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PHILOSOPHICAL SOCIETY OF GREAT BRITAIN.

ORDINARY MEETING, MARCH 1, 1875.

REV. G. HENSLOW, M.A., F.L.S., F.G.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed, and the following elections were announced :—

MEMBERS :—J. Beeston, B.A. (London), Stepney Green.

ASSOCIATES :—Rev. Garton Howard, B.A. (Cambridge), Fenny Bentley ; Rev. J. Wolfendale, Tutbury.

Also the presentation of the following Works to the Library :—

"Proceedings of the Royal Society," Part 158.	*From the Society.*
"Proceedings of the Geological Society," Part 121.	*Ditto.*
"Ancient Cave Men of Devon." By W. Pengelly.	*Professor Tennant.*
"The Catholic Layman." 2 vols.	*A. E. Gayer, Esq., Q.C.*
"On Hemerozoology." By the Rev. F. B. Goodacre, M.D.	*The Author.*
"Design." By Dr. Moore.	*The Publisher.*
"Doctrine of an Unpersonal God." By Rev. W. Martin.	*Ditto.*
"Biology." By Rev. Professor Watts.	*Ditto.*
"God in Consciousness." By Rev. J. Morris.	*The Author.*
"Jesus the Centre." By Rev. J. Wolfendale.	*Ditto.*

The following paper was then read by the author :—

ON THE CHRONOLOGY OF RECENT GEOLOGY.

By S. R. PATTISON, Esq., F.G.S.

THE antiquity of man on the earth is one of the questions which at present stand in the way of an *entente cordiale* between religion and science. The geologist, looking at the

facts with a mind coloured by contemplating the vast duration of the earth's building-up, naturally refers to cycles of ages. The zoologist, studying the more restricted area of the dying out of sundry species in time, is content with much less. The late Baron Bunsen, familiar with the loose guesses of comparative philology, adopted twenty thousand years as his conclusion. The Scripture student, with Genesis in his hand, asks only for six or seven thousand years. Can either of the rivals prove his assertions? If we find that neither can do this to demonstration, but that each submits considerations worthy of notice, then all dogmatizing on the subject is out of place. This is the present condition of the question.

The dozen years which have elapsed since Sir C. Lyell published his *Antiquity of Man* have been rich in contributions of facts and reasoning on the subject, but have not brought forward any demonstration. The interesting and careful researches of Prestwich,* Dupont, Belgrand, Evans, Dawkins, and others; and the still more numerous philosophizings on both sides of the Channel, and on both sides of the Atlantic, are favourable to a brief reconsideration of the subject.

I hold that a decision in either way does not really touch revelation, and therefore is wholly apart from religion. This ought to enable us to treat the matter without passion. Convenient hypothesis is often the bane of science. Long after the insufficiency of an empirical rule has been fully demonstrated its formulæ still haunt the field and influence the speech. This has eminently been the case with the uniformitarian theory as applied to the formation of the present surface of the earth. It is admitted that this theory cannot reasonably account for existing gravel-beds, and yet the very men who have displaced it adopt its cast-off expressions. Sound often survives sense.

If there is any province in which dogmatism is peculiarly inappropriate, it is that which comprises our inquiries concerning man's antiquity. The authorities have succeeded to the old geographers, who

> "On pathless downs,
> Place elephants instead of towns."

The written record to which some of us appeal; does not, and does not profess to, bear full testimony on this head; the unwritten one is wholly made up of materials that have been

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* Nothing was accepted on this subject until Mr. Prestwich's researches in 1859 gave public scientific value to the facts.

placed and disordered in a succession extremely difficult to unravel. The one has no chronological beginning, is obviously incomplete, and permits in its text a variation of 1,200 years or more; the other allows of variations in chronology absolutely unlimited.

By recent geological chronology, I mean the evidences as to succession displayed by the strata of the recent period, the period contemporaneous with the introduction of man into Europe.

(1.) The proposition I seek to establish is, that geology furnishes no proof, nor high probability, that this event took place longer ago than about six or seven thousand years. Neither from geology can we absolutely displace the affirmance of the short period; nor can we from Scripture conclusively displace the assertion of a longer one.

As a preliminary, I wish to dispose of the stories about men older than the quaternary; that is, older than the fourth of the great geological divisions of the past. The alleged discoveries of remains of men in pliocene (tertiary) strata, at St. Prés, in Val d'Aras, and in Sweden, are entirely destitute of proof, and so is the announcement of Monsieur l'Abbé Bourgeois, made to the Anthropological Congress at Paris, and afterwards at Brussels, of man in the miocene. Subsequent examination into these statements has altogether failed to support them.

By common consent, then, the earliest deposits in which human remains have been found are the gravels in the valley and table-lands of the Somme, and other rivers in the north of France, and south and east of England, and the floor-beds of caves on the edges of rocky valleys in Western Europe. In the Somme Valley the remains have been found at heights of 30 ft. below the present water-level, and in the caves from 30 ft. to 50 ft. above it.

Considerable changes in the surface have therefore taken place since the deposits were laid down. Has this change of surface been effected by the slow action of present causes, excavating and filling up the valleys by turns; or, if otherwise, is there any warrantable measure or order of succession, and therefore of time, to be deduced from them? We of course exclude from our consideration the present surface-soil, and the immediate subsoil of the historical era. The latter includes the peat, and is synchronous with the ages of polished stone, and of metals down to the present. This latter series counts little over 2,000 years in Western Europe. It is far too much tainted with novelty to be of interest to us in the present inquiry,

though it is the tomb of the reindeer and many denizens of our land, now utter strangers to us.

We will not here yield to the temptation of recapitulating the facts. The excellent, accessible, and popular works of Lyell, Evans, Prestwich, Dawkins, and others, render such recapitulation wholly uncalled for. We will first glance at the gravels, and then into the caves, and afterwards state the deductions and arguments *pro* and *con*.

Mr. Prestwich puts the case of the implements thus: "The flint implements have been found in beds of sand and gravel along the line of existing river-valleys, in some cases but little above the level of the rivers, and others on adjacent hills, at heights of from 30 to 100 feet above the river."* He afterwards adds that isolated implements of the same kind have been found on table-lands 200 feet above the level of the existing stream. The instances of their discovery now extend widely over the valleys flanking the chalk adjacent to the main streams of drainage. "There can be no possible doubt," says Mr. Evans, "that a certain series of gravels, sands, and clays, containing organic remains and flint implements in extremely variable quantity, all belong to one geological period, and owe their existence and present position to similar causes."†

We at once assume that the flint implements are of the age of the gravels and earth in which they are found. They have not been dropped and penetrated since. They may have been re-sorted and disturbed with the gravel itself, but they belong to it. We have therefore man, as a worker in stone, in connection with a distinct stratum, the last in which we find remains of great mammals now extinct. We have only to inquire if this stratum yields to geology any proofs of its own absolute age; and if so, do such proofs accord with our conclusions on the same subject, derived from the book of Genesis. How long ago, then, were the gravels deposited?

(2.) When we set out on this inquiry we are met at once by apologies all round, for the necessary uncertainty attaching to the whole subject. Belgrand, the highly-accomplished French Government engineer, says: "Les phénomènes géologiques qui se sont accomplis dans ces temps anciens, sont eux-mêmes peu importants; ils se bornent à quelques oscillations d'une faible amplitude du sol de l'Europe septentrionale et au relèvement très lent des continents, que nous constatons encore de nos jours. Il est donc difficile d'émettre une opinion sur la

* *Philosophical Transactions*, 1864, part ii. p. 257.
† *Stone Age*, p. 611.

durée de l'époque quaternaire, et je crois que les calculs qu'on a faits sur ce point sont purement hypothétiques."*

The language of the careful editor of *Reliquiæ Aquitaniæ*, Professor Rupert Jones, is an echo of many others. He says, "How long a time was required for the changes in land and sea, mountain and valley, for the change from the glacial to a boreal and pluvial climate, with its ever-recurring snow and rain, excavating the higher valleys and filling up the coast valleys with enormous accumulations of sands and gravels, we have but few means of calculation to judge by." †

With the Lyellian school, the theory of the formation of the Somme and Thames valleys, and of all other valleys in whose flanks or basin palæolithic implements have been found, is, that a flat surface of chalk was left by the original sea, here and there dotted with banks of marine tertiary mud and sand; that the action of the rain gradually formed hollows, and connected these, until a channel was made, deepened by ordinary rains and floods; and that the waters occasionally accumulated, so as to erode the chalk and distribute the pebbles as we now find them.

It is admitted,—nay, supposed,—that, according to the calculations of Mr. Croll, this erosion would take place at first only at the rate of 1 foot in 1,000 years, and afterwards somewhat more rapidly in the limited area of the valley. The Thames now lowers its bed only 1 foot in 11,740 years, and therefore the amount of time since the deposit of the gravel-beds at Gray's Inn or at Ealing, say 100 feet above the present level, and four miles wide, is truly inconceivable.

Now, as we are not dealing with a fact of observation, but of deduction, if it is inconceivable, it is, of course, relegated to the domain of the imagination. The action of rain and rivers, though a true cause, ceases to be a true cause, in relation to an effect which it cannot produce. With any amount of time and present forces, the work assigned is plainly impossible. The eroding and lifting power of the present streams are wholly inadequate. On the one hand, Sir C. Lyell says, "I see no reason for supposing that any part of the revolutions in physical geography, to which the maps above described have reference (post-pliocene oscillations of level), indicate any catastrophes greater than those which the present generation has witnessed." But, on the other hand, Professor Prestwich lays it down, "That the formation of the higher gravels can be owing to the action of the present rivers is clearly impossible under existing

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* *La Seine*, Belgrand, p. 103, Introduction.

† *Proceedings of Geologists' Association*, vol. iii. p. 207.

conditions." We make no apology for calling so early, or for presently quoting so often the words of Mr. Prestwich. No one can follow in a path once trodden by him, without using his footprints. He thus admits the futility of present operations, and points to the greater agencies of the past. "River action of greater intensity and periodical floods imparting a torrential character to the rivers, the consequences of the joint operation are obtained." *

He refers to his reasoning as that which thus "brings down the larger mammalia to a period subsequent to that when the extreme glacial condition prevailed, and closer to our own times." . . . . "These conditions, taken as a whole, are compatible only with the action of rivers, flowing in the direction of the present rivers, and in operation before the existing valleys were excavated through the higher plains, of power and volume far greater than the present rivers, and dependent upon climatal causes distinct from those now prevailing in these latitudes. The size, power, and width of the old rivers is clearly evinced by the breadth of their channel, and the coarseness and mass of their shingle beds; whilst the volume and power of the periodical inundations are proved by the great height to which the flood silt has been carried above the ordinary old river levels,—floods which swept down the marsh and land shells, together with the remains of animals of the adjacent shores, and entombed them either in the coarser shingle of the main channel, or else in the finer sediment deposited by the subsiding waters in the more sheltered positions." † . . . . "To estimate the time to which we have to carry back the high-level gravels, we have to consider what may have been the duration of their accumulation, and that of the subsequent excavation of the valleys with the resulting low-level gravels. A difficulty here meets us at the onset. The accumulation of sand, gravel, and shingle along the course of rivers is so irregular (sometimes very rapid, at other times slow,—what is done one year being undone another), that we are entirely without even the few data by which we are approximately guided in ordinary sedimentary strata. The thickness of the deposits affords no criterion of the time required for their accumulation. They rarely exceed 20 feet, and are more frequently not above 10 feet to 12 feet thick. It is well known that recent inundations have covered valleys with sand and gravel to the depth in places of four, six, or even

