CHAPTER XIX.

Volcanic rocks of the Eocene period—Auvergne—Igneous formations associated with lacustrine strata—Hill of Gergovia—Eruptions in Central France at successive periods—Mont Dor an extinct volcano—Velay—Plomb du Cantal—Train of minor volcanos stretching from Auvergne to the Vivarais—Monts Domes—Puy de Côme—Puy Rouge—Ravines excavated through lava—Currents of lava at different heights—Subjacent alluviums of distinct ages—The more modern lavas of Central France may belong to the Miocene period—The integrity of the cones not inconsistent with this opinion—No eruptions during the historical era—Division of volcanos into ante-diluvian and post-diluvian inadmissible—Theories respecting the effects of the Flood considered—Hypothesis of a partial flood—Of a universal deluge—Theory of Dr. Buckland as controverted by Dr. Fleming—Recapitulation.

EOCENE VOLCANIC ROCKS.

When we treated in the seventeenth chapter of the lacustrine deposits of Central France, we purposely omitted to give a detailed account of the associated volcanic rocks, to which we now recall the attention of the reader. (See the Map, p. 226.)

We stated that, in the arenaceous and pebbly group of the lacustrine basins of Auvergne, Cantal, and Velay, no volcanic pebbles had ever been detected, although massive piles of igneous rocks are now found in the immediate vicinity. As this observation has been confirmed by minute research, we are warranted in inferring, as we before explained, that the volcanic eruptions had not commenced when the older subdivisions of the fresh-water groups originated.

In Cantal and Velay we believe no decisive proofs have yet been brought to light that any of the igneous out-bursts happened during the deposition of the fresh-water strata; but there can be no doubt that in Auvergne some volcanic explosions took place before the drainage of the lakes, and at a time when the Eocene species of animals and plants still flourished. We shall first advert to these proofs as relating to the history

of the period under consideration, and shall then proceed to show that there are in the same country volcanic rocks of much newer date, some of which appear to be referrible to the Miocene era.

Volcanic rocks associated with Lacustrine in Auvergne.—The first locality to which we shall call the reader's attention is Pont du Chateau near Clermont, where a section is seen in a precipice on the right bank of the river Allier *. Beds of volcanic tuff alternate with a fresh-water limestone, which is in some places pure, but in others spotted with fragments of volcanic matter, as if it were deposited while showers of sand and scoriæ were projected from a neighbouring vent †. This limestone contains the *Helix Ramondi* and other shells of Eocene species. It is immaterial to our present argument whether the volcanic sand was showered down from above, or drifted to the spot by a river, for the latter opinion must presuppose the country to have been covered with volcanic ejections during the Eocene period.

Another example occurs in the Puy de Marmont, near Veyres, where a fresh-water marl alternates with volcanic tuff containing Eocene shells. The tuff or breccia in this locality is precisely such as is known to result from volcanic ashes falling into water, and subsiding together with ejected fragments of marl and other stratified rocks. These tuffs and marls are highly inclined, and traversed by a thick vein of basalt which, as it rises in the hill, divides into two branches.

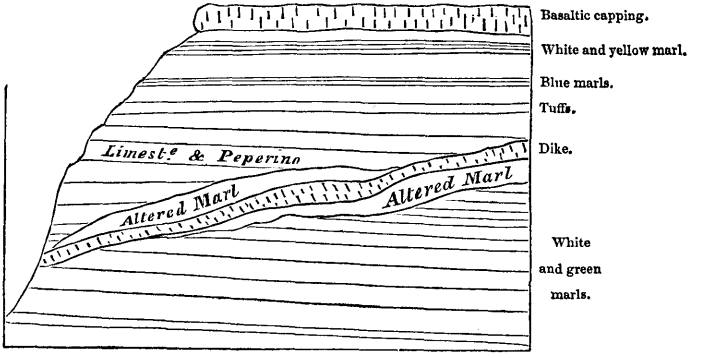
Gergovia.—The hill of Gergovia near Clermont affords a third example. We agree with MM. Dufrénoy and Jobert that there is no alternation here of lava and fresh-water strata, in the manner supposed by some other observers ‡; but the position and contents of some of the tuffs prove them to have been derived from volcanic eruptions which occurred during the deposition of the Eocene formations.

