THE ARRIVAL OF MAN IN BRITAIN IN THE PLEISTOCENE AGE.

(THE HUXLEY LECTURE FOR 1910.)

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Introductory.

It was with very mixed feelings that I accepted the highest honour that the Royal Anthropological Institute has to offer, of giving one of the Huxley Memorial Lectures, and of following the eminent men who have preceded me as lecturers. In my youth, after leaving Oxford in the sixties, I fell under the influence of Huxley, sat at his feet as a junior colleague in Jermyn Street, and left the Geological Survey on his advice to take up my life work in Manchester. While doing pioneer work there in organising the museum, and the geological department in the Owens College, that ultimately grew into the first of the provincial universities, he was my guide, philosopher and friend,—a never-failing refuge in times of stress and difficulty. In a word, his influence has moulded my life and work. On these grounds, therefore, I feel peculiar pleasure in giving this lecture. On the other hand, I fully recognise that the principal work of anthropology at the present time is in the direction of the accumulation of materials for the use of the future master builder. The foundations of the science are practically now as they were left at Huxley's death, and the building has not yet risen far above the ground. The materials piled up in the hope of being used, good, bad, and indifferent, are vast in extent and are rapidly receiving additions from workers all over the world. The time, however, has not yet arrived to build. The non-heroic task alone is left of classifying the observed facts and of testing the value of hypotheses. In this lecture I propose to discuss the antiquity of man as revealed in the geological record, and of the conditions under which palæolithic man arrived in Britain.

The Classification of the Tertiary Period based on the Evolution of the Higher Mammalia.

Before we can discuss any of the above questions it is necessary to define the subdivisions of the Tertiary period. The classification which I proposed in 1880

still holds the field with but slight modifications. It is based on the appearance in orderly succession of the higher Eutherian (Placental) mammals, that were then, as Professor Gaudry happily puts it, *en pleine évolution*, and on the gradual approximation of the successive mammal-faunas to that now living in Europe. It applies equally to the Tertiary faunas of Africa, Asia, and the Americas, and in Australia the same principle may be applied to the lower groups of Prototheria and Metatheria. It is as follows:—

Table of Divisions of Tertiary Period.

VI. The Historic Period in which the events are recorded in history.	Documents and events connected with them.
V. Prehistoric Period in which domestic animals and cultivated fruits appear and man has multiplied exceedingly on the earth.	Ages of Prehistoric Iron, Bronze, Neolithic Ages.
IV. Pleistocene Period in which living species of mammalia are more abundant than the extinct.	Palæolithic man, living species of Eutherian mammals abundant.
III. Pliocene Period in which living species of mammalia first appear, and the extinct species are preponderant.	Living species of Eutherian mammals appear.
II. Miocene Period in which all the species are extinct.	Living genera appear.
I. Eocene Period in which there are no living genera. The mammalia now on the earth are represented by allied forms belonging to existing families and orders.	Living families and orders appear.

I have omitted the Oligocene division of the continental palæontologists, because it groups together two distinct and consecutive phases of mammalian evolution—the Anoplotherian of the Upper Eocene, and the Deinotherian of the Lower Miocene.

The specialisation of the mammalia implied in the above table is represented in the following diagram, in which it will be observed that orders, families, genera and species fall into the shape of a genealogical tree, with its trunk hidden in the Secondary period, and its branches and twigs passing upwards through all the stages to the present day—a tree of life, with the living Eutherian mammalia for its fruit and foliage. Were the extinct species taken into account it would be seen that they fill in the intervals between the living forms and that they approximate to the living species in proportion as they approach nearer to the present day.

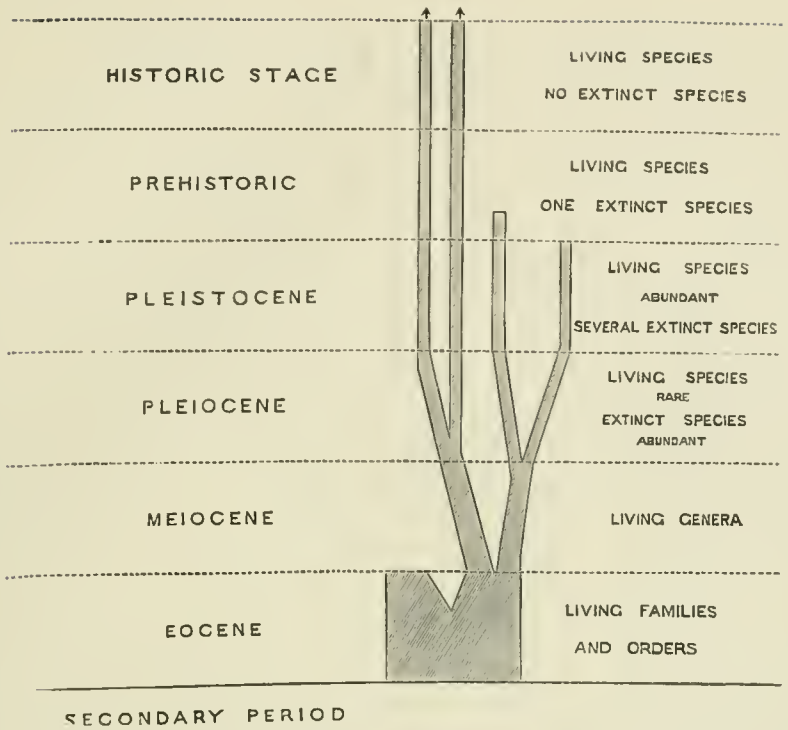

FIG. 1.—DIAGRAM SHOWING THE SPECIALISATION OF THE EUTHERIAN MAMMALIA IN THE TERTIARY PERIOD.

No Evidence of Man in Eocene, Miocene, or Pliocene Periods.

If this diagram, based upon the evolution of the mammalia, be used in our search for the first traces of man on the earth, it is obvious that we cannot expect to find the most highly organised of the mammalia in any portion of the geological record, where there are no other living mammalian species, or, in other words, in the two earlier stages of the Tertiary period. In the Eocene there are no living Eutherian genera, and in the Miocene no living Eutherian species. In the latter the Primates are only represented by the higher anthropoid apes—the Dryopitheeus and others. We can only look for man in the Pliocene age, when the living forms come in, and only expect to find him in the Pleistocene, when the living Eutherian forms were dominant, and the face of nature as a whole was almost as it is to-day. The general evidence as to this, as was pointed out in 1880,[1] is simply overwhelming and it still holds the field.

The evidence that man was living in France in the Miocene age, based upon the flints collected by Bourgeois at Thenay, has long ago been rejected as worthless,[2] because it is not certain that they really came from the Miocene strata of the district, and because some of them, now preserved in the museum at St. Germains,

[1] Dawkins' *Early Man in Britain*, 1880, Macmillan, pp. 66–67.
[2] *Op. cit.*, pp. 66–68.

bear plough marks, and are obviously derived from the surface, and because others are probably the result of natural agents without the intervention of man. More recently it has been rejected both by MM. Boule and Déchelette.[1]

A second alleged case of the discovery of worked flints by M. Rames in 1877 in the upper Miocene strata of Puy Courny near Aurillac in Cantal is equally inconclusive. Here flakes, more or less chipped at the edges, and other battered and chipped specimens, have been taken by MM. G. and A. Mortillet, Quatrefages, Capitan, Chantre and others to be of human workmanship. Here, again, the two above quoted eminent authorities, MM. Boule and Déchelette[1] point out that they do not present any proof of having been fabricated by man. When we consider that the mammalia found in the same deposit are Deinothere, and Hipparion, it is obvious that there is no place for man in this mammal fauna. Had man been living on the earth in the Miocene age he would, like every one of the other living mammalia of the period, be represented by a form differing from man in the same manner as the Deinothere differs from the existing elephants and the three-toed Hipparion from the living horses. It is incredible that man alone of all the mammalia living at the time in Europe should not have either become extinct, or changed into some other form in the long lapse of ages separating the Miocene period from the present day, during which many of the Miocene genera, and all the species, have become extinct. Those who believe in the doctrine of evolution will see the full weight of this argument against the presence of man in the Miocene fauna, not only of Europe but of the whole world. If evolution be true, there is no place in nature for man until the Pliocene age when the living species first appear.

All these considerations have, however, been ignored by the eminent Belgian geologist M. Rutot,[2] who holds that man is proved not only to be of Miocene but of the earlier ill-defined Oligocene age, on account of the presence of "eoliths" or broken and chipped flint in the deposit of Boncelles, in the valley of the Ourthe. In coming to this conclusion he has assumed, in common with many others in this country and on the Continent, that eoliths could not have been made without the intervention of man. We will therefore test the value of this assumption.

The Value of the Evidence of "Eoliths."

The name eolith,[3] covers chipped and broken flints assumed to be artificial, or, if natural, to have been used by man. Originally it covered only the collection of rude implements made by Professor Prestwich,[4] and Mr. Harrison from the high level clays, sands and gravels of Ightham in Kent, that are to a large extent derived from the clay with flints, forming a mantle of subaerial *débris* over a large

[1] Déchelette, *Manuel d'Archéologie*, i, *Archéologie Préhistorique*, 1908, p. 19 *et seq.*

[2] *Bull. Soc. Geol. Belg.*, xx, xxi, 1907.

[3] 1893, *Proceed. Geol. Assoc.*, xiii, p. 162; 1898, Cunnington, *Quart. Journ. Geol. Soc.*, Lond.

[4] *Quart. Journ. Geol. Soc.*, xxi, 1891.

part of southern England. In many cases the clay has been washed away by the rain and streams, the sands and gravels being left behind, in plateaux and terraces at various levels above the present stream.

The plateau in question is some 600 feet above the sea, and from it numerous palæolithic implements of the ordinary river-drift (Acheulian) type have been obtained, as well as the ruder eoliths figured by Prestwich,[1] in 1891. Since that time the range of the eoliths has been extended to other deposits, mainly gravels, in various parts of Britain and Ireland—sometimes in association with the above well-known types, and of various ages, from the pliocene strata of Lenham, through the pleistocene and glacial deposits down to the shingle on the present shore line. The chief exponent of the Eolithic cult, as it may be called, on the Continent, M. Rutot, has found eoliths over a large portion of Belgium, Luxemburg and France, in various deposits ranging in the Oligocene to the Neolithic stage of the Prehistoric period. It is undoubtedly true that eoliths do occur in all these strata, but before they can be used as evidence it is necessary to show that they have been made by man, and could not have been made by any other agency in nature.

