

## ERA OF THE SUPERFICIAL FORMATIONS.

## COMMENCEMENT OF PRESENT SPECIES.

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WE have now completed our survey of the series of stratified rocks, and traced in their fossils the progress of organic creation down to a time which seems not long antecedent to the appearance of man. There are, nevertheless, monuments of still another era or space of time which it is all but certain did also precede that event.

Over the rock formations of all eras, in various parts of the globe, but confined in general to situations not very elevated, there is a layer of stiff clay, mostly of a blue colour, mingled with fragments of rock of all sizes, travel-worn, and otherwise, and to which geologists give the name of diluvium, as being apparently the produce of some vast flood, or of the sea thrown into an unusual

agitation. It seems to indicate that, at the time when it was laid down, much of the present dry land was under the ocean, a supposition which we shall see supported by other evidence. The included masses of rock have been carefully inspected in many places, and traced to particular parent beds at considerable distances. Connected with these phenomena are certain rock surfaces on the slopes of hills and elsewhere, which exhibit groovings and scratchings, such as we might suppose would be produced by a quantity of loose blocks hurried along over them by a flood. Another associated phenomenon is that called *crag and tail*, which exists in many places,—namely, a rocky mountain, or lesser elevation, presenting on one side the naked rock in a more or less abrupt form, and on the other a gentle slope; the sites of Windsor, Edinburgh, and Stirling, with their respective castles, are specimens of *crag and tail*. Finally, we may advert to certain long ridges of clay and gravel which arrest the attention of travellers on the surface of Sweden and Finland, and which are also found in the United States, where, indeed, the whole of these phenomena have been observed over a large surface, as well as in Europe. It is very remarkable that the direction from which the

diluvial blocks have generally come, the lines of the grooved rock surfaces, the direction of the crag and tail eminences, and that of the clay and gravel ridges—phenomena, be it observed, extending over the northern parts of both Europe and America—are *all from the north and north-west towards the south-east*. We thus acquire the idea of a powerful current moving in a direction from north-west to south-east, carrying, besides mud, masses of rock which furrowed the solid surfaces as they passed along, abrading the north-west faces of many hills, but leaving the slopes in the opposite direction uninjured, and in some instances forming long ridges of detritus along the surface. These are curious considerations, and it has become a question of much interest, by what means, and under what circumstances, was such a current produced. One hypothetical answer has some plausibility about it. From an investigation of the nature of glaciers, and some observations which seem to indicate that these have at one time extended to lower levels, and existed in regions (the Scottish Highlands an example) where there is now no perennial snow, it has been surmised that there was a time, subsequent to the tertiary era, when the circumpolar ice extended far into

the temperate zone, and formed a lofty, as well as extensive accumulation. A change to a higher temperature, producing a sudden thaw of this mass, might set free such a quantity of water as would form a large flood, and the southward flow of this deluge, joined to the direction which it would obtain from the rotatory motion of the globe, would of course produce that compound or south-easterly direction which the phenomena require. All of these speculations are as yet far too deficient in facts to be of much value; and I must freely own that, for one, I attach little importance to them. All that we can legitimately infer from the diluvium is, that the northern parts of Europe and America were then under the sea, and that a strong current set over them.

Connected with the diluvium is the history of *ossiferous caverns*, of which specimens singly exist at Kirkdale in Yorkshire, Gailenreuth in Franconia, and other places. They occur in the calcareous strata, as the great caverns generally do, but have in all instances been naturally closed up till the recent period of their discovery. The floors are covered with what appears to be a bed of the diluvial clay, over which rests a crust of stalagmite, the result of the droppings from the roof since the

time when the clay-bed was laid down. In the instances above specified, and several others, there have been found, under the clay bed, assemblages of the bones of animals, of many various kinds. At Kirkdale, for example, the remains of twenty-four species were ascertained—namely, pigeon, lark, raven, duck, and partridge; mouse, water-rat, rabbit, hare, deer, (three species,) ox, horse, hippopotamus, rhinoceros, elephant, weazel, fox, wolf, bear, tiger, hyena. From many of the bones of the gentler of these animals being found in a broken state, it is supposed that the cave was a haunt of hyenas and other predaceous animals, by which the smaller ones were here consumed. This must have been at a time antecedent to the submersion which produced the diluvium, since the bones are covered by a bed of that formation. It is impossible not to see here a very natural series of incidents. First, the cave is frequented by wild beasts, who make it a kind of charnel-house. Then, submerged in the current which has been spoken of, it receives a clay flooring from the waters containing that matter in suspension. Finally, raised from the water, but with no mouth to the open air, it remains unintruded on for a long series of ages, during which the clay flooring

receives a new calcareous covering, from the droppings of the roof. Dr. Buckland, who examined and described the Kirkdale cave, was at first of opinion that it presented a physical evidence of the Noachian deluge; but he afterwards saw reason to consider its phenomena as of a time far apart from that event, which rests on evidence of an entirely different kind.

