that the greater number of infusory animals are very simple in their structure. Dr Ehrenberg of Berlin, after many years' investigation, has convinced himself that all those kinds which are sufficiently large to admit of examination, viz. not smaller than the $\frac{1}{300}$th part of a line, have a considerable range of structure. He used very simple means to secure the accuracy of his observations, and found that all the species of *Trichoda, Vorticella, Kerona, Paramæcium, Kolpoda, Trachelius, Vibrio, Enchelys, Cyclidium,* and *Monas,* in so far as they do not belong to a higher organization, possess at least a mouth and internal stomach. These animals, in place of being *Agastrica,* so named by Latreille, are, on the contrary, *Polygastrica,* because many of them possess more than fifty ventral sacs, all of which they can fill and empty at pleasure. These sacs are held by Müller and others to be infusoria swallowed by the animal. If we touch

the drop of water in which they swim, with colouring matter of indigo, of lac, of carmine, or sap-green, they fill their single stomachs with it in the space of one or two minutes. This is very easily and distinctly seen in some of the most frequent of these creatures, as *Kolpoda cucullus*, *Cyclidium glaucoma*. Dr Ehrenberg has also observed in some of the lowest of the infusoria, the formation of a reticular ovarium surrounding the ventral sacs. He could not discover any circulation or vessels in the *Paramæcium aurelia*, as asserted by Gruithuisen. But it is certain that the *Bacillariæ*, particularly the *Closterium lunula* of Nitzsch, and *acerosum* (*Vibrio lunula*, Müller, and *Vibrio acerosus*, Schrank), are provided with feet in the form of papillæ, at both ends of the body, by means of which their progressive motion is performed. It may also be noticed, that the part in the body of the *Brachiones* named heart, first by Corti, and afterwards by Bory St Vincent, is not so, but is, according to Nitzsch and others, a maxillary apparatus. Dr Ehrenberg is the first who has observed in all Brachiones in the *Megalotrocha*, Bory, and in a whole family of ciliated, not rotating *Furcularia*, 1 to 12 eyes. Lastly, Dr Ehrenberg is of opinion, that the compound infusoria supposed to have the same structure as ascidia, have truly a mouth at their anterior, and an anus at their posterior extremity.—*Isis*, Heft 3. 1830.

23. *On the Power of Horses. By B. Bevan, Esq.*—To determine the average power of horses under different kinds of labour, has been a subject deemed worthy of the inquiries of scientific writers. It is one of those points which can be determined only by experiment. The power to be maintained depends upon the velocity, and various formulæ are given by writers. The best of these is that given by Professor Leslie. In the period from 1803 to 1809, I had the opportunity of ascertaining correctly the mean force exerted by good horses in drawing the plough, having had the superintendance of the experiments on that head at the various ploughing matches, both at Woburn and Ashridge, under the patronage of the Duke of Bedford and the Earl of Bridgewater. I find among my memoranda the result of eight ploughing-matches, at which there were seldom fewer than seven teams as competitors for the various prizes. The first result is from the mean force of each horse in six teams, of

two horses each team, upon light sandy soil, = 156 lb.; the second result is from seven teams, of two horses each team, upon loamy ground near Great Berkhamstead, = 154 lb.; the third result is from six teams, of four horses each team, with old Hertfordshire ploughs, = 127 lb.; the fourth result is from seven teams, of four horses each team, upon strong stony land (improved ploughs), = 167 lb.; the fifth result is from seven teams, of four horses each team, upon strong stony land (old Hertfordshire ploughs), = 193 lb.; the sixth result is from seven teams, of two horses each team, upon light loam, = 177 lb.; the seventh result is from five teams, of two horses each, upon light sandy land, = 170 lb.; the eighth result is from seven teams, of two horses each, upon sandy land, = 160 lb. The mean force exerted by each horse from fifty-two teams, or 144 horses, = 163 pounds each horse; and, although the speed was not particularly entered, it could not be less than at the rate of 2½ miles per hour. As these experiments were fairly made, and by horses of the common breed used by farmers, and upon ploughs from various counties, these numbers may be considered as a pretty accurate measure of the force actually exerted by horses at plough, and which they are able to do without injury for many weeks;—but it should be remembered, that if these horses had been put out of their *usual* walking pace, the result would have been very different. The mean power of the draught horse, deduced from the above mentioned experiments, exceeds the calculated power from the highest formula of Mr Leslie.—*Annals of Philosophy*, vol. viii. p. 22.

24. *Fertility of the Unio Pictorum.*—Dr Unger, in his interesting anatomico-physiological account of this animal, published at Vienna in 1827, already mentioned, reckoned in a full grown animal 300,000 embryos and young individuals. This extraordinary abundance, which does not occur in animals lower in the scale, as in the medusæ, appears even considerable when contrasted with the fecundity of insects. This vast number is probably the production of only a single year, which will give for the whole life of the animal a produce of many millions of individuals.