On this question the evidence brought before the Anthropological Institute in 1905, by Mr. Warren,[2] is absolutely conclusive. The eoliths may be grouped as follows:—(*a*) Those with battered surfaces formed by many impacts: (*b*) with flaked surfaces formed by the impact of sharp blows: (*c*) with chipped edges formed either by impacts, or by pressure on the edges. They can be formed, and in all probability were formed naturally in various ways, by earthquakes, by wave action, by torrents, rivers and floods, by the pressure of the creep of the soil ever on the move from the higher to the lower grounds, by the action of land slides, by the drag of ice and by the sinking of the gravel beds, owing to the solution of the rocks below, by the carbonic acid in the rainwater. It has further been proved by experiments, carried out in England by Mr. Warren, and in France by MM. Capitan and Boule,[3] that even well-known paleolithic types, such as scrapers and re-touched flakes, can be formed accidentally by the pressure of the human foot, and by the hurtling together of flints in a cement mill. The researches of the Abbé, H. Breuil published in the current number of *l'Anthropologie* (xxi, pp. 385–408) complete the case against the eoliths. He has proved that the eoliths in the gravel at the base of the Thames sand or lowest eocene strata of Belle Assise (Oise) have been formed naturally by the pressure and movement of one flint upon another, resulting in chips with conchoidal fractures, "bulbs of

[1] Prestwich, *Quart. Journ. Geol. Soc.*, xxi, p. 24. It may be noticed that the first two out of the three plates illustrating this paper represent eoliths, while in the third there are specimens of the river-drift (Acheulian) type found in the same plateau gravel.

[2] S. Hazzledine Warren, "On the Origin of Eolithic Flints by Natural Causes, especially by the Foundering of Drifts," *Journ. Anthrop. Inst.*, xxxv, p. 337, pl. 26. Also *Man*, 1905, p. 103; 1906, p. 3.

[3] Capitan, *Revue de l'Ecole d'Anthropologie*, 1901, xi, p. 151; Boule, "L'Origine des Eolithes" *Anthropologie*, 1905, p. 263.

percussion," and secondary chipping, and sometimes in shapes indistinguishable from worked flints, scrapers, and other well marked paleolithic implements. Even M. Rutot failed to distinguish them, and assigned them to his "stréptyen" or age of transition from the "eolithic" to the paleolithic period. That they were formed within the mass of gravel, by natural causes, is proved by the fact that, in many cases, the chips and flakes rested almost in place on the blocks from which they had been broken. With all these facts before us it is impossible to admit coliths are evidence of man's handiwork, not only in cases where the study of the mammals renders difficult to believe that man could have been then on the earth, but also in cases which do not present that biological difficulty. It is, of course, accepted by all students of the progress of mankind that the simpler instruments must have been employed by man, before he learnt to make the more complex, and that the points and sharp edges of flints and other stones were used before the more elaborate tools. If, however, ruder forms *can* be the result of accidents of nature, as has been shown above, they are of no value as archæological documents throwing light upon the problem of the first appearance of man on the earth.

As the evidence stands at present, and leaving eolithic flints out of account, the geological record is silent as to pliocene man. It is improbable that he lived in Europe at that remote period, since only very few of the mammals of the period—the hippopotamus and the axis and rusa—are now living on the earth. It is, however, clear that the close approximation of some of the Pliocene to living species, marks the dawn of the order of nature to which man belongs, and in which, in the Pleistocene age, he forms the central and most imposing figure.

We may note, at this point in our enquiry, that there is no line of division between the Pliocene and Pleistocene sufficiently strongly marked to justify the classification usually adopted on the Continent, in which the Tertiary, or third, is mapped off from the Quaternary, or the fourth of the great life-periods. The evolution of the higher mammalia in Europe has gone on from the Eocene to the present day, in regular and comparatively orderly succession as noted in the diagram (Fig. 1), and the present phase of life (the Historic) is merely the last of the long series which went before. We are living in the Tertiary period. When, therefore, MM. Boule and Déchelette agree in rejecting the evidence as to Tertiary man they mean the evidence as far down as the close of the Pliocene, or down to the end of that period in which I am unable to find evidence in the geological record of the presence of man on the earth.

The Precursor of Man in Java in the Pleistocene Age.

We come now to the period in which the existing mammalia were dominant, and in which, therefore, man may be expected to appear. The discovery in an old river deposit at Trinil in Java of the remains described in 1894, by M. Dubois,[1]

[1] Dubois, "*Pithecanthropus erectus, eine Menschenaenliche Uebergangsform Aus Java*," 4to, 1894, *Landesdrukerei, Batavia. Verhandl. Berlin. Gesellsch. Anthrop. Ethn. et Urgeschichte*, 1895, p. 474.

revealed the presence of a form intermediate between the higher apes and man—the *Pithecanthropus erectus*, considered by Sir William Turner, Professor Cunningham, Dr. Topinard and other eminent anatomists to be the most ape-like of mankind, and by Sir William Flower, Drs. Marsh, Virchow,[1] Manouvrier and others equally eminent, the most man-like of the apes. Looking at the dimensions of the skull the brain appears to me too large to be classified with the apes, and the erect posture implied by the femur,[2] although it is obviously diseased, is an additional reason for considering its possessor on the human side of the line dividing man from the anthropoid apes. Whatever view be taken, there can be no doubt that Drs. Garson and Keith are right in taking Pithecanthropus to be "a missing link." With the attainment of the erect position, says Dr. Munro in his address to the British Association, and the consequent "specialisation of his limbs into hands and feet, man entered on a new phase of existence. With the advantage of manipulated organs and a progressive brain he became *Homo sapiens*, and gradually developed a capacity to understand and utilize the forces of Nature."

The place of this singular precursor of men in the geological record is indicated by the remains of the associated animals. They consist of species now living in the oriental region, tapir, axis, Indian buffalo and rhinoceros and of extinct species, such as *Elephas stegodon*, hexaprotodont hippopotamus, and a gigantic manis. This association of living with extinct species proves the age to be pleistocene, and in my opinion formed after a study of the faunas of the Nerbudda and the Sevalik Hills, to an early stage in that period. Pithecanthropus appears not only at the point in the geological record where he ought to appear, but in the tropical region, considered by Dr. Falconer and Lord Avebury to have been the probable birthplace of the human race. He marks the first great departure of man from the higher anthropoid apes, not only in brain but in hand.

The Arrival of Palæolithic Man in Europe and the Classification of his Implements.

We must now pass on to the consideration of the conditions under which man appears in Europe. The palæolithic implements found during the last half century in the river deposits and caves, established the fact of the existence of a hunter in the Pleistocene period, ignorant of pottery and not aided in the pursuit of wild animals by the dog, "the first servant of man," and belonging to a mammalian fauna of living and extinct forms, ranging over the whole of Europe except the ice-covered region of Scandinavia.

[1] Virchow, *Verhandl. Berl. Gesellsch. Anthrop. Ethnologische*, 1895, p. 435 and p. 468.

[2] Dr. Munro, in his address to the Anthropological Section of the British Association at Nottingham in 1893, shows what an enormous influence the erect posture has exerted on the evolution of man, by setting free the hands from the necessity of being used as feet. The inter-action of hand on brain, and of brain on hand, that has done so much to raise man from the level of the beasts, is worthy of the attention of those who deny the value of introducing handicrafts into the Elementary Schools.

In France the discoveries of Bourgeois in the river deposits of Amiens and Ableville, and those of Lartet and Christy in the caves of Auvergne, have been followed up in Europe and Northern Africa by various observers, and have recently been crowned by the revelation of the marvellous frescoes in the caves of Auvergne, and of the Pyrenees by Cartailhac, Breuil, and others. To them we are indebted for the following classification :—[1]

6. Magdalenien 5. Solutréen 4. Aurignacien	... ...	Epoque du Renne.
3. Moustiérien	... ...	Epoque du Mammouth.
2. Acheulien	... ...	Epoque du Mammouth et de l'Hippopotamus.
1. Chelléen ...	... ...	Epoque de l'Hippopotamus.

These divisions are based on the variation in the implements, and on the different groups of mammalia found along with them, and are taken to represent a chronological sequence. They are open to the criticism that it is not likely that the palæolithic hunters in the same region at the same time used exactly the same implements. At the present time there is a considerable variation in the equipment of savage tribes belonging to the same group, as for example, in Africa, some being much better armed than others. Are the remains of the animals killed in the chase, and left behind in the refuse heaps, to be looked upon as throwing light on the relative numbers of the wild animals living in the district rather than as showing those which were more easily captured than the rest ?

Also the difference in the habitat of the mammals has to be considered. It has been shown by Cartailhac and Breuil,[2] that while reindeer were abundant in Southern France and the region of the Pyrenees, stags, bison, and horses occupied the district of Santander in Spain, and are represented in the frescoes of the cave of Altamira, which they assign to the Solutréen and Magdalenien times. It is in my opinion safer to view the above classification as useful in marking local phases of culture rather than as a definite system of chronological sequence[3] of general application over the whole Continent. It does not apply to Great Britain, as I pointed out in 1880 in my work on *Early Man*. Here the three earlier groups of implements representing stages 1, 2, 3 occur together in intimate association in both the river-deposits and the caverns, while the three later, 4, 5, 6, are so mingled together in the caverns that there can be no reasonable doubt that they belong to the same period of occupation. The British palæolithic implements also fall naturally into two groups, as Sir John Evans showed in 1872,[4] those of the river-drift man and the

[1] Déchelette, *Manuel d'Archéologie*, i, *Archéologie Prehistorique*, p. 43. The names are based on the finds made in the caves of La Madelaine, Aurignac, and Moustier, in the camping ground of Solutré, and in the river deposits of St. Achene and Chelles.

[2] Cartailhac and Breuil, *La Caverne Altamira*, 4to, Monaco, 1906.

[3] Déchelette (*Archéologie Prehistorique*, 8vo, Paris, 1908), may be taken to represent the current view of French archæologists on this question.

