the Queen's University, Ireland; and 2,915*l.* for the Queen's Colleges, Ireland. The total educational estimate for the year was stated by Mr. Forster to be 914,721*l.*, being a net increase of 74,010*l.* over that of last year. The day scholars in average attendance have increased from 1,082,000 to 1,200,000. There are 223 more male and 104 more female teachers than last year. Since 1868 the number of Science schools has increased from 300 to 810, and the number of scholars is now nearly 30,000; the number of scholars in Art has increased since last year from 123,562 to 157,198. The increase in the number of scholars in the regular schools is stated to be in excess of the increase of population. These statistics are interesting, as showing that the increased desire for education in the country at least keeps pace with the advance of opinion among the governing classes in favour of a truly national system of education. The query whether prevention is better than cure is forcibly suggested by three other votes which were passed on the same night:—315,627*l.* for convict establishments in England and the colonies, 203,880*l.* for the maintenance of juvenile prisoners in reformatories, and 643,070*l.* for the constabulary force in Ireland. When shall we arrive at the pitch of civilisation of one of the Swiss Cantons, where the expenditure for educational purposes exceeds that for all other purposes put together?

WE learn from the last report of the Geological Survey of Italy (R. Comitato Geologico) that that body will publish a geological map of Italy on the scale of 1 to 600,000 during the course of next year. The map is that which was compiled by Professor I. Cocchi in 1867 and sent to the Universal Exhibition in Paris. It was a hand-coloured map, the Ordnance map of Upper and Central Italy in six sheets being used as a basis. In compiling this map Professor Cocchi made use of all the published and unpublished materials that he could find. The most southern provinces of the Peninsula and Sicily were not however represented, for although notes and papers on their geology were not wanting, that part of the kingdom had not been mapped geologically. The new map will be divided into four sheets, and new plates will be engraved copying the topography of the Ordnance map, and introducing such modifications and improvements as may be deemed necessary for the new object to which the map is to be applied. The colouring will be done by chromolithography. Accompanying the map there will be a short descriptive memoir and two geological sections, one along the length and the other across the breadth of the country.

M. DIAMILLA-MULLER calls upon all directors of magnetical observatories to observe the declination and inclination every ten minutes from midnight 29th of August (Paris time), to the next midnight, and send the results to him at the bureaux of the Association Scientifique de France. He adds, "On croyait généralement que le soleil agissait indirectement par suite des changements de température qu'il produit à la surface de la terre. J'avais déjà présenté l'hypothèse, basée sur les observations d'Arago, tendant à établir que l'action directe du soleil sur le magnétisme est absolument semblable à l'action d'un aimant sur le fer. Cette théorie est confirmée par les observations faites dans les Colonies anglaises, où l'on remarque l'opposition de signe que le changement de déclinaison du soleil imprime aux courbes qui représentent la variation magnétique dans les pays tropicaux. Il est nécessaire de constater, par une observation directe, que cette loi d'opposition, en rapport avec la déclinaison solaire, s'exerce dans toutes les régions du globe."

PROF. LIONEL BEALE's inaugural lecture to the course of Pathological Anatomy, delivered at King's College, May 5th, 1870, is issued as a separate publication, with the title "On Medical Progress; in memoriam R. B. Todd."

THE third part is published of Dr. Manzoni's "Bryozoi fossili Italiani," accompanied by four plates.

ANOTHER contribution to astronomical literature lies on our table, in the shape of the second volume of "Astronomical Observations taken during the years 1865-69, at the private Observatory of Mr. J. G. Barclay, of Leyton."

MR. KEITH JOHNSTON, jun., publishes, in his usual admirably clear style, a map of the Lake Region of Eastern Africa, showing the sources of the Nile, recently discovered by Dr. Livingstone; with notes on the exploration of this region, its physical features, climate, and population.

*ON VOLCANOES**

VOLCANOES are but so many existing proofs of the activity of internal forces at the present moment, and, as a geologist, I may be almost pardoned if I regret that we do not in our happy isles possess even a single example of an active volcano.

As regards the geographical distribution of recent volcanoes, a glance at the geological map of the world will suffice to show that they are in reality scattered all over its surface, yet, it may be added, more rarely occurring at any great distance from the sea, although exceptional instances are met with inland, in all the four quarters of the globe.

