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JOURNAL OF
THE TRANSACTIONS
OF
The Victoria Institute,
OR
Philosophical Society of Great Britain.

EDITED BY THE HONORARY SECRETARY,
CAPT. F. W. H. PETRIE, F.R.S.L., &c.

VOL. XIII.



LONDON :

(Published for the Institute)

E. STANFORD, CHARING CROSS, S.W.

EDINBURGH : R. GRANT & SON. DUBLIN : G. HERBERT.

PARIS : GALIGNANI & CO.

NEW YORK : ANSON, D. F. RANDOLPH & CO.

1880.

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*THE PRESENT STATE OF THE EVIDENCE BEARING
UPON THE QUESTION OF THE ANTIQUITY OF
MAN.* By T. McK. HUGHES, M.A., Woodwardian Pro-
fessor of Geology, Cambridge.

THE subject before us is one of very great interest. It refers to times so far removed from our own that the wild interest of an unexplored land belongs to it, and yet so near that we can entertain the possibility and indulge the hope of exploration; and when we know that man was there, our interest grows still greater, and we look at it as on a wild region into which a tribe had wandered and got lost, of whom we think we might get traces yet if we could follow.

The subject embraces a wide field of inquiry, and may be approached from many sides. Philologists are questioned about the original oneness of language, and then, on the assumption of a common origin, are asked to estimate how

NOTE TO PROFESSOR HUGHES' PAPER.—For some years the Institute has encouraged research bearing upon the question of the "Antiquity of Man," more especially because the extreme views incautiously advanced by many, tended alike to injure the cause of Science and those higher interests with which this Society has also identified itself.

Professor Hughes' very high standing as a Geologist, and his painstaking accuracy, and caution, alike fitted him to take up the subject, and the following pages were written by him after a further examination of the reported evidences of the antiquity of man. It will be seen that Professor Hughes holds that the earliest known evidences of man's antiquity are amongst the Post-glacial Gravels, the period of which is almost the latest in Geological time; those therefore who have claimed for man an extreme antiquity will find his origin brought forward through well-nigh incalculable ages.—The Institute is much indebted to Professor Hughes, and also to those who have kindly discussed the subject, or sent in the after-communications, each of which is left to rest upon its own merits.

In the present state of the controversy we can only discern that cautious, accurate inquiry, and an avoidance of imperfect generalizations and hasty conclusions, will promote the cause of *Truth*.—Ed.

long, according to observed modes and rates of change, it would take to develop the manifold speech of to-day.

Physicists are called upon to tell us for how long the great lamp of heaven if not replenished can have burned; for if its age must be reduced, and yet include all the æons of geologic time, how very short the part through which man lived.

Biologists are asked if they can say what is man's place in nature among the groups of living things that people earth, and, on the hypothesis of evolution, how long it is since he has become that which we call man.

None of these questions are for me to-night. Though I must mention a theory of works of art of ancient date referred by some to "man's precursors," I shall dismiss that case on other grounds.

I take the question to refer to man,—man as we know him—of whom we all agree to speak as man.

I will suppose that I am asked first this: In what formations have we found conclusive evidence that man was there? and, secondly, having satisfied ourselves as to the relative position of the beds in which his works are found, can we assign any exact numerical estimate of years since those beds were laid down? and if we give that up, whether we can trace him back to a remote antiquity, and from what evidence we derive the impression or conviction that that was far removed from earliest history?

This part of the question is entirely geological. We may consider that we have proved the relative position of the beds with which we have to deal. But to refer to them by name without more explanation, I will first give a sketch of these from older up to newer as they come.

After the period when the present forms of life appeared upon the earth in numbers marked and well-defined—a period named from this the "dawn of recent days," the *Eocene*, there came a time when over Europe and beyond, the crumplings of the crust of earth left basins here and there not quite coincident with those that were before, and by this change drove out some forms of life, and let others in, which may have existed elsewhere before that time. Still few were there like those now seen in recent times, and hence they call the period by the name *Oligocene*.

When later on, by waste of shore and continent, hollows were silted up, and with that too the land was raised; less sea, more land, with lakes and streams, prevailed. England then stood above the waves, and here and there small peaty patches tell of swamps with reedy margin, where the leaves of plants blown in accumulated deep in mud.

In France the land was still more lowered, and received from lake and sea more mud and sand, and therefore deeper, wider beds there represent the time when a less number of the very same life-forms prevailed than afterwards. These beds were hence called *Miocene*, and in them it has been said that evidence of man's handiwork has been found.

Next came the *Pliocene*; in which we place the Crag, marine deposits of shingle, sand, and shells, found in our eastern counties; and on the Continent made up of various kinds of beds, but all containing more of the forms of life that now exist, and hence the name. In this, too, evidence of man's art is seen by some in rude drilled bones and teeth, such as are strung by savages for ornament.

After that followed a time, when from the great upheaving of the land the snow lay thick on all the northern heights of Europe, and glaciers crept down into the sea, and icebergs, with earth and stone fallen from crag or picked up on the shore, floated far south, melted and dropped their load. We need not now discuss the probability that then there might have been such combinations in the heavens as would intensify the extremes of heat and cold at either pole. This is a fair field of inquiry, and if we could obtain some means for correlating marked periods on the earth with cosmical events, then we might hope to arrive at some more accurate chronology; but we have too many unknown quantities to solve this problem with the data yet before us. Such questions we pass by, and only note that we had once within the later times such cold that frost held fast our northern shores, and ice came down in glaciers from the heights. When, later on, the land began to rise from underneath the sea, and the high ranges sank, and a more uniform temperature prevailed over all north-western Europe, the ice fell back, and could not gain in winter what it lost under the summer's sun. Then the streams, filled with melted snow and heavy rain, came down in floods over all the lower plains. The wandering animals, and even man, were often caught by the sudden rise of rivers winding about across the widening valleys, and their remains were buried in the mass of débris carried down. As time went on, the rivers, finding their way to lower levels, cut back waterfall and rapid to the hills, and left, now here now there, a terrace as a mark where once in ancient days the stream had run; and throughout all these later ages it is said that man was there, holding his own among fierce beasts, in forests and in caves along the river banks and rocky shore.

Now we will criticise the evidence adduced of man's existence at these different times, and, having satisfied ourselves

as to which cases we may accept as proved, will then consider the changes which have taken place since the date to which in the present state of the evidence we can with certainty assign his earliest known appearance.

We may dismiss at once the case reported from the Dardanelles of works of art found in deposits said to be of Miocene age. The descriptions* prove that it was not given on the authority of one competent to judge in such a case, and it never was confirmed.

Another instance referred to the same period we must consider more in full, because the evidence has been accepted by men of high authority in France.† In beds said to be Miocene, at Thenay, near Pontlevoy, the Abbé Bourgeois found flints which he supposed were dressed by man. These flints are now exhibited in the Museum at St. Germain, where I saw them with Sir Charles Lyell several years ago, and again with others since. Some of them seemed entirely natural, common forms, such as we find over the surface everywhere, broken by all the various accidents of heat and frost and blows. A few seemed as if they might have been man's handiwork, —cores from which he had struck off flakes such as we know were used by early man, of which I show examples. Yet this is not quite clear, for, had the evidence been good that they were found in place there still would have been a doubt whether they were man's work. But when we came to inquire about the evidence that they occurred in beds of Miocene age, we learned that only those that we put down as natural were found by the Abbé himself; the others were brought in by workmen, picked up, we may suppose, upon the heaps turned over by their spades, and so perhaps just dropped down from the surface.

When all the other higher forms of life were different it was not probable that man should have been the same, even when we remember that his intellect allowed him to adapt himself unmodified to different states of life, taking the clothing of the meaner brutes for his own use, and lighting fires and building homes, anticipating the future in more various ways than they. It would require the clearest evidence in such a case to prove that man was there, or that some other form as "man's precursor" represented him, but such evidence there is not.

* *Journ. Anthropol. Inst.*, vol. iii. April, 1873, p. 127.

† Bourgeois, "Étude sur des Silex Travillés trouvés dans les Dépôts Tertiaires de Thenay (Loir et Cher)." — *Congrès International d'Anthrop. et d'Archéol. Préhist.* 2me. Session, Paris, 1867. Hamy. *Paléont. Hum.*, 1870.

Next in the Crag the teeth of sharks, bored through, as if for wear, were found,* part of a string of ornaments such as commonly are worn by savages. Of these I give examples: one a boar's tusk, from the lake dwellings of Switzerland; another, a tooth from a deposit of palæolithic age, in a cave just above the miraculous grotto of Lourdes in the Pyrenees.

But let us see whether such holes are not sometimes the work of nature, and inquire more carefully whether these from the Crag were probably produced by nature or by art. For this purpose I have examined fragments of bone and teeth of various size and shape, and found them marked over the surface with many a pit or deeper hole, or even perforation irregularly placed, not as if by design, but accident. There they were in every stage, all over, yet of one type. One sawn across explains the whole. The chamber of a shell which bores its way into the solid rock or softer shale was clearly shown. When the mass lay embedded in the mud it was but touched here and there. If it was thin the animal bored right through into the sand or clay below, and showed the tooth pierced through—a perfectly well-turned and finished work, so good they thought it was man's. But if the mass was thick and near the surface, the little mollusc made a home entirely within it, and its shell often remains there, and reveals the history and manner of formation of the holes.

To the Miocene and Pliocene have been assigned some bones of large sea mammals marked as if cut by implements, and some fashioned as if for use as batons, swords, or clubs. Of these I have seen some, and in those cases certainly would not admit the evidence. There are so many common natural accidents that scratch and cut and break, that it requires far more accumulative evidence of design in the resulting form than any I have seen before we could assume man's agency. Some bones when fossilised break with a clean fracture, and show a smooth and even surface. Some of the specimens are held to be of doubtful origin, but in the best of those that I have seen, though I had no reason to suspect the origin, I felt it was too much to say that it was shaped by man.

An account has also been given by the Abbé Bourgeois of flints from Pliocene beds at St. Prest, near to Chartres, said to be worked by man, but this we may dismiss on the same ground as those before referred to given on the same authority.†

* *Journ. Anthropol. Inst.* vol. ii. April, 1872, p. 91.

† Bourgeois, *Congr. Inter. d'Anthro.* 1867, p. 67

Another case brought forward from abroad but recently, has found much favour here as there.* Around the Lake of Zurich there are left traces of ancient lakes at somewhat higher levels. A bed of clay below with glacial stones, a bed of plants between half-turned to coal, a mass of clay moraine-like on the top, tell of the time when Alpine ice crept further down the hills, and touched upon the lake, now more, now less encroaching. In these beds the peaty mass of lignite, known as Dürnten coal, was largely dug for fuel. I have worked a long time down below to see the evidence myself. The sequence of the beds is clear. But recently two Swiss professors have proclaimed that they have obtained proofs incontestable that man was there, and wove a basket, fragments of which were found among the drifted plants which formed the coal. These fragments, it is said, consist of pointed sticks, sharpened across the grain, not tapering naturally, and a cross set of binding withies, all now pressed and changed, but by such characters referred to work of man. Now I have found myself along the shore fragments of wood and twigs half decomposed and waveworn till they were cut to a point obliquely to the grain, as they describe the Dürnten sticks. Across such fragments often others fell, and when the whole was then compressed what wonder if they left a mark of wattle or of basket-work? and the whole mass has suffered such great pressure from the superincumbent weight of clay that all the round twigs and stems are squeezed quite flat, as in the specimens before you. These Dürnten pointed sticks, however, I have not seen, and, therefore, speak with caution, showing only how I think the thing might be otherwise explained.

More recently the legitimate ambition to be first to make a great discovery, not controlled and kept subordinate to judgment, has adduced other examples, where the age of man has been too hastily referred to glacial or inter-glacial times. Whatever may be found hereafter, the evidence on which this case has now been based was not such as would justify the statements founded on it. Widespread beds of loam and sand, and gravel, cover the lower levels of East Anglia; and, probably ranging over a vast period, have been collectively described as "middle-glacial," for below are glacial beds, and in the middle series boulder clay, and over them, whether in part *remanié* or not, another boulder clay. Lying in hollows and on the flanks of valleys, cut through this ancient loam and other beds, are river terraces of later date;

* Rüttimeyer, *Archiv. für Anthropologie*, 1875; Heer, *Primæval World of Switzerland*.

and these, because in great part made up of the older beds, are like them, and require experience to distinguish. In these old terrace deposits implements of man's undoubted work have long been found; but recently it has been said that some of these beds belong to the older series.* This, then, becomes a matter of opinion. For my part, being well acquainted with the deposits in question, and having listened to the evidence, I give my testimony quite against the glacial or the interglacial age of any of the beds from which the hatchets came. It is, however, said that other evidence has since been found, conclusive as to this. I can but criticise that which has been adduced; but I will say that if such has been found and been so long withheld, while there are so many deeply interested, and so many who would like to verify at once and on the ground the statements made, then I do hold that there has not been shown that love of full investigation which is the soul of science.

Upon the screen I give diagrammatic views of some of the sections showing the newer beds in which the implements were found, and older middle glacial, from which their relative position may be seen. These I have more fully described elsewhere.†

In many countries where rocks of limestone tower in cliffs and crags above the valleys, and are tapped below by undermining streams, the rain which falls upon the higher ground is lost in cracks and joints, and carries off the rock dissolved in water, which contains a little acid caught by the falling rain or drawn from decomposing plants. The fissures thus enlarged into the gaping chasms called "swallows' holes," the "katabothra" of the Greeks, admit a copious torrent, carrying stones and sand which grind and bruise and open out the jointed rock into great caves and subterranean courses. These, when tapped at lower levels, are soon left dry, and offer to prowling beasts of prey a safe retreat, and often man availed himself of them, as testify the Adullamites and Troglodytes of every age.