[4] *Ancient Stone Implements of Great Britain*, 8vo.

cave man, the first being represented by the discoveries made in fluviatile deposits and by the lower horizon in the caverns of Kent's Hole and of Creswell Crags, and the second by the upper palæolithic strata in the above mentioned caves, and by Wookey Hole, near Wells, and others. The first of these is immeasurably older than the second, and presents a stage in culture far lower than that of the second. We shall deal with them separately. It will, however, be necessary to review the pleistocene fauna of Britain before we can discuss either one or the other.

The Early Pleistocene Mammalia in Britain.

The mammalia of the forest-bed of Norfolk and Suffolk[1] represent the earliest Pleistocene group in Britain. They consist of the following species:—

Survivals from the Pliocene, Living Species.

Hippopotamus, *H. amphibius*, L.

Survivals from the Pliocene, Extinct Species.

(2) Sabre-toothed lion, *Machairodus.*
Deer of Polignac, *Cervus polignacus*, Rob.
Deer of Etouaires, *C. etueriarum*, Cr. et Job.
Sedgwick's deer, *Cervus Sedgwickii*, Falc., *Cervus dicranios*, Nesti
Etruscan rhinoceros, *R. etruscus*, Falc.
Big-nosed rhinoceros, *R. megarhinus*, Christol.
Southern elephant, *Elephas meridionalis*, Nesti.
(2) Stenos horse, *Equus stenonis*, Nesti.

Newcomers, Living Species

Musk shrew, *Sorex moschatus*, Pallas.
Shrew, *Sorex vulgaris*, L.
Common shrew, *S. vulgaris*, L.
(2) Continental field vole, *Arvicula arvalis*, Griffith.
Siberian vole, *A. gregalis*, Desm.
Water vole, *Arvicula amphibius*, Desm.
Red field vole, *A. glareolus*, Schreber.
Field mouse, *Mus silvaticus.*
Hamster, *Criectus vulgaris*, Desm.

[1] Dawkins, *Quart. Journ. Geol. Soc.*, 1872, London, p. 417. This list only represents the terrestrial mammalia. Mr. Clement Reid, *Mem. Geol. Survey, Geology of the Country around Cromer*, 1882, p. 2, assigns the Forest-bed to "the newer Pliocene." This is, however, negatived by the continental evidence as to the Pliocene mammalia, and it cannot be maintained, if the living and extinct species in the list be duly weighed. There are no Pliocene strata on the Continent containing these mammalia.

[2] On the authority of E. T. Newton, "Vertebrata of the Forest-bed Species of Norfolk and Suffolk," *Memoirs of Geological Survey of England and Wales*, 8vo, 1882. I am also indebted to Mr. Newton for the additions to the list made since that time.

Mole, *Talpa Europæa*, L.
Squirrel, *Sciurus vulgaris*, L.
Beaver, *Castor fiber*, L.
Grizzly bear ? *Ursus ferox*, Lew. et Clark.
Wolf, *Canis lupus*, L.
Fox, *C. vulpis*, L.
(2) Spotted hyæna, *H. crocuta* (*var. Spelæa*, Gold.).
Glutton, *Gulo luscus*, L.
(2) Marten, *Martes silvatica*, Nilsson.
(2) Otter, *Lutra vulgaris*, Erxl.
Wild boar, *Sus scrofa*, L.
Horse, *Equus caballus*, L.
Stag, *Cervus elaphus*, L.
Roe deer, *C. capreolus*, L.
Urus, *Bos primigenius*, Boj.

Newcomers, Extinct Species.

Cuvier's beaver, *Trogontherium Cuvieri*, Owen.
Cave-bear, *Ursus spelæus*, Goldf.
Thick-antlered deer, *Cervus verticornis*, Dawk. (= *C. Belgrandi*).
Deer of the Carnutes, *C. Carnutorum*, Falc.
Broad-fronted deer, *C. latifrons*, Dawk.
(2) Newton's deer, *C. rectus*, Newt.
Irish elk ? *Megaceros hibernicus*, Owen.
(2) Savins goat, *Caprovis Savinii*, Newton.
Mammoth, *Elephas primigenius*, Blum.
Straight-tusked elephant, *E. antiquus*, Falc.

In the above list the most important features are the incoming of mammals hitherto unknown in Europe, both living and extinct, and their association with the well-known Pliocene species of France and Italy. They formed the advanced guard of the migration of the Pleistocene mammalia into Pliocene Europe, and their arrival in Britain marks the dawn of the Pleistocene age. We must also note that the great majority of the living species are those now living in the temperate climates of Europe and Asia.

The strata, in which these animals occur, underlie the boulder clays of the Norfolk and Suffolk cliffs, and are therefore older than the glacial deposits of the district. The associated flora indicates a temperate climate gradually becoming colder.

I am unable to accept the eolithic evidence of Mr. Abbott[1] that man was in Britain at this time because the chipped flints from the Cromer forest-bed may be due to accident and not to design.

[1] *Natural Science*, x, 1897, p. 89.

The Mid-Pleistocene Mammalia.

The next stage in the invasion of Britain by the Pleistocene mammalia, is that presented by the lower brick-earths of the Thames Valley in Kent and Essex.[1] They are as follows:—

Mid-Pleistocene Mammalia.		Ilford.	Grays Thurrock.	Crayford, Erith.
Survivals from Early Pleistocene—Living species = 11.				
Horse	*Equus caballus*, L.	×	×	×
Urus	*Bos primigenius*, Boj.	×	×	×
Roe	*Cervus capreolus*, L.	×	×	—
Stag	*C. elaphus*, L.	×	×	×
Hippopotamus	*Hippopotamus major*	×	×	—
Wild boar	*Sus scrofa*, L.	—	×	—
Fox	*Canis vulpes*, L.	×	×	—
Wolf	*C. lupus*, L.	×	×	×
Brown bear	*Ursus arctos*, L.	×	×	×
Beaver	*Castor fiber*, L.	×	×	—
Water-rat	*Arvicola amphibius*, L.	×	×	×
Survivals from Early Pleistocene—Extinct species = 4.				
Straight-tusked elephant	*Elephas antiquus*, Falc.	×	×	×
Mammoth	*E. primigenius*, Blum.	×	×	×
Big-nosed rhinoceros	*Rhinoceros megarhinus*, Christol.	×	×	×
Irish elk	*Megaceros hibernicus*, Ow.	×	×	×
New comers—Living species = 9.				
River drift Man	*Homo sapiens*, L.	—	—	×
Musk sheep	*Ovibos moschatus*, Desm.	—	—	×
Bison	*Bison priscus*	×	×	×
Grizzly bear	*Ursus ferox*, Lew. and Clark	×	×	×
Otter	*Lutra vulgaris*, Erxl.	—	×	—
Spotted hyæna	*Hyæna crocuta*, Zimm.	—	×	×
Wild cat	*Felis catus*, L.	—	×	—
Lion	*F. leo*, L.	×	×	×
Marmot	*Spermophilus erythro genoides*, Falc.	—	—	×
Man		—	—	×
New comers—Extinct species = 2.				
Woolly rhinoceros	*R. tichorhinus*, Cuv.	×	—	×
Small-nosed rhinoceros	*R. leptorhinus*, Ow. (= *R. hemitachus*, Falc. = *R. Merckii* Kaup).	×	×	×

[1] These fluviatile are considered, by Prestwich and others, to belong to a late stage of the Pleistocene period, because they are at a low level. This, however, cannot be taken as a test of age, unless it is certain that the valley has been cut down by the river, now flowing at its bottom, leaving behind it, in the course of its excavation, terraces of gravels, to mark its work, the higher being the older. It is also necessary to assume that the land has remained stationary at one level above the sea. In this case the valley was probably like most of the other British valleys excavated before the Pleistocene age, and has since been subjected to great oscillations of level. The test absolutely fails when it is applied to the Forest-bed, and to the Pliocene and Miocene deposits of Europe. See *Early Man in Britain*, p. 142.

In this fauna most of the pliocene survivals in the forest-bed deposit are absent, and the Etruscan rhinoceros is represented by the leptorhine or small-nosed rhinoceros, of Owen. The woolly rhinoceros, the companion of the mammoth, in its wanderings from Northern Siberia over Middle Europe, appears in Britain for the first time. It may also be remarked that the Valley of the Lower Thames is the only place upon record where the three above-named species of rhinoceros are found together. The southern elephant (*Elephas meridionalis*) had either become extinct or had retreated southwards, probably into Italy. The Arctic mammalia are represented by the musk sheep, the most arctic of all, but they were few in number.

There is clear proof of the presence of man at this time in the discovery, by Mr. Flaxman Spurrell, of a well-marked camping ground at Crayford,[1] in which there was a large accumulation of the splinters formed in the making of implements of the ordinary river-drift type. The presence of the river-drift man in the Valley of the Thames at this time, in association with the same group of Mammalia, has since been confirmed by the discovery of a very large series, representing nearly all the river-drift types of implements, by Mr. and Mrs. Stopes, in Milton Street Pit, Swanscombe, in the district between Crayford and Gravesend.

It must further be remarked that these ancient fluviatile deposits are generally covered by a confused, and folded, stratum of old surface *débris* (trail), which may be, as I have suggested, the result of hard frosts and melting snows, that accelerated the creep of the soil downwards. It is probably the result of a severe climate, and it may be the equivalent of one or other of the complicated glacial deposits in the region north of the Thames. Professor Sollas, in his last address to the Geological Society, has given a section of similar order,[2] in which river-drift implements occur in association with mammoth, horse, stag, urus, and reindeer, at Wolvercote, in Oxfordshire, underneath a folded and contorted gravel, which he takes to be the equivalent of the nearest layer of boulder clay. In neither case, however, is the precise relation to the boulder clays clearly established.

We shall deal later with the general question of the relation of man to the glacial period.

The Late Pleistocene Mammalia.

The last phase in the invasion of Britain by the pleistocene mammalia is characterised by the arrival of the northern group, and more especially of the reindeer found in abundance in association with other groups in the river deposits and in the caves. Man also is represented by the river-drift, and the cave-man.

[1] One of these, broken in the making, was found and fitted into the block of flint from which it had been made, one-half having been found by Lord Avebury, and the other by myself at different times. This collection of flints is now in the British Museum, Natural History.

[2] *Quart. Journ. Geol. Soc.*, xxxvi, p. 544.