* This place, and all the others in Auvergne, mentioned in this chapter, were examined by the author, in company with Mr. Murchison, in 1828.

† See Scrope's Central France, p. 21. ‡ Scrope, ibid. p. 7.

The bottom of the hill consists of slightly inclined beds of white and greenish marls, more than three hundred feet in thickness, which are intersected by a dike of basalt, which may be studied in the ravine above the village of Merdogne. The dike here cuts through the marly strata at a considerable angle,

No. 60.



Hill of Gergovia.

producing, in general, great alteration and confusion in them for some distance from the point of contact. Above the white and green marls, a series of beds of limestone and marl, containing fresh-water shells, are seen to alternate with volcanic tuff. In the lowest part of this division, beds of pure marl alternate with compact fissile tuff resembling some of the subaqueous tuffs of Italy and Sicily called *peperinos*. Occasionally fragments of scoriæ are visible in this rock. Still higher is seen another group of some thickness, consisting exclusively of tuff, upon which lie other marly strata intermixed with volcanic matter.

There are many points in Auvergne where igneous rocks have been forced by subsequent injection through clays and marly limestones, in such a manner that the whole has become blended in one confused and brecciated mass, between which and the basalt there is sometimes no very distinct line of demarcation. In the cavities of such mixed rocks we often find calcedony and crystals of mesotype, stilbite and arragonite. To

formations of this class may belong some of the breccias immediately adjoining the dike in the hill of Gergovia; but it cannot be contended that the volcanic sand and scoriæ interstratified with the marls and limestones in the upper part of that hill were introduced, like the dike, subsequently by intrusion from below. They must have been thrown down like sediment from water, and can only have resulted from igneous action which was going on contemporaneously with the deposition of the lacustrine strata.

The reader will bear in mind that this conclusion agrees well with the proofs, adverted to in the seventeenth chapter, of the abundance of silex, travertin and gypsum precipitated when the upper lacustrine strata were formed: for these rocks, as we have pointed out, are such as the waters of mineral and thermal springs might generate.

The igneous products above mentioned, as associated with the lacustrine strata, form the lowest members of the great series of volcanic rocks of Auvergne, Cantal, and Velay, which repose for the most part on the granitic mountains (see Map, above, p. 226). There was evidently a long succession of eruptions, beginning with those of the Eocene period, and ending, so far as we can yet infer from the evidence derived from fossil remains, with those of the Miocene epoch. The oldest part of the two principal volcanic masses of Mont Dor and the Plomb du Cantal may perhaps belong to the Eocene period,—the newer portion of the same mountains to the Miocene; just as Etna commenced its operations during the newer Pliocene era, and has continued them down to the Recent epoch, and still retains its energy undiminished. There are some parts of the Mont Mezen, in Velay, which are perhaps of the same antiquity as the oldest parts of Mont Dor. Besides these ancient rocks, of which the lavas are in a great measure trachytic, there are many minor cones in Central France, for the most part of posterior origin, which extend from Auvergne, in a direction north-west and south-east, through Velay, into the Vivarais, where they are seen in the basin of

the Ardêche. This volcanic line does not pass by the Plomb du Cantal; it was formed, as nearly as we can conjecture in the present imperfect state of our knowledge, during the Miocene period; but there may probably be found, among these cones and their accompanying lavas, rocks of every intermediate age between the oldest and newest volcanic formations of Central France.

We shall first give a brief description of the Mont Dor and the Plomb du Cantal, and then pass on to the train of newer cones, examining the evidence at present obtained respecting their relative ages, and the light which they throw on the successive formation of alluviums and on the excavation of valleys.

Mont Dor.—Mont Dor, the most conspicuous of the volcanic masses of Auvergne, rests immediately on the granitic rocks standing apart from the fresh-water strata *. This volcano rises suddenly to the height of several thousand feet above the surrounding platform, and retains the shape of a flattened and somewhat irregular cone, all the sides sloping more or less rapidly, until their inclination is gradually lost in the high plain around. It is composed of layers of scoriæ, pumice-stones, and their fine detritus, interstratified with beds of trachyte and basalt, which descend often in uninterrupted currents, till they reach and spread themselves around the base of the mountain †. Conglomerates also, composed of angular and rounded fragments of igneous rocks, are observed to alternate with the above; and the various masses are seen to dip off from the central axis, and to lie parallel to the sloping flanks of the great cone, in the same manner as we have described when treating of Etna.