From such a cave up in the crags of Craven some evidence is adduced that man existed far back into glacial times, and this, perhaps, is the best case that has been urged.‡ There a large group of animals, such as occur elsewhere along with man, and more doubtfully traces of man himself, were found in beds overlapped by glacial clay which had sealed up the mouth of the vast den in which these relics lay. This excavation I have watched myself at intervals from the commencement, and I hold

* *Mem. Geol. Surv. Geology of Fenland.*

† *Journ. Anthro. Inst.* vol. vii. November, 1877, p. 162.

‡ Tiddeman, *Brit. Assoc. Reports*, 1870-8.

that as the cliff fell back by wet or frost, and limestone fragments fell over the cave mouth, with them came also masses of clay, which, since the glacial times, had laid in hollows in the rock above. We dug and found such there, and, more, I observed that the clay lay across the mouth as though it had thus fallen, and not as if it came direct from glacial ice that pushed its way athwart the crag in which the cave occurs. It seemed to have fallen obliquely from the side where the fissured rock more readily yielded to the atmospheric waste, so that it somewhat underlay the part immediately above the cave. On the inside the muddy water which collected after flood, held back by all this clay, filled every crevice and the intervals between the fallen limestone rock, while still outside was the open *talus* of angular fragments known as "screes."

These are the most important cases that I know where man has been referred to glacial or inter-glacial times; but all, it seems to me, quite inconclusive. On the contrary, there is much in them, and much besides pointing the other way. In support of which opinion I will now offer some independent evidence, showing that some similar beds with man and the beasts that are found with him in earliest times can be proved to be post-glacial.

There are river gravels, as near Cambridge, at Barrington and Barnwell, which contain an ancient group* of mammals, earlier, it would appear, than those which most commonly occur with man, and yet the gravel in which they are found is made up largely of the washings and siftings of the boulder clay, which, therefore, was more ancient.

In a cave high in the limestone rocks that overhang the Elwy, in North Wales, are found human remains associated with rhinoceros, hyæna and cave-bear; but underneath and in the beds in which they lie are found fragments of rocks which must have come from other basins, transported by glacial agency across the watershed, and washed in where they are found, out of the boulder clay, which, therefore, in this case also is shown to be more ancient.† We should expect before the glacial times a somewhat different group, but on this head more evidence is wanting.

I will not waste time to discuss whether the objects we refer to man now found in numbers in post-glacial river gravels are really of human work.‡ That is now generally allowed, and I have placed upon the table specimens from some of the more

* Fisher, *Camb. Phil. Soc.* February, 1879.

† *Journ. Anthro. Inst.* vol iii. 1873.

‡ See Evans, *Ancient Stone Implements of Great Britain.*

important places. Accepting such things as human work, I will just enumerate a few of the many districts where they are found, to show that it is not an exceptional case to be explained by some local cataclysm caused by the sudden upheaving of the land, perhaps with earthquake shocks, or to the bursting of a barrier where the waters long pent up rushed down and filled the valley. We have to deal with facts so clear, so numerous, so widespread, and so similar everywhere, that we see we must at once refer them to the common ways of river denudation.

Along the Somme, loam, sand, and gravel, nearly a hundred feet above the river level of to-day, have yielded these works of man. We know that they are river gravels, from the shells that they contain. Similar implements are found along the Garonne, and in the basin of the Loire. They are brought from Africa and from India. In our own country, in the valleys of the Thames, the Ouse, the Medway, and the Avon, at 40, 50, 60, 80 feet above the river level; along the Solent and the coast near Barton, and near Bournemouth, and in the Isle of Wight, in terraces of ancient rivers, 100 to 150 ft. above the sea, they have been found. Everywhere in these older beds, with nearly the same groups of animals, the same types of instruments are found, distinct from later forms, quite recognisable.

And in caves we find traces of man with the extinct and migrated mammalia. In the Dordogne they have been classified by date, La Madelaine, the two Laugeries, and Le Moustier, the oldest being Le Moustier. In our own country, on the coast of Devon, in the cliffs of Yorkshire, Derbyshire, in Wales both North and South, along the Wye, and almost wherever limestone crags are found, these caves have furnished shelter to an early race of man. I do not know that as yet any exact relation has been established between a cave with works of man and any terrace with the samé. A diagram on the screen shows the position of one of the celebrated Pyrenean caves (Gourdan)* with reference to the higher terraces of river gravel opposite to it. They stand at the same height above the river. This cave contains the usual group of extinct and migrated mammalia, and of man abundant evidence in bone and stone, of which examples lie upon the table. The terraces immediately opposite have not, so far as I am aware, yielded remains of man, but lower down the river instruments of palæolithic type have been procured by M. Noulet, and may be seen in the Museum at Toulouse.

* Piette, *Acad. des Sci.* 31 Jul., 1871; *Matériaux pour l'Hist. de l'Homme*, 1871, p. 494.

Perhaps no cave-deposits that we know are quite so old as the oldest river terrace that has yielded traces of man, still all the earlier ones may be included in the same bracket, and referred to the oldest stone or palæolithic times.

From the caves we cannot get much evidence of the lapse of time. The circumstances that affect the mode and rate of their formation, or the growth of travertine, or the slow infilling of the cave with mud, are far too variable, and dependent upon too many local causes to found on them a date. I have myself found modern bottles under as great a depth of stalagmite as elsewhere covers mammoth bones.

But from the terraces we may derive some help to form an estimate of the great lapse of time, though we may not as yet assign a term of years. What, then, are these terraces, and how formed? It might appear at first an explanation not quite consistent with known facts to state that all the valleys with which we are concerned in this inquiry were scooped out by the gradual action of the streams, and that the terraces but mark old margins, where the streams once ran at higher levels. Why, it is said, if so, do we not find at every intermediate step of this continuous gradual waste the marginal deposits? Elsewhere* I have more fully dwelt upon this question, pointing out that every river only just hands on along the flat the mud and gravel it receives from higher lands, but at the rapids and the waterfalls it still cuts back its channel, lengthening the lower reaches of the river at the expense of the upper. The terrace generally marks the vertical height of the higher above the lower reach. It is clear that synchronous deposits may be found at the two levels, but it is also clear that, if we see a terrace far above the level of the present stream and far down the valley from the waterfall or rapid that tumbles from the level of that terrace higher up the stream, then we may measure the antiquity of that terrace by the time that it would take the waterfall or rapid to cut back from where it was when the terrace was being formed to where we find it now. Some circumstances we must take account of which would increase the *rate* of waste, and so reduce the *time*. If an upheaval take place near the sea where formerly the long low flats were added to, not cut through by the river, then the flood, tumbling over the now-raised soft deposits of mud or sand or gravel into the sea, would soon cut back its channel. Also movements in the hills might cause some changes; or again, a not unimportant thing in chalk districts, the gradual removal of a clay covering which caused the water to collect in runlets first, then streams, would let the water soak into the porous

* Royal Institution, March 24th, 1876.

beds below, to find its way out in springs at lower levels, or, possibly, beneath the sea, and so all denudation by the streams be stopped. No observations have, as far as I can tell, been made in any of the river basins with which we are now concerned upon the rate of retrocession of the rapids or falls, such as would enable us to form a numerical estimate of the number of years that must have elapsed since the implement-bearing terrace gravels were left where they now lie.

But there are circumstances that give the impression which, in most of those who have seen many similar examples, amounts to a conviction, that the time must have been in most cases enormously long.

At the Reculvers, on the Thames estuary, a bed of gravel caps the cliff quite 50 feet above the sea. This has flint weapons in it. When the Thames ran at that level down by its mouth, it cannot have run at a lower level by London; yet, as far as we know from old remains, London was as now 2,000 years ago. Teddington, to which they say the tide came up when first it got its name, was then no higher, and so we trace the valley far up into the oolitic hills, so far I doubt whether now we could identify the corresponding levels. How long did it take to cut back such a valley and so far, seeing that within the time of history we know of no great difference in its channel?

So for the Somme. The Romans left what they lost down in the peat quite 80 feet below the terrace on which the city of Amiens stands. This terrace we can trace much further both up and down the valley. Beds of the same age, too, are found at Menchecourt at a lower level. They may be synchronous with those of Amiens, if the rapids then came between. The rapids had passed Amiens before the Roman times. Where are they now? Far back towards central France. How long it took to cut the valley back so far I will not try to speculate, having no data, but I feel that it must be something very great, seeing that the historic period of 2,000 years has done so little.

Another line of inquiry I will mention to conclude with. In the long periods of geologic time races appear and last awhile, and then are not, and a new group of living things represents them in the next succeeding age. How they went out we cannot tell. It was not by cataclysms, for they go one by one, and the deposits tell of slow accumulation; but more as if some gradual changes over various regions of the earth made each successive place in time unsuitable for all the life that once was there. First, those which were most susceptible and able to migrate went off. So nature has arranged for a constant succession upon earth's surface;

and having regard to some forms, fixed as the oyster on the solid rock, immovable, lest in these changes they should be all destroyed, provided that their young should freely swim till they had found a station suitable for them, then plant themselves for life; so also do the seeds of plants. And thus we have learned to look upon the fact that there had been great changes in the forms of life between two periods, as proving also a great lapse of time, seeing that all the indications we can trace show that these things were gradual.

In the same beds with man's remains are creatures now extinct: the mammoth, for example, and others too, more numerous, now only found much further north or south, which once lived there, but migrated. It is not sufficient explanation to remark how such large animals, as being fierce wild beasts or good for food, are often now killed off or driven out by man. For with them in this case are some small shells, one (*Corbicula fluminalis*) now found no nearer than the Nile; the other (*Unio littoralis*), gone as far as the rivers of France; but they once lived with the extinct mammalia and with man in Britain. It seems more likely that we have but the continued working of the laws which from the earliest geologic ages have determined the range in time of genera and species, and as all through the early epochs of the world the greater changes in the life were carried out in very long periods as deduced from independent reasoning, so it appears that in these later ages during the time required for the formation of the valleys and their terraces a corresponding change was brought about in the great groups of life that dwelt with man in north and western Europe, and this fact much strengthens our belief in the vast time which has elapsed since his appearance there.

Such, then, it seems to me is a fair statement of the present state of the evidence for the antiquity of man. First, it has completely broken down in all cases where it has been attempted to assign him to a period more remote than the post-glacial river gravels, and there is much reason for thinking that should evidence be hereafter forthcoming on which he may be relegated to a more remote antiquity, it will not be found in northern Europe. And next, although we cannot offer any numerical estimate of the antiquity of the human remains found in the river gravels, still, having regard to the geographical and palæontological changes which have taken place since the period when those gravels were deposited, as compared with the changes which have taken place during the eighteen centuries which in our country we may call historic, it would appear that the age of man must be a very large multiple of the historic times.

The CHAIRMAN.—We are much indebted to Professor Hughes for this very interesting and important paper, all the more so because, in spite of his labours in his professional work, he has given so much valuable time to its preparation. Indeed, he has been so much occupied as not to have been able to send in the MS. in time for the Council to have it printed. I hope, however, that the meeting has gone sufficiently far with him to be able to discuss the paper.

Mr. J. E. HOWARD, F.R.S.—There are a few observations I should like to make with regard to what has been said about the Valley of the Somme, and the degree of rapidity with which rivers have worn down that and other valleys. The valley of the Thames is one with which, of course, we are all more or less familiar, and we know that the deposits under London and in the neighbourhood disclose something as to the antiquity of the work that has been accomplished. We thus obtain some measure of the time which we may suppose the river to have taken in excavating the valley, supposing it to have been excavated in the same way as has been suggested with regard to the valley of the Somme and other valleys in France. The first of the strata at which you arrive in digging the foundations of houses in London,—and I have had personal experience of this recently within a few hundred yards of St. Paul's,—consists of sand and gravel, and contains some remains of the Roman period. Then, beneath these, you arrive at strata which (I am told) contain the bones of the mammoth and other extinct animals. These, it seems to me, indicate a state of things belonging to the Pliocene period, or the period of the extinct animals. I do not think we can arrive at the conclusion that there has been, since then, any excavation, but quite the reverse, when we find these strata superimposed upon each other about 20 or 30 feet under London. (Hear, hear.) [The magnificent tusks of the mammoth, now in the British Museum (found at *Ilford*), show that the tributaries of the Thames flowed at about the same level when this creature was drowned at the ford over the Roding.] We know that the rivers in the neighbourhood of London do not now excavate the valleys at all; it is rather the contrary, for they appear to fill up very considerably. (Hear.) This I know to be the case in regard to the river Lea, near which I live, and in the neighbourhood of which I have works, and have seen excavations. The Lea valley, in the vicinity of Bow, has been filled up since the Roman period to the extent of 5 or 6 feet, as is shown by the excavations that have been made; for the workmen have found, and I have received from them, many curious and interesting relics of Roman times. Therefore, I am unable to understand the argument we have heard as to the formation of valleys by slowly-flowing rivers such as the Thames. It does not appear to me that in any conceivable time,—even if you were to take an eternity,—you could excavate the Valley of the Thames by means of the river flowing through it: it would rather, as I have already said, have a tendency to fill up the valley. With regard to the valley of the Somme,

it was at one time asserted that the deposits found there were of extreme antiquity,—I allude to the deposits in which the earlier works of man were found. This was the theory in England ; but it was not exactly this supposition that set M. Bouchier de Perthes, who was the first great explorer in that region, to work. He started on the basis of a very definite theory, which he explains in his elaborate books, certainly interesting, and which I have perused since I read my last paper here. His supposition was that man was contemporaneous with the mammoth (of which there can be no doubt); and that wherever the bones of these great extinct animals are found, there also, in the course of time, would be found the works of man and his remains. This was his theory, and he began to examine what was then called the diluvian strata, which I think in England are now called the drift. He set to work to find such remains in the drift, and although he was ridiculed, he persevered for many years, and never ceased till he had found, not only the works of man in the *diluvium*, but also what were clearly his bones. (Hear, hear.) The works of M. Boucher de Perthes prove that the diluvian strata are not formed by pluvial deposits, but by some great cataclysm. I do not believe that any of the causes at present at work have formed the valleys or can account for the configuration of the hills ; but that we must go to much more powerful causes in order to account for what we see. (Applause.)

