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ARTICLE XLIV.—*Abridged Sketch of the Life of Mr. David Douglas, Botanist, with a few details of his travels and discoveries.*

(Continued from last Number.)

After the misfortune recorded in our last, Douglas pursued his way to Fort Vancouver by the same route by which he had come, botanizing still more sedulously than ever, in order to make up as far as possible for his recent heavy loss. In October, he left the Columbia, as it afterwards unfortunately proved, for the last time. A land where his discoveries had furnished him frequently with the brightest moments of the purest joy, and where also his losses had caused him days of the most poignant sorrow and regret. He arrived at Waohoo on the 23rd December. On the 31st he was at Hawaii, on which stand the great volcanic peaks. His account of the ascent of these is most interesting and we angle from his journal as much as our limits and the patience of readers may be supposed to render admissible.

After all preliminary preparations, and passing two days with his party drenched with rain on the skirts of Mouna Kuah, we find him on the 9th January 1834, recovering from the effects of the weather, and partaking of a young wild bull, shot by a person who had joined them. The weather on the following day still improving, he cleared the wooded region, but night coming on quickly returned to its edge and encamped. All were on foot early on the 11th. After passing the last plants to be seen on the ascent, viz: a gigantic composite (*Argyrophyton Douglasii*) and a small *Juncus* he begins his scientific remarks.

"The great difference produced on vegetation by the agitated and volcanic state of the mountain is very distinctly marked. Here there is no line between the phenogamous and cryptogamous plants, but the limits of vegetation itself are defined with the greatest exactness, and the species do not gradually diminish in number and stature, as is generally the case on such high elevations."

"The line of what may be called the woody-country, at the upper verge of which the barometer expresses 21·450 inches, thermometer 46° at 2 P. M., is where we immediately enter on a region of broken and uneven ground, with here and there lumps of lava rising above the general declivity to a height of three hundred to four hundred feet, intersected by deep chasms, which shew the course of the lava when in a state of fluidity. This portion of the mountain is highly picturesque and sublime. Three kinds of timber of small growth are scattered over the low knolls, with one species of *Rubus* and *Vaccinium*, the genus *Fragaria*, and a few *Graminia*, *Filices*, and some alpine species. This region extends to bar. 20.020 in., air 40°, dew point 30°. There is a third region, which reaches to the place where we encamped yesterday, and seems to be the great rise or spring of the lava, the upper part of which at the foot of the first extinct peak is bar. 20.010 in., air 39°."

"12th. At six o'clock, accompanied by three Islanders, and two Americans, I started for the summit of the mountains; bar. at that hour indicated 20.000 inches, therm. 24°; hygr. 20°; and a keen west wind was blowing off the mountain, which was felt severely by us all, and especially by the natives, whom it was necessary to protect with additional blankets and great coats. We passed over about five miles of gentle ascent, consisting of large blocks of lava, sand, scoriæ, and ashes, of every size, shape and color, demonstrating all the gradations of calcination, from the mildest to the most intense. This may be termed the table land or platform, where spring the great rent holes of the subterranean fire or numerous volcanoes. The general appearance is that of the channel of an immense river heaved up. In some places the round boulders of lava are so regularly placed, and the sand is so washed in around them, as to give the appearance of a causeway, while in others, the lava seems to have run like a stream. We commenced the ascent of the great peak at nine o'clock, on the N. E. side, over a ridge of tremendously rugged lava, four hundred and seventy feet high, preferring this course to the very steep ascent of the south side, which consists entirely of lava, ashes, and scoriæ, and we gained the summit soon after ten. Though exhausted with fatigue before leaving the table land, and much tried by the increasing cold, yet such was my ardent desire to reach the top, that the last portion of the way seemed the easiest. This is the loftiest of the chimneys: a lengthened ridge of two hundred and twenty one yards two feet running nearly straight N. W. To the north, four feet below the extreme summit of the peak, the barometer was instantly suspended, the cistern being exactly below, and when the mercury had acquired the temperature of the circumambient air, the following register was entered at 11 h. 20 m.; bar. 18.362 in.; air 33°; hygr. 0″ 5. At 12 o'clock the horizon displayed some snowy clouds; until this period the view was sublime to the greatest degree, but now every appearance of a mountain storm come on. The whole of the low S. E. point of the island was throughout the day covered like a vast plain of snow with clouds. The same thermometer laid on the bare lava, and exposed to the wind at an angle of 27° expressed at first 37° and afterwards at 12 o'clock 41°, though when held in the hand, exposed to the sun, it did not rise at all. It may well be conjectured that such an immense mass of heating material, combined with the influence of internal fire, and taken in connexion with the insular position of Mouna Kuah, surrounded by an immense ocean of water, will have the effect of raising the snow line considerably: except on the northern declivity, or where sheltered by large blocks of lava, there was no snow to be seen: even on the top of the cairn where the barometer was fixed, there were only a few handsful. One thing struck me as curious, the apparent non-diminution of sound, not as respects the rapidity of its transmission, which is, of course, subject to a well known law. Certain it is, that on mountains of inferior elevation, whose summits are clothed with perpetual snow and ice, we find it needful to roar into one another's ears, and the firing of a gun, at a short distance, does not disturb the timid antelope on the high snowy peaks of N. W. America. Snow is doubtless a non-conductor of sound, but there may be also something in the mineral substance of Mouna Kuah which would effect this."

"Were the traveller permitted to express the emotions he feels when placed on such an astonishing part of the earth's surface, cold indeed must his heart be, to the great operations of nature, and still colder towards nature's God, by whose wisdom and power such wonderful scenes were created, if he could behold them without deep humility and reverential awe. Man feels himself as nothing, as if standing on the verge of another world. The death like stillness of the place, not an animal nor an insect to be seen, far removed from the din and bustle of the world, the whole impresses on his mind with double force, the extreme helplessness of his condition; an object of pity and compassion, he feels utterly unworthy to stand in the presence of a great and good, and wise and holy God, and to contemplate the diversified works of his hands!"

We find the description of the visit to the great crater of Mouna Roa, undertaken a few days afterwards possessed of even still greater interest, while some amusing traits of the natives are touched upon. We shall therefore draw more largely from this, the last it may be called, of the written work of the lamented Douglas.

"On the 22nd of January, the air being pleasant, and the sun occasionally visible, I had all my packages assorted by nine A. M. and engaged my old guide Honori, and nine men to accompany me to the volcano and to Mouna Roa. As usual there was a formidable display of luggage, consisting of *papas*, *calabashes*, *poe*, *tara* &c., while each individual provided himself with the solace of a staff of sugar cane, which shortens with the distance, for the pedestrian when tired and thirsty sits down and bites off an inch or two from the end of his staff. A friend accompanied me as far as his house on the road, where there is a large church, his kind intention being to give me some provision for the excursion, but as he was a stout person I soon out-stripped him. On leaving the bay, we passed through a fertile spot, consisting of paro patches in ponds, where the ground is purposely overflowed and afterwards covered with a deep layer of fern leaves to keep it damp. Here were fine groves of bread fruits, and ponds of mullet and ava-fish. The scenery is beautiful, being studded with dwellings, and better plantations of vegetables, and of *Monis papyrifera* of which there are two kinds, one much whiter than the other. The most striking feature in the vegetation consists in the tree-fern, same smaller species of the same tribe, and a curious kind of composite, like an *Eupatorium.* At about four miles and a half from the bay, we entered the wood, through which there is a tolerably cleared path, the muddy spot being rendered passable by the stems or trunks*of tree ferns, laid close together crosswise. They seemed to be the same species I had observed on the ascent to Mouna Kuah. About an hours walk brought us through the wood, and we then crossed another open plain of three miles and a half at the upper end of which, in a most beautiful situation, stand the church, and close to it, the chief's house. Some heavy showers had drenched us through; still, as soon as our friend arrived, and the needful arrangements were made, I started, and continued the ascent, over a very gently rising ground, in a southerly direction, passing through some delightful country, interspersed with low timber. At night we halted at a house, of which the owner was a very civil person, though remarkably talkative. Four old women were inmates of the same dwelling, one of whom, eighty years of age, with hair white as snow, was engaged in feeding two favorite cats with fish. My little terrier disputed the fare with them, to the no small annoyance of their mistress. A well looking young female amused me with singing, while she was engaged in the process of cooking a dog on heated stones. I also observed a handsome young man whose very strong stiff black hair was allowed to grow to a great length on the top of his head, while it was cut close over the ears, and falling down on the back of his head and neck had all the appearance of a Roman helmet."

"January the 23rd. This morning the old lady was engaged in feeding a dog with fox-like-ears, instead of her cats. She compelled the poor animal to swallow poe, by cramming it into his mouth, and what he put out at the sides, she took up and ate herself; this she did as she informed me by way of fattening the dog for food. A little while before day break my host went to the door of the lodge, and after calling over some extraordinary words which would seem to set orthography at defiance a loud grunt in response from under the thick shade of some adjoining tree ferns was followed by the appearance of a fine large black pig, which coming at his master's call was forthwith caught and killed for the use of myself and my attendants. The meet was cooked on heated stones, and three men were kindly sent to carry it to the

* Hids Bay.

volcano, a distance of twenty-three miles, tied up in the large leaves of Banana and Ti-tree. The morning was deliciously cool and clear with a light breeze. Immediately on passing through a narrow belt of wood, where the timber was large and its trunks matted with parasitic ferns, I arrived at a tract of ground, over which there was but a scanty covering of soil above the lava, interspersed with low bushes and ferns. Here I beheld one of the grandest scenes imaginable; Mouna Roa reared his bold front, covered with snow, far above the region of verdure while Mouna Roa was similarly clothed, to the timber region on the south side, while the summit was cleared of the snow that had fallen on the nights of the 12th and two following days. The district of Hido, "Byron's Bay," which I had quitted the previous day, presented, from its great moisture, a truly lovely appearance, contrasting in a striking manner with the country where I then stood, and which extended to the sea, whose surface bore evident signs of having been repeatedly ravaged by volcanic fires. In the distance, to the south-west, the dense black cloud which overhangs the volcano, attests, amid the otherwise unsullied purity of the sky, the mighty operations at present going on in that immense laboratory. The lava, throughout the whole district, appeared to be of every colour and shape, compact, bluish and black, porous, or vesicular, heavy and light. In some places it lies in regular lines and masses, resembling narrow horizontal basaltic columns; in others, in tortuous forms, or gathered into rugged humps of small elevation; while, scattered over the whole plain, are numerous extinct, abrupt, generally circular craters, varying in height from one hundred to three hundred feet, and with about an equal diameter at their tops. At the distance of five miles from the volcano, the country is more rugged, the fissures in the ground being both larger and more numerous, and the whole tract covered with gravel and lava, &c., ejected at various periods from the crater. The steam that now arose from the cracks bespoke our near approach to the summit and at two P. M., I arrived at its northern extremity, where finding it nearly level, and observing that water was not far distant, I chose that spot for my encampment. As however the people were not likely to arrive before the evening, I took a walk round the west side, now the most active part of the volcano, and sat down there, not correctly, speaking, to enjoy, but to gaze with wonder and amazement on this terrific sight, which inspired the beholder with a fearful pleasure. From the descriptions of former visitors, I judge that Mouna Roa must now be in a state of comparative tranquillity. A lake of liquid fire, in extent about a thirteenth part of the whole crater, was boiling with furious agitation; not constantly, however, for at one time it appeared calm and level, the numerous fiery red streaks on its surface alone attesting its state of ebullition, when again, the red hot lava would dart upwards and boil with terrific grandeur, spouting to a height which from the distance at which I stood I calculated to be from forty to seventy feet, when it would dash violently against the black ledge, and then subside again for a few moments. Close by the fire was a chimney above forty feet high, which occasionally discharges its steam, as if all the steam-engines in the world were concentrated in it. This preceded the tranquil state of the lake which is situated near the south-west or smaller end of the crater. In the centre of the great crater, a second lake of fire, of circular form, but smaller dimensions, was boiling with equal intensity: the noise was dreadful beyond all description. The people having arrived, Honori last, my tent was pitched twenty yards back from the perpendicular wall of the crater; and as there was an old hut of Ti leaves on the intermediate bank, only six feet from the extreme verge, my people soon repaired it for their own use. As the sun sunk behind the western flank of Mouna Roa, the splendour of the scene increased; but when the nearly full moon rose in a cloudless sky, and shed her silvery brightness on the fiery lake, roaring and boiling in fearful majesty, the spectacle became so commanding, that I lost a fine night for making astronomical observations by gazing on the volcano, the illumination of which was but little diminished by a thick haze that set in at midnight. On Friday, January the 24th, the air was delightfully clear and I was enabled to take the bearings of the volcano and adjoining objects with great exactness. To the north of the crater are numerous cracks and fissures in the ground, varying in size, form and depth, some long, some straight, round or twisted, from whence steam constantly issued, which in two of them is rapidly condensed, and collects in small basins or wells one of which is situated at the immediate edge of the crater, and the other four hundred and eighty yards to the north of it. The latter fifteen inches deep, and three feet in diameter, about thirteen feet north of a very large fissure, according to my thermometer, compared with that at Greenwich and at the Royal Society, and found without error, maintains a temperature of 65°. The same instrument, suspended freely in the above mentioned fissure, ten feet from the surface, expressed, by repeated trials 158°; and an equal temperature was maintained when it was nearly level with the surface. When the Islanders visit this mountain they invariably carry on their cooking operations at this place. Some pork and a fowl that I had brought, together with taro-root and sweet potatoes, were steamed here to a nicety in twenty seven minutes, having been tied up in leaves of Banana. On the sulphur bank are many fissures which continually exhale sulphurous vapours and form beautiful prisms, those deposited in the inside being the most delicate and varied in figure, encrusting the hollows in masses, both large and small resembling swallows' nests on the wall of a building. When severed from the rock or group they emit a crakling noise by the contraction of the parts in the process of cooling. The great thermometer placed in the holes, showed the temperature to be 195°.5′, after repeated trials, which all agreed together, the air being then 71°."

"I had furnished shoes for those persons who should descend into the crater, with me but none of them could walk when so equipped, preferring a mat sole made of tough leaves, and fastened round the heel and between the toes, which seemed indeed to answer the purpose entirely well. Accompanied by three individuals, I proceeded at one P. M., along the north side, and descended the first ledge over such rugged ground as bespoke a long state of repose, the fissures and flanks being clothed with verdure of considerable size; thence we ascended two hundred feet to the level platform that divides the great and small volcanoes."

"On the left, a perpendicular rock three hundred feet above the level, shows the extent of the volcano to have been originally much greater than it is at present. The small crater appears to have enjoyed a long period of tranquillity, for down to the very crust of the lava, particularly on the east side, there are trees of considerable size, on which I counted from sixty to one hundred and twenty four annual rings or concentric layers. The lava at the bottom flowed from a spot, nearly equidistant from the great and small craters, both uniting into a river from forty to seventy yards in breadth and which appears comparatively recent. A little south of this stream, over a dreadfully rugged bank I descended the first ledge of the crater, and proceeded for three hundred yards over a level space, composed of ashes, scoriæ, and large stones that have been ejected from the mouth of the volcano. The stream formerly described is the only fluid lava here. Hence to arrive at the black ledge, is another descent of about two hundred and forty feet, more difficult to be passed than any other, and this brings the traveller to the brink of the black ledge, where a scene of all that is terrific to behold presents itself before his eyes. He sees a vast basin, recently in a state of igneous fusion, now, in cooling, broken up, somewhat in the manner of the great American lades, when the ice gives way, in some places level in large sheets, elsewhere rolled in tremendous masses, and twisted into a thousand different shapes, sometimes even being filamentose, like fine hair, but all displaying the mighty agency still existing in this immense depository of subterraneous fire. A most uncomfortable feeling is experienced when then traveller becomes aware that the lava is hollow and faithless beneath his tread. Of all sensations in nature, that produced by earthquakes or volcanic agency, is the most alarming: the strongest nerves are unstrung, and the most courageous mind feels weakened and unhinged, when exposed to either. How insignificant are the operations of man's hands, taken in their vastest extent, when compared with the magnitude of the works of God!"

"On the black ledge, the thermometer held in the hand, five feet from the ground, indicated a temperature of 89°, and when laid on the Lava, in the sun's rays, 115°, and 112° in the shade; on the bank of the burning Lake, at the south end, it rose to 124°. Over some fissures in the Lava, where the smoke was of a greyish rather than a blue tinge, the thermometer stood at 94°. I remained for upwards of two hours in the crater, suffering all the time an intense headache, with my pulse strong and irregular, and my tongue parched, together with other symptoms of fever. The intense heat and sulphurous nature of the ground had corroded my shoes so much, that they barely protected my feet from the hot lava. I ascended out of the crater at the south-west or small end, over two steep banks of scoriæ, and two ledges of rock, and returned by the west side to my tent, having thus walked quite round this mighty crater."

"Saturday, Jan. 25th. I slept soundly until 2, a.m., when, as not a speck could be seen on the horizon, and the moon was unusually bright, I rose with the intention of making some lunar observations; but though the thermometer stood at 41°, still the keen mountain breeze affected me so much, of course mainly owing to the fatigue and heat I had suffered the day before, that I was reluctantly obliged to relinquish the attempt, and being unable to settle again to sleep, I replenished my blazing stock of fuel, and sat gazing on the roaring and agitated state of the crater, where three new fires had burst out since ten o'clock the preceding evening. Poor Honori, my guide, who is a martyr to asthma, was so much affected by their exhalations (for they were on the north bank, just below my tent) that he coughed incessantly the whole night, and complained of cold, though he was wrapt in my best blanket, besides his own tapas, and some other articles that he had borrowed from my Woakee man. The latter slept with his head towards the fire, coiled up most luxuriously, and neither cold, heat, nor the roaring of the volcano, at all disturbed his repose."

On his descent from the Volcano Mr. Douglas describes some extensive caves.

"Among the grassy undulating ground are numerous caves, some of great magnitude from forty to sixty-five feet high, and from thirty to forty feet broad, many of them of great length, like gigantic arches, and very rugged. These generally run at right angles with the dome of Mouna Roa and the sea. Some of those natural tunnels may be traced for several miles in length, with occasional holes of different sizes in the roofs, screened sometimes with an overgrowth of large trees and ferns, which renders walking highly dangerous. At other places the vaults have fallen in for the space of one hundred or even three hundred yards, an occurrence which is attributable to the violent earthquakes that sometimes visit this district. The inhabitants convert these caverns to use in various ways; employing them occasionally as permanent dwellings, but more frequently as cool retreats, where they carry on the process of making native cloth, from the bark of the mulberry tree, or where they fabricate and shelter their canoes from the violent rays of the sun."

"They are also used for goat-folds and pig-styes, and the fallen in places, where there is a greater depth of decomposed vegetable matter, are frequently planted with tobacco, Indian corn, melons, and other choice plants. At a distance of ten miles north of Kapupala, and near the edge of the path, are some fine caverns above sixty feet deep. The water dropping from the top of the vault collected into small pools below, indicated a temperature of 50°, the air of the cave being 51°, while in the shade on the outside the thermometer stood at 82°. The interior of the moist caverns are of most beautiful appearance; not only from the singularity of their structure, but because they are delightfully fringed with ferns, mosses, and jungermanniæ, thus holding out to the Botanist a most inviting retreat from the overpowering rays of a tropical sun."

At Kapupala the traveller having apologized to the worthy chief for declining an invitation to abide in a nice dwelling prepared for him, preferring a spot retired from the disagreeables of the village, he is presented with a fowl cooked on heated stones underground, some baked tara, and sweet potatoes, together with a calabash full of delicious goat's-milk, poured through the husk of a cocoa nut, in lieu of a sieve. On the morrow of the 26th, it being Sunday, Honori, the guide, officiates as preacher. In the interval between services the school house was visited.

"I visited the school in the interval, when Honori had retired to compose his second sermon, and found the assemblage under the direction of the chief, who appears to be a good man, though far from an apt scholar; they were reading the second chapter of the Epistle to the Galatians. The females were by far the most attentive, and proved themselves the readiest learners. It is most gratifying to see far beyond what is called the pale of civilization, this proper sanctification of the Lord's day, not only consisting in a cessation from the ordinary duties, but in reading and reflecting upon the purifying and consolatory doctrines of Christianity. The women were all neatly dressed in the native fashion, except the chief's wife and some few others, who wore very clean garments of calico. The hair was either arranged in curls, or braided on the temples, and adorned with tortoise-shell combs of their own making, and chaplets of balsamic flowers, the peaflowering racemes of the maurarii tree, and feathers, &c. The men were all in the national attire, and looked tolerably well dressed, except a few of the old gentlemen."

"The schoolmaster, a little hump-backed man, about thirty years old, little more than three feet high, with disproportionately long legs, and having a most peculiar cast in his right eye, failed not to prompt and reprove his scholars, when necessity required, in remarkably powerful tones of voice, which, when he read, produced a trumpet-like sound, resembling the voice of a person bawling into a cask."

"Honori had the people called together, by the sound of a conch shell, blown by a little imp of a lad, perched on a block of lava in front of the school house, when, as in the morning, he "lectured" on the third chapter of St. John."