* *Philosophical Transactions*, part ii., 1864, p. 250.
† *Ib.*, p. 286.

ten feet in the course of a few days, and, therefore, there are no high-level gravels, which, so far as thickness is concerned, might not have been deposited in the course of a few weeks, or even a few days." *

Turning to other witnesses, we find Professor Morris, alluding to the Thames gravel, saying,—"I am inclined to consider it as resulting from fluviatile action, and that at a period when a river far more deep and extensive than the present stream flowed along the valley."†

And Mr. Evans,—"Certainly, the whole character of the deposits is more in accordance with their resulting from the occasional flooding of the streams than from any other cause. If this be so, who shall tell at what intervals such floods occurred, and what was the average effect of each in deepening the valleys?"‡

Mr. Tylor calculates that in the pluvial period there must have been 120 times as much water per acre as at present. It is impossible to conceive causes now in operation, on the present scale, producing continuously any such phenomena. It is not necessary for my argument to show more than the full admission, by the most distinguished geological observers, that there must have been a sufficient departure from the present established course of things to form and place these gravels. So Dupont,—attributing the formation of the valleys to rains far more powerful and prolonged than the present, — "Aussi devons-nous rechercher, dans une augmentation des pluies, la raison des masses d'eau qui donnèrent naissance à nos vallées et admettre que la quantité d'eau qui tombait alors sous nos latitudes, était plus grande qu'aujourdhui."§

M. Dupont estimates that at the beginning of the mammoth age the valley of the Meuse was eight miles broad at Dinant, and at the close of the same period less than one mile. "Les phénomènes physiques se produisaient sur une immense échelle."‖ Afterwards the water ceased to conquer the land, and has been barely able to continue its present channel.

Mr. A. Tylor, in the year 1868, brought forward proofs of excessive rainfalls during the formation of the river-valleys, and characterized the period during which it occurred as the "pluvial period." He discussed these questions in his papers

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* *Philosophical Transactions*, part ii., 1864, p. 299.
† *Quarterly Journal of the Geological Society*, vol. vi. p. 223.
‡ Evans, *Stone Implements*, p. 620.
§ Dupont, *L'Homme pendant les Ages de la Pierre*. Bruxelles, 1872.
‖ *Ib.*, p. 125.

on the quaternary period, the publication of which commenced in the *Journal of the Geological Society*, vol. xxiv. p. 103, and was continued in another paper, read May 6th, 1868. He advances the following important considerations:—

1. The contour of the river-bed is such as could only have resulted from pluvial and fluvial action.
2. After the heaviest rainfall in recent times there is not sufficient force of water to remove the vegetation so as to make any change in the present surface.
3. There is therefore evidence of an enormous rainfall at the commencement and close of the second period.
4. The materials show that floods brought down from the uplands heavy materials into the valleys.

He adds:—"We are able to correlate the gravel of the river Aire, containing remains of hippopotami, with that of a number of rivers which appear to have risen in times of floods from 40 to 80 feet above the present ordinary level, in that part of the second period which I term the 'pluvial period.'" All the observers now, in England, Belgium, and France concur in this. Then we have from Mr. Godwin-Austen's researches in 1850-1851 proofs of a vast river and delta system having existed in what is now the English Channel; valleys occupying lines of depression in the line of existing rivers. The Somme, Seine, Thames, and others were valleys deepened by the great waters which occupied them. Beds of thick sand and silt were deposited by the action of vast floods.

Now all these witnesses are experts of the first class, and write from personal observation. Professor Dawson of Montreal, surely a competent witness from observation in both continents, says:—"Slow and gradual movement, even if interrupted, could not have produced these sharply-defined terraces." . . . "When we stand by the grassy and tree-clad slopes of a river valley, and consider that they have been just as they are during all the centuries of history, it is difficult to resist the prejudice that they must always have been so, and that vast periods have been required for their excavation at the slow rate now observed; but if we carry ourselves in imagination to the time when a plain was raised out of the sea, bare and bald, and a river began to run in it, we at once see our error. The river so running, and beginning to cut a channel, must in a few years execute a stupendous work of erosion, almost diluvial in its character; but in the course of centuries its work becomes completed, a state of equilibrium succeeds,

and its banks, protected by vegetation, scarcely experience any modification." *

Belgrand, from a consideration of the physical phenomena of the Seine valley, concludes that the valleys were scooped out by waters of flooded rivers running at the highest levels of the gravels by a process far more violent than the present forces, and that they were by the same process filled with gravel from the destruction of the surrounding beds, and then again scooped out by floods which continued long enough to produce great rushes of water from the plateaux above, down into the valley whilst and after it was thus again excavated.† The section at Fisherton, near Salisbury, given by Mr. Evans in the *Quarterly Journal of the Geological Society*, vol. xx. p. 191, shows exactly the state of things. High up under the brow of the hill, 80 feet above the bottom, is a patch of gravel lying in the cheek of an eroded hollow in the chalk; lower down is another patch which passes under the present small stream. In both are there flint instruments, and in both are there mammalian remains of the mammoth age. Difficult as it is to imagine that the mammoth could have resorted to the river-banks, and man pursuing it at intervals during an excavation of 80 feet, yet this is the fact deducible from the evidence; and it is equally deducible that this excavation was not caused by the slow operation of present forces, but by some means incomparably more rapid and effective.

Mr. Prestwich tells us: "That the rivers were larger and more rapid than now, is evident from the great quantity of *débris*, the prevalence of the gravels, the coarseness of the sands, and the general absence of mud sediments." . . . "The melting of winter snows, and combined possibly with a larger rainfall, must have afforded to the old rivers a volume of water far exceeding any present supply, and giving them more of a torrential character." It appears, therefore, that the gravels in these rivers are part of the phenomena of their erosion.

Original inequalities and lines of depression became the natural channels of running water, the latter in flood erodes the substratum, washes away the lighter materials, and grinds and sorts the pebbles; thus forming gravel and sand. After this process had gone on to nearly the present levels, and during some part of the time, and when the action was still intermittent, man followed the mammalia into these parts.

What we have, therefore, is violent diluvial action, under the influence of which the valleys were formed in pre-existing

* *Leisure Hour*, 1874, p. 767. † *La Seine*, p. 99.

gutters or lines of weakness of the chalk, and partially filled by hard rubble from the eroded materials. Then there was, first, a short occupation by man, and afterwards a recurrence of eroding action, accompanied by a considerable elevation of the land, and next a lowering or a flow of the sea into the ends of the old depressions first opened to its action by these movements. The waters still were larger than at present, making huge deposits of clay, mud, and sand; but by a rise of the land—gradual, though not continuous,—the rivers became reduced to present dimensions, present levels were fixed, and man resumed his occupation and remained as a dweller.

(3.) I will now advert more specifically to the fact already alluded to,—the violent disturbance in the framework of Europe that took place before the historical period, before the neolithic period, closing, probably, the palæolithic age of man's occupation. This disturbance the following witnesses will prove:—

Sir C. Lyell says:—"There were probably many oscillations of level during this last conversion of continuous land into islands."

Belgrand, speaking of the level of the Seine, says:—"Il y a donc eu, entre les temps des hauts et des bas niveaux, un relèvement du continent, peu considérable comme fait géologique, mais suffisant, cependant, pour produire de graves perturbations dans le régime des eaux, et pour modifier la forme du fond de la vallée." *

The fractures in the chalk, and contortions of the old drifts on the island of Möen, fifty miles south of Copenhagen, prove the action of great and frequent oscillations and disturbances since the older pleistocene beds were deposited, although these dislocations usually leave but slender traces in gravel-beds. Professor Dawson adds:—"This seems to have been a comparatively rapid subsidence and re-elevation, leaving but slender traces of its occurrence, but changing to some extent the levels of the continents, and failing to restore them fully to their former elevation, so that large areas of the lower grounds still remained under the sea." † After considering the effect of crust movements in the earth as bearing upon the question, he adds:—"There is, therefore, nothing unreasonable in that view which makes the subsidence and re-elevation at the close of the post-glacial period somewhat abrupt, at least when compared with more ancient movements." ‡

We have then the undoubted fact that the mammoth age was characterized by at least one period of terrestrial disturbance, by which the land and water were greatly modified in

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* *La Seine*, p. 99. † *Ib.*, p. 290. ‡ *Ib.*, p. 292.

level and contour. England was broken off from France, the British islands formed, and the rivers reduced to their present size and courses.

Sir C. Lyell says:—"The naturalist would have been entitled to assume the former union, within the postpliocene period, of all the British isles with each other, and with the Continent, even if there had been no geological facts in favour of such a position."*

The recent examination of the bed of the English Channel, for the purposes of a submarine tunnel, confirms the conclusion that its disruption is only of recent geological date, that it is a denuded hollow in the line of ancient rivers, broken into by oscillation, and pared down by the inroad of the sea in post-glacial times.†

(4.) I will briefly refer to the cave evidence. England and Wales, like most European countries, contain caves that have been occupied by man from the earliest times to the present. They inclose not only relics of all ages since they were the dwellings or resorts of the people first encountered by the Romans, but of a still earlier race whose implements are found sealed up in stalagmite, with bones of extinct mammals of the same epoch as the valley and terrace gravels. All such caves are within one hundred and fifty feet of running water, or of the sea, the majority of them within seventy or eighty feet. The lowest fossil contents ascertained, correspond with the lowest fossiliferous gravels. I will just refer to a few of these. Kent's Cavern, at Torquay, offers us in its lowest bed a typical instance of the occurrence of man's works contemporaneously with the mammoth. This locality is familiarized to us all by the popular demonstrations of Mr. Pengelly. The stratum in question was accumulated or drifted when the entrance to the cave was from seventy to one hundred feet lower than at present relatively to the sea-level. After an elevation had first taken place, a second depression occurred, bringing the cave floor level with the sea beach; since that, gradual changes only have followed, from causes now in operation, resulting in the present contour of the country. Unquestionably this indicates vast lapses of time; but the two principal factors—the raising and submersion—require the intervention of causes

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* *Age of Man*, p. 277.

† I much regret that, at the time of writing, I had not before me Professor Geikie's able work on the "Great Ice Age." In discussing it I should have claimed him as a witness for catastrophe at this epoch, on the ground of that which he terms—"those mysterious forces by which the solid crust of the globe is elevated and depressed" (p. 509).

not now in operation in the district. We know not how suddenly they may have arisen and fulfilled their course. A space of two thousand years is adequate to account for all the phenomena, if we take this into account, whilst, on the other hand, no allowance of time whatever is adequate to account for it on the other supposition, *i.e.* as effected by causes now progressing here.

Brixham Cave is another in which works of man are in the lowest stratum. It has been channelled by a strong stream of running water flowing through the crevices of the rock from the table-land above; the waters were gathered in the cave, and rushing out by a stream to the sea 60 feet higher than the present base of the surrounding valleys. In Brixham Cave the remains of the mammoth,—gnawed bones,—occur in the lowest bed. The implements are worked flints of the simplest shape, triangular and lance-shaped, with cutting edges. The bones were some of them carried in by water with pebbles and mud, others by beasts of prey inhabiting the cave.