The summit of the mountain terminates in seven or eight rocky peaks, where no regular crater can be traced, but where we may easily imagine one to have existed which may have been shattered by earthquakes, and have suffered degradation by aqueous causes. Originally, perhaps, like the highest

* See the Map, p. 226. † Scrope's Central France, p. 98.

crater of Etna, it may have formed an insignificant feature in the great pile, and may frequently have been destroyed and renovated.

We cannot at present determine the age of the great mass of Mont Dor, because no organic remains have yet been found in the tuffs, except impressions of the leaves of trees of species not determined. Some of the lowest parts of the great mass are formed of white pumiceous tuffs, in which animal remains may perhaps be one day found. In the mean time, we conclude that Mont Dor had no existence when the grits and conglomerates of the Limagne, which contain no volcanic materials, were formed; but some of the earliest eruptions may perhaps have been contemporary with those described in the commencement of this chapter. To the latest of these eruptions, on the other hand, we refer those trachytic breccias of Mont Perrier which were shown in the sixteenth chapter, p. 217, to alternate with Miocene alluviums.

Velay.—The observations of M. Bertrand de Doue have not yet established that any of the most ancient volcanos of Velay were in action during the Eocene period, although it is very probable that some of them may have been contemporaneous with the oldest of the Auvergne lavas. There are beds of gravel in Velay, as in Auvergne, covered by lava at different heights above the channels of the existing rivers. In the highest and most ancient of these alluviums the pebbles are exclusively of granitic rocks; but in the newer, which are found at lower levels, they contain an intermixture of volcanic substances. We have already shown, in the sixteenth chapter, that, in the volcanic ejections and alluviums covered by the lavas of Velay, the bones of animals of Miocene species have been found, in which respect the phenomena accord perfectly with those of Auvergne.

Plomb du Cantal.—In regard to the age of the igneous rocks of the Cantal we are still less informed, and at present can merely affirm that they overlie the Eocene lacustrine strata of that country. The Plomb du Cantal (see Map, wood-cut

No. 56) is a conical mass, which has evidently been formed, like the cone of Etna, by a long series of eruptions. It is composed of trachytic and basaltic lavas, tuffs, and conglomerates, or breccias, forming a mountain several thousand feet in height. This volcano evidently broke out precisely on the site of the lacustrine deposit before described (Chapter xvii.), which had accumulated in a depression of a tract composed of micaceous schist. In the breccias, even to the very summit of the mountain, we find ejected masses of the fresh-water beds, and sometimes fragments of flint, containing Eocene shells. Deep valleys radiate in all directions from the central heights of the mountain, especially those of the Cer and Jourdanne, which are more than twenty miles in length, and lay open the geological structure of the mountain. No alternation of lavas with undisturbed Eocene strata have been observed, nor any tuffs containing fresh-water shells; on the northern side of the Plomb du Cantal, at La Vissiere, near Murat, we have pointed out on the Map (wood-cut, p. 226) a spot where fresh-water limestone and marl are seen covered by a thickness of about 800 feet of volcanic rock. Shifts are here seen in the strata of limestone and marl *.

Although it appears that the lavas of the Cantal are more recent than the fresh-water formation of that country, it does not follow that they may not belong to the Eocene period. The lake may possibly have been drained by the earthquakes which preceded or accompanied the first eruptions, but the Eocene animals and plants may have continued to exist for a long series of ages, while the cone went on increasing in dimensions.

Train of minor Volcanos.—We shall next consider those minor volcanos before alluded to, which stretch in a long range from Auvergne to the Vivarais, and which appear for the most part to be of newer origin than the mountains above described. They have been thrown up in a great number of isolated points, and much resemble those scattered over the

* See Lyell and Murchison, Ann. des Sci. Nat., Oct. 1829.

Phlegræan fields and the flanks of Etna. They have given rise chiefly to currents of basaltic lava, whereas those of Mont Dor and the Cantal are in great part trachytic. There are perhaps about three hundred of these minor cones in Central France; but a part of them only occur in Auvergne, where some few are found at the bottom of valleys excavated through the more ancient lavas of Mont Dor, as the Puy de Tartaret, for example, whence issues a current of lava which, flowing into the bed of the river Couze, gave rise to the lake of Chambon. Here the more ancient columnar basalts of Auvergne are seen forming the upper portion of the precipices which bound the valley.