On Tuesday, the 28th January he again moves from Kapupala upwards, for a sight of the highest peak of Mouna Roa.

"Among my attendants was one singular looking personage, a stripling, who carried a small packet of instruments, and trotted away in a "cutty sark," of scanty longitude, the upper portion of which had been once of white, and the lower of red flannel. Honori brought up the rear, with a small telescope slung over his shoulder, and an umbrella, which owing perhaps to his asthmatic complaint, he never fails to carry with him, both in fair and foul weather."

"At eleven, a.m., we came to a small pool of fresh water, collected in the lava, the temperature of which was 55°; here my people halted for a few minutes to smoke. The barometer stood at 26 inches, the air 62°, and the dew point at 58°. The wind was from the south, with a gentle fanning breeze and a clear sky. Hence the path turns north-west for a mile and a half, becoming a little steeper, till it leads to a beautiful circular well, three feet deep, flowing in the lava, its banks fringed with Strawberry vines, and shaded by an Acacia Tree Grove. Here we again rested for half an hour. I would recommend to any Naturalists who may in future visit this mountain, to have their canteens filled at the well just mentioned, for my guide, trusting to one which existed in a cave further up, and which he was unable to find, declined to provide himself with this indispensable article at the lower well, and we were consequently put to the greatest inconvenience. Among the brush wood was a strong kind of raspberry bush, destitute of leaves; the fruit I am told is white. At 4 P. M. we arrived at a place where the lava suddenly became rugged, and the brushwood low, where we rested and chewed Sugar Cane, (of which we carried a large supply), and where the guides were anxious to remain all night. As this was not very desirable, since we had no water, I proceeded for an hour longer, to what might be called the line of Shrubs, and at two miles and a half further on, encamped for the night. We collected some small stems of a heath-like plant, which with the dried stalks of the same species of compositæ which I observed on Mouna Kuah, afforded a tolerably good fire. The man who carried the provisions, did not make his appearance—indeed it is very difficult except by literally driving them before you, to make the natives keep up with an active traveller. Thus I had to sup upon Taro Roots. Honori as I expected, did not come up. I had no view of the surrounding country for the region below, especially over the land, was covered with a thick layer of fleecy mist, and the cloud which always hovers above the great volcano, overhung the horizon, and rose into the air like a great tower. Sunset gave a totally different aspect to the whole, the fleecy clouds changed their hue to a vapoury tint, and the volume of mist above the volcanoes, which is silvery bright during the prevalence of sunshine, assumed a fiery aspect, and illumined the sky for many miles around. A strong north-west mountain breeze sprung up, and the stars, especially Canopus and Sirius, shone with unusual brilliancy. Never even under a tropical sky did I behold so many stars. Sheltered by a little brushwood, I lay down on the lava beside the fire, and enjoyed a good night's rest, while my attendants, swarmed together in a small cave, which they literally converted into an oven by the immense fire they kindled in it."

"Wednesday, January 29th.—The morning rose bright and clear, but cold, from the influence of a keen mountain breeze. As the man who carried the provisions was still missing, the preparation of breakfast occupied but little time, so that accompanied by the Bird Catcher and "Cutty Sark," I started at half past six for the summit of the mountain, leaving the others to collect fuel, and to look for water. Shortly before day-break the sky was exceedingly clear and beautiful, especially that part of the horizon where the sun rose, and above which the upper rim of his Disc was visible like a thread of gold, soon to be quenched in a thick haze, which was extended over the horizon. It were difficult, nay almost impossible to describe the beauty of the sky, and the glorious scenes of this day. The lava is terrible beyond description and our track lay over ledges of the roughest kind, in some places glassy and smooth like slag from the furnace, compact and heavy like basalt; in others tumbled into enormous mounds, or sunk in deep valleys, or rent into fissures, ridges, and clefts. This was at the verge of the snow—not twenty yards of the whole space could be called level or even. In every direction vast holes or mouths are seen, varying in size, form, and color, from ten to seventy feet high. The lava that has been vomited forth from these openings presents a truly novel spectacle. From some, and occasionally indeed from the same mouth, the streams may be seen pressed forward transversely, or in curved segments, while other channels present a floating appearance; occasionally the circular tortuous masses resemble gigantic cables, or are drawn into cords, or even capillary threads, finer than any silken thread, and carried to a great distance by the wind. The activity of these funnels may be inferred from the quantity of slag lying round them, its size, and the distance to which it has been thrown. Walking was rendered dangerous by the multitude of fissures, many of which are but slightly covered by a thin crust, and every where our progress was exceedingly laborious and fatiguing. As we continued to ascend, the cold and fatigue disheartened the Islanders, who required all the encouragement I could give, to induce them to proceed. As I took the lead, it was needful for me to look behind me continually, for when once out of sight, they would pop themselves down, and neither rise nor answer to my call. After resting for a few minutes at the last station, I proceeded about seven miles further, over a similar kind of formation, till I came to a sort of low ridge, the top of which I gained soon after eleven P. M., the thermometer indicating 37°, and the sky very clear. This part was of gradual ascent, and its summit might be considered the southern part of the dome. The snow became very deep, and the influence of the sun melting its crust, which concealed the sharp points of the lava, was very unfavorable to my progress. From this place to the north, towards the centre of the dome, the hill is more flattened. Rested a short time, and a few minutes before noon, halted near the highest black shaggy chimney, to observe the sun's passage. In recording the following observations, I particularly note the places, in order that future visitors may be able to verify them. To the S. W. of this chimney, at the distance of one hundred and seventy yards stands a knoll of lava, about seventy feet above the gradual rise of the place. The altitude was 104°. 52′. 45″. This observation was made under highly favorable circumstances, on a horizon of Mercury without a roof, it being protected from the wind by a small oil cloth—bar. 18°. 953″. therm. 51°; in the sun's rays 43°. 5′, and where buried in the snow 31°., the dew point at 7°.!! Wind, S. W. The summit of this extraordinary mountain is so flat, that from this point no part of the Island can be seen, not even the high peaks of Mouna Kuah, nor the distant horizon of the sea, though the sky was remarkably clear. It is a horizon of itself, and about seven miles in diameter. I ought, ere now, to have said that the Bird Catcher's knowledge of the volcanoes did not rise above the woody region, and now he and my two other followers were unable to proceed further. Leaving these three behind, and accompanied by only Calipso, I went on about two miles and a half, when the great terminal volcano or cone of Mouna Roa burst on my view: all my attempts to scale the black ledge here were ineffectual, as the fissures in the lava were so much concealed, though not protected, by the snow, that the undertaking was accompanied with great danger. Most reluctantly was I obliged to return, without being able to measure accurately its extraordinary depth. From this point I walked along upon the brink of the high ledge, along the east side, to the hump, so to speak, of the mountain, the point, which, as seen from Mouna Kuah, appears the highest. As I stood on the brink of the ledge the wind whirled up from the cavity with such furious violence, that I could scarcely keep my footing within twenty paces of it. The circumference of the black ledge of the nearly circular crater, described as nearly as my circumstances would allow me to ascertain, is six miles and a quarter. The ancient crater has an extent of about 24 miles. The depth of the ledge from the highest part (perpendicular station on the east side) by an accurate measurement with a line and plummet, is twelve hundred and seventy feet. It appears to have filled up considerably all round; that part to the north of the circle seeming to have, at no very remote period, undergone the most violent activity, not by boiling and overflowing, nor by discharging under ground, but by throwing out stones of immense size to the distance of miles around its opening, together with ashes and sand. Terrible chasms exist at the bottom, appearing, in some places, as if the mountain had been rent to its very roots; no termination can be seen to their depth, even when the eye is aided with a good glass, and the sky is clear of smoke, and the sun shining brightly. Fearful indeed must the spectacle have been, when this volcano was in a state of activity. The part to the south of the circle, where the outlet of lava has evidently been, must have enjoyed a long period of repose. Were it not for the dykes on the west end, which shew the extent of the ancient cauldron, and the direction of the lava, together with its proximity to the existing volcano, there is little to arrest the eye of the naturalist over the greater portion of this huge dome, which is a gigantic mass of slag, scoriæ, and ashes. The barometer remained stationary during the whole period spent on the summit, nor was there any change in the temperature or in the dew point to-day. While passing, from eight to nine o'clock, over the ledges of lava of a more compact texture, with small but numerous vesicles, the temperature of the air being 36°.–37°., and the sun shining powerfully, a sweet musical sound was heard, proceeding from the cracks and small fissures, like the faint sound of musical glasses, but having at the same time a kind of hissing sound like a swarm of bees. This may perhaps be owing to some great internal fire escaping. Or is it rather attributable to the heated air on the surface of the rocks, rarified by the sun's rays? In a lower region, this sound might be overlooked, and considered to proceed by possibility, from the sweet harmony of insects, but in this high attitude it is too powerful and remarkable, not to attract attention. Though this day was more tranquil than the 12th, when I ascended Mouna Kuah, I could perceive a great difference in sound: I could not now hear half so far as I did on that day, when the wind was blowing strong. This might be, owing to this mountain being covered with snow, whereas on the 12th, Mouna Kuah was clear of it. Near the top I saw one small bird, about the size of a common sparrow, of a light grey mixed colour, with a faintly yellow beak—no other living creature met my view above the woody region. This little creature, which was perched on a block of lava, was so tame as to permit me to catch it with my hand, when I instantly restored it its liberty. I also saw a dead hawk in one of the caves. On the east side of the black ledge of the Great Terminal Crater, is a small conical funnel of scoriæ, the only vent-hole of that substance, that I observed in the Crater. This mountain appears to be differently formed from Mouna Kuah, it seems to be an endless number of layers of lava, from different overflowings of the great crater. In the deep caves at Kapupala, two thousand feet above the level of the sea, the several strata are well defined, and may be accurately traced, varying in thickness with the intensity of the action, and of the discharge that has taken place. Between many of these strata are layers of earth, containing vegetable substances, some from two feet to two feet seven inches in thickness, which bespeak a long state of repose between the periods of activity in the volcano. It is worthy of notice, that the thickest strata are generally the lowest, and they become thinner towards the surface. In some places I counted twenty-seven of these layers, horizontal, and preserving the declination of the mountain. In the caves which I explored near my camp, which are from forty to seventy feet deep, thin strata of earth intervene between successive beds of lava, but none is found nearer the surface than thirteen layers. No trace of animal, shell, or fish, could I detect in any of the caverns or caves, either in this mountain or Mouna Kuah. At four P. M. I returned to the centre of the dome, where I found the three men whom I have left, all huddling together to keep themselves warm. After collecting a few specimens of lava, no time was to be lost in quitting this dreary and terrific scene. The descent was even more fatiguing, dangerous, and distressing than the ascent had proved, and required great caution to escape unhurt: for the natives benumbed with cold, could not walk fast. Darkness came on all too quickly, and though the twilight is of considerable duration, I was obliged to halt, as I feared, for the night, in a small cave. Here though sheltered from the N. W. breeze, which set in more and more strongly, as the sun sunk below the horizon, the thermometer fell to 19°, and I was yet far above the line of vegetation, unable to obtain any materials for fire, and destitute of clothing, except the thin garments soaked in perspiration, in which I had travelled all day, and which rendered the cold most intense to my feelings. I ventured, between ten and eleven P. M. to make an effort to proceed to the camp. Never shall I forget the joy I felt when the welcome moon, for whose appearance I had long been watching, first shewed herself above the volcano. The singular form which this luminary presented, was most striking. The darkened limb was uppermost, and as I was sitting in darkness, eagerly looking for her appearance on the horizon, I descried a narrow silvery belt 4° to 5° high, emerging from the lurid fiery cloud of the volcano. This I conceived to be a portion of the light from the fire, but a few moments shewed me the lovely moon shining in splendour in a cloudless sky, and casting a guiding beam over my rugged path. Her pale face actually threw a glow of warmth into my whole frame, and I joyfully and thankfully rose to scramble over the rough way, in the solitude of the night, rather than await the approach of day in this comfortless place. Not so thought my followers. The bird-catcher and his two companions would not stir; so with my trusty man Calipso, who follows me like a shadow, I proceeded in the descent. Of necessity we walked slowly, stepping cautiously from ledge to ledge, but still having exercise enough to excite a genial heat. The splendid constellation of Orion, which had so often attracted my admiring gaze in my own native land, and which had shortly passed the meridian was my guide. I continued in a south-east direction till two o'clock, when all at once I came to a low place, full of stunted shrubs. Of more robust habit, however than those at the camp, I instantly struck a light and found by an examination of my barometer, that I was nearly five hundred feet below the camp. No response was given to our repeated calls. It was evident that no human being was near, so by the help of the moon's light we shortly collected plenty of fuel, and kindled a fine fire. No sooner did its light and warmth begin to diffuse themselves over my frame, than I found myself instantly seized with violent pain and inflammation in my eyes, which had been rather painful on the mountain, from the effect of the sun's rays shining on the snow; a slight discharge of blood from both eyes followed, which gave me some relief, and which proved that the attack was as much attributable to violent fatigue as any other cause. Having tasted neither food nor water since an early hour in the morning, I suffered severely with thirst; still I slept for a few hours, dreaming the while of gurgling cascades, overhung with sparkling rainbows, of which the dewy spray moistened my whole body, while my lips were all the time glued together with thirst, and my parched tongue almost rattled in my mouth. My poor man Calipso was also attacked with inflammation in his eyes, and gladly did we hail the approach of day."

"The sum rose brightly on the morning of Thursday, January 30th, and gilding the snow over which we had passed, showed our way to have been infinitely more rugged and precarious, than it had appeared by moonlight. I discovered that by keeping a mile and a half too much to the east, we had left the camp nearly five hundred feet above our present situation; and returning thither over the rocks, we found Honori engaged in preparing breakfast. He had himself reached the camp about noon on the second day. He gave me a calabash full of water, with a large piece of ice in it, which refreshed me greatly. A few drops of Laudanum in the eyes afforded instant relief both to Calipso and myself. The man with provision was here also, so we shortly made a comfortable meal, and immediately after, leaving one man behind with some food for the bird-catcher, and his two companions, we prepared to descend, and started at nine A. M. to retrace the path by which we had come. Gratified though one may be at witnessing the wonderful woks of God, such a pricalen as the summit of this mountain presents, still it is with thankfulness that we again approach a climate more congenial to our natures, and welcome the habitations of our fellow men, where we are refreshed with the scent of vegetation, and soothed by the melody of birds. When about three miles below the camp, my three companions of yesterday appeared like mawkins on the craggy lava, just at the very spot where I had come down. A signal was made them to proceed to the camp, which was seen and obeyed, and we proceeded onwards, collecting a good many plants by the way. Arriving at Strawberry Well, we made a short halt to dine, and ascertained the barometer to be 25° 750′; air 57°; and the well 51°; dew 56°. There were vapouring light clouds in the sky and a S. W. wind. We arrived at Kapupala at 4 P.M. The three other men came up at seven, much fatigued, like myself. Barometer at Kapupala at 8 P. M. 27° 936′, air 57° and the sky clear."

Thus was described for the first time Mouna Roa, within whose summit and flanks is contained one of the outlets of earth's interior fires,—an opening to that awful laboratory, of whose operations we may have a slight glimpse, standing fearfully at a distance, while our comprehension quails at the attempt to investigate their causes or origin. In the crater of Mouna Roa, are the deep caverns, the profound unfathomable abysses, the ceaseless flow of fiery molten matter, which sometimes glides like a rapid stream into these abysses, till it is lost to the view, and in other places surges and boils up into swelling lofty jets, as if impatient of being pent in by those walls of lava, scoriæ, and ashes, which itself in its own former fury had formed. How vastly deep, expanded, and powerful must be the interior movement that produces all this! Well has it been surmised that the dreadful earthquake originates in the same agency. Were the plastic fluid masses of the active volcano solidified, and crusted over, we should then have the hollow rumbling and onward wave of the earthquake, overturning men's habitations like anthills, and no exit being permitted, the solid granite would be upheaved, and the foundations of the mountains laid.

Mr. Douglas continued on these Islands botanizing, and was at

Woahoo in May, from which place he communicated with his friends in England; having returned to Hawaii, he was again out on the south side of Mouna Roa, on the 12th July, 1834, on the road to Hido. Here he was cautioned to avoid the pits, dug purposely by the natives, for the taking of wild cattle. Notwithstanding this friendly warning, it appears he was not sufficiently on his guard. Some islanders, on the same day, in pursuit of cattle, perceived one of these pits broken, and on looking in, saw Mr. Douglas' body at the bottom, with a bullock standing over it. Assistance being soon had, the animal was shot, and the ill-fated and amiable naturalist taken out without a sign of life. He had been miserably bruised and gored to death. There had been three pits at this spot, close to some water, two upon the line of the path, and another to one side. On examination, it appeared as if the unfortunate traveller had looked at the two on the road, in one of which was a cow; that he had afterwards proceeded about thirty paces, and then leaving his bundle and little dog, had turned back to the third pit, in which there happened to be another animal. He must have approached this too incautiously, and either by the earth giving way, or by a false step have fallen in, and came into the power of the enraged beast. Amid those scenes which he loved so well, but far from human help, so perished one devoted to science, and who in a few years, and with slender means had accomplished much in her cause. He had been successful to a high degree in gratifying the lovers of botany by his discoveries, and in adding to the pleasures of those tender hearts who delight in the floral riches of the garden. His contributions had been not so much of a kind to increase largely the number of hot house plants, but rather of those that with a little early warmth and protection, will flourish out of doors in a temperate climate. On this account, therefore, he may be considered to have contributed more abundantly to the amount of amusement and to the benefits of social life. He added to the enjoyment of all those who can afford to have a patch of soil, however small, around their humble dwellings. In this manner has been encouraged the pursuit of a gentle art, the study of which softens the heart and improves the mind, or in the beautiful words of the poet, "Emollit mores, nec sinit esse feros."

The remains of the deceased were conveyed to Woahoo, on the 3rd August, examined by a medical gentleman, and next day consigned to the narrow house, the grave, in the presence of Richard Charlton, Esq., British Consul, Captain Seymour, and officers of the Challenger, and all the foreign residents at the place. Lament may be allowed for David Douglas. Through eleven years of toil and hardship, danger, difficulty, and loss, he had strenuously worked his way, following his vocation with a devoted spirit and undaunted courage. He feared God, was beloved by his friends, and esteemed by all who ever had the happiness of knowing him. An inscrutable decree cut him down as he grasped the laurel of wordly fame. Fleeting though that may often be, still the noble qualities of his soul hold fresh impressions on the memory of his friends, and his worth as a useful member of society, and practical botanist, will live and be felt while the study and cultivation of plants and flowers remain pleasing and beneficial to mankind. G. B.

ARTICLE XLV.—*A Holiday Visit to the Acton Copper Mines.* By one of the Editors.

Before entering upon the special subject of this paper, we shall explain to our readers in what place within the Province of Canada these mines may be found. If, then, we start from the terminus of the Grand Trunk Railway at Montreal, and crossing the far-famed Victoria Bridge take the road towards Portland, we get upon the highway to the village of Acton. Travelling thus in a direction a little north of east we pass over the beautiful plains of the county of Chambly and the still more lovely valley of the Yamaska, which, were they cultivated with any degree of skill, or intelligence, would rival for productiveness the prairies of the west, and yield immense wealth to their owners and the country. As it is, the fields are for the most part miserably neglected—the soil is apparently wrought-out and impoverished by frequent cropping—the grain crops are very scanty, and the herbage of the pasture lands is little more than stunted Canada thistles. Lean men and lean kine pick up a poor subsistence on these wasted meadows of this fine county. So thoroughly has the land been cleared that bush or tree of any kind is scarcely to be seen, and even fences are few and far between. The old timber has long ago been swept away, root and branch; and the idea of planting trees for shelter, beauty or fuel, has not yet entered the rustic minds of the happy *habitans*. As we near the river Yamaska, the scenery becomes certainly more picturesque. Clumps of wood and fertile fields relieve the eyes, and to the right the Belœil Mountain rises in front almost sheer out of the plain. Its abrupt and sloping sides are at this season luxuriantly clothed with softest verdure. This great intrusive mass of trappean rock is an object of striking beauty and one of the choicest retreats for the lovers of Nature. Its geological structure and character indicate without mistake the peculiar disturbances to which this region of country was subjected during the ancient Silurian period. Obtruded into the stratified deposits of the locality in a pasty, if not also in a molten state, and assuming a crystalline character, it has withstood for ages—an everlasting mountain—the destructive forces to the action of which it has been exposed. The bluff and rugged appearance of its north-eastern side and its gradual slope to the south-west indicate that during the tertiary age it was washed by the waters of the northern ocean. As the land gradually rose from the bed of the deep it stood as one of a group of small islands amid a waste of waters bearing on their bosom flows, and bergs of ice. But many a change has passed over the earth's surface since these very ancient days. For ages Belœil has stood as it now appears an outpost sentinel of the Mountains of Vermont. It has long looked over the fertile valley of the St. Lawrence. It has been the abode of the wolf, the bear and concolor, and the camping ground of the wild Indian. Civilization has for half a century at least driven these away from its precincts and it is now a pleasant resort of the summer tourist. For the botanist no place can be more delightful or richer of results. Its flora comprises a great part of the plants that are peculiar to the northern United States and to Canada. Were it our purpose now to descant upon this inviting topic we might say much that would be interesting but we must pass on, however reluctantly, to our appointed destination. Leaving Belœil we sight, in the distance to the west, the conical peak of Mount Johnston and the huge whale-like elevation of Rougemont. Around us the land is dry and barren. Farms and clearances are not so common. Tangled bush and mossy swamp everywhere prevail. We pass the flourishing town of St. Hyacinthe and traverse a country which for many miles has no features of interest, and little to indicate that it can be of much value for permanent settlement. About seventy miles from Montreal we finally reach the village of Acton, a station on the line of railway. Once it was a poor and little frequented place, but now, thanks to the copper mines, it is full of vigorous life. There is no beauty about it at all. The country around it has not to any great extent been cleared. Patches of cultivated and pasture land here and there nestle in the woods. Stumps and scrubby bush are on all sides conspicuous features. The soil is not good; for the most part it is barren sand and scarcely worth the labour of cultivation. In some seasons it will afford good pasturage for which purpose it is most likely to be henceforth devoted.

