

CHAPTER XIII.

Effects produced by the action of animal and vegetable life on the material constituents of the earth's crust—Imbedding of organic remains in deposits on emerged land—Growth of Peat—Peat abundant in cold and humid climates—Site of many ancient forests in Europe now occupied by peat—Recent date of many of these changes—Sources of Bog Iron-ore—Preservation of animal substances in Peat—Causes of its antiseptic property—Miring of quadrupeds—Bursting of the Solway Moss—Bones of herbivorous quadrupeds found in peat—Imbedding of animal remains in Caves and Fissures—Formation of bony breccias—Human bones and pottery intermixed with the remains of extinct quadrupeds in caves in the South of France—Inferences deducible from such associations.

WE now come to the second subdivision of the inquiry explained in the preceding chapter,—the consideration of the permanent modifications produced in the material constituents of the earth's crust, by the action of animal and vegetable life.

New mineral compounds, such as might never have existed in this globe but for the action of the powers of vitality, are annually formed, and made to enter into deposits accumulated both above and beneath the waters. Although we can neither explain nor imitate the processes of animal and vegetable life whereby those substances are produced, yet we can investigate the laws by virtue of which organic matter becomes imbedded in new strata,—sometimes imparting to them a peculiar mineral composition,—sometimes leaving durable impressions and casts of the forms of animate beings in rocks, so as to modify their structure and appearance.

It has been well remarked by M. Constant Prevost, that the effects of geological causes are divisible into two great classes; those produced on the surface during the immersion of land beneath the waters, and those which take place after its emersion. Agreeably to this classification we shall consider, first, in what manner animal and vegetable remains become included and preserved in solid deposits on emerged land, or that part

of the surface which is not *permanently* covered by water, whether of the sea or lakes; secondly, the manner in which organic remains become imbedded in sub-aqueous deposits.

Under the first division we shall treat of the following topics:—1st, the growth of peat, and the preservation of vegetable and animal remains therein;—2ndly, the preservation of animal remains in stalactite, and in the mud of caves and fissures;—3dly, the burying of organic remains in alluvium and the ruins of land-slips;—4thly, of the same in blown sand;—5thly, of the same in volcanic ejections, and alluvions composed of volcanic productions.

*The growth of Peat and the preservation of Vegetable and
Animal Remains therein.*

THE generation of peat, when not completely under water, is confined to moist situations, where the temperature is low, and where vegetables may decompose without putrifying. It may consist of any of the numerous plants which are capable of growing in such *stations*: but a species of moss (*sphagnum palustre*) constitutes a considerable part of the peat found in marshes of the north of Europe; this plant having the property of throwing up new shoots in its upper part, while its lower extremities are decaying*. Reeds, rushes, and other aquatic plants may usually be traced in peat, and their organization is often so entire, that there is no difficulty in discriminating the distinct species.

In general, says Sir H. Davy, one hundred parts of dry peat contain from sixty to ninety-nine parts of matter destructible by fire, and the residuum consists of earths usually of the same kind as the substratum of clay, marl, gravel, or rock on which they are found, together with oxide of iron. “The peat of the chalk counties of England,” observes the same writer, “contains much gypsum; but I have found very little in any

* For a catalogue of the plants which contribute to the generation of peat, see Dr. Rennie on Peat, p. 171—178. Dr. Macculloch’s *Western Isles*, vol. i. p. 129.

specimens from Ireland or Scotland, and in general these peats contain very little saline matter*." From the researches of Dr. Macculloch, it appears that peat is intermediate between simple vegetable matter and lignite, the conversion of peat to lignite being gradual, and being brought about in a great lapse of time by the prolonged action of water †.

Peat is sometimes formed on a declivity in mountainous regions where there is much moisture, but in such situations it rarely if ever exceeds four feet in thickness. In bogs, and in low grounds into which alluvial peat is drifted, it is found forty feet thick and upwards, but in such cases it generally owes one-half of its volume to the water which it contains. It has seldom, if ever, been discovered within the tropics, and it rarely occurs in the valleys even in the south of France and Spain. It abounds more and more in proportion as we advance farther from the equator, and becomes not only more frequent but more inflammable in northern latitudes ‡; the cause of which may probably be that the carbonic acid and hydrogen, which are the most inflammable parts, do not readily assume the gaseous form in a cold atmosphere.