25. *Traditional Story regarding the last of the Wolves in Morayshire.*—The last wolves existing in this district had their

den in a deep sandy ravine, under the Knock of Braemory, near the source of the Burn of Newton. Two brothers, residing at the little place of Falkirk, boldly undertook to watch the old ones out, and to kill their young; and as every one had suffered more or less from their depredations, the excitement to learn the result of so perilous an enterprize was universal. Having seen the parent animals quit their den in search of prey, the one brother stationed himself as a sentinel, to give the alarm, in case the wolves should return, while the other threw off his plaid, and, armed with his dirk, alone crawled in to dispatch the cubs. He had not been long in the den, when the wolves were seen by the watchman hastening back to the ravine. A sudden panic seized the wretched man, and he fled without giving the promised warning, and never stopped till he crossed the Divie, two miles off. There, conscience-stricken for his cowardice, he wounded himself in various places with his dirk; and, on reaching Falkirk, he told the people, who eagerly collected to hear the result of the adventure, that the wolves had surprised them in the den, that his brother was killed, and that he had miraculously escaped, wounded as he was. A shout of vengeance rent the air, and each man, catching up whatever weapon he could lay hands on, the whole gathering set out, determined, at all hazards, to recover the mutilated remains of their lost friend. But, what was their astonishment, when, on reaching the Hill of Bogney, they beheld the mangled and bloody form of him whom they supposed dead, dragging itself towards them. For a moment they were awed by a superstitious fear; but they soon learned the history of his escape. He had found little difficulty in killing the cubs, and he was in the act of making his way out, when the mouth of the hole was darkened, and the she-wolf was upon him. With one lucky thrust of his dirk, he dispatched her at once; but his contest with her grim companion was long and severe; and although he fought in that narrow place, and from behind the body of the brute he had killed, he was nearly torn to pieces before he succeeded in depriving his ferocious enemy of life. The indignation of the people against the dastard brother, on thus beholding his falsehood and cowardice made manifest, knew no bounds. They dragged him before the laird, who, on hearing the case, adjudged him to be forthwith hanged on the summit of a conical hill,—a sentence that was immediately put into execution. The hill is called Thomas Rhymer's Hill, for what reason I could never make out.—*Sir T. D. Lauder, Floods of Moray*, p. 67.

26. *The Lacerta agilis ovo-viviparous in Scotland.*—Desmarest, Daudin, and the French naturalists, are quite agreed as to this lizard, which is widely dispersed over Europe, being oviparous; and that the ova are deposited at the bottom of walls, &c. exposed to the sun. In Scotland, the animal is ovo-viviparous, as I have repeatedly ascertained, from specimens which have been in my possession in 1827, 1828, and 1829. One of these, caught on 19th June 1829, brought forth, in July, nine young, which, however, for want of proper food, all died within a fortnight. Mr Rennie, in the Library of Entertaining Knowledge, vol. vi. p. 108, makes the same remark upon a female specimen, which he caught near Sorn in Ayrshire. May not the difference of climate account for this? And may not the *Lacerta agilis*, in countries where the heat is sufficient to hatch the extruded eggs, be oviparous, and in colder temperatures, ovo-viviparous?—*James Stark.*

27. *Phosphorescence of the Sea in the Gulf of St Lawrence.*—Captain Bonnycastle, R. E., whilst coming up the Gulf on the 7th of September 1826, observed this phenomenon under the following circumstances:—At two o'clock A. M., the mate, whose watch it was on deck, suddenly aroused the captain in great alarm, from an unusual appearance on the lee-bow. The night was star light, but suddenly the sky became overcast in the direction of the high land of Cornwallis county, and a rapid, instantaneous, and very brilliant light, resembling the Aurora Borealis, shot out of the hitherto gloomy and dark sea on the lee-bow, and was so vivid that it lighted every thing distinctly even to the mast-head. The mate, having alarmed the master, put the helm down, took in sail, and called all hands up. The light now spread over the whole sea between the two shores; and the waves, which before had been tranquil, began now to be agitated. Captain Bonnycastle describes the scene, as that of a blazing sheet of awful and most brilliant light. A long and vivid line of light, superior in brightness to the parts of the sea not imme-

diately near the vessel, shewed the base of the high, frowning, and dark land abreast; the sky became lowering and intensely dark. The oldest sailors had never seen any thing of the kind to compare with it, except the captain, who said that he had observed something of the kind in the Trades. Long tortuous lines of light, in a contrary direction to the sea, shewed us immense numbers of very large fish darting about as if in consternation at the scene. The sprit-sail yard and mizen-boom were lighted by the reflection, as though gas lights had been burning immediately under them; and until just before day-break, at four o'clock, the most minute objects in a watch were distinctly visible. Day broke very slowly, and the sun rose of a fiery and threatening aspect. Rain followed. Captain Bonnycastle caused a bucket of this fiery water to be drawn up; it was one mass of light when stirred by the hand, and not in sparkles, as usual, but in actual corruscations. A portion of this water kept in an open jug preserved its luminosity for seven nights. On the third night the scintillations in the sea re-appeared, and were rendered beautifully visible by throwing a line overboard and towing it along astern of the vessel. On this evening the sun went down very singularly, exhibiting in its descent a double sun; and when only a few degrees above the horizon, its spherical figure changed into that of a long cylinder, which reached the horizon. In the night the sea became nearly as luminous as before. On the fifth night, the luminous appearance nearly ceased. Captain Bonnycastle is of opinion that this phenomenon is caused, not by living marine animals, but from phosphoric matter evolved from exuviæ and secreted matter of fishes, &c.—*Trans. Lit. and Hist. Society of Quebec*, vol. i.