The old houses of the hamlet are rapidly being put out of countenance by new and more pretentious erections. Large buildings are springing up on every side for stores, work-shops and dwelling-houses. Already wealth is beginning to flow into this hitherto obscure and neglected place. Its population within the last few months must have increased seven-fold at least. Signs of prosperity are everywhere manifest. The barren fields which formerly might have been purchased for an old song, are now transformed into town-building lots, and rising enormously in value. According to the course of things in this country the village bids fair to become, e. e long, a town and the town, in due course, to be raised to the rank of an incorporated city.

The mines are about half a mile distant to the west from the village. The road at first passes over low and swampy ground, part of which has been cleared. A little way on the road becomes dry and sandy. About half way there is a considerable ridge of sand which lies in a direction to the west of south. Hemlock is the prevailing timber; sphagnum abounds in the swamps, in which also there is an undergrowth of curious shrubs and plants. The region is by no means picturesque but rather the very reverse. A lover of beautiful scenery would never think of seeking it here. A botanist would scarcely think the labour of forcing his way through swamps, charred stumps, fallen rotten timber, and prickly branches, repaid even by the pretty and interesting plants he would pick up. With compass in hand we attempted to explore the surrounding waste, and, except for the novelty of the thing, it was rather weary work. We satisfied ourselves of this, however, that the mound of sand runs through the bush in a line parallel to the limestone rocky ridge, about half a mile to the west, on the flank of which the mines are found, and may have been formed, in the process of the elevation of the continent, on the shores of an ancient estuary.

To a geologist this region is, however, very inviting. The traces of copper which the surface affords are sufficient stimulants to invite elaborate research. The elevations of the strata with their curious contortions are themselves interesting. The prospect of finding a fossil among such altered rock-masses by which the position of the formation in the great Silurian series might with accuracy be determined, would of itself be an inducement for the expenditure of much time and labour. As we approach the mines we are reminded by the traffic of vehicles laden with kegs heavy with precious ore that we are in the precincts of a place of unusual industry. The sound of the hammer too rings pleasantly upon the ear, and the deep hollow noise of constant blasts awaken interest in the scene. As we reach the termination of the road between the village and the mines a sight of much interest opens up to our view. An open space of about a mile in length and a quarter of a mile in breadth, entirely cleared of timber, lies before us. It is covered with temporary wooden buildings and heaps of broken rocks. Along its whole length it is cut up by trenches and shafts and deep quarries. In the back ground there rises a ridge of rock to the height of about 100 feet strewn with broken masses of stones and crowned with a scanty growth of bush.

But instead of describing these mines any further ourselves, we shall take advantage of an exceedingly lucid and succint account of the locality contained in the "Report of the Geological Survey of Canada for 1858." We had the pleasure of tracing for ourselves the topographical descriptions which it contains and verifying their remarkable accuracy.

"The existence of the copper ore on the thirty-second lot of the third range of Acton was I believe discovered by Mr. H. P. Merrill, and at the request of Mr. Cushing, the proprietor of the land, Mr. Hunt visited the locality in August last. As then seen, before any excavation had been made, the surface presented an accumulation of blocks of copper ore, evidently in place, and covering an area of about sixteen paces in length by ten paces in width. These masses consisted of variegated sulphuret of copper, intermingled with limestone and a silicious matter, without any thing like vein-stone, and evidently constituted a bed subordinate to the limestone, whose strike was about N. E., with a dip to the north-west at an angle of about forty degrees. In continuation of this bed for about seventy paces in either direction, the limestone was observed to hold little patches and seams of variegated ore and yellow pyrites, with stains of the blue or green carbonates of copper. The limestones in the immediate vicinity presented several veins of quartz crossing the strike, but containing only traces of copper.

"During Mr. Hunt's visit, a small amount of excavation was made with pick and shovel, and a farther extent of work has been done since, but though this has not added materially to the information at first obtained, there can be no doubt, even should the limits of the deposit extend no farther than those above indicated, that there is here an unusually rich bunch of copper ore.

"The mine is just half a mile to the south of the Acton station of the Grand Trunk Railway. The road to it is over a marshy piece of ground, and it is crossed by one or two low mounds of yellow sand. At the end of the road, a hill rises to the height of about 105 feet above the marsh, and descends to a marsh on the other side. It stands on a base of a quarter of a mile in width and for nearly one-half the distance is composed of a sub-crystalline magnesian limestone dipping to the N. W. with an inclination varying from thirty to forty degrees. The limestone is light grey in fresh fractures, and weathers to a dull pale yellowish tint on the exterior. It is in some parts studded with concretionary nodules consisting of concentric layers of carbonate of lime with a transverse fibrous structure. The exterior of these is of a botryoidal form, and the layers are in some places partly replaced by chert preserving the fibrous structure. These nodules very much resemble some concretionary forms of travertine, and the occasional intercalation of magnesian layers in the nodules makes it probable they are the latter. As stated by Mr. Hunt the limestone of the hill is intersected by several small veins of quartz, and one of them, more conspicuous than the rest, carries traces of the yellow sulphuret of copper and of galena. The mass of limestone visible, extending a short distance beyond the summit of the hill, has a thickness of about 270 feet. It is divided into heavy beds in which irregular masses of chert are disseminated in unequal quantities in different places, being most abundant towards the bottom.

"The summit of the limestone from the north-eastern corner of the lot proceeds south-westward for about thirty chains, and in the succeeding 300 yards turns gradually south and ultimately a little to the east of south before becoming concealed. In the other direction, after running some distance, it sinks beneath a marsh on the thirty-first lot of the third range, and again makes its appearance on the rail road, which it crosses about three quarters of a mile to the east of the Acton station, meeting and crossing the Black River about 220 yards north of it.

"The rock underlying the limestone is concealed, but that which immediately overlies it at the mine, appears from partial exposures to be a lavender-grey shale or slate with a cleavage independent of the bedding. In this slate there appear to be irregularly distributed large masses of a harder rock, which is internally of a light olive-green, uniformly and finally speckled with darker green spots looking like serpentine, many of which are surrounded with a bluish-grey film. The rock under atmospheric influences becomes light yellowish-brown on the surface, and in its weathering strongly resembles some of the serpentines of the Eastern Townships. Some of the masses measure fifty yards in length by twenty in breadth, on the north side of the rail road there is one of twice those dimensions, apparently sunk into the top of the limestone. Thin layers of the rock occasionally appear to be interstratified evenly among the slates. In thick masses spots of calc spar are sometimes disseminated, giving the rock a cellular and somewhat trappean aspect, but there is no evidence that it is intrusive and it occasionally assumes the character of a sandstone with small quartz pebbles running in the direction of the beds. In the speckled part of the rock very thin partitions of the same colour and hardness as the darker green spots run in several directions. These partitions on analysis prove to be a ferruginous chlorite, and the whole rock may be described as a hydrous silicate of alumina with much iron and magnesia.

"These slates and harder masses have a thickness of about eighty-five feet. They are succeeded by isolated masses of limestone of various sizes and somewhat rounded or lenticular forms, some of them attaining magnitudes of thirty yards in length by by twenty in breadth, and even eighty yards in length by ten in breadth. As seen on the surface they present a succession of protruding lumps, which run in a line parallel with the summit of the limestone, turning with it to the southward at the south-western part of the exposures. These calcareous masses consist of grey limestone made up of irregular and apparently broken beds and rounded forms, and bold irregular ragged pieces of chert in more or less abundance, with strings and spots of calc spar. The serpentine-like rock sometimes appears to surround these calcareous masses.

"The copper ore appears to occupy a position immediately near the isolated masses of limestone, and very little of it to penetrate into the serpentine-like rock or the slate. Indications of it occur on both sides of the calcareous masses and in some places can be traced as if surrounding them; but the chief part appears to be beneath them and intermediate between them and the slates and serpentine-like rock. The ore consists of the pyritous, variegated and vitreous sulphurets of copper, the second species being the most abundant and the third more abundant than the first. The green carbonate also occurs, but it must be regarded as a secondary product formed at the surface and in cracks. The chief excavation has been made in a cross-cut running S. 45 E., which is at right angles to the strike. The depth excavated is from four to eight feet, and the following is the succession of masses met with in the cross-cut, given in a descending order and reduced to vertical thickness for horizontal measurement.

	Feet.
1. Limestone; this may be a boulder deeply sunk in the soil but it is supposed to be in place and to belong to one of the isolated masses of the stratification.........	3
Concealed..	3
Limestone in place, belonging to one of the isolated masses; small irregular spots of the pyritous sulphuret of copper occur in the rock; this is probably part of the same mass as the first three feet and the concealed three feet would also be a part, making the whole 8 feet....	2
2. Variegated sulphuret of copper enclosing numerous angular fragments of limestone in irregular aggregations; this mass dipped with the stratification, but thinned out and terminated downwards...........................	2
3. Limestone broken in various sized angular fragments by a number of reticulating cracks of from one quarter of an inch to three inches in width, and filled with variegated sulphuret of copper, with spots of white crystalline calc spar and occasional crystals of transparent quartz.....	15
4. Breccia or conglomerate with a paste composed of variegated and vitrious sulphurets of copper mingled with fine grained silicious matter, enclosing fragments of lime-	

stone, some angular and some rounded; some of them almost wholly calcareous and others largely silicious. The sulphurets of copper run in parallel clouded streaks, the clouded character being occasioned by the presence of more or less silicious matter mingled with the steel-grey and the purple of the two sulphurets...........	4
5. Limestone...	2
6. Copper breccia or conglomerate of the same characters as before..	4
7. Limestone...	3
8. Slate with traces of copper (green carbonate on the surface)..	12
9. Serpentine-like rock..............................	14
10. Slate with traces of copper (green carbonate on the surface)..	4
11. Concealed to the limestone.......................	25
	93 ft.

"The thickness of fifteen feet given to the brecciated limestone of No. 3 is deduced from a horizontal measurement of ten yards across the strike and a supposed slope of thirty degrees, which is about the dip of the bed and of the strata where it can be made out in the vicinity. But no clear indication of bedding is visible in the body of the breccia, and as the excavation across it is yet only two feet deep, it may hereafter be proved that by some irregularity the slope is less than thirty degrees; in that case the thickness would have been reduced in proportion to the diminution of the slope. If the slope should be eighteen degrees the thickness will be ten feet.

"The two breccia or conglomerate beds numbered 4 and 6 contain the great body of the copper ore. On the strike these beds are exposed for about eight yards to the south-west. There is then an interruption by the presence of a wall of the serpentine-like rock, which crosses the strike in the shape of a slender wedge coming to a point north-westwardly and gradually spreading out into the strata in an opposite direction. A farther quantity of copper conglomerate, however, exists on the opposite side of the wedge shaped wall. The condition of the rock to the north-east of the cross-cut has not yet been sufficiently ascertained to give any description of it except from an excavation at the distance of about forty-five yards. Here a mass of ore has been mined for about two fathoms on the strike, commencing with a breadth of nine feet, and irregularly diminishing to the north-westward. Beyond the excavation it appears to diminish farther and probably thin out. On the northwest side this mass was limited by limestone belonging to the line of isolated masses and on the south-east by a mass of serpentine-like rock, the face of which stands in a nearly vertical attitude.

"In costeening pits, which have been carried across the strike of the upper part of the ore, at distances of about eighty yards on one side of the cross-cut and 110 yards on the other, indications of ore continue to exist in the stains of green carbonate and small masses of the sulphurets, but the work done is not sufficient to give facts that bear upon the mode on which the ore is connected with the rock.

"In so far as the facts ascertained by the present condition of the excavation enable an opinion to be formed, it appears to me probable that the copper ore mingled with silicious matter constitutes the paste of a breccia or conglomerate, the fragments of which have been accumulated in a depression in the surface of the argillaceous and silico-magnesian sediments forming the slates and their associated harder masses, while the sulphurets of copper have been deposited from springs bringing the metal in solution from some more ancient formation. The whole conditions of the case appear to bear a striking resemblance to those of the copper deposits of the Urals as described by Sir Roderick Murchison, except that in Russia the ores are carbonates instead of sulphurets.

"However this may be, there is no doubt the mass of ore is a very important one; already, after but nine weeks' work, not far from three hundred tons have been housed, supposed to contain about thirty per cent. of pure metal. The value of this quantity would be about $45,000, while exclusive of lordship, the mining expenses, and those necessary to carry the ore to a market, will be comparatively small. The quantity of ore excavated appears to have produced but a moderate impression on the total mass in sight.

"Whether such another bunch of copper ore will be met with associated with the limestone it is impossible to say: but even should one exist, it would perhaps be too much to expect that it would be found immediately at the surface.

"Many of the facts connected with the mode in which the copper ore of the conglomerate is related to the fragments, were ascertained by slitting a slab of the rock by means of a lapidary's wheel and polishing the surface. The same test has been applied to a block of the Upton conglomerate, and it is found there is some analogy in the two cases, except that the Upton ore is altogether pyritous sulphuret and much more thinly distributed among the fragments. While large blocks of the Acton conglomerate give thirty per cent. and upwards, of pure metal, the best blocks obtained by me from the conglomerate of Upton do not yield more than five per cent. But this if the quantity of rock with such a per centage were larger and the masses not too widely scattered, would constitute a valuable mine. It would, however, require a careful crop trial to determine whether the quantity is available."

Since these observations have been made by Sir William Logan, the cupriferous deposits have been much more exposed, and their character more distinctly marked. In order to bring the matter fully before our readers we would further avail ourselves of certain geological notes which we found in the hands of the proprietors of the mines, and which we are kindly permitted to use, the descriptions and conclusions of which, after careful inspection of the ground, we are disposed to accept.

1. *Appearances of Mr. Sleeper's Openings.*

EASTERN OPENING.—Beds dip N. 40° W. about 50°, and consist of nodular limestone alternating with shale and overlaid by it. Copper Pyrites in small, apparently not workable, quantity, occur in both rocks, especially at their junction. The shale is much tinged with carbonate of copper. Underlying the limestone is a hard gray, irregularly bedded, earthy rock (? a volcanic ash or tufa). This rock I regard as allied to *Palagonite tuff*, and for convenience shall call it simply tufa or tufaceous rock. The section at this place is nearly as follows: (Fig. 1).

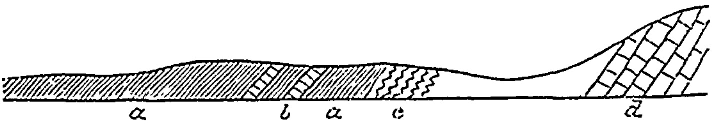

Fig. 1.

(*a*) Shale. (*b*) Copper Limestone. (*c*) Tufaceous rock. (*d*) Limestone of the hill or ridge south of the Mine.

SECOND OPENING (Fig. 2).—This is connected with the former by a trench in the strike, showing shale with copper stains.

Beginning at the great hill limestone, we have 22 paces without section, then 27 paces shale and tufa, the latter predominating in the upper part, then 4 yards limestone, nearly vertical, then shale extending about 30 paces. At the junction of the limestone and upper shale are traces of copper pyrites, and black oxide of copper. Section as follows:—the letters referring to the same rocks as in Fig. I.

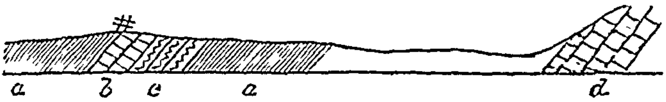

Fig. 2.

Third Opening (*Sleeper's latest*).—At this place there is a great thickness of vertical and contorted shale, apparently underlaid by tufa. The copper limestone is represented by a layer of highly cupriferous material about one foot thick at the outcrop. This was only imperfectly exposed: (Fig. 3). The ore here is purple copper.

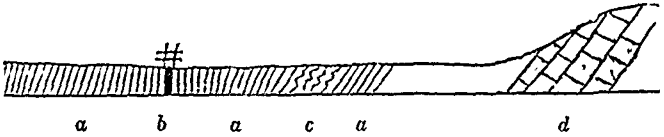

Fig. 3.

Fourth Opening (*Sleeper's shaft pit*).—At this place the copper limestone is highly developed, and presents an upper bed about 5 feet thick, holding yellow pyrites and rapidly thinning out toward the dip, a lower layer about 4 feet, very rich in purple copper in laminæ parallel to the bedding, and below this unproductive limestone and shale, which last also overlies the upper limestone. The whole of these beds are thrown into a sharp anticlinal fold. The shaft has been sunk on the part dipping toward the hill, say S. E., and the main pit exposes the crown of the arch and its N. W. side. At the corner of the fold is a fissure or vein running S. 20° W., underlying to the N. W., and containing calc spar and quartz with yellow pyrites. The valuable portion of the ore is, however, the 4 feet bed of cupriferous limestone. This does not appear to run out so far as yet followed to the dip, but disappears suddenly when followed to the east, where either a change in the original deposition or a dislocation brings in a mass of the tufaceous rock and shale, intervening between this and the last mentioned opening: (Fig. 4.)

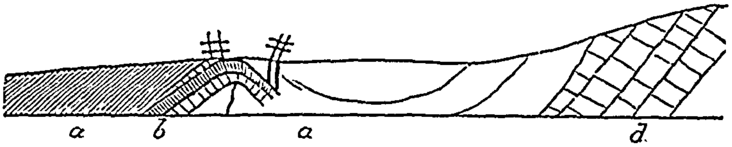

Fig. 4.

Fifth Opening (*Sleeper's original pit*).—Here the arrangement has been similar to that at the last opening, but the crown of the arch of copper limestone, now worked away, has been broader and at the surface. There is also evidence here of transverse dislocations bringing narrow belts of tufa and shale across the limestone. As in the last mentioned place the copper limestone still continues productive toward the dip.

Sixth Opening—Here the lower and unproductive part of the copper limestone is exposed. It seems largely developed, but the upper cupriferous portion has either not been deposited or has been removed by denudation. It should be sought toward the dip, and as the stratification seems arched here as at the last mentioned places, it may be found on either side.

Otte's shaft is sunk on the shale underlying the copper limestone, and which is here nearly vertical, so that it cannot reach the deposits above referred to. Near the shaft, and to the rise of the beds, there appears a cupriferous bed which deserves exploration, more especially as it is evidently not the same with that exposed in the other workings.

2. *Western Extension of the Bed.*

The copper limestone extends for some distance to the westward, its outcrop bending to the southward. In several places it contains traces of copper ores, and should be opened by trenches as at Sleeper's pits.

3. *Eastern Extension.*

No opening occurs in the beds eastward of the first above mentioned; but Mr. Sleeper reports good indications in the low land to the east, and at the railway cutting still farther east the copper limestone and tufa appear but are not known to be productive. Benjamin's opening is off the line of strike, on the Hill limestone and shows nothing of value. This is also the case with Wright's opening, which is on the escarpment of the hill limestone, there bending so as to dip nearly north.

4. *Theory of the Deposit.*

This may be stated as follows. Water holding sulphate of copper in solution has been diffused, probably by submarine springs, through calcareous sediment, possibly containing organic matter, and the salt of copper being deoxidised has been deposited in the beds as sulphuret of the metal. The limestone itself holding this deposit is an irregular nodular bed, the "copper limestone," of the above description subordinate to the thick shale overlying the great limestone of the Acton ridge. After deposition molecular action has led to the formation of nodules and segregative veins of the copper ore, and at a later period the beds have been contorted and faulted, and in the fissures thus formed true veins, holding copper pyrites in a matrix of calc spar and quartz, have been deposited."

In regard the exposures at Upton it may be remarked that they seem to be the equivalent of the Acton Hill limestone, and show numerous veins holding yellow pyrites, and in some places galena, with calc spar and quartz. Some of these veins run parallel to the strike, which is N. E. and S. W., the dip being S. E., but there is another set nearly at right angles to it. The true equivalent of the Acton copper limestone may be found running parallel to the great limestone at some little distance.