But the greater part of the minor cones of Auvergne are placed upon the granitic platform, where they form an irregular ridge about eighteen miles in length and two in breadth. They are usually truncated at the summit, where the crater is often preserved entire, the lava having issued from the base of the hill. But frequently the crater is broken down on one side, where the lava has flowed out. The hills are composed of loose scoriæ, blocks of lava, lapilli, and puzzuolana, with fragments of trachyte and granite.

The lavas may be often traced from the crater to the nearest valley, where they usurp the channel of the river, which has often excavated a deep ravine through the basalt. We have thus an opportunity of contrasting the enormous degradation which the solid and massive rock has suffered by aqueous erosion and the integrity of the cone of sand and ashes which has, in the mean time, remained uninjured on the neighbouring platform, where it was placed beyond the reach of the power of running water.

Puy de Côme.—We may mention the Puy de Côme and its lava current, near Clermont, as one of the numerous illustrations of the phenomenon here alluded to. This conical hill rises from the granitic platform at an angle of about 40 degrees to the height of more than 900 feet. Its summit presents two distinct craters, one of them with a vertical depth of

250 feet. A stream of lava takes its rise at the western base of the hill, instead of issuing from either crater, and descends the granitic slope towards the present site of the town of Pont Gibaud. Thence it pours in a broad sheet down a steep declivity into the valley of the Sioule, filling the ancient river-channel for the distance of more than a mile. The Sioule, thus dispossessed of its bed, has worked out a fresh one between the lava and the granite of its western bank; and the excavation has disclosed, in one spot, a wall of columnar basalt about fifty feet high *.

The excavation of the ravine is still in progress, every winter some columns of basalt being undermined and carried down the channel of the river, and in the course of a few miles rolled to sand and pebbles. Meanwhile the cone of Côme remains stationary, its loose materials being protected by a dense vegetation, and the hill standing on a ridge not commanded by any higher ground whence floods of rain-water may descend.

Puy Rouge.—At another point, farther down the course of the Sioule, we find a second illustration of the same phenomenon in the Puy Rouge, a conical hill to the north of the village of Pranal. The cone is composed entirely of red and black scoriæ, tuff, and volcanic bombs. On its western side there is a worn-down crater whence a powerful stream of lava has issued and flowed into the valley of the Sioule. The river has since excavated a ravine through the lava and subjacent gneiss, to the depth of 400 feet.

On the upper part of the precipice forming the left side of this ravine, we see a great mass of black and red scoriaceous lava; below this a thin bed of gravel, evidently an ancient river-bed, now at an elevation of 50 feet above the channel of the Sioule. The gravel again rests upon gneiss, which has been eroded to the depth of 50 feet †. It is quite evident in this case that, while the basalt was gradually undermined and

* Scrope's Central France, p. 60, and plate.

† See Lyell and Murchison on the Excavation of Valleys, Edin. New Phil Journ., July 1829.

carried away by the force of running water, the cone whence the lava issued escaped destruction, because it stood upon a platform of gneiss several hundred feet above the level of the valley in which the force of running water was exerted.

It is needless to multiply examples, or the Vivarais would supply many others equally striking. Among many we may instance the cone of Jaujac, and its lava current *, which is a counterpart of that near Pranal last mentioned.

Lavas and Alluviums of different Ages.—We have seen that on the flanks of Etna, since the commencement of the present century, several currents of lava have flowed at the bottom of the Val del Bove, at the foot of precipices formed of more ancient lavas and tuffs. So we find in Auvergne that some streams of melted matter have flowed in valleys, the sides of which consist partly of older lavas. These are often seen capping the hills in broad sheets, resting sometimes on granite, sometimes on fresh-water strata.

