

In another chapter Davilla records the following fossils from Canstadt, therefore probably from the same beds as his *Ornitholite*:—molar teeth of *Rhinoceros*, “Une canine, blanche, à petites herborisations bleuâtres, adhérente à une portion de mâchoire pareillement herborisée;” another tooth, “Arborisée . . . son intérieur est calciné et adhère fortement à la langue;” six other teeth, “Sçavoir, deux arborisées, de Canstadt, l’une de *Rhinoceros*,* l’autre inconnue, † deux simplement fossiles, dont une de Cheval dans son alvéole. Plus, une portion de mâchoire aussi fossile, trouvée à Canstadt,” and fifteen other bones unnamed. These memoranda would lead one to refer the Canstadt *Ornitholite* to the Pleistocene age.

(To be continued.)

CORRESPONDENCE.

On the Causes of Earthquakes.

SIR,—The occurrence of an earthquake of unusual violence in England has naturally given rise to very general inquiries and speculations on the nature and causes of these phenomena; and various theories more or less ingenious, but, for the most part, vague and obscure, have been broached upon the subject in the different organs of public instruction.

I have not, however, seen anywhere a notice of that simple, and to my mind conclusive, view of the question which I have put forward in my recent work on *Volcanos*, and I therefore venture to call your attention and that of your readers to it.

I there refer (p. 294) “these sensible vibratory undulations of the earth’s surface to the snap and jar occasioned by a sudden and violent rupture of solid rock-masses at a greater or less depth, and probably the instantaneous injection into the fissures so formed of intumescent molten matter from beneath.” I am happy to find an almost complete accordance between this view and that offered by yourself in your last number. But when you go on to suggest the sudden crystallization of vast underlying masses of mineral matter as the probable cause of such ruptures in the overlying rocks, I must part company with you. Why should we resort to imaginary hypotheses to explain that which, if nature is consistent with herself, is to be simply accounted for by well-known facts? It is certain that the greater number of *volcanic* eruptions are preceded or accompanied by *local* earthquakes, evidently caused by the splitting and rending of the rocks that form the flanks of the volcano, or the surrounding area, by the expansion and rise of intumescent lava beneath.

In these cases an actual escape of condensed vapour and molten mineral matter does generally take place. Not so, it is true, in the case of other earthquakes, which are usually (not always) felt over more extended areas, and therefore probably proceed from a focus of disturbance more deeply seated, so as not to admit of any outward discharge of erupted matter, gaseous or fluid, but which, nevertheless, are undistinguishable from the former in their *seismic* phenomena, and therefore may well be believed to

* Scheuchzer, *Physiq. Sacrée*, pl. 48, fig. 18.

† *Ib.*, fig. 18, altera.

have the same origin. An earthquake of this latter class I believe, with Mr. Mallet, to be an "incomplete effort to establish a volcano;" that is, the outward escape of pent-up volcanic heat.

In many volcanic mountains we actually see the rents, the "snap and jar" of whose rupture through the solid rocks forming the mountain's side occasioned the earthquake. For instance, during the eruption of Vesuvius in 1860, a violent earthquake-shock was felt along the southern base of the mountain, and a crevice was seen to have opened through its flank behind Torre del Greco, radiating from the side of the eruptive explosions down to the sea, the coast of which was permanently elevated some two feet along a considerable distance. In some of the violent eruptions of the volcanos of Iceland, and also of the Pacific Islands, the mountain has been seen to be split across from top to bottom by such shocks.

The superficial fissures and changes of level which are often observed to accompany earthquakes not attended by outward eruptions, testify to the occurrence of some violent fractures and dislocation having taken place at some depth beneath. Here, then, we have a *vera causa*, seen and known to be at work in many instances, quite sufficient to explain the phenomena of those where the cause is not so apparent, owing probably to the deeper position of the point at which the shock originates. Is it not then, I ask, the most reasonable theory to refer the earthquake to the same primary cause as the volcanic eruption, namely, "the sudden expansion of some deeply-seated mass of mineral matter, owing to increase of temperature or diminution of pressure?" (See p. 296; Volcanos.)

If we suppose the heated matter below the crust of the earth—of the existence of which (at least throughout the great bands of volcanic and seismic disturbance) we have positive ocular proof in its frequent eruptions—to be (as of necessity it must be) exerting a continual upward pressure against the overlying rocks, and creating in them a violent tensile strain, it is certain that any diminution, however slight, in the amount of pressure *above* them—even the sudden lightening of the atmospheric pressure alone—may give occasion to the yielding of the cohesive force of the rocky crust, and its consequent snapping and jarring fracture, to which I attribute every earthquake. Thus is explained the more frequent occurrence of these phenomena at the periods of the Autumnal Equinox, and also when the moon is at the meridian of the locality affected, as shown in the tables of Mr. Perrey and Mr. Mallet to be the fact.