Since the above notes were written considerable progress has been made in the work of excăvation and there is still no apparent diminution of the cupriferous rock—it does not appear to thin out as it penetrates the strata in which it is embedded. That it occurs in masses of irregular thickness along the strike of the underlying limestone and thus has the character of nodular matter rather than of a regular aqueous deposit is obvious. It is not improbable that at the period of the infiltration of the copper, disturbances and alteration of the associated strata took place to a considerable extent, reducing them into their present abnormal state. It is only therefore by actual experiment that the real character of this cupriferous deposit can be ascertained. It may underlie in workable quantities, the whole of the space within the synclinal of Acton and Upton and thus prove to be one of the most extensive and valuable copper regions in the world.

But it may only be found in detached pockets of greater or less extent, and irregularly distributed throughout the valley; even in this case it will be of great value and amply repay for many years to come skilful and judicious labour.

The proprietors are about to open shafts and to erect suitable machinery for working them to the north of the present mines. These operations will determine in some measure the extent and character of the deposits. Before another year closes we may therefore hope to present to our readers a more definite account of the geological character of the Acton mines. It is evident that they are in the hands of enterprising men and are being worked with intelligence and vigour. At present they present a busy scene of active life. About 200 men, women and boys, are engaged at good wages in the various departments of the works. The strong men are busy boring and blasting and carrying off the precious fragments from the mines. Others are breaking the masses of rock into small pieces, and then a multitude of boys and girls are washing, picking, and arranging the pieces according to the quantity of copper they contain. Other workmen fill the barrels with the broken washed and selected ore; and from the mines to the Railway station at the village, there is a constant traffic of Canadian carts laden with the metallic spoils.

Several thousand tons have by this time been shipped to the market at Boston. The assay of the best quality of the ore gives from 25 to 30 per cent. of copper. This is a large percentage and must prove highly remunerative to the fortunate owners. When the requisite machinery is erected for mining, crushing, washing and smelting the rock, much that cannot now be removed from the locality on account of the cost of transit to Boston will yield a workable profit, and the copper of the richest ores will become more immediately available. The quality of the Acton copper is already coming into notice and is reckoned only second to that of Lake Superior.

By the enterprise of a few intelligent men, there has thus during the past year been opened up to Canada a source of industry and wealth that will not only benefit the parties immediately concerned but also the country at large. Whatever of value we can extract from the earth is a real addition to our wealth, increases our available means for the employment of human labour, and for the extension of our agriculture and commerce. The discovery of the Acton mines will, we doubt not, become an important epoch in the history of our national industry. A. F. K.

ARTICLE XLVI.—*Notes on the Earthquake of October*, 1860. Read before the Natural History Society of Montreal, Oct. 29, 1860.

On the 17th October, Canada and the Northern States of the American Union, were visited by an earthquake vibration of a more general and impressive character than any that has occurred for many years, and we propose to present to our readers such reports as have reached us with respect to its distribution, time, and local intensity, and to add for comparison and future experience a summary of the earthquakes that have occurred in Canada since its colonization, and some remarks on the laws of these phenomena as far as they have been ascertained.

In Canada the earthquake of the 17th. was experienced in its greatest intensity in the lower part of the river, and with diminished force as far west as Hamilton. In the United States, in like manner, it was most violent on the Atlantic coast and extended westward apparently with less intensity as far as Troy. Between Hamilton and Father Point it was felt throughout the whole of Canada. At River Ouelle and other places in the lower St. Lawrence it was so violent as to throw down chimnies and damage walls, and several severe shocks were felt. In Upper Canada there appears to have been but one shock and this comparatively feeble. We have at present no information as to the extension of the vibrations to the north of Canada and to the south of the Northern States.*

The following list of places in which observations were made of the time and intensity of the shocks has been compiled chiefly from the newspapers, to which much credit is due for the careful and intelligent manner in which they have collected and recorded the facts.

The places have been arranged in the order of their longitudes, from east to west, and it will be observed that the time is earlier in eastern localities, but on comparing Bic and Belleville nearly nine degrees of longitude apart, it will be seen that the difference of time is only a little less than that due to the difference of longitude. The Hamilton observation would give an earlier time, but as the shock was slight and the testimony of only one observer was recorded, there may be an error. The shock thus appears to have been nearly simultaneous throughout Canada.

* It was felt in New Brunswick also.

Bic, 6 a. m., Three shocks at intervals of some seconds, noise continued for 10 minutes.

Green Island, 6 a. m.

Rivière du Loup, 6 a. m. A series of shocks lasting nearly five minutes. A schooner off this place experienced a shock resembling that of striking on a sand-bank, and the waters of the Gulf were unusually agitated.

River Ouelle, 6.15 a. m. Very violent, damaging walls and throwing down chimneys, especially in low grounds.

Eboulements, near Murray Bay, 5.30 a. m. Violent. Five other feeble shocks in rapid succession, another at noon and another at 5 p. m. This is the only place where these latter shocks are mentioned, but the hour of the first is probably an error, as Bay St. Paul, quite near Eboulements, agrees in this respect more nearly with other places.

Bay St. Paul, 5.50 a. m. Violent shock; chimneys fell.

St. Thomas (Montmagny) 6 a. m. Two shocks.

St. Joseph de la Beauce, 6.10 a. m.

Quebec, 5.50 a. m. Several shocks, severe, especially in lower parts of the city and in the environs; but less so than at River Ouelle, &c.

Leeds, Megantic, 6.10 to 6.15 a. m.

Richmond, 5.45, a. m.

Three Rivers, about 6 a. m. Shocks felt for two minutes.

Granby, about 6 a. m.

St. Hyacinthe, 5.45 a. m. Three shocks continuing more than a minute, buildings reported damaged.

Maskinonge, 6 a. m. Shocks felt for more than a minute, supposed to be from North to South.

Montreal, 5.50. Two or three perceptible shocks, felt less on the Mountain than on lower ground.

St. Martin, Isle Jesus, 5.55. At Dr. Smallwood's observatory, two distinct and smart shocks. The wave passed from East to West. Barometer 29.964 inches, temperature 40° 3, wind N. E., cloudy.

Cornwall, 6 a. m.

Prescott, 5.30 a. m.

Belleville, 5.30 a. m. One shock.

Hamilton, 4.45, a. m.

In all or nearly all of the above places the earthquake was preceded by a rumbling noise which gradually decreased after the vibrations had passed. The difference of duration ascribed to the shocks appears to arise mainly from the circumstance that some observers include the continuance of vibration in buildings, &c., as well as that of the subterranean sound; and in this way it is probable that by some persons two or more shocks have been regarded as one.

The following graphic account of the phenomena as observed at River Ouelle appeared anonymously in a Quebec paper, and is the most detailed statement we have seen of the effects of the earthquake in those localities in which it was most violent,

Rivière Ouelle, 17 octobre, 1860.

"Ce matin trois fortes secousses de tremblement de terre sont venues jeter la frayeur au milieu de nos populations.

"Les batisses situées de chaque côté de notre rivière ont souffert généralement. Une cheminée chez E. Chas. Têtu, deux chez M. C. Casgrain, une chez M. Frenette, une chez Auguste Casgrain, une chez madame Frs. Casgrain, et chez une dizaine d'autres personnes ont été renversées. La croix de notre Eglise et le coq sur qui la montait sont à terre; les murs des notre belle église sont lézardés. Les secousses étaient effrayantes; la première, la plus violente, a commencé à six heures et quart, et a duré quatre minutes et 40 secondes, très violentes durant dix secondes et s'affaiblissant graduellement; la secousse la plus faible à six heures et vingt minutes, a duré trois à quatre secondes, et la troisième a commencé a six heures et demie, et n'a duré que deux à trois secondes; mais, comme la première, c'était un choc saccadé faisant danser les meubles, décrochant les cadres, les horloges, etc.

"Les secousses ont été plus faibles sur les hauteurs, que dans les plaines, de sorte que mes bâtisses se sont trouvées à l'abri des accidents.

"Jamais de mémoire de nos habitants, nous n'avons eu des coups aussi forts. Je suis demeuré devant mon horloge tout le temps pour m'assurer de sa durée, afin de pouvoir computer avec d'autres endroits la marche de ce grand et terrible phénomène.

"Un bruit sourd et fort nous a d'abord averti et ensuite sont venus les secousses et les craquements."

The observation of Dr. Smallwood that the wave proceeded from east to west accords with that of some other observers and may be regarded as correct. At the same time the nearly simultaneous occurrence of the shock throughout Canada, perhaps indicates that the wave did not move horizontally but reached the surface from a great depth and at a high angle as Perrey seems to suppose the earthquakes of Eastern America have usually done. It must however be observed that at the rate of propagation given by Mallet for earthquake waves through hard rock, which is not less than 10,000 feet per second, it is quite possible that even a horizontal wave may appear to be felt at the same instant at great distances.*

All the observers agree that the sound preceded the shock and continued after it, and that the first shock was the most violent; and it is also very generally noted that it was most severely felt on low ground and least so on rocky eminences. This last character which belongs to earthquakes generally, seems to arise from the greater resistance opposed to the vibrations by loose materials as compared with hard rocks.

It appears from the published lists that the late earthquake is the last of at least twenty-nine that have visited Canada since its discovery by Europeans, and we now proceed to give some account of these previous instances, availing ourselves mainly of the facts and conclusions stated by Mallet and Perry, the two most extensive and laborious collectors of earthquake statistics.

Mallet defines an earthquake as "the transit of a wave of elastic impression in any direction from verticality upward to horizontality in any azimuth through the crust of the earth, from any centre of impulse, or from more than one, and which may be attended with tidal and sound waves dependent upon the impulse and upon the circumstances of position as to sea and land." Such "earth-waves" travel outward from the centre of impulse with immense velocity and appear as upward shocks or undulating rolls according to the greater or less verticality of the motion. They may also be complicated with indirect shocks arising from unequal or circuitous transmission of the vibrations, and these complex shocks usually occur in great and destructive earthquakes.

The causes of these vibratory waves are too deep-seated to be directly known to us, but they must occur when any part of the crust of the earth is subjected to tension, and when this is suddenly relieved by fracture or otherwise, and again when any part of the earth's crust is left unsupported and collapses under the force

* See Mallet on the Dynamics of Earthquakes.—*Transactions Royal Irish Academy, Vol. XXI.*

of gravity. Geology teaches us to refer such effects to the slow expansion or contraction of great masses of rock under the influence of heat, to the disengagement of elastic gases under pressure, to the removal of matter from the interior to the surface by volcanoes, to the transference of sediment from the land to the sea basins. Such causes are constant and secular, and of course the precise time at which the tension or unsupported weight shall give way can scarcely be calculated, and may occur with suddenness and at irregular intervals; and so nice may be the balancing of opposing forces, that observation shows us that the attraction of the moon or an unusually low state of atmospheric pressure may overset the equilibrium and induce an extensive vibration of the solid crust of the earth, yet the actual causes of the phenomenon may have been for ages slowly preparing for it.

The fractured condition of the rocks of the earth shows that earthquakes have been occurring throughout all geological time, and they are by no means rare phenomena at present. For the whole earth their rate of occurrence is stated to be nearly 3 per month or 36 per annum; and no doubt very many are unrecorded and would considerably increase the average. But their distribution locally is very unequal. While in some spots slight earthquakes are of almost constant recurrence and in others great agitations of the earth are not infrequent, in other extensive regions no earthquakes are known to have occurred. Earthquakes are manifestly connected with the causes of volcanic action, and follow the same law of distribution on the surface of the globe; though in volcanic regions earthquakes and volcanic eruptions sometimes alternate, as if the suppression of the latter gave increased energy to the former. Hence volcanic vents have been regarded as safety valves to those pent-up *Seismic* agencies, as they have been called, which shake the pillars of the solid land.

In Mallet's map of the distribution of earthquakes, in the Report of the British Association for 1858, a belt of intense seismic activity runs from the Falkland Islands and Cape Horn along the Andes and Rocky Mountains, giving off a branch through Columbia to the West India Islands. It crosses over to Asia by the Peninsula of Alaska and the Aleutian Islands, and runs down through Kamtschatka, the Kurile and Japan Islands, from which it gives off a branch along the Ladrone Islands, but the main body crosses over to the Philippines, and from these a great crescent-shaped patch stretches around Celebes, Java, and Sumatra. This crescent of the East India Islands seems to be the most intense seat of earthquake force in the world. It sends off branches in different directions. One of these passes eastward and southwest through New Guinea and the New Hebrides to New Zealand, and probably beyond it to the Antartic continent, giving off a long branch through the Polynesian Islands. Another goes northward and spreads itself in Central Asia. A third running up the Malayan Peninsula and through northern India, Persia, and Asia Minor, passes along the south of Europe and extends to the Azores, giving off a faint branch through France and the British Islands to Iceland. The great earthquake band thus traced, includes nearly all the active volcanoes, except a few apparently isolated spots in the Ocean, like the Sandwich Islands. There are however broad sheets of the earth's surface traversed by the earthquake vibrations proceeding from this band of maximum action, and there are also subordinate bands of small intensity which have not been noticed in the above sketch. To the latter belongs the east coast of America, which seems to constitute a continuation of the West Indian branch, extending upwards along the Appalachian chain to Labrador, and perhaps completing the circle of the North Atlantic by a submarine continuation to Iceland.

We of course know nothing certainly of earthquakes in eastern America until after its colonisation by Europeans, yet this does not constitute a difference between America and the old continent so great as might at first sight be supposed. We know comparatively little of earthquakes even in the old world until the 16th century. Nothing more strongly indicates the little attention given to natural phenomena in the middle age of the earths history, than the fact that while the recorded earthquakes even in Europe and the neighbouring parts of Asia and Africa are only from 10 to 68 per century in the first 15 centuries of our era, they rise in the 18th century to 660 and in the 19th already amount to 925. No attention seems to have been given to earthquakes in the periods of classical antiquity and the middle ages, except when they proved very destructive or were supposed to be connected with some historical event. The great and otherwise alarming increase of earthquakes in modern times is in truth to be attributed principally to the revival of learning, to the invention of printing, and to the progress of the natural and physical sciences. Hence between the 15th and 17th centuries the recorded earthquakes in Europe and its vicinity rise suddenly from 41 to 180, and the increase seems only to have been arrested in the 18th century, when these causes were in full activity. The progress of navigation in the Pacific, and the discovery of America, have, when we regard the whole world, also enormously increased the number of instances, so that the earthquakes for the whole world were in the 17th and 18th century 35.3 per annum and in the first half of the 18th century alone 3240 in all, while the total number from the 10th to the 15th centuries inclusive was only 532.

The earliest earthquake in Eastern North America, in the catalogue prepared by Mr. Mallet for the British Association, is that felt in New England in 1638. The earliest in Canada is that of 1663. The following list taken from the Report above referred to and other sources, includes all the subsequent earthquakes recorded as having affected Canada, or the neighbouring parts of America.

1638, June 2, *New England.*—Violent, two shocks, direction N. W. & S. E., houses thrown down.
1658, April 4, " Violent.
1660, January 31, " "
1662, January 26, " Violent, three shocks, chimneys thrown down.
" Nov. 6, "
1663, February 5, CANADA.—Very violent, succeeded by minor shocks until July following, ice broken up, rivers discoloured, cliffs and banks thrown down, buildings injured: extended to Nova Scotia and New England.
1665, February, 24, " At Tadoussac and Malbaie, violent.
" Oct. 15, " Violent, accompanied by loud noise.
1668, not dated, *New England.*
1669, " "
1727, Nov. 9, " Violent, followed by slight shocks, direction N. E. to S. W., loud explosions, earth opened at Newbury, and ejected sand, &c.
1728, January 30, *New England.*
" Aug. 2, " Slight shocks continued from November 1727 to this date.
1729, March 25, " Repeated slight shocks from this date till 1741.
1732, September 5, CANADA, *New England* and as far as Maryland, buildings injured.
1737, February 6, *New England.*—At Boston, one shock.

" December 7, " and New York, three shocks, buildings injured.
1738, Oct. or Nov., " At Boston.
1741, December 6, " Boston, &c., slight.
1744, May 16, CANADA.—At Quebec a considerable vibration.
" June 3, *New England.*—At Cambridge, slight.
1746, Feb. 2, " At Boston.
1755, Oct., CANADA.—No shocks, but unusual rise and fall of water in Lake Ontario. On Nov. 1st of this year occurred the great Lisbon earthquake which was felt over the Atlantic and inthe West Indies, but I find no record of its being felt in Canada.
" Nov., *New England* and Eastern U. States to Maryland. Also Nova Scotia. Three or four shocks, two of them violent. Houses were damaged.
" Nov. 21, " At Boston.
" Dec. 19, " Same region as on the 18th, but slightly.
1756, January 1, *New England.*—At Boston.
" November 16, " "
" December 4, " "
1757, July 8, " "
1758, February 2, " "
1760, " 3, "
" November 9, " At Boston, slight.
1861, February, " "
" March 12, *North America.*—Violent shocks.
" " 16, *New England.*—Boston.
1763, October 30, *Philadelphia.*—Violent.
1766, February 2, *New England.*—Especially Massachusetts and Rhode Island.
" August 25, *New England.*—Newport, R. I.
" Dec. 17, " Portsmouth, N. H., a violent shock.
1776, February 2, " In Rhode Island.
1783, July 29, *New York.*—Rather violent.
1785, January 2, *New England.*—At Cambridge, shocks at same time at Baltimore.
1786, November 29, *New England.*—At Cambridge.
1787, February 25, " "
1791, May 16, " At Rast Haddam, Conn., which was visited by a series of slight shocks, continuing through aeveral years.
" April 18, *New England.*—To Pennsylvania, a severe shock followed by slighter ones.
" December, CANADA.—Severe shocks at St. Paul's Bay, walls cracked, &c.

1796, February, CANADA.—A violent shock, rocks fell from cliffs at Niagara.
1799, March 17, *Philadelphia.*—One shock.
1800, November 29, " A severe shock.
" December 25, *New England.*—Various places.
1801, November 12, *Philadelphia.*
1804, May 18, *New York.*
1810, Nov. 9, *New England.*—Several places, a severe shock.
1811, December 16, At this date commenced the terrible earthquakes which were felt extensively in the valley of the Mississippi and in various parts of the Eastern and Western States until 1813. The great earthquake of Caraccas occurred in March 1812.
1816, September 9, CANADA.—A severe shock felt at Montreal.
" " 16, " A second shock, less violent.
1818, Oct. 11, " Felt near Quebec.
1819, August 15, " At St. Andrews.
" November 10, " At Montreal, slight. Followed by an awful storm with rain impregnated with matter like soot.
1821, February, " At Quebec, a slight shock.
1823, May 30, " On shore of Lake Erie, slight but water of " lake rose to height of 9 feet.
1824, July 9, *New Brunswick.*—A severe shock.
1827, August 23, *New England.*—At New London, Conn.
1828, August 20, CANADA.
1829, January, *New York.*—At Portsmouth.
1831, July 14, CANADA.—At Murray Bay, Beauport, &c.; walls and chimnies were thrown down at the former place.
1832, *Nova Scotia.*—Slight.
1833, March and April, CANADA.—Several shocks at Murray Bay, &c.
1837, April 12, *Hartford*, Conn.—Very slight.
1840, August 9, *New England.*—Especially in Connecticut, several slight shoks.
" September 10, CANADA.—At Hamilton, a violent shock apparently from W. to E.
" November 11, *Philadelphia.*—A severe shock.
" " 14, *New Haven.*—In Connecticut.
1841, January 25, *New York.*—Several shocks, W. to E.
" Spring, CANADA.—Said to have been felt at Quebec, but regarded as uncertain.
1842, November 8 and 9, CANADA.—Montreal, Three Rivers, &c., severe shocks and agitation of the River.
1844, " " At Montreal.
1847, " " Felt at Montreal.

1855, February 8, *Nova Scotia*, *New Brunswick*, and *New England* slight.
" " 19, *New England*.—In Maine.
1856, May 1, CANADA.—At Ottawa and its vicinity, (See Canadian Nat. Vol. I).
1857, October, " In the Upper Province.
1858, January 15, CANADA.—At Niagara, slight.
" May 10, " At Richmond, slight.
" June 27, *New England*.—At New Haven, slight.
1859, CANADA.—At Metis.

On comparing the above table with the deductions of Mallet and Perry for the entire globe, we perceive the applicability to Canada of the law ascertained by them, that the greatest and most frequent shocks occur a little after the middle and toward the close of each century. Thus in Canada and New England the years from 1658 to 1663, from 1756 to 1766, and from 1791 to 1796, were periods of special seismic activity, and in the present century our most severe shock has been in 1860, and judging from the previous centuries will no doubt be followed by others.

With respect to seasons of the year, the published catalogues show that January presents the maximum, and May and June the minimum activity for the northern hemisphere, and that the autumn and winter months are those in which earthquakes occur most frequently. Nearly in accordance with this, in the above list the earthquakes are distributed as follows:—

January	8	July	4	Spring	16
February	4	August	6	Summer	12
March	5	September	4	Autumn	25
April	4	October	7	Winter	30
May	6	November	14		
June	3	December	8		

We have only to add that the present article is to be regarded only as an imperfect and hasty summary, and that we shall gratefully receive and publish, in a supplementary article, any information which our correspondents may supply respecting either the late earthquake or any of its predecessors. J. W. D.