ANTHROPOLOGY.

28. *The Norwegians.*—We must not judge of the Norwegians by the English standard. Most were ruined, and all impoverished, by the late war; and the bankruptcy of the Danish government added to their misfortunes. We cannot then expect to find among them the comforts of England; but they make amends for the want of them by the heartfelt kindness with which they receive us. The women, too, will bear no comparison with the dainty dames of more fortunate countries.

Their lot is a hard one; and, like the sex every where, better fitted for adversity than prosperity, they bear it with cheerfulness. They take a larger share in domestic toils than they ought to be allowed to do; yet they possess some advantages. They are neither literary nor sentimental; and, if they have no voluptuousness to learn in galleries of half naked pictures by the best masters, they are probably not the worst for it. If not gorgeously clad, they are modest and retiring, without any of that masculine confidence of manner which women who are much inured to society usually possess. In the great world, given up to vanity, they are here devoted to piety and affection. Nor does that benevolence which relieved Park in the heart of Africa, desert them here. The apathy of the men is apt to be confounded with want of spirit; but when they do feel, they feel deeply. The Norwegians, with all their poverty, are a fortunate people, in having obtained, without bloodshed, a degree of freedom enjoyed by no other country in the world, but America *.—*Everest's Travels in Norway.*

29. *Natives of New Guinea are Cannibals.*—A notice of the natives of New Guinea, by Mr Marsden, was read at the Royal Asiatic Society. The notice principally has reference to the question of the existence of cannabalism among the natives of New Guinea; and the information it contains was derived by Mr Marsden about the year 1785, through the medium of the Malayan language, from two Lascar sailors, belonging to the Northumberland East-Indiamen, who were of a party sent on shore from that ship while at anchor in the bay, on the north-west coast of the island, in March 1783, for the purpose of procuring wood and water. This party was cut off by the natives, several of them being killed, and the rest made prisoners. The latter had their hair cut off, and their hands bound; but they were afterwards allowed to move about freely in day-time, and were tolerably well used. The dead bodies of those who had

* In the "*Four Norwegians*," a series of novels by our friend and former fellow-student, the celebrated Professor H. Steffens (which by-the-by ought to be translated into our language), there are admirable delineations of Norwegian character and scenery. The mountain scenery of Scotland, which so much resembles that of Norway, has been powerfully described by Sir Thomas Dick Lauder, in the "*Wolf of Badenoch.*"

been killed in the affray were eaten by the natives, but none of the prisoners were killed for that purpose: no distinction is made between such as are slain and such as die a natural death. The survivors witnessed the fate of two of their comrades, one a mate, the other a midshipman. The flesh was cut off from different parts of the body and limbs with small knives, then prepared by heating over the fire, in earthen pots, and eaten without salt or pepper *. The bodies of friends and relations are eaten, as well as those of enemies; and both are treated in the same manner. There is no deficiency of provision in the country. Sago, in particular, of which they make a kind of bread, called Toyo, is abundant. The inhabitants are very numerous. According to the ideas of the Lascars, 10,000 men would not be sufficient to subdue them; yet they have no king. The men from whom the preceding information was obtained were released, after a detention of about six months, upon the interference of the Raja of a neighbouring island.

GEOGRAPHY.

30. *M. Gerard's Journey in the Himala Range.*—A meeting of the Physical Committee of the Asiatic Society of Calcutta was held on the 27th of January 1830, Sir E. Ryan in the chair. A letter was read from Mr J. G. Gerard to Captain Archer, dated Monastery of Ranum, 15th November 1829, describing his excursion to the mountains in the vicinity of Ladag. The trip was one of disappointment and distress, along a most dreary route, but interesting from the grandeur of its desolation. He lost several of his people from the severity of the climate; and considering that he was himself affected by indisposition, he was fortunate in having escaped. The first disaster in his camp was in crossing the Puralassa, at the height of 16,500 feet. The poor man perished at noon-day with his load on his back, and the sun shining fiercely on the surrounding snow. The next accident happened in the passage of the range that bounds the Spectee Valley on the east, it being no common trial for the stoutest of the party. They had slept, at 16,700 feet elevation, in the bed of a stream, and began the ascent under a temperature as low as

* The Battas in the interior of Sumatra use both at such feasts; the red, or Chili, pepper being understood.