Late-Pleistocene Mammalia in Britain.	River strata.	Ossiferous caverns.
Survivals from Early and Mid Pleistocene — Living species = 24.		
River drift man ... ...*Homo sapiens*	×	×
Cave man ... ... „ „	—	×
Horse ... ...*Equus caballus*, L....	×	×
Brown's fallow-deer... ... ...*Cervus Browni*, Dawk.	×	—
Roe ... ...*C. capreolus*, L.	×	×
Stag ... ...*C. elaphus*, L.	×	×
Urus ... ...*Bos primigenius*, Boj.	×	—
Bison ... ...*Bison europæus*, Gm.	×	×
Musk-sheep ... ...*Ovibos moschatus*, Desm.	×	—
Hippopotamus ... ...*Hippopotamus amphibius*, L. ...	×	×
Wild boar ... ...*Sus scrofa*, L.	×	×
Wild cat ... ...*Felis catus*, L.	×	×
Lion ... ...*F. leo*, L.	×	×
Spotted hyæna ... ...*Hyæna crocuta*, Zim.	×	×
Wolf ... ...*Canis lupus*, L.	×	×
Fox ... ...*C. vulpes*, L....	×	×
Otter ... ...*Lutra vulgaris*, Erxl.	×	×
Brown bear ... ...*Ursus Arctos*	—	×
Grizzly bear ... ...*Ursus ferox*, Lew. and Cl.	×	×
Glutton ... ...*Gulo luscus*, L.	×	×
Water-vole ... ...*Arvicola amphibius*, L.	×	×
Red field-vole ... ...*A. glareolus*, Schreb.	×	×
Hare ... ...*Lepus timidus*, L.	×	×
Beaver ... ...*Castor fiber*, L.	×	×
Mouse... ... ...*Mus musculus*, L.	×	×
Shrew... ... ...*Sorex vulgaris*, L.		×
Man	×	×
Survivals from Early and Mid-Pleistocene — Extinct species = 7.		
Straight tusked elephant ... ...*Elephas antiquus*, Falc.	×	×
Mammoth ... ...*E. primigenius*, Blum.	×	×
Woolly rhinoceros ... ...*Rhinoceros tichorhinus*, Cuv. ...	×	×
Small-nosed rhinoceros ... ...*R. leptorhinus*, Ow.	×	×
Irish elk ... ...*Megaceros hibernicus*, Ow.... ...	×	×
Machairodus ... ...*Machairodus latidens*, Ow. ...	—	×
Cave-bear ... ...*Ursus spelæus*, Goldf.	—	×
New forms—Living species = 15.		
Antelope saiga ... ...*A. saiga*, Pal.	×	×
Reindeer ... ...*Cervus tarandus*, L.	—	×
Arctic fox ... ...*Canis lagopus*, L.	—	×
Badger ... ...*Meles taxus*, L.	—	×
Stoat ... ...*Mustela erminea*, L.	—	×
Weasel ... ...*M. putorius*, L.		×
Marten ... ...*M. martes*, L.	—	×
Caffer cat ... ...*Felis caffer*, Desm.	—	×
Leopard ... ...*F. pardus*, L.	—	×
Lynx ... ...*F. lynx*, Tem.	—	×
Short-tailed field-vole ... ...*Arvicola agrestis*, L.	—	×
Continental field-vole ... .*A. arvalis*, L.	—	×
Russian vole ... ...*A. rutticeps*, Keys. u. Bl.	×	×
Pouched marmot ... ...*Spermophilus erythro genoides*, Falc.	×	×
Arctic lemming ... ...*Nyodes torquatus*, Desm.	×	×
Norwegian lemming ... ... „ *Norwegicus*, Desm. ...	×	×

The northern mammalia, as may be seen by the following table showing the range of the principal species in the river-deposits and caves, are so closely associated with those already in possession of the land, that they were beyond a doubt living in the same district, at approximately the same time, and formed part of the same fauna. It is, however, not accepted by Professor James Geikie and other eminent geologists, who relegate the northern group to one or other of their glacial periods, and the warm and temperate groups to one of their inter-glacial ages, although the mixed character of the fauna was pointed out some thirty years ago. We will, therefore, reconsider the evidence in detail, so far as it relates to the species associated with palæolithic man.

Late Pleistocene Mammalia associated with Man in River Deposits and Caves.

	River Deposits.				Caves.				
	Fisherton, Salisbury.	Bedford.	Ipswich.	Wolvercote, Oxford.	Kent's Hole, Torquay.	Wookey Hole, Wells.	Pont Newydd, Cefn.	Ty Newydd, St. Asaph.	Cresswell Caves.
River drift man	×	×	×	×	×	—	×	×?	×
Cave man	—	—	—	—	×	×	—	×?	×
Brown bear	—	—	—	—	×	×	—	—	×
Grizzly bear	—	—	×?	—	×	×	×	×?	×
Cave bear	—	×	×?	—	×	×	×	×?	×
Glutton	—	—	—	—	—	—	—	—	×
Badger	—	—	—	—	×	—	—	×	×
Weasel	—	—	—	—	×	—	—	—	×
Pole cat	—	—	—	—	×	—	—	—	—
Marten	—	—	—	—	—	—	—	—	×
Otter	—	—	×	—	—	—	—	—	—
Fox	—	—	×	—	×	—	—	×	×
Arctic fox	—	—	—	—	—	—	—	—	×
Wolf	×	—	—	—	×	×	—	×	×
Spotted hyæna	—	—	—	—	×	×	×	×	×
Wild caffer cat	—	—	—	—	—	—	—	×	×
Leopard	—	—	—	—	—	—	—	—	×
Lynx	—	—	—	—	—	—	—	—	—
Lion	×	—	×	—	×	×	—	—	×
Sabre-toothed lion	—	—	—	—	×	—	—	—	×
Irish elk	—	—	×	—	×	×	—	×	×
Reindeer	×	×	×	—	×	×	—	×	×
Roe	×	—	—	—	—	—	—	×	×
Stag	—	—	—	×	×	—	—	×	×
Musk sheep	—	—	—	—	—	—	—	—	—
Urus	×	—	×?	×	×	×?	—	—	×
Bison	×	×	×?	—	×	×?	—	—	×
Hippopotamus	—	×	—	—	—	—	—	—	—
Wild boar	—	—	—	—	×	—	×	×	×
Horse	—	×	×	×	×	×	×	×	×
Leptorhine rhinoceros	—	—	—	—	—	—	×	—	—
Woolly rhinoceros	×	×	×	—	×	×	—	×	×
Straight-tusked elephant	—	×	—	—	—	—	—	—	—
Mammoth	—	—	×	×	×	×	—	×	×
Lemming	—	—	—	—	—	—	—	—	—
Hare	—	—	—	—	×	—	—	—	×
Alpine hare	—	—	—	—	×	—	—	—	—
Pouched marmot	×	—	—	—	×	—	—	—	—
Castor fiber	×	—	—	—	—	—	—	—	—

The Late Pleistocene Mammals associated with Man in Britain.

The mammalia are associated with human implements in the following localities, that have been selected out of a very large series.

The remains of the mammalia in the above list are so closely intermingled that there is no room for doubt that they were swept down by the same floods, and eaten by the wild beasts inhabiting the caves during the same series of seasons—spring, summer, autumn, winter. In the hyæna dens, for example, we find that the hyænas fed on the hippopotamus, the leptorhine rhinoceros, and the straight-tusked elephant, probably in the summer; and in the winter on the reindeer, and the horse and other animals of the temperate group.

Man is represented in the river deposits by implements of the various types assigned in France to the groups found at Chelles, St. Acheul, and the cave of Moustier. In this country these are so closely associated together, as may be seen from Sir John Evans' great work on Ancient Stone Implements, that there can be no reasonable doubt that they were used by the same tribes at the same time. This conclusion is confirmed by the discoveries made by Mr. Worthington Smith[1] in the Valley of the Lea and of the Thames, on camping grounds at Caddington, Stoke Newington, and elsewhere.

I turn now to the evidence of the caves.[2] In the above table the remains of river-drift man in the caves of Kent's Hole, near Torquay, Wookey Hole, near Wells, of Pont Newydd and Ty Newydd, near St. Asaph, and of Cresswell, leave no room for doubt that the animals hunted by man in those regions belong to the same fauna as that of the river deposits. The implements from the cave of Kent's Hole fall into two distinct series, the upper containing the remains of cave men along with the teeth and bones of the contemporary wild animals, and the lower, mainly breccia with the rough river-drift implements in association with bones and teeth of bear and other animals. Nearly all the species identified by myself and Mr. W. A. Sanford were obtained from the upper horizon. Unfortunately we were unable to catalogue the vast collection of remains, and therefore cannot give the relative numbers of the animals captured by man and of the hyænas. This, however, I have done in the group of caves explored by Mr. Mello and myself at Cresswell,[3] which had been used as dens by hyænas, and from time to time as shelters by the palæolithic hunters.

The numbers in the following table represent the distribution of the bones and

[1] *Man the Primeval Savage*, 8vo, 1894, London.

[2] Kent's Hole and Wookey Hole, Dawkins' *Cave Hunting*, 8vo, 1874, c. vii. The Pont Newydd cave explored by Professor Hughes, *Quart. Journ. Geol. Soc.*, xxviii, p. 410. The Ty Newydd caves, Dr. Hicks and Mr. Davies, *Quart. Journ. Geol. Soc.*, xlii, p. 9, and xliii; Professor Hughes, *ib.*, xliv and xlv; the Rev. C. H. Pullen, *ib.*, liv, p. 121. The caves of Cae Gwyn, Ffynnm Beuno and Ty Newydd form a network of caves, and are grouped together in the above table under the head of Ty Newydd.

[3] Mello, *Quart. Journ. Geol. Soc.*, 1875, p. 679; Mello and Dawkins, *Quart. Journ. Geol. Soc.*, 1876, p. 240; 1877, p. 579; 1879, p. 724.