There is a vast extent of surface in Europe covered with peat, which in Ireland is said to extend over a tenth of the whole island. One of the mosses on the Shannon is described by Dr. Boates to be fifty miles long, by two or three broad; and the great marsh of Montoire, near the mouth of the Loire, is mentioned by Blavier as being more than fifty leagues in circumference. It is a curious and well-ascertained fact that many of these mosses of the north of Europe occupy the place of immense forests of pine and oak, which have many of them disappeared within the historical era. Such changes are brought about by the fall of trees and the stagnation of water, caused by their trunks and branches obstructing the free drainage of the atmospheric waters, and giving rise to a marsh. In a warm climate such decayed timber would immediately be

* Irish Bog Reports, p. 209.

† System of Geology, vol. ii. p. 353.

‡ Rev. Dr. Rennie, *ibid.* p. 260.

removed by insects, or by putrefaction ; but, in the cold temperature now prevailing in our latitudes, many examples are recorded of marshes originating in this source. Thus, in Mar forest, in Aberdeenshire, large trunks of Scotch fir, which had fallen from age and decay, were soon immured in peat formed partly out of their perishing leaves and branches, and in part from the growth of other plants. We also learn that the overthrow of a forest by a storm, about the middle of the seventeenth century, gave rise to a peat moss, near Lochbroom, in Ross-shire, where, in less than half a century after the fall of the trees, the inhabitants dug peat*. Dr. Walker mentions a similar change when, in the year 1756, the whole wood of Drumlanrig was overset by the wind. Such events explain the occurrence, both in Britain and on the continent, of mosses where the trees are all broken within two or three feet of the original surface, and where their trunks all lie in the same direction †.

Nothing is more common than the occurrence of buried trees at the bottom of the Irish peat-mosses, as also in most of those of England, France, and Holland ; and they have been so often observed with parts of their trunks standing erect, and with their roots fixed to the sub-soil, that no doubt can be entertained of their having generally grown on the spot. They consist for the most part of the fir, the oak, and the birch ; where the sub-soil is clay, the remains of oak are the most abundant ; where sand is the substratum, fir prevails. In the marsh of Curragh, in the Isle of Man, vast trees are discovered standing firm on their roots, though at the depth of eighteen or twenty feet below the surface. Some naturalists have desired to refer the imbedding of timber in peat mosses to aqueous transportation, since rivers are well known to float wood into lakes ; but the facts above mentioned show that, in numerous instances, such an hypothesis is inadmissible. It has moreover been observed that in Scotland, as also in many parts of the continent, the largest trees are found in those peat mosses

* Dr. Rennie's *Essays*, p. 65.

† *Ibid.* p. 30.

which lie in the least elevated regions, and that the trees are proportionably smaller in those which lie at higher levels; from which fact De Luc and Walker have both inferred that the trees grew on the spot, for they would naturally attain a greater size in lower and warmer levels. The leaves also, and fruits of each species, are continually found immersed in the moss along with the parent trees, as, for example, the leaves and acorns of the oak, the cones and leaves of the fir, and the nuts of the hazel.

Sometimes, in the same bog, a stratification is observed of different kinds of wood, oak being found in the lowermost stratum, and birch and hazel in a second bed above. Sometimes still higher, a stratum, containing alder with the twigs of the bog myrtle (*Myrica galæ*), have been found*; the succession of strata, in this instance, indicating a gradual conversion of a dry tract into a swamp, and lastly a peat-moss.

The durability of pine-wood, which in the Scotch peat-mosses exceeds that of the birch and oak, is due to the great quantity of turpentine which it contains, and which is so abundant that the fir-wood from bogs is used by the country people, in parts of Scotland, in the place of candles. Such resinous plants, observes Dr. Macculloch, as fir, would produce a fatter coal than oak, because the resin itself is converted into bitumen †.