In the North we find the volcanoes of Iceland, Jan Meyen, Kamskatca, Alaska, and others; whilst the Antarctic voyages of Ross proved that the mountains of the land nearest accessible to the South Pole were also active volcanoes.

At the equator, all but innumerable volcanoes are seen in the islands of the Indian and Polynesian Archipelagos, as well as in the Pacific and Atlantic Oceans, and on the main land of South America. Midway between the Equator and the Poles are situated the volcanoes of New Zealand, the Canaries, Cape Verde, Azores, and Sandwich Islands, as also those of Arabia, Eastern Africa, Mexico, Central America, and the volcanoes of the whole range of the Andes down to Terra del Fuego. Nearer home, Vesuvius, Etna, Stromboli, Santorin, and numerous others in the Mediterranean, if not so grand in their dimensions as some of those previously referred to, still present on the large scale all the various aspects of volcanic phenomena, both submarine as well as terrestrial.

If now, however, we take a broader view of volcanic phenomena, and, in addition to the before-mentioned still existing proofs of the general distribution of volcanic centres, as they have been termed, we also take into consideration the occurrence of eruptive rocks of similar origin which are everywhere found disturbing and breaking through the strata of even the oldest rock formations, it will be seen, as least as far as the geology of the earth's surface is at present known to us, that there is scarcely a single area of any magnitude, of either the land or sea, which, at some period or other, has not been broken through or disturbed by what may be termed volcanic forces acting from within the mass of the earth itself; and it is impossible to come to other than the conclusion that these agencies must have played a most important part in determining the main features of the earth's external configuration as well in our times as throughout all periods of its history.

If now the question be asked, what is a volcano? the simplest reply would be "a hole in the ground deep enough to reach such portions of the interior of the earth as are in a molten condition."

In ordinary language, however, the appellation of volcano is usually restricted to those cone-shaped mountains, from the hollow summit of which flames, smoke, and vapours are at times seen to ascend, and which occasionally break out into more imposing activity by vomiting forth showers of ashes and fragments of incandescent rock, or by pouring out torrents of molten stone, to deluge and devastate the unfortunate country in the vicinity.

It having always been admitted that volcanoes owed their origin to forces operating from below, it was suggested by Von Buch, and supported by Humboldt and others, that volcanic cones must be formed by some portion of the surface of the earth, weaker than the rest, being forced out, or, as it were, thrown up like a soap-bubble by the pressure of the vapour and gases confined below, the strata being thereby elevated, fractured, and tilted up on all sides, so as to produce a conical elevation, the central fissure in which became a crater or vent for the escape and passage of the gaseous and liquid emanations from below.

* Outline of a Lecture delivered at St. George's Hall, Langham Place, 9th June, 1870, by David Forbes, F.R.S.

This hypothesis, which accounted for the formation of volcanic cones and craters by a process of upheaval, or, as it was termed, the "crater of elevation," is here alluded to, only because it for a long time was accepted by many eminent men of science, until the subsequent researches, especially of Mr. Scrope and Sir Charles Lyell, demonstrated conclusively that it is not confirmed when their actual structure is studied in the field, and explained their true formation, by what is now termed the "crater of eruption" theory.

If we imagine a volcanic cone cut through its centre, so as to present us with a section of its entire mass, it will be seen that the mineral matter of which it is composed possesses in itself a sort of arrangement in layers, which at first sight somewhat resembles beds of ordinary sedimentary origin broken through and tilted up towards the centre; a closer examination, however, shows that these layers were never at any time horizontal, but that, on the contrary, they had from the very first been deposited in the same inclined position in which they are now seen, and that they must have been formed subsequently, not previous to the opening of the crater itself, since they are entirely composed of matter thrown up from its orifice.