17°, without a glimpse of the sun to warm them. The coolee could not overcome the pressure of the fatigue, cold and sickness, and he perished on the snow. Mr Gerard's mussalchee also perished; he was speaking, and even laughing, a few minutes before he became a corpse, and breathed his last like a person going asleep.—Mr Gerard's failure in reaching Leh principally arose from the jealousy of the government, which stopped him on the threshold of the inhabited country, where the wuzeer had, in anticipation of his arrival, crossed the intervening ridge. Our traveller found him at an elevation of 16,000 feet, surrounded by Tartars in black tents, horses, and dogs; while upon the elevated acclivities of the neighbouring mountains were herds of yaks and shawl goats, all in the luxuriance of life, in a region which theorists had placed far within the domains of eternal snow. The wuzeer and himself were soon upon friendly terms with each other, drank tea, ate beef, and smoked. His official errand had not apparently warped his private feelings; yet, though he evinced neither jealousy nor rigour, he seemed impatient to get the traveller fairly out of his sight. He accepted of many things presented to him, and was very anxious to have a musical snuff-box, a toy which Mr Gerard unfortunately had not provided himself with, not conceiving that such an article could have been even heard of, much less valued, in these wilds. During the nights the cold was intense, the thermometer, the day previous to the meeting with the wuzeer, standing at sunrise at $13\frac{1}{2}$°. On crossing the Lartche-Long range, the next after Paralassa, Mr Gerard found some shells at a positive height beyond 16,500 feet. The tableland of Rodpshoo offered few objects of scientific research, except its physical configuration and stupendous altitude; the only inhabitants being pastoral tribes, who live in black tents amongst the valleys, which are here upon a medium level of 16,000 feet. The whole aspect of the country was mountainous, and no expanse of level was visible, except that of the lakes, the soil undulating in heaps as far as he could see, till bounded by a snowy chain, which, he concluded, defines the declension of the streams towards the Indus. On the 20th September he lost his way upon the shore of a salt lake, and passed the night in a sheep fold, without any sort of shelter or food. "Next morning (he writes) we were covered with snow, from which we were afraid to extricate ourselves till the sun began to melt it. The camp was discovered in a gorge, at an elevation of 16,000 feet; and here I found my situation most alarming, being confined to my bed, and all around white with snow, and our rear and front intersected by enormous mountains, the lowest level being Lake Chumorerell, which is still upwards of 15,000 feet. This is a beautiful sheet of water, our route lying along its margin for a day's march of nine hours. Another lake was covered with wild-fowl, screaming like sea-gulls announcing a storm. Their borders were speckled by the black tents of Tartar shepherds, who migrate from pasture to pasture with their flocks;—what they do in winter I cannot conceive. During the day we had to contend with scorching sunshine, and at night with a temperature varying from 16° to 18°, once 13°, in the tent, at an elevation of 17,000 feet. Herds of wild horses were frequently close to us, but they would not allow us to approach sufficiently near to fire at them with any effect. They are a singular species, between the mule and the ass; and in colour, being spotted, they resemble the deer,—as also in their habits, for they gallop off to the cliffs with as much agility. I am inclined to think them a kind of zebra. The limit of the snow was very lofty in some places, not under 20,000 feet; yet, on my north-east, there appeared, at intervals, white tops of the most transcendent grandeur and altitude, indicative of scenes where the mind wanders with emotion, the more heightened from the undefined nature of the objects. My nearest approach to the Indus was only three days' journey; and I shall always regret the circumstance of my situation, which deprived me of the gratification of beholding that desolate, and almost unapproachable, river; but I durst not attempt to deviate from the high roads: the yaks which carried my camp being hired, and our provisions for twelve days already failing us, which obliged me to sacrifice several pretty shawl " goats for food to my people." At one spot, under the Chinese government, Mr Gerard was closely watched, and kept in restraint, which was the more irksome as the soil was covered with fossils. At another spot, but under Ladak, he was more fortunate, and pursued his objects undisturbed. He managed, during the trip, to make a splendid collection of shells and shell-rock, gathered at elevations between 15,000 and 16,000 feet. His route down the Valley of Spectee was far from uninteresting. He visited several monasteries, and entertainments of lamas, partaking of their greasy tea and beer. The situation of the monastery of Ranum, whence his letter is dated, he describes as delicious, after the bleak and gelid regions of Ladak, with grapes, apples, and other fruits, all round; a glowing temperature during the day, but chill nights. M. Cromo de Koros, he states, was just above him, and they met daily. His works, Mr Gerard adds, are of the first character, and full of interest.

ARTS.

31. *Enormous quantity of Iron manufactured, and of Coal consumed in Wales.*—The quantity of iron annually manufactured in Wales has been calculated at about 270,000 tons. Of this quantity a proportion of about three-fourths is made into bars, and one-fourth sold as pigs and castings. The quantity of coal required for its manufacture on the average of the whole, including that used by engines, workmen, &c., will be about $5\frac{1}{2}$ tons for each ton of iron; the annual consumption of coal by the iron-works will therefore be about 1,500,000 tons. The quantity used in the smelting of copper-ore, imported from Cornwall, in the manufacture of tin-plate, forging of iron for various purposes, and for domestic uses, may be calculated at 350,000, which makes altogether the annual consumption of coal in Wales = 1,850,000 tons. The annual quantity of iron manufactured in Great Britain is 690,000 tons. From this statement it will be observed that the quantity of iron smelted in Wales is upwards of one-third of the total quantity made in Great Britain. The manufacture of the Welsh iron is in the hands of a few extensive capitalists, and is carried on with great spirit and attention to improvement. The principal works are in the town of Merthyr, and its immediate neighbourhood; and, as the greatest proportion of metal produced is manufactured into bar-iron, a process which, in the refining, puddling, and cementing of the metal, necessarily requires a great number of furnaces, their appearance, on approaching Merthyr, by night, from the hills with which it is surrounded, presents a

scene which is probably without a parallel.—*Forster in Transactions of the Natural History Society of Northumberland, Durham, and Newcastle.*