In Hatfield-moss, which appears clearly to have been a forest eighteen hundred years ago, fir-trees have been found ninety feet long, and sold for masts and keels of ships; oaks have also been discovered there above one hundred feet long. The dimensions of an oak from this moss are given in the Philosophical Transactions, No. 275, which must have been larger than any tree now existing in the British dominions.

In the same moss of Hatfield, as well as in that of Kincardine and several others, Roman roads have been found covered to the depth of eight feet by peat. All the coins, axes, arms, and other utensils found in British and French mosses, are also Roman; so that a considerable portion of the European peat-

* Lib. Ent. Know., Timber Trees, p. 32. † Syst. of Geol., vol. ii., p. 356.

bogs are evidently not more ancient than the age of Julius Cæsar. Nor can any vestiges of the ancient forests described by that general, along the line of the great Roman way in Britain, be discovered, except in the ruined trunks of trees in peat.

De Luc ascertained that the very site of the aboriginal forests of Hircinia, Semana, Ardennes, and several others, are now occupied by mosses and fens; and a great part of these changes have, with much probability, been attributed to the strict orders given by Severus, and other emperors, to destroy all the wood in the conquered provinces. Several of the British forests, however, which are now mosses, were cut at different periods by order of the English parliament, because they harboured wolves or outlaws. Thus the Welsh woods were cut and burnt in the reign of Edward I.; as were many of those in Ireland by Henry II., to prevent the natives from harbouring in them and harassing his troops.

It is curious to reflect, that considerable tracts have by these accidents been permanently sterilized, and that during a period when civilization has been making great progress, large areas in Europe have, by human agency, been rendered less capable of administering to the wants of man. Rennie observes with truth, that in those regions alone which the Roman eagle never reached—in the remote circles of the German empire, in Poland and Prussia, and still more in Norway, Sweden, and the vast empire of Russia—can we see what Europe was before it yielded to the power of Rome*. Desolation now reigns where stately forests of pine and oak once flourished, such as might now have supplied all the navies of Europe with timber.

At the bottom of peat mosses there is sometimes found a cake, or "pan," as it is termed, of oxide of iron, and the frequency of bog iron-ore is familiar to the mineralogist. The oak which is so often found dyed black in peat, owes its colour to the same metal. From what source the iron is derived is by no

* *Essays, &c.*, p. 74.

means obvious, since we cannot in all cases suppose that it has been precipitated from the waters of mineral springs. According to Fourcroy there is iron in all compact wood, and it is the cause of one-twelfth part of the weight of oak. The heaths (*Ericæ*) which flourish in a sandy, ferruginous soil, are said to contain more iron than any other vegetable.

It has been suggested that iron, being soluble in acids, may be diffused through the whole mass of vegetables, when they decay in a bog, and may, by its superior specific gravity, sink to the bottom, and be there precipitated, so as to form bog iron-ore; or where there is a subsoil of sand or gravel, it may cement them into ironstone or ferruginous conglomerate*.

One interesting circumstance attending the history of peat-mosses is the high state of preservation of animal substances buried in them for periods of many years. In June, 1747, the body of a woman was found six feet deep, in a peat-moor in the Isle of Axholm, in Lincolnshire. The antique sandals on her feet afforded evidence of her having been buried there for many ages; yet her nails, hair, and skin, are described as having shown hardly any marks of decay. In a turbarry on the estate of the Earl of Moira, in Ireland, a human body was dug up, a foot deep in gravel, covered with eleven feet of moss; the body was completely clothed, and the garments seemed all to be made of hair. Before the use of wool was known in that country, the clothing of the inhabitants was made of hair, so that it would appear that this body had been buried at that early period; yet it was fresh and unimpaired †. In the Philosophical Transactions, we find an example recorded of the bodies of two persons having been buried in moist peat, in Derbyshire, in 1674, about a yard deep, which were examined twenty-eight years and nine months afterwards; “the colour of their skin was fair and natural, their flesh soft as that of persons newly dead ‡.”

