

ADDITIONS to the article, Of the Production of Strata, Vol. I. p. 15.

I.

Concerning the Strata in different parts of the Earth.

WE have some examples of quarries and pits of considerable depths, of which the different strata have been examined and described; such as the pit of Amsterdam, which descends 232 feet, and that of Marly-la-ville, which is 100 feet deep. Many other examples might be given, if observers had agreed in their denominations. But some give the name of *marl* to white clay; others apply the term *slint* to round calcareous stones; and others give the denomination of *sand* to calcareous gravel. Hence little advantage can be derived either from their researches or their long dissertations on these subjects; because we are under a perpetual uncertainty with regard to the nature of the substances they describe. We shall, therefore, confine ourselves to the following examples.

An excellent observer has written to one of my friends, in the following terms, concerning the strata in the neighbourhood of Toulon: 'To the north of the city of Toulon,' he remarks, 'there is an immense quantity of stony matter,

'matter, which occupies the declivity of the chain of mountains, and stretches through the valley from east to west; and one part of it forms the soil of the valley, and loses itself in the sea. This stony matter is commonly called *saffre*; but it is that species of tufa which is denominated *marga toffacea fistulosa* by naturalists. M. Guettard desired me to furnish him with all the information I could obtain concerning this saffre, as well as specimens of the matter itself, that he might examine it, and give a detail of its qualities in his memoirs. I sent them both; and I believe I have satisfied him; for he has thanked me for the information I communicated. He tells me, that he is to return to Provence and Toulon in the beginning of May. . . . M. Guettard, however, will probably give us nothing new upon this subject; for M. de Buffon has exhausted it in the first volume of his Natural History, under the article, *Proofs of the Theory of the Earth*; and it appears, that, in composing this article, he had in his eye the mountains of Toulon and their ridge.

'At the commencement of this ridge, which consists of a more or less hard tufa, we find, in small cavities of the nucleus of the mountain, quantities of very fine sand, which are probably the balls mentioned by M. de Buffon. After breaking other superficial

‘ parts of the nucleus, we find numbers of sea-shells incorporated with the stone. I have several of these shells, the enamel of which is well preserved. I will send them soon to M. de Buffon.’

M. Guettard, who has made more observations of this kind than any other naturalist, expresses himself in the following terms, when he treats of the mountains in the neighbourhood of Paris*.

‘ Below the vegetable soil, which exceeds not two or three feet, is placed a bed of sand from four or six to twenty, and often thirty feet thick. This bed is commonly replete with stones of the nature of grind-stone. . . . In some districts, we meet with detached masses of free-stone in this sand bed.

‘ Below this sand, we find a tufa, from ten or twelve, to thirty, forty, and even fifty feet thick. This tufa is not commonly of one equal thickness. It is frequently cut by different strata of spurious or clayey marl, of the *cos* which the workmen call *tripoli*, or of good marl, and even by small beds of pretty hard stones. . . . Under this bed of tufa are found those which furnish stones for building. These beds vary in thickness: At first they exceed not one foot. In some districts, three

* Lettre de M. Buffon à M. Guenand de Montbeillard, Toulon, Avril 16, 1775.

‘ or four of them lie above each other. They are succeeded by one of about ten feet, both the surface and interior parts of which are interspersed with moulds or impressions of shells. It is followed by another about four feet, which rests upon one from seven to eight, or rather upon two of three or four feet. After these beds, there are several others, which together form a mass of at least three fathoms. This mass, after piercing a bed of sand, is succeeded by clays.

‘ This bed of sand is earthy and reddish, and is from two and a half to three feet thick. After this comes a bed of spurious clay of a bluish colour; it is a clayey earth mixed with sand; the thickness of this bed is about two feet, and is followed by another of five, which consists of a smooth black clay, the broken portions of which are nearly as brilliant as jet. Lastly, this black clay is succeeded by a blue, which forms a stratum from five to six feet thick. In these different clays we find pyrites of a pale yellow colour, and of various figures. . . The water found below all these clays prevented us from penetrating any deeper.’