32. *Importance of the Discovery of the Curing of Herrings.* —The discovery of the mode of curing and barrelling herring, by an obscure individual of the name of Beukles, or Beukelzon, towards the middle of the 14th century, contributed more, perhaps, than any thing else, to increase the maritime power and wealth of Holland. At a period when the prohibition of eating butcher-meat during two days every week, and forty days before Easter, was universal, a supply of some sort of subsidiary food was urgently required; so that the discovery of Beukles became of the greatest consequence, not to his countrymen only, but to the whole Christian world. The Emperor Charles V. being, in 1550, at Biervliet, where Beukles was buried, he visited his grave, and ordered a magnificent monument to be erected, to record the memory of a man who had rendered so signal a service to his country.

33. *On the Setting of Plaster, by M. Gay Lussac.*—The property which plaster-of-Paris (gypsum or sulphate of lime) possesses, when deprived of its water by heat, of setting into a firm mass, by combining with additional water, is well known to most persons. The consistency which it acquires is very variable, and it is purest plaster that acquires the least. The solidification has been attributed to the presence of some hundredth parts of carbonate of lime; but doubtless erroneously, for the heat necessary to bake plaster, and, which, in the small way, does not rise to 150° cent. is not sufficient to decompose carbonate of lime. Besides, baked plaster does not ordinarily contain quicklime, and the addition of this base to plasters of feeble consistency, does not sensibly improve them. I think that the difference observable in the consistency of baked plasters is to be ascribed to their hardness in a crude state. I conceive that hard stone plaster, after losing its water, will resume a firmer consistency in returning to its former condition, than that which is more tender. The primitive molecular arrangement, is in some sort regained. On the same principle it is, that good cast steel, the carbon of which has been removed by cementing it with oxide of iron, produces, by a fresh cementa-

tion with carbon, a steel much more homogeneous and perfect than that obtained under the same circumstances by the cementation of iron.—*Quarterly Journal*, July–Sept. 1829.

STATISTICS.

34. *German Universities.*—In the Isis we have the following "characteristic" of the German universities. *Göttingen* is eminent in history; *Halle* in theology; *Leipzig* in philology; *Heidelberg* in law; *Bonn* in natural history; *Tübingen* in theology; *Konigsberg*, philosophical tendency of the natural sciences; *Würtzburg* in medicine; *Berlin*, eminent in all the sciences; *Munich*, eminent in all the sciences; *Kiel* active, but kept down by the University of *Copenhagen*.

NEW PUBLICATIONS

1. *Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne.* Vol. I. Part I. 4to. pp. 130. With Eleven Plates.