* Dr. Rennie, *Essays, &c.*, p. 347.

† *Ib.* p. 521, where several other instances are referred to.

‡ *Phil. Trans.*, vol. xxxviii., 1734.

Among other analogous facts we may mention, that in digging a pit for a well near Dulverton, in Somersetshire, many pigs were found in various postures, still entire. Their shape was well preserved, the skin, which retained the hair, having assumed a dry, membranous appearance. Their whole substance was converted into a white, friable, laminated, inodorous, and tasteless substance; but which, when exposed to heat, emitted an odour precisely similar to broiled bacon*.

We naturally ask whence peat derives this antiseptic property? It has been attributed by some to the carbonic and gallic acids which issue from decayed wood, as also to the presence of charred wood in the lowest strata of many peat-mosses, for charcoal is a powerful antiseptic, and capable of purifying water already putrid. Vegetable gums and resins also may operate in the same way †.

The tannin occasionally present in peat is the produce, says Dr. Macculloch, of tormentilla, and some other plants, but the quantity he thinks too small, and its occurrence too casual, to give rise to effects of any importance. He hints that the soft parts of animal bodies, preserved in peat-bogs, may have been converted into adipocire by the action of water merely; an explanation which appears clearly applicable to some of the cases above enumerated ‡.

The manner, however, in which peat contributes to preserve, for indefinite periods, the harder parts of terrestrial animals, is a subject of more immediate interest to the geologist. There are two ways in which animals become occasionally buried in the peat of marshy grounds; they either sink down into the semifluid mud, underlying a turfy surface, upon which they have rashly ventured, or, at other times, a bog "bursts," in the manner described in a preceding chapter, and animals may be involved in the peaty alluvium.

In the extensive bogs of Newfoundland, cattle are sometimes found buried with their heads only and neck above ground,

* Dr. Rennie, *Essays, &c.*, p. 521.

† *Ibid.*, p. 531.

‡ *Syst. of Geol.*, vol. ii., pp. 340—346.

and after having remained for days in this situation, they have been drawn out by ropes and saved. In Scotland, also, cattle venturing on the “quaking moss” are often mired, or “laired,” as it is termed; and in Ireland, Mr. King asserts that the number of cattle which are lost in sloughs is quite incredible*.

The description given of the Solway moss will serve to illustrate the general character of these boggy grounds. That moss, observes Gilpin, is a flat area, about seven miles in circumference, situated on the confines of England and Scotland. Its surface is covered with grass and rushes, presenting a dry crust and a fair appearance; but it shakes under the least pressure, the bottom being unsound and semifluid. The adventurous passenger, therefore, who sometimes in dry seasons traverses this perilous waste, to save a few miles, picks his cautious way over the rushy tussocks as they appear before him, for here the soil is firmest. If his foot slip, or if he venture to desert this mark of security, it is possible he may never more be heard of.

“At the battle of Solway, in the time of Henry VIII. (1542), when the Scotch army, commanded by Oliver Sinclair, was routed, an unfortunate troop of horse, driven by their fears, plunged into this morass, which instantly closed upon them. The tale was traditional, but it is now authenticated; a man and horse, in complete armour, having been found by peat-diggers, in the place where it was always supposed the affair had happened. The skeleton of each was well preserved, and the different parts of the armour easily distinguished †.”

This same moss, on the 16th of December, 1772, having been filled with water during heavy rains, rose to an unusual height and then burst. A stream of black half-consolidated mud began at first to creep over the plain, resembling, in the rate of its progress, an ordinary lava current. No lives were lost, but the deluge totally overwhelmed some cottages, and

* Phil. Trans., vol. xv., p. 949.

† Observations on Picturesque Beauty, &c., 1772.

covered four hundred acres. The highest parts of the original moss subsided to the depth of about twenty-five feet, and the height of the moss, on the lowest parts of the country which it invaded, was at least fifteen feet.