ARTICLE XLVII.—*The Meteor of July* 20, 1860, by C. S. LYMAN. From Silliman's Journal, September, 1860.

This remarkable meteor was visible over a portion of the earth's surface at least a thousand miles in length, (N. N. W. to S. S.E.)

by seven or eight hundred in width; or from Lake Michigan to the Gulf Stream and from Maine to Virginia. The newspapers have contained many notices of its appearance as seen at various places within these limits, but most of these accounts are too vague to be of any scientific value. We are not yet in possession of a sufficient number of good observations for a final discussion of the phenomena presented, and can only at this time notice briefly a few of the best that have come to hand, and state some approximate results derived from them respecting the height of the meteor above the earth, the direction of its path, &c.

At New Haven, it was seen, during a portion of its flight, by several members of the Scientific Faculty at the house of Prof. J. A. Porter, and pains were at once taken to fix its apparent path by reference to parts of the building, tree-tops, stars, &c., near which it had been seen, and also to determine its time of flight, by noting the time required to repeat the various acts performed while it was in sight. The bearings and altitudes of the points noted for fixing the path were subsequently determined instrumentally. Independent data of the same kind were also obtained by going with many different observers to the places occupied by them at the time, and observing with compass and quadrant the path in the sky pointed out by each, and noting the time for each in the manner already indicated.

By laying down these bearings and altitudes on a globe, a normal or average path was obtained, which cuts the horizon at N. 62° W. and S.. 62° E., and gives a maximum altitude of 53°, in a direction S. 28° W.

The time of flight for the different observers, determined as above stated, ranged from 10 to 20 seconds—giving an average of fourteen or fifteen seconds, which agrees with the careful estimate made at the time by the observers at Prof. Porter's.

Valuable observations have also been received from individuals in different places, some items of which we proceed to state. They will be given more fully hereafter.

Mr. J. D. Lawson, of New York, saw the meteor from the corner of Fourth street and Broadway, and has furnished data which gives for maximum altitude (N.) $56\frac{3}{8}$°. Another independant observation at the same spot, as published in the *Journal of Commerce*, gives from data subsequently obtained by Prof. H. A. Newton, an altitude of about 55°. We use for N. Y. 56° as the mean of the two.

Mr. F. Huidekoper, of Meadville, Pa., makes the altitude at that place 39° 30′ from the northern horizon; the point of disappearance at altitude 3° 30′, and 10° 45′ S. of east; time from crossing meridian till disappearance, 10 to 12 seconds.

Mr. W. King, a surveyor, at Erie, Pa., makes the altitude 44°, and point of disappearance in a cloud due east at an altitude of 22°.

Mr. S. B. McMillan, of E. Fairfield, Ohio, reports it as having been seen, "moving from a point about 10° E. of N. to within as much of a due east direction," attaining an altitude of 15°.

Rev. T. K. Beecher at Elmira, N. Y., saw it pass very nearly through his zenith, and "so very close to" μ Lyræ "as to quench, if not eclipse it." This star was then about 11° from his zenith and in azimuth S. 76½° E. The meteor separated into two parts with an explosion when near the zenith.

Other observations (not now at hand), which have been used in obtaining our results, have been received from Mr. B. V. Marsh of Philadelphia, and Prof. Hallowel, of Alexandria.

A comparison of these observations, and a few of the best that have been published, give approximate results as follows:

(1.) The vertical plane in which the meteor moved cuts the earth's surface in a line crossing the northern part of Lake Michigan, passing through, or very near to, Goderich on Lake Huron (C. W.), Buffalo, Elmira and Sing Sing, N. Y., Greenwich, Con., and in the same direction across Long Island into the Atlantic.

(2.) In this plane the path that best satisfies the observations is sensibly a straight line approaching nearest to the earth (41 miles) at a point about south of Rhode Island, and having an elevation of 42 miles above Long Island Sound, of 44 over the Hudson, 51 at Elmira, 62 at Buffalo, 85 over Lake Huron, and 120 over Lake Michigan. The western observations, however, which are few and imperfect, seem to indicate a somewhat greater elevation than this for the western part of the path. Possibly, therefore its true form may have been a curve convex towards the earth, resulting from the increasing resistance of the atmosphere as the meteor descended into denser portions of it. The observations made on this side of Buffalo, which are somewhat numerous and many of them good, are very well satisfied by the straight path already described. Further and more accurate observations beyond Buffalo are greatly needed for determining the true form and position of the orbit, both in respect to the earth's surface and in space.

(3.) The close approximation to parallelism to the earth's surface of the eastern portion of the observed path leaves it a matter of doubt, considering the imperfection of the observations, whether the meteor finally passed out of the atmosphere and went on its way in a disturbed orbit, or descended gradually into the Atlantic. The former supposition is perhaps the more probable, especially if the path was curved, as above suggested, instead of a straight line.

(4.) The meteor exhibited different appearances in different parts of its course. It seems to have been observed first as a single body, more or less elongated, gradually increasing in brilliancy, throwing off occasionally sparks and flakes of light, until it reached the neighbourhood of Elmira, N. Y. Here something like an explosion occurred, and the meteor separated into two principal portions with many subordinate fragments all continuing on their course in a line behind each other, and still scattering luminous sparks along their track, until a point was reached about south of Nantucket, when a second considerable explosion took place, and afterwards the principal fragments passed on till lost to view in the distance. The most trustworthy observations represent the meteor as disappearing while yet several degrees above the horizon, (generally from 3° to 6° or 8°). Besides the actual changes of form which the body successively underwent, apparent changes would present themselves to each observer arising from change of direction in which the meteor was seen.

(5.) It is not easy, from the observations in hand, to determine with much accuracy the velocity of the meteor while passing through our atmosphere. The time of flight is doubtless largely over-estimated by most observers, especially those unaccustomed to measure intervals of a few seconds. Timing with a watch, a repetition of the acts performed during the flight of the meteor usually reduces the interval to not more than one third, or even one fifth, of the observer's own estimate. From 15 to 30 seconds is a fair range for good observations, and probably to no observer was the meteor in sight over 45 seconds or a minute, although a minute and a half and two minutes are very common estimates A comparison of the most probable estimatee of time with the length of path observed, gives a velocity ranging from eight to fifteen miles a second. Probably 12 or 13 miles is a tolerable approximation. This, allowing for the earth's motion in its orbit, gives 26 or 27 miles a second as the actual velocity of the meteor in space. Its relative velocity may have been much greater when just entering the atmosphere, than after encountering its accumulated resistance.

(6.) The actual diameter of the luminous mass, taking its apparent diameter as nearly equal to that of the moon, (the estimate of many observers nearest its track) must have been from one fifth to one-third of a mile. Many estimates would make it still larger. The two principel heads when passing New Haven must have been from one to three miles apart.

(7.) A report is mentioned by many observers as having been heard from one and a half to five minutes after the meteor passed. The least time in which such a report could have been heard, taking the usual constant for the velocity of sound (1090·47 feet a second) would be about three minutes and a half. This is a point of much interest, and needs to be investigated.

The "rushing sound" spoken of by many as heard while the meteor was passing, is of course to be attributed to imagination.

ARTICLE XLVIII.—*La Verrier's Report on the Solar Eclipse of July*, 18, 1860, *at Tarazona.* From Silliman's Journal, September, 1860.

At the last moment, and after our notices of this phenomenon were printed (see pp. 281, 285, 288) we have received LeVerrier's Report of the Observations of the French Expedition to Spain, made to the Minister of Public Instruction, which we hasten to lay before our readers, slightly condensed, although other matters which some of our correspondents will naturally look for here are thereby displaced. The interest with which Le Verrier's new views of the physical constitution of the Sun will be read is our apology to all such.

Le Verrier was accompanied to Spain by Messrs. Yvon Villarceau, and Chacornac, who were occupied chiefly with determining the height and position of two or more of the luminous appendages. M. Foucault studied the corona, and made the photometric and photographic experiments. M. Le Verrier observed the astronomical phases of the phenomenon, and was also charged with the duty of obtaining an exact description of the whole scene. Two telescopes on Foucault's plan were devoted to the measurements, being provided with micrometers of peculiar construction, devised by Yvon Villarceau for rapid and easy manipulations in the dark. Two excellent telescopes of 6 inch aperture (one for the use of the Spanish observers) were also provided, to which must be added the photographic apparatus, a meridian circle, chronometers, barometers, seekers, and lastly the great meridian instrument belonging to the War Department, and with which the longitude was determined—forming a grand total of scientific baggage which on the 28th of June, was dispatched for Spain. The outfit of the English expedition was even yet more considerable. Early in July, Mr. Yvon Villarceau joined the instruments at Tudela in the centre of Spain, on the banks of the Ebro, and immediately proceeded with them to Tarazona and to the chosen station called the *Sanctuaire*, 1,400 metres(=4592 feet) above the sea. M. Le Verrier and Foucault, fearing clouds, descended on the morning of the 18th to a plateau near the cemetery of Tarazona where the weather was magnificent during the whole eclipse. Passing the description of the contacts and observations for time, &c., we note that at totality they found the general illumination of the atmosphere much greater than the relation of former observers of total eclipses had led them to expect, so that they could read and write easily without using their lamps.

Says Le V.: "The first object which I saw in the field of the telescope after the commencement of totality was an isolated cloud separated from the moon's border by a space equal to its own breadth, the whole about a minute and a half high by double that length. Its colour was a beautiful rose mixed with shades of violet, and its transparency seemed to increase even to brilliant white in some parts. A little below on the right two clouds lay superimposed on each other, the smaller above, and the two of very unequal brilliancy. The rest of the western edge of the disc and the lower part showed nothing more than the corona, the light of which was perfectly white and of the greatest brilliancy. But 30° below the horizontal diameter on the east I discovered two lofty and adjoining peaks, the upper sides of both tinted with rosy and violet light, while the lower sides were brilliant white. I do not doubt that the toothed form I assign to these peaks is real, which as it contrasted with that of the first appendages I have described, I verified with great care; moreover, in shifting the telescope, whose high power permitted a sight of only a small part of the solar disc at one time, I saw a third peak a little higher also tooth-formed, and resembling the two others in colour and form, differing only in its larger dimensions. The remainder of the disc offered nothing remarkable, and on returning to the upper region I found the two first described clouds unchanged. As the moment of reappearance of the Sun approached, and while waiting for the first rays, I made, during about 20", perhaps my most important observation. The margin of the disc which two minutes before was entirely white was now tinged by a delicate fillet of unapreciable thickness of a purplish red—then as the seconds glided by, this fillet enlarged by degrees and formed soon around the black disc of the moon, over a breadth of about 30°, a red border perfectly defined in thickness, crescent-formed and with an irregular outline above. At the same instant the brilliancy of the part of the corona which during the last second emerged from behind the moon's disc was exalted so rapidly that I was in doubt if the sun's light was not returned. It was only on the reappearance of the direct rays, the brightness of which obliterated in turn the corona, that I was sure of the nature of three phenomena present at the same time, which I thus sum up.

1. The visible parts of the emergent sun over its whole breadth and up to the height of seven or eight seconds was covered by a bed of rosy clouds, which appeared to gain in thickness as they emerged from behind the disc of the moon. Must we believe that the entire surface of the sun is overspread at a small elevation, as it is strewn with faculæ, and that the roseate clouds are emanations, appearing like spots on the sun's disc?

2. The intensity of the light in the corona which is always white, varies with great rapidity in the immediate vicinity of the sun's disc.

3. The reappearance of the direct sunlight was at 3^h 0^m $49^s{\cdot}0$. Total obscuration continued 3^m $14^s{\cdot}3$. The disc of the moon completely cleared the sun at 4^h 6^m 20^s.

(M. Focault's interesting observations on the photographs, etc., are unavoidably postponed for want of room.)

Le Verrier goes on to state that the observation of his party authorise, in his opinion, important modifications in the generally received notions respecting the physical constitution of the sun. Arago in his notice of solar eclipses, says—"where exist the reddish flames with well defined outlines which during the total eclipse of the 8th of July, 1842, passed considerably beyond the outlines of the lunar disc? These flames were either in the moon or in the sun, or in our atmosphere; unless, indeed, denying their actual existence, we regard them as an effect of light, for example as phenomena of diffraction.

The two last suppositions have found few partizans. Before adopting any hypothesis it is necessary to decide by observation a certain feature of the phenomenon. During the eclipse, the disc of the moon moves across the disc of the sun. But do these reddish clouds follow the moon in its movement? or does each cloud remain invariably above the same point on the solar disc? In the first case the origin of the luminous clouds is to be sought in the moon; in the second case, these clouds belong to the sun. For clearness sake, assume the latter supposition, and observe what appearances should present themselves when the lunar disc passes like a screen over the whole. Consider first a cloud situated on the east and adherent to the sun's limb. This object will be visible at the instant when totality commences. The advancing moon will regularly, at the rate of a half second of arc in a second of time, cover with its limb successively the lower, then the middle and lastly the higher portions—thus constantly diminishing the height of the cloud. For a cloud situated on the west these appearances will be reversed, its magnitude increasing as the moon gradually uncovers it. If then the roseate appendages seen during a total eclipse, depend on the sun, the fact should appear by the variation in height between those which appear in the east and the west. The phenomena will appear otherwise if the clouds appertain to the moon.

In the absence of equatorial solar clouds, the question in dispute can still be decided by observations on those seen on the south or north of the disc. The height of these clouds ought not to vary it is true, whether they belong to the moon or to the sun, but in the latter case carried away by the sun they would be displaced in the lunar disc with a certain velocity, while if they are adherent to the moon's disc, they would not be displaced. Hence the study of the height of the luminous clouds, whether east and west or north and south, has the highest interest. All the elements of the desired demonstration are found in the Spanish observations. In my first report, I mentioned the successive increase in thickness of a band of rosy clouds visible from the east to the end of the eclipse. Messrs. Yvon Villarceau and Chacornac have carefully noted the motions of a cloud, situated on the north

This cloud according to M. Villarceau, in two minutes time was displaced 3½° on the moon's disc, in moving to the west. The measurement of M. Chacornac's cover over an interval of six minutes in time, in which the cloud moved 11⅓°.

Beautiful observation, and one which could not have been hoped for! We see that the duration of the motion studied by Chacornac, much exceeds the time of total obscuration. The last measure was made more than three minutes after sun-light had reappeared! It is important to note, among other points that this was not done with a cloud vaguely seen after the return of sun-light, but fortunately it was a measurement so carefully made as to be a gurantee against the possibility of illusion. It should be added that the displacement of the luminous cloud determined by observations made at the *Sanctuaire*, is precisely, equal to that required by calculation, assuming the cloud to belong to the sun. There remains, then, no foundation for a doubt, as to the nature of the rosy clouds which have been variously called flames, mountains, protuberences, and clouds.

The observation on one of the appendages, perfectly isolated from the disc of both sun and moon and of a sharply pronounced character, and on the other the appearance of a rosy band on the west at the moment of emersion, and the rate of motion of a second appendage, fixed by Villarceau and Chacornac, prove that these objects belong to the sun. Let us then hereafter give the name of *solar clouds* to the rosy appendages which become visible when the solar light is sufficiently dimmed.

A few words more will finish the description of the phenomenon and of the observatians. Ismaïl Effendi, a young Egyptian attached to the Paris observatory for three years past, a very expert astronomer, and who accompanied the French expedition to Spain, has sent me a drawing which proves the appearance of luminous clouds in the east immediately before the commencement of the eclipse. The clouds in question form a slightly elevated but continuous band embracing 95° of the outline of the sun. This band was not long visible, but was eclipsed behind the lunar disc, and it had in effect ceased when I passed over this region in exploring the whole periphery with a power which allowed me to see only portions successively.

The magnetic observations were made at Paris, the variations being sensibly simultaneous for the whole of Europe, and M. Desains, who took note of the magnetic observations, detected no perturbations during the eclipse.

Physical constitution of the Sun.—A reconstraction or even a complete abandonment of the theory hitherto prevalent as to the physical constitution of the sun appears to me essential. It must give place to one far more simple.

We have been hitherto assured that the sun was composed of a central dark globe; that above this globe existed an immense atmosphere of sombre clouds, still higher was placed the photosphere, a self-luminous, gaseous envelope, and the source of the light and heat of the sun. Where the clouds of the photosphere are rent, says the old theory, the dark body of the sun is seen in the spots which so frequently appear. To this complex constitution must be added a third envelope formed of the accumulation of roseate clouds.

Now, I fear that the greater part of these envelopes are only fictious—that the sun is a body, luminous, simply because of its high temperature, and covered by an unbroken layer of roseate matter whose existence is now proved. This luminary thus formed of a central nucleus, liquid or solid, and covered by an atmosphere, falls within the law common to the constitution of celestial bodies.

[M. Le Verrier goes on to discuss with some detail the solar spots in the light of these new views, but this we must defer for another occasion. It is certain that a subject of so much interest will command much consideration from physicists and astronomers and we will take care to give it the attention it deserves.

Nor will the question be settled peaceably—already M. Faye (*Comptes Rend.*, Aug. 13) in presenting to the French Academy a long letter from Baron Feilitzsch with an account of his observations (also in Spain), declares it to be his opinion as well as that of Baron F. that the eclipse of 1860, furnishes the most decisive evidence in favour of the opinion which refers the corona and the luminous clouds to simple optical appearances, and not to the essential constitution of the sun or of his atmosphere. M. Faye adds that the opinion appears to be confirmed by a comparison of the results of other observers—that the sun has no atmosphere and that the appearance are purely optical!—Ed.]

MISCELLANEOUS.

BRITISH ASSOCIATION.

OXFORD, JUNE 27.

(From the Athenæum, January &c., 1860.)

A day of sun and cloud, warm, soft, and sometimes bright, ushered in the Meeting of the British Association for the Advancement of Science. The Prince Consort came down to Oxford to resign the Presidency of the Association. He was received with the customary acclamations, by a large and brilliant assembly, who filled the Sheldonian Theatre in almost every part. The Chancellor, Vice-Chancellor and all the heads of the University were present, as well as the men of science from all parts of Europe. After a few graceful words on the part he had himself taken in watching and fostering the progress of Science during the past year, and on the merits of his successor in the Presidential Chair, the Prince Consort made way for Lord Wrottesley, who rose and delivered the annual discourse.

The President's Address.

Gentleman of the British Association,—If, on taking this Chair for the first time as your President, I do not enlarge upon my deficiences for adequately filling the responsible office to which you have done me the honour to elect me, I hope you will believe that I am not the less sensible of them.

Science in Oxford University.

We are now once more assembled in this ancient and venerable seat of learning; and the first topic of interest which presents itself to me, who owes to Oxford what academic training I have received, is the contrast presented by the state of Science and the teaching of Science in this University in the autumn of the year 1814, when my residence here commenced, and for five years afterwards, with its present condition. As the private pupil of the late Dr. Kidd, and within a few yards of the spot from which I have now the honour to inaugurate the Meeting of this distinguished Association, I first imbibed that love of Science from which some of the purest pleasures of my life have been derived; and I cannot mention the name of my former Tutor without acknowledging the deep debt of gratitude I owe to the memory of that able, conscientious and single-hearted man.

It was at this period that a small knot of Geologists, headed by Broderiph, Buckland, the two Conybeares and Kidd, had begun to stimulate the curiosity of the Students and resident Graduates by lectures and geological excursions in the neighbourhood of this town. The lively illustrations of Buckland, combined with genuine talent, by degrees attracted crowds to his teaching; and the foundations of that interesting science, already advancing under the illustrious Cuvier in France, and destined soon to spread over Europe, were at this time fairly laid in England within these classical Halls. Many a time in those days have my studies been agreeably interrupted by the cheerful laugh which invariably accompanied the quaint and witty terms in which Buckland usually announced to his brother geologists some new discovery, or illustrated the facts and principles of his favourite science. At the time, however, to which I refer, the study of physical science was chiefly confined to a somewhat scanty attendance on the Chemical Lectures of Dr. Kidd, and on those on Experimental Philosophy by Rigaud; and in pure mathematics the Fluxional Notation still kept its ground. In the year 1818, Vince's Astronomy, and in the following year the Differential Notation, were first introduced in the mathematical examinations for honours. At that time, that fine foundation the Radcliffe Observatory was wholly inactive; the Observer was in declining health and the establishment was neither useful to astronomical students, nor did it contribute in any way to the advancement of astronomical science. Even from the commencement of the present century, and in proportion as the standard of acquirement in classical learning was gradually raised by the emulation excited by the examinations for honours, the attendance on the above-mentioned Lectures gradually declined: but a similar cause enhanced the acquirements of students in pure and applied mathematics, and the University began to number among its Graduates and Professors men of great eminence in those departments of knowledge. Nor were the other sciences neglected: and as Chairs became vacant, or new Professorships were established, men of European reputation were appointed to fill them. In proof of all this, I need only direct attention to the names on the roll of Secretaries, Vice-Presidents, and Presidents of Sections, to convince you that Oxford now contains among her resident Graduates men amply qualified to establish and advance the scientific fame of that University, of which they are the established ornaments.

Museum—Study of Nature.