In the years 1806 and 1807, the Wernerian and Huttonian Theories of the Earth were publicly canvassed in the Royal Society of Edinburgh. These spirited discussions excited much attention, and gave rise, and nearly at the same time, to the Wernerian Natural History Society of Edinburgh, and the Geological Society of London. The activity and success of these the two parent geological societies of this country has been great. They have besides excited a general desire for geological knowledge throughout the empire, as is shewn by the establishment of geological and natural history societies from the Lands-End of England to the capital of the Highlands of Scotland. The Cornwall Society has published two volumes of memoirs. The Newcastle Society has just published vol. i. part i. in 4to. of their memoirs, under the title of "Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne." As the title of the volume implies, this Society, like the Wernerian, extends its views to other branches of natural history besides geology, although the latter is the prominent subject. It contains six papers on zoology, one on botany, and seven on geology. The first and fifth papers contain details in regard to a new species of Swan, by Messrs Wingate and Selby, which prove that the bird in question is fully entitled to be considered a new species. It is named Cygnus Bewickii, in honour of the late admirable artist Bewick. The following is the specific character: *Cygnus, albus, fronte genisque ferrugineo maculatis. Rostro basi tuberculo flavo, pedibus nigris. Cauda cuneata, rectricibus octodecim.* The second article is a notice of that rare bird the Honey Buzzard, shot in the county of Northumberland by the Hon H. T. Liddell. Dr Johnston of Berwick gives a notice and drawing of the specimen of a whale, cast on the coast near Berwick. This notice is also interesting, but it leaves room for inquiry as to the particular species here delineated. Mr J. Alder's account of the land and fresh water shells found in the vicinity of Newcastle, is an acceptable contribution to this department of zoology. We hope ere long these much neglected tribes will be more attended to than at present. Mr Turner's notice in regard to the spider is worthy of being recorded. The botanical paper, by a good practical botanist, Mr Winch, contains "Remarks on the *Distribution* of the Indigenous Plants of Northumberland and Durham, as connected with the Geological Structure of these Counties." We think favourably of such papers, and hope Mr Winch will continue his investigations in this difficult and important department of botany. Mr Buddle's Notice of the Whin Dike in the Benwell Colliery, will be useful to those connected with the collieries, and to the surveyors who may be engaged in collecting materials for the geological map of Newcastle. Mr Forster, in a notice on the effects of a *basaltic dike* at Butterknowle Colliery, near Cockfield, states distinctly the effect of the plutonian rock on the coal, but we much doubt if the rock is true basalt. Mr Hutton's notes on the new red sandstone of Durham, below the magnesian limestone, are creditable to him as a geological observer, and interesting, by proving the identity of its arrangement with that of similar sandstones in many and widely extended districts in other countries, thus further illustrating the truth of the views of Werner and Friesleben. Mr Trevelyan's notice of the bed of whin at Stanhope, in Weardale, and Mr Forster's observations on the geology of the Ratcheugh Crag, near Alnwick, are useful illustrations of the relations of trap-rocks to the secondary strata. At the Ratcheugh Crag the trap presents one of those alternations with limestone, so frequently met with in Scotland, the country of all others in this island the most instructive in regard to the geological history of secondary trap rocks. The Ratcheugh Crag trap-rock we suspect is not basalt, as mentioned by Mr Forster.—Mr Patinson's notice of the hazel-nuts found in a vein of lead-ore, corrects a mistake which we know has also been committed in other mines. But the most extensive and important memoir, is that entitled "Observations on the South Welsh Coal Basin, by Mr Francis Forster." This coal field, or basin, affords not only numerous beds of common bituminous coal, but also beds of glance-coal, or anthracite; and the quantity of ironstone it contains is so vast, that nearly one-third of the immense supply of British iron is raised, smelted, and manufactured within its circumference. Mr Forster also remarks that it is the source from which the Cornish mines derive their supply of coal, and is the market to which London must look for a supply, whenever that period arrives that the coal of our northern districts either becomes so scarce, or is so difficult and expensive to procure, that it cannot compete with that of Wales. The sides of the coal basin are of mountain-limestone, which rests upon the old red sandstone. The coal formation exhibits the usual rocks and alternations. In some places the position of the strata appears changed by some action after their deposition, in others natural unaltered wavings of the strata occur. The quantity of carburetted hydrogen gas occurring in the Welsh collieries is very trifling, as compared with the Durham and Northumberland districts: this, Mr Forster remarks, may in some degree arise from the greater inclination of the strata allowing the gas to find its way to the surface between the planes of the different beds; that it cannot be altogether attributed to the great inferiority of the Welsh coals, for the *artificial* production of gas is evident, from the remarkable fact, that the glance-coal (stone coal) seams generally abound more in *fire-damp*, than the seams of bituminous coal. In regard to the quantity of coal in the whole basin, Mr Forster calculates, it is true in a rough way, that it may amount to about *sixteen thou-*

sand million of tons. The annual quantity of coal consumed and exported from Wales, amounts, according to our author, to 2,754,895 tons.

2. *Principles of Geology; being an Attempt to explain the former Changes of the Earth's Surface, in Reference to Causes now in Operation.* By Charles Lyell, Esq. F. R. S., Foreign Secretary to the Geological Society of London, &c. Vol. I. pp. 511.

Mr Lyell is young, active, and intelligent, therefore well qualified to become a geologist, and that he is an adept in this science, the present work affords satisfactory evidence. The first volume of his Geology (all that is yet published), is very interesting and amusing, and should be read by every one who takes an interest in this rising branch of natural history. The arrangement of his materials is good, it being that proposed and followed by Werner, in his Lectures on Geognosy, and of which accounts have been published by himself and his pupils. The four first chapters of the volume are occupied with the history of geology, not, however, given with sufficient fairness, owing to particular prejudices,—but all of us are liable to such failings. Chapters six, seven, and eight, make us acquainted with the views of authors in regard to geological climate. Here, although the author displays his usual ingenuity and address in statement and argument, we find no new views; nor is this to be regretted, considering the slender store of materials we possess for speculating on primeval climates. The next eight chapters contain a view of the destroying and forming effects of water on the earth. Here our author has followed the arrangement and views of Werner, and, by bringing up the subject to the present time, has done a service to English geology. The remaining chapters contain a full detail, according to the Wernerian arrangement, of the phenomena of volcanoes and earthquakes, and of the changes these have occasioned on the surface and in the crust of the earth. We trust the most important part of the work, that which treats of the rocks and formations of the crust of the earth, will speedily make its appearance. If executed with equal ability with the present, it will supply a deficiency in our present geological literature.

3. *The South African Quarterly Philosophical Journal. No. I. from October* 1829 *to January* 1830; *and No. II. from January to April* 1830. 8vo. Cape Town.

A philosophical journal from Southern Africa will naturally excite the surprise of some, and the curiosity of others. To us it is delightful to observe a thirst for knowledge and improvement springing up even alongside the Hottentot and the Bushman; in a country, too, which, as the eloquent author of the introductory observations to the first number of the journal remarks, "is placed on the highway of communication betwixt the world's nations, whether aged in wisdom or in ignorance, or yet little more than the half-formed germ of prospective empires; canopied by a sky of strange unsearched splendour; and nourished by a land of unrivalled interest; with fantastic mountains, immersing their foundations in seas, and their summits in the vapours of a hemisphere, almost unknown."

