

II.

Of the Places where Shells are found, p. 204.

TO the enumeration I have given of the great quantities of shells found in all parts of the world, I might add many particular observations which have been communicated to me during these last thirty-four years. I have received letters from the American islands, by which I am assured, that, in almost all of them, shells are found, either petrified or in their natural state, in the interior parts of the earth, and often below the first stratum or vegetable soil. In the Malouine islands, M. de Bougainville found stones which divided into thin plates or leaves, and upon which were impressions of fossil shells, of a species unknown in these seas *. To the same purpose I have letters from several parts of India and of Africa, Don Ulloa informs us †, that, in that district of Chili which extends from Talca Guano to Conception, different kinds of shells are found in great numbers, and without any mixture of earth; and that these shells are used to make lime. He adds, that this peculiarity would not be so remarkable, if these shells were found only in low

* Voyage Auteur du Monde, tom. 1. p. 100.

† Tom. 3. p. 314. de son Voyage.

places,

places, which might be covered with the sea. But what is singular, he remarks, that the same heaps of shells are found in the hills at the height of fifty fathoms above the level of the sea. I relate this fact, not because it is singular, but because it corresponds with all the others, and is the only one known to me concerning fossil shells in this part of the world, where I am persuaded that petrified shells will be found as well as every where else, at heights much greater than fifty fathoms above the level of the sea; for the same Don Ulloa has since found petrified shells in the mountains of Peru at the height of above 2000 fathoms; and, according to M. Kalm, shells are seen in North America upon the tops of several hills: He tells us, that he saw them on the summit of the Blue Mountains. They have also been found in the chalk quarries near Montreal, in certain stones near Lake Champlain in Canada *, and in the most northern regions of this New Continent; for the Greenlanders believe, that the world had been drowned by a deluge, and, in evidence of this event, they quote the shells and the bones of whales which cover the most elevated mountains of their country †.

If from this we pass to Siberia, we shall find the same proof, of the ancient abode of the

* Mem. de l'Acad. des Sciences, année 1752, p. 194.

† Voyage de M. Crantz; *Hist. Gen. des Voyages*, tom. 19. p. 105.

ocean upon all our Continents. Near the mountain Jenifeik, there are other mountains less elevated, upon the summits of which we find heaps of shells well preserved both in figure and natural colours. These shells are all empty, and some of them fall into powder as soon as they are touched. *The sea of this country produces no shells similar to those found on the tops of mountains.* The largest of these shells exceed not an inch in breadth, and others are very small *.

But I can exhibit facts which are still more obvious. Every man, in his own province, has only to open his eyes, and he will see shells in all places where lime-stone is found, as also in most clays, though, in general, marine productions are more rare in clays than in calcareous substances.

In the territory of Dunkirk, on the top of the mountain of the Recollets, near that of Casfel, and at 400 feet above the level of the sea, there is a horizontal stratum of shells, which are so closely packed together that most of them are broken. Above this stratum, there is a bed of earth from seven to eight feet deep. These shells are situated at the distance of six leagues from the sea, and they are of the same species, with those found on its coast†.

* Relation de Mess. Gmelin et Muller; *Hist. Gen. des Voyages*, tom. 13. p. 342.

† Mem. pour la Subdelegation de Dunkerque, relativement à l'Histoire naturelle de ce Canton.

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In Mount Gannelon, near Anet, and at some distance from Compiègne, there are several quarries of excellent lime-stone. Between the different strata of the lime-stone we find gravel mixed with an infinite number of sea-shells, or portions of shells, which are very light and friable. In the same place, there are common oyster-shells in fine preservation, and extend more than a league and a quarter in length. In one of these quarries, there are three strata of shells in different states. In two of these strata, they are so much broke, that their species cannot be distinguished: But, in the third, there are oysters, which have suffered no alteration, but that of being excessively dried. The nature, figure, and enamel of the shells, are the same as in the live animals. These shells have acquired a great lightness, and easily exfoliate. The lime-stone quarries are situated at the foot of the mountain, and have a small declivity. In descending towards the plain, we find oysters, which are neither dried, nor have undergone any change, but have the same weight, and the same enamel with those which are daily taken out of the sea*.

In the neighbourhood of Paris, these marine shells are not less common. The marl pits of Bougival furnish a kind of middle-

* Extrait d'une Lettre de M. Lefchevin à M. de Buffon; *Compiègne*, O^g. 8. 1774.

sized

fized oysters. They are not entire, but cut in different directions, and finely polished. Near Belleville, where free-stone is quarried, we find a mass of sand in the earth, which contains branched bodies, which may have been corals or madrepores converted into stone. These marine bodies are not in the sand alone, but in the stones, which likewise contain shells of different kinds, as volutes, univalves, and bivalves*.

Switzerland is not less abundant in fossil marine bodies than France and the other countries we have mentioned. In Mount Pilate, in the canton of Lucerne, we find petrified sea-shells, and the bodies and relics of fishes. In the same mountain, there are corals, and slates which easily exfoliate, and, between the leaves, a fish is generally found. Some years ago, the jaws, and even entire heads of fishes, together with their teeth, were discovered†.