The strata in the quarries of the district of Moxouris, above the suburb of Saint-Marceau, are disposed in the following order.

‘ 1, Ve-

	Feet.	Inches.
1. Vegetable soil - - -	1	
2. Tufa - - -	12	
3. Sand - - -	18	
4. Yellowish earth - -	12	
5. Tripoli; that is, a white, fat, compact earth, which hardens when exposed to the sun, and marks any substance in the same manner as chalk	30	
6. Flints, or a mixture of greasy sand - - -	12	
7. Rock - - -	2	
8. A stratum of small stones, from one to two feet -	2	
9. Two strata of stone, which dissolve by the operation of the air and weather -	1	
10. Earth and gravel - -	1	6
11. Free-stone - - -	1	6
12. Very hard lime-stone -	1	
13. A greenish stratum -	1	6
14. A tender calcareous stone, which forms two strata, one of 18 inches, and the other of two feet - - -	3	6
15. Several small beds of bastard calcareous stone. They precede the sheet of water common in pits. This sheet the		

diggers

Feet.

diggers are obliged to remove before they can obtain the potters clay, which lies between two waters*. In all 99

I have given this specimen for want of a better; for the uncertainties with regard to the nature of the different strata are apparent. We cannot, therefore, be too anxious in recommending to observers to be more exact in defining the nature of those materials they attempt to describe. They may at least distinguish them into vitrescent and calcareous, as in the following example.

The soil of Lorrain is divided into two great zones: The eastern, which covers the chain of *Voges*, which are primitive mountains composed entirely of vitrifiable and chrysalized matters, as granite, porphyry, jasper, and quartz, disposed in detached blocks or groups, and not in regular strata or beds. In all this chain of mountains, there is not the smallest vestige of any marine production; and the hills which proceed from them consist of vitrifiable sand. Where they terminate, and upon a continued bounding line of their descent, the other zone commences, which is totally calcareous, dispo-

* Mem. de l'Acad. des Sciences, année 1756.

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sed in horizontal beds, and replete, or rather completely formed, of sea bodies*.

The banks and beds of the earth in Peru are perfectly horizontal, and correspond sometimes at a great distance in different mountains, most of which are two or three hundred fathoms high. They are in general inaccessible, and often as perpendicular as walls, which gives us an opportunity of perceiving the extremities of their horizontal strata. When any of them happens to be round and detached from others, each bed appears like a very flat cylinder, or a section of a cone of no great height. These different beds, placed one above another, and distinguished by their colour and various contours, often resemble a regular and artificial structure. In this country, we see the mountains perpetually assuming the appearance of ancient and sumptuous palaces, of chapels, of castles, and of domes. They are sometimes fortifications composed of long curtains, and defended with bulwarks. After examining these objects, and the correspondence of their strata, we can hardly entertain a doubt, that the circumjacent land has not, at some period, been really sunk. It appears, that those mountains, whose bases were most solidly supported, remained as monuments

* Note communicated to M. de Buffon, par M. l'Abbé Besson, March 15th 1777.

to indicate the height which the soil of these countries anciently possessed*.

The mountain of Birds, called in Arabic *Gebeliter*, is so equal from top to bottom, for the space of half a league, that it rather resembles a wall regularly built by the hands of man, than a rock formed in this manner by the operation of Nature. The Nile washes this mountain a long way; and it is distant from Cairo in Upper Egypt four and a half days journey†.

To these observations, I shall add a remark made by most travellers, that, in Arabia, the soil is of various natures. The region nearest to Mount Libanus presents nothing but broken and overturned rocks, and is called *Arabia Petraea*. The removal of the soil, by the movement of the waters, has rendered this country almost totally barren; whilst the lighter mud, and all the good earth, have been carried to a greater distance, and deposited in that part of the country called *Arabia Felix*. Besides, the *revers* in Arabia Felix, as well as every where else, are more rugged toward the African sea, *i. e.* to the west, than toward the Red sea, which is on the east.

* Bouguer, *figure de la Terre*, p. 89.

† Voyage du P. Vanheeb.