A recent inundation in Sligo (January, 1831) affords another example of this phenomenon. After a sudden thaw of snow the bog between Bloomfield and Geevah gave way, and a black deluge, carrying with it the contents of a hundred acres of bog, took the direction of a small stream, and rolled on with the violence of a torrent, sweeping along heath, timber, mud, and stones, and overwhelming many meadows and arable land. On passing through some boggy land the flood swept out a wide and deep ravine, and part of the road leading from Bloomfield to St. James's Well was completely carried away from below the foundation for the breadth of two hundred yards.

The antlers of large and full-grown stags are amongst the most common and conspicuous remains of animals in peat. They are not horns which have been shed, for portions of the skull are found attached, proving that the whole animal perished. Bones of the ox, hog, horse, sheep, and other herbivorous animals, also occur; and in Ireland and the Isle of Man, skeletons of a gigantic elk; but no remains have been met with belonging to those extinct quadrupeds of which the living congeners inhabit warmer latitudes, such as the elephant, rhinoceros, hippopotamus, hyæna, and tiger, though these are so common in superficial deposits of silt, mud, sand, or stalactite, in various localities throughout Great Britain. Their absence seems to imply that they had ceased to live before the atmosphere of this part of the world acquired that cold and humid character which favours the growth of peat.

From the facts before mentioned, that mosses occasionally burst, and descend in a fluid state to lower levels, it will readily be seen that lakes and arms of the sea may occasionally become the receptacles of drift-peat. Of this accordingly there are numerous examples, and hence the alternations of

clay and sand with different deposits of peat so frequent on some coasts, as on those of the Baltic and German Ocean. We are informed by Deguer that remains of ships, nautical instruments, and oars, have been found in many of the Dutch mosses; and Gerard, in his History of the Valley of the Somme, mentions that in the lowest tier of that moss was found a boat loaded with bricks, proving that these mosses were at one period navigable lakes and arms of the sea, as were also many mosses on the coast of Picardy, Zealand, and Friesland, from which soda and salt are procured*. The canoes, stone hatchets, and stone arrow-heads, found in peat in different parts of Great Britain, lead to similar conclusions,—but these will more properly be considered when we treat of subaqueous phenomena.

Imbedding of Animal Remains in the Stalactite and Mud of Caves and Fissures.

WE explained in the former volume how vast fissures have been formed from time to time by earthquakes, and suggested that the continual percolation of acidulous waters through rocks of limestone might have enlarged these fissures into caverns. We shall now consider in what manner the remains of animals may become preserved in rents and cavities, confining ourselves at present to the monuments of events which are known or can be inferred to have happened within the human era.

As the same caves and fissures may remain open throughout periods of indefinite duration, and may become the receptacles of the remains of species inhabiting a country at very different epochs, it requires the utmost care to avoid confounding together the monuments of occurrences of very distinct dates. Dr. Buckland, in his indefatigable researches into this class of phenomena, has often guarded with great skill against such anachronisms, pointing out the comparatively recent preser-

* Rennie on Peat Moss, p. 205.

vation of some organic relics which have become mingled in a common tomb with those of older date.

Fissures are very common in calcareous rocks, and these are usually, in the course of ages, filled up in part by small angular fragments of limestone, which scale off under the influence of frost and rain. Vegetable earth and land-shells are washed in at the same time, and the whole mass often becomes cemented together by calcareous matter dissolved by rain-water, or supplied by mineral springs. In an uncultivated country the edges of such fissures are usually overgrown with bushes, so that herbivorous animals, especially when chased by beasts of prey, or when carelessly browsing on the shrubs, are liable to fall in and perish. Of this kind is a fissure still open in Duncombe Park, in Yorkshire, where the skeletons of dogs, sheep, goats, deer, and hogs, have been found, lodged upon different ledges that occur at various depths in a rent of the rock descending obliquely downwards*.