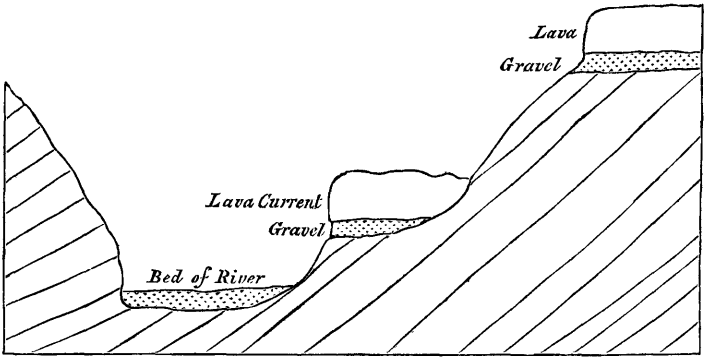
Many of the earlier lavas of Auvergne have flowed out upon the platform of granite before all the existing valleys had been excavated; others again spread themselves in broad sheets over the horizontal lacustrine deposit, when these had been covered with gravel, probably soon after the drainage of the lakes. Great vicissitudes in the physical geography of the country must have taken place since the flowing of these ancient lavas; and it is evident that the changes were gradual and successive, caused probably by the united agency of running water and subterranean movements. We frequently observe one mass of lava capping a hill, and a second at a lower elevation, forming a terrace on the side of a valley; or sometimes occupying the bed of a river.

It is a most interesting fact that we almost invariably find in these cases beds of gravel underlying the successive currents of lava, as in Catalonia before described (pp. 189, 190). Occasionally, when the highest platform of lava is 700 or 800 feet above the lowest, we cannot fail to be struck with the won-

* See Scrope's Central France, plate 14.

derful alterations effected in the drainage of the country since the first current flowed; for the most elevated alluviums must

No. 61.



Lavas of Auvergne resting on alluviums of different ages.

originally have been accumulated in the lowest levels of the then existing surface. As some geologists have referred almost all the superficial gravels to one era, and have supposed them to be the result of one sudden catastrophe, the phenomena of Auvergne above alluded to are very important. The flows of volcanic matter have preserved portions of the surface in the state in which they existed at successive periods, so that it is impossible to confound together the alluviums of different ages. The reader will see at once by reference to the wood-cut (No. 61) that a considerable interval of time occurred between the formation of the uppermost bed of gravel and that next below it; during which interval the uppermost lava was poured out and a valley excavated, at the bottom of which the second bed of gravel accumulated. In like manner the pouring out of a second current of lava, and a farther deepening of the valley, took place between the date of the second gravel and that of the modern alluvium which now fills the channel of the river *.

* For localities in Central France where lavas or sheets of basalt repose on alluviums at different elevations above the present valleys, consult the works of MM. Le Grand d'Aussi, Montlosier, Ramond, Scrope, Bertrand de Doue, Croizet, Jobert, Bouillet, and others.

When rivers are dispossessed of their channels by lava, they usually flow between the mass of lava and one side of the original valley. They then eat out a passage, partly through the volcanic and partly through the older formation; but as the soft tertiary marls in Auvergne give way more readily than the basalt, it is usually at the expense of the former that the enlarging and deepening of the new valley is effected, and all the remaining lava is then left on one side, in the manner represented in the above wood-cut.

Age of the more modern lavas.—The only organic remains found as yet in the ancient alluviums appear to belong to the Miocene period; but we have heard of none discovered in the gravel underlying the newest lavas, — those which either occupy the channels of the existing rivers or are very slightly elevated above them. We think it not improbable that even these may be of Miocene date, although the conjecture will appear extremely rash to some who are aware that the cones and craters whence the lavas issue, are often as fresh in their aspect as the majority of the cones of the forest zone of Etna.

The brim of the crater of the Puy de Pariou, near Clermont, is so sharp, and has been so little blunted by time, that it scarcely affords room to stand upon. This and other cones in an equally remarkable state of integrity have stood, we conceive, uninjured, not *in spite of* their loose porous nature, as some geologists might think, but in consequence of it. No rills can collect where all the rain is instantly absorbed by the sand and scoriæ, as we have shown to be the case on Etna (see above, p. 102), and nothing but a waterspout breaking directly upon the Puy de Pariou could carry away a portion of the hill, so long as it is not rent by earthquakes or engulphed.

