

ERA OF THE TERTIARY FORMATION.—  
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THE chalk-beds are the highest which extend over a considerable space ; but in hollows of these beds, comparatively limited in extent, there have been formed series of strata—clays, limestones, marls, alternating—to which the name of the *Tertiary Formation* has been applied. London and Paris alike rest on basins of this formation, and another such basin extends from near Winchester, under Southampton, and re-appears in the Isle of Wight. There is a patch, or fragment of the formation in one of the Hebrides. A stripe of it extends along the east coast of North America, from Massachusetts to Florida. It is also found in Sicily and Italy, insensibly blended with formations still in progress. Though comparatively a local formation,

it is not of the less importance as a record of the condition of the earth during a certain period. As in other formations, it is marked, in the most distant localities, by identity of organic remains.

The hollows filled by the tertiary formation must be considered as the beds of estuaries left at the conclusion of the cretaceous period. We have seen that an estuary, either by the drifting up of its mouth, or a change of level in that quarter, may be supposed to have become an inland sheet of water, and that, by another change, of the reverse kind, it may be supposed to have become an estuary again. Such changes the Paris basin appears to have undergone oftener than once, for, first, we have there a fresh-water formation of clay and limestone beds; then, a marine-limestone formation; next, a second fresh water formation, in which the material of the celebrated *plaster of Paris* (gypsum) is included; then, a second marine formation of sandy and limy beds; and finally, a third series of fresh-water strata. Such alternations occur in other examples of the tertiary formation likewise.

The tertiary beds present all but an entirely new set of animals, and as we ascend in the series, we find more and more of these identical with

species still existing upon earth, as if we had now reached the dawn of the present state of the zoology of our planet. By the study of the shells alone, Mr. Lyell has been enabled to divide the whole term into four sub-periods, to which he has given names with reference to the proportions which they respectively present of surviving species—first, the eocene, (from ἠως, the dawn; χαινος, recent;) second, the miocene, (μειων, less;) third, older pliocene, (πλειων, more;) fourth, newer pliocene.

#### EOCENE SUB-PERIOD.

The eocene period presents, in three continental groups, 1238 species of shells, of which forty-two, or 3·5 per cent, yet flourish. Some of these are remarkable enough; but they all sink into insignificance beside the mammalian remains which the lower eocene deposits of the Paris basin present to us, shewing that the land had now become the theatre of an extensive creation of the highest class of animals. Cuvier ascertained about fifty species of these, all of them long since extinct. A considerable number are *pachydermata*,\* of a

\* Thick-skinned animals. This term has been given by Cuvier to an order in which the hog, elephant, horse, and rhinoceros are included.

character approximating to the South American tapir: the names, palæotherium, anthracotherium, anoplotherium, lophiodon, &c., have been applied to them with a consideration of more or less conspicuous peculiarities; but a description of the first may give some general idea of the whole. It was about the size of a horse, but more squat and clumsy, and with a heavier head, and a lower jaw shorter than the upper; the feet, also, instead of hooves, presented three large toes, rounded, and unprovided with claws. These animals were all herbivorous. Amongst an immense number of others are found many new reptiles, some of them adapted for fresh water; species of birds allied to the sea-lark, curlew, quail, buzzard, owl, and pelican; species allied to the dormouse and squirrel; also the opossum and racoon; and species allied to the genette, fox, and wolf.

#### MIOCENE SUB-PERIOD.

In the miocene sub-period, the shells give eighteen per cent. of existing species, shewing a considerable advance from the preceding era, with respect to the inhabitants of the sea. The advance in the land animals is less marked, but yet considerable. The predominating forms are still pachy-

dermatous, and the tapir type continues to be conspicuous. One animal of this kind, called the *dinotherium*, is supposed to have been not less than eighteen feet long; it had a mole-like form of the shoulder-blade, conferring the power of digging for food, and a couple of tusks turning down from the lower jaw, by which it could have attached itself, like the walrus, to a shore or bank, while its body floated in the water. Dr. Buckland considers this and some similar miocene animals, as adapted for a semi-aquatic life, in a region where lakes abounded. Besides the tapirs, we have in this era animals allied to the glutton, the bear, the dog, the horse, the hog, and lastly, several felinæ, (creatures of which the lion is the type;) all of which are new forms, as far as we know. There was also an abundance of marine mammalia, seals, dolphins, lamantins, walruses, and whales, none of which had previously appeared.

