

I believe, I am primarily indebted to Lyell; views which I taught to my class in Dublin, and which time has only tended to confirm; namely, that the Great Ice Age was introduced by a general rise of the land bordering the North Atlantic, accompanied by increased cold and Glacial conditions, followed by submergence and inter-Glacial, or milder, conditions of temperature; this again, by emergence and elevation ultimately attaining to the present levels, including minor marginal undulations. These were the three great physical epochs of the Glacial period. When firmly grasped, they are the wards of a key which serves to unlock the many difficulties in the phenomena of the Post-Pliocene period. If Sir Henry Howorth will condescend to make use of this key he will probably find a solution to his difficulties as regards the views of his opponents, while fresh light will be thrown on those he so ably expounds. He will see how it explains the superimposition of marine stratified deposits on glaciated rock-surfaces and *moraine-profonde* matter-deposits, differing in age and in conditions of formation. I am writing these notes at a distance from books, maps, and memoirs, which I hope will be accepted as my apology for errors, whether of omission or commission.

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#### NOTICES OF MEMOIRS.

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##### I.—BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. TORONTO, AUGUST 18TH, 1897.

###### PRESIDENTIAL ADDRESS

By Sir JOHN EVANS, K.C.B., D.C.L., LL.D., Sc.D., V.P.S.A., For. Sec. G.S., etc.

THE President said the British Association, for a second time, had the honour and pleasure of accepting the hospitality of Canada. On their last visit in 1884, their place of assembly was Montreal, a city which is justly proud of her M'Gill University; to-day they met within the buildings of another of the Universities of the vast Dominion, and in a city the absolute fitness of which for such a purpose must have been foreseen by the native Indian tribes when they gave to a small aggregation of huts upon that spot the name of Toronto—"the place of meetings." His election to the important post he now held might, in the main, be regarded as a recognition by this Association of the value of Archæology as a science. It was no doubt hard to define the exact limits to be assigned to Archæology as a science, and Archæology as a branch of history and *belles lettres*. A distinction did, however, exist between Archæology proper and what, for want of a better word, might be termed Antiquarianism.

A familiarity with all the details of Greek and Roman mythology and culture must be regarded as a literary rather than a scientific qualification; and yet, when among the records of classical times they came upon traces of manners and customs which had survived for generations, and which seemed to throw some rays of light upon

the dim past, when history and writing were unknown, they were approaching the boundaries of scientific Archæology.

Every reader of Virgil knew that the Greeks were not merely orators, but that with a pair of compasses they could describe the movements of the heavens and fix the rising of the stars; but when by modern Astronomy we could determine the heliacal rising of some well-known star, with which the worship in some given ancient temple was known to have been connected, and could fix its position on the horizon at some particular spot, say, three thousand years ago, and then found that the axis of the temple was directed exactly towards that spot, we had some trustworthy scientific evidence that the temple in question must have been erected at a date approximately 1100 years B.C. If on or close to the same site we found that more than one temple was erected, each having a different orientation, these variations, following as they might fairly be presumed to do, the changing position of the rising of the dominant star, would also afford a guide as to the chronological order of the different foundations. The researches of Mr. Penrose seemed to show that in certain Greek temples, of which the date of foundation was known from history, the actual orientation corresponded with that theoretically deduced from astronomical data.

Sir J. Norman Lockyer had shown that what holds good for Greek temples applied to many of far earlier date in Egypt, though up to the present time hardly a sufficient number of accurate observations had been made to justify us in foreseeing all the instructive results that might be expected to arise from Astronomy coming to the aid of Archæology.

The intimate connection of Archæology with other sciences was in no case so evident as with respect to Geology.

By the application of geological methods many archæological questions relating even to subjects on the borders of the historical period had been satisfactorily solved.

When they came to the consideration of the relics of the Early Iron and Bronze Ages, the aid of chemistry had of necessity to be invoked. By its means they were able to determine whether the iron of a tool or weapon was of meteoritic or volcanic origin, or had been reduced from iron-ore, in which case considerable knowledge of metallurgy would be involved on the part of those who made it. With bronze antiquities the nature and extent of the alloys combined with the copper might throw light not only on their chronological position, but on the sources whence the copper, tin, and other metals of which they consisted were originally derived.

Like Chemistry, Mineralogy and Petrology might be called to the assistance of Archæology in determining the nature and source of the rocks of which ancient stone implements were made; and, thanks to researches of the followers of those sciences, the old view that all such implements formed of jade and found in Europe must

of necessity have been fashioned from material imported from Asia could no longer be maintained. In one respect the Archæologist differed in opinion from the Mineralogist, namely, as to the propriety of chipping off fragments from perfect and highly-finished specimens for the purpose of submitting them to microscopic examination.

When they came to discuss that remote age in which were found the earliest traces at present known of man's appearance upon earth, the aid of Geology and Palæontology became absolutely imperative.