We know that the solid crust of the earth is, and has been from the earliest geological periods, continually undergoing oscillatory movements of elevation or depression. These must have been always accompanied by the fracture and fissuring of its rigid component rocks, at great depths no less than near the surface. Do not these movements correspond with, and amply explain, the frequent occurrence of earthquakes, which are precisely the kind of phenomena we should expect to experience from such sudden and violent snapping and rending of the rocks beneath us? I content myself with this explanation of the cause of earthquakes, and think it quite unnecessary to resort to any other, such as terrestrial electricity, magnetism, crystallization, the breaking-in of the roofs of imaginary subterranean cavities, or the condensation of vapour evolved from submarine volcanos; to which last theory Mr. Mallet, as I think, unnecessarily resorts.

I remain, Sir, your very obedient servant,

G. POULETT SCROPE.

London, 20th November, 1863.

[The late date at which Mr. Scrope's letter arrived, precludes the possibility of my noticing at any length his very valuable communication. The experience of Mr. Scrope,

and his indefatigable and acute observation of volcanic phenomena, over a period of many years, entitle his opinions to the most marked respect, and his excellent works on the subject have always excited my admiration. His views, to which he recalls my attention, had escaped me at the time of writing my article in the November number; but I made no reference to any authors or any published views, because I simply wished to put forward what I only regarded as a speculative idea, whether the crystallization of vast rocks could give rise, by their expansion or contraction, to the rupture of rock-strata not necessarily in immediate contiguity with the crystalline mass, but held in a state of tension by the difference in volume produced by crystallization. Mr. Scrope has misunderstood me altogether in supposing I meant a *sudden crystallization*: what I meant was, that the "snap" of the rock-strata, held in tension by the increased or diminished volume of the crystalline mass, was *sudden*. The crystallization of rock-masses I believe to be very slow, perhaps often occupying enormous periods of time to effect over great masses. Still, however slow the alteration of volume takes place, a tensile strain must be continuously accumulating until it exceeds the adhesive force of the strata, and then a "snap" occurs. I also referred in my remarks only to such earthquakes as occur without visible or evident association with active or eruptive volcanic phenomena; such, for example, as the late English earthquake, or those so constantly taking place in the neighbourhood of Comrie, in Scotland. It seems to me that there are two classes of earthquakes, one connected with volcanic phenomena, as stated by Mr. Scrope, the other, simply "snaps and jars," without any connection with volcanic phenomena at all, and produced by the crystallization, the drying and contracting, or increase of volume by heat or other suchlike natural causes which are not dependent on subterranean volcanic materials, such as molten lava or the supposed incandescent internal fluid core of our earth. I put forth the idea of crystallization as one of the possible causes of what I supposed to be non-volcanic earthquakes, with some timidity, knowing and appreciating the labours of Mr. Scrope and Mr. Mallet, and the more so that I had had little time to devote to the due consideration even of my own idea. I thought it one, however, worth promulgating, and I am gratified to read the terms in which Mr. Scrope speaks of it.—ED. GEOL.]

Mammalian Remains from Grays Thurrock.

SIR,—With a view to the settlement of some undecided points connected with the "mammalian fauna" of the pre-glacial deposit, and of the post-glacial high and low level gravels, etc., any geologists or palæontologists possessing collections from Grays Thurrock, or any of the other fossiliferous localities in the valley of the Thames, or corresponding river-valleys in the south-east of England, will greatly oblige the undersigned, by communicating to him whether they possess good specimens, containing teeth, of bears, or of hyænas; and if so, what amount of evidence the specimens present.

H. FALCONER.

21, Park Crescent, Portland Place, Nov. 12, 1863.

Mammoth Remains at Leicester.

DEAR SIR,—As it is of importance in these "drift-searching" days that all remains found of mammals in the drift should be made known to your readers, I have much pleasure in communicating to you that information was this morning brought me of a horn or tusk, of very large dimensions, had been laid open in a cutting for drainage in the valley of the Soar, in the outskirts of Leicester, and near the village of Belgrave. I at once proceeded to the President of our Philosophical Society, and obtained his permission to secure it for our town museum; and also to inform one of our leading geologists, James Plant, Esq., of the fact. We drove to the

VOL. VI.

3 N