This journal is an auxiliary to the *South African Institution*, established at the Cape of Good Hope last year, under the patronage of the present active and intelligent Governor Sir Lowry Cole, and the presidency of Colonel Bell.

The object of the Institution is the promotion of knowledge in all that relates to the Natural History, and geographic, physical, and economic statistics of South Africa,—the encouragement of such investigations as tend to that effect,—the collection of such objects as will confirm, augment, and diffuse information. The two Numbers, transmitted to us by the Institution, we consider highly creditable not only to the Institution itself, but also to the authors of the different memoirs. Among these we observe communications by Dr Smith, a well known and active naturalist,—by Mr Bowie, whose name is familiar to the botanists of Britain,—but we regret that an individual so talented and accomplished as the Rev. James Adamson, one of the secretaries, and a most active member of the Institution, does not appear as a contributor. The following is a list of the communications published in the first Number:—1. Description of the Birds inhabiting Southern Africa, by Dr Smith. 2. Notice of Earthquakes which occurred at the Cape of Good Hope in December 1809, by

Mr Buchenroder. 3. Description of two undescribed Fishes, by W. D. Webster, Esq., Surgeon R. N. 4. Sketches of the Botany of Southern Africa, by Mr J. Bowie. 5. Diary of a Journey made by Governor Simon Vander Stell to the country of the Amaquas, in the year 1685. 6. Memoir relative to the Captaincy of Ria de Senna, a Portuguese settlement on the south-east coast of Africa, by the late Governor Terao. 7. Extract, &c. calculated to assist inquiry as to the probable or actual existence of coal in any given district. 8. Mr Surgeon Leslie's observations on the Bushmen of Orange River, reprinted from the New Edinburgh Philosophical Journal.

Number II. contains, 1. Continuation of Dr Smith on African Birds. 2. Mr Reid on the Properties of the Wax of the Candleberry Myrtle. 3. On the Culture of the Vine, and on the Making of Wine, by D. Cloet, Esq. 4. Remarks on Delagoa Bay, by a Naval Officer. 5. Captain Hall on Penitentiary Houses in North America. 6. De la Beche's Arrangement of Rocks. 7. Mr Bowie on the Culture of Exotic Vegetables, adapted for the soil and climate of South Africa. In this paper we find that Ulex Europæus (common furze or whin) was introduced many years ago into our South African colony; also that the Common Broom (Spartium scoparium) Elder (Sambucus niger), Box-tree (Buxus sempervirens), Privet (Ligustrum vulgare), are cultivated there, but not extensively. The Scotch Pine or Fir (Pinus sylvestris), the Weymouth Pine (Pinus strobus), and the Stone Pine (Pinus pinea), have been introduced into the Cape district. The Scotch Pine and Stone Pine were introduced so early as the year 1695. The Ash (Fraxinus excelsior) was introduced in 1827; the Alder (Alnus glutinosa) previous to 1695; Common Myrtle (Myrtus communis) at a very early period. 8. Observations relative to the Origin and History of the Bushmen, by Dr Smith. 9. Diary of a Journey made by Governor Simon Van-der Stell to the country of the Amaquas, continued from the first Number. At the end of each Number, under the head Miscellaneous Intelligence and Local Intelligence, there are many interesting details, particularly meteorological. The meteorology of the Cape cannot be completed without a thorough examination of the atmosphere by good instruments: of these, by far the best are those of Professor Leslie.

4. *Report of the Council of the Banff Institution for Science, Literature and the Arts.*

The Literary and Philosophical Institutions in Scotland to the north of the Frith of Forth, are, 1. The *Society of Antiquaries in Perth*, concerning which we do not possess any distinct information; 2. The *Northern Institution* at Inverness, a very flourishing association, of which we gave an account in our former volumes; and, 3. The *Banff Institution.* From the printed Report of the Council of this Institution, we observe, that, although hitherto none of the memoirs read before the Society, which appear to be often of a geological nature, have been published, still the Society is actively employed. Ere long, we trust this Society, and also that of Inverness, both situated in very interesting districts of Scotland, will, like the also infant Society of Natural History of Newcastle, lay before the public the results of their investigations.

5. *First Report of the Scarborough Philosophical Society.*

The Societies of York, Whitby, and Newcastle, which have done so much for the diffusion of geological information throughout the north of England, may claim, as one of the beneficial results of their example, the establishment, in 1827, of the Scarborough Philosophical Society. A history of the Society, and various official documents, are printed in the Report; and along with these, an interesting and remarkably well arranged catalogue of the flourishing museum attached to the establishment. The geological part of the catalogue we recommend to the notice of geologists.

