GEOLOGY.

Introductory Address by the President, Sir C. Lyell.

On the Occurrence of Works of Human Art in Post-pliocene Deposits. *By* Sir Charles Lyell, *LL.D., D.C.L., F.R.S.*

No subject has lately excited more curiosity and general interest among geologists and the public than the question of the antiquity of the human race; whether or no we have sufficient evidence to prove the former co-existence of man with certain extinct mammalia, in caves or in the superficial deposits commonly called drift or "diluvium." For the last quarter of a century, the occasional occurrence, in various parts of Europe, of the bones of man or the works of his hands, in cave-breccias and stalactites associated with the remains of the extinct hyæna, bear, elephant, or rhinoceros, has given rise to a suspicion that the date of man must be carried further back than we had heretofore imagined. On the other hand, extreme reluctance was naturally felt on the part of scientific reasoners to admit the validity of such evidence, seeing that so many caves have been inhabited by a succession of tenants, and have been selected by man, as a place not only of domicile, but of sepulture, while some caves have also served as the channels through which the waters of flooded rivers have flowed, so that the remains of living beings which have peopled the district at more than one era may have subsequently been mingled in such caverns and confounded together in one and the same deposit. The facts, however, recently brought to light during the systematic investigation, as reported on by Falconer, of the Brixham Cave, must, I think, have prepared you to admit that scepticism in regard to the cave-evidence in favour of the antiquity of man had previously been pushed to an extreme. To escape from what I now consider was a legitimate deduction from the facts already accumulated, we were obliged to resort to hypotheses requiring great changes in the relative levels and drainage of valleys, and, in short, the whole physical geography of the respective regions where the caves are situated—changes that would alone imply a remote antiquity for the human fossil remains, and make it probable that man was old enough to have co-existed, at least, with the Siberian mammoth.

But, in the course of the last fifteen years, another class of proofs have been advanced, in France, in confirmation of man's antiquity, into two of which I have personally examined in the course of the present summer, and to which I shall now briefly advert. First, so long ago as the year 1844, M. Aymard, an eminent palæontologist and antiquary, published an account of the discovery in the volcanic district of Central France, of portions of two human skeletons (the skulls, teeth, and bones), imbedded in a volcanic breccia, found in the mountain of Denise, in the environs of Le Puy en Velay, a breccia anterior in date to one, at least, of the latest eruptions of that volcanic mountain. On the opposite side of the same hill, the remains of a large number of mammalia, most of them of extinct species, have been detected in tufaceous strata, believed, and I think correctly, to be of the same age. The authenticity of the human fossils was from the first disputed by several geologists, but admitted by the majority of those who visited Le Puy and saw, with their own eyes, the original specimen now in the museum of that town. Among others, M. Pictet, so well known to you by his excellent work on Palæontology, declared after his visit to the spot his adhesion to the opinions previously expressed by Aymard. My friend, Mr. Scrope, in the second edition of his 'Volcanoes of Central France,' lately published, also adopted the same conclusion, although, after accompanying me this year to Le Puy, he has seen reason to modify his views. The result of our joint examination,—a result which, I believe, essentially coincides with that arrived at by MM. Hébert and Lartet, (names well known to science,) who have also this year gone into this inquiry on the spot,—may thus be stated. We are by no means prepared to maintain that the specimen in the museum at Le Puy (which unfortunately was never seen *in situ* by any scientific observer) is a fabrication. On the contrary, we incline to believe that the human fossils in this and some other specimens from the same hill, were really imbedded

by natural causes in their present matrix. But the rock in which they are entombed consists of two parts, one of which is a compact, and for the most part thinly laminated stone, into which none of the human bones penetrate; the other containing the bones is a lighter and much more porous stone, without lamination, to which we could find nothing similar in the mountain of Denise, although both M. Hébert and I made several excavations on the alleged site of the fossils. M. Hébert therefore suggested to me that this more porous stone, which resembles in colour and mineral composition, though not in structure, parts of the genuine old breccia of Denise, may be made up of the older rock broken up and afterwards redeposited, or as the French say, *remanié*, and therefore, of much newer date, an hypothesis which well deserves consideration; but I feel that we are at present so ignorant of the precise circumstances and position under which these celebrated human fossils were found, that I ought not to waste time in speculating on their probable mode of interment, but simply state that, in my opinion, they afford no demonstration of man having witnessed the last volcanic eruptions of Central France. The skulls, according to the judgment of the most competent osteologists who have yet seen them, do not seem to depart in a marked manner from the modern European, or Caucasian type; and the human bones are in a fresher state than those of the *Elephas meridionalis* and other quadrupeds found in any breccia of Denise which can be referred to the period even of the latest volcanic eruptions.