Mr. D. HOWARD, F.C.S.—With regard to the level of valleys, it is sufficiently ascertained that the deposit made in the valley of the Lea is now going on, and that there is no denudation ; in fact, it would rather appear that there has been an actual rise in the level of the valley. The points traditionally referred to as being where, at the time of King Alfred, the Danes sailed up, are at such a level that it would be impossible for them to sail to at the present day. But that there is some foundation for this tradition is shown by the fact that some remains, which appeared to be those of a Danish vessel, were found near Old Ford, at a spot to which the tide would not, apart from the question of the gateways which prevent its flowing freely, now allow such a vessel to reach. But, with regard to the question that has been raised in reference to these valleys, there is one point which I have never heard fully explained, and that is, how far the bones of man are found in them. Undoubtedly, the presence of the bones of man would be much more satisfactory than the finding of flint implements. The vagaries of flint when weathering are so extraordinary, that it requires cumulative evidence to give satisfactory proof of the pieces that are found having been made by man ; but bones are things that require no cumulative evidence, because it can be shown at once that they either are or are not of human origin. (Hear, hear.)

Mr. T. K. CALLARD, F.G.S.—I am afraid that we are somewhat at a disadvantage to-night, in not having had the paper which has been read, in a printed form before us, and Professor Hughes will excuse me if I am not able to deal with the subject as readily as I might have done had I been able to refer to the paper, and mark it as he went along. I am very pleased

to find that with the usual candour and skill with which Professor Hughes deals with all geological subjects, he has cleared away to-night some of the supposed evidences of the antiquity of man, and brought us down to two or three important points, which we can discuss much better than if we had to be thinking of Swiss lakes and kitchen middens, and going here and there for evidence. (Hear, hear.) He has cleared the way a great deal, and shown that the antiquity of man, as far as we yet know, does not extend so far back as has been thought by many scientific men. I would, however, make this remark, that Professor Hughes has dismissed any discussion with regard to the flint implements before us, in what I think rather too rapid a manner, because I certainly have not been able to understand on what ground he says, so positively, that they are of human workmanship. They may be ; but, on the other hand, we may be deceived in forming such a conclusion. (Hear, hear.) The Brandon gravels have been referred to, and I have here some flints from the Brandon gravels. May I trespass so far as to ask Professor Hughes if this one, with the point broken off, is in his judgment, an implement ? (Showing it to Professor Hughes.)

Professor HUGHES.—Certainly, I should accept it as such.

Mr. CALLARD.—Here is another from St. Acheul. Would you accept that as an implement ?

Professor HUGHES (examining it).—No.

Mr. CALLARD.—You accept one flint readily, the other you as readily refuse to accept ; but I think that if they were handed round the room, there are very few gentlemen who would be able to see much difference between them. This [referring to a third one] I picked up on the surface of the soil near St. Acheul, and I see no reason to believe it to be of human workmanship ; but, at the same time, I think it looks as much like the work of man as the flint you have accepted as an implement from Brandon.

Professor HUGHES.—Respecting the third specimen, it might have been made by man, or it might have been the result of accidental fracture. I could not be certain. My reason for thinking that man might have made the one and that he never made the other I will state when I reply, and I will then point out what constitutes the difference between them to my eye.

Mr. CALLARD.—That some of the best specimens have the appearance of being made by man I readily admit ; but seeing that the naturally fractured ones so nearly resemble them, it would suggest the need of great caution in pronouncing any specimen to be of human origin in the absence of collateral evidence. There is a flint which you accept at once ; now here is another, exactly like it, which never has been out of its matrix, and which man could not have made. These are the things which make me say, we must pause before we decide that man has done this or that. If man has not made these implements, then of course the whole argument falls to the ground, as far as evidence from the gravel is concerned. Then, again, Professor Hughes has taken it for granted that the river Somme cut the Somme valley. Now, I certainly should not take it for granted. I have been

all over the ground and examined it carefully, and, as far as I saw, I came away with the clear conviction that the Somme river, although running through the Somme valley, never excavated that valley.* There are about twenty-eight miles of the valley between St. Acheul and Moulin Quignon, in both of which places implement-bearing gravels are found. St. Acheul is 149 feet above the level of the sea at St. Valery, and Moulin Quignon 106 feet above the same level. If, then, the river ever ran at the height of these gravel beds, the fall would be 43 feet between these places. A fall of 43 feet in twenty-eight miles gives a good deal less than 2 feet per mile. When I looked at this fact, I asked myself the question,—“Is it possible that a river flowing with a fall of less than 2 feet per mile could have eroded this immense valley?” (Hear, hear.) Then it must be borne in mind that the Somme is but a small narrow river, while the valley through which it flows is wide, being sometimes two or three miles in breadth, and I would venture to say that if you could spread the river all over the valley I could walk across it without having my shoes covered with water. I am sure Professor Hughes will agree with me that there is no erosion going on at the present time, and if that be so, the data for calculation is taken away. I may add that I took a boat and rowed for five hours up the river, to see whether I could find the continuation of the banks that could have kept the river in, for we know that where there are no banks there can be no river. I had a friend with me, and the conclusion we reached was that there was an absence of continuous embankment necessary to keep the water up to the height where the implements were found, namely among the gravels of M. Tattegrain Brulé, 80 feet above the level of the Somme. I crossed on my next visit to Amiens, Pont de Camon, to see how high the bank was on the other side, and I am quite certain I am right in saying there was not sufficient height of bank to have kept the stream in so as to have occasioned it to reach the higher parts on the St. Acheul side, where erosion is said to have occurred and the implements are found. Correctly speaking, there was no bank at all, but simply a rising ground stretching back into the country. [The speaker here pointed out on the map what he was describing.] From all the appearances I saw, it was clear to me that the water had never flowed up to the points I have indicated. I recrossed the river, and came along the banks on the south-western side, and before I had reached the peat beds of Longueau I could see that I was getting many feet below where the implements were found, and I suppose I shall be justified in saying that the minimum of the banks must have been the maximum of the stream. If the water, half a mile from St. Acheul, had come this way [pointing to the map], it would have flowed out upon the surrounding country, whereas a river that could have done the amount of erosive work attributed to the Somme ought to have been well stemmed in, but no signs of this exist.

* See Mr. J. Parker's view. (Vol. viii., p. 51. An extract from his paper will be found in the appendix.)

I presume that the sections on the wall have been taken from measurement?

Professor HUGHES.—They were sketched by the eye when standing at a distance, and to make the diagram clear the vertical heights have been exaggerated.

Mr. CALLARD.—I certainly saw the locality different. You have got the height equal on the right and left.

Professor HUGHES.—The view you have taken is from a different line of sight.

The CHAIRMAN.—I think it would be better to allow Professor Hughes to answer any remarks that may be made at the end of the discussion.

Mr. CALLARD.—I had two friends with me, and we were not casually looking about, but were there for the purpose of examining the valley, and I am prepared to say that the opposite side [pointing to the map] was not sufficiently high to allow the river to touch the place where the implements were found. If you admit there has been some alteration in the contour of the country, some change in the level of the land, then I say all the data for the argument from erosion is gone; but with the contour of the country the same as now, if I were on the spot with Professor Hughes, I think I could convince him that the river never could have touched the place where these implements were found. (Applause.)

Mr. T. JONES.—I would ask permission to make a remark. Some years ago a shock of earthquake was felt all along the coast of Wales, and so marked was the tremulation of the earth that at the Greenwich Observatory the telescope was seen to rise and fall. On the following morning the observer found that the time at which he had seen the instrument rise and fall agreed with the time at which the earthquake was travelling along the coast of North and South Wales. Now, this being so, it seems very possible that there may be occasional changes in the contour of the country so affected, and that after a shock of earthquake the land does not revert back to exactly the same level it had before, if this be so, it seems to me that it has a tendency to disturb the erosive principle that has been contended for.

Mr. J. THORNHILL HARRISON, F.G.S.—I do not agree with the author of the paper when he says that the peculiarities of the Glacial and recent periods cannot be explained by the occurrence of cataclysms, but upon this question I cannot now enter. I would call attention to the raised beaches in the West of England and on many parts of the coast, and suggest that in times past the tide rose in the Exe, the Teign, the Axe, and very probably in the Thames and other rivers, to a much higher level than it does at present, owing to the altered configuration of the coast by the encroachment of the sea. I consider the valleys of these rivers were formed by other processes of nature than the erosive action of the water falling within the river basins and flowing down their channels. (Hear, hear.)

Rev. G. HENSLOW, F.G.S. (a visitor).—I think the discussion has been somewhat diverted from the subject of the paper, which is "The Antiquity of Man," as far as the best evidence is concerned. The last speakers seem rather to have entered on the question of physical geography. Most of them have criticised Professor Hughes's remarks; but I should like to say

that I agree with him from beginning to end. I hold that the records of mammalia in the Eocene and Miocene periods are such that it is impossible even to expect to find man's remains in these deposits. For given reasons Professor Hughes says that the remains of the animals, I presume he alludes to the mammalia, found in them are so different from those of later times, that man, if he existed at all, must have been different also. If we take Professor Gaudry's deductions, I think he shows conclusively that not only is there not a single species of mammalia that lived at the time of those deposits to be found in existence at the present moment ; but that those which did exist then *have given rise*, by evolution, to the modern species. In those days there was no such hyæna as we have now ; I take it that the horse did not exist, but its earliest ancestor, if we may accept the theory that they sprang one from the other, was the *Eohippus*. Similarly, if we reason by analogy, and draw a comparison between the mammalia of those periods and the mammalia of the present day, assuming that the ancestor of man must have been subject to the same laws of evolution as they ; then, man, as he is now, *could not* have existed. Whether there was any intermediate, half-rational being, and whether he could make and use flint implements, is another question. It is, however, certain that man, as we know him, could not have existed in the Miocene or Eocene periods, if we are to judge by analogy. I would submit this view to the consideration of Professor Hughes. With regard to another point that has been referred to, we know that rivers do cut out the material from the channel through which they flow, and that they also may become silted up, these two operations going on together. But the whole gist of the paper lies in the fact that it brings us to this,—that all the evidences of the existence of man are confined to the Post-glacial period. Whether he can be carried beyond that is another matter ; but I see no reason why he should not be. The horse existed before the Glacial epoch, and therefore man might have existed as well ; but as far as these northern regions are concerned, I see no evidence whatever that he did.

The CHAIRMAN.—I think that what was said by Mr. Henslow was quite to the point, because the paper certainly dealt with those physical conditions which we see around us as affording a chronology by which we are to measure the age of man. I could not help thinking that if you gave me an earthquake, I would give you almost any physical condition you please. (Hear, hear.) Perhaps most of you may not be as well acquainted as I am, from the circumstances in which I have been placed, with some of those great physical changes that do occur at intervals in different parts of the world. It is but a few years since a district comprising 1,800 miles of South America was raised a considerable height, and remained in its altered position. Such a fact, of course, alters all the physical conditions affecting the adjacent rivers. I may mention another interesting fact which shows how little the chronology to be derived from the mud deposit of rivers can be relied on. Sir William Parker took his fleet up a branch of the Yang-tsi-Kiang in 1841 ; and in 1851, when I went up, that branch had become all solid land, and I sailed up a new branch altogether. (Hear, hear.) Not only was this the

case, but within the memory of man, where the river was there are now islands and cities, with thousands of inhabitants upon them. (Hear, hear.) You see, therefore, in how short a time the whole of the physical features of a large tract of country may be altered, and how the chronology to be derived from any particular river may be entirely upset. (Applause.)

Mr. S. R. PATTISON, F.G.S.—I should like to say a few words before Professor Hughes replies. Every one must have been pleased with the attractive tone and moderation of the paper, but I am not sure that the conclusion was quite so satisfactory to me as the title and general contents seemed to indicate. The title and general contents of the paper are "On the Evidences already obtained as to the Antiquity of Man"; and as to his statement of these evidences,—especially with regard to certain distinct operations which he has brought before us,—this is quite satisfactory; but when at the end of his paper he infers from the state of things he describes that the river Somme has cut its way, since the formation of the flint implements, to an extent that implies an enormous lapse of time, I fail to see that he gives us sufficient evidence in support of his conclusion; and when he says that the geological evidence is such that there has been a total extinction of the mammalia, and that therefore it must have taken the enormous amount of time implied by such a state of things, I fail still more to see any evidence to support that proposition. Now, it seems to me in reference to that which has been offered to this Society, that there are factors in the business that have not been taken into sufficient account by Professor Hughes. He has not considered those violent actions of nature referred to by the Chairman, in the case of the sudden changes that have taken place in rivers by reason of earthquakes, nor has he alluded to those changes which take place with equal suddenness, and also with very great force, by reason of severe and exceptional floods. (Hear, hear.) But beyond all this we have in the ancient Somme valley proofs of a continuous course of rapid erosion,—far more rapid than the erosion now going on, which is proved to be *nil*, or next to *nil*. We have the fact that the valley has been eroded in a rapid and turbulent or tumultuous manner, with intervals of rest, during which the materials were deposited,—so that we have evidence of a state of things in existence at one time of which we have now no example there. It is clear that the Somme valley must have been cut where it is, and not by the present stream, and therefore that it must have been subjected to forces which are not now in operation, and the moment we have to introduce into the discussion forces that are not now in existence, we necessarily introduce a different and an unknown measure of time; so that I am at liberty to say that the excavation of the valley took place under circumstances which necessarily imply great rapidity, because the employment of great force means rapidity of action. (Hear, hear.) Consequently, I am free to say, from the same evidence as Professor Hughes refers to when he says, "I see the proofs of immense periods," I can only see proofs of short periods. (Hear, hear.) However, I will not dwell upon this. I will only add that, with all due respect for the more competent knowledge of Professor Hughes, I think the evidence he

has adduced indicates a course of things leading to the proposition that the inferences he has drawn are not quite so satisfactory as the fascinating narrative he has given us.