6. *Transactions of the Plymouth Institution.*

Printed copies of several memoirs which are to appear in the forthcoming volume of the Transactions of the Plymouth Institution, have been sent to us by the authors, for which they have our best thanks; but these, although interesting and important, we do not hold ourselves entitled to make *public use* of until the appearance of the volume of which they are to form a part. Before our next Number the volume will be published, when we shall have an opportunity of laying an account of its contents before our readers.

7. *Zoological Researches.* By JOHN V. THOMPSON, Esq. F.L.S., &c. Surgeon to the Forces. No. III.

This number of Mr Thompson's interesting work, of which we on former occasions expressed our satisfaction, has just reached us. It contains one memoir on the Cirripedes or Barnacles, with two plates; and an addendum on Nebalia, with one plate. The memoir on the Barnacles contains a series of curious observations, which go to show that these creatures belong not to the testacea but to the crustacea. A fourth number, from the same active naturalist, was announced to be published in April last, but, as far as we know, has not yet made its appearance.

List of Patents granted in England, from 6th to 27th February 1830.

1830.

Feb. 6. To M. WILSON, of Warnford Court, Throgmorton Street, London, merchant, for "an improved method of preparing and cleansing paddy or rough rice." Communicated bv a foreigner.

To T. R. WILLIAMS, of Nelson Square, Blackfriars' Road, Surrey, Esq. for "improvements in power-looms, applicable to the weaving of wire and other materials."

12. To J. F. SMITH, of Dunstan Hall, Chesterfield, Derbyshire, Esq. for "certain improvements in preparing or finishing piece goods, made from wool, silk, or other fibrous materials."

To E. COWPER of Streatham Place, Surrey, Gentleman, for "certain improvements in the manufacture of gas." Communicated by a foreigner.

To T. M. U. L. R. DU BUISSON, of Fenchurch Street, London, merchant, for "a new method of extracting, for the purpose of dyeing, the colour from dye-woods and other substances used by dyers." Communicated by a foreigner.

27. To J. BRAITHWAITE and J. ERICSSON, New Road, Middlesex, engineers, for "an improved method of manufacturing salt."

To E. W. RUDDER and R. MARTINEAU, Birmingham, Warwick, cockfounders, for "certain improvements in cocks for drawing off liquids."

To C. RANDOM, Baron de Berenger, Targate Cottage, Kentish Town, St Pancras, Middlesex, for "improvements in fire-arms, and in certain other weapons of defence."

To W. GRISSENTHWAITE, Esq. Nottingham, for "an improved method of facilitating the draft, or propulsion, or both, of wheeled carriages."

To H. HURST, Leeds, Yorkshire, clothier, for "certain improvements in manufacturing woollen cloth."

1830.

Feb. 27. To M. POOLE, Lincoln's Inn, Gentleman, for "a certain combination of, or improvements in, springs, applicable to carriages and other purposes."

To J. C. DYER, Manchester, patent card manufacturer, for "certain improvements on, and additions to, machines or machinery for conducting to, and winding upon, spools, bobbins, or barcells, rovings of cotton, flax, wool, or other fibrous substances of the like nature."

To W. GRISSENTHWAITE, Esq. Nottingham, for "certain improvements in steam-engines."

List of Patents granted in Scotland from 21*st July to* 6*th September* 1830.

1830.

July 21. To JOHN ERICSSON of New Road, London, engineer, for an invention of "an improved engine for communicating power for mechanical purposes."

29. To JOHN FREDERICK SMITH of Dunstan Hall, Chesterfield, in the county of Derby, Esq., for an invention of "certain improvements in preparing or finishing piece goods made from wool, silk, or other fibrous substances."

To JOHN RAWE junior of Albany Street, Regent Park, in the county of Middlesex, one of the Society of Friends, and JOHN BOASE of the same place, Gent., for an invention of "certain improvements on steam-carriages and in boilers, and a method of producing increased draft."

Aug. 3. To RICHARD IBOTSON of Poyle, in the parish of Stanwell, in the county of Middlesex, paper-maker, for an invention of "an improvement or improvements in the method or apparatus for separating the knots from paper-stuff or pulp, used in the manufacture of paper."

19. To JOSEPH CHESSEBOROUGH, dyer, of Manchester, in the county of Lancaster, patent manufacturer, in consequence of improvements made by himself, and communications by a foreigner residing abroad, for an invention of "certain improvements on, and additions to, machines or machinery to be used and applied for conducting to and winding upon spools, bobbins or barrels, rovings of cotton, flax, wool, or other fibrous substances of the like nature."

To JOHN YATES, late of Hyde, in the county of Chester, but now of Hayfield, in the county of Derby, calico-printer, for an invention of "a method or process of giving a metallic surface to cotton, silk, linen, and other fabrics."

To WILLIAM MALLET of Marlborough Street, in the City of Dublin, iron-manufacturer, for an invention of "a new method of making iron wheelbarrows of wrought-iron, with a wrought-iron wheel, by which new method said iron wheelbarrows can be made lighter, stronger, more durable, and cheaper than any iron wheelbarrows which have been heretofore in use."

Sept. 6. To JOHN RUTHVEN of the City of Edinburgh, engineer and manufacturer, for an invention of "an improved machinery for the navigation of vessels, and propelling of carriages."

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