But while I have thus failed to obtain satisfactory evidence in favour of the remote origin assigned to the human fossils of Le Puy, I am fully prepared to corroborate the conclusions which have been recently laid before the Royal Society by Mr. Prestwich, in regard to the age of the flint implements associated in undisturbed gravel, in the north of France, with the bones of elephants, at Abbeville and Amiens. These were first noticed at Abbeville, and their true geological position assigned to them by M. Boucher de Perthes, in 1847, in his 'Antiquités Celtiques,' while those of Amiens were afterwards described in 1854, by the late Dr. Rigollot. For a clear statement of the facts, I may refer you to the abstract of Mr. Prestwich's Memoir in the Proceedings of the Royal Society for 1859, and have only to add that I have myself obtained abundance of flint implements (some of which are laid upon the table) during a short visit to Amiens and Abbeville. Two of the worked flints of Amiens were discovered in the gravel-pits of St.-Acheul—one at the depth of 10, and the other of 17 feet below the surface, at the time of my visit; and M. Georges Pouchet, of Rouen, author of a work on the Races of Man, who has since visited the spot, has extracted with his own hands one of these implements, as Messrs. Prestwich and Flower had done before him. The stratified gravel resting immediately on the chalk in which these rudely fashioned instruments are buried, belongs to the post-pliocene period, all the freshwater and land shells which accompany them being of existing species. The great number of the fossil instruments which have been likened to hatchets, spear-heads, and wedges is truly wonderful. More than a thousand of them have already been met with in the last ten years, in the valley of the Somme, in an area 15 miles in length. I infer that a tribe of savages, to whom the use of iron was unknown, made a long sojourn in this region; and I am reminded of a large Indian mound, which I saw in St. Simon's Island, in Georgia—a mound 10 acres in area, and having an average height of 5 feet, chiefly composed of cast-away oyster shells, throughout which arrow-heads, stone-axes, and Indian pottery are dispersed. If the neighbouring river, the Alatamaha, or the sea which is at hand, should invade, sweep away, and stratify the contents of this mound, it might produce a very analogous accumulation of human implements, unmixed perhaps with human bones.

Although the accompanying shells are of living species, I believe the antiquity of the Abbeville and Amiens flint instruments to be great indeed if compared to the times of history or tradition. I consider the gravel to be of fluviatile origin; but I could detect nothing in the structure of its several parts indicating cataclysmal action, nothing that might not be due to such river-floods as we have witnessed in Scotland during the last half-century. It must have required a long period for the wearing down of the chalk which supplied the broken flints for the formation of so much gravel at various heights, sometimes 100 feet above the present level of the Somme,—for the deposition of fine sediment including entire shells, both terrestrial and aquatic, and also for the denudation which the entire mass of stratified drift

has undergone, portions having been swept away, so that what remains of it often terminates abruptly in old river-cliffs, besides being covered by a newer unstratified drift. To explain these changes, I should infer considerable oscillations in the level of the land in that part of France—slow movements of upheaval and subsidence, deranging but not wholly displacing the course of the ancient rivers. Lastly, the disappearance of the elephant, rhinoceros, and other genera of quadrupeds now foreign to Europe, implies, in like manner, a vast lapse of ages, separating the era in which the fossil implements were framed and that of the invasion of Gaul by the Romans.

Among the problems of high theoretical interest which the recent progress of Geology and Natural History has brought into notice, no one is more prominent, and at the same time more obscure, than that relating to the origin of species. On this difficult and mysterious subject a work will very shortly appear, by Mr. Charles Darwin, the result of twenty years of observation and experiments in Zoology, Botany, and Geology, by which he has been led to the conclusion, that those powers of nature which give rise to races and permanent varieties in animals and plants, are the same as those which, in much longer periods, produce species, and, in a still longer series of ages, give rise to differences of generic rank. He appears to me to have succeeded, by his investigations and reasonings, in throwing a flood of light on many classes of phenomena connected with the affinities, geographical distribution, and geological succession of organic beings, for which no other hypothesis has been able, or has even attempted, to account.

Among the communications sent in to this Section, I have received one from Dr. Dawson, of Montreal, confirming the discovery which he and I formerly announced, of a land shell, or pupa, in the coal formation of Nova Scotia. When we contemplate the vast series of formations intervening between the tertiary and carboniferous strata, all destitute of air-breathing Mollusca, at least of the terrestrial class, such a discovery affords an important illustration of the extreme defectiveness of our geological records. It has always appeared to me that the advocates of progressive development have too much overlooked the imperfection of these records, and that, consequently, a large part of the generalizations in which they have indulged in regard to the first appearance of the different classes of animals, especially of air-breathers, will have to be modified or abandoned. Nevertheless, that the doctrine of progressive development may contain in it the germs of a true theory, I am far from denying. The consideration of this question will come before you when the age of the White Sandstone of Elgin is discussed—a rock hitherto referred to the Old Red, or Devonian formation, but now ascertained to contain several reptilian forms, of so high an organization as to raise a doubt in the minds of many geologists whether so old a place in the series can correctly be assigned to it.

On Human Remains in Superficial Drift. By the Rev. Dr. ANDERSON.

The author gave a view of the alleged cases in connexion with the discovery of human remains in the superficial drifts, alluvial detritus, and such diluvial accumulations as are of an ancient or pre-historic origin. Undoubted cases existed of human remains enclosed in hard compact concretionary rocks, buried deep in the silts of rivers, and high up in caverns, associated with the bones of extinct carnivora now only existing in southern latitudes. One is startled at the idea of a North Briton inhabiting the same cave with a lion, mammoth, or a huge bear, and all apparently contemporaneous occupants, according to their species, of the British Isles. As to the instances occurring in beds of lakes, rivers, and seas, and which have become mineralized, he contended that a few years, or even months, often sufficed for the formation of a compact durable mass of calcareous and siliceous rock, in which human bones, skeletons, pottery, coins, and implements were imbedded.

He referred to a case betwixt Aberdour and Burntisland, in Fife, which he examined a few weeks ago, where an incrustation was now forming of great depth, and in which are imbedded land shells, branches of trees, and where on the face of the incrusted cliff, twigs of the living trees are becoming entangled in the calcareous breccia. Several raised beaches occur on the shores of Fifeshire, of considerable elevation, and some of them strewed over with shells of the pleistocene age. They