REV. H. MARTYN HART, M.A.—Before Professor Hughes replies, I think I may say that we all agree in one thing, and that is in being thankful that he has given us a specimen of the cautious accuracy with which a man thoroughly acquainted with a subject proceeds to discuss it. I am quite sure that what we call religion will not suffer at the hands of Professor Hughes. The cause of truth only suffers at the hands of the incautious and inaccurate, and of those hasty generalisers who can never wait patiently for an accumulation of facts; but upon some one or two isolated cases hurry to a conclusion,—a conclusion often very far from being warranted. As an example of the unjustifiable manner in which this subject has been treated by a certain class of writers, I may mention that some time ago a periodical, the *School Magazine*, was edited by Dr. Morell, one of H.M.'s Inspectors of Schools, and in its first number was an article on Man. One paragraph ran,—that human remains had been found at a depth of 600 feet in the Mississippi Delta, and that Dr. Benet Dowler had proved, by “a hard and indisputable process of calculation,” that man has been upon the Delta of the Mississippi for 57,000 years. I wrote to the writer for his authority. After one evasive letter, he wrote a second time to intimate that I could not have much acquaintance with the subject if I was not familiar with Nott and Gliddon's *Types of Mankind*; and, referring me to the page, he said I should find “the hard and indisputable process of calculation” there. I found the volume in the British Museum, and there read,—that at New Orleans borings had been made to a depth of 600 feet, and that the base of the alluvial deposit had not been reached, and that when excavations for certain gas-works were being made, under the fourth forest level, and at a depth of 60* (not 600) feet from the surface, a skeleton was found. The cranium was in a state of good preservation. The trees were cypresses, and by counting the rings of growth, and by calculating the time the great river takes to make a deposit of an inch,—the Egyptian Nilometer being appealed to for the exact number of years!—the precise number

* Mr. Hart's absence prevents an apparently needful correction being made. Sir C. Lyell, in the fourth edition of his *Antiquity of Man* (1873), refers to only two instances of fossil human remains having been found in the Mississippi valley; the first being that of the skeleton of a Red Indian, the cranium in good preservation, found 16 feet below the surface when excavating for some gas works: Dr. Dowler considered it to be 57,600 years old. Sir C. Lyell cites his opinion with apparent approval (p. 46), and gives his reasons, founded upon a calculation as to the rate of deposit of the mud; but Messrs. Humphreys and Abbot, quoted by Sir C. Lyell in the later edition of his work as reliable authorities, have calculated that the whole ground on which New Orleans stands, down to a depth of 40 feet, has been deposited in forty-four centuries. In regard to the second instance of fossil human remains, Sir C. Lyell says, “It is necessary to suspend our judgment as to the high antiquity of the fossil” (p. 239).—ED.

of 57,600 years was arrived at, during which the bones had lain in their grave, and during which vast lapse of time the cranium had been enabled to resist the process of decay. The calculation itself, moreover, was transparently inaccurate. And although this article had been put into the hands of thousands of school children, with the authority of one of H.M.'s Inspectors, yet I was unable to persuade them to withdraw or even correct the gross mis-statement, and the sole result has been that I received a challenge from Mr. Bradlaugh to meet him in discussion anywhere. Let all take a leaf from Professor Hughes's book, and hazard no definite calculation; but let us wait patiently for more data, resting quite sure, as again and again we have been taught, that the records of the Book of Nature will never contradict the assertions of the Book of Grace,—

“Read each aright, and each will read the same.”

REV. H. G. TOMKINS.—Since the Nile has been mentioned in connection with calculations as to the lapse of ages and the antiquity of man, I may be allowed to remark that the deductions of Mr. L. Horner from his observations in the Delta have been set aside by more recent inquirers,—“The whole inquiry,” says Dr. Birch, “is for many reasons more than unsatisfactory.”—Wilkinson, *Anct. Egyptians*, New Edition, 1878, vol. i., p. 9, footnote.

MR. W. TOPLEY, F.G.S. (a visitor).—I should like to say with regard to the Brandon flints, that Professor Hughes probably may not be aware of the fact that some memoranda have been sent in to the Royal Society on the subject, and are now in the hands of the Secretary, and I hope will be gone into. A large number of people disbelieved the evidence that was adduced; and although I do not argue the point, I must say that I thought the evidence insufficient. But all the officers of the Geological Survey who have seen the place, say they have not the slightest doubt but that the implements found in the brick earth have been undoubtedly overlaid by a boulder glacial deposit. I do not think Professor Hughes was so clear when he passed onwards a little period. I should like to know his opinion as to the actual antiquity of man. It may be useful to take the historic age as a multiple; but what multiple is it? Of course, the whole of his argument is called in question upon the authenticity of these flint implements; but, according to his showing, the Somme and the Thames have for the last 2,000 years been in pretty much the same state as they are now. Assuming it is only 2,000 years ago since the change began, what multiple is that with regard to the period to which we are to go back to find the age of these implements? I should like Professor Hughes to state whether, according to his view of the evidence, although it has been called in question, he, in common with a great many geologists, would stretch the chronology of man to its utmost limits? He might tell us of the wonderful succession of events that have taken place in Kent's Cavern, where, below the hyæna beds and flint implements, there is a great gap, and then still earlier deposits and flint implements, and along with these a totally different fauna, the hyæna and the elephant being altogether absent, and the remains are almost exclusively bears; so that one can hardly but believe that

a great gap did separate that lower deposit from the upper. He says it is difficult to correlate the ages of the cave deposits with the gravel, and in that I agree with him ; but if the fauna of the caves containing hyænas is in any way comparable with the fauna of the river gravels containing implements, how much older must be the fauna of Kent's Cavern containing bears and rough implements ?

Professor HUGHES.—I must apologise that owing to pressure of work and to my being called off unexpectedly, I was unable to send in my paper in time to have it printed before the meeting. The discussion has covered a very wide field, a wider field than I had anticipated would have to be traversed, so that I must go quickly over the notes I have taken. The first speaker talked principally about the Thames district, and brought examples from London of Roman remains which have been found over the deposits to which I have called attention. But I fail to see how these Roman remains bear upon the question I was dealing with. The Roman remains were dropped on the surface and buried in the ground, and still more recent things have been found nearer the surface. What I stated was that the formation in which the mammoth and man were found was an alluvial deposit which must have been left by a river behaving as rivers usually do. All the earlier speakers laid great stress on the fact that in the Thames valley near London the river is not doing any work of excavation at the present time. With that I entirely agree, and one of my chief arguments is founded on it. The Thames in the lower part of its course deposits what it got from higher ground ; for the denudation we must go higher up the valley.

Mr. J. E. HOWARD.—The mammoth remains show no denudation since that period. The Thames has not cut down the valley since the time the mammoth inhabited the district.

Professor HUGHES.—[Professor Hughes described on the black-board the mode in which he asserted the denudation to have taken place.] He continued,—I was glad to hear that all the speakers allowed a long time to have been required to form the valley at the present rate of waste ; but the point which has been lost sight of is the denudation which takes place at the rapids and waterfalls, and though, as has been mentioned by one speaker, the river bed of the Somme at the period of the deposition of the flint-implement-bearing gravels may have fallen at the rate of 2 ft. in a mile, even that would admit of rapid denudation if the fall were not uniform along the whole length. The denudation would go on at the rapids where the valley was being *cut back* (not *cut down*) and in the lower reaches below the falls and rapids there would be no excavation going on. Earthquakes might modify the conditions by producing fissures, but we ought to go and examine the ground in each case and see whether there is any evidence of such cracks. I have noticed how the rate of waste would be affected by upheaval and depression, but we have no evidence in these cases of exceptional or cataclysmic action. If there had been such we should see masses of stone and coarse material carried to points where the velocity of the water was checked. But I ask you to look at the sand and gravel and

say whether you think they can have been deposited that way. You find shells and you find loam interstratified with the gravel, and it is quite clear from their character and arrangement that they were not carried by great cataclysms. The raised beaches of the coast are quite different from the river terraces of which I speak. They are sea beaches at a higher level than is now reached by the tide, and though some can be explained by the action of the sea on a sloping shore now cut back to a cliff, no tide could carry the shingle up and form a beach several hundred feet above the sea. Again, with regard to the width of the valley we have no reason to suppose that it was ever filled with water right across. A river is continually shifting its channel on the low ground. I have walked over many dry places in Wales where I have myself known the river once ran. A river does not cut straight down along the whole of its course. What a river does is this. [Here he illustrated his remarks by sketches drawn upon the black-board.] When it is checked at any point by an obstacle, such as a hard rock or by its having reached low flat ground, it is thrown across the valley from side to side, partly by the weir-like banks thrown up by itself, and undermining first one side then the other, forms in time a wide valley. When it has cut down through the obstacle, or upheaval has put an end to the ponding back by the sea, then the river excavates a deep channel through the alluvial plain which was formed during the stationary period, and patches of the old alluvial deposits are left as terraces. The next point was that there were no human bones found. Now, we must remember that in all the explorations made by the *Challenger* and the various ships that have been sent out for the purpose of dredging, no single human bone has been dredged up, and yet how many thousands have gone to the bottom of the sea. Again, when the Lake of Haarlem was drained not a human bone was found; so that there is not very much importance to be attached to the absence of bones in the gravel. I take my stand upon this, that here [pointing to the flint implements] you have the work of man. Three pieces of flint have been put before me by way of test. I suppose the gentleman who questioned me knew something of them, but I knew nothing. I recognised these pieces [showing them] as the work of man, from the combination of blows that have produced the form usually associated with man's handiwork; but with regard to this [holding up another piece], I do not know how it has been produced, but I am certain that nature alone has been at work here. In the implement which I say is the work of man I find that blows have been delivered all round the edge with the evident and definite design of producing this form. We can recognise these implements from the outline, and refer them to a certain date by their known association. It is possible that in some cases the flint may have received a blow or two to try it, and then have been thrown away. Here is one of such pieces [showing it]. It is not dressed round the edge; it is a mere rough piece, such as we find abundance of. I have expressed a doubt as to this [producing a piece of flint], in the production of which only three blows have been required. The reason why I have a doubt about it is this:—We have found the old

workings, where the ancient people dug down to the flints and dressed them, leaving the bits they knocked off behind them, and these bits have been found lying about in heaps of hundreds.

Mr. CALLARD.—Do you find them at St. Acheul. This [the flint in question] comes from that place. I brought it myself, and, as far as I know, there is no indication of any workings there.

Professor HUGHES.—In the particular place where you picked that up they may not have been working ; but they did not use these implements only in the place where they were worked. You may find them carried by man or by streams. Then there were half-made implements and misfits. That is one reason why we find such an immense number ; they threw these away. Mr. Topley has asked me to say what multiple I will take. That I will not say ; but I think it must be a large one. That, however, is only my opinion ; I have no data to go upon. I think, however, we must feel that the time is much greater than we have been accustomed to deal with in studying history. When I am asked how far off a man is, I may say I do not know the exact distance ; but I can say whether it is further than Westminster. And when astronomers tell us that they knock off two or three millions from the distance of the sun, do we feel inclined to say to them, “As you are not sure about the distance, perhaps the sun is only a mile or two off ?” No, we do not ; we allow the correction, still leaving as the measure of the sun’s distance those enormous quantities which it is difficult to grasp at all. As to the distribution of the bears and the other mammalia, I think I have left a sufficient margin. I talked of a period within which all those palæolithic times are included. When subdivisions could be made to correspond, well and good. There is reason for the bears and hyænas not being found together. The bears did not get on well with the hyænas, and where you do find them together the bears have the worst of it. In some great caves in the Pyrenees there is hardly anything but bears, and there the skeletons of the bears are found quite whole and entire. These were the dens they lived in, and whither they dragged themselves to die ; in other caves there were only found portions of the remains of bears, because these were parts of carcasses dragged in by other creatures and eaten. Then, in the older cases, the groups of life are so different from those of to-day that if we were to find any traces of man we should not expect to find him as he is now, and it was on this hypothesis that some French *savans* said they would refer the earlier instances to Man’s precursors. (Applause.)

The meeting was then adjourned.

REMARKS BY HIS GRACE THE DUKE OF ARGYLL, K.G.

I CONCUR entirely in the general argument of Professor Hughes on the antiquity of man.

I would observe, however, that it assumes, as most geologists do generally assume, that the gravels which have been found to hold human implements are exclusively *river-gravels*.