Our attention is next drawn to the erratic blocks or boulders, which in many parts of the earth are thickly strewn over the surface, particularly in the north of Europe. Some of these blocks are many tons in weight, yet are clearly ascertained to have belonged originally to situations at a great distance. Fragments, for example, of the granite of Shap Fell are found in every direction around to the distance of fifty miles, one piece being placed high upon Criffel Mountain, on the opposite side of the Solway estuary; so also are fragments of the Alps found far up the slopes of the Jura. There are even blocks on the east coast of England, supposed to have travelled from Norway. The only rational conjecture which can be formed as to the transport of such masses from so great a distance, is one which presumes them to have been carried and dropped by icebergs, while the

space between their original and final sites was under ocean. Icebergs do even now carry off such masses from the polar coasts, which, falling when the retaining ice melts, must take up situations at the bottom of the sea analogous to those in which we find the erratic blocks of the present day.

As the diluvium and erratic blocks clearly suppose one last long submersion of the surface, (*last, geologically speaking,*) there is another set of appearances which as manifestly shew the steps by which the land was made afterwards to reappear. These consist of *terraces*, which have been detected near, and at some distance inland from, the coast lines of Scandinavia, Britain, America, and other regions; being evidently ancient beaches, or platforms, on which the margin of the sea at one time rested. They have been observed at different heights above the present sea-level, from twenty to above twelve hundred feet; and in many places they are seen rising above each other in succession, to the number of three, four, and even more. The smooth flatness of these terraces, with generally a slight inclination towards the sea, the sandy composition of many of them, and, in some instances, the preservation of marine shells in the ground, identify them perfectly with existing sea-

beaches, notwithstanding the cuts and scoopings which have every here and there been effected in them by water-courses. The irresistible inference from the phenomena is, that the highest was first the coast line; then an elevation took place, and the second highest became so, the first being now raised into the air and thrown inland. Then, upon another elevation, the sea began to form, at its new point of contact with the land, the third highest beach, and so on down to the platform nearest to the present sea-beach. Phenomena of this kind become comparatively familiar to us, when we hear of evidence that the last sixty feet of the elevation of Sweden, and the last eighty-five of that of Chili, have taken place since man first dwelt in those countries; nay, that the elevation of the former country goes on at this time at the rate of about forty-five inches in a century, and that a thousand miles of the Chilian coast rose four feet in one night, under the influence of a powerful earthquake, so lately as 1822. Subterranean forces, of the kind then exemplified in Chili, supply a ready explanation of the whole phenomena, though some other operating causes have been suggested. In an inquiry on this point, it becomes of consequence to learn some particulars respecting the



levels. Taking a particular beach, it is generally observed that the level continues the same along a considerable number of miles, and nothing like breaks or hitches has as yet been detected in any case. A second and a third beach are also observed to be exactly parallel to the first. These facts would seem to indicate quiet elevating movements, uniform over a large tract. It must, however, be remarked that the raised beaches at one part of a coast rarely coincide with those at another part forty or fifty miles off. We might suppose this to indicate a limit in that extent of the uniformity of the elevating cause, but it would be rash to conclude positively that such is the case. In the present sea, as is well known, there are different levels at different places, owing to the operation of peculiar local causes, as currents, evaporation, and the influx of large rivers into narrow-mouthed estuaries. The differences of level in the ancient beaches might be occasioned by some such causes. But, whatever doubt may rest on this minor point, enough has been ascertained to settle the main one, that we have in these platforms indubitable monuments of the last rise of the land from the sea, and the concluding great event of the geological history.

The idea of such a wide-spread and possibly

universal submersion unavoidably suggests some considerations as to the effect which it might have upon terrestrial animal life. It seems likely that this would be, on such an occasion, extensively, if not universally destroyed. Nor does the idea of its universal destruction seem the less plausible, when we remark, that none of the species of land animals heretofore discovered can be detected at a subsequent period. The whole seem to have been now changed. Some geologists appear much inclined to think that there was at this time a new development of terrestrial animal life upon the globe, and M. Agassiz, whose opinion on such a subject must always be worthy of attention, speaks all but decidedly for such a conclusion. It must, however, be owned, that proofs for it are still scanty, beyond the bare fact of a submersion which appears to have had a very wide range. I must therefore be content to leave this point, as far as geological evidence is concerned, for future affirmation.

There are some other superficial deposits, of less consequence on the present occasion than the diluvium—namely, lacustrine deposits, or filled-up lakes; alluvium, or the deposits of rivers beside their margins; deltas, the deposits made by great ones at their efflux into the sea; peat mosses; and

the vegetable soil. The animal remains found in these generally testify to a zoology on the verge of that which still exists, or melting into it, there being included many species which still exist. In a lacustrine deposit at Market-Weighton, in the Vale of York, there have been found bones of the elephant, rhinoceros, bison, wolf, horse, felis, deer, birds, all or nearly all extinct species; associated with thirteen species of land and fresh water shells, "exactly identical with types now living in the vicinity." In similar deposits in North America, are remains of the mammoth, mastodon, buffalo, and other animals of extinct and living types. In short, these superficial deposits shew precisely such remains as might be expected from a time at which the present system of things (to use a vague but not unexpressive phrase) obtained, but yet so far remote in chronology as to allow of the dropping of many species, through familiar causes, in the interval. Still, however, there is no authentic or satisfactory instance of human remains being found, except in deposits obviously of very modern date; a tolerably strong proof that the creation of our own species is a comparatively recent event, and one posterior (generally speaking) to all the great natural transactions chronicled by geology.