"Water charged with silt probably found its way into the cave by the lower or north entrance, and deposited the cave earth, in which occurs so great an accumulation of bones, including, in addition to the above-named animals, those of the various deer, bear, fox, rhinoceros, hare, and lemming. Looking at all the circumstances of the case, I consider it most probable that at that second period the cave was at times dry, and at other times flooded, not by streams flowing in from higher ground, but by flood waters from streams at a level lower than that of the cave; that during the former interval the cave continued to be frequented by carnivores, who brought in their prey to devour; and that by each successive inundation successive collections of bones were covered up and imbedded in the sediment with which the flood waters were charged."* In Brixham Cave there occurred thirty-six specimens of flint, fifteen of which had been artificially worked. Mr. Prestwich suggests that the flints were lost or left behind by man during occasional visits to the cave, either for the sake of temporary refuge, or in following prey which may have sought shelter there.

He further considers that we can only account for the phenomena of Brixham Cave on the suppositions:—

1. Of greater rainfalls.
2. Of an intensely cold climate.

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* Prestwich, p. 558.

3. Spring floods of great power, such as now occur in Arctic regions.
4. Sea action.
5. A slow movement of elevation.

Mr. Boyd Dawkins, in his ample and able researches into the subject, embodied in his most interesting book, referring to the Victoria Cave at Settle, estimates that the two feet of *débris* accumulated at its mouth since the ancient British period, supplies a chronometer, and indicates the lapse of 1,200 years. He applies this to the six feet between this and the floor of the men of the polished stone period (neolithic), and thus makes the latter 3,600 years ago; and then to the still earlier (mammoth) age, which brings the occupation of the cave by man to about 5,000 years ago. But he admits that in ancient times the frosts may have been more intense than they are now, and therefore that the rate of weathering may have been faster.* Thus the calculation is invalidated, and one-half the number of years has equal claims on our belief,—or superior, if favoured with other considerations.

There are a sufficient number of good instances of the occurrence of bones with palæolithic implements only, to warrant the conclusion that the early cave period is synchronous with that of the gravels. The cave was the resort of the first hunters.

The most remarkable and complete of the Belgian caves are those on the Meuse and its tributaries, described in the able work of M. Dupont, Director of the Natural History Museum at Brussels.† No less than forty-three caverns which open in the limestone cliffs of the Meuse or its tributaries have been carefully explored; of these, twenty-five have furnished remains of man's work associated with extinct mammals. The caves open at heights varying in different parts of the valley from 12 to 60 yards from its level. They all have a floor of ancient mud, the result of periodical inundations of the river. Some of the bones were thus washed in, but the greater part were accumulated during occupation by living men and animals. We select one of the twenty-five caves,—that of *Magrite*, near Pont-à-Lesse. Dry, large, open, light, it has been often chosen as a convenient abode. Its floor is covered with rolled pebbles and 2½ yards of river mud, including four distinct successive surfaces, and each layer containing bones. These remains vary

* Prestwich, p. 115.
† *L'Homme pendant les Ages de Pierre dans les Environs de Dinant-sur-Meuse et Bruxelles.* 1872.

from stage to stage. The lowest bed contains worked flints of rude triangular form, and some other used stones. In this ancient mud, and with these implements of man, washed by water, but not transported, are found the bones of

Mammoth	1 old, 1 young, 1 very young.	
Rhinoceros.....	8 individuals.	
Bear	3	„
Horse.....	17	„
Chamois.....	2	„
Reindeer.....	30	„
Stag	3	„
Hyena	4	„

and many others. I will not enumerate further, but refer you to M. Dupont's book. The upper layers contain fewer of extinct mammals and more of the bones of the reindeer and horses. The flint tools, too, exhibit some slight advance in art. In the third bed was found a carved reindeer bone, with cut ornamentation. Some of the bones in the earliest deposits display traces of designed fracture and cutting. In their selection and treatment they show the action of man's mind. In many cases the mode of introduction of mammoth bones and flints is not clear; they may have been introduced by crevices, or surface floods, but in others the evidence is that of entry by the open mouth of the cave. In both, the floor has been covered by mud of inundation, occupied by man and beast of prey, abandoned and sealed over by stalagmite, then after an interval occupied again; and thus it has gone on until recent times. In one case there are six beds of ossiferous mud, and five layers of stalagmite. The openings of the caves in Belgium once flooded by the stream of the valley, are now 200 feet above the latter, in solid limestone. It has therefore been inferred that 200 feet have been scooped out of the valley by causes now in operation since the inhabitancy of the cave. But there is no appreciable lowering of the valley going on now, and therefore this reasoning is obviously illusory. There is no such cause in operation.

This is precisely analogous to the alleged scooping out of the wide valley of the Somme. The one is as impossible as the other, and if geologists have to bring in other and more powerful causes for the one set of effects, they must do the same for the other also. The only interpretation of the Belgian caves, in regard to their mud deposits, is that which assigns the material to the drifting and sorting powers of water

intermittent between periods of occupation during which they were dry. In other words, they were on the borders of a river, subject to inundation, and within the limits of the inundation. The caves of the Dordogne and of Bruniquel, in France, do not present the action of floods, but accretion of soil by inhabitation without disturbance. Undoubtedly they show that wild animals now extinct haunted these caves and that man hunted them, and used them for food, and also the flesh of reindeer in a district where the latter do not now exist, besides that of some creatures still living in the district.

As far then as geological evidence of antiquity goes, it is merely a question as to what changes have taken place in the valleys since the accumulation of the soil forming the floors,—what was the time necessary for the formation of the stalagmite which in some cases overlies them, and of the calcareous breccia into which they have been converted. These are dependent upon such variable conditions that it seems utterly hopeless to attempt to assign positive dates. Here, again, we have to quote from Mr. Prestwich the cautious remark:—"Some doubt must always attach to the determination of the relative antiquity of the cave remains, owing to the several possible causes of disturbance, whether by physical operations which re-arranged the contents of the cave, or by the agency of animals or of man producing local displacements."*

And with regard to the stalagmite on which so much stress has been laid as proving extreme antiquity, various observers,—Mr. Farrar, at the Victoria Cave; Professor Phillips in the Ingleborough Caves; and Mr. Dawkins,—may be said to have established the average rate, at a quarter of an inch per annum; (*i.e.*) 20 feet of stalagmite may be formed in 1,000 years; and, says the last named,—"It may fairly be concluded, that the layers of stalagmite cannot be used as an argument in support of the remote age of the strata below."†

The mammoth or palæolithic age, and the reindeer or neolithic age, cannot always be sharply separated though usually betraying change of level between them. Perhaps in America they cannot be separated at all. Some of the French and Belgian caves of the first stage show that the rudest implement contained was still used among the later people. But on the whole the distinction is real and well-founded, and indicates true succession. Palæolithic man may have been altogether a transitory visitor in these parts. His cave abodes may have been mere

* *Report on Brixham Cave*, p. 560. † *Ib.*, p. 40.

summer hunting lodges. At all events, we do not track him north-eastwards into the frozen lands of Siberia with the mammoth, unless, passing beyond the latter, he is now represented by the Eskimos, to which tribe he certainly bore a very great resemblance, but which probably was the result of a later migration.*

Mr Dawkins adds:—"We may therefore infer that the same palæolithic race of men ranged over the whole region from the Pyrenees and Switzerland as far to the north as Belgium, as far to the east as Würtemburg, and west as Devonshire. The cave-dwellers are the same as those who have left the rude flint implements in the river gravels." Mr. Dawkins enumerates nineteen species, including the mammoth, found in the palæolithic gravels, not found afterwards, which may be assumed to have become extinct in these parts before the historic period. He infers from this that an interval of considerable length must have intervened to allow for the migration and extinction of these creatures.†

But this is only a repetition of the hypothesis, for the violent disturbance and disruption of the land in the interval would render far less time than is supposed equally or even more probable.

Mr. Dawkins justly infers the migration of the great mammalia in an uninterrupted range from the south of France to Devonshire and Ireland. This, of course, could only have been effected by the absence of portions of the Channel, *i.e.* by the elevation of the land now submerged. Hence, as we have before seen, the necessity for an actual movement of the crust of the earth, sufficient to account for a great change in the physical geography of the west of Europe, including a period of action, which raised the land and reduced the mighty rivers to comparatively tiny streams, falling into the encroaching sea, which now swept the submerged area. These considerations forced on us from the life of the period, as well as by the appearances of the gravel-beds, bring us to the conclusion that the epoch of the great mammoth and man was terminated by catastrophes in which the former perished, and the latter withdrew. On man's reappearance, after the lapse of ages, the mammalia are represented by somewhat smaller forms, man resumes his place with greater comparative power over nature. Thus he continued, and slowly improved himself in Western Europe, until about the sixth century B.C., when he receives from the East the art of making bronze, and

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* Boyd Dawkins, p. 359. † *Ib.*, p 260.

a few centuries later he uses iron and other metals. Stone falls into desuetude, and is banished to the remoter islands, or used only as a makeshift.

The non-uniformitarian nature of the oscillations referred to is shown in all the "raised beaches" round our coasts. The old sea-bed, at an elevation of from 40 to 60 feet above its former level, is covered with a mass of angular shingle, resulting from local fresh-water floods or rains poured out subsequently to their rise and settlement, in a degree not now experienced in the same localities.

Mr. Boyd Dawkins says:—"The general surface of the valleys has undergone but little change since history began, and the excavation of rivers has been so small as to have escaped accurate measurement."*

(5.) We are now in a position to discuss the bearing of these geological discoveries on absolute chronology. We have before said that even in the present advanced state of our knowledge all schemes of chronology are at best mere suggestions having more or less probability.†

In the midst of the quaternary period, on the boulder drift, we stand on the upraised sea-bottom of the icy ocean, and in the banks around us we may still discern in some places shingle and rubble once pushed along the bottom of the sea by an iceberg, or thrown down by the melting of an ice-raft. In some places we may perceive the denuded land left bare by the melting of the ice-cap. Coming down through the ages from this far-off time, we next discern a surface spotted with forests, intersected by vast rivers, occupied by large mammals pursued by men. Here first we encounter the being described by Schiller:—

> "Darkly hid in cave and cleft,
> Shy, the Troglodyte abode;
> Earth, a waste, was found and left
> Where the wandering Nomad strode;
> Deadly, with the spear and shaft,
> Prowl'd the hunter through the land."

It is, however, just as reasonable to conclude that these were the characteristics of the human race *elsewhere at that time*, as it would be for the celebrated Zulu savage to construct a theory of mankind founded on the empty powder-cans and pitfalls in the wake of Gordon Cumming. We have no indication whatever of the character or duration of this occupancy, save that

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* Boyd Dawkins, p. 271.

† The observation of Cicero, in the *Academic Questions*, applies:—"These assertions seem strange, but the man who has made them could not take his oath that such is the case; nor could I take mine that it is not the case."

given by the succession of mammals, denoted by remains of young individuals, or the irregular layers of the earliest gravels and silt. From these slight data we know that it must have endured for a considerable period. How much of this period is covered by the implement time, no record tells us. The cave deposits associated with the latter may have been introduced in a very few years. There is no scientific requirement for very many centuries. Of what was taking place in other parts of the earth at the same time, amongst other assemblages of creatures, we have no information. We can only surmise, and hope this gap will be filled up by future researches in the East.