I have already alluded to some particulars in which this great University has advanced in the career of scientific improvement, but everything else has been somewhat thrown into the shade by the important event of this year, the opening of the new Museum. The University could have given no more substantial proof of a sincere interest in the diffusion of science than in the foundation of this noble Institution; and I am sure that among the distinguished cultivators of science here assembled, there is not one who does not entertain a hearty desire for the success of the various efforts now in progress for the purpose of stimulating our University students to a closer contemplation and more diligent study of the glorious works of Nature,—a study which, if prosecuted earnestly, raises us in the scale of human beings and improves every moral and intellectual faculty. Towards the attainment of a result so much to be desired, the Museum will most powerfully contribute; and those who frequent it will owe deep obligations to Mr. Hope and the other benefactors who have generously added to its stores. But there are other causes in operation which tend to the same end; and among them, in addition to such improvements as arise out of the changes consequent on the recent Act of Parliament, may be mentioned the alteration in the distribution of University honours.

The institution of the School of Physical Science forms a most important feature in the recent changes, and will doubtless be productive of good results, provided that sufficient encouragement by way of reward be held out to those whose tastes lead them to devote themselves to those departments of knowledge, and that the compulsory arrangements in respect of other studies allow sufficient time to the student to accomplish his object. The great majority of physical students must necessarily belong to that class who have their subsistence to earn; and however earnest may be their zeal for mental improvement, there will be few candidates for the honours of the Physical School unless due encouragement be given to excellence in that department. It was therefore with sincere pleasure that I learned that three Fellowships had been founded at Magdalen College as prizes for proficiency in Natural

Science; and that at the same College, and at Christ Church and Queen's, scholarships and exhibitions had been provided for students who evince during their examinations the greatest aptitude for such studies. Moreover, the acquisition of a Radcliffe travelling Fellowship has been made to depend upon obtaining distinction in the School of Natural Science. In addition to all this, that beneficent and enlightened lady, Miss Burdett Coutts, has founded two Scholarships, with the view of extending among the clergy educated at the University a knowledge of Geology. Great hopes are justly excited in the minds of all well-wishers to the University by these events, and by reflection on the great change of opinion which must have taken place since the period when Dr Kidd, with the aid of Dr. Daubeny, Mr. Greswell and others, in vain attempted to raise a small sum, by private subscription, for building a modest receptacle for the various collections of Natural History. How little could these public-spirited individuals have foreseen, that within a few short years a sum approaching to 100,000*l.* would be appropriated to the building and furnishing that splendid monument of Oxford's good will to science, the New Museum!

Astronomy.

At the beginning of the year 1820, when the Astronomical Society was founded, the private Observatories in this country were very few in number. The establishment of that Society gave a most remarkable stimulus to the cultivation of the science which it was intended to promote. I can give no better proof of this than the fact that the *Nautical Almanac* now contains a list of no less than twelve private Observatories in the United Kingdom, at nearly all of which some good work has been done; and in addition to this, some Observatories, which have been since discontinued, have performed most important services—I may instance that of the two Herschels at Slough, and that of Admiral Smyth at Bedford.

It may not be uninteresting if I describe the nature and utility of some of the results which these several establishments have furnished to the world: I say the *world* advisedly, for scientific facts are the common inheritance of all mankind.

But first a word as to the peculiar province of the observatories which are properly called "public," such as the far-famed Institution at Greenwich. Their task is now more peculiarly to establish, with the last degree of accuracy, the places of the principal heavenly bodies of our own system, and of the brighter or fundamental fixed stars which are about 100 in number. But in early stages of Astronomy, we were necessarily indebted to public Observatories for all the data of the science. On the other hand, their voluntary rivals occupy that portion of the great astronomical field which is untilled by the professional observer, roving over it according to their own free will and pleasure, and cultivating with industrious hand such plants as the more continuous and severe labours of the public astronomer leave no time or opportunity to bring to maturity.

The observations of our private observers have been chiefly devoted to seven important objects:—

First. The observing and mapping of the smaller stars, under which term I include all those which do not form the peculiar province of the public observer.

Secondly. The observations of the positions and distances of double stars.

Thirdly. Observations delineations, and Catalogues of the Nebulæ.

Fourthly. Observations of the minor planets.

Fifthly. Cometary observations.

Sixthly. Observations of the solar spots and other phenomena on the Sun's disc.

Seventhly. Occultations of stars by the Moon, eclipses of the heavenly bodies and other occasional extra-meridional observations.

And first as to cataloguing and mapping the smaller stars. This means, as you know, the accurate determination by astronomical observation of the places of those objects, as referred to certain assumed fixed points in the heavens. The first Star Catalogue worthy to be so called, is that which goes by the name of Flamsteed's or the British Catalogue. It contains above 3,000 stars, and is the produce of the labours of the first Astronomer Royal of Greenwich,—labours prosecuted under circumstances of great difficulty, and the results of which were not given to the world in a complete form till many years had elapsed from the time the observations were made which was during the latter half of the seventeenth century. About the middle of the eighteenth century, the celebrated Dr Bradly, who also filled the post of Astronomer Royal, observed an almost equally extensive catalogue of Stars,and the begining of the nineteenth century gave birth to that of Piazzi of Palermo. These three are the most celebrated of what may be now termed the ancient Catalogues. About the year 1830, the attention of modern astronomers was more particularly directed to the expediency of re-observing the stars in these three Catalogues,—a task which has much facilitated by the publication of a very valuable work of the Astronomical Society, which rendered the calculation of the observations to be made comparatively easy, and, accordingly, observations were commenced and completed in severel private and public Observatories, and from which some curious results were deduced as, *e. g.* sundry stars were found to be missing, and others to have what is called *proper motion.* And now a word as to the utility of this cource of observation. It is well observed by Sir John Herschel, "that the stars are the landmarks of the universe; every well determined star is a point of departure which can never deceive the astronomer, geographer, navigator, or surveyor." We must have these fixed points in order to refer to them all the observations of the wandering heavenly bodies, the planets and the comets. By these fixed marks we determine the situation of places on the earth's surface, and of ships on the ocean. When the places of the stars have been registered celestial charts are constructed; and by comparing these with the heavens, we at once discover whether any new body be present in the particular locality under observation and thus have most of the fifty-seven small or minor planets between Mars and Jupiter been discovered. The observations, however, of these smaller stars, and the registry of their places in Catalogues, and the comparisons of the results obtained at different and distant periods, have revealed another extrordinary fact no less than that our own sun is not fixed in space, but that it is constantly moving forwards towards a point in the constellation Hercules, at the rate as it is supposed, of about 18,000 miles an hour carrying with it the whole planetary and cometary system; and if our sun moves probably all the other stars or suns move also, and the whole universe is in a perpetual state of motion through space.

The second subject to which the attention of private observers has been more particularly directed, is that of double or multiple stars, or those which, being situated very close to one another appear single to the naked eye; but when viewed through powerful telescopes are seen to consist of two or more stars. The measuring the angles and distances from one another of the two or more component stars of these systems, has led to the discovery that many of these very close stars are,in fact acting as suns to one another and revolving round their common centre of gravity,each of them probably carrying with it a whole system of planets and comets, and, perhaps each carried forward through space like our own sun. It became then a point of great interest to determine whether bodies so far removed from us as these systems observed Newton's law of gravity and to this end ,it was necessary to observe the angles and distances of a great number of these douluble stars scat ered everywhere through the heavens, for the purpose of obtaining data to compute their orbits. This has been done, and chiefly by private observers ; and the result is that these distant bodies are found to be obedient to the same laws that prevail in our own system.

The Nebulæ are as it were, systems or rings of stars scattered through space at incredible distances from our star system, and perhaps from one another ; and there are, many of these mysterious clouds of light, and there may be endless invisible regions of space similarly tenanted. Now, the nearest fixed star of our star system whose distance has been measured, is the brightest in the constellation Centaur, one of the Southern constellations, and this nearest is yet so far removed, that it takes light, travelling at the rate of about 192,000 miles per second, three years to arrive at the earth from that star. When we gaze at it, therefore we see it only as it existed three years ago ; some great convulsion of nature may have since destroyed it. But there are many bright stars in our own system, whose distance is so much greater than this, as *a* Cygni for example that astronomers have not succeeded in measuring it. What, then must be the distance of these nebulæ, with which so much space is filled ; every component star in which may be a sun, with its own system of planets and comets revolving around it, each planet inhabited by myriads of inhabitants ! What an overpowering view does this give us of the extent of creation ! The component stars of these nebulæ are so faint, and, apparently, so close together, that it is necessary to use telescopes of great power and with apertures so large as to admit a great amount of light for the observation. We owe it more especially to four individuals that telescopes have been constructed at a great cost and with great mechanical skill, sufficiently powerful to penetrate these depths of space. Those four individuals are the Herschels, father and son, Lord Rosse, and Mr. W. Lassell. That praiseworthy nobleman, Lord Rosse began his meritorious career by obtaining a First Class at this University and has, as you know, spent large sums of money and displayed considerable mechanical genius in erecting, near his own castle in Ireland, an instrument of far greater power than any other in the world; and with it he has observed these nebulæ, and employed skilful artists to delineate their forms : and he has moreover made the very curious discovery, that some of them are arranged in a spiral form, a fact which gives rise to much interesting speculation on the kind of forces by which their parts are held together. It were much to be wished that observations similar to these, and with instruments of nearly the same power, should be made of the Southern nebulæ also; that this generation might be able to leave to posterity a record of their present configurations. The distinguished Astronomer, Mr. W. Lassell, the discoverer of Neptune's satellite, has just finished at his own cost, an instrument equal to the task, mounted equatorially ; and I am not without hope that it may, at perhaps no very distant period, be devoted to its accomplishment. A recent communication from him to the Astronomical Society expresses satisfaction with the mounting of his instrument, and after many trials its great speculum has at last come forth nearly perfect from his laboratory.

Comets.

Of all the phenomena of the heavens, there are none which excite more general interest than comets—those vagrant strangers, the gipsies as they have been termed of our solar system, which often come we know not whence, and at periods when we least expect them : and such is the effect produced by the strangeness and suddenness of their appearance, and the mysterious nature of some of the facts connected with them, that while in ignorant times they excite alarm, they now sometimes seduce men to leave other employments and become astronomers. Now, though the larger and brighter comets naturally excite most general public interest, and are really valuable to astronomers, as exhibiting appearances which tend to throw light on the internal structure of these bodies, and the nature of the forces which must be in operation to produce the extraordinary phenomena observed, yet some of the smaller telescopic comets are, perhaps, more interesting in a physical point of view. Thus the six periodical comets, the orbits of which have been determined with tolerable accuracy, and which return at stated intervals, are extremely useful, as being likely to disclose facts of which, but for them, we should possibly have ever remained ignorant. Thus, for example, when the comet of Encke, which performs its revolution in a period of a little more than three years, was observed at each return, it disclosed the important and unexpected fact, that its motion was continually accelerated. At each successive approach to the sun it arrives at its perihelion sooner and sooner; and there is no way of accounting for this so satisfactory as that of supposing that the space, in which the planetary and cometary motions are performed, is everywhere pervaded by a very rarefied atmosphere or ether, so thin as to exercise no perceptible effect on the movements of massive solid bodies like the planets, but substantial enough to exert a very important influence on more attenuated substances moving with great velocity. The effect of the resistance of the ether is to retard the tangential motion, and allow the attractive force of gravity to draw the body nearer to the sun, by which the dimensions of the orbit are continually contracted and the velocity in it augmented. The final result will be that, after the lapse of ages, this comet will fall into the sun; this body, a mere hazy cloud, continually flickering as it were like a celestial moth round the great luminary, is at some distant period destined to be mercilessly consumed. Now the discovery of this ether is deeply interesting as bearing on other important physical questions, such as the undulatory theory of light; and the probability of the future absorption of comets by the sun is important as connected with a very interesting speculation by Prof. William Thomson, who has suggested that the heat and light of the sun may be from time to time replenished by the falling in and absorption of countless meteors which circulate round him; and here we have a cause revealed which may accelerate or produce such an event.

Luminous bodies in the Sun.

On the 1st of September last, at 11h 18m A. M., a distinguished astronomer, Mr. Carrington, had directed his telescope to the sun, and was engaged in observing his spots, when suddenly two intensely luminous bodies burst into view on its surface. They moved side by side through a space of about 35,000 miles, first increasing in brightness, then fading away; in five minutes they had vanished. They did not alter the shape of a group of large black spots which lay directly in their paths. Momentary as this remarkable phenomenon was, it was fortunately witnessed and confirmed, as to one of the bright lights, by another observer, Mr. Hodgson, at Highgate, who, by a happy coincidence, had also his telescope directed to the great luminary at the same instant. It may be, therefore, that these two gentlemen have actually witnessed the process of feeding the Sun, by the fall of meteoric matter; but however this may be, it is a remarkable circumstance, that the observations at Kew show that on the very day, and at the very hour and minute of this unexpected and curious phenomenon, a moderate but marked magnetic disturbance took place; and a storm or great disturbance of the magnetic elements occurred four hours after midnight, extending to the southern hemisphere. Thus is exhibited a seeming connection between magnetic phenomena and certain actions taking place on the sun's disc—a connection, which the observations of Schwabe, compared with the magnetical records of our Colonial Observatories, had already rendered nearly certain. The remarkable results derived from the comparison of the magnetical observations of Captain Maguire on the shores of the Polar Sea, with the contemporaneous records of these Observatories, have been described by me on a former occasion. The delay of the Government in re-establishing the Colonial Observatories has hitherto retarded that further development of the magnetic laws, which would doubtless have resulted from the prosecution of such researches.

We may derive an important lesson from the facts above alluded to. Here are striking instances in which independent observations of natural phenomena have been strangely and quite unexpectedly connected together: this tends powerfully to prove, if proof were necessary, that if we are really ever to attain to a satisfactory knowledge of Nature's laws, it must be accomplished by an assiduous watching of all her phenomena, in every department into which Natural Science is divided. Experience shows that such observations, if made with all those precautions which long practice combined with natural acuteness teaches, often lead to discoveries, which cannot be at all foreseen by the observers though many years may elapse before the whole harvest is reaped.

Moon's Motion.

A curious controversy has lately arisen on the subject of the acceleration of the Moon's motion, which is now exciting great interest among mathematicians and physical astronomers. Prof. Adams and M. Delaunay take one view of the question; MM. Plana, Pontécoulant, and Hansen the other. Mr. Airy, Mr. Main, the President of the Astronomical Society, and Sir John Lubbock support the conclusions at which Prof. Adams has arrived. The question in dispute is strictly mathematical; and it is a very remarkable circumstance in the history of Astronomy, that such great names should be ranged on opposite sides, seeing that the point involved is really no other than whether certain analytical operations have been conducted on right principles; and it is a proof, therefore, if any were wanting, of the extraordinary complexity and difficulty of these transcendental inquiries. The controversy is of the following nature:—The Moon's motion round the Earth, which would be otherwise uniform, is disturbed by the Sun's attraction; any cause therefore which affects the amount of that attraction affects also the Moon's motion: now, as the excentricity of the Earth's orbit is gradually decreasing, the average distance of the Sun is slightly increasing every year, and his disturbing force becomes less; hence the Moon is brought nearer the Earth, but at the rate of less than one inch yearly, her gravitation towards the Earth is greater, and her motion proportionably accelerated. It is on the secular acceleration of the Moon's mean motion, arising from this minute yearly approach, that the dispute has arisen; so infinitesimally small are the quantities within the reach of modern analysis. Mr. Adams asserts that his predecessors have improperly omitted the consideration of the effect produced by the action of that part of the Sun's disturbing force which acts in the direction of a tangent to the Moon's orbit, and which increases the velocity; his opponents deny that it is necessary to take this into account at all. Had not M. Delaunay, an able French analyst, by a perfectly independent process, confirmed the results of Prof. Adams, we should have had the English and Continential astronomers waging war on an algebraical question. On the other hand, however, the computations of the ancient lunar eclipses support the views of the Continent; but if Mr. Adams's mathematics are correct, this only shows that there must be other causes in operation, as yet undiscovered, which influence the result; and it is not at all unlikely, that this most curious and interesting controversy will eventually lead to some important discovery in Physical Astronomy.

Chemistry.

In Chemistry I am informed that great activity has been displayed, especially in the organic department of the science. For several years past processes of substitution (or displacment of one element or organic group by another element or a group, more or less analogous) have been the main agents employed in investigation, and the results to which they have led have been truly wonderful; enabling the chemist to group together several compounds of comparatively simple constitution into others much more complex, and thus to imitate, up to a certain point, the phenomena which take place within the growing plant or animal. It is not indeed to be anticipated that the chemist should ever be able to produce by the operations of the laboratory the arrangement of the elements in the forms of the vegetable cell or the animal fibre; but he may hope to succeed in preparing some of the complex results of secretion or of chemical changes produced within the living organism,—changes which furnish definite crystallizable compounds, such as the forminates and the acetates, and which he has actually obtained by operations independent ot the plant or the animal.

New Dyes.

Turning to the practical applications of chemistry, we may refer to the beautiful dyes now extracted from aniline, an organic base formerly obtained as a chemical curiosity from the products of the distillation of coal-tar, but now manufactured by the hundred weight in consequence of the extensive demand foı the beautiful colours known as Mauve, Magenta, and Solferino, which are prepared by the action of oxidizing agents, such as bichromate of potash, corrosive sublimate, and iodide of mercury upon aniline.

Nor has the inorganic department of chemistry been deprived of of its due share of important advances. Schönbein has continued his investigations upon ozone, and has added many new facts to our knowledge of this interesting substance; and Andrews and Tait, by their elaborate investigations, have shown that ozone, whether admitted to be an allotropic modification of oxygen or not, is certainly much more dense than oxygen in its ordinary condition.

Geology—Antiquity of man.

The bearing of some recent geological discoveries on the great question of the high antiquity of Man was brought before your notice at your last Meeting, at Aberdeen, by Sir Charles Lyell, in his opening address to the Geological Section. Since that time many French and English naturalists have visited the valley of the Somme in Picardy, and confirmed the opinion originally published by M. Boucher de Perthes, in 1847, and afterwards confirmed by Mr. Prestwich, Sir C. Lyell, and other geologists, from personal examination of that region. It appears that the position of the rude flint-implements, which are unequivocally of human workmanship, is such, at Abbeville and Amiens, as to show that they are as ancient as a great mass of gravel which fills the lower parts of the valley between those two cities, extending above and below them. This gravel is an ancient fluviatile alluvium by no means confined to the lowest depressions (where extensive and deep peat-mosses now exist), but is sometimes also seen covering the slopes of the boundary hills of chalk at elevations of 80 or 100 feet above the level of the Somme. Changes, therefore, in the physical geography of the country, comprising both the filling up with sediment and drift, and the partial re-excavation of the valley, have happened since old river-beds were, at some former period, the receptacles of the worked flints. The number of these last, already computed at above 1,400 in an area of fourteen miles in length, and half a mile in breadth, has afforded to a succession of visitors abundant opportunities of verifying the true geological position of the implements.

The old alluvium, whether at higher or lower levels, consists not, only of the coarse gravel with worked flints above mentioned but also of superimposed beds of sand and loam, in which are many freshwater and land shells, for the most part entire, and of species not living in the same part of France. With the shells are found bones of the Mammoth and an extinct Rhinoceros, *R. tichorhinus*, an extinct species of Deer, and fossil remains of the Horse, Ox, and other animals. These are met with in the overlying beds, and sometimes also in the gravel where the implements occur. At Menchecourt, in the suburbs of Abbeville, a nearly entire skeleton of the Siberian Rhinoceros is said to have been taken out about forty years ago, a fact affording an answer to the question often raised, as to whether the bones of the extinct mammalia could have been washed out of an older alluvium into a newer one, and so redeposited and mingled with the relics of human workmanship. Far-fetched as was this hypothesis, I am informed that it would not, if granted, have seriously shaken the proof of the high antiquity of the human productions, for that proof is independent of organic evidence or fossil remains, and is based on physical data. As was stated to us last year by Sir C. Lyell, we should still have to allow time for great denudation of the chalk, and the removal from place to place, and the spreading out over the length and breadth of a large valley of heaps of chalk flints in beds from 10 to 15 feet in thickness, covered by loams and sands of equal thickness, these last often tranquilly deposited, all of which operations would require the supposition of a great lapse of time.

That the mammalia Fauna, preserved under such circumstances, should be found to diverge from the type now established in the same region, is consistent with experience; but the fact of a foreign and extinct Fauna was not needed to indicate the great age of the gravel containing the worked flints.

Another independent proof of the age of the same gravel and its associated fossiliferous loam is derived from the large deposits of peat above alluded to, in the Valley of the Somme, which contain not only monuments of the Roman, but also those of an older stone period, usually called Celtic. Bones, also, of the bear of the species still inhabiting the Pyrenees, and of the beaver, and many large stumps of trees, not yet well examined by botanists, are found in the same peat, the oldest portion of which belongs to times far beyond those of tradition; yet distinguished geologists are of opinion that the growth of all the vegetable matter, and even the original scooping out of the hollows containing it, are events long posterior in date to the gravel with flint implements nay, posterior even to the formation of the uppermost of the layers of loam with freshwater shells overlying the gravel.