I entertain great doubt on this point. The distribution of our superficial gravels seems to me to indicate that some of them do not belong to any river system, but that they have been spread over hill and valley by marine action. If human implements have been found in gravels of marine origin, an entirely new element is introduced into the question.

My own belief is, that a submergence under the sea to the extent of upwards of 2,000 feet has been one of the very latest of geological changes. During part of this submergence, glacial condition prevailed over a large part of what is now Europe.

My further impression is, that man appeared on the scene when the land was emerging, and that the elevation was comparatively rapid. During this period it is most probable that heavy rains prevailed, and if so, the double action of elevation and of continual floods would greatly shorten the time required for the cutting out of the beds of streams or the deepening of valleys.

The Palæolithic weapons indicate a people somewhat in the condition of the Eskimo, and they may have been the outliers of races in a very different condition, who lived in non-glacial climates to the South.

I wish the attention of geologists were more directed to the questions connected with the admitted fact of sea-gravels at a high elevation on our Welsh and Scottish mountains.

REMARKS BY PROFESSOR T. R. BIRKS, M.A. (CAMB.).

PROFESSOR HUGHES'S paper seems to me fully to confirm two principles which I hold: 1st. That there is no genuine scientific evidence for a pre-*quaternary* existence of man, *i.e.*, for carrying him further back geologically than the close of the Glacial Drift period. 2nd. That the only *definite* scientific ground alleged for assigning an immense antiquity to that Drift period is the hypothesis of Mr. Croll, which would fix it definitely to a distance of either 200,000, or 800,000 years.

When Mr. Croll's theory is taken out of the way, the geological evidence for the high antiquity of man resolves itself into two questions:—1st. Does the contemporaneity of man with certain extinct mammals prove the antiquity of man or the comparative recency of those mammals themselves? 2nd. Are the conjectural estimates with regard to the growth of stalagmite, and the periods required for the erosion of certain beds of gravel, involving many elements of a most vague and conjectural kind, a sufficient ground for uperseding and treating as non-existent the distinct and definite statements of Scripture with regard to man's creation and the period when it occurred?

These estimates would all be modified at once by the physical consequences which must have resulted from such a fact as the Flood of Noah, however brief the period of its actual duration. With regard to erosion, five months, under the circumstances narrated in Gen. ix., might, and probably would, produce effects which could not be wrought by 50,000, or even 800,000 years of change under the present and modern conditions of gradual and almost insensible change, when the deep has been shut up in its "decreed place," and the surface of the ground has been dry, and when great but more moderate changes of the sea-level have only occurred at intervals of many thousand years.

The six days of creation in the first page of Scripture are, in my judgment, a definite line of separation, drawn by God Himself, between indefinite ages of chaos and darkness and the successive seasons of a Divine cosmos. I have little faith in the success of those who take their stand on the edge of chaos, and gaze intently on its darkness only, in measuring out intervals of time in that dark chaos so exactly as to form any scientific presumption whatever against conclusions drawn from an inductive study of the whole testimony of Scripture with regard to the plan and course of Divine Providence for the last 6,000 years.

I think Professor Hughes's paper is a valuable contribution towards a fair and impartial estimate on the conjectures on the one side and the definite evidence on the other.

REMARKS BY REV. HENRY BRASS, M.A., F.G.S.

A VERY able, thoughtful, impartial paper, and a valuable contribution to this important controversy; but the concluding remarks are to me far from satisfactory.

(1.) It is assumed that no changes in the level of the valleys of the Thames, Somme, &c., can have taken place during what the author calls "a very large multiple of the historic times." Yet such changes of level have recently

been, and are still taking place in many parts of the world—*e.g.*, the coasts of Scandinavia, Greenland, Cutch, South America, Pozzuoli, &c.*

“Will the geologist declare with perfect composure that the earth has at length settled into a state of repose? Will he continue to assert that the changes of relative level of land and sea, so common in former ages of the world, have now ceased? If, in the face of so many striking facts, he persists in maintaining this favourite dogma, it is in vain to hope that, by accumulating the proofs of similar convulsions during a series of antecedent ages, we shall shake his tenacity of purpose:†—

‘Si fractus illabatur orbis,
Impavidum ferient ruinæ.’—Hor., lib. iii., ode iii.

(2.) It ignores altogether the world-wide tradition of a recent great Deluge. Even if this were not universal, the forces which produced such a great catastrophe would probably more or less affect the levels of many distant parts of the earth’s surface.

(3.) It is assumed that flint flakes and implements are necessarily the work of *man*.

(4.) Allowing them to be the work of man, are they of necessity contemporaneous with the gravel-beds in which they are sometimes found? How is it the *bones* of man are “conspicuous by their absence”? Did primæval man never die? Have these beds never been visited in subsequent ages for their rich stores of flint? What has become of the immense number of chippings of “the great *gun-flint* period”? Have any of them found their way into the museums of collectors amongst “undoubted relics of the great antiquity of man”? The notorious “fossil jaw” of Amiens reminds us that great men are not infallible, and that a gravel-bed may be disturbed without its being suspected.

REMARKS BY PROFESSOR W. BOYD DAWKINS, F.R.S.

I ENTIRELY hold with Professor Hughes in the view which he takes relating to the antiquity of man, and the necessity of looking narrowly into facts

* The following remarks by Professor Huxley, made (August 22, 1879) at the meeting of the British Association, are interesting:—“The question as to the exact time to be attached to alluvial remains in the Somme valley cannot be settled satisfactorily. Few persons except men of science are aware that there have been enormous changes during the last 500 years in the north of Europe. The volcanoes of Iceland have been continually active, great floods of lava had been poured forth, and the level of the coast had been most remarkably changed. Similar causes might have produced enormous changes in the valley of the Somme, and therefore any arguments based as to time upon the appearances of the valley were not to be trusted.”—ED.

† C. Lyell, *Principles of Geology*, 8th edition, p. 450.

bearing on the question. All the alleged cases of the existence of man before the Palæolithic age, on the Continent, seem to me on a careful inquiry to be unsatisfactory. If the flints found at Thenay, and supposed to prove the existence of Meiocene man, be artificial, and be derived from a Meiocene stratum, there is, to my mind, an insuperable difficulty in holding them to be the handiwork of man. Seeing that no living species of quadruped was then alive, it is to me perfectly incredible that man, the most highly specialised of all, should have been living at that time. The flints shown in Paris by Professor Gaudry appear to be artificial; while those in the Museum of St. Germain appear to be partly artificial and partly natural, some of the former, from their condition, having been obviously picked up on the surface of the ground. The cuts on the Meiocene fossil bones discovered in several other localities in France may have been produced by other agencies than the hand of man.

Nor in the succeeding Pleiocene age is the evidence more convincing. The human skull found in a railway cutting at Olmo, in Northern Italy, and supposed to be of Pleiocene age, was associated with an implement, according to Dr. John Evans, of Neolithic age. Some of the cut fossil bones discovered in various parts of Lombardy, and considered by Professor Capellini to be Pleiocene, were undoubtedly produced by a cutting implement before they became mineralized, a point on which the examination of the specimens leaves me no reason for doubt. I do not, however, feel satisfied that the bones became mineralized in the Pleiocene age; and the fact, that only two species of quadruped now alive then dwelt in Europe, renders it highly improbable that man was living at this time. This zoological difficulty seems to me insuperable.

The only other case which demands notice is that which is taken to establish the fact that man was living in the Interglacial age, in Switzerland. The specimens supposed to offer ground for this hypothesis consist of a few pointed sticks in Professor Rüttimeyer's collection at Basle, of the shape and size of a rather thin cigar, crossed by a series of fibres running at right-angles. They appear to me after a careful examination to present no mark of the hand of man, and to be merely the resinous knots which have dropped out of a rotten pine trunk, and survived the destruction of the rest of the tree. As the evidence stands at present there is no proof, on the Continent or in this country, of man having lived in this part of the world before the middle stage of the Pleistocene age, when most of the living mammalia were then alive, and when mammoths, rhinoceroses, bison, horses and Irish elks, lions, hyænas, and bears haunted the neighbourhood of London, and were swept down by the floods of the Thames as far as Erith and Crayford.

REMARKS BY J. THORNHILL HARRISON, ESQ., F.G.S., M.I.C.E.

THE author's first question is, "In what formation have we found conclusive evidence that man was there?"

Leaving the earlier formations, he brings within view the latest beds known to geologists, the Tertiary and Post-tertiary. These beds bear evidence of the truth of the Mosaic record, as to the creation on the sixth day, first of the mammals, then of man.

The Tertiary beds contain remains of mammals, but, as the author says, the evidence is insufficient to prove that man was there.

In the Post-tertiary beds remains of man are, for the first time, found embedded in the earth; but when within the range of this deposit was man created? That is the question.

Lyell subdivides the Post-tertiary into Post-pliocene and Recent. *The former* embraces the period known as Glacial; part, often a considerable part, of the mammalia of this period belongs to extinct species; whereas the mammalia as well as shells found in deposits of the *Recent* period are identical with species now living.

That man existed on the earth during the deposit of beds of the Recent period there is no question. The objects found in caves and in the Post-glacial river-gravels are admitted to be really of human workmanship. The point chiefly contested by the author is the existence of man in Glacial and Inter-glacial times; and upon this he says that "all the evidence is to him quite inconclusive," at the same time he admits that traces of man with the extinct mammalia have been found in caves and Post-glacial river-gravels.

Let me ask, What evidence is there of the existence of the mammals during the Glacial period which does not equally apply to man? There is evidence of the pre-existence of the mammals, and we conclude therefore their continued existence during the Glacial period, but it by no means follows that during that period man was not co-existent. It is admitted that man lived along with the extinct mammalia, and it seems to me probable that he did so only during the Glacial period. Let this question be answered, What occasioned the extinction of the mammals, and how does man survive?

The author says, "In the long periods of geologic time races appear and last awhile, and then are not, and a new group of living things represents them in the next succeeding age. How they went out we cannot tell. It was not by cataclysms, for they go out one by one, and the deposits tell of slow accumulation; but more as if some gradual change over various regions of the earth made each successive place in time unsuitable for all the life that once was there."

It was not thus the mammals ceased to be; they *were* in man's time, but *are not*. There still remains, within the polar circle, undissolved throughout

many recurring generations, ice of the Glacial period. What does it record? The sudden destruction and instantaneous preservation of numerous mammalia, which year by year released from their icebound prison, are devoured by ravenous bears and other denizens of the polar seas. Numberless tusks lie scattered over Asia, imperishable records of a sudden destruction which overtook the animals in whose heads they grew. Is it not probable that these animals and men were overwhelmed, and, it may be, frozen as those now found nearer the Pole, and that as the ice dissolved their bodies were devoured, and the tusks alone remain the record of their pre-existence?

These did not go out one by one. By a cataclysm alone can this sudden destruction and preservation be accounted for; we do not know of any "every-day operations which are capable of producing such effects."

The author's second question is, "Can we assign any exact numerical estimate of years since these beds were laid down?"

He remarks, "We have to deal with facts so clear, so numerous, so widespread, and so similar everywhere, that we must at once refer them to the common ways of river denudation."

Were it necessary to refer the geological facts alluded to, to the "common ways of river denudation," the conclusion of the author "that the age of man must be a large multiple of the historic times" would possibly be inevitable; but I do not think that such necessity exists, or that such reference can explain the facts referred to.

It appears certain that man did live with the extinct mammalia during part at least of the Glacial period. During that period the atmosphere of the temperate zone would be most conducive to health and longevity; the sky cloudless, the air dry and moderately warm, the ground wetted by dew alone. (For God had not yet caused it to rain on the earth.) The theory I would suggest as worthy of consideration is, that when the glaciation attained its maximum degree, the disturbance of the equilibrium of the crust was so great, owing to the enormous accumulation of ice and snow at the poles, that a cataclysm did occur, by which the ice-bound regions were plunged towards the Equator; that the ice and snow were launched from their seat; and that the consequent dashing to and fro of the waters caused a universal deluge, the deluge of the Bible, when Noah and his family, by the interposition of the Almighty, were saved, whilst the rest of mankind with the extinct mammal were overwhelmed and perished.

I cannot expect this theory to be accepted without proof; I therefore propose to adduce some reasons for its suggestion.

The frequent reference by the author and by Lyell to instances of "depression" and "upheaval" of the surface of the earth is an admission that the earth's crust has a considerable freedom of motion *vertically*. Accepting this view (to a limited extent), the effect of any considerable weight added to one part of the surface would be to destroy the equilibrium of the crust, considered as a spheroidal shell, and at the weakest parts to crush it, and elevate new mountain chains, and simultaneously, by volcanic action, to force from

the interior large masses of molten matter, which distributed by water would become stratified rocks of varied thickness and of distinctive character.

The former action is exhibited during the Tertiary period by the upheaval of the Alps, Apennines, Carpathian and Himalayan ranges, and *the latter* operation is exemplified by the formation of newer Pliocene beds of Italy and Sicily. Respecting these Lyell says,—

“There is probably no part of Europe where the newer Pliocene formations enter so largely into the structure of the earth’s crust, or rise to such heights above the level of the sea, as Sicily. They cover nearly one half the island, and near its centre, Castogiovanni, reach an elevation of 3,000 feet.”

The beds are regularly horizontal and several hundred feet in thickness, the limestone passes downwards into sandstone and conglomerate, below which are clay and blue marl. These are most interesting stratified beds, formed undoubtedly from materials disorged by volcanic action from the interior of the earth.

During the deposition of these beds there is undoubted evidence that the Glacial period had commenced, and that the glaciation at the Pole was steadily extending.