	Robin Hood.			Church Hole.			Mother Grundy's Parlour.				Pin Hole.	
	A. White sand.	B. Lower red clay and sand.	C. Cave earth and breccia.	A. White sand.	B. Lower red sand.	C. Cave earth and breccia.	A. White sand.	B. Lower red sand.	B. Red clay.	C. Sandy cave-earth.	A. White sand.	B. Red sand.
River drift man	—	8	× × 1032	—	23	× × 211	—	—	×	×	—	×
Cave man	—	—		—	—		—	—		—	—	×
Brown bear	—	× × 12	44	—	× × 22	× × 34	—	—	× ×	× ×	—	× ×
Grizzly bear	—	—	—	—	×	—	—	—	—	—	—	×
Pole cat	—	—	—	—	—	—	—	—	—	—	×	×
Glutton	—	13	112	—	2	17	—	—	×	×	—	×
Fox	—	—	—	—	—	—	—	—	—	—	—	×
Arctic fox	—	3	68	—	7	12	—	—	—	—	—	×
Wolf	—	65	965	—	185	235	—	×	×	×	—	×
Spotted (cave) hyæna	—	—	1	—	—	—	—	—	—	—	—	—
Sabre-toothed lion	—	1	3	—	1	—	—	—	—	—	—	—
Lion	—	—	—	—	—	—	—	—	—	—	—	—
Leopard	—	7	—	—	—	—	—	—	—	—	—	×
Irish elk	—	55	470	—	138	278	—	—	—	×	—	×
Reindeer	—	31	—	—	11	34	—	×	×	×	—	×
Bison	—	143	626	—	120	267	—	×	×	×	—	×
Urus	—	33	439	—	101	252	—	—	—	×	—	×
Horse	—	—	—	—	—	—	—	×	×	—	—	—
Woolly rhinoceros	—	13	50	—	18	50	—	—	—	—	—	×
Leptorhine rhinoceros	—	—	1	—	—	—	—	—	—	—	—	—
Mammoth	—	—	—	—	—	—	—	×	×	—	—	—
Wild boar	—	—	—	—	—	—	—	—	—	—	—	—
Hippopotamus	—	2	51	—	2	8	—	—	—	—	—	—
Hare	—			—			—				—	—

teeth of the various animals in the stratified deposits. I would call attention to the preponderance of the reindeer and horse over the bisons and uri, and of the woolly rhinoceros over the mammoth—and more particularly to the difference between the group of animals in the Pin Hole, Robin Hood, and Church Hole caves, as compared with that of Mother Grundy's Parlour. Here the leptorhine rhinoceros and the hippopotamus occur in the lower strata, in association with the horse, bear, fox and hyæna. The absence of implements in this horizon may be explained by the fact that this hyæna den was not then used as a shelter by the river drift man, whose tools occur in the upper stratum, while the absence of the mammoth, woolly rhinoceros and reindeer may imply that there was a group of mammals in this district earlier than that in which the above species were so conspicuous. It must, however, be noted that elsewhere, as for example in the Vale of Clwyd, the same two species—the hippopotamus and the leptorhine rhinoceros, were contemporary both with the reindeer and with the river drift man. They also occur in like association in the river deposits of Britain. In France they are taken by M. Boule and other eminent observers to be inter-glacial and to mark the earliest palæolithic stage, both in the caverns and river deposits. In Britain they are associated with the implements of the river drift men in mid and late Pleistocene deposits, and do not occur along with the implements of cave men.

The mixture of species seen in the Cresswell caves is presented by almost every Pleistocene cave and river drift deposit in middle and northern Europe, and is the result of the Pleistocene immigrants coming in from different quarters, and ultimately occupying the same area at approximately the same time, as I pointed out in 1872, under climatical and geographical conditions totally different from those of the present day.

The Migration of the Pleistocene Mammalia into Europe.

At the beginning of the Pleistocene age Britain formed part of the continent of Europe, and the Atlantic coastline, now sunk 100 fathoms below the sea level, ranged far to the west of Ireland, as shown on the accompanying map (Fig. 2). Europe, too, was joined to northern Africa by the elevation of the Mediterranean area so as to make one bridge of land extending across the Straits of Gibraltar, another linking Italy with northern Africa by way of Sicily, and Malta, and converting the Greek Isles into ranges of hills standing out from the plain that then ranged southwards and eastwards to join the mountain plateau of Asia Minor. The Mediterranean sea was divided into two land-locked basins like the Black Sea, and Africa, north of the Sahara, was practically continuous with southern Europe. There was then no barrier to migration from south to north, from northern Africa to the north of Scotland and the west of Ireland. Nor was there any barrier to the migration of animals into Europe from northern and eastern Asia. We shall deal with them group by group.

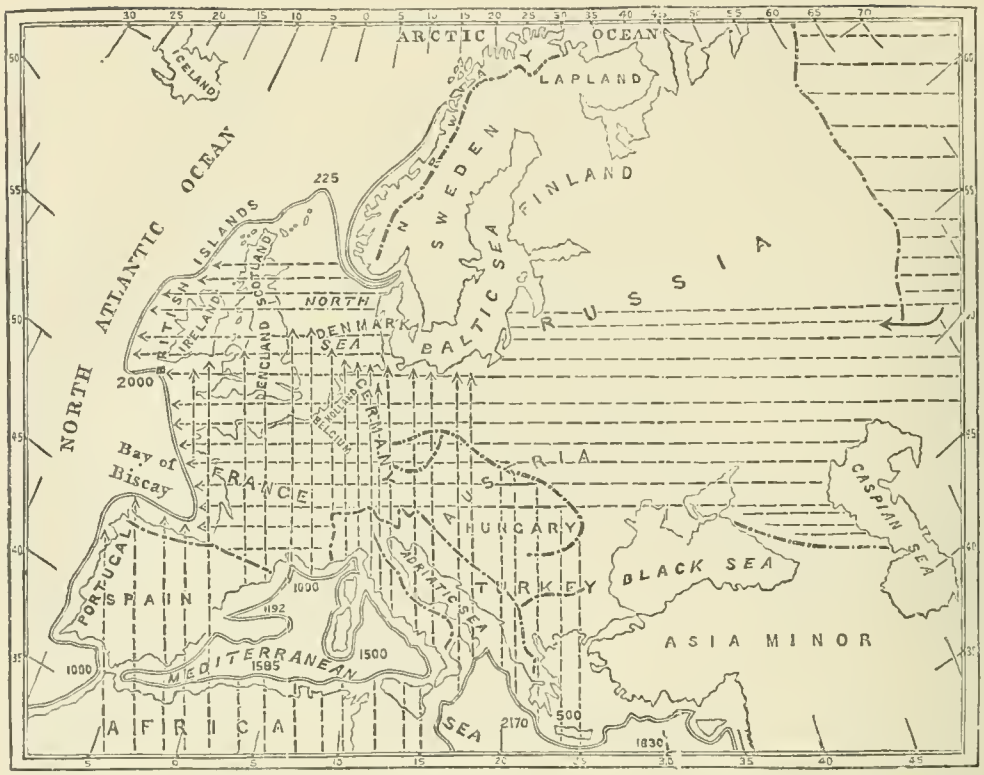

FIG. 2. MAP OF PLEISTOCENE EUROPE SHOWING THE RANGE OF NORTHERN AND SOUTHERN ANIMALS.

The double line represents the probable outline of the Pleistocene land.
The vertical broken lines show the range of the southern mammalia, and the horizontal ones that of the northern forms.

Living Species now restricted to the Temperate Zone.

The incoming Pleistocene species, now found only in the Temperate zones of Europe, Asia, and America, consist of animals of widely different habits and range. The more important of them are as follows:[1]—

Musk shrew.	Marten.	Bison.
Pika.	Ermine.	Urus.
Pouched marmot.	Stoat.	Saiga antelope.
Hare.	Otter.	Stag.
Lynx.	Brown bear.	Roe.
Wild cat.	Grizzly bear.	Fallow deer.
Wolf.	Badger.	Wild boar.
Fox.	Horse.	

The musk shrew, now living in the region of the Don and Volga, haunted the rivers of Norfolk, and the pouched marmot hibernated in Wiltshire and Somerset.

[1] For full list see *Early Man in Britain*, p. 98.

At the present time three species of pika, or tailless hare, inhabit Siberia. In the Pleistocene age the genus ranged as far to the west as Gibraltar, and is represented in Britain by the cave pika of Brixham and Kent's Hole. The Saiga antelope of the plains of the Volga and the Irtisch, south of latitude 55°, now ranging as far to the west as Poland, occur in the river deposits of London and the caves of the Dordogne. The fallow deer, now only indigenous in the warm temperate Mediterranean region, wandered as far north as Harwich, and is represented by a variety (*Cervus Brownii*) found at Clacton. The bison, now living under the protection of the Tzar in Lithuania, and under feral conditions in the Urals and Caucasus, ranged over the whole of Europe and as far to the north-west as North Wales. The bones and teeth found in northern Siberia, and Eschscholtz Bay, and other localities in the northern regions of America prove, that, in former times, the herds were conterminous with those that are now very nearly destroyed by the hunters in North America. The urus and the horse ranged over the whole of Pleistocene Europe. Among the incoming carnivores, the grizzly bear ranged from Britain and Ireland as far to the south-west as Gibraltar. At the present day both the brown and the grizzly bears inhabit the same regions in North America, and therefore there is no reason for surprise that they should be found together in Pleistocene Europe. The whole of this temperate group, in my opinion, invaded Europe from west-central Asia and Asia Minor.

Living Species of Northern Habit.

The second group of invading forms is presented by the following list of Arctic animals:—

Russian vole.	Musk sheep.
Norwegian lemming.	Reindeer.
Arctic lemming.	Arctic fox.
Alpine (= Irish, Scotch, Arctic) hare.	Glutton.

At the present time the four last named in the above list live side by side in circumpolar America, and the Arctic fox, the glutton or wolverine, and the reindeer range over the far north of Asia and Europe. The musk sheep is traced by its fossil and subfossil remains from its present habitat on the American shores of the Arctic Sea through Siberia, into Europe, where it ranges as far to the south as the Alps and Pyrenees, and as far to the west as Bath in Somerset. The reindeer also ranged over middle Europe as far as the same southern limits, and as far to the west as Ireland.

We may also note that four other animals, the snowy vole, the Alpine marmot, the chamois, and the bouquetin, now only found in the colder regions of the European mountains, then occupied the lower grounds in France, Spain, and Italy, the marmot ranging as far down the valley of the Rhine as Belgium.

We may assume that the northern group of animals enumerated above could only have ranged as far south as the Alps and Pyrenees, in the Pleistocene age,

under conditions of life similar to those under which they live at the present time in a cold climate.

The Living Species now found in Warm Climates.