The exploration of caverns, both in the British Isles and other parts of Europe, has in the last few years been prosecuted with renewed ardour and success, although the theoretical explanation of many of the phenomena brought to light seems as yet to baffle the skill of the ablest geologists. Dr. Falconer has given us an account of the remains of several hundred hippopotami, obtained from one cavern, near Palermo, in a locality where there is now no running water. The same palæontologist, aided by Col. Wood, of Glamorganshire, has recently extracted from a single cave in the Gower peninsula of South Wales, a vast quantity of the antlers of a reindeer (perhaps of two species of reindeer), both allied to the living one. These fossils are most of them shed horns;

and there have been already no less than 1,100 of them dug out of the mud filling one cave.

In the cave of Brixham, in Devonshire in and another near Palermo in Sicily, flint implements were observed by Dr. Falconer, associated in such a manner with the bones of extinct mammalia, as to lead him to infer that Man must have co-existed with several lost species of quadrupeds; and M. de Vibraye has also this spring called attention to analogous conclusions, at which he has arrived by studying the position of a human jaw with teeth, accompanied by the remains of a mammoth, under the stalagmite of the Grotto d'Arcis, near Troyes, in France.

Microscopy.

But I cannot take leave of this department of knowledge without likewise alluding to the progress made in scrutinizing the animal and vegetable structure by means of the microscope—more particularly the intimate organization of the brain, spinal cord, and organs of the senses; also to the extension, through the means of well-directed experiment, of our knowledge of the functions of the nervous system, the course followed by sensorical impressions and motorial excitement in the spinal cord, and the influence exerted by or through the nervous centres on the movements of the heart, blood-vessels and viscera, and on the activity of the secreting organs;—subjects of inquiry, which, it may be observed, are closely related to the question of the organic mechanism whereby our corporeal frame is influenced by various mental conditions.

Conclusion.

I may perhaps be permitted to express the hope that the examples I have given of some of the researches and discoveries which occupy the attention of the cultivators of science may have tended to illustrate the sublime nature, engrossing interest and paramount utility of such pursuits, from which the beneficial influence in promoting the intellectual progress and the happiness and well-beirg of mankind may well be inferred. But let us assume that to any of the classical writers of antiquity sacred or profane, a sudden revelation had been made of all the wonders involved in Creation accessible to man; that to them had been disclosed not only what we now know, but what we are to know hereafter, in some future age of improved knowledge; would they not have delighted to celebrate the marvels of the Creator's power? They would have described the secret force by which the wandering orbs of light are retained in their destined paths; the boundless extent of celestial spaces in which worlds on worlds are heaped; the wonderful mechanism by which heat and light are conveyed through distances which to mortal minds seem quite unfathomable; the mysterious agency of electricity destined at one time to awaken men's minds to an awful sense of a present Providence, but in after-times to become a patient minister of man's will, and convey his thoughts with the speed of light across the inhabited globe; the beauties and prodigies of contrivance which the animal and vegetable world display, from mankind downwards to the lowest zoophyte, from the stately oak of the primæval forest to the humblest plant which the microscope unfolds to view; the history of every stone on the mountain brow, of every gay-coloured insect which flutters in the sunbeam;—all would have been described, and all which the discoveriers of our more fortunate posterity will in due time disclose, and in language such as none but they could command. It is reserved for future ages to sing such a glorious hymn to the Creator's praise. But is there not enough now seen and heard to make indifference to the wonders around us a deep reproach, nay, almost a crime. If we have neither leisure nor inclination to track the course of the planet and comet through boundless space; to follow the wanderings of the subtle fluid in the galvanic coil or the nicely-poised magnet; to read the world's history written on her ancient rocks, the sepulchres of stony relics of ages long gone past; to analyze with curious eye the wonderful combination of the primitive elements, and the secret mysteries of form and being in animal and plant; discovering everywhere connecting links, and startling analogies and proofs of adaptation of means to ends—all tending to charm the senses, to teach to reclaim a being who seems but a creeping worm in the presence of this great creation—what, I repeat, if we will not, or cannot, do these things or any of these things,—is that any reason why these speaking marvels should be to us almost as they were not? *Marvels* indeed they are; but they are also mysteries the unraveling of some of which task to the utmost the highest order of human intelligence. Let us ever apply ourselves seriously to the task, feeling assured that the more we thus exercise, and by exercising improve our intellectual faculties, the more worthy shall we be, the better shall we be fitted, to come nearer to our God.

PROCEEDINGS.—SECTION II.

Botany,—Darwin's Theory.

'On the Final Causes of the Sexuality of Plants, with particular Reference to Mr. Darwin's Work "On the Origin of Species by Natural Selection,"' by DR. DAUBENY.—Dr. Daubeny began by pointing out the identity betwen the two modes by which the multiplication of plants is brought about, the very same properties being imparted to the bud or to the graft as to the seed produced by the ordinary process of fecundation, and a new individual being in either instance equally produced. We are, therefore, led to speculate as to the final cause of the existence of sexual organs in plants, as well as in those lower animals which can be propagated by cuttings. One use, no doubt, may be the dissemination of the species; for many plants, if propagated by buds alone, would be in a manner confined to a single spot. Another secondary use is the production of fruits which afford the nourishment to animals. A third may be to minister to the gratification of the senses of man by the beauty of their forms and colours. But as these ends are only answered in a small proportion of cases, we must seek further for the uses of the organs in question; and hence the author suggested that they might have been provided, in order to prevent that uniformity in the aspect of Nature, which would have prevailed if plants had been multiplied exclusively by buds. It is well known that a bud is a mere counterpart of the stock from whence it springs, so that we are always sure of obtaining the very same description of fruit by merely grafting a bud or cutting of a pear or apple tree upon another plant of the same species. On the other hand, the seed never produces an individual exactly like the plant from which it sprang; and hence, by the union of the sexes in plants, some variation from the primitive type is sure to result. Dr. Daubeny remarked that if we adopt in any degree the views of Mr. Darwin with respect to the origin of species by natural selection, the creation of sexual organs in plants might be regarded as intended to promote this specific object. Whilst, however, he gave his assent to the Darwinian hypothesis, as likely to aid us in reducing the number of existing species, he wished not to be considered as advocating it to the extent to which the author seems disposed to carry it. He rather desired to recommend to naturalists the necessity of further inquiries, in order to fix the limits within which the doctrine proposed by Mr. Darwin may assist us in distinguishing varieties from species.

Prof. Huxley, having been called on by the Chairman, deprecated any discussion on the general question of the truth of Mr. Darwin's theory. He felt that a general audience, in which sentiment would unduly interfere with intellect, was not the public before which such a discussion should be carried on. Dr. Daubeny had brought forth nothing new to demand or require remark.—Mr. R. Dowden, of Cork, mentioned, first, two instances in which plants had been disseminated by seeds, which could not be effected by buds; first, in the introduction of *Senecio squalida*, by the late Rev. W. Hincks; and, second, in the diffusion of chicory, in the vicinity of Cork, by the agency of its winged seeds. He related several anecdotes of a monkey, to show that however highly organized the Quadrumana might be, they were very inferior in intellectual qualities to the dog, the elephant and other animals. He particularly referred to his monkey being fond of playing with a hammer; but although he liked oysters as food, he never could teach him to break the oysters with his hammer as a means of indulging his appetite.—Dr. Wright stated that a friend of his, who had gone out to report on the habits of the gorilla—the highest form of monkey—had observed that the female gorilla took its young to the sea-shore for the purpose of feeding them on oysters, which they broke with great facility.—Prof. Owen wished to approach this subject in the spirit of the philosopher, and expressed his conviction that there were facts by which the public could come to some conclusion with regard to the probabilities of the truth of Mr. Darwin's theory. Whilst giving all praise to Mr. Darwin for the courage with which he had put forth his theory, he felt it must be tested by facts. As a contribution to the facts by which the theory must be tested, he would refer to the structure of the highest Quadrumana as compared with man. Taking the brain of the gorilla, it presented more differences, as compared with the brain of man, than it did when compared with the brains of the very lowest and most problematical form of the Quadrumana. The deficiencies in cerebral structure between the gorilla and man were immense. The posterior lobes of the cerebrum in man presented parts which were wholly absent in the gorilla. The same remarkable differences of structure were seen in other parts of the body; yet he would especially refer to the structure of the great toe in man, which was constructed to enable him to assume the upright position; whilst in the lower monkeys it was impossible, from the structure of their feet, that they should do so. He concluded by urging on the physiologist the necessity of experiment. The chemist, when in doubt, decided his questions by experiment; and this was what was needed by the physiologist.—Prof. HUXLEY begged to be permitted to reply to Prof. Owen. He denied altogether that the difference between the brain of the gorilla and man was so great as represented by Prof. Owen, and appealed to the published dissections of Tiedemann and others. From the study of the structure of the brain of the Quadrumana, he maintained that the difference between man and the highest monkey was not so great as between the highest and the lowest monkey. He maintained also, with regard to the limbs, that there was more difference between the toeless monkeys and the gorilla than between the latter and man. He believed that the great feature which distinguished man from the monkey was the gift of speech.

On the Intellectual Development of Europe, considered with Reference to the Views of Mr. Darwin and others, that the Progression of Organisms is determined by Law, by Prof. DRAPER, M.D., of New York.—The object of this paper was to show that the advancement of man in civilization does not occur accidentally or in a fortuitous manner, but is determined by immutable law. The author introduced his subject by recalling proofs of the denomination of law in the three great lines of the manifestation of life. First, in the successive stages of development of every individual, from the earliest rudiment to maturity; secondly, in the numberless organic forms now living contemporaneously with us, and constituting the animal series; thirdly, in the orderly appearance of that grand succession which in the slow lapse of geological time has emerged, constituting the life of the Earth, showing therefrom not only the evidences, but also proofs of the dominion of law over the world of life. In these three lines of life he established that the general principle is to differentiate instinct from automatism, and then to differentiate intelligence from instinct. In man himself three distinct instrumental nervous mechanisms exist, and three distinct modes of life are perceptible, the antomatic, the instinctive, the intelligent. They occur in an epochal order, from infancy through childhood to the more perfect state. Such holding good for the individual, it was then affirmed that it is physiologically impossible to separate the individual from the race, and that what holds good for the one holds good for the other too; and hence that man is the archetype of society, and individual development the model of social progress, and that both are under the control of immutable law: that a parallel exists between individual and national life in this, that the production, life, and death of an organic particle in the person, answers to the production, life, and death of a person in the nation. Turning from these purely physiological considerations to historical proof, and selecting the only European nation which thus far has offered a complete and completed intellectual life, Prof. Draper showed, that the characteristics of Greek mental development answer perfectly to those of individual life, presenting philosophically five well-marked ages or periods,—the first being closed by the opening of Egypt to the Ionians; the second including the Ionian Pythagorean, and Eleatic philosophies, was ended by the criticisms of the Sophists; the third, embracing the Socratic and Platonic philosophies, was ended by the doubts of the Sceptics; the fourth, ushered in by the Macedonian expedition and adorned by the splendid achievements of the Alexandrian school, degenerated into Neoplatonism and imbecility in the fifth, to which the hand of Rome put an end. From the solution of the four great problems of Greek philosophy, given in each of these five stages of its life, he showed that it is possible to determine the law of the variation of Greek opinion, and to establish its analogy with that of the variations of opinion in individual life. Next, passing to the consideration of Europe in the aggregate, Prof. Draper showed that it has already in part repeated these phases in its intellectual life. Its first period closes with the spread of the power of Republican Rome, the second with the foundation of Constantinople, the third with the Turkish invasion of Europe: we are living in the fourth. Detailed proofs of the correspondence of these periods to those of Greek life, and through them to those of individual life, are given in a work now printing on this subject, by the author, in America. Having established this conclusion, Prof. Draper next briefly alluded to many collateral problems or inquiries. He showed that the advances of men are due to external and not to interior influences, and that in this respect a nation is like a seed, which can only develop when the conditions are favourable, and then only in a definite way; that the time for psychical change corresponds with that for physical, and that a nation cannot advance except its material condition be touched,—this having been the case throughout all Europe, as is manifested by the diminution of the blue-eyed races thereof; that all organisms and even man are dependent for their characteristics, continuance, and life on the physical conditions under which they live; that the existing apparent invariability presented by the world of organization is the direct consequence of the physical equilibrium, but that if that should suffer modification, in an instant the fanciful doctrine of the immutability of species would be brought to its proper value. The organic world appears to be in repose because natural influences have reached an equilibrium. A marble may remain motionless for ever on a level table, but let the table be a little inclined, and the marble will quickly run off; and so it is with organisms in the world. From his work on Physiology, published in 1856, he gave his views in support of the doctrine of the transmutation of species; the transitional forms of the animal and also the human type; the production of new ethnical elements, or nations; and the laws of their origin, duration, and death.

The announcement of this paper attracted an immense audience to the Section, which met this morning in the Library of the New Museum. The discussion was commenced by the Rev. Mr. Cresswell, who denied that any parallel could be drawn between the intellectual progress of man and the physical development of the lower animals. So far from the author being correct with regard to the history of Greece, its masterpieces in literature—the Iliad and Odyssey—were produced during its national infancy. The theory of intellectual development proposed was directly opposed to the known facts of the history of man.—Sir B. Brodie stated, he could not subscribe to the hypothesis of Mr. Darwin. His primordial germ had not been demonstrated to have existed. Man had a power of self-consciousness—a principle differing from anything found in the material world, and he did not see how this could originate in lower organisms This power of man was identical with the Divine Intelligence; and to suppose that this could originate with matter, involved the absurdity of supposing the source of Divine power dependent on the arrangement of matter. The Bishop of Oxford stated that the Darwinian theory, when tried by the principles of inductive science, broke down. The facts brought forward did not warrant the theory. The permanence of specific forms was a fact confirmed by all observation. The remains of animals, plants, and man found in those earliest records of the human race—the Egyptian catacombs, all spoke of their identity with existing forms, and of the irresistible tendency of organized beings to assume an unalterable character. The line between man and the lower animals was distinct: there was no tendency on the part of the lower animals to become the self-conscious intelligent being, man; or in man to degenerate and lose the high characteristics of his mind and intelligence. All experiments had failed to show any tendency in one animal to assume the form of the other. In the great case of the pigeons quoted by Mr. Darwin, he admitted that no sooner were these animals set free than they returned to their primitive type. Everywhere sterility attended hybridism, as was seen in the closely-allied forms of the horse and the ass. Mr. Darwin's conclusions were an hypothesis, raised most unphilosophically to the dignity of a causal theory. He was glad to know that the greatest names in science were opposed to this theory, which he believed to be opposed to the interests of science and humanity.—Prof. Huxley defended Mr. Darwin's theory from the charge of its being merely an hypothesis. He said, it was an explanation of phenomena in Natural History, as the undulating theory was of the phenomena of light. No one objected to that theory because an undulation of light had never been arrested and measured. Darwin's theory was an explanation of facts; and his book was full of new facts, all bearing on his theory. Without asserting that every part of the theory had been confirmed, he maintained that it was the best explanation of the origin of species which had yet been offered. With regard to the psychological distinction between man and animals; man himself was once a monad—a mere atom, and no body could say at what moment in the history of his development he became consciously intelligent. The question was not so much one of a transmutation or transition of species, as of the production of forms which became permanent. Thus the short-legged sheep of America were not produced gradually, but originated in the birth of an original parent of the whole stock, which had been kept up by a rigid system of artificial selection. —Admiral FitzRoy regretted the publication of Mr. Darwin's book, and denied Prof. Huxley's statement, that it was a logical arrangement of facts.—Dr. Beale pointed out some of the difficulties with which the Darwinian theory had to deal, more especially those vital tendencies of allied agents.—Mr. Lubbock expressed his willingness to accept the Darwinian hypothesis in the absence of any better. He would, however, express his conviction, that time was not an essential element in these changes. Time alone produced no change.—Dr. Hooker, being called upon by the President to state his views of the botanical aspect of the question, observed, that the Bishop of Oxford having asserted that all men of science were hostile to Mr. Darwin's hypothesis, —whereas he himself was favourable to it,—he could not presume to address the audience as a scientific authority. As, however, he had been asked for his opinion, he would briefly give it. In the first place, his Lordship, in his eloquent address, had, as it appeared to him, completely misunderstood Mr. Darwin's hypothesis: his Lordship intimated that this maintained the doctrine of the transmutation of existing species one into another, and had confounded this with that of the successive development of species by variation and natural selection. The first of these doctrines was so wholly opposed to the facts, reasonings, and results of Mr. Darwin's work, that he could not conceive how any one who had read it could make such a mistake,—the whole book, indeed, being a protest against that doctrine. Then, again, with regard to the general phenomena of species, he understood his Lordship to affirm that these did not present characters that should lead careful and philosophical naturalists to favour Mr. Darwin's views. To this assertion Dr. Hooker's experience of the Vegetable Kingdom was diametrically opposed. He considered that at least one half of the known kinds of plants were disposable in groups, of which the species were connected by varying characters common to all in that group, and sensibly differing in some individuals only of each species; so much so that, if each group be likened to a cobweb, and one species be supposed to stand in the centre of that web, its varying characters might be compared to the radiating and concentric threads, when the other species would be represented by the points of union of these; in short, that the general characteristic of orders genera, and species amongst plants differred in degrees only from those of varieties, and afforded the strongest countenance to Mr. Darwin's hypothesis. As regarded his own acceptation of Mr. Darwin's views, he expressly disavowed having adopted them as a creed. He knew no creeds in scientific matters. He had early begun the study of natural science under the idea that species were original creations; and it should be steadily kept in view that this was merely another hypothesis, which in the abstract was neither more nor less entitled to acceptance than Mr. Darwin's: neither was, in the present state of science, capable of demonstration, and each must be tested by its power of explaining the mutual dependence of the phenomena of life. For many years he had held to the old hypothesis, having no better established one to adopt, though the progress of botany had, in the interim, developed no new facts that favoured it, but a host of most suggestive objections to it. On the other hand, having fifteen years ago been privately made acquainted with Mr. Darwin's views, he had during that period applied these to botanical investigations of all kinds in the most distant parts of the globe, as well as to the study of some of the largest and most different Floras at home. Now, then, that Mr. Darwin had published it, he had no hesitation in publicly adopting his hypothesis, as that which offers by far the most probable explanation of all the phenomena presented by the classification, distribution, structure, and development of plants in a state of nature and under cultivation; and he should, therefore, continue to use his hypothesis as the best weapon for future research, holding himself ready to lay it down should a better be forthcoming, or should the now abandoned doctrine of original creations regain all it had lost in his experience.

Review of Proceedings.

Fairbairn President! These two words announce the story of the British Association for the year to come. Manchester being the place selected for the meeting of 1861, it has been thought both just and gracious that the honours of the chair should be given to a representative man of that great city. How rapid and how democratic is the movement of English life! Mr. Fairbairn was a grown man at a time when Manchester was scarcely known south of the Trent save as a town of cotton, just as Dunstable may have been known as a town of straw; when it had no representative in the House of Commons, and scarcely any representatives in the republic of science. Yet he has lived not only to see its political representatives among the first in influence at Westminster; its scientific representatives seated among the highest in all learned societies; its social and commercial representatives, its mayor and aldermen, received with distinction in the most exclusive and aristocratic city of the empire; and himself chosen by the most illustrious men of this nation, assembled in the classic halls of Oxford, to succeed to a dignity vacated within the past week by the august Consort of the Queen. How different from the day when Dalton first intimated to the world without, that Manchester was not a mere cotton ball! The whole world of science will ratify the choice of Mr. Fairbairn for the Presidential chair.

The week which began with the Prince's speech, and which has closed, under the auspices of Lord Wrottesley, with the nomination of Mr. Fairbairn, has been eminently useful, various and agreeable. Since Friday, the air has been soft, the sky sunny A sense of sudden summer has been felt in the meadows of Christ Church and in the gardens of St. John's; many a dreamer of dreams, tempted by the summer warmth, has followed the Cadiz proverb, and stealing from section A or B, has consulted his ease and taken a boat. To say that the meeting has been held in Oxford, is to say that it has been held in the midst of objects of the highest human interest and of the most delightful associations—in a city of students and professors—within reach of libraries, museums, philosophical instruments, observatories, collections of natural history, such as no other provincial city in England,—or in Europe,—can boast. The hospitality has been limitless. The colleges, the private houses, have been full. The splendid and piquant New Museum, has been open day and night. An unusual flutter of silk and muslin has warmed with a brighter glow the old caves of the Bodleian. Groups that Watteau would have loved to paint have been daily seen under the elms of the Broad Walk or in the shades of Magdalen. Exeter chapel, which Mr. Scott has transformed into the likeness of the Sainte Chapelle in Paris, has had its hosts of pilgrims. Every morning has brought its charming breakfast parties, every evening its charming early dinners, closed by its no less charming receptions. A splendid lecture has been given by Prof. Walker on the present state of our knowledge of the Sun; two admirable sermons have been preached at St. Mary's by Mr. Temple and Mr. Mansell, on the Religious Aspects of Science; and on Saturday night, when there was no reception at the New Museum, Dr. Daubeny received a select portion of the *savans* of both sexes in his tent at the Botanic Gardens. A batch of new Doctors of Civil Law has been added to the illustrious roll, amongst whom Prof. Sedgwick was the unquestionable lion of the day. Talking of lions reminds us that the Red Lions have had their annual feed; this time under the presidency of Prof. Huxley. There have been excursions numberless; the students of Geology riding chiefly to Shotover; the lovers of Art chiefly to Blenheim. The Duke of Marlborough has paid the members of the British Association the delicate compliment of throwing open his noble grounds and galleries at the hours most convenient for their visits, and in cases where proper applications have been made, of allowing the treasures of his private apartments to be inspected in the most liberal manner. Hundreds have accepted His Grace's generous invitation to Blenheim, where the grounds are in perfect beauty, and the glorious Raffaelles, Rubens', and Van Dycks have recently been arranged and noted by the accomplished hand of Mr. Scharf.