Now what does this glaciation mean? Simply this, that the crust of the earth no longer transmitted heat sufficient to melt the snow that fell upon it; that at that period there was no diversion, as now, of vast volumes of tidal waters of high temperature from the Equator to the Pole, and that there was a gradual but steady accumulation of snow and ice in the polar regions. This accumulation implies a corresponding evaporation and abstraction of water from the equatorial regions. The result would be a simultaneous loading of the crust at the Pole, and diminution of pressure on the parts previously covered by the sea. The natural consequence would be a squeezing-out of molten matter from the interior as above referred to, and probably the simultaneous crushing of the crust and formation of mountains, or further elevation of those previously raised.

Such results would, however, in no way arrest the process of snow-accumulation at the Pole; the higher the mass of snow became, the greater tendency would there be to extract every particle of moisture from the atmosphere, and it is difficult to conceive a limit to the process until the ocean should be dried up and all the water be collected in a frozen condition at the Pole.

I have as yet based my argument solely upon the admitted freedom of the earth’s crust to move vertically. I must now suggest the probability (as I have already more fully explained in a paper presented to the Institute) of the crust of the earth being free to move horizontally on the internal mass of matter, as well as vertically, and that, when its equilibrium was destroyed by the combined accumulation of snow at the Poles and abstraction of weight unequally from the surface towards the Equator, the crust of the earth did shift its position as already suggested—reeling to and fro—by which some of the ice was thawed; it steadied again, but eventually so far shifted its position as to launch the burden of accumulated frozen materials towards the Equator

producing thereby all the phenomena requisite for a practically universal deluge.

As the reeling or nutation recurred, land which at one time was near the Pole and stood high above the water would at another stage of the nutation be plunged below the water as it approached the Equator, the climate being arctic under the former and tropical under the latter condition; further, these alternations of depression and elevation and changes of climate would recur at intervals, until again the axis of rotation of the external crust coincided with that of the internal mass. It would be most improbable that the same spot of the crust would return to its former position at the Pole. The new position of the Pole, in the good providence of God, is such, that a wonderful balance between the accumulation of ice and its dissolution is maintained, the chief regulating element being the tidal waters, diverted by the projecting continent of America, the warmth of which moderates the climate of all countries bordering on the Atlantic, influences materially that of Spitzbergen, and slowly, it would appear, thaws the remaining old ice of the Glacial period.

This theory affords a simple explanation of the changes of climate and physical geography which are proved to have occurred during the Glacial period, but have not received satisfactory explanations; accepting this theory there remains no occasion to estimate geological periods of time by allowing $2\frac{1}{2}$ feet in a century as the rate of upheaval and depression of the surface through hundreds and thousands of feet.

No such sudden destruction by water as that which overtook man at one period of his existence could have occurred under such gradual alterations of relative level of land and water. It is necessary to accept a cataclysm as the cause of such a catastrophe, and it is my firm belief that such a cataclysm did occur.

The extraordinary physical forces in operation during the Glacial, but unknown in any preceding period, are sufficient to account for all the geological peculiarities of that era, besides the crushing-up of mountains, the voluminous discharge of molten matter from the earth's interior, the sweeping and distributing power of water of varied depths moving over submerged hill and dale, here denuding, there accumulating, which forces were common to previous geological periods; there was introduced the force exerted by ice resting and in motion as a river on the surface of the grounds, floating freely or trailing along the bed of the ocean, leaving distinctly the marks of its past action on solid rocks and distributing extensively over the continents of Europe, Asia, and America boulders, clay, gravel, and sand. It is unnecessary to enter into details of the operation of this glacial force. The like operations still continue, but not on the same grand scale. It is not philosophical to argue that all things continue as they were, and that we must take the natural operations of to-day as the measure of those which have passed away. "The common ways of river denudation" are insignificantly minute when compared with the ways of the enormous degrading, transporting, and dispersing forces to which I have referred.

Is it not probable that during the Glacial period the tropical regions of the earth were intensely hot and unsuitable for the abode of man, as though the angel with *the flaming sword* drove man from the garden of Eden there situated? again, was not the unstable condition of the earth sufficient to make Cain a fugitive and a wanderer on the earth, and that devoid of rain the ground should not yield her strength? Do we not read of Tubal Cain who instructed his fellows to work in brass and iron? Mark, brass first, then iron. And may we not direct attention to God's covenant with man after the Flood not again to destroy the earth with a flood, and explain His setting the bow in the heavens as a token of His covenant?—at which it is grievous to hear sneers from those who profess to believe in Christianity. It is probable that during the Glacial period the sky was cloudless in the temperate zone; we read that when God formed man He had not caused it to rain on the earth, but a mist went up from the earth. Is it not very probable that until after the termination of the Glacial period the rainbow had never appeared in the sky in man's time?

It seems to me impossible to estimate actual time from any facts which geology presents, but there is nothing in the geological records which should lead us to distrust the records of Scripture.

REMARKS BY THE REV. J. MAGENS MELLO, M.A., F.G.S.

THE subject brought before us by Professor Hughes is undoubtedly one of very great interest, and I venture to send a few remarks which have occurred to me in connection with it. His criticisms upon the evidence offered in support of Miocene and Pliocene man seem to be thoroughly sound, and the evidence adduced proved to be valueless. In confirmation of what he has said regarding the supposed basket-work from Dürnten, I may add that I have frequently seen upon the sea-shore such rolled fragments of wood, softened and shaped by the waves; I have noticed them in abundance at Hastings, and also at Whitby and elsewhere; and where there happens to be much clay they may often be seen embedded in it, and if matted together they would undoubtedly leave their impressions upon each other's surfaces. I believe I may state that Professor Dawkins does not accept the theory of the human origin of the Dürnten basket-work.

As to the Pre-glacial man of the Victoria Cave, it seems hardly worth while now to discuss the question whether the clay is a glacial deposit *in situ* or a *remanié*, since the bone of contention can no longer be considered human. Any evidence of man's antiquity drawn from the amount of stalagmite which may overlie bones or implements is, I think, altogether untrustworthy. So many varying circumstances affect the rate of the formation of

stalagmite, and the clue which we may have as to those circumstances in any particular case is often so indistinct and broken, that we cannot follow its indications with any confidence. We know that beds of a tufaceous character, such, for instance, as the upper so-called stalagmite of Kent's Hole, may attain many feet in thickness in a very small number of years.

The most weighty evidence as yet before us of a probably high antiquity for man in North-Western Europe appears to be that derived from the alterations in physical geography which seem to have taken place since his advent; such evidence is derived from the present height of certain terraces containing his works far above the level of existing rivers. Such alterations would appear to have taken place in the case of the Thames, the Clyde, the Somme, the Seine, and other streams. In some of the instances given, however, the river-banks bordered estuaries, and were probably affected by the tides, in which case we need not look to the slow accumulation by ordinary fluvial deposits of sediment; and it is possible that where estuarine terraces occur, both the higher and the lower terrace may have been contemporaneously formed, since a high-tide and a low-tide terrace are a common occurrence on our coasts, and the subsequent elevation of the land would account for the present position of the terraces above the level of the river. Such elevation appears to have occasionally been far from slow. Canoes, which seem to have been constructed with metallic tools, have been found 25 feet above the present high-water mark on the banks of the Clyde; and it is a well-known fact that the alteration of some of our coasts has been both great and rapid during the historical period. We have no certain clue as to the rate of changes of elevation in the Pleistocene age. Evidence drawn from inland valleys may require more careful examination, as the cutting power of rivers varies greatly in different districts according to the volume and rapidity of the stream, and also the nature of the rocks passed over; and in times when the country was more densely wooded, the rainfall may have been far in excess of the present average. That the accumulation of bones of the extinct mammalia found in conjunction with human remains in caves cannot all be assigned to the work of a flood is very clear to any one who has taken part in the exploration of such caves. I will refer only to those with which I am best acquainted, viz., the caves of Cresswell; these are, it may be observed, not more than 15 ft. above the present level of the stream. The bones found in them, with but few exceptions, bear no evidence of having been rolled along by a current of water, but, on the contrary, appear to have been left where they are now found, in many cases, by the hyænas, which devoured the carcasses of the animals; the fractured edges are frequently seen to be as sharp as if done quite recently; this could not have been the case had they been subjected to rolling in water for even a very short period. Other evidence of their being the slow accumulations of many years in the spot where they are now found is seen in the character of the beds in which they occur. The floors of the caves are not of one uniform nature, but are distinctly stratified, and contain remains to a certain extent peculiar to each.

There is also the clearest evidence of the animals having lived and bred, if not in the caves, yet in their immediate neighbourhood; the jaws of the hyenas are those of individuals of every age,—of the young, with the permanent teeth merely beginning to show through the bone, and of the veteran, with teeth ground down to stumps. The coprolites also of these animals and the bones they have gnawed abounded in some of the caves.

I think there is strong evidence that man was contemporaneous with the now extinct mammalia during a lengthened period and one marked by important physical changes; but *how* long that period was the evidence as yet is not forthcoming.

Some who have written on this subject have spoken of the remains of the sheep and goat, and also of iron, as having been found with the bones of the Pleistocene animals; but that they were contemporaneous there is, I think, no proof; the few isolated cases in which they are said to have been found together cannot be set against the great mass of evidence as to their non-contemporaneity; and the carelessness of workmen, the accidental fall from an overlying deposit, the burrowing of foxes, rabbits, or badgers, might very easily account for the few instances brought forward. There seems to be every reason to suppose that the sheep, goat, and other domestic animals made their first appearance in connection with Neolithic man.

The chief points which it seems to me require very careful examination as to their bearing upon the question of a prolonged antiquity of man, are those relating to finds of implements apparently deposited at a time when the physical geography of the country was considerably different to what it is at present; such finds, for instance, as have been recorded from the drift of Hampshire, which is now deeply cut into by numerous streams, and is also intersected by the Southampton Water. As far as now appears, those implements must have been dropped into that drift at a period antecedent to those physical changes which have so cut up the once-uniform sheet of gravel. We also require further light to be thrown upon the cases I have already alluded to, in which similar finds are recorded from high levels, in localities far removed from the sea; and most especially do we want to know something more as to the time when the separation of these islands from the Continent and from one another took place. The evidence seems very clear that man lived in this country with the Pleistocene mammalia before that separation was brought about. The abrupt line apparently existing between Palæolithic and Neolithic man is very remarkable; as far as I am aware, no signs of an overlap have been discovered. What is the meaning of that sharp demarcation, assuming it to have a real existence? And what length of interval does it imply between the disappearance of one race of man, and the animal which were his contemporaries, and the incoming of the newer race? Is it not probable that the separation of England from the Continent, with various climatal changes, may have filled up the interval? It is to such a break and to such changes that we are led to look for the explanation of the apparent sharp transition from the Pleistocene into Prehistoric and recent times

whilst as to the fact of a connection having existed at no distant period (speaking of time geologically) between the continent of Europe and these islands there is abundant evidence, not the least striking part of which is that which shows a gradual diminution as we pass westwards and northwards of plants and animals of existing species, which are common both to Great Britain and the North-Western regions of Europe. It can only be reasonably accounted for by the supposition that the connection was severed before the species had time to spread generally.

REMARKS BY S. R. PATTISON, ESQ., F.G.S.

PROFESSOR HUGHES is so cautious, that his testimony concerning disputed facts has all the strength of an admission. We may, therefore, accept as conclusive, 1st, his denial of any evidence of the existence of man in Pre-glacial times; 2nd, his statement of the untrustworthiness of stalagmite as a measure of duration; and 3rd, his affirmance of the absence of any measure of Post-glacial time in geology. Into the field thus cleared of positive scientific facts hypothesis enters, and seeks to govern by analogies. Here we do not consider the Professor as equally skilful, or even equally cautious. Unlike his distinguished predecessor at Cambridge, Sedgwick (*clarum et venerabile nomen*), he repudiates *cataclysm* in the past, and relies on causes in present operation, and apparently on present rates of action. He argues that all the events indicated have been brought about by minute changes; that this has been the case with the cutting back of the rivers forming the valleys of the Thames* and the Somme, with the change in the groups of mammalia, and the variation in the local freshwater fauna. Therefore, he says, that the time which has elapsed since the deposition of the flint implements is "enormously long," a "vast time," a "great lapse;" implying that it is far longer than is assigned by the ordinary Mosaic chronology. But the power of these analogies depends entirely on the circumstances of the two cases being equal. Surely Professor Hughes cannot hold that this is the case. We affirm, on the contrary, that the elevation of the inland cliffs and of the coast, the traces of violent land movements, the tokens of alternate immense rushes of water and ice with periods of repose and tranquil sediment, the excavation of materials by side-cutting and their rolling and re-sorting, are phenomena which, in the extent indicated, do not now occur, and can never have occurred from causes now in action at the present or any other conceivable rate of uniform progress. If this be so, or if it may be so,

* A Member, writing from Cirencester, states that he has not observed evidence of the "cutting back" higher up the stream of the Thames.

then the whole analogy is destroyed. Having displaced existing causes, or rather existing *rates* of action, we are then free to assert that the irregular work of Post-glacial forces may have been accomplished, say within 10,000 years, for aught that geology can show to the contrary. In fact, that science does not, as yet, displace the common chronology of our Bible, which, as we well know, admits of very considerable extension. We are at liberty, therefore, so far as geology is concerned, to accept the reasonings of Dr. Southall, Dr. Andrews, Dr. Dawson, Mr. Callard, and others, on the recent origin of man, the close and crown of animated nature, according to the commonly-received interpretation of the Scripture.

REMARKS BY JAMES C. SOUTHALL, M.A., LL.D.