This conclusion has, however, to be reconciled with the evidence of the incoming animals now only to be found in the warmer regions of the earth.

Porcupine.	Spotted hyæna.
Lion.	Striped hyæna.
Leopard.	African elephant.
African lynx.	Hippopotamus.
Caffer cat.	

The porcupine of northern Africa and the Mediterranean region generally, lived in the Pleistocene age as far to the north as Belgium. The leopard, common to Africa and the warmer regions of Asia, ranged through Europe as far north as Somersetshire, and through the Iberian peninsula and France into Saxony. It was associated in its wanderings northwards with the caffer cat, now living throughout Africa, and with the lynx of the Mediterranean region. The lion, now living only in the warm climates of Africa and southern Asia, followed its prey as far north as Yorkshire (Kirkdale) and as far to the north-east as Poland. The spotted hyæna of Africa, south of the Sahara desert, then abounded in southern and middle Europe, and in Britain as far as the Vale of Pickering. It also inhabited the caves of Ireland, and ranged as far to the north-east as the Altai Mountains. The striped hyæna of Africa and the warmer regions of Asia ranged over Pleistocene Europe as far as Provence, and the African elephant, now no longer met with north of the Sahara, passed northwards as far as Sicily, and into Spain as far as Madrid. The range of the whole group is represented by the vertical dotted lines in Fig. 2.

The Incoming Extinct Species.

The extinct species found along with man in Britain may be divided into similar groups. The mammoth and the woolly rhinoceros, found together in the frozen *tundras* of Northern Siberia, and ranging over Europe, the former as far as the Mediterranean, and the latter as far as the Alps and Pyrenees, are northern Asiatic forms, while the leptorhine rhinoceros, the Irish elk and the cave bear probably belong to the Temperate group. The megarhine rhinoceros, the only Pliocene extinct species associated with man, in the mid-Pleistocene deposits of the Lower Thames is, like the rest of the Pliocene species, of warm or warm temperate habit, ranging from Italy through France to Norfolk and Suffolk.

The Mixed Fauna caused by Climatical Changes.

If, with all these facts before us, we refer to the map, Fig. 2, it will be seen that there are three zones clearly defined in Europe. (1) The northern, into

which no southern forms penetrated: (2) the middle, in which both northern and southern forms are intermingled, extending from the British Isles to the barriers of the Alps and Pyrenees: and (3) the southern, in which the northern forms are conspicuous by their absence. This distribution is obviously the result of climatical changes by which the northern animals were driven to their furthest limits to the south, and the southern animals were allowed to find their way to the north over the whole of the area ranging from Yorkshire to the Alps and Pyrenees. On the great continent extending from the Sahara, northwards, to the Atlantic (see Fig. 2), the climate was continental, and in the severe cold of winter the northern animals, reindeer and musk sheep, ranged southwards, and in the hot summers the southern group, hippopotami and the rest, migrated northwards over the same ground. In each season the frontier between the two moved north and south, as it now does in Asia and North America. In these two continents the debatable ground now is but a narrow zone, because the seasons have been on the average the same year after year. In Pleistocene Europe, besides this seasonal change, there were great secular oscillations of temperature marked by the glacial deposits of the north, and by the repeated advance and retreat of the glaciers of the mountain chains of middle Europe. The frontier between the two was shifted northwards and southwards over the whole of the region occupied by the mixed fauna, not in one season, but in a geological period of vast and unknown duration.

The mixture of the northern and southern forms described above is explained by Drs.[1] James Geikie, Croll, Wallace, and others, by the presence of the northern during a glacial, and of the southern during an interglacial period—these periods being separated from one another by æons, according to Dr. Croll,[2] of 10 to 12,000 years—and by the supposition that their remains have afterwards been mingled together. I am unable to find any evidence in support of this view. In the caves, and in the river deposits, there is the clearest proof that the two inhabited the same area at times so closely approximate that they were eaten by the same packs of spotted hyænas, or swept down by the same succession of floods. The spotted hyæna, which Dr. James Geikie considers to be interglacial, preyed upon the reindeer, taken to be glacial, in 28 out of 31 British caves that I have tabulated. In all these the teeth-marked bones and antlers leave no doubt that the kill was eaten at once, and not after the lapse of some thousands of years. When we find a similar mixture of northern and southern forms not only over the whole of Middle Europe but also of Siberia, the theory that their occupation of a given area took place at times separated from one another by long intervals, to say nothing of glacial periods, appears to me to be untenable.[3]

[1] *Ice Age*, 2nd edit., p. 512.

[2] *Climate and Time*, p. 252.

[3] Indeed, Dr. James Geikie (*op. cit.*, p. 523) gives his case away when he writes that "the northern temperate and southern mammalia, whose relics occur in the English valley gravels, belong to one and the same interglacial period—a period that could have lasted only a few thousand years."

These groups invaded Europe and ultimately arrived in Britain from different areas, the southern first, and the northern afterwards, but they undoubtedly occupied the same districts in the same series of seasons, in a climate that was gradually passing from temperate to glacial, and from glacial to temperate, conditions. To my mind the winter and the summer in Pleistocene Europe was like that of Siberia and North America outside the Polar circle, and as there was no Arctic night, there was no summer and winter like that of the circumpolar regions.

This is not the place to enter into the glacial controversy[1] as to the interpretation of the boulder clays, sand and gravels that occupy Northern Europe. It is sufficient for our purpose to accept the fact that they have been accumulated by melting ice, that at the period of maximum cold formed a great sheet over the British Isles north of a line passing through Bristol and London and extending due eastwards over the continent to the north of the continuation of that line through Germany into central Russia. The southern margin of this ice-sheet was continually advancing or retreating during the whole of the Pleistocene period. It began in the Pliocene age in the Scandinavian mountains, and was represented in Scotland by glaciers, according to Dr. James Geikie, as late as the Neolithic division of the prehistoric period. In the Alps it is represented by four periods of glaciation named by Penck and Brückner the gunz, mundel, riss and wurm, separated by three interglacial periods, and ranging from the Pliocene to the present day. Under these circumstances it is clear that the terms glacial and interglacial and post-glacial relate to climatical conditions in Europe both before and after the Pleistocene age. For my part, in classifying the Pleistocene mammalia in Britain some fifty years ago, considered up to that time by Professor Phillips and others pre-glacial, I used the term post-glacial in the sense that the animals in question, from their position in the river deposits, were later than the boulder clays of the districts in which they occur in south-eastern England. For the same group Dr. James Geikie uses the term interglacial, because at that time there were glaciers in Scotland, although it would follow that if this principle be of general application, we are now living in an interglacial period because the glaciers are still to be found on the mountains of Europe. Dr. Croll even goes so far as to assert that the carboniferous flora grew in an interglacial period. All the terms are in hopeless confusion, and in my opinion should only be used to represent local conditions.

The migration of the temperate and northern groups of animals into Pleistocene Europe was probably due to the lowering of the temperature in northern Siberia, by which they were driven from their feeding grounds in Asia, and compelled to move into Europe at the end of the Pliocene period, the temperate coming in first and

[1] I share the views of Professor Bonney in his address to the British Association at Sheffield, in 1910, with regard to the British Isles having been submerged in part as outlined by Sir Charles Lyell, in 1863, in his *Antiquity of Man*, and I am unable to accept the view of the extreme glacialists that the marine shells at high levels on the Pennine Chain, and on the hills of Wales, Ireland and Scotland have been pushed up by glaciers from the bottom of the sea to heights of more than 1,000 feet above sea-level.

the northern afterwards; the former spreading over the whole of Pleistocene Europe, and the latter as far south as the Alps and Pyrenees. Both arrived in Britain before the ice-sheet covered Ireland, and before the valleys of Lancashire and Yorkshire were filled with glacial gravels and boulder clays.[1] The mammoth, horse, reindeer, and hyæna occur at Hessle,[2] near Hull, in pre-glacial deposits, and at Bielsbeck,[2] some few miles farther to the north, the reindeer and mammoth are associated with the Irish elk, urus, horse, wolf, lion, the straight-tusked elephant and the leptorhine rhinoceros, under similar pre-glacial conditions.

The southern group of mammals too, migrating northwards from the warmer regions of the south, ranged over Southern and Middle Europe, and the British Isles as far to the north as Kirkdale cave, Yorkshire, and as far to the west as Ireland in pre-glacial times, before the ice-sheet covered those regions. In proof of this I would mention the pre-glacial forest-bed of the eastern counties, the pre-glacial marine gravels of Sewerby,[3] near Bridlington, yielding the remains

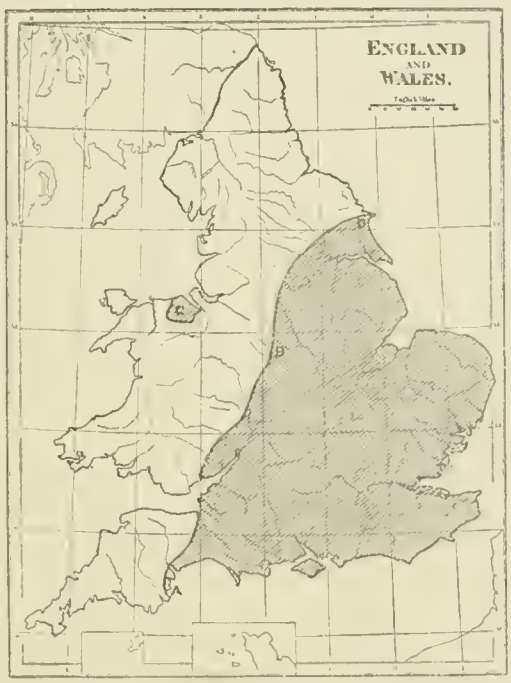

FIG. 3.—RANGE OF THE RIVER-DRIFT MAN IN BRITAIN.

[1] The boulder clays are the result of the melting of ice under conditions in which the materials in the ice have not been sorted by the action of currents of water, while the laminated clays and nine-tenths of the gravels are formed of glacial materials sorted and rearranged by marine and fluviatile currents. They are so intimately mingled together in the glacial drift that in many cases, as for example, in the docks at Salford, they were probably formed at the same time, as boulder clay at one spot, and sand and gravel at another.

[2] These are in the museums of York and Hull, and in various private collections. For the stratigraphy see Crofts, *Trans. Hull Geol. Soc.*, vi, part i, Stather, *ib.*, part 2.

[3] For bibliography see Drake and Sheppard, *Proc. Yorks. Geol. Soc.*, xvii, part 1, 1909, p. 7.

of hyæna and hippopotamus along with mammoth, straight-tusked elephant, bison and urus, and the caves of Ireland with hyæna, mammoth, and others.

The Place of the River-Drift Man in these Migrations.

With all these facts before us we are able to consider the place of man in these migrations, and to deal with his range in the Pleistocene age in relation to the mammalian groups. We shall take the river-drift man first.

The river-drift implements in Britain are found in the river deposits only of England, south and east of a line passing through Devonshire (see Fig. 3), the Bristol Channel, and along the western side of the lower valley of the Severn, and striking to the north-east from the Severn through the Midlands to the line of the Humber and Flamborough Head, in Yorkshire. To the south-east of this line, as may be seen from the geographical data in Sir John Evans' *Ancient Stone Implements*, they are abundant. I am indebted to Mr. Boynton for the most northern locality in which they have been found, at Huntow, near Bridlington, as well as for the figure (Fig. 4) of the implement that extends their range to the district north of the Humber. To the north and west of this line river-drift implements occur in the caves of Kent's Hole, A, of Fig. 3, and those of Cresswell, B. and C, those of the district of St. Asaph in North Wales. Throughout this area river-drift man followed the seasonal migrations of the wild animals, ranging northwards and southwards. This is proved by the distribution of the implements made of the greensand chert of Dorset, and the Blackdown Hills northwards over the plains of Somerset to the Severn, and into Oxfordshire and beyond. To the north and west of this hunting ground the ice, or it may be, the sea or glacial conditions generally formed a barrier, probably during the mid, and certainly in the late, divisions of the Pleistocene age (Fig. 3).

On the Continent the river-drift man is proved by his implements to have hunted over the whole of France, Spain, and Italy (Fig. 5). His range is extended to the south and the east by the discoveries made in 1875 in Algeria by Dr. Bleicher, and recently elsewhere by Mr. Boule, and by various implements found in Egypt and Asia Minor. River-drift man is also now proved by the officers of the Indian Survey to have ranged over nearly the whole of the Indian peninsula, and to have hunted the pleistocene animals of that region with the same implements and weapons as in Europe. From Europe to India, from Bridlington to the valley of the Nerbudda and to Madras is "a far cry." It must, however, be noted that the discovery of river-drift implements in Asia Minor and in Egypt, probably indicate the general direction of the migration, although they have not as yet been found in association with the remains of pleistocene animals, that would place their age beyond dispute.[1]

[1] Implements more or less of river-drift type occur over a very large portion of Africa south of the Sahara from the falls of the Zambesi to Cape Colony. They are found in the surface soil and the sub-soil gravels, etc., and have not yet been discovered in association with pleistocene animals. The so-called palæoliths of North America are proved by their association

The impression left on my mind by this southern range of river-drift man is that he belongs—just as the cave-hyæna and hippopotamus belong—to the southern group[1] of mammalia, and that he followed them from the south over Europe as far to the north as the British Isles (Fig. 5). He was probably represented by various tribes in various places, differing from one another like those of North America at the time of the Spanish conquest.

The low type of man found in a cave at Neanderthal between Elberfeld and Dusseldorf is proved by the discoveries in 1886 in the cave of Spy to have ranged from the Valley of the Rhine to the province of Namur, and by the further discoveries in 1907 in the cave of La Bufﬁa de la Chapelle-aux-Saints,[2] in Corrèze, as far to the south-west as the Valley of the Dordogne, and by the re-examination by Dr. Keith of a skull found many years ago by Professor Busk to be represented in the caves of Gibraltar. It is defined by Mr. Boule as possessing pithecoid characters, enormous supercilliary ridges, great prognathism, by the occipital foramen being farther back, and by the height index (6·25) being lower than in any existing race. There is no chin. The skull is long, the cephalic index being 7·5. The tribes possessing these characters probably extended far beyond the area mentioned above, in the stage of the pleistocene defined by M. Boule as the Moustier stage of the mid-pleistocene. It is probable, in the absence of direct evidence, that the river-drift men in Britain belonged to the same primitive race.

The human remains described by Mr. E. T. Newton[3] from the mid-pleistocene deposits of Galley Hill, near Northfleet, do not in my opinion throw light on the question. They may be of later date, and the deformation and condition generally of the skull prevents such accurate measurements[4] being taken, as are necessary before the find can be used as a document in anthropology. "The characters," writes Mr. Newton . . . "are not such as will permit of any very definite conclusions being drawn as to the precise race to which they may have belonged."[5] Both Sir John Evans and myself, in the debate on the paper, considered the age of the remains to be uncertain, and under these circumstances it is the safer course to put the discovery to "a suspense account." I know of no human remains in Britain that throw any light on the physique of the river-drift man.

It is obvious that a uniform state of culture, such as is presented by the river-drift man, does not necessarily imply a unity of race, and it is very unlikely that the tribes hunting in the tropical forests of India were the same as those that

with implements of well-known Red Indian type to have been made by the ancestors of the Red Indians.

[1] Hitherto I have grouped river-drift man with the temperate group of invading forms. On reviewing the whole question the evidence appears to me very strong in favour of his classification along with the southern group.

[2] *L'Anthropologie*, 1908, xix, p. 314.

[3] *Quart. Journ. Geol. Soc.*, li, p. 505, pl. 16.

[4] *Op. cit.* Out of six measurements taken of this fragmentary and distorted calvarium five are noted by Mr. Newton as doubtful. The sixth or circumferential is also no exception, because the length and breadth on which its accuracy depends are doubtful.

[5] *Op. cit.*, p. 517.

followed the chase in Europe. It is more probable that it is the outcome of a primitive stage of savage life, from which mankind has emerged, and which may perhaps be represented by the implements of palæolithic type found throughout Africa, south of the Sahara desert, and as yet not proved to be of palæolithic age.

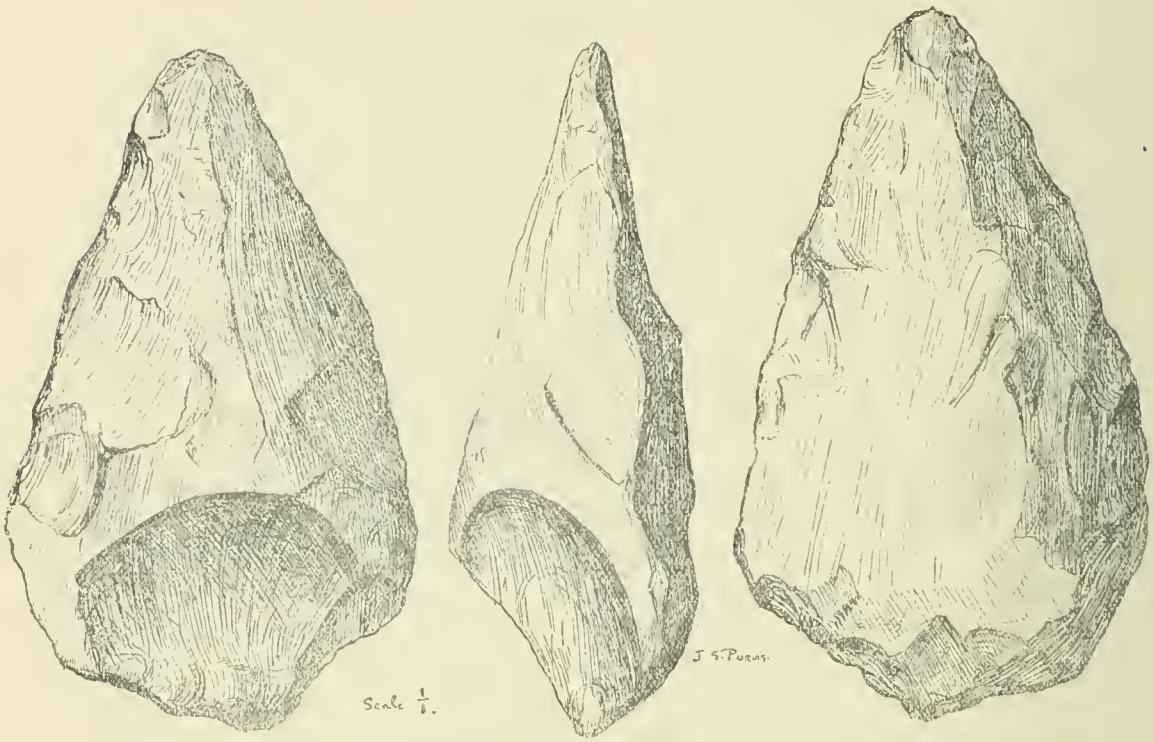

Fig. 1. River-drift implement, Huntow, Bridlington (Boynton coll.).

The Cave-Man probably belongs to the Northern Group.

I pass now to the consideration of the cave men. In 1880 I pointed out that the examination of the caves and river deposits of Britain and Europe proved that the hunter stage of culture presented by the cave-men was not only higher, but also later than that of the river-drift man. Are we to look upon this as the result of an evolution, from the ruder implements and culture generally of the river-drift man? In my opinion this question must be answered in the affirmative. It is not, however, proved that this evolution took place in Europe, even in those areas where the sequence is clear. In France, for example, the various groups of implements may have been introduced by different tribes migrating at different times from other areas.

The range of the culture of the cave men presents a striking contrast to that of the river-drift men (Fig. 5). It is confined to the region north of the Alps and the Pyrenees, and is not found over Southern Europe and North Africa, where the conditions of life were easier. The cave man, with this higher culture, led the

same life, using the same implements in hunting the same animals, reindeer, musk sheep, woolly rhinoceros, etc., over the whole of the pleistocene continent, from Yorkshire as far to the south-west as the Pyrenees, and over France, Germany, and Switzerland, as far to the east as Poland and Moravia.[1] In other words, he occupied the region in Central Europe, which was that occupied by the northern group of animals. The only exception to this generalisation is presented by the cave of Altamira, near Santander, in the western continuation of the Pyrenees, where the food of the makers of the frescoes consisted not of reindeer, but of red deer and bisons.[2]

All these considerations lead me to group the cave man with the northern mammalia, leaving the question of race to be settled by future discoveries. Unfortunately on this point the caves of Britain throw no light. Nor are we helped much, in solving this problem, by the caves of France. Even if we allow that the human remains in the cave of Cro Magnon belong to the "Aurignacean" stage of the French archæologists, and are not an interment of later date, and that consequently there was a tribe in Auvergne of tall men (5 feet 11 inches) with long head, well developed forehead, and a chin, it does not follow that the same tribe inhabited the caves of Britain or of Germany. We may, however, note that this tribe is proved by Dr. Verneau and others to have ranged over Southern France as far as the caves of Mentone,[3] and whatever opinion may be held as to the antiquity of their burials, there can be no doubt that the type of Cro Magnon is immeasurably higher in the scale than that of Neanderthal.

The Relation of the Cave Men to the Eskimo.

If the implements, weapons, and manner of life of the cave man are compared with those of living races, there is only one that can claim to be their representative, and possibly their successor—the Eskimo, inhabiting at the present time a narrow strip of the Arctic littoral, from Greenland as far as Behring Straits. In ancient times they inhabited also the north-eastern angle of Asia, and extended in America far to the south of their present limits. They live by fishing, fowling, and hunting, and use the implements of stone, bone, antler, and ivory, that are practically identical with those used by the cave man in the south of France. This is true even to minute details. The stone lamp, for example, of the Eskimo,

[1] Dr. Martin Kříz, *Beiträge zur Kenntniss der Quartärzeit in Mähren*, 8vo, Steinitz, 1903.

[2] My reasons for putting this discovery to a suspense account are given in my work *Cave-hunting*, 8vo, 1874, p. 249 *et seq.* The Palæolithic age is, however, very generally accepted by the leaders of anthropology on the Continent, and the skull is looked upon as a type of race.

[3] The discoveries made in 1901 by the Prince of Monaco in these caves of Grimaldi have thrown a flood of light on the cave-dwellers in the district of Mentone. They prove among other things the existence of a negroid race in Europe, and that the earliest inhabitants of the district hunted the hippopotamus, *elephas antiquus*, and the rhinoceros leptorhinus of Owen. They are now in course of publication, and until this is completed they cannot be satisfactorily dealt with. For outline see *Congrès Int. d'Anthrop. et d'Archéolog. Préhist. Monaco*, 1906, pp. 111–161.

is represented by that found in the cave of Kostelik,[1] in Moravia, and by the smaller examples used to light up the frescoed caves of La Monthe in Central France, and Altamira, near Santander, in Northern Spain. The figures of the animals, either outlined or carved, or painted, are also of the same order, and indicate that the art was the same.

To the objection that savage tribes living under similar conditions might independently invent the same implements, and that therefore the identity of implements does not necessarily imply a connection between the users of them, the answer may be made that there are no peoples now on the earth that use the same *set* of tools without having been at some time in touch with one another. The ruder and simpler forms, such as flakes, borers, and scrapers probably arose out of the environment, but when a whole set agrees, intended for various uses, and some of them rising above the common wants of savage life, the argument as to connection is, to my mind, of considerable weight.

FIG. 5.—RANGE OF PALÆOLITHIC MAN.

R. = River-drift man. C. = Caveman. E. = Eskimos.

[1] Dr. Kříz, *op. cit.*, p. 458.

The view that the culture of the Eskimo is derived from that of the cave men is considerably strengthened by the range of the animals hunted by the latter in Europe over vast regions in Northern Asia that separates them from the land of the Eskimo. The reindeer, the musk sheep, the marmots, the Arctic foxes, the grouse, and the snowy owls, used for food by the cave men in France, are still so used by the Eskimo, and the group of extinct animals hunted by the former in Europe is represented by fossil remains found throughout the region that divides the cave man of the Upper Danube from the Eskimo of Behring Straits. The mammoth and the woolly rhinoceros have been met with in vast numbers in the river deposits and in the caves in Central and Southern Russia in Europe, and throughout Siberia.

In the caves of the Altai Mountains[1] the same two animals are associated with the Irish elk, cave hyæna, brown bear, pouched marmot, beaver, Arctic hare, elk, stag, roe, bison, horse, and wild boar, and we do not lose sight of this group of animals even at Behring Straits. It is true that the woolly rhinoceros is not found in North America, but the group is represented by the animals discovered by Captains Beechey and Kellett in the frozen gravels forming the cliffs of Eschscholtz Bay, the elk, reindeer, the bison, the horse, and the mammoth. Then, the western portion of Arctic America, now occupied by the Eskimo, belonged to the same zoological province as Northern and Central Asia and Europe, and there were no barriers to prevent migration from the one to the other.

Nor are we without evidence that palæolithic man hunted the above group of animals in Siberia. In 1892 M. Savenkov described[2] a collection of implements found in the brick-earth of Krasnoïarsk, in the Valley of the Yenisei, in association with the following animals: mammoth, woolly rhinoceros, horse, urus, bison, reindeer, and elk. They consist of stone implements of the type found at Moustier, made from fragments of the erratic blocks of the district, and of various articles made of bone, reindeer—antler, and mammoth—ivory. M. Savenkov assigns this ancient camping ground to the end of the Palæolithic period, or in other words to the age of the reindeer. It is also proved by its position to be postglacial, or after the ice had retreated from that portion of the Valley of the Yenisei.

In all these facts I see cumulative evidence in favour of the view that the cave men have handed down their culture to the Eskimo by means of the post glacial hunters in Northern Asia. I do not, however, think it proves an identity in race, as I thought in 1880.[3] It may have been brought about by the contact of tribes of different race. On reviewing the whole evidence, it seems to me, that the physical relation of the cave men to the Eskimo is an open question, which cannot be definitely answered till we have more evidence than we now possess of the palæolithic hunters of Siberia, as well as more evidence from the caves of

[1] Brandt, *Mélanges Biologiques tirées du Bull. Acad. Imp. des Sc. de St. Petersburgh*, vii, 1870.

[2] *Congr. Int. d'Archéol. Preh. et d'Anthrop. Moscov*, 1892, t. 1, p. 121.

[3] *Early Man in Britain*, c. vii.

Europe. As the case stands now the cave man belongs to the northern group of mammalia and probably came into Europe with them from Asia and returned with them into Asia at the close of the Pleistocene period. I would further suggest that the regions of Asia north and west of the great mountain barrier, now the meeting place of temperate and southern forms, may have been the area in which the culture of the cave man was evolved from that of the river-drift man.

The Changes at the Close of the Pleistocene Period.

We must now pass to the consideration of the changes that took place at the close of the Pleistocene period. On the Continent generally there is no evidence of any great geographical change, and the retreat of the glaciers to the higher regions is the only evidence as to climate. The British area, up to that time part of the Continent, became depressed beneath the waters of the sea, and assumed almost its present insular shape, the North Sea and the Atlantic filling the lower grounds and ultimately joining at the Straits of Dover, and forming a barrier to the migration of the land animals from the Continent. The climate also became insular, and very much what it is to-day. Under these changed conditions of life it is no wonder that many of the pleistocene species became extinct, and that most of the northern and southern animals died out in Britain, leaving behind the present wild fauna, mainly of temperate species. At this time we lose sight of palæolithic man, who disappears without leaving behind any traces of his culture or equipment to his neolithic successor in the Prehistoric period. This is probably due to the great length of the interval between the Pleistocene and Prehistoric periods implied by the great geographical climatal and zoological changes above mentioned. It certainly has not been bridged over by any discoveries made in Britain.[1] On the Continent, the zoological break, although, as might be expected from the fact that there was no great geographical change, is not so strongly marked, is of the same general order, and in my belief only to be explained by changes in the fauna spread over a period sufficiently long to allow of the extinction, and disappearance from Europe, of the characteristic pleistocene species. It is something more than *une simple lacune de nos reconnaissances*, as Mr. Déchelette puts it, to be filled in by the "Azilien," a phase of transition from the Pleistocene to the Prehistoric period. This *phase de transition* appears to me to be based on very weak evidence and to represent only a sequence of deposits ranging from the latest stage of the Pleistocene to the Neolithic age. The flat harpoons of stag's antler, considered by MM. Cartailhac and Boule to prove the transition in the caves of Reilhac[2] and Mas d'Azil, are found in the neolithic Swiss pile dwellings, Wawyl, and elsewhere. The barley also and the stones of the cultivated plum of the cave of Mas d'Azil are neolithic in

[1] For evidence of this see *Journ. Anthrop. Inst.*, 1894, p. 248 *et seq.*

[2] For further details and references as to these two caves see my address to the antiquarian section of the Roy. Archæol. Institute: "The Present Phase of Prehistoric Archæology," *The Archæol. Journ.*, December, 1897.

Switzerland, and can hardly be taken to prove that barley fields and plum orchards were in the south of France in pre-Neolithic times. In both these caves I can only recognise two distinct civilisations, the newer or Neolithic, characterised by the presence of domestic animals and cultivated plants, and the older or that of the cave men, the hunter of the reindeer. I am unable to see any signs of transition between the two, nor am I aware of any other discoveries that throw light on the question in any part of the world. The neolithic was undoubtedly evolved from the palæolithic civilisation in some quarter of the world, but there is no evidence that this took place in Europe, or that the present European peoples are the lineal descendants of those who ranged over Europe in the Pleistocene age. There is ample time in the vastness of the interval between the Pleistocene and Prehistoric periods for the appearance, and disappearance, of many successive races of mankind.

Conclusion.

In conclusion I would add a few words on the antiquity of man—a burning question for the last sixty years. It is to be measured by the sequence of geological events, the changes in animal life and the advance of man in culture. It cannot be measured in years because there are no chronometers in nature that register so small a unit of time. We get no help as to a date in terms of years but only a general idea of the great length of time, from the study of the erosion of the land or the deposit of sediment in lakes, in river beds, and in the sea, or from the advance or retreat of glaciers. Outside history there is a simple sequence of events following one another in due order and with varying intervals, the length of which we do not know. These we are tempted to look upon very much in the same way as a child on a lofty mountain peak views the scene below, range after range, forest, river, and marsh succeeding one another, and apparently close together, although they are really wide apart. It is difficult to grasp the true perspective. Speaking for myself, the more minutely I examine the events that have taken place since man appeared on the earth, the more profoundly am I impressed with the vastness of his antiquity, and with the futility of any attempt to compute it in terms of years.

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