Yet the main interest of the week has unquestionably centred in the Sections, where the intellectual activities have sometimes breathed over the courtesies of life like a sou'-wester, cresting the waves of conversation with white and brilliant foam. The flash, and play, and collisions in these Sections have been as interesting and amusing to the audiences as the Battle at Farnborough or the Volunteer Review to the general British public. The Bishop of Oxford has been famous in these intellectual contests, but Dr. Whewell, Lord Talbot de Malahide, Prof. Sedgwick, Mr. Crawford, and Prof. Huxley have each found foemen worthy of their steel, and made their charges and countercharges very much to their own satisfaction and the delight of their respective friends. The chief cause of contention has been the new theory of the Development of Species by Natural selection—a theory open—like the Zoological Gardens (from a particular cage in which it draws so many laughable illustrations)—to a good deal of personal quizzing, without, however, seriously crippling the usefulness of the physiological investigations on which it rests. The Bishop of Oxford came out strongly against a theory which holds it possible that man may be descended from an ape,—in which protest he is sustained by Prof. Owen, Sir Benjamin Brodie, Dr. Daubeny, and the most eminent naturalists assembled at Oxford. But others conspicuous among these, Prof. Huxley—have expressed their willingness to accept, for themselves, as well as for their friends and enemies, all actual truths, even the last humiliating truth of a pedigree not registered in the Herald's College. The dispute has at least made Oxford uncommonly lively during the week.

NATURAL HISTORY SOCIETY'S ROOMS.

Montreal, November 5th, 1860.

The Society held its usual monthly meeting. The President, the Lord Bishop of Montreal, in the Chair.

The Minutes of last meeting and the report of the Council were read and adopted, several new members were balloted for, and others proposed.

The following donations were presented :—

From Geo. Barnston, Esq., Michipicoton.

A pair of Black Ducks.—(*Anas obscura*).
An Eared Greel.—(*Podiceps auritus*).
A Marsh Harrier.—(*Circus cyanus*).
A Wilson's Snipe.—(*Fringa Wilsonii*).
A Falcon.—(*Falco anatina.*)

From Mr. Cunninghame.

Specimens of Copper Ore from Acton.

From Mr. Blackwell.

A fine Bust of the late Dr. Buckland.

The thanks of the Society were voted to the donors.

Thereafter it was resolved, viz: That on occasion of the decease of the late Andrew F. Holmes, M.D., L.L.D., this society desires to record its high appreciation of his personal and scientific character, and its gratitude for his services as a pioneer of Natural Science in Canada, and more especially as one of the founders of this Society, a zealous promoter of its interests in its earlier years, and an important contributor to its collections.

And that in testimony of respect for the deceased and sympathy with his surviving relatives, a copy of this resolution be transmitted by the corresponding secretary to Mrs. Holmes.

The ordinary business having been finished, and a large number of members being assembled in the Library, the President called upon Principal Dawson to read a paper "On the recent Earthquake with notices of previous Earthquakes in Canada." This paper was of much interest, and will be found among the articles of this number of the *Naturalist;* it elicited an animated discussion.

From the report of the Committee on Lectures, and papers for the monthly meetings, it appears that this winter there will be a succession of scientific subjects of a novel and instructive kind brought before the Society.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF AUGUST, 1860.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29.854	29.826	29.954	50.0	68.8	59.2	.258	.319	.352	.71	.47	.70	W.	W. S. W.	S. W. by S.
2	972	859	990	52.5	80.6	66.0	.282	.445	.407	.74	.43	.63	S. W.	S. W.	S. W.
3	907	783	851	56.0	88.2	77.0	.315	.530	.639	.71	.40	.69	E. by S.	S. S. E.	W. by S.
4	717	741	705	73.0	85.6	70.2	.725	.603	.523	.88	.49	.72	S. W. by W.	W. by S	N. W.
5	809	811	909	68.0	83.5	67.8	.393	.597	.489	.59	.53	.75	N. E.	W.	W. by S.
6	904	809	785	64.3	93.2	72.4	.464	.710	.559	.77	.46	.72	S. by W.	S. S. W.	S. W.
7	705	583	604	70.3	90.2	75.2	.551	.699	.745	.75	.54	.86	S. by E.	W.	N. N. W.
8	720	616	594	71.1	87.2	73.2	.572	.664	.728	.76	.52	.79	W. by S.	W.	S. by W.
9	585	614	708	73.2	79.0	65.8	.393	.574	.516	.85	.58	.84	S. S. W.	S. S. W.	S. by W.
10	699	608	701	64.2	92.2	68.0	.464	.556	.437	.77	.57	.63	S. S. W.	S. by W.	W.
11	851	907	957	54.1	83.2	54.5	.335	.558	.355	.80	.50	.80	N.	N. E. by E.	S. by E.
12	824	786	811	46.1	80.9	66.2	.262	.624	.502	.84	.59	.78	S. E. by E.	S.	S. S. W.
13	444	146	735	63.8	65.0	60.8	.543	.583	.462	.94	.94	.91	S. by E.	N. E.	W. N. W.
14	914	911	952	53.6	66.9	56.7	.376	.463	.420	.88	.71	.94	W.	S. W.	S. W.
15	995	30.070	30.057	54.5	72.0	64.2	.328	.397	.464	.77	.52	.76	W. by N.	N. by W.	W. by S.
16	30.018	29.880	29.960	50.1	78.6	63.9	.250	.443	.503	.71	.46	.86	W. S. W.	S. W.	S. S. W.
17	29.867	740	711	61.4	85.0	67.3	.466	.507	.489	.85	.43	.75	W. S. W.	W. S. W.	S. S. W.
18	751	571	719	62.9	70.6	63.7	.517	.651	.536	.91	.88	.92	W. S. W.	S. S. W.	W. N. W.
19	814	794	880	61.7	79.7	68.4	.466	.612	.443	.85	.62	.65	E. by N.	S. E.	S. E. by E.
20	826	766	851	67.6	77.4	68.9	.626	.705	.671	.95	.81	.96	S. S. E.	S. S. E.	S. S. W.
21	799	857	861	67.3	83.0	67.0	.598	.565	.591	.92	.57	.89	S. S. W.	S. W.	S.
22	857	834	918	62.3	83.7	67.2	.523	.514	.571	.94	.45	.50	S. by W.	S. W.	S. S. W.
23	856	803	824	65.6	86.2	72.2	.362	.511	.566	.87	.41	.74	S. S. W.	N. E. by E.	N. N. E.
24	874	711	735	64.2	68.8	66.1	.576	.642	.604	.92	.92	.94	S. E. by E.	S. by E.	S. by E.
25	606	484	526	65.0	77.6	62.1	.618	.678	.498	1.00	.73	.91	S.	S. S. E.	W. by S.
26	534	600	711	62.3	75.8	63.0	.530	.590	.422	.97	.68	.75	W.	N. W.	W.
27	682	621	646	52.2	75.6	57.3	.361	.476	.497	.94	.59	.87	S. S. E.	W.	S. W.
28	634	666	692	53.9	61.4	57.3	.396	.583	.378	.96	.71	.81	S. S. W.	S. W.	S. W.
29	733	715	809	55.5	76.4	59.2	.298	.541	.439	.90	.60	.88	S. W.	S. W.	S. W.
30	755	568	459	54.4	78.9	65.0	.390	.564	.420	.94	.61	.68	S. W.	W. by S.	S. W.
31	468	480	514	56.1	72.1	60.2	.391	.600	.456	.87	.78	.88	S. W.	W. N. W.	W, by N.

Day of Month.	Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in inches.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.] 6 a. m.	2 p. m.	10 p. m.
1	166.90	2.5	....	....	Clear.	Clear.	Clear.
2	4.80	1.0	....	....	"	Cumb. 2.	Cir. 2.
3	80.20	1.0	....	....	" Heavy Dew.	Clear.	Cu. Str. 9.
4	113.40	2.0	0.487	....	Cu. Str. 8.	Cu. Str. 6.	Str. 2. Aurora Borealis.
5	119.60	1.5	....	....	Clear.	Clear.	Clear. Aurora Borealis.
6	13.80	1.0	....	....	"	"	Cu. Str. 6.
7	41.70	0.5	....	....	"	Hazy.	" 9. dist. th. vivid lt'ng.
8	39.40	2.5	....	....	"	Clear.	Str. 2. Aurora Borealis.
9	63.50	2.5	0.300	....	"	Cu. Str. 8. thund.	Clear. " "
10	32.60	2.0	....	....	"	" 2.	C. Str. 9. Lightning.
11	59.30	2.5	Inapp.	....	Cu. Str. 10.	Clear.	Clear. Aurora Borealis.
12	60.70	1.0	....	....	Fog.	"	" " "
13	59.40	4.0	0.929	....	Rain.	Rain.	Cu. St. 9.
14	36.50	2.5	0.011	....	Cu. Str. 8.	Cu. Str. 6.	" 9.
15	149.40	1.5	....	....	" 6.	Clear.	Clear.
16	82.30	1.0	....	....	Clear Heavy Dew.	St. 2.	Cu. St. 2. Aurora Borealis.
17	116.90	1.0	....	....	" " "	Clear.	Clear.
18	55.10	3.0	0.900	....	Nimb. 9.	Rain.	C. Str. 4. " "
19	134.39	2.0	....	....	Cu. Str. 8.	Cu. Str. 4.	" 6.
20	174.71	3.0	0.430	....	Rain.	" 9.	Clear.
21	101.20	2.5	0.230	....	Cu. Str. 8.	" 2.	" " "
22	54.20	3.0	....	....	" 10.	Cumb. 2.	" " "
23	90.60	2.5	....	....	Clear. Heavy Dew.	Clear.	Rain.
24	136.00	3.0	4.095	....	Rain. Dist. thunder.	Cu. Str. 10.	Cu. Str. 8.
25	72.80	4.0	0.500	....	Cu. 4.	" 8.	" 6. Lunar Rainbow
26	251.60	3.0	....	....	" Str. 8.	Clear.	Clear.
27	71.80	2.0	0.453	....	Clear.	Cu. St. 8.	Cu. Str. 6.
28	199.50	1.5	0.181	....	Cu. Str. 4.	Slight Rain.	" 4.
29	181.50	1.5	Inapp.	....	" 6.	Showers.	Clear.
30	157.30	1.5	....	....	Clear.	Clear.	"
31	138.10	2.5	0.070	....	Cu. Str. 10.	Cu. St. 4.	Cirr. Str. 2.

REPORT FOR THE MONTH OF SEPTEMBER, 1860.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.		
	6 a.m.	2 p.m.	10 p.m.	6 a. m.	2 p. m.	10 p. m.	6 a.m.	2 p.m.	10 p.m.	6 a.m.	2 p.m.	10 p.m.	6 a. m.	2 p. m.	10 p. m.
1	29.718	29.786	29.833	53.0	70.1	50.5	.380	.397	.283	.94	.52	.78	N. N. W.	W. by N.	N. W.
2	916	914	30.073	45.6	64.6	53.9	.280	.243	.370	.88	.42	.84	W. by N.	N. W.	W. by S.
3	30.212	30.208	130	42.9	72.3	59.2	.237	.263	.358	.87	.31	.73	W. N. W.	W. by N.	W. S. W.
4	114	037	29.974	44.0	83.4	67.7	.258	.630	.550	.88	.54	.82	S. S E.	S. W.	S. W.
5	29.916	29.804	843	65.2	82.3	70.2	.604	.650	.621	.94	.59	.84	S. E.	W. by S.	W. by S.
6	839	845	957	63.3	80.3	59.7	.535	.599	.380	.92	.59	.76	W. by S.	W. S. W.	W. by S.
7	918	812	752	63.5	81.4	62.9	.369	.585	.829	.90	.56	.75	S. W.	S. W.	S. W.
8	935	911	917	51.3	58.0	44.2	.368	.336	.224	.96	.72	.79	N. E. by E.	N. by E.	N. by W.
9	938	960	993	48.5	62.6	48.0	.285	.370	.251	.85	.66	.74	N. E. by E.	N. by E.	N: W.
10	992	783	397	48.0	64.2	55.0	.214	.493	.328	.95	.67	.77	W. by S.	W. by S.	W. by S.
11	892	701	877	35.9	64.4	53.0	.293	.403	.375	.96	.67	.93	W. S. W.	W. S. W.	S. E.
12	639	726	747	45.6	44.8	46.3	.297	.275	.293	.98	.92	.96	N. E. by E.	N. N. E.	N.
13	800	889	770	47.3	71.4	55.0	.199	.371	.341	.90	.49	.83	N. by W.	W. by N.	W. by S.
14	30.094	30.099	30.100	37.1	71.7	62.0	.298	.397	.485	.92	.52	.86	W. by S.	W. by S.	W. by S.
15	107	017	29.970	47.4	81.9	66.7	.273	.617	.495	.85	.58	.77	W. by S.	W. by S.	S. W.
16	29.970	29.916	876	42.0	70.1	65.1	.492	.516	.549	.79	.70	.89	S. W.	S. S. W.	S. W.
17	760	815	897	62.8	72.3	62.2	.549	.489	.429	.97	.62	.77	S. S. W.	W.	S. W.
18	919	916	962	67.0	80.1	65.0	.291	.638	.420	.89	.62	.68	S. W.	S. S. W.	S. E. by E.
19	860	853	871	42.0	73.0	63.8	.368	.614	.556	.93	.68	.92	S. E. by E.	S. E. by E.	S. S. E.
20	679	612	596	51.7	69.3	65.0	.321	.678	.819	.87	.97	.89	S. S. E.	S. S. E.	W.
21	498	566	790	52.3	63.9	48.3	.334	.422	.324	.86	.73	.70	W. S. W.	W. S. W.	S. W.
22	854	725	863	42.0	61.4	54.6	.251	.413	.390	.96	.77	.93	S. W.	S. E.	W. S. W.
23	933	30.017	999	39.7	60.0	47.2	.225	.242	.256	.91	.48	.81	S. W. by W.	S. S. W.	S. E.
24	712	29.609	654	54.8	76.3	61.2	.355	.548	.473	.84	.62	.88	S. S. E.	S. E.	S. E. by E.
25	467	376	438	86.0	62.8	51.0	.413	.453	.311	.90	.80	.89	S. S. E.	W. S. W.	W. S. W.
26	584	738	889	49.0	52.9	44.8	.292	.302	.234	.82	.76	.80	W. S. W.	W. S. W.	W.
27	30.045	975	979	33.7	49.7	41.8	.162	.223	.228	.84	.64	.87	W.	W. S. W.	S. W.
28	29.667	910	30.225	39.7	47.0	34.2	.210	2.80	.170	.86	.88	.87	N. by W.	N. W.	W. by N.
29	30.106	30.155	224	31.6	44.2	34.2	.149	.196	.155	.84	.68	.79	W. S. W.	W. by S.	N.W. by W.
30	317	324	335	31.0	48.4	34.0	.130	.236	.175	.74	.70	.89	W. S. W.	W. S. W.	S.
...	......	......	......	......	......	......	......	......	......	......	......	......	....	....	....

Day of Month.	Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.] 6 a. m.	2. p. m.	10 p. m.
1	41.10	2.0	....	....	Clear.	Clear.	Cu. St. 2.
2	0.00	2.0	....	....	"	C. C. Str. 4.	Clear.
3	98.60	2.0	....	....	Slight frost.	Clear.	"
4	45.40	1.5	....	....	Clea.	Cir. Str. 4.	Cu. Str. 8.
5	128.10	3.5	0.300	....	Rain	Clear.	Clear.
6	17.20	2.0	....	....	Cirr. Str. 4.	"	" Aurora Borealis.
7	162.00	2.5	....	....	Clear.	"	C. C. Str. 9.
8	223.10	2.5	....	....	Cu. Str. 8.	Cu. Str. 9.	Clear.
9	123.40	1.0	....	....	Clear.	" 6.	"
10	103.70	1.0	....	....	Slight frost.	" 8.	Cu. Str. 9. Aurora Borealis.
11	62.00	2.5	0.800	....	Clear heavy dew.	" 10.	Rain.
12	227.10	3.5	2.466	....	Rain.	Rain.	Cu. Str. 9.
13	254.30	1.5	....	....	Clear.	Clear.	Clear.
14	104.20	2.0	....	....	"	"	"
15	50.00	2.5	....	....	"	"	" Aurora Borealis.
16	1.00	2.0	Inapp.	....	C. Str. 6.	C. Str. 10.	C. Str. 10.
17	166.20	1.5	0.300	....	" 8.	" 4.	" 9. Aurora Borealis.
18	27.80	2.0	....	....	Fog.	Clear.	Clear.
19	6.60	2.0	Inapp.	....	Clear.	Cu. Str. 6.	" Aurora Borealis.
20	261.30	3.0	0.640	....	Cu. Str. 10.	Rain.	Cu. Str. 4.
21	138.90	2.0	0.600	....	" 10.	Cu. Str. 6.	Clear.
22	118.11	4.5	0.400	....	Clear.	" 2.	Cu. Str. 9.
23	46.00	2.0	....	....	"	Clear.	Clear.
24	302.40	2.0	1.300	....	C. Cu. Str. 6.	Cu. C. Str. 2.	Cu. Str. 10. Thunder.
25	264.80	3.5	3.643	....	C. Str. 9.	" 4.	" 8.
26	397.80	2.5	0.400	....	" 8.	C. Str. 2.	" 8.
27	316.04	2.0	....	....	Clear frost.	" 2.	C. C. Str. 6.
28	77.60	3.0	0.437	....	Cu. Str. 10.	" 8.	C. C. Str. 6. Thunder & light'g.
29	225.40	1.5	....	....	Clear frost.	" 10.	C. Str. 10.
30	48.00	2.0	....	....	" "	Clear.	Clear.
...	....	......	....	....	....	....	....

REMARKS FOR AUGUST, 1860.

Barometer .... Highest, the 15th day, 30·070 inches.
Lowest, the 30th day, 29.459 "
Monthly Mean, 29.760 "
" Range, 0.611 "

Thermometer ... Highest, the 10th day, 92°2.
Lowest, the 12th day, 39°2.
Monthly Mean, 69°29.
Monthly Range, 52°9.

Greatest intensity of the Sun's rays, 110°6.
Lowest point of Terrestrial radiation, 31°1.
Amount of Evaporation, 3.02 inches.
Mean of Humidity, .740.
Rain fell on 13 days, amounting to 9.361 inches; it was raining 51 hours and 44 minutes, and was accompanied by thunder and lightning on 2 days.

Meteor in E. 5th day at 8.45 p. m.
Meteor in S. 12th day at 8·30 p. m.
Solar Rainbow 19th day.
Lunar Rainbow at 8 p.m. 25th day.
Most prevalent wind, the S. W.
Least prevalent wind, the S.
Most windy day, the 26th day; mean miles per hour, 10.70.
Least windy day, the 2nd day; mean miles per hour, 0.20.
Aurora Borealis visible on 10 nights.
The Electrical state of the Atmosphere has indicated high intensity.
Solar Halo visible on 16th day at 9.30 a. m.
Slight frost on the morning of the 12th day

REMARKS FOR SEPTEMBER, 1860.

Barometer. ...... Highest, the 30th day, 30.335 inches.
Lowest, the 25th day, 29.376 "
Monthly Mean, 29.885 "
Monthly Range, 0.450 "

Thermometer. Highest, the 15th day, 83°9.
Lowest, the 30th day, 25°5.
Monthly Mean, 56°40.
Monthly Range, 27°5.

Greatest intensity of the Sun's rays, 105°6.
Lowest point of terrestrial radiation, 20°1.
Amount of Evaporation, 2·90 inches.
Mean of humidity, .777.
Rain fell on 13 days, amounting to 11.286 inches; it was raining 58 hours 36 minutes, and was accompanied by thunder and lightning on two days.

Solar Halo 14th day.
Lunar Corona and imperfect Halo 27th day.
Very slight snow fell on the 29th day. Inappreciable the 1st of the season.
Sharp frost on the mornings of the 29th and 30th days.
Morning Rainbow on the 20th day.
Most prevalent wind, the W. S. W.
Least prevalent wind, the N.
Most windy day, the 26th day; mean miles per hour, 18.86.
Least windy day, the 2nd day; mean miles per hour 0.00.
Aurora Borealis visible on 5 nights.
The Electrical state of the Atmosphere has indicated moderate intensity.