Above the village of Selside, near Ingleborough in Yorkshire, a chasm of enormous but unknown depth occurs in the scar-limestone, a member of the carboniferous series. "The chasm," says Professor Sedgwick, "is surrounded by grassy shelving banks, and many animals, tempted towards its brink, have fallen down and perished in it. The approach of cattle is now prevented by a strong lofty wall, but there can be no doubt that, during the last two or three thousand years, great masses of bony breccia must have accumulated in the lower parts of the great fissure, which probably descends through the whole thickness of the scar-limestone, to the depth of perhaps five or six hundred feet †."

A fissure in the limestone of the Coiron, in France, is seen on the high road between Aubenas and Ville-Dieu, filled with a breccia, consisting of angular fragments of the rock and land-shells cemented together. The mode of its formation is

* Buckland, *Reliquiæ Diluvianæ*, p. 55.

† Memoir on the Structure of the Lake Mountains of the North of England, &c., read before the Geological Society, January 5, 1831.

admirably illustrated by the rapid growth of a similar deposit not far distant. At the pass of Escrinet, on the northern escarpment of the Coiron hills, near Aubenas, a tabular mass of limestone is seen disintegrating into innumerable angular fragments, which are transported by the rain to the foot of the declivity, where they have accumulated at one spot, in a talus fifty feet in thickness and five hundred yards wide. The upper part is composed for the most part of loose fragments, on which numerous land-shells are seen living; the lower portion is consolidated by stalagmite into a compact mass which serves for mill-stones. The calcareous cement has a red tinge, but not of so deep a colour as most of the Mediterranean breccias*.

By the decomposition of the calcareous rocks near Nice, a soil is produced of a blood-red colour; and red breccias, consisting of fragments of rock and land-shells cemented together, are continually forming. If the mountains here were rent by earthquakes, we might expect the fissures to be gradually filled with red breccias like those of higher antiquity so celebrated in many parts of the Mediterranean.

It often happens that fissures communicate with subterranean caverns, a fact somewhat confirmatory of the views of those geologists who attribute the origin of limestone caverns in great part to the movements and dislocations of the strata. In this case the fissure may serve for ages as a natural pit-fall to animals passing by, and their bones, with all the earth, sand, and fragments of rock that fall through these passages, may be washed down or subside by their own weight, so as to reach the cavern below where thick deposits may be amassed.

Oftentimes when the bones of animals are strewed along the bottom of fissures or caves which they may have inhabited, they become covered over with mud introduced by land-floods, and are thus preserved from decomposition. Thus on the floor of many caverns mentioned by Dr. Buckland, in the Mendip Hills and Derbyshire, sedimentary mud has been left in recent times during floods.

* I examined this spot in the year 1828, accompanied by Mr. Murchison.

The same author observed in every cave examined by him in Germany, a deposit of mud or sand, sometimes with, and sometimes without, an intermixture of rolled pebbles and angular fragments of rock, and having its surface covered over with a *single* crust of stalagmite *. In the English caves he remarked a similar absence of *alternations* of alluvium and stalagmite. On the banks of the Meuse, however, at Chockier, about two leagues from Liège, a cavern has been recently discovered where there are three distinct beds of stalagmite, between each of which occur breccia and mud, mixed with some quartz pebbles, and the bones of extinct quadrupeds †.

But this exception does not invalidate the generality of the phenomenon observed by the Professor, and of which we have as yet seen no satisfactory explanation. The principal cause we suspect to be, that if several floods pass at different intervals of time through any subterranean passage, the last, if it has power to drift along fragments of rock, will also tear up any alternating stalagmitic and alluvial beds that may happen to have been previously formed. Another cause may be, that in a country in which torrents and rivers are gradually deepening their channels, and cutting through masses of cavernous limestone (an excavating process which is most rapid during epochs of subterranean disturbance, when the levels of a district are altered), it will only happen once that the stream will break into hollows or fissures communicating with a certain series of caverns. When the erosive action has proceeded farther, and the river has sunk to a greater depth, the drainage of the country will be effected in a valley at a level inferior to that of the caves, and consequently no transported matter will afterwards be introduced into them.