The commencement of an eruption is known in most cases by certain preliminary symptoms indicative of great internal disturbance, such as rumbling noises, and sounds as if of explosions below, which have been likened to subterranean thunder. The surface waters, springs and wells in the vicinity generally acquire an unusually high temperature, diminish in volume or disappear altogether, and repeated earthquake shocks more or less severe are felt, which eventually culminate in a grand convulsion, by which the surface is rent asunder with fearful violence, allowing immense volumes of previously pent up vapour and gases to rush forth from the fissure with such impetuosity as to hurl high into the air huge fragments of the shattered rocks, along with vast quantities of molten lava, in so liquid a condition that during its ascent it is seen to be splashed about in the air like water, and to become separated into particles of all sizes. Vast quantities of these particles, to which the name of volcanic ash or dust has been applied, are instantaneously reduced to so fine a state of division, literally "blown to atoms," as to become converted into an almost impalpable powder, capable of being carried away by the winds prevailing during an eruption to distances of even hundreds of miles from the orifice from which they had been ejected, and ultimately settle down on the land or in the sea to form deposits, whose nature would often be a puzzle to geologists, did not the microscope at once reveal their true mineral character and volcanic origin. Other particles less finely divided become granulated and fall down from the air in the shape of small black grains, known as volcanic sand; whilst still larger portions, owing to the bubbles of vapour or gas entangled in their substance, descend as black porous or spongy stones, from the size of a pea to that of one's head, or larger; and have received the names of Lapilli, scoriæ, or volcanic cinders, from their presenting much the appearance of an ordinary cinder from a coal fire. Although the scoriæ thrown up by volcanoes are in major part of a dark colour, there are also others (called trachytic) much lighter both in colour and weight, which are usually more common at the commencement of an eruption, the ordinary pumice stone which is imported in large quantities from the volcanoes in the Lipari Islands, for the use of the painters, &c., is an example of this variety familiar to you all. A peculiar form of lava is produced by the currents of wind blowing over the surface of the molten matter in the crater, catching up portions of it and drawing them out into long slender filaments like hair or spun glass of all shades of black, brown, or yellow. In the Sandwich Islands, where this variety is very abundant, it is called Pele's hair, from the name of one of their ancient goddesses. In the intervals of an eruption, or after the greatest force of the rush has spent itself, the vapours often rise through the molten lava in the crater, in smart puffs which carry up with them portions of the fluid lava high into the air, whence they descend consolidated as spheres or somewhat elongated bodies consisting of an external shell of solid lava, hollow or only filled with vapour or gas in the centre. From their resemblance to military projectiles, these bodies, which vary from the size of an orange to that of a pumpkin, have received the name of volcanic bombs.

The mineral matter thrown up into the air from a volcanic vent necessarily descends again by virtue of its own weight, a portion drops back into the crater, but the major part falling beyond it, accumulates around its brink to form a mound, which, since the larger and heavier pieces are not projected to so great a distance as the others, keeps, as it increases in size, raising itself more rapidly in height nearest around the vent, then farther off, and thus builds up a hollow cone, the throat or chimney of which is kept open, at least during the continuance of an eruption, by the upward rush of the gases and vapours forced through it by the pressure below. The action of the heat being of course much more intense in the chimney or throat of the crater, now causes, the at first comparatively loose materials which formed its walls, to soften and cement themselves together on the inside into a sort of compact stony tube of communication with the lower regions, much more solid and resistant than the rest of the mass of which as before described the entire cone had been built up. Once this is the case, the molten lava, forced up by the gaseous pressure below, frequently ascends into the crater itself, and overflowing its brim, pours down the outside of the cone, just like water when placed over too rapid a fire is seen to boil over the edge of the pot in which it is heated. These occasional overflows of lava explain how in the section of a volcanic cone layers of more compact lava are so frequently seen alternating with those of the porous scoria and volcanic sand before described. In more rare instances, as for example in the eruption of Mauna Loa, in the Sandwich Islands, in February 1859, the lava is ejected in so wonderfully liquid a condition, and in such enormous volumes, as to present the appearance of a red-hot fountain; the jet of molten lava thrown up from the crater on that occasion is described as about 250 feet in diameter, and as rising some 500 feet above the level of the brim of the crater itself. Occasionally, during an eruption, the rim of the crater, unable to support the weight of the molten lava which fills it, gives way at its weakest point, the lava bursting out and carrying away one side of the cone itself; at other times the lava, after having risen some height up the crater, finds out a point of weakness and breaks through, discharging itself by a fissure some way up the side of the cone, as was the case with the volcano of Sajama, in Bolivia, in 1859, and with Etna in 1865. In many eruptions the lava does not ascend at all into the crater, but breaks out at the very base of the cone, or even at some considerable distance from it, through a subterranean passage. This took place in the eruption of Kilauea, in the Sandwich Islands, in June 1840, when the lava first showed itself at the surface at Arare, some six miles eastward of the crater which supplied it. In fact, most volcanoes will, upon examination, be found at one or other period in their history to have presented examples of more than one, if not of all, these different modes of discharging their molten products.