Next comes the period of disturbance and augmented action. This, from the nature of the causes at work, is also without positive chronology. Numerous oscillations of land over a large area might, and probably did, take many ages to produce the results which ended in equilibrium and settlement. But it seems evident that *geology* has nothing to say against the assumption that 2,000 years might have sufficed for this part of the palæolithic epoch, including the revolution effected by change of level at or near its close. We find that North America shows the same prevalence, first of rough implements exclusively, then of polished ones. But without the break between which exists in our parts obviously from catastrophe. Yet how different are the fancies inaugurated by the uniformitarian master and his disciples, from the sober deductions which an unprejudiced person may make from the same premises. Sir C. Lyell says: "Since the advent of man on the earth, we have therefore to deal with periods of incalculable length. Figures cannot enable us to appreciate these enormous lapses of time."* "In the old glacial drifts of Scotland the relics of man are found along with those of the fossil elephant."† "The date of the origin of some of these beds (the peat beds) cannot be estimated at less than 40,000 or 50,000 years."‡ "The change from the chipped to the polished stone period is very gradual. It embraces thousands of centuries."§ "So far as investigations have gone, they indisputably refer the existence of man to a date remote from us by many hundreds of thousands of years."‖

Now, it will not surprise you to learn that not one of these dogmas is founded on geology; nor do we arrive, in our imaginary flight backwards, at any different race of men; for Sir Charles affirms that the human skeleton in the Belgian

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* *Antiquity of Man*, p. 196. † *Ib.*, p. 19. ‡ *Ib.*, p. 197.
§ *Ib.*, p. 197. ‖ *Ib.*, p. 193.

mammoth caves does not betray any marked departure in structure, whether of skull or limb, from the modern standard of certain living races of the human family.*

Again, Sir Charles says that, between the palæolithic and the neolithic there is evidently "a vast interval of time," but gives no grounds for the assertion save the modern slow extinction of the tiger in Bengal, and *more suo* he invalidates his own conclusion by saying that "it is probable that causes more general and powerful than the agency of man,—alterations in climate, variations in the range of many species of animals, vertebrate and invertebrate, and of plants, geographical changes in the height and depth and extent of land and sea,—some or all of these combined, have given rise in a vast series of ages to the annihilation, not only of large mammalia, but to the disappearance of the *Cyrena fluminalis*, once common in the rivers of Europe."† Why vast series of ages? The more general causes and powers thus evoked, operating for a few centuries, are quite equal to the task required.

The advent of man, according to Sir Charles Lyell, belongs to the second continental period, when Britain was a portion of the Continent, and was insensibly being raised, and the ice retreating northwards, and with it the Arctic quadrupeds; whilst the mammoth and woolly rhinoceros and great hippopotamus still wandered on the banks of the broad rivers. After this came the breaking up of the British area into its present island form, during which many oscillations of level occurred, the land became lowered, the climate ameliorated; then came neolithic and historic times. Sir Charles affirms that the first human period is an integral portion of a cycle of 224,000 years, but wisely does not say what portion. He says that *if* it occurred at the epoch to which he has assigned it, then it is so remote as to cause the historical period to sink into insignificance. This is merely intimating that the changes referred to might have occurred without catastrophe, and, if they did, would have required over 100,000 years. We may just as forcibly say, and if they did not, they may have required 2,000 years only.

Mr. Boyd Dawkins is equally bold with Sir Charles Lyell, and his carefully-observed and detailed facts are equally at variance with his working theory.‡ After stating that the

* *Antiquity of Man*, p. 419. † *Ib.*, p. 418.

‡ But Mr. Dawkins elsewhere maintains that it is impossible to gauge time past, outside historical record. He also founds his opinion on pre-glacial, or inter-glacial, appearance of man on the occurrence of his companion the reindeer.

animal remains are clearly post-glacial, he concludes with the strange and unauthorized statement,—"We may also infer with a high degree of probability that man migrated into Europe along with the pleistocene mammalia in the pre-glacial age." This he props up by the statement that the remains in the Victoria Cave "may be considered pre-glacial," and therefore the small fragment of bone found in the cave in 1872 establishes the fact that man lived in Yorkshire before the glacial period. The reasoning is curious. If the mammoth, whose remains are found in the caves, was post-glacial, we should find its remains in the drifts; but we do not; therefore it was pre-glacial; and therefore man, a fragment of whose bone was found in the mammoth stratum in 1872, was also pre-glacial, and protected from destruction by the ice-sheet. Now, the value of the non-finding of the mammoth-bones in the drift is *nil;* and as they are found in the drift elsewhere, it is less than nothing. The question for consideration is, What is the latest date to be assigned to the extinction of the mammoth in this country? We find none of its remains in the neolithic period,—say for the 2,000 years before Cæsar. This sends it back, say, to the antecedent 2,000 years, and in some portion of this time was the great diluvial disturbance.

If the high-level and low-level gravels are parts of the same series, on the theory either of Belgrand, that the valleys were first filled with them and then scooped out in them, or of Prestwich, that the gravels are the residuum of the water action which formed the valleys, the question of time is the same in either case. What time is required for either the wearing-down operation or the scooping-out? If this is supposed to have been effected by present causes, then the longest period hitherto assigned is not too long. But if all are agreed that other causes, if similar to the present, yet worked far more powerfully, then almost any time which allows succession of intermittent action is sufficient for the purpose, and the received Biblical chronology is as good as any other. Sir Charles Lyell adduces in proof of the extreme antiquity of man the vast distance of time which separated the origin of the higher and lower level gravels of the valley of the Somme, both of them rich in flint implements of similar shape. Yet this distinction of time between high and low level gravels is virtually abandoned. High and low level are mere names for the consecutive portions of the same phenomena, which might all have occurred in a few centuries. They do not support the allegations of vastness which are put forward. And yet, with Sir Charles Lyell, the whole of the grand oscillation, comprising the submergence and

re-emergence, took "in round numbers 180,000 years for its completion."

Well does the veteran philosopher add:—"I am aware that it may be objected that the average rate here proposed is a purely arbitrary and conjectural one."*

Dr. Andrews appears to show, by careful observations, that the present surface-land of North America rose out of the waters of the glacial period between 5,500 and 7,500 years ago. This appears to limit within these bounds the possible duration of the human period in North America. Dr. Dawson says there are other lines of evidence which would reduce the residence of man in America to a much shorter time.† From a communication to "Nature," of January 14, 1875, we gather that the distinction between palæolithic and neolithic obtains in implements imbedded in the soil there—the former being always rough and more deeply buried. But we also infer that both belong to one type of people, and that the superiority of the latter is the result of progressive improvement.

The wearing away of the land to the south of the Hampshire coast, partly in soft beds and partly in chalk, would require, it is said, far more than ten thousand years. But why go into such a calculation at all, inasmuch as the hypothesis of gradual uniform erosion is wholly inadmissible. Mr. Evans, placing his spectator on the edge of the Bournemouth cliff, and bidding him gaze over the waste of waters in quest of the lost Atlantis, may as well accept the ancient tradition of its *sudden* submergence, confirmed as it is by the appearance of the cliffs. The gazer, on any other supposition, could have beheld no appreciable change, and there would have been nothing remarkable in the prospect, however long he might have continued at his post. With regard to the antiquity of the implements, Mr. Evans says:—"With our present amount of knowledge, it is hopeless to attempt its determination with anything like precision."‡ This does not exclude hypotheses, but it reduces it to mere working suggestion. What, then, is the value of Mr. Evans's argument for a long period between the change from palæolithic to neolithic? He says: "It can hardly have been the work of a few years, or even of a few centuries." Granted; but when it is evident that the change did not take place from ordinary slow causes, but was necessitated by sudden alterations, a period of one thousand years will amply suffice. If Mr. Tylor

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* Since these observations were written, and on the 22nd of the present month, this distinguished philosopher has passed away.

† Dawson, *Earth and Man*, p. 295.

‡ *Ibid.*, p. 617.

is right in intercalating the pluvial period here, we have then, antecedent to this, say at least 3,000 years in the ordinary chronology of the Bible, within which to place the mammoth age and its hunters in the West.

We may assume it as established that there was a time when England was connected with the continent, when big animals roamed in summer up the water-courses and across the uplands, and man, armed only with rude stones, followed them into the marshes and woods, hunted them for sustenance, and consumed them in shelter of caves, then accessible from the river levels. This state of things was continued until disturbed by oscillations of surface, accompanied by excessive rainfalls and rushes of water from the water-sheds of the rivers, until the great animals were driven out or destroyed, and man ceased to visit these parts. The disturbances continued, the Straits of Dover were formed, the configuration of the soft parts of the islands and continents was fixed, action subsided, and the present state of things obtained. Man resumed his residence, but with loss of the mammoth and its companions. The reindeer now constituted the type of a state of things which lasted down to the historic period, without any other break from that time to this.

We have then, first a period during which the waters of the valleys ran at higher levels, and were considerably larger,—the mammoth age. Then a diluvial and pluvial period, part of the mammoth age,—a period of great physical changes; and afterwards the present state of things.

Now we know tolerably well the duration of the last. Secular history concerning the West contains no records earlier than the date usually assigned to the foundation of Carthage, B.C. 844, which leaves 1,643 years after the Flood, during which all written history is silent, and 1,656 years before the Flood, also quite dark. The latter 1,656 years was a time of great operations. We know that enormous physical results have been produced and completed in very brief time. Instances of this are matters of familiar history. If we assign 1,656 years for the occurrence of this turbulent epoch, no one can say that it is insufficient. Then we have upwards of 3,000 years from the alleged introduction of man, according to the book of Genesis; if the mammoth period occupied 1,000 years, we have 2,000 years before secular history for the duration of the neolithic age, and all its accompaniments; *i.e.*, take the whole of the period since the Flood as the recent period, and the 1,656 before that, to include the man-and-mammoth age and diluvial period. It should not be forgotten that the

necessities of the genealogies and migrations after the Flood recorded in Genesis, appear to require a far longer time than the annalists assign. Any extension conceded by the chronologists would be absorbed by the geologists, as their data allow of great extension, though not requiring it. Among the changes involved during the period which includes the epoch of disturbance, is that of the severance of the Isle of Wight from the mainland, which must have been subsequent to the blotting-out of the great river, preceding the Thames, Seine, Somme, and Rhone in a vast delta, on the banks of which the implements at Bournemouth were found. Mr. Fox, quoted with approval by Mr. Evans, says:*—"The severance of this island from the mainland, it appears to me, effected under very unusual circumstances, and at no very distant period, the present channel of the Solent being pretty nearly equally deep and equally broad throughout its entire length of fourteen miles, proves at once that it was not formed in the usual way of island-severing channels,—*i.e.*, by gradual encroachments of the sea,—but by its being originally the trunk or outlet of a very considerable river." † In further indicating the progress of the changes that took place here at the close of the mammoth period, Mr. Evans says:—"Directly this closer communication with the sea formed for the Dorsetshire rivers, they would of course, owing to the now rapid fall, excavate their valleys with greater speed at their mouths, and directly they became tidal the sea would make rapid inroads on the soft sand and clay exposed to their action." ‡ Thus quickly would the change be made which has finally resulted in the present configuration and contour.

Chronologists are agreed that about 2,000 years before Christ, Abraham migrated from Mesopotamia to Canaan, and that at this time, Egypt, at least, was old in civilization.§ Beyond this we have no positive scale of time in Scripture; for it is evident, from the narrative itself, that the latter does not cover the whole of time.

Usher estimates from Scripture, the creation of man as about 2,000 years before this. During the latter portion of this time, civilization was proceeding under settled governments in the East, interrupted, says the record and tradition, by a flood.

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* Dawson, *Earth and Man*, p. 605.

† *Ib.*, p. 605. ‡ *Ib.*, p. 610.

§ "This is the boundary, in looking backwards, of Time—absolute; all beyond is time—relative."—Duke of Argyll, *Man Primeval*, p. 84.

So Lucretius,—

> "Thus, too, the insurgent waters once o'erpowered,
> As fables tell, and deluged many a state;
> Till, in its turn, the congregated waves
> By cause more potent conquered, heaven restrain'd
> Its ceaseless torrents, and the flood decreased."

Barbarism covered the whole Western world; neither in the 2,000 years before Abraham, nor in the 2,000 years afterwards, have we any light reflected from these regions to the East. In this 4,000 years, or in the somewhat longer period which probably will be ultimately settled as warranted by the record, we place hypothetically all the phenomena of the later mammalian age, including the introduction of man as a hunter, the first occupation of the caves by him also, the diluvial phenomena of the wide valleys, the oscillations and disturbances of the earth's crust, alterations in the coast-line and physical settlement of the country; after this comes the second occupation of the caves. In short, if we say that, hypothetically, the whole first-known human age occurred within 4,000 years of the Christian era, no one can say that it is geologically impossible. Who can say that 1,643 years is insufficient to comprise all the phenomena that occurred during a period confessedly characterized by more rapid and extensive action than the present,—a period during which ruptures in the earth's crust, oscillations, and permanent uprising took place, and the intermittent action of violent floods caused the deposit and disturbance and resettlement of the gravels and brick-earth? There is nothing to interfere with the prevalent opinion that man was introduced here whilst the glacial period was dying out, and whilst it was still furnishing flood-waters sufficient to scour and re-sort the gravels of the valleys down which they flowed. This supposition may be extended to both the great continents. Professor Dawson says,—"A sufficient number of probable indications appear to make it not unlikely that man had reached America before the disappearance of the mastodon."*

The late Sir R. Murchison, and the late Mr. J. W. Flower, who had made careful study of the drifts, attributed the implement gravels to the sudden and tumultuous action of floods not of long continuation. In the discussion on Mr. Prestwich's paper of February, 1872, the latter expressed himself "willing to concede that the implement-bearing gravel-beds had been deposited under more tumultuous action than that due to rivers of the present day, though still forced to attribute

* *Leisure Hour*, 1874, p. 740.

the excavation of the existing valleys, and the formation of terraces along their slopes, to river-action."*

Why then, with all this geological evidence of uncertainty recorded by the masters of the science, do the same masters or their disciples, dogmatize on the subject of long periods? Why has this scientific dogmatism crept into elementary treatises, and is there laid down with all the confidence of axiomatic knowledge? Verily the domain of fashion is not confined to dress, but certainly extends to geological theories. In Dr. Draper's "History of the Conflict between Religion and Science,"† the following dogmata occur:—"Recent researches give reason to believe that under low and base grades the existence of man can be traced back into tertiary times." Now, on this subject the most recent authorities on both sides the Atlantic not only give no countenance to this, but flatly deny it. The reviewer of Mr. Boyd Dawkins's book, in the *Athenæum*, in the face of all the geological evidence, quietly says:—"We may infer with a high degree of probability that a palæolithic people migrated from the East into Europe along with the peculiar pleistocene Fauna in the *pre-glacial* age, and disappeared with the same Arctic mammalia, leaving behind them as their representatives the Eskimos; they were cave-dwellers, and occupied their time with hunting and fishing, and supporting life in a rigorous climate. An indefinite interval of time which cannot be measured by years, separated these palæolithic peoples from their successors of the prehistoric times."

Sir Charles Lyell, in his "Student's Geology" adduces the old arguments, the disappearance of various species of animals, the deepening and widening of valleys, the change in the course of rivers, the formation of solid floors of stalagmite and the change of climate, to support his statement, that "the 3,000 or 4,000 years of the historical period do not furnish us with any appreciable measure for calculating the number of centuries which would suffice for such a series of changes; which are by no means of a local character, but have operated over a considerable portion of Europe." We have seen that the opposite conclusion is at least equally tenable, and far more probable. According to Mephistopheles in "Faust":—

> "Words answer well, when men enlist 'em,
> In building up a favourite system;
> With words men dogmatize, deceive;
> With words dispute or words believe;
> And be the meaning much or little,
> The word can lose nor jot nor tittle."

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* *Geol. Soc. Proceedings.* † H. S. King & Co., 1875, p. 195.

Mr. A. Tylor, much more of an observer than a theorist, maintains on geological grounds that the high and low level gravels are of one formation, closely connected in age, forming one continuous deposit at irregular intervals, dating from the time immediately preceding the historical period.* The last testimony of the Oxford Professor, given in his recent inaugural discourse, is that "This last great change in the long geological record is one of an exceptional nature."†

On the whole I have called attention to an admitted sequence of events since the introduction of man which comprises physical operations vast, violent, and unusual, as well as long ages of uniform action. The time required *may* have been more than our ordinary interpretation of the Biblical narration prescribes, but it cannot be maintained that it *must* have been so; on the contrary, there are not wanting parallelisms between the two records that should induce us to accept the inferences of a short period from the one, until absolutely displaced by proofs, not yet furnished, of a longer period from the other.

I have, in this paper, discussed both fact and hypothesis. I have tried to discriminate between the two, and to sum up the evidence in the words of the witnesses themselves. This is just what eager disputants do not do, and hence arise misunderstandings. The Lyellian scheme is a fair working hypothesis; so is that of the Scripturist. Until either is absolutely verified, I may adopt one or the other without obloquy; neither can be imposed on me. I accept the latter, and seek to maintain it, because, as I have attempted to show, on the testimony of geologists, it is the more probable. I have not referred to other sciences than geology, affecting this conclusion, for my topic is restricted to this one. A parallel process has been going on in at least one of these sciences, for I find from Herodotus that in his day the priests were given to assign an extreme and fabulous antiquity to their nations. The Babylonians counted 468,000 years from their first king to Cyrus. The Indians and Chinese to a much longer period.‡ Science has reduced these to the first dates from Babylonian history 2,234 B.C., and for Egyptian only a few centuries earlier, to 2,500 B.C. for the Chinese, and to 2,256 B.C. for the Indian;—dates the general agreement of which is at least very remarkable, and which bring us face to face with a great social, perhaps a great physical, break.

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* *Nature*, Feb. 18. † *Rawlinson's Herodotus*, vol. ii. p. 2.
‡ *Quarterly Journal of the Geological Society*, vol. xxiii. p. 468.

The CHAIRMAN.—I am sure all will join with me in thanking Mr. Pattison for his paper. (Cheers.)

The HON. SECRETARY.—I have received a letter on this paper from Mr. Whitley, who says :—

"Mr. Pattison refers to the flints found in Brixham Cavern as implements worked by man. After a searching examination of this cavern and the surface formations around it, it is my opinion that there is satisfactory evidence to prove that the so-called flint knives are only subsoil flakes, which are found in similar gravel and loam, both within and without the cavern, and that they are fragmentary and imperfect of their kind. These flints are now deposited in the Christy Museum, Victoria-street, and may be seen on any Friday. I minutely inspected them on the 19th inst., and compared them with those which I had found in the soil above the cavern, and the evidence of their relationship in form, in fracture, and in colour, was most complete. Not only is this so, but all the corroborative evidence which has been put forward has completely broken down. The remarkably symmetrical scraper figured by Mr. Evans in his 'Ancient Stone Implements' (fig. 412) has been found to be a surface implement placed among the others by mistake, and has been withdrawn from the specimens. 'The portion of a cylindrical pin or rod of ivory,' relied on by Mr. Evans as the only object wrought from an animal substance found in the cavern, is not now placed in the company of the flints. Of this relic Mr. Pengelly, who superintended the exploration of the cave, says : 'I have no recollection of this specimen, and, as Mr. Prestwich says its position is not certain, I am inclined to suspect that it does not belong to the cavern series of specimens. It may, I believe, be safely stated that every object forwarded to the Committee was numbered by myself, and that its position was duly recorded in the register.'* The assumed evidence of wear by use is only the broken and jagged edges, which every fractured flint knocked about in a mass of gravel shows more or less on its angles. For many years past visitors to the cave have been shown a plaster model of a most perfect and large flint flake, said to be a representation of one of the flint knives deposited in the rooms of the Geological Society, but no such flint is found amongst those now in the Christy Museum. The public have been deceived, and the delusion of 'knives' supported. Having made so searching an investigation of the evidence produced from this cavern in support of the high antiquity of man, and given the results in a paper read before this Institute, I cannot allow my friend, Mr. Pattison, to dislodge me from the ground which I have won and fortified, by the assumption that these ragged flints are human implements. I trust that the members of the Victoria Institute will visit the Christy Museum and judge for themselves.

"N. WHITLEY."

Mr. PATTISON.—I have looked over collections of flints with Mr. Whitley, and, among them, those from Brixham ; but though we agreed about most, there were two or three which bore undoubted traces of design, and I attributed them to human workmanship—I could not do otherwise. Of course, I admit that many of the bushels and tons of edged flints that are found, are

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* *Transactions of Devonshire Association for the Advancement of Science*, vol. vi. p. 836.

natural flints; but there are many, I am sure, which are artificial, and on this subject Mr. Whitley and I are at issue. There were thirty-six specimens of Brixham flints, fifteen of which were artificially worked; and if there was only one specimen of artificial workmanship, it would be as good as a thousand. I hold letters from Mr. Prestwich, and from Mr. Boyd Dawkins, saying, in effect, that all computations of the dates of geological phenomena are inaccurate and useless for chronological purposes. Mr. Dawkins then refers me to his book and seeks to explain, or rather recapitulates the statement made in that book, that there are glacial phenomena at Settle more recent than the remains of man. This may be so, without its proving that these remains are pre-glacial, for this would carry them back to a far greater antiquity than any one supposes, or than there is any evidence of.

The Rev. Prebendary Row.—Has Mr. Pattison's attention been directed to the excavations made in Troy?

Mr. Pattison.—No: I have looked to see whether they would furnish any evidence, but they are too modern for us here this evening.

Mr. Row.—I understand a flint age was discovered there, or a set of flints supposed to belong to the first flint age, and below that a much higher form of civilization; if this were clearly established, it seems to me that it would have a most important bearing on this question.

Mr. Pattison.—I have not followed it at all, but I should think it very likely, but not very important, because the evidences of a primitive civilization and barbarism overlay each other in turn, and these changes have been very rapid indeed in Asia Minor—a country which used frequently to be overrun by barbarism.

Mr. A. Tylor.—I have listened to Mr. Pattison's paper with much attention, and think it is by far the best *résumé* on the antiquity of man which has appeared. Hitherto those who have written well upon this subject have been original observers as well as writers, and have taken their own point of view. In the paper we have just heard every one must admit that the evidence is most fairly stated, although we may differ as to the conclusions. I can say, for myself, that in what I have written I have tried to make out the relative age of man and of the gravel-beds themselves, from the geological evidence alone, and not from the opinions of others. Perhaps I may be allowed to refer to the change of view that has taken place, even in my time, in regard to the age and manner of deposition of these gravel-beds. When I first joined the Geological Society, thirty years ago, what is called the glacial hypothesis was not much known. Playfair, in 1805, observed the land ice-action in Switzerland, but did not apply it to lower ground. Agassiz and the older (Dr.) Buckland, in 1837, took the whole world by surprise when they spoke of glaciers having once existed in these temperate climates. The older geologists, such as Hutton and Playfair, had not given sufficient attention to the probable accumulation of snow and ice in former periods, or to the evidence everywhere of such great and recent changes of

climate. The glacial theory was first mentioned in 1837; by 1857 it was accepted with avidity all over the world, and nearly everything diluvial was attributed to ice; Agassiz even spoke of glaciers coming down to the sea in Brazil: there are signs of them, I believe, in Equatorial Africa. I think I was the first to revive the Huttonian doctrine about rain—that is to say, to show that there must at one time have been twenty or thirty times as much rain as at present. Mr. Pattison has been obliged to limit his quotations from Prestwich and Lyell; but if he had given more, he would have shown that they both always demanded ice-action, or floods produced from melting snow. Dana imagines that the old Mississippi was fifty miles wide, and was supplied by melting snow. He does not give any calculation as to the depth of the snow-field, or sun's heat, to supply a river of that size. I calculate it would take 600 times the present rain and heat to supply water to feed Dana's river.* There is no passage in Prestwich which gives you the idea that he contemplated a previous greater rainfall than we have at present; in fact, he thought the mean temperature was only just above freezing. The prehistoric period was a complete snow age according to Prestwich; with one degree over frost there could be very little rain indeed, yet all the torrents which he speaks of, were to be the products of melting snow or an occasional torrential shower; he depended almost entirely on snow and ice-water for the excavation of the valleys, which Sir C. Lyell referred partly to tidal action. There has been as much change on this point in geology as on most others, arising from more extended observation. Lyell at first followed Buckland, and urged strongly, in his early writings, that man was extremely modern, and that species were permanent, and not subject to change. I mention this to show that a similar great change of view has taken place on the permanency of climate: first came the water-action of Hutton and Playfair; then, the view of ice and snow-action of Prestwich and Lyell; and now Mr. Pattison has been so bold as to say that all the world are agreed that there was excessive rain-action, or a pluvial period. This certainly helps his argument for reconsideration of the question, because it shows that those eminent geologists did not always hold the same theory, but had their primary, secondary, and tertiary views and notions within sixty or seventy years. I first brought forward my theory in 1853, of greater rivers; and when afterwards, in 1866, I suggested my pluvial period, I was told that it would not do, as it smacked of the Deluge. To-night Mr. Pattison has only taken the geological branch of evidence of the antiquity of man. As you are aware, there are many other sources by which you can get some confirmation on this subject as a check on your conclusions. Mr. Pattison has not alluded to Egypt, where there is a long chronology and a list of kings for 30,000 years. The question there is, whether those kings

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* *Geol. Mag.*, Sept. 1875.

were all in one line, or whether there were separate kingdoms for Upper and Lower Egypt, and three or four monarchs reigning together? There are the advocates of a short as well as of a long chronology. Then there is the question of race: there was within twenty years a belief—a scientific belief—held by most eminent naturalists, that mankind did spring from a pair, and that all animals did the same. I heard the late Professor E. Forbes, at the Royal Institution, declare, very clearly and positively, that there was no evidence in the animal kingdom of any one individual belonging to a species being found in a position apart from others of the species. He believed in the doctrine of specific centres. The test of the theory of evolution is really to be found in the evidence of geology. Darwin's theory of evolution, all must admit, is most convenient for classification of specimens, and for arrangement of species, by nearest affinities or by their smallest differences; but because organisms are arranged in a settled scheme, it does not follow that there is a progressive or unlimited range of development for each part or characteristic of a species. The law of change is a question to be decided by observation; both Forbes' and Darwin's theories * were supported and deduced solely from a consideration of actual observed facts. You may find in the Reptiles four main divisions: successive changes of form, in time, occur in every part of the skeleton; sometimes ascending to a more complex form, at other times descending: no one can say there is a gradual gain in size, power, intelligence, or fitness for reptile life in any one of the divisions, or any progression or evolution: no one has yet connected these changes with any positive law of development; we can point to numerous changes in forms succeeding each other, but links in the chain are wanting. I plead for liberty of opinion and for suspension of opinion as to the laws that govern the incoming of new species, until all the *fossil* evidence has been analyzed by the scientific method. There is a particular family of Brachiopoda of which 3,000 species are recognized by naturalists; many Brachiopoda are living now, and they begin at the earliest times in the Silurian rocks: they are, you know, a very numerous family, containing many living species; but many more are preserved in a fossil state. There is no evidence of what may be called evolution among them—no species appears to be the development of another species. The forms of individuals of the same species of this family, taken from the opposite sides of the Atlantic, have been compared without finding the smallest difference in localities so distant

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* Hœckel (in 1876 edition of *History of Creation*, edited by Ray Lankester) makes a remark in favour of Centres of Creation, although he is a strong evolutionist (page 46, vol. ii.). Thus—"We may be permitted to assume that the original form of every larger or smaller natural group only originated *once* in the course of time, and in only *one* part of the earth." I observe that a very unscientific term, "spontaneous generation," frequently occurs in this work.—(*A. Tylor.*)

from the common centres. Colonies of species, started at particular times in different formations, have spread to immense distances, and their track can be traced by the persistency of type which characterizes almost all the species, until suddenly they come to an end, and a new form as suddenly occupies their place. Every specimen contained in museums all over the world has been examined by the most competent naturalists, to find a single clear case of development, or a repetition of the same species in this immense family, but at present without success. The numbers of the lowest organisms have never decreased; therefore there can have been no general system of progressive development from some low organic type.* As to the law of changes, the late Mr. Babbage made this suggestion: That you might make a machine to go on with a clock, with a particular series of differences, for thousands of years; and then, by an automatic change prearranged in the formation you would find the series changed, and go on afresh, and so on for ever, the machinery carrying its law of change with it. That is very much the case with the family of the Brachiopoda: new species are constantly coming in, and old ones dying out. No one has suggested what change of condition has to do with form or sculpture of the shell of mollusca; every change of form must have an object—origin, near or remote. We are however met by this difficulty: that there is no discernible law for a genus or species first coming in: it was on this ground that the great naturalist, Edward Forbes, believed in specific centres. If the *Terebratula caput serpentis*, now living in the North Sea, could be fossilized, no living naturalist could say that it ought to belong to the present period more than to the Oolite, or to the Oolitic period more than to the Silurian. We have nothing to assist us to define the cause of change, or to help the Darwinian view of struggles for existence, or changes of material conditions, influencing the shape or size of any organ, in the case of any one species of the Brachiopoda. Edward Forbes had studied morphology, and yet he considered every individual fossil as having sprung from one pair of the particular primordial species. If you take man, you will find that in different countries he has a different brain, size, aspect, and skin, and is under very different modifications; but there is no evidence of any living men

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* See Barrand's *Colonies*, and Davidson's *Brachiopoda*, page 264, 1857-62; also page 47, Davidson's *Journal de la Société Malacologie*, 1876; also Murchison, King, and others on the persistency of this species with distribution of the species of the Brachiopoda. I quote one passage—"Since the Cambrian period, both great divisions continue to be represented without showing any tendency to pass one into the other."—(*A. T.*) Principal Dawson, F.R.S., in his 1874 Annual Address as President of fixity of species, the Natural History Society of Montreal, strongly insists on the giving remarkable instances among the Fauna on the coast of America (see note, vol. ix. p. 236).—Ed.

not having had a common ancestor. Those differences that now exist may have taken a very long time to bring about, and therefore I think Mr. Pattison's chronology far too short. Many naturalists think that 20,000 years was the least time in which such a change could be accomplished; still, domestic cattle have changed very rapidly. The 20,000 years human period was the view of Bunsen, the great Egyptologist, and is, of course, subject to discussion.* We have not such good evidence, however, as to time in geology, as in other sciences, such as archæology and philology. If your members will take up the subject of the origin of ideas, manners, and customs, with a reference to Egyptian and other ancient records, and to the analogies of natural history, and the evidence of climatal modifications, and so on, I am sure that you would get a very valuable series of papers on the antiquity of man. Such work, if impartially and systematically done, would give a fairer and more impartial view of the state of knowledge on this subject than has ever been hitherto presented.

Mr. J. E. Howard.—Let me say a word about the Babylonian chronology. Mr. Pattison has referred to it as indicating a very long period, and giving a series of kings for hundreds of thousands of years. The members of the Society of Biblical Archæology who are present, can attest the recent discoveries of Mr. Smith, which tend to confirm the Fragments of Berosus. Xisuthrus, in the arrow-headed inscriptions, is the name of Noah; but Mr. Smith has ascertained that the Babylonian records only trace ten generations from the first of the land Alorus—to Xisuthrus, which is exactly the same number that we have in Genesis from Adam to Noah. We have this difficulty, that the length of the reigns of these kings is extravagantly long. The duration of the reigns is given in what are called *sari*, a *saros* being supposed to be 3,600 years, and the whole reign of these ten kings, 120 sari, gives the preposterously long period, for ten men, of 120 times 3,600 years.

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* Professor W. Kitchen Parker, F.R.S., in a letter upon this subject, says:

"These race-distinctions of character took place rapidly, I have no doubt. Your Yankee is a good sub-species already, and a fine new type he is—good luck to him! but he has lost for ever the full form, fresh colour, mild expression, and quiet self-possession of that happiest of all breeds, the Anglo-Saxon. I suspect that the African tribes—the Negro especially—became modified in a bad way from a nobler old-world type, not merely because of the *sun and the swamp*, but also because of their being frightfully sensual and baboonish. It is very remarkable how gently the features of the Easterns become *Mongolian*, as we pass from the north-west to the south-east of Asia, and I believe that forms could be found that would connect the ugliest Chinese with our nearest cousins in districts contiguous to the water-shed of the Indus. The whole subject is full of difficulties, and the rashest and most bigoted ethnologists are to be found amongst those who think they have got an easy method now of contradicting Scripture. Those of us who feel safe on that Rock can afford to wait for more light."—Ed.

	Berosus.		Smith.
Sari.	*From Apollodorus.*	*From Abydenus.*	*From Cuneiform Inscriptions.*
X.	1. Alorus.	1. Alorus.	1. —
III.	2. Alaparus.	2. Alaparus.	2. —
XIII.	3. Amilon (Amillarus).	3. Amillarus.	3. —
XII.	4. Ammenon.	4. Ammenon.	4. —
XVIII.	5. Megalarus.	5. Megalarus.	5. —
X.	6. Daonus (Daos).	6. Daos.	6. —
XVIII.	7. Euedoreschus.	7. Euedoreschus.	7. —
X.	8.	8. Amempsinus.	8. —
VIII.	9.	9. Otiartes (Ardates).	9. Ubura-tutu Servant of Tutu=Bel=Father.
XVIII.	10. Xisuthrus (Sisithrus).	10. Sisithrus.	10. Hasis-adra.*

"So that the number of all the kings is ten, and the term which they collectively reigned, 120 *sari*."—Cory, *Ancient Fragments*, p. 20, *et seq.*

120 sari=432,000 years (?). "Now a *sarus* is 3,600 years—a *neros* 600—and a *sossus* 60."

It is remarkable that whilst in the Bible we have ten generations in the line of Noah, we have also the same number of generations from the first king of Chaldea to the reign of Noah—the reverent worshipper of the Chaldean historians. The length of the reigns presents a difficulty; but it is also difficult to understand how the antediluvians could have lived as long, as we usually admit, unless by special and continued miraculous power. This hypothesis might, perhaps, be admitted without extending such a gift of nearly a thousand years of life to the rest of mankind? We ought not to deduce our conclusions as to the period of man's past existence from one science alone, such as geology; but from a review of the whole history of mankind, taking into consideration all that bears upon the question. This has never yet been properly attempted.

Mr. Pattison.—I did not adduce the Babylonian point with any intention

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* The meaning of this name is "attentive to worship."—See *Trans. Society Bib. Arch.*, vol. iii. part 2.

		LXX.
130+800.	1. Adam.	1. Ἀδάμ.
105+807.	2. Sheth.	2. Σήθ.
90+815.	3. Enosh.	3. Ἐνώς.
70+840.	4. Kenan.	4. Καϊνάν.
65+830.	5. Mahalaleel.	5. Μαλελεήλ.
162+800.	6. Yered.	6. Ἰάρεδ.
65+300.	7. Chanoch.	7. Ἐνώχ.
187+782.	8. Methushelach.	8. Μαθουσάλα.
182+595.	9. Lemech.	9. Λάμεχ.
500+100+350.	10. Noach.	10. Νῶε.

1. Adam.	5. Mechuyael.
2. Cayin.	6. Methushael.
3. Chanoch.	7. Lemech.
4. Jerad.	8. Tubal Cayin.

to discuss it, but in order to comfort some of us respecting the changes which take place in the opinions of scientific men. I hope that in future, instead of these epochs of immense duration being assigned in our geological text-books for the duration of man, we shall be able to show that the Scriptural period is far more consistent with the facts of geology.

Rev. J. JAMES.—Of the geological theories which have arisen from time time, two only have been brought before us to-night, namely, the glacial and the pluvial, both of which are indisputably true causes of many of the changes which have taken place. But there is another theory which in my early days, forty years ago, was dwelt upon a good deal—a theory showing that manifold changes have been, and are still being, from time to time introduced by catastrophic action, especially of water. I will mention an instance, of which I have taken particular cognizance, owing to a passage in Sir Charles Lyell's book—easily referred to—in which he mentions certain phenomena connected with the Tinière, a little torrent which flows into the Lake of Geneva, between the castle of Chillon and Villeneuve. Sir Charles Lyell mentions that the railway line from Lausanne to Villeneuve had to be cut through an elevated cone formed by the action of the Tinière, and that this deep cutting had disclosed three or four strata of gravel from five to eight feet thick, with thin strata of soil, from four to six inches thick, interlaid between them. He is, of course, compelled to assume that, during the periods necessary for the formation of the several intermediate layers of soil, there would be a cessation of the gravel-deposit, but that then it would begin again (why or wherefore he does not explain) at the same rate of gradual formation as obtains, according to his view, at present, viz., at the mean rate of six or nine inches in a hundred years. And measuring all these strata of gravel by that rule, he brings out a great number of ages as the result. Now it struck me, as I read the book, that it would have been far more natural to suppose that the beds of gravel were formed, from time to time, by some sudden action, such as on a small scale I witnessed recently at Weesen, on Lake Wallenstadt; and that the length of time taken up by the formation of the entire cone was rather to be gathered from what might be thought requisite for the accretion of the several interlying thin strata of soil. On visiting the spot, I found the idea of catastrophic action, as accounting for the several strata of gravel, entirely confirmed. Looking up the mountain-side, down which the torrent flowed, I found that at a great height, right over the line of the little torrent Tinière, there were two converging mountain-tops with a narrow chasm or ravine between them—a chasm or gorge just fitted to enclose a lake or tarn, or, at least, such a reservoir of water as may be seen in many a narrow valley among the hills of our manufacturing counties in the North of England, and such as we all have known occasionally to burst with devastating effect upon the regions below them. In short nothing seemed to me more natural than to suppose that such a reservoir, or tarn, or lake should have been from time to time formed of the waters flowing from

those mountain-sides; and that this natural reservoir should, then, from time to time (it may be after intervals of hundreds of years) have overflowed and burst through its natural barrier of gravel and rock; and that, when once a sluice was opened, it should have brought down with it a vast quantity of gravel to the more level country at the foot, and should there in a few days or weeks have formed one of those beds five or eight feet thick, for the formation of which Lyell gives hundreds and thousands of years. I have ventured to think it might be worth while for this meeting to be thus reminded of that kind of catastrophic action of which earlier geologists took so great account, and which certainly takes place even in the present day, side by side with that more gradual and almost imperceptible action which seems to be the one idea of some modern geologists. Here at the Tinière was an instance where it would have been natural for a cataclysm, or avalanche of sand and gravel to occur from time to time, burying the old surface-soil, and for a new layer of soil afterwards gradually to accumulate, and for grass to grow slowly again upon the surface of the latest formed gravel-bed. And yet, even here, Sir C. Lyell, prepossessed by his one idea, has been so blinded to the elder theory, by which the facts of the case are so naturally explained, that although compelled to assume, between the several formations of the various gravel strata, long periods of unaccountable repose, during which the torrent would cease to overspread with its sediment the newly-formed soil, he nevertheless adduces this very case of La Tinière as an instance of the ordinary, continuous, gradual, and imperceptible action of water. I cannot help saying that his doing so exemplifies his own remark, quite as applicable to a true as to a false theory :—"A false theory, it is well known, may render us blind to facts which are opposed to our prepossessions, or may conceal from us their true import when we behold them."—*Principles of Geology*, p. 498.

Mr. T. W. Masterman.—Mr. Pattison says in the last paragraph of the paper: "The Lyellian scheme is a fair working hypothesis, so is that of the Scripturist; until either is absolutely verified, I may adopt one or the other without obloquy; neither can be imposed on me." Now I differ from this statement. I ask, is not the question of man's existence on this earth for a longer or shorter period an important point for a believer in revelation to inquire into and to have strong views about; for if you admit that there was a race of men existing for 10,000 years before the present age, you seem to undermine important passages in God's Word? Can you hold that long antiquity of man and maintain the grand doctrines of the Fall and the Redemption? I think we must totally exclude from papers like this any allusion to Revelation or Scripture, or else we must allow some allusions in the discussions to these matters, and there is one text which I feel bound to quote: "Wherefore, as by one man sin entered into the world, and death by sin: and so death passed upon all men, for that all have sinned: . . . . For as by one man's disobedience many were made sinners: so by the obedience of one shall many be made righteous." Does not that text

fail if we admit that 10,000 years has been the duration of man's existence on this planet?

The Rev. Dr. CURREY.—I do not pretend to any extensive knowledge of the subject of geology, but I can scarcely agree with Mr. Masterman in his views in reference to the antiquity of man. There are differences of opinion on the subject, and while he may entertain the view he has expressed, there are other people who have an equally strong belief in Revelation and all its truths, who take a different view in regard to the possibility of reconciling their ideas with the *great* antiquity of man. With reference to the text which Mr. Masterman has quoted, all we need say is, that we do not abandon that text, but only his method of interpreting it. If it is said that we are to abandon Revelation when we discuss the antiquity of man, I think the Institute must give up discussing such subjects altogether. But, as I understand it, our object is to consider how far the results of modern science can be reconciled with religion, even if it leads to a different interpretation of the texts of Scripture from that to which we have been accustomed; for it is possible to hold firmly to the truths of Scripture, without refusing to admit new modes of interpretation, if they are consistent with reason and seem to be established by sound argument. Mr. Pattison lays great stress on the fact that geology affords no chronological data, and I observe that other persons who hold very different opinions with regard to the antiquity of man, make the same assertion. But the proposition that "geology affords no chronological data" may be understood in two different senses; it may mean that geology gives no ground for supposing any such antiquity, or that it affords no data for framing a *system* of chronology, and determining *how many* thousands of years have passed since the creation of man. Now although there may be no sufficient data for forming a system of chronology (and I think Mr. Pattison's paper shows, at least, that we have not sufficient data for this purpose), geology may furnish us with evidence—I will not say conclusive, but forcible evidence—in favour of a very great antiquity. For my own part, I believe (for the investigations of science and of history seem to show) that the period has been very long, but I do not believe that we have sufficient data for determining how long. I do not think, however, that this, my belief, is contradictory to the scriptural records. The dates affixed to the margin of some of our Bibles are not part of the Bible itself: they are formed by calculations made at a time when geology was unknown, and although they seem to agree with the obvious meaning of the text, the arguments in favour of them are not conclusive. In records so brief, of times so remote, it may well be that gaps were left, which were not intended to be filled up: but this is not the time to discuss the modes in which difficulties of interpreting the same may best be overcome. In such questions we must not be too positive; when we have evidence before us acquired by true science, we may examine the records with new light, and find in them a meaning which, though not lying upon the surface, may yet be the true one.

Dr. E. HAUGHTON.—In reference to what has fallen from Mr. Masterman,

it seems to me that men of science who are not members of the Victoria Institute, may take the position of approaching every scientific subject with minds entirely unbiassed by the consideration of whether they believe in Revelation or not. I suppose we all here believe in Revelation, but when we discuss subjects from a philosophical point of view, we cannot too thoroughly clear our own minds of every prejudice if we wish to arrive at the truth. Our object is not to get up an *odium theologicum* against those who differ from us; but to discuss our subjects dispassionately, and to invite our opponents to come here and to make the most they can of their arguments, so that there may be fair play from every possible point of view. I therefore think that the holding of any particular opinion as to the interpretation of Scripture by a man of science, even if he be a member of this Institute, is not to be a matter of obloquy. (Hear, hear.)

Mr. E. H. PICKERSGILL.—I think that every candid and impartial mind will fully endorse the strictures that have been passed upon Mr. Masterman, who told us that if we accept the theory of the greater antiquity of man we must reject the theory of the Fall; though he gave us no reason for that view. If we are asked how are we to reconcile the two records, Mr. Pattison tells us, in his second page, where he says: "The written record to which some of us appeal does not, and does not profess to, bear full testimony on this head; the unwritten one is wholly made up of materials that have been placed and disordered in a succession extremely difficult to unravel. The one has no chronological beginning, is obviously incomplete, and permits, in its text, a variation of 1,200 years; the other allows of variations in chronology absolutely unlimited." With regard to the question of the formation of stalagmitic matter in caves, such as that at Torquay, considering what an important part some have endeavoured to make it play in the argument in favour of the great antiquity of the human remains found under it, I am glad to find Mr. Pattison telling us, that the mere existence of these layers of stalagmite does not necessarily prove any great antiquity. Mr. Pattison, quoting from Mr. Dawkins, says:—"It may fairly be concluded that the layers of stalagmite cannot be used as an argument in support of the remote age of the strata below." I think this paper is very likely to be prejudiced by the consideration that it is a distinct challenge of the theory upon which must rest, I suppose, at least to a very great extent, the posthumous fame of that venerable philosopher whose mortal part England lay at rest in her national mausoleum only a few hours ago (Sir C. Lyell). But there is another and a weightier consideration; namely, that disregarding other questions, we should follow the truth, and follow it whithersoever it leads. With regard to the gravels which have been introduced into the discussion to-night, I would bring forward an argument which tells very strongly against the Lyellian theory. You have these high-level gravels, and also the low-level gravels; and Sir Charles Lyell tells us that, according to his theory, a vast interval of time must have intervened between the formation of the high gravels and the formation of the low gravels. Now, let us accept

this theory. If a great interval of time *has* elapsed between the formation of the two, it will be only natural, from a common-sense point of view, to suppose that the fossil remains in the two would be distinctly different; but what do we find? I have it here, on the authority of Mr. Evans and of Sir Charles Lyell himself, that the fossil remains in the two sets of gravels are very similar. To take another aspect of the question: I certainly think that, looked at from an *à priori* point of view, the Lyellian theory, to a scientific mind, would have a preference, and for this reason; that, according to the Lyellian theory, we are dealing with causes at present in operation, and the scientific man, in solving a difficult problem, would always prefer to use known factors rather than unknown ones. In this connection there is one fact quoted here, which I think is worth almost all the other facts advanced. Mr. Pattison says:—"Slow and gradual movement, even if interrupted, could not have produced these sharply-defined terraces." Now here is a fact: If, by comparing these sharply-defined terraces with the work which we know to be actually accomplished by the slow process of wearing away, we find that the facts in the two cases are distinctly different, we shall surely be justified by every scientific law in referring these different results to different causes. There is one other matter to which I should like to call attention, and the argument is somewhat analogous to the one I have just referred to. It is with regard to the caves in Belgium. Mr. Pattison says:—"The opening of the caves in Belgium, once flooded by the stream of the valley, is now 200 feet above the latter, in solid limestone." According to the Lyellian theory, those 200 feet have been scooped out by the gradual process of wearing away.* But Mr. Pattison goes on to tell us that there is no such cause in operation. Why, then, the whole thing (he says) is illusory, because the very object and existence of the Lyellian theory is to refer all those changes to causes which are at present going on around us. I think the paper before us is a singularly fair and impartial one, and it is certainly distinguished by close logic and critical acumen.

Mr. E. CHARLESWORTH (a visitor).—Although I have paid some attention to the superficial formations of the earth's surface, yet I feel utterly incompetent to express any opinion as to the philosophy of the view taken by Sir Charles Lyell in relation to the enormous period of time during which man has existed upon the earth. But I can say this much: that I think Sir Charles Lyell's calculation with regard to the 30,000 years during which the cataract of Niagara has been cutting its way through the rock, seems to me certainly consistent with fair and legitimate deduction from the facts evolved by Sir Charles. But then comes the question, Can you correlate with the cutting of the channel the existence of man? Can you show that any human remains, of any sort whatever, date their existence before the commencement of that

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* This subject is taken up by Mr. J. Parker (vol. viii. p. 51), who disagrees with Sir C. Lyell.—ED.

30,000 years?* With regard to the measurement of geological time, I am a firm believer in the great periods of time during which life has existed on this earth. But when we come to consider *how* many thousands or scores of thousands of years man has existed, then I must admit fully that we are all in a haze. There is one point to which I should like to call attention with reference to the chronology of these gravel deposits, and that is the growth of the coral reefs. They have been made the subject of most efficient and careful study, and one of the most distinguished men living in the roll of those who have devoted their lives to scientific research—Mr. Dana, a professor in an American university—ascertained the depth of the coral reefs in the Pacific to be upwards of 2,000 feet. He finds the present rate of growth to be half an inch per year. Then he multiplies that half-inch by the measurement—and these, remember, are not geological reefs, but living reefs of the present day—and he finds they have taken 192,000 years for their growth. I do not ask you to believe this, but men like Agassiz, and Lyell, and Dana, and others, have exercised a great deal of intellectual power in order to arrive at solutions of questions of this kind, and have bestowed quite as much labour, of quite as high a class, as astronomers have upon their studies. There is this difference however between their chronology, that when an astronomer tells us of bodies in the firmament whose light has been thousands of years travelling through space before it has reached this earth, we feel bound to believe him, for he points out the exact date of an eclipse, and we find him right to a moment.† And when we see this, are we not justified in having faith in his calculations, when he comes before us with the marvellous and striking announcement,

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* Sir W. Thomson concluded, from different lines of argument, that the age of the earth as a body cool enough for habitation cannot be much greater than 100 million years. Professor Tait, in his *Recent Advances in Physical Science*, recapitulates *the same* arguments, but *with different* conclusions, and states the limit of age to be about *ten* million years (*see Nature*, April, 1876).—Ed.

† "Astronomy, as a whole, is more certain than geology; it is a more advanced science, and many parts of it depend on a definite law, already ascertained, and involve fewer uncertain elements. But it by no means follows that the more doubtful parts of astronomy are clearer and better known than the plainest and simplest conclusions of geology. In all there is an immense interval between the plainest parts and the most obscure. Mr. Charlesworth's remark must involve this assumption: Astronomers are as certain of the distance of the most distant stars, or of the nebula of Orion, as of the relative distances of the sun, moon, and earth, on which the calculation of eclipses depends; but this is manifestly, and almost absurdly, untrue. We see that they mistook nearly 4 millions of miles in the absolute distance of the sun till within the last few years. The notion of the immense distance of the nebula of Orion is one part or corollary of those views of the nebulæ which recent observations have done so much to disprove. Mr. Proctor's papers, for instance, all tend to establish quite a different view."—(Communicated by *Professor T. R. Birks, Camb.*)

that light has been so long travelling through space before it reached this earth?* I have read the paper before us with great interest; and, without committing myself to Mr. Pattison's views on all matters, I may certainly say, I think that it is one of the most interesting and able papers that was ever brought before a scientific society.

Mr. R. W. Dibdin.—I understand Mr. Charlesworth to say that we have reason for believing in the astronomical computation of time; but we have no such reason for believing in geological computations.

Mr. Charlesworth.—A geologist cannot give us the same test possibly. But his intellectual power and his scientific knowledge are the same.

Rev. Dr. Butler.—How can we ascertain that the coral reefs have always gone on increasing at the same rate? What data have we to show that thousands of years ago the coral reefs did increase at the same rate? The argument is inconclusive as it stands.

Mr. D. Howard.—There are one or two facts which I should like to bring before the meeting; one is with regard to the question of the movement of gravel. The present rate of rivers never could have produced the results which have been attributed to it. It is a simple mechanical problem; the power of water to move heavy bodies is a perfectly well-known quantity. It varies from nothing up to any force you will. Given, a certain current of water, running at a certain rate, at a certain inclination, it is not difficult to say what sized stone it will carry away. If it is not running with sufficient rapidity it will not move a single stone. A single hour of a sufficient current will move more gravel than centuries of a slower one. I remember, after a violent thunderstorm, passing through a valley of somewhat similar formation to that which has been referred to, and there was a sudden deposition of six or eight feet of gravel over the road. There we have a condition produced similar to that in the case mentioned, yet it does not mark a geological period at all. It would have taken a great many centuries to have produced that result by a gradual process. In measuring time in this way, we almost always discover that that very important factor, whether the process is constant, has been left out. As to the growth of stalagmite, it depends on the rapidity of the action upon calcareous rock, of carbonic acid in water. The stalagmite is no measure of time whatever; the speed of its formation depends simply on the balances of power of solution and redeposition of calcareous matter in water charged with carbonic acid, which is a chemical but not a chronological fact. One illustration shows how uncertain natural phenomena are in respect of time; I allude to the extraordinary formation of vegetable growth in the Nile, which Sir

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* The nebula of Orion is said to be 60,000 years of light distant from us; but certain considerations, not necessary to be referred to here, tend to make it a question whether the 60,000 should not be only 20 or 30 years (*see also note on previous page*).—Ed.

Samuel Baker gives us. The place was comparatively clear a few years ago, but now it is a matter of the greatest difficulty to force a passage at all, after centuries of unobstructed navigation. As to the coral reefs, the different quantity of lime at different depths in the water has a most important bearing on the question: the speed of growth must depend on the amount of carbonate of lime which it is possible for the builders to get. But this point is little understood at present. There are different depths of the sea where the processes are completely reversed. It is also a question whether the coral began near the surface on a sinking bottom. Before we can decide time in this manner, we must discover whether what is going on has been going on at a constant rate, else we might as well try to catch a train with a watch which had no balance-spring.

Rev. G. Henslow. — There are several things which one would feel inclined to talk about, but time passes, and the hour is getting late. It is interesting to see that we appear to be returning, to some extent at least, to the cataclysmic theory of former geologists, and to which Mr. Prestwich also appears to be coming round. No doubt the "uniformitarian" processes are going on to a large extent, but whether we are to abandon the cataclysmic views entirely is quite another thing. Mr. Prestwich refers to the glacial theory, as an instance of the arrangement of the globe for the benefit of man. That is a teleological idea, which had never occurred to me before, and it is certainly worthy of our consideration; but he says we have now a uniform condition without cataclysms, and he contends that this is due to the glaciation of the previous period. With reference to the antiquity of man himself, I see no objection to the notion of his having lived in the *pliocene* or pre-glacial epoch. We know the flora of this country was then identical with what we have now, as far, at least, as the Cromer Forest and lignite beds show; and the climatal conditions of their existence must have been much the same as now. But in all the gravels where man's remains have been detected, they are either lying in depressions scraped out of the "glacial drift" itself, as at Bedford; or else are from obvious reasons post-glacial. Yet that man might have existed before that time cannot be gainsaid. If the idea suggested by Mr. Belt, in his book on Nicaragua, should be confirmed, it would be very interesting to know that man must have existed before the glacial epoch. Whether, however, he lived during the *Miocene* epoch is another matter. I myself think not, though some, but doubtful, evidence has been thought to have been found; for we know from examining the animals of that period, that not only is there *not a single Miocene vertebrate species now living*, but that all existing mammalian forms have been developed since that epoch; thus, if we take the horse as it now is, the genus *equus* is not known at all in the Miocene period, but its ancestral representative, the *hipparion*, is abundant. If the horse has come from the hipparion, and both the civet and hyena of to-day differentiated from the *ictitherium*, then *man*, by analogy, *would not be the same now as he would have been then; i.e.* on the imaginary

supposition of an ancestral "pre-homo" having lived in the Miocene epoch. With regard to corals, we know that they grow far better on the windward than on the leeward side of land, because there they get a continually renewed supply of water. The sea is "full of rivers," as the discoveries made in the *Challenger* show; and a coral island, if it does not lie in the line of a particular current, will in that stratum of water in which it lies naturally exhaust the carbonate of lime and oxygen which it requires for vigorous growth. If it is in still water, therefore, it is not likely to increase so fast as when a fresh body of water is continually brought to play upon it.

Mr. PATTISON.—I am not aware that there is much that I need trouble you with. With regard to what has been said about the possibility of man being older than the present Pleistocene period, I think no observations yet made carry back the existence of man further than the upper gravels, and the assemblage of animals in which he is found may, I think, be useful, as our Chairman has intimated, as negative evidence with regard to the Miocene period. The case of the coral is beyond my subject, inasmuch as there is no allegation that the commencement of the present coral reefs was coeval with the introduction of Man. No one knows the distinctions attaching to this subject better than Mr. Charlesworth, who worked at it long ago in the Crag deposits, and who knows how different these corals are to the corals of modern days. As to the case of the rate of deposition of gravels which has been so appositely brought forward, we have no time this evening for discussing it, and it is a subject which deserves to be treated by itself, for it has a very important bearing on this question. With regard to catastrophes, the case I have put is the introduction of a catastrophe at the latter end of the Palæolithic period after man visited these parts, to account for the shorter time which I propose to substitute for the theories of geologists who have gone in for a long period of time. But I need not dwell on that, for I hope that in my paper I brought it forward with sufficient clearness to make it intelligible.

The meeting was then adjourned.