The changes in the surface configuration and in the extent of the land, especially in a country like Britain, as well as the modifications of the fauna and flora since those days, had been such that the archæologist pure and simple was incompetent to deal with them, and he must either himself undertake the study of these other sciences or call experts in them to his assistance. The evidence that man had already appeared upon the earth was afforded by stone implements wrought by his hands, and it fell strictly within the province of the archæologist to judge whether given specimens were so wrought or not; it rested with the geologist to determine their stratigraphical or chronological position, while the palæontologist could pronounce upon the age and character of the associated fauna and flora.

Of late years the general tendency of those engaged upon the question of the antiquity of the human race had been in the direction of seeking for evidence by which the existence of Man upon the earth could be carried back to a date earlier than that of the Quaternary gravels.

There is little doubt that such evidence would eventually be forthcoming, but, judging from all probability, it was not in Northern Europe that the cradle of the human race would eventually be discovered, but in some part of the world more favoured by a tropical climate, where abundant means of subsistence could be procured, and where the necessity for warm clothing did not exist.

With Palæolithic man, we were treading on comparatively secure ground, and the discoveries of the last forty years in Britain alone enabled us to a great extent to reconstitute his history. We might not know the exact geological period when first he settled in the British area, but we had good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth, when the fauna of the country was of a totally different character from that of the present day, when the extension of the southern part of the island seaward was in places such that the land was continuous with that of the continent, and when in all probability a far

more rainy climate prevailed. We had proofs of the occupation of the country by man during the long lapse of time that was necessary for the excavation of the river valleys. We had found the old floors on which his habitations were fixed, we had been able to trace him at work on the manufacture of flint instruments, and by building up, the one upon the other, the flakes struck off by the primæval workmen in those remote times we had been able to reconstruct the blocks of flint which served as his material.

That the duration of the Palæolithic Period must have extended over an almost incredible length of time, was sufficiently proved by the fact that valleys, some miles in width and of a depth of from 100 to 150 feet, had been eroded since the deposit of the earliest implement-bearing beds. Nor was the apparent duration of this period diminished by the consideration that the floods which hollowed out the valleys were not in all probability of such frequent occurrence as to teach Palæolithic man by experience the danger of settling so near to the streams, for had he kept to the higher slopes of the valley there would have been but little chance of his implements having so constantly formed constituent parts of the gravels deposited by the floods.

The examination of British cave-deposits as at Kent's Cavern, Torquay, afforded corroborative evidence of this extended duration of the Palæolithic Period.

In a cavern at Creswell Crags, on the confines of Derbyshire and Nottinghamshire, a bone had been found engraved with a representation of parts of a horse in precisely the same style as the engraved bones of the French caves.

It was uncertain whether any of the river-drift specimens belonged to so late a date as these artistic cavern-remains; but the greatly superior antiquity of even these to any Neolithic relics was testified by the thick layer of stalagmite, which had been deposited in Kent's Cavern before its occupation by men of the Neolithic and Bronze Periods.

Towards the close of the period covered by the human occupation of the French caves, there seemed to have been a dwindling in the number of the larger animals constituting the Quaternary fauna, whereas their remains were present in abundance in the lower and therefore more recent of the valley gravels. This circumstance might afford an argument in favour of regarding the period represented by the later French caves as a continuation of that during which the old river gravels were deposited; and yet the great change in the fauna that had taken place since the latest of the cave-deposits included in the Palæolithic Period was indicative of an immense lapse of time.

We found distinct traces of river-action from 100 to 200 feet above the level of existing streams and rivers, and sometimes at a great distance from them; we observed old fresh-water deposits on the slopes of valleys several miles in width; we found that

long and lofty escarpments of rock had receded unknown distances since their summits were first occupied by Palæolithic man; we saw that the whole side of a wide river valley had been carried away by an invasion of the sea, which attacked and removed a barrier of chalk cliffs from 400 to 600 feet in height; we found what was formerly an inland river had been widened out into an arm of the sea, now the highway of our fleets, and that gravels which were originally deposited in the bed of some ancient river now capped isolated and lofty hills.

And yet, remote as the date of the first known occupation of Britain by man might be, it belonged to what, geologically speaking, must be regarded as a quite recent period, for we were now in a position to fix with some degree of accuracy its place on the geological scale. Thanks to the investigations ably carried out at Hoxne in Suffolk, and at Hitchin in Hertfordshire, by Mr. Clement Reid, under the auspices of that Association and of the Royal Society, we knew that the implement-bearing beds at those places undoubtedly belonged to a time subsequent to the deposit of the Great Chalky Boulder-clay of the Eastern counties of England. It was, of course, self-evident that this vast deposit, in whatever manner it might have been formed, could not, for centuries after its deposition was complete, have presented a surface inhabitable by man. Moreover, at a distance but little farther north, beds existed which also, though at a somewhat later date, were apparently formed under glacial conditions. At Hoxne the interval between the deposit of the Boulder-clay and of the implement-bearing beds was distinctly proved to have witnessed at least two noteworthy changes in climate. The beds immediately reposing on the clay were characterized by the presence of alder in abundance, of hazel, and yew, as well as by that of numerous flowering plants indicative of a temperate climate very different from that under which the Boulder-clay itself was formed. Above these beds, characterized by temperate plants, came a thick and more recent series of strata, in which leaves of the dwarf Arctic willow and birch abounded, and which were in