#### PLIOCENE SUB-PERIOD.

The shells of the older pliocene give from thirty-five to fifty; those of the newer, from ninety to ninety-five per cent. of existing species. The pachydermata of the preceding era now disappear,

and are replaced by others belonging to still existing families—elephant, hippopotamus, rhinoceros—though now extinct as species. Some of these are startling, from their enormous magnitude. The great mastodon, whose remains are found in abundance in America, was a species of elephant, judged, from peculiarities of its teeth, to have lived on aquatic plants, and reaching the height of twelve feet. The mammoth was another elephant, but supposed to have survived till comparatively recent times, as a specimen, in all respects entire, was found in 1801, preserved in ice, in Siberia. We are more surprised by finding such gigantic proportions in an animal called the megatherium, which ranks in an order now assuming much humbler forms—the edentata—to which the sloth, ant-eater, and armadillo belong. The megatherium had a skeleton of enormous solidity, with an armour-clad body, and five toes, terminating in huge claws, wherewith to grasp the branches, from which, like its existing congener, the sloth, it derived its food. The megalonyx was a similar animal, only somewhat less than the preceding. Finally, the pliocene gives us for the first time, oxen, deer, camels, and other specimens of the *ruminantia*.

Such is an outline of the fauna of the tertiary era, as ascertained by the illustrious naturalists who first devoted their attention to it. It will be observed that it brings us up to the felinæ, or carnivora, a considerably elevated point in the animal scale, but still leaving a blank for the quadrumana (monkeys) and for man, who collectively form, as will be afterwards seen, the first group in that scale. It sometimes happens, however, as we have seen, that a few rare traces of a particular class of animals are in time found in formations originally thought to be destitute of them, displaying as it were a dawn of that department of creation. Such seems to be the case with at least the quadrumana. A jaw-bone and tooth of an animal of this order, and belonging to the genus macacus, were found in the London clay, (eocene,) at Kyson, near Woodbridge, in 1839. Another jaw-bone, containing several teeth, supposed to have belonged to a species of monkey about three feet high, was discovered about the same time in a stratum of marl surmounted by compact limestone, in the department of Gers, at the foot of the Pyrenees. Associated with this last were remains of not less than thirty mammiferous quadrupeds, including three species of rhinoceros, a large anoplotherium, three species

of deer, two antelopes, a true dog, a large cat, an animal like a weazel, a small hare, and a huge species of the edentata. Both of these places are considerably to the north of any region now inhabited by the monkey tribes. Fossil remains of quadrumana have been found in at least two other parts of the earth,—namely, the sub-Himalayan hills, near the Sutlej, and in Brazil, (both in the tertiary strata;) the first being a large species of *semnopithecus*, and the second, a still larger animal belonging to the American group of monkeys, but a new genus, and denominated by its discoverer, Dr. Lund, *protopithecus*. The latter would be four feet in height.

One remarkable circumstance connected with the tertiary formation remains to be noticed,—namely, the prevalence of volcanic action at that era. In Auvergne, in Catalonia, near Venice, and in the vicinity of Rome and Naples, lavas exactly resembling the produce of existing volcanoes, are associated and intermixed with the lacustrine as well as marine tertiaries. The superficies of tertiaries in England is disturbed by two great swells, forming what are called anticlinal axes, one of which divides the London from the Hampshire basin, while the other passes through



the Isle of Wight, both throwing the strata down at a violent inclination towards the north, as if the subterranean disturbing force had *waved* forward in that direction. The Pyrenees, too, and Alps, have both undergone elevation since the deposition of the tertiaries; and in Sicily there are mountains which have risen three thousand feet since the deposition of some of the most recent of these rocks. The general effect of these operations was of course to extend the land surface, and to increase the variety of its features, thus improving the natural drainage, and generally adapting the earth for the reception of higher classes of animals.