The eruption of Etna in 1865, which I witnessed, did not proceed from the summit or main crater, but broke out on the side of the mountain, about 5,000 feet above the level of the sea. Along the fissure or rent formed by this convulsion, no less than seven distinct cones rose up at intervals, building themselves up very rapidly from the enormous quantities of scoriæ which were thrown up from their rents; as they became larger the bases of several of these cones extended until they united, and so formed a range of hills, the summits of which in but a few weeks reached the height of several hundred feet, and entirely changed the character of the scenery of this part of the island. The four lowest cones were the most active, but from none of their craters was there any overflow of lava, which, however, poured out from the very base of the cones, forming a fiery river apparently about three miles across, which destroyed all before it, cutting through a large pine forest, and at one place leaping like a cascade of liquid fire over a precipice some 150 feet in height.

The formation of a new or re-opening of an old volcanic vent is usually accompanied by a terrific explosion, often to be heard at immense distances; thus, in 1812, the outburst of the volcano of San Vincent was heard in the north of South America some 700 miles distant. The enormous force developed by the rush of gases and vapours from the fissure may be imagined when it is known that in the eruption of Mount Ararat, in 1840, huge masses of rock weighing as much as 25 tons were thrown out of the crater; Cotopaxi is said to have even hurled a 200-ton rock to a distance of nine miles; whilst the volcano of Antuco, in Chili, in 1828, sent stones flying to a distance of 36 miles.

The issue of gaseous matter from the crater of a volcano is often described as a column of flame; this is incorrect, for although possibly a little burning hydrogen or sulphuretted hydrogen might be present, especially on the outer edge of the column, the appearance of a column or fountain of flame is in reality due to the gaseous matter of which it consists being illuminated by the fragments of red-hot rock and molten lava thrown up along with it (like sparks in fireworks), assisted by the reflection from the red-hot sides of the crater itself, and from the surface of the molten lava below.

The chemical composition of the gasiform emanations from volcanoes proves that they are in greater part incombustible, and therefore does not support the idea that the body of such a column of vapour and gases could be in flames, *i.e.*, actually burning. On the outside of the column, however, innumerable brilliant scintillations of a bluish colour are frequently seen, due to particles of sulphur taking fire as they come in contact with the outer air, and patches of melted sulphur are splashed about, burning brightly as they fall through the air on to the slopes of the cone. The emission or belching forth, as it has been called, of the gaseous matter with its accompanying red-hot ashes and scoriæ, is more an intermittent than a continuous operation. When an eruption is at its height the spasmodic puffs or blasts are jerked out at intervals of but a few seconds, attended by a terrific roaring or bellowing noise difficult to describe in words.

The buried cities of Stabia, Herculaneum, and Pompeii, covered up in parts to the depth of 100 feet by the ashes of Vesuvius, are ocular proofs of the vast quantity which can be sent out of a volcanic vent during an eruption. The volcano of Sangay, in Ecuador, in constant activity since 1728, has buried the country around it to a depth of 400 feet under its ashes, and a French geologist has estimated that in the course of only two days the volcano of Bourbon has thrown out no less than 300,000 tons of volcanic ashes. The immense distances to which these may be transported by the winds is no less surprising; the ashes of Vesuvius, in the eruption which buried Pompeii, darkened the sun at Rome, and were carried as far as Syria and Egypt; those from San Vincent, in 1812, are reported to have made the sky as dark as night in the Barbadoes; and in Iceland, in 1766, the air became so charged with ashes for a distance of 150 miles around Hecla, that even the brightest light could not be distinguished at a few yards.

Amongst the still active volcanoes we meet with some whose craters are several miles in diameter, encircled by precipitous sides rising to even a thousand feet above the bottom of the crater when at rest, which, as in the Sandwich Islands, may contain reservoirs, or rather lakes of liquid lava, two to four miles across, and at times send forth rivers of molten stone several miles in breadth, extending their fiery inundation to a distance of even forty miles from the crater whence they issued. In the eruption of Hualalai, in 1801, a lava current, after reaching the coast, poured out such volumes of melted matter as to fill up a bay some twenty miles deep, and in its place extend a headland some three or four miles farther into the sea. The rate at which these rivers of molten stone flow is a very varying one; in 1805 the lava current from Vesuvius is said to have run down the first three miles in four minutes, yet only completed its total distance of six miles in three hours; and in 1840 that from Mauna Loa advanced no less than eighteen miles in two hours; whilst on the other hand it is recorded that during the eruption of Etna, which commenced in 1614, and continued many years, the lava stream only completed a distance of six miles in ten years, notwithstanding that all this time it was seen to be in slow but almost imperceptible motion; during the eruption of this volcano in 1865, I found, however, that at the edge of the current the rate of motion varied from 15 to 120 feet per hour according to local circumstances; in the centre of the stream the lava was evidently still more rapid in its movements.