Attempt to divide Volcanos into ante-diluvian and post-diluvian.—The opinions above expressed are entirely at variance with the doctrines of those writers who have endeavoured to arrange all the volcanic cones of Europe under two divisions,

those of ante-diluvian and those of post-diluvian origin. To the former they attribute such hills of sand and scoriæ as exhibit on their surface evident signs of aqueous denudation; to the latter, such as betray no marks of having been exposed to such aqueous action. According to this classification almost all the minor cones of Central France must be called post-diluvian; although, if we receive this term in its ordinary acceptation as denoting posteriority of date to the Noachian deluge, we are forced to suppose that all the volcanic eruptions occurred within a period of little more than twenty centuries, or between the era of the flood, which happened about 4000 years ago, and the earliest historical records handed down to us respecting the former state of Central France. Dr. Daubeny has justly observed, that had any of these French volcanos been in a state of activity in the age of Julius Cæsar, that general, who encamped upon the plains of Auvergne, and laid siege to its principal city, (Gergovia, near Clermont,) could hardly have failed to notice them. Had there been even any record of their existence in the time of Pliny or Sidonius Apollinaris, the one would scarcely have omitted to make mention of it in his Natural History, nor the other to introduce some allusion to it among the descriptions of this his native province. This poet's residence was on the borders of the Lake Aidat, which owed its very existence to the damming up of a river by one of the most modern lava currents*.

The ruins of several Roman bridges and of the Roman baths at Royat confirm the conclusion that no sensible alteration has taken place in the physical geography of the district, not even in the chasms excavated through the newest lavas since ages historically remote. We have no data at present for presuming that any one of the Auvergne cones has been produced within the last 4000 or 5000 years; and the

* Daubeny on Volcanos, p. 14.

same may be said of those of Velay. Until the bones of men or articles of human workmanship are found buried under some of their lavas, instead of the remains of extinct animals, which alone have hitherto been met with, we shall consider it probable, as we before hinted, that the latest of the volcanic eruptions may have occurred during the Miocene period.

Supposed effects of the Flood.

They who have used the terms ante-diluvian and post-diluvian in the manner above adverted to, proceed on the assumption that there are clear and unequivocal marks of the passage of a general flood over all parts of the surface of the globe. It had long been a question among the learned, even before the commencement of geological researches, whether the deluge of the Scriptures was universal in reference to the whole surface of the globe, or only so with respect to that portion of it which was then inhabited by man. If the latter interpretation be admissible, the reader will have seen, in former parts of this work, that there are two classes of phenomena in the configuration of the earth's surface, which might enable us to account for such an event. First, extensive lakes elevated above the level of the ocean; secondly, large tracts of dry land depressed below that level. When there is an immense lake, having its surface, like Lake Superior, raised 600 feet above the level of the sea, the waters may be suddenly let loose by the rending or sinking down of the barrier during earthquakes, and hereby a region as extensive as the valley of the Mississippi, inhabited by a population of several millions, might be deluged *. On the other hand, there may be a country placed beneath the mean level of the ocean, as we have shown to be the case with part of Asia †, and such a region must be entirely laid under water should the tract which separates it from the ocean

* See vol. i. p. 89, and Second Edition, p. 101.

† Vol. ii. p. 163, and Second Edition, p. 169.

be fissured or depressed to a certain depth. The great cavity of western Asia is 18,000 square leagues in area, and is occupied by a considerable population. The lowest parts, surrounding the Caspian Sea, are 300 feet below the level of the Euxine,—here, therefore, the diluvial waters might overflow the summits of hills rising 300 feet above the level of the plain; and if depressions still more profound existed at any former time in Asia, the tops of still loftier mountains may have been covered by a flood.

But it is undeniable, that the great majority of the older commentators have held the deluge, according to the brief account of the event given by Moses, to have consisted of a rise of waters over *the whole earth*, by which the summits of the loftiest mountains on the globe were submerged. Many have indulged in speculations concerning the instruments employed to bring about the grand cataclysm; and there has been a great division of opinion as to the effects which it might be expected to have produced on the surface of the earth. According to one school, of which De Luc in former times, and more recently Dr. Buckland, have been zealous and eloquent supporters, the passage of the flood worked a considerable alteration in the external configuration of our continents. By the last-mentioned writer the deluge is represented as a violent and transient rush of waters which tore up the soil to a great depth, excavated valleys, gave rise to immense beds of shingle, carried fragments of rock and gravel from one point to another, and, during its advance and retreat, strewed the valleys, and even the tops of many hills, with alluvium *.