M. Altman remarks, that, in one of the highest parts of the Alps, near Grindelvald, where the famous glaciers (Gletchers) are formed, there are fine marble quarries, which he has represented in one of the engravings of these mountains. The marble quarries are only a few paces distant from the glacier. The marble

* Mem. de M. Guettard; *Acad. des Sciences*, année 1764, p. 492.

† Promenade au Mont Pilate; *Journal étranger*, mois de Mars, 1756.

is of various colours, as white, yellow, jasper, red, and green. The marble is drawn on sledges above the snow as far as Underseen, where they are embarked to be carried to Berne by lake Thorne, and afterwards by the river Aare*. Thus marble and calcareous stones are found, at great heights, in this part of the Alps.

M. Capperel, in making researches on Mount Grimfel, one of the Alps, has remarked, that the hills and smaller mountains which limit the valleys, are mostly composed of free-stone, of a grain more or less fine and close. The tops of these mountains generally consist of limestone, of various colours and hardness. The mountains more elevated than these calcareous rocks, are composed of granite and other stones, which appear to be of the nature of granite and of emery. It is in these granitic stones that rock-crystal begins to be formed. But, in the limestone rocks below, we find nothing but spar and calcareous concretions. In general, it has been remarked, concerning shells of every kind, whether fossil or petrified, that certain species are always found together, and that others are never met with in these places. The same thing happens in the ocean, where particular species of testaceous animals are constantly found toge-

* *Essai de la Description des Alpes Glaciales*, par M. Altman.

ther, in the same manner as certain plants always grow together on the surface of the earth*.

It has been too generally believed, that there are no shells, or other productions of the sea, on the highest mountains. It is true, that there are several summits, and a great number of peaks, which are entirely composed of granite and vitrifiable rocks, and in which no mixture can be perceived. These contain neither the moulds of shells, nor the relics of any marine bodies. But there is a much greater number of mountains, and some of them very high, where these relics are to be found. M. Costa, professor of anatomy and botany in the university of Perpignan, in the year 1774, discovered, some fathoms below the top of Mount Nas, situated in the middle of the Spanish Cerdagne, and one of the most elevated parts of the Pyrennees, a great number of lenticular stones, *i. e.* blocks composed of lenticular stones, and these blocks were of different figures and different sizes; the largest might weigh from forty to fifty pounds. He remarked, that the part of the mountain where these lenticular stones were found, seemed to have formerly sunk; for, in this place, he saw an irregular, oblique depression, very much inclined to the horizon; and one of its extremities respected the top, and the other the bottom of

* *Lettres Philosophiques de M. Bourgeet, Bilist. Reisen, mis d'Avril, Mai, et Juin, 1750.*

the mountain. He could not distinctly perceive the dimensions of this depression, because most of it was covered with snow, though it was the month of August. The banks of rocks which surrounded these lenticular stones, as well as those immediately below, are calcareous for more than a hundred fathoms. This Mount Nas, to judge of it by the eye, seems to be as high as Canigou, and presents no vestige of a volcano.

A thousand other examples of marine shells, found in an infinity of places, as well in France as in different parts of Europe, might be given. But such an enumeration of particular facts, which are already too much multiplied, would swell this work, without answering any useful purpose. From the whole, however, we cannot refrain from drawing this obvious conclusion, that all the inhabited parts of the earth have formerly, and during a very long course of time, been covered with the waters of the ocean.

I shall only remark, that these sea-shells are found in different states. Some of them are petrifications, or stones moulded into the form of shells; and others are in the same state as they still exist in the ocean. The quantity of petrified shells, which are nothing but stones figured by shells, is infinitely greater than that of fossil shells, and they are never found together,

ther, nor even in places contiguous; it is only in the neighbourhood, and some leagues distant from the sea, that we find beds of shells in their natural state, and these are commonly the same with those which exist in the adjacent seas. Petrified shells, on the contrary, are found, almost every where, at great distances from the sea, and on the highest hills, many species of which belong not to our seas, and several of them have no existing representatives; such as those ancient species we formerly mentioned, which only existed when the globe was much warmer. Of more than a hundred species of *cornua ammonis*, remarks one of our learned Academicians, with which we are acquainted, and which are found in the environs of Paris, of Rouen, of Dive, of Langres, and of Lyons, as well as in the Cevennes, in Provence, in Poitou, in Britain, in Spain, and in other countries of Europe, there is but one species, called the *Nautilus papyraceus*, found in our seas, and five or six others produced in foreign seas*.

* Mem. de l'Acad. des Sciences, année, 1722, p. 242.

III.

Of those great Volutes called Cornua Ammonis, and of some large Bones of terrestrial Animals.

IN p. 211. I said, *That many shell-fishes inhabit the deepest parts of the ocean, and are never thrown upon the coasts; authors have, therefore, termed them Pelagie, to distinguish them from the other kind, which they call Littorales. It is probable that the cornu ammonis, and some other species found only in a petrified state, belong to the former, and that they have been impregnated with stony matter in the very places where they are discovered. It is also probable, that the species of some animals have been extinguished, and that these shells may be ranked among this number. The extraordinary fossil bones found in Siberia, in Canada, in Ireland, and several other places, seem to confirm this conjecture; for no animal has hitherto been discovered to whom bones of such enormous size could possibly belong.*

Upon this passage I have to make two important remarks:

1. That these *cornua ammonis*, which are so different from each other both in figure and size,