The entire mass of a lava stream often advances, even when to the eye it would appear to have become quite solid; upon my throwing a heavy stone on to the top of a lava current so far consolidated that the stone merely fixed itself into the surface without sinking deeper, it was seen that the stone moved along with the lava which otherwise looked as if stationary. The surface of this lava consolidated and cooled with almost incredible rapidity, so much so that, notwithstanding the protestations of my guides, I walked over lava currents when, at the same time, the fiery stream still flowing below could be distinctly seen through the cracks in the crust over which I passed.

On this occasion also the stems of the pine-trees in the forest which was destroyed by this eruption were converted into charcoal as high as the lava reached, but the upper portions of the trees then toppled over, and remained in an almost unaltered and uncharred condition on the top of the lava current which had so quickly cooled. The crust which forms on the top of lava when cooling, being an excellent non-conductor, acts so efficiently in preventing further escape of heat, that we find streams of lava requiring many years and even ages to become quite cold. Dolomier relates that the lower part of the Ischia lava of 1301 was still hot in the year 1785.

When, owing to the descriptions of the ground around volcanoes, the water from springs, rivers, lakes, or the sea itself, is brought into contact with the heated mineral matter below, we have the production of the so-called mud volcanoes or of fissures sending forth torrents of heated mud and water, and often, to the great surprise of the inhabitants, throwing out numbers of fishes which had lived previously in these sources. The Geysers of Iceland are somewhat similar phenomena, but on the present occasion time will not permit these subjects being treated in detail.

Whilst some volcanoes like Stromboli, the lighthouse of the Mediterranean, as it was called by the ancients, have continued in incessant activity from the oldest historical periods down to the present day, the eruptions of others are only known to have taken place at long intervals. Vesuvius, although imagined by Strabo to have had a volcanic origin, was not known even by tradition to have ever been in eruption until the year 79, when Pompeii was overwhelmed by it. Since that time, however, up to the present date, it has given ample proof of its volcanic activity, yet its history shows several intervals of a century, and one of more than two centuries, in which no eruption took place. No outbreak of the volcano Sangay in Ecuador is recorded before 1728, since which year it has been in continued activity, and Krabla in Iceland also remained at rest for several hundred years before 1724. In fact, it may be safely affirmed that it is quite impossible for us to know whether any volcano at all is entitled to be regarded as really extinct. Even for ages after the last outburst of lava. it is found that smoke and acid vapours continue to be given off from most volcanic rents, and the extraction of the sulphur found in the craters and sublimed into the fissures around dormant volcanoes, forms in many countries an important branch of industry.

Although, as yet, I have confined my remarks altogether to terrestrial volcanoes, it must not be supposed that the depths of the sea are exempt from such visitations, and in the last few years we have had several prominent examples to the contrary in different parts of the world. Submarine volcanoes were well known to the ancients; Pliny and older writers refer to those in the Mediterranean which threw up the islands of Delos, Rhodes, Anappe, Nea, &c. In the Cyclades very curious examples have occurred, both in very ancient and in the most recent times. Of these islands, Therasia is recorded to have been formed in the third century B.C., as also somewhat later in the same century the island of Thera, now called Santorin; subsequently Hiera, 91 B.C., and then Thea, A.D. 19, appeared, which last two were, in 726, united by an eruption, and together formed the present island of Kaimeni. In 1575 a smaller island called Little Kaimeni showed itself, around which, in 1650, numerous other islets were thrown up, which subsequently became united to Little Kaimeni during the eruptions, which continued from 1707 to 1812, when the island, thus increased in size, became known as New Kaimeni. Finally, the last eruption (still going on), which commenced 28th January, 1866, presented us, on the 2nd February, with a new island, now called King George's Island, from the present King of Greece, which, according to the latest accounts, still continues to increase in size. Numerous other examples might be cited, but I shall only mention the island of Johanna Bogoslawa, in Alaska, which, although it only first showed itself above the water in May 1796, had, in 1806, increased so as to be an immense volcanic island, the summit of which was then elevated to no less than 3,000 feet above the level of the sea.