But we agree with Dr. Fleming †, that in the narrative of Moses there are no terms employed that indicate the impetuous rushing of the waters, either as they rose or when they re-

* Buckland, Reliquiæ Diluvianæ.

† See a Memoir by the Rev. John Fleming, D. D., on the Geological Deluge, Edin. Phil. Journ., vol. xiv. p. 205, whose opinions were reviewed by the author in Oct. 1827, in an article in the Quarterly Review, No. lxxii. p. 481.

treated, upon the restraining of the rain and the passing of a wind over the earth. On the contrary, the olive-branch, brought back by the dove, seems as clear an indication to us that the vegetation was not destroyed, as it was then to Noah that the dry land was about to appear.

We have been led with great reluctance into this digression, in the hope of relieving the minds of some of our readers from groundless apprehension respecting the bearing of many of the views advocated in this work. They have been in the habit of regarding the diluvial theory above controverted as alone capable of affording an explanation of geological phenomena in accordance with Scripture, and they may have felt disapprobation at our attempt to prove, in a former chapter *, that the minor volcanos on the flanks of Etna may, some of them, be more than 10,000 years old. How, they would immediately ask, could they have escaped the denuding force of a diluvial rush of waters? The same objection may have presented itself when we quoted, with so much respect, the opinion of a distinguished botanist, that some living specimens of the Baobab tree of Africa, or the Taxodium of Mexico, may be five thousand years old †. Our readers may also have been astonished at the high antiquity assigned by us to the greater part of the European alluviums, and the many different ages to which we refer them ‡, as they may have been taught to consider the whole as the result of one *recent* and *simultaneous* inundation. Lastly, they may have felt some disappointment at observing, that we attach no value whatever to the hypothesis of M. Elie de Beaumont, adopted by Professor Sedgwick, that the sudden elevation of mountain-chains 'has been followed again and again by mighty waves desolating whole regions of the earth §,' a phenomenon which, according to the last-mentioned of these writers, has 'taken

* Chap. viii. p. 100. † See above, p. 99.
‡ P. 147. § P. 101.

away all anterior incredibility from the fact of a recent deluge*.'

For our own part, we have always considered the flood, if we are required to admit its universality in the strictest sense of the term, as a preternatural event far beyond the reach of philosophical inquiry, whether as to the secondary causes employed to produce it, or the effects most likely to result from it. At the same time, it is evident that they who are desirous of pointing out the coincidence of geological phenomena with the occurrence of such a general catastrophe, must neglect no one of the circumstances enumerated in the Mosaic history, least of all so remarkable a fact as that the olive remained standing while the waters were abating.

Recapitulation.—We shall now briefly recapitulate some of the principal conclusions to which we have been led by an examination of the volcanic districts of Central France.

1st. Some of the volcanic eruptions of Auvergne took place during the Eocene period, others at an era long subsequent, probably during the Miocene period.

2ndly. There are no proofs as yet discovered that the most recent of the volcanos of Auvergne and Velay are subsequent to the Miocene period, the integrity of many cones and craters not opposing any sound objection to the opinion that they may be of indefinite antiquity.

3rdly. There are alluviums in Auvergne of very different ages, some of them belonging to the Miocene period. Many of these have been covered by lava-currents which have been poured out in succession while the excavation of valleys was in progress.

4thly. There are a multitude of cones in Auvergne, Velay, and the Vivarais, which have never been subjected to the action of a violent rush of waters capable of modifying considerably the surface of the earth.

5thly. If, therefore, the Mosaic deluge be represented as universal, and as having exercised a violent denuding force, all

* Anniv. Address to the Geol. Soc., Feb. 18th, 1831.

these cones, several hundred in number, must be post-diluvian.

6thly. But since the beginning of the historical era, or the invasion of Gaul by Julius Cæsar, the volcanic action in Auvergne has been dormant, and there is nothing to countenance the idea that, between the date usually assigned to the Mosaic deluge and the earliest traditional and historical records of Central France (a period of little more than twenty centuries), all or any one of the more entire cones of loose scoriæ were thrown up.

Lastly, it is the opinion of some writers, that the earth's surface underwent no great modification at the era of the Mosaic deluge, and that the strictest interpretation of the scriptural narrative does not warrant us in expecting to find any geological monuments of the catastrophe, an opinion which is consistent with the preservation of the volcanic cones, however high their antiquity.