(Richmond, Virginia).

I CERTAINLY concur in what Professor Hughes says as to the breaking-down of the evidence for the existence of Miocene, Pliocene, and Glacial man. It is hardly worthy of serious consideration, and I think the bringing forward of insufficiently considered facts of this sort for the purpose of establishing the antiquity of man brings discredit on the cause of science. If the antiquity of man is to be proved, we must have more careful and judicious investigators. The Miocene man of the Dardanelles, the chipped flints from Thenay, the perforated sharks' teeth of the Crag, the sharpened sticks from Dürnten, the human fibula from the Victoria Cave, have been severally patronized by very distinguished scientific names, and should serve to admonish us of the necessity for that "caution—caution—caution," which Mr. John Evans has been compelled to recommend.

The remarks of Professor Hughes with regard to the evidence bearing on the antiquity of Quaternary man are so vague, that it is difficult, while dissenting from his conclusions, to criticise what he has said.

If, I understand him, he rests the antiquity of Quaternary man on the fact that the palæolithic implements of the river gravels antedate the excavation of the river valleys by the present streams. He argues that the time required for the Somme River to excavate its valley is the measure of the age of the upper gravels, and the implements found in them.

He asserts that there are ancient terraces along the banks of this river, and that these terraces mark the former position of the stream, as it cut its way back from the sea up to the present "rapids," which are now, he says, "far back towards Central France."

At the mouth of the Somme the gravels fringe the coast at an elevation of 100 feet above the sea. If I understand Professor Hughes, the cataract or the rapids must have originally existed at the sea, and the rapids have slowly retreated into "Central France."

He apparently regards the volume of water as being the same then as now.

The Somme River at Amiens is, I believe, some 50 or 60 feet wide, the river valley being a mile or a mile and a half wide. The length of the river from its head (some 12 miles N.E. of St. Quentin) is 124 miles. The fall from the source to the mouth is 220 feet, or 1.77 foot per mile,—about the flow of the Thames at Oxford.

When the excavation, however (according to Professor Hughes' theory), commenced, the river at its mouth at St. Valéry ran 140 feet higher than its present level at that point, for the plateau there is 140 feet above the sea. The fall at that time in the Somme from its source to its mouth was only 80 feet, or about 8 inches per mile; that is to say, the Somme river at that time had about one-third of the present flow of the Thames above Oxford, and about one-half of the flow of the Thames below Oxford.

The stream, spread at the time over the almost level plateau, must have had a depth of less than an inch.

The course of the river above Amiens to its source, 80 miles, is a winding one, which tended still farther to weaken the force of the current.

I do not comprehend how Professor Hughes deems it possible for such a stream to excavate a valley a mile or a mile and a half wide, and 150 to 200 feet deep. If it be true that man witnessed the commencement of such a work of excavation, he is old indeed; the time since his appearance on earth is, in fact, almost incomputable. Professor Hughes indeed points out the fact that there has been no change in the valley in two thousand years, and we may confidently believe that the present stream will not materially augment the excavation in twenty thousand more.

The upper gravel bed exhibits multitudes of chalk pebbles larger than a man's head, and some few far-travelled boulders of sandstone weighing a ton.

The shallow stream we have spoken of (less than an inch in depth), moving by a circuitous course, with a fall of eight inches per mile, is supposed to have swept the chalk out of the valley, to have moved and rolled these pebbles and boulders, and to have laid down gravel-beds sometimes 20 feet thick.

It is perfectly evident, on the contrary, from the phenomena as exhibited in the European river valleys, as well as in those of the United States, that these gravels (as well as the loess, 20 to 100 feet thick in the United States), were deposited by mighty floods, which filled the valleys across their whole breadth from hill to hill.

I have studied these gravels with some attention at Richmond, Virginia, where they cover the country to the right and left of the James River for miles. Richmond is, at the head of tide, 110 miles from the sea. The gravels here are not confined to the valley, but are spread beyond the limits of the valley, 150 feet above the present stream, over the level country north and south of the river. They were not deposited exclusively in the trough

of a valley, but between Richmond and the sea they extend indefinitely over the whole plain on either side of the river. This is not all; they extend over the entire tide-water area of the State, from the Potomac to the Roanoke (in North Carolina). They cover this whole region like a sheet 150 miles from north to south and 100 miles east and west. They begin with this fanlike expansion at the head of tide, and continue to the sea. After going a few miles above Richmond the gravels are only found near the river, and it is the same above Fredericksburg, on the Rappahannock. In North Carolina the same phenomena are reproduced; the gravels brought down the rivers, after they reach tidewater, spread in one continuous sheet across the State. I have no doubt it is the same in South Carolina. Now this contradicts at once the theory of an excavation, as connected with the deposition of the gravels. A similar appearance seems to be presented in what Sir Charles Lyell calls the tabular mass of drift on the Hampshire coast, in England.

The gravels which I have described in Virginia were brought down, as ascertained by their mineralogical character, from the mountains. They are not found on the banks of streams which do not issue from the mountains as, for example, the Appomattox. They are found high up on the bluffs of the rivers which take their rise in the Blue Ridge and the Alleghanies, and when they reached the head of tide they were by some agency dispersed over the whole face of the country to the right and left, until they reached the sea.

I think it possible that below Richmond, and similar points, the rush of fresh water in the rivers was met by the waves of the sea, which rolled inward at the same time, in consequence of a depression of the coast. The fresh water and the salt water met, and at the point of junction the gravels were spread far and wide over the present low country of Virginia.* I offer this as a mere conjecture; the subject is full of difficulty.

It was possibly the same in the valley of the Somme. The gravels occur on the French coast, as I have stated, 100 feet above the sea-level. When they were left there, the river ran 100 feet higher, and the sea stood 100 feet higher.

As the coast subsided and the sea rose to that level, the river sent down a flood of fresh water to meet the incoming waves. There are evidences both of the freshwater flood and of the movements of the coast-lines.†

As to the manner in which the Somme Valley was formed, I do not deem it incumbent to explain it. The valley was there when the gravels were spread over it; it was there at the close of the Glacial epoch. The "terraces," if such there be, were there also.

* This gravel becomes finer as we go below Richmond.

† The 100 feet gravel-bed on the coast shows this, and marine remains have been found at Abbeville, 25 feet above the present bed of the stream.

Professor Hughes seems to rest his whole argument on the fact of the existence of these terraces. But it is positively asserted by those who have made the most careful examinations, that there are no terraces in the case. This is the statement of Mr. Alfred Tylor, F.G.S. It is positively asserted by Professor Andrews, of Chicago. And in a paper read before the "Geologists' Association" (see Proceedings, vol. iv. No. 5), by Mr. James Parker, F.G.S., &c., on the Somme Valley, the same declaration is made.

"I need not notice at length," says Mr. Parker, "the terraced character which is given to the banks in the section [of Sir C. Lyell], and which, of course, goes far to help the hypothesis of river action. Mr. Tylor, in a series of carefully-measured sections, has shown that these terraces do not exist in any part which he has explored. I can add my testimony to the fact that no continuous horizontal terraces exist in any part I have explored also (and I may say I have traversed quite three-fourths of the course of the Somme); certainly not of the character as shown in the section" (p. 19).

As to the *rate* of excavation of its bed by a river, I wish to remark that that depends on the character of the material through which the stream passes, on the volume and velocity of the water, and on the movements of elevation or depression of the coast-lines. Now, let us suppose that when the sea and the Somme River at St. Valéry stood 100 feet higher, suddenly, from some cause, the level of the sea should fall, or, which is the same thing, that the land should rise. In this case, through a mud bottom, or through gravel and sand, the river would cut a deeper channel back in a very brief time.

Professor Hughes refers also to the change in the fauna which has taken place since the palæolithic times. I have discussed this elsewhere. I will only remark here, that it is now admitted that the reindeer was found in Central Europe at the beginning of our era, and that the lion was found in Thessaly about the same date. The Irish elk lived also to historic times. In America the remains of the mastodon are found habitually under circumstances implying the existence of the animal only a few thousand years ago. All are familiar with the discoveries in connection with the mammoth and rhinoceros tichoriinus in Siberia.

I think the excavation theory advocated by Professor Hughes is not held on the Continent, nor in America. Professor Dana, certainly one of the greatest of living geologists, and who holds to the antiquity of man, remarks in his *Manual of Geology* (p. 553), speaking of what he calls the Post-glacial flood: "The fact that such a flood, vast beyond conception, was the final event in the history of the glacier, is manifest in the peculiar stratification of the flood-made deposits, and in the spread of the stratified Drift southward along the Mississippi Valley to the Gulf, as first made known by Hilgard. Only under the rapid contribution of immense amounts of sand and gravel, and of water from so unlimited a source, could such deposits have accumulated." M. Dupont, in his "Report on the Belgian Caves"; M. Belgrand, in his work on "The Paris Basin"; Professor J. W.

Dawson, and many others, take the same view. Whatever else may be true, there is no doubt about the flood.*

There are ancient beaches on the great lakes of North America, showing that the water formerly stood in these basins at a much higher level. The beaches are Post-glacial in date. Has the water in these lakes excavated these basins?

REMARKS BY N. WHITLEY, ESQ., C.E.

I CONSIDER the paper of Professor Hughes to be of especial value and importance at the present time, in clearing the study of the evidence of the early advent of man of a number of doubtful cases which have for many years surrounded this subject with a haze of uncertainty, and which required a considerable amount of research and labour to clear away. This has now been done, and for which our warmest thanks and grateful acknowledgments are due to the learned Professor.

The result being, as the evidence at present stands, that in all cases where it has been attempted to assign to man a period more remote than that of the Post-glacial river gravels the evidence has completely broken down, and that man is neither Pre-glacial, nor Inter-glacial, but Post-glacial.

Professor Hughes is further of opinion that the earliest traces of man are to be found in the old "river gravels" of the Somme, and in similar deposits, consisting of numerous stone implements of human workmanship. Around the point of the genuineness of these supposed implements, therefore, the interest of the controversy now centres.

It is important further to notice that no other relics of man are mentioned by him as being found in these gravels except the so-called implements; and that in these beds the bones of the extinct animals have been found in great abundance, but not a single bone of man, or any other relic indicative of his presence has been discovered associated with them.

It is a matter of regret that the author has considered it unnecessary to produce any evidence that these fractured flints are really of human workmanship, as this is in fact, now the issue of the whole contention; but on this vital point we are referred in a foot-note to Dr. Evans' *Ancient Stone Implements of Great Britain*.

Turning to Dr. Evans' elaborate work, I find no proof whatever given

* Below Richmond, far down the river, the Jurassic is exposed in the river-bluffs, overlaid by the Tertiary and Quaternary deposits. In this Jurassic is a heavy bed of rolled gravel, composed of the same up-country rocks as the Quaternary bed; which shows that these great floods of fresh water were not confined to the Quaternary period. There were a river and a river-valley here in the Jurassic (or Triassic?) period.

that these flints are man-made implements : at considerable length Dr. Evans discusses the "characteristics of their authenticity" (p. 575); but this only relates to the indications by which they can be distinguished from modern "spurious imitations," which is a very different matter from that of their being genuine human implements. The so-called "Implements" of the gravel beds of the Somme are undoubtedly *authentic*, in that they are really found in the gravel-beds, and may be known from new-made forgeries ; but it does not therefore follow that they are *genuine* as implements made by man. (See *Trench on Words*, p. 197.—On the "confusion often made between genuine and authentic." 2d. ed.) And, in fact, Dr. Evans in this place does not appear to draw such a conclusion.

Both Sir Charles Lyell* and Sir John Lubbock† have considered it necessary for them to prove that the "flint implements" are of human workmanship, but they do not support this proposition by any direct evidence ; they do, however, convincingly prove by the vitreous gloss and dendritic markings on its surface that the split flint is not a modern forgery; and then they jump to the conclusion that it is a genuine implement. This is obviously a mistake of the question.

Mr. Prestwich alone has fairly grappled with this subject; and I have given his arguments in full and my reply, at page 45 of my *Flint Implements from Drift*.

On the other hand, there is a considerable amount of sound rebutting evidence to show that these split flints are not man-made tools, of which I will only now adduce two arguments :—

1st. These flints are usually found at the lower part of the stratum of angular flint-gravel, where the fractured surfaces of the whole mass are stained the same colour, show the same kind of fracture, and exhibit the same vitreous gloss and dendritic markings as the supposed implements. *And the most symmetrical implement is found to pass by imperceptible gradations through other forms of fractured flint into the rough angular gravel by which it is surrounded; the fracture of which is confessedly the result of natural causes.*

In the Museum of Practical Geology in Jermyn Street there are a large number of rough flint "implements" side by side with naturally-fractured flints of approximate forms; the object being to show that the simpler forms referred to fortuitous fracture may have suggested the type of the "undoubtedly artificial implements." But by an inspection of the labels the attempt to refer some to one class and some to the other confessedly breaks down. Thus in series D, six specimens in succession are described as,—

- " 42. Seems entirely natural.
- 43. Seems also entirely natural—perhaps used.
- 44. Apparently being dressed into form.

* *Antiquity of Man*. First ed., p. 112.

† *Pre-historic Times*, p. 276.

- 44 *a.* Natural or partly dressed.
 44 *b.* Natural or partly dressed.
 45. Appears dressed."

Specimen No. 10 probably approached the nearest to the Somme type, but even this flint is described as "natural, but perhaps chipped at the edge."*

These flints were collected and described by a first-class "expert," having the "experienced eye," which Lyell says is necessary to distinguish the false from the true implement; and yet in this case the present Woodwardian Professor of Geology at Cambridge could not distinguish from his point of view the work of man from that of nature, the gradation of form and fracture being so imperceptible.