The volcanic products thus forced out under the sea present, as might be expected, a very different aspect from that of the ashes, scoria, and lava from terrestrial volcanoes; the molten lava coming in contact with the water is at once broken up into fragments, coarser or finer, in proportion to the greater or less cooling power of the water in immediate contact with them, and often in great part instantly converted into fine mud, of a greyish colour when formed from trachytic lava, but more commonly of a chocolate or other dark tint, and much denser when produced from the more prevalent pyroxenic lava. Beds of this character, spread out by the action of the sea, often enclosing shells, fish, and other organic remains, become in time consolidated and upheaved, and as they often present an appearance much resembling ordinary [volcanic] rocks, they have frequently puzzled geologists, who at first found a difficulty in explaining the presence of such fossils in rocks apparently of igneous origin.

Many writers on this subject hold to the belief that volcanoes are mere local phenomena, each one springing from its own comparatively small reservoir of molten matter, supposed to have originated from the softening or fusion of rocks pre-existing on the spot at some depth below the surface. To me, however, this hypothesis appears altogether untenable when it is remembered, amongst other objections which I have elsewhere considered, that volcanic rocks are encountered in all parts of our globe, often continuous or nearly so, over immense areas, and that all these rocks, without reference to the part of the world in which they occur, are invariably alike in character to one another.

Volcanic rocks may be classified under two heads, viz., the dark-coloured, more dense; and the less heavy, light-coloured lavas, termed, respectively, the basic or pyroxenic, and the acid or trachytic lavas. Both these varieties may proceed from the same volcanic vent in succession—for instance, in Vesuvius, where the mineral matter which buried Pompeii is trachytic, but the later lavas are generally pyroxenic in character. This also was the case in the recent eruption of Santorin, as reported upon by the Austrian Scientific Commission.

The examination of volcanic products, no matter how distant the volcanoes may be from one another from which they are taken, prove them to be altogether identical in general, mineral, and chemical constitution.

Taking all these and other data into due consideration, I cannot arrive at any other conclusion than that all volcanoes are connected with one another in depth, and having one common source, not necessarily situated at any enormous depth below the surface, but in which the molten matter—whilst always containing certain general characters—has undergone considerable modifications in composition, mineralogical and chemical, from time to time in the world's history; for under the term volcanic rocks, I would here include all eruptive rocks without exception, whether called granites, syenites, porphyrites, basalts, or lavas, all of which I regard as but so many members of one series, or simply as the products of the volcanic action of different geological epochs.

So much for the molten products of volcanoes. Now a few words on their gasiform emanations, which consist in greater part of the vapour of water, *i.e.* steam, along with volatile chlorides, hydrochloric and sulphurous acids, nitrogen and sulphuretted hydrogen gases. The sulphur, seen to be sublimed in so large quantities, is probably derived from the mutual reactions of the sulphurous acid and sulphurated hydrogen gases, as they come into contact with one another.

Now if it be true that we have a vast accumulation of molten matter at a certain depth below the surface, which observation further informs us must, in major part, consist of the silicates and sulphides of the metallic elements, then, in my opinion, at least, it only requires the assumption that water from the sea should, by some means or other, find its way down into such a reservoir, to account for all the phenomena of volcanoes, both mechanical as well as chemical. The greater part of the water so introduced would be at once converted into steam, which, in its turn, would become still further expanded by a heat so great as that of molten lava, and would develope an enormous power. Calculations have been made which show that water, even when treated to a much less temperature, would exert an "ejection force," as it has been termed, even exceeding that developed in eruptions of the highest volcanoes known. Another portion of the water with the air carried down along with it, acting upon the highly heated sulphides, would become decomposed, and furnish the sulphuretted hydrogen, sulphurous acid, and nitrogen gases given off, whilst the common salt in the sea water, by its action on the hot silicates in presence of steam, would eliminate hydrochloric acid, and account for the appearances of it, as well as of the volatile chlorides found in volcanic fumes. If we accept this explanation, the chemical reactions would be but the effects and not the cause of volcanic phenomena.