In the cave of Paviland, called Goat's Hole, on the coast of Glamorganshire, besides the bones of many extinct animals which occur in a mass of loam, a modern breccia has been formed, consisting of earth cemented by stalagmite, and con-

* Rel. Dil. p. 108.

† Journ. de Géologie, tome i. p. 286. July, 1830.

taining marine-shells and birds' bones, all of recent species. The mouth of this cave is from thirty to forty feet above high-water mark, being situated in a lofty cliff of limestone, facing the estuary of the Severn, the waves of which, during great storms, occasionally dash into it. The left side of a human skeleton was also found here under a cover of six inches of earth. In a cavernous aperture leading from the roof of this cave to the face of the cliff was discovered a bed of brown earth, apparently derived from dust driven in continually by the wind; and in this earth were the bones of various birds, of moles, water-rats, mice, and fish, and a few land-shells, all clearly the remains of modern animals. Their presence in this almost inaccessible spot can only be explained, says Dr. Buckland, "by referring the bones of birds, moles, rats, and mice, to the agency of hawks, and the fish-bones to that of sea-gulls. The land-shells, which are such as live at present on the rock without, may easily have fallen in. Had there been any stalagmite uniting these bones into a breccia, they would have afforded a perfect analogy to the accumulation of modern birds' bones, by the agency of hawks, at Gibraltar*."

The formation last alluded to occurs in perpendicular fissures at the north extremity of the rock of Gibraltar, where a reddish calcareous earth, containing numerous bones of small birds, is in the act of accumulating. Around these fissures a number of hawks nestle and rear their young in the breeding-season, and the bones are the remains of their food. Major Imrie mentions also a concretion in the rocks below King's Lines, Gibraltar, consisting of pebbles of the prevailing calcareous rock, wherein, at a considerable depth under the surface, part of a green glass bottle was found imbedded †.

In a cave of mountain-limestone at Burringdon, in the Mendip Hills, supposed to have been once used as a place of sepulture or refuge, human bones have been met with, encrusted with stalactite, one of the skulls being filled with this

* Buckland, *Reliquiæ Diluvianæ*, p. 93.

† *Ib.* p. 156.

substance in the interior *. The state of the bones, says Dr. Buckland, affords indications of very high antiquity.

The remains of human skeletons have been also found in the cave of Wokey Hole, near Wells, in the Mendips, dispersed through reddish mud and clay, and some of them united by stalagmite into a firm osseous breccia. "The spot on which they lie is within reach of the highest floods of the adjacent river, and the mud in which they are buried is evidently fluvatile †."

We shall conclude with alluding to some caverns recently examined in the south of France, in which human bones and fragments of pottery are described as intermingled in the same deposits with the remains of extinct mammalia. We may first mention the cavern of Bize, in the department of Aude, where M. Marcel de Serres met with a small number of human bones mixed with those of extinct animals and with land-shells. They occur in a calcareous stony mass, bound together by a cement of stalagmite. On examining the same caverns, M. Tournal found not only in these calcareous beds, but also in a black mud which overlies a red osseous mud, several human teeth, together with broken angular fragments of a rude kind of pottery, and also marine and terrestrial shells of our own epoch. The teeth preserve their enamel, but the fangs are so much altered as to adhere strongly to the tongue. Of the terrestrial shells thus associated with the bones and pottery, the most common are *Cyclostoma elegans*, *Bulimus decollatus*, *Helix nemoralis* and *H. nitida*. Among the marine are found *Pecten jacobæus*, *Mytilus edulis*, and *Natica mille-punctata*, all of them eatable kinds. Bones of quadrupeds were found in the same mass belonging to three new species of the deer kind, an extinct bear (*Ursus arctoides*), besides the wild bull (*Bos urus*), formerly a native of Germany ‡.

In the same part of France, M. de Christol has found in

* Buckland, *Reliquiæ*, p. 164.

† *Ib.* p. 165.