2nd. I have inspected most of the gravel-beds whence these "implements" have been obtained, both in England and on the Continent, and also the accessible museums in which they have been placed; and I have never found one single "Drift implement" showing the same indubitable evidence of use by man, as is stamped on the true stone tools of the Neolithic age.

Even the degraded Bushman of South Africa, who has no house or home, no animals but a few wretched half-wild dogs, and no clothing but rough skins, makes a stone implement, with a *hole* in it for a handle, to dig out roots from the soil. And these undoubted implements are now found over a large area, conclusively indicating a former extension of the Bushmen who used them over that which they now occupy.†

Wherever man, even the most degraded savage, has been, he has left multi-form and indubitable relics of his presence, but the supposed Palæolithic man of the Drift gravel-beds has left no evidence of his former existence but rough stone implements, and these unlike any genuine implements known to have been used by man, and so uncouth in form that it is doubtful to what use they could have been applied; and with these, says Sir Charles Lyell, are a vast variety of very rude implements, some of which can only be recognised by an experienced eye as bearing marks of human workmanship (*Antiq. of Man*, p. 118, 1st ed.); and we now further find others which so blend with the natural forms of the angular flint gravel, that the most accomplished expert cannot determine the difference between the work of nature and the work of man.

Considering judicially the weight which should be attached to the whole of the evidence for and against the "implement" theory of these flints, from the ancient valley gravels, it appears to me more reasonable to reject the supposed existence of the so-called Palæolithic man,—than to believe that these fractured flints are of human workmanship.

* "On Flint Implements." By T. McK. Hughes, M.A. The "Geological Repertory." *Proc. Soc. Ant. Lond. Africa.* By Keith Johnston. P. 441.

PROFESSOR HUGHES' REPLY TO THE FOREGOING
COMMUNICATIONS.

It gives me great satisfaction to meet with the approval of so skilled and careful an observer as the Duke of Argyll, and I quite agree with his Grace in believing that, whether we are investigating the evidence for the antiquity of man, or the sequence of events which we include in what is known as the Glacial period, the most important inquiry is,—what was the extent, horizontal and vertical, of the last great movement of depression in the British Isles? It marks the close of *our* Glacial period, and seems to precede the commencement of *our* human period. It was probably the sea of that submergence that lifted off the last of the ice. We do not expect to find traces of man's sojourn here when the whole was covered by ice, nor was he likely to have left much indication of his visits when the greater part was covered by water. I did not go into this question, because I have not within my own knowledge any evidence of remains of man having been found in the marine deposits of that age.

With regard to Prof. Birks' observations, I may remark that, as I cannot regard the astronomical combinations referred to as even the principal cause of the prevalence of Alpine conditions in our area at any period, I, of course, cannot accept them as a measure of the age of the Glacial period. I think, on referring to my paper, it will be seen that I do not lay much stress on the contemporaneousness of man with certain extinct mammals, except so far as we can infer that such palæontological changes seem to take place slowly, and to be dependent on terrestrial movements, which also, we believe, take place gradually. To the growth of stalagmite as a measure of time I attach no importance, and have made full allowance for local changes of level, which would accelerate the rate of waste. I appeal to river terraces, not to any doubtful deposits which may be due to cataclysmic action. What it comes to is this,—that there is at present no certainty about the age of the old river-terraces in which we find the remains of man; but apply what test we will, we have always the same result, that, according to observed rates of change, the time must have been very long, unless we assume that every case that has been examined is an exceptional one, in which there has been an exceptional and local acceleration of all the operations of nature.

I must ask Mr. Brass to read the former paper by myself, referred to in p. 10, and I think he will see that I am far from assuming that no recent changes of level have taken place affecting the flow of rivers and the rate of waste in valleys. It is the recognition of this and other similar facts that makes me believe that in the present state of our knowledge it is impossible to assign a term of years to the period during which the rivers have been at work.

Whether a valley has been in the main cut out by an ordinary river or by

some exceptional flood, is a question about which a field geologist can generally form a good opinion.

Prof. Huxley's remarks, quoted in a footnote on p. 342, refer to the effect which such changes might have on the rate of denudation, but do not call in question the fact that the valley has in the main been scooped out by the river.

Of course many mistakes have been made, as might have been expected, where so many people with very various previous experience of such phenomena have been examining the gravels and loams for evidence of the existence of man during the period of their deposition. What we have to ask is, are there *any* well-authenticated cases?—and I think we must admit that there are.

Prof. Boyd Dawkins' note, referring as it does to several cases which I have not had an opportunity of examining, usefully supplements and supports the arguments I have adduced.

Mr. Harrison will find recorded plenty of instances of the large mammalia in northern regions being caught by river floods, or in the ice, and perishing in herds. Although this may occur only now and then, it is part of the ordinary operations of nature there. When I said they went out one by one, I was not referring to individuals, but to species (races and groups). To follow the theories propounded by Mr. Harrison would lead me too far from the points I proposed to deal with in my paper.

Mr. Mello raises some interesting questions, which I fear cannot at present be answered, among them the reason of the gap between the Palæolithic and Neolithic periods. There are some things which lead one to infer that the Palæolithic type, though it went back very far, also came down to Neolithic times; as, for instance, the occurrence of so many Palæolithic forms among the misfits of Grime's graves near Brandon, in Suffolk, and the Palæolithic implements scattered over the surface at La Ganterie, near Dinan, in Brittany.

Mr. Pattison would find among the causes now in operation full explanations of floods and debacles sufficient to fill many a valley with coarse *débris*. When a flood dammed for a time some of the upper waters of the Rhone, and then they broke loose upon the valley, filling it, as I myself saw, with rocks and stone; when a thunder-storm had burst upon a small hill-side in Westmoreland, and I saw the greater part of a field covered in two hours with gravel 10 feet deep,—all this was but the common way of rain and river denudation. But we know that kind of *débris* when we see it, and it is not in that kind of gravel that the implements I referred to were found, still less in a gravel showing any evidence of having been transported by great rushes of water due to violent earth-movements.

I regret that the Member writing from Cirencester has been unable to find evidence in that district to satisfy him as to the mode of formation of the Thames and other similar valleys, but I doubt not that the views I have put forward on this point will on further inquiry be more generally admitted.

The vagueness referred to by Dr. Southall arises, I think, from this, that I assume as proved certain views in physical geography with which he does not agree, and, therefore, the figures on which he relies cannot be applied to the statement of observations as given by me. For instance, I hold that broad valleys are formed by the rivers winding from side to side along the flatter parts, but that a river never runs in a shallow stream evenly covering the whole of the bottom of a valley. Again, I never knew a river with a uniform fall along its whole length, and believe that a slope of much less than a foot per mile along the flatter parts, with a fall of 6 or 10 feet at the rapids, would cut back a valley, though there might be no denudation going on, except at the rapids. The general principle upon which I lay so much stress, that a river cuts back at the rapids, and that the denudation of valleys is chiefly due to that kind of action, has received ample illustration this year. I have known the rapids cut back in some of our Welsh rivers many yards in the recent heavy floods. Nor can I follow Dr. Southall in his explanation of the formation of loess and gravels. The loess, or brick-earth, may be seen after floods have spread over the lowlands; as, for instance commonly in the rivers which run into the Humber, Wash, and Thames estuary, and is only the mud which has settled down from the flood-water when it has been allowed to stand and the sediment to settle. This is a well-known phenomenon, and is directed and turned to account in the process of warping. But the gravel requires water running at a high velocity to transport it, and cannot be spread at one and the same time over the whole valley.

Mr. Whitley confines his remarks to the question whether the objects appealed to in evidence are really the work of man or not, and refers to a collection I made many years ago to illustrate the probability that man, first adopting common natural forms, then modifying these, had the fashion of his tools suggested by nature. Mr. Whitley objects to receive my evidence that a finished weapon is the work of man, because I have stated that I have found specimens which I thought were natural forms, but which had received a blow or two which made them more likely to be useful, and because I would not venture to say whether those blows were accidental or given designedly by man. If I see a stone chisel-dressed all over, and recognize it as the work of man, because I have seen man make such things, but have not known them produced by nature, and I see also a weathered fragment under a crag broken by frost and fall, and I say I have no doubt that it has been broken by natural causes, is my evidence about these of no value because I refuse to say whether another piece which I find by a road is altogether natural or roughly-hewn by man?

APPENDIX.

Mr. JAMES PARKER, F.G.S., in a paper upon "The Valley of the Somme," read before the Ashmolean Society at Oxford, said that :—

"It was not a part of his task then to explain the phenomena of the Somme valley ; but with that map before him he felt called on to say a few words as to the operations which he thought it suggested. He might add that the view he took was based not only on the data then before them, but upon the study of the levels of the Ordnance Survey in a much more minute degree than was represented by the figures on his diagram, and beyond this by many a tramp over the hills in question, sometimes in geological excursions, more often archæological. The great parallel lines of rivers, the furrows as it were stretching in a direction similar to that of the sloping chalk, suggested that the river valleys belonged to the operations consequent on the upheaval of the great mass of chalk from its ocean bed. He compared the result with what any one might see on any argillaceous shore, where the base was impervious and yet soft. The descending tide left channels and furrows, by which the surface was drained, but afterwards modified in character by evaporation and exposure to atmospheric influence. The great chalk expanse of a hundred miles was enormous in comparison to the few yards of a tidal shore, and so were the valleys of 100 and 200 feet depth to the little drifts of 2 or 3 inches. But this was not all. If it were argued that the effect was not proportionately sufficient, it might also be reasonably replied that the emergence of this vast chalk-bed from the ocean was probably not of that passive character which belonged to a tide receding from the shore ; but it might well have been the result of active elevation of the chalk, and such elevation could scarcely have been unaccompanied by fissures and inequalities which, as a rule, would lie, as regards their greater intensity, in lines at right angles to the main axis of elevation. That was just what those valleys did, and the minor fissures represented by the smaller ravines lay again in a general sense at right-angles to them, as might be seen by a glance at the Ordnance map before them, on which the valleys were slightly tinted. The general aspect of the Somme valley and its tributary ravines pointed distinctly to operations connected with the rising from the ocean-bed. Whether that took place in tertiary or post-tertiary times, whether once or more than once, were not questions with which he had now to deal. All he would lay stress on was that those rivers and valleys, and among them the Somme river and Somme valley, did not owe their origin to the slow excavation of river action, and therefore the assumption of that action, as a measure of time in connection with phenomena which the valley presented, was an absolute error."

Mr. Parker's paper, referred to at page 331, will be found quoted at length in Volume VIII. of the *Transactions of the Victoria Institute*.

NOTES.

THE following extract from the notes to the preface of Vol. xii. of the *Journal of Transactions* of the Victoria Institute seems fitly placed at the conclusion of the present volume :—

1. Age of the EARTH :—Chief Justice Daly, LL.D., President (for 1878) of the American Geographical Society, referring to this subject and a careful collocation thereon of the views of Astronomers, Geologists, and Physical Geographers, said, it was found that there was “a wide diversity of opinion between them upon the question of time—a diversity so irreconcilable as to show that our knowledge is not yet sufficiently advanced to admit of any reliable theory as to the age of the Earth.”

2. With regard to the bearing of recent Geological discovery upon the statements of Scripture, more than one paper and discussion referring thereto appear in Volume xiii. The following opinions will not be without their interest to many :—

“We need not, in accepting the Bible narrative of man’s creation, repudiate one fact accurately deduced from modern scientific research.”—*The late Radcliffe Observer* (R. Main, 1878). *Relig. Hist. of Man*, p. 5. (See also Preface, *Trans.*, vol. xi.)

“Nothing can exceed in truth and grandeur these words (*Gen. i.*) of the inspired historian, * * the most keen-eyed hypercriticism could see nothing to object to.”—*Ibid.*, in *Aids to Faith*. (See also *Trans.*, vol. xi. p. 431.)

“With regard to Physical Science, I think we have seen that its real advances are in favour of Religious Faith.”—*Ibid.*, *Trans.*, vol. x., p. 174.

“The language of Scripture neither is, nor can be, * * contrary to the language of Science.”—Professor Challis, M.A., F.R.S., F.R.A.S., Plumian Professor of Astronomy at Cambridge. *Trans.*, vol. ix. p. 140.

“The Bible abounds in illustrative references to natural objects and phenomena, * * these are remarkable for their precise truth to nature.”—Principal Dawson, LL.D., F.R.S. *Trans.*, vol. ix. p. 173.

“The great discoveries as to the physical constitution and probable origin of the universe, the doctrine of the correlation and conservation of forces, * * these, and many other aspects of the later progress of Science, must tend to bring it back into greater harmony with revealed Religion.”—*Ibid.*, in *Origin of the World*. (See also Preface, *Trans.*, vol. xi.)

“There has never been produced in my own mind * * the slightest impression that we (he, and those who studied under him) were considering facts and laws in any way opposed to Christian Faith, to the inferences of Natural Theology, or the deductions from Scripture.”—The late Professor Phillips, F.R.S., speaking of his duties as Professor of Geology at Oxford. *Aids to Faith*. (See also *Trans.*, vol. xi. p. 432.)

“We all admit that the book of Nature and the book of Revelation come alike from God, and that, consequently, there can be no real discrepancy between the two, if rightly interpreted.”—Professor G. G. Stokes, M.A., F.R.S., &c., Secretary of the Royal Society. (See Preface, *Trans.*, vol. v.)

See also the very important paper read by Professor Stokes, F.R.S., before the Church Congress in 1879.