The destructive effects attendant on volcanic convulsions are of two different characters, viz., those arising from the earthquakes which accompany and, as a rule, precede outbreaks; and those caused by the products ejected from the volcano itself. The connection of earthquakes with volcanoes has been noted from the oldest times; the earthquakes which commenced A.D. 63, were but the efforts made by Vesuvius to relieve itself, which culminated in the great eruption of 79; the same was the case in Mexico with Jorillo in 1759, and with the great earthquake of 1834 in Chili, which ended in the outbreaks of Osorno and three other volcanoes of the Andes; and lastly, in 1868, the terrible earthquake which visited the coast of Peru and totally destroyed the cities of Arica and Iquique, was followed by the eruption of Isluga, which, according to the latest news, still continues. There seems little reason to doubt that all earthquakes are of purely volcanic origin, and that volcanoes themselves may be regarded as so many safety-valves for blowing off the surplus steam, gases, and molten products from our great internal boiler; for, as a rule, it has been observed that earthquakes either cease altogether or diminish greatly in violence as soon as a neighbouring volcano has cleared its throat.

Although I have resided several years in what are called earthquake countries, and have experienced numerous and severe shocks, amongst others those which resulted in the total destruction of the cities of Copiapo and Mendoza, on which latter occasion some 20,000 inhabitants perished in the ruins, it seems to me quite impossible to convey in words anything like a true picture of such a dreadful catastrophe; the feeble shocks occasionally felt in England cannot give you even the remotest idea of what a severe earthquake is in reality, for not only are cities destroyed and whole villages swallowed up in an instant, as in the case of Arqure during the eruption of Mount Ararat in 1840, but when situated on the coast, even when they have withstood the shock itself, they may be entirely swept away by the great sea wave which follows close upon it, as happened with the cities of Arica and Iquique, in Peru, little more than a year ago. Equally terrible is the destruction caused by the showers of ashes and torrents of molten rock, as in the well-known instances of Pompeii, Herculaneum, and others, too numerous to mention.

The study of volcanic phenomena presents a wide and interesting field for exploration, for as yet our knowledge of the subject is lamentably defective. To follow it up, however, the student should work out a path for himself, taking advantage of every new means of research placed in his hands by the advance made by the collateral sciences, and steering clear of all schools or preconceived notions. Schools in science are what parties are in politics; the "follow my leader" style will not do in this age, for it does not permit of that perfect independence of thought absolutely requisite to ensure success in the pursuit of science. The study of science is the search after truth, but in its study the persevering and conscientious worker, although sure to attain good results in the end, must always bear in mind that his results, even when proved to be *truths*, are still only fragments of *the whole truth*, and that he therefore should guard himself against overrating their value, *i.e.* the extent of their application, since this can only be correctly estimated when these fragments have been found to fit accurately into their true place in the grand plan of nature.

D. FORBES

SCIENTIFIC SERIALS

THE *Journal of Botany* for July commences with a short account by Dr. D. Moore on a form of *Salix arbuscula* in Ireland, which inclines rather towards *S. myrsinites*. Dr. Seemann proceeds with his "Revision of the Natural Order *Bignoniaceæ*," and Mr. Worthington Smith with his valuable "Clavis Agaricinorum," these three articles completing the portion of the paper devoted to original articles, which we regret to see reduced to so small a space. Then follow the second part of Dr. Braithwaite's "Recent Additions to our Moss Flora," and appreciative reviews of Dr. Hooker's "Students' Flora," and Prof. Babington's "Flora of Iceland."

THE *Student and Intellectual Observer* for July contains several good articles, though none of any striking originality. The longest is by Dr. W. B. Carpenter, on the Deep Sea, its Physical Conditions, apparently a report of a lecture delivered during the winter in St. George's Hall. Dr. Henry White's article on Demonism and Convulsionism gives some interesting details of the epidemic which prevailed in Europe during the 17th century. Dr. Wickham Legg, on Zymotics, discusses the theory of the fungus-germ theory of diseases of this class, which he admits explains a good many of the facts, but demands too great a concession in the outset, in the presence in the blood of nearly twenty distinct and separate substances, which exist only to serve as a nidus for the specific ferment, and to be a source of injury to the individual. Mr. Llewellynn Jewitt contributes an article on Celts and other Implements of Bronze, profusely illustrated; Mr. Barff, a third article on Poisons; and Mr. Henry J. Slack, two short papers on the Juniper Fungus (*Podisoma*), and on the Structure of *Pinnulariæ*. The two publications of the quarter selected for separate reviews are Proctor's "Other Worlds than Ours" and Wallace's "Contributions to the Theory of Natural Selection;" and minor papers and reports fill up the number.