‡ M. Marcel de Serres, *Géognosie des Terrains Tertiaires*, p. 64. Introduction.

caverns in a tertiary limestone at Pondres and Souvignargues, situated two leagues north of Lunel-viel, (department of Herault,) human bones and pottery confusedly mixed with the remains of the rhinoceros, bear, hyæna, and many other terrestrial mammals. They were imbedded in an alluvial mud, of the solidity of calcareous tufa, and containing some flint pebbles and fragments of the limestone of the country. Beneath this mixed accumulation, which sometimes attained a thickness of thirteen feet, is the original floor of the cavern, about a foot thick, covered with bones and the dung of animals (*album græcum*), in a sandy and tufaceous cement.

The human bones in these caverns of Pondres and Souvignargues were found, upon a careful analysis, to have parted with their animal matter to as great a degree as those of the hyæna which accompany them, and are equally brittle, and adhere as strongly to the tongue.

In order to compare the degree of alteration of these bones with those known to be of high antiquity, M. Marcel de Serres, and M. Ballard, Chemist of Montpellier, procured some from a Gaulish sarcophagus in the plain of Lunel, supposed to have been buried for fourteen or fifteen centuries at least. In these the cellular tissue was empty, but they were more solid than fresh bones. They did not adhere to the tongue in the same manner as those of the caverns of Bize and Pondres, yet they had lost at least three-fourths of their original animal matter.

The superior solidity of the Gaulish bones to those in a fresh skeleton is a fact in perfect accordance with the observations made by Mr. Mantell on bones taken from a Saxon tumulus, near Lewes.

Let us now consider what conclusions are deducible from the important facts above enumerated. Must we infer that man and these extinct quadrupeds were contemporaneous inhabitants of the south of France at some former epoch? We should unquestionably have arrived at this conclusion if the bones had been found in an undisturbed *stratified* deposit of

subaqueous origin, especially if it contained shells in regular layers like that of North-Cliff in Yorkshire, described by Mr. Vernon, from which we learn that the mammoth coexisted with thirteen species of our living British land and fresh-water testacea*. But we must hesitate before we draw analogous inferences from evidences so equivocal as that afforded by the mud, stalagmites and breccias of caves, where the signs of *successive* deposition are wanting.

No one will maintain that man, the hyæna, and the bear, were at once joint tenants of these caverns; and if it be necessary to assume that the mud and pebbles were washed into their present position by floods, the same inundations might possibly have caught up the bones lying in more ancient deposits, and thus have mingled the whole together in the same mass.

More than ordinary caution is required in reasoning on the occurrence of human remains and works of art in alluvial deposits, since the chances of error are much greater than when we have the fossil bones of the inferior animals only under consideration. For the floor of caves has usually been disturbed by the aboriginal inhabitants of each country, who have used such retreats for dwelling places, or for concealment, or sepulture. In such spots have treasures been often buried in periods of disturbance, or diligently sought for in times of tranquillity. The excavations made in Sicily for treasure-trove, in places where no money was ever buried, are believed to exceed in number all the spots in which coin was ever hid during the wars between the Saracens and Christians.

Dr. Buckland, in speaking of the cave of Paviland, before mentioned, states that the entire mass through which the bones were dispersed, appeared to have been disturbed by ancient diggings, so that the remains of extinct animals had, in that instance, actually become mixed with the recent bones and shells. In the same cave he found a human skeleton, and the remains of recent testacea of eatable species, which may have

* See ante, vol. i. p. 96.

been carried in by man. The same observation is applicable to the marine testacea of the cavern of Bize, and we suspect the whole phenomena to be very analogous.

To decide whether certain relics have been introduced by man, or natural causes, into masses of transported materials, must almost always be a task of some difficulty, especially where all the substances, organic and inorganic, have been mixed together and consolidated into one breccia; a change soon effected by the percolation of water charged with carbonate of lime. It is not on such evidence that we shall readily be induced to admit either the high antiquity of the human race, or the recent date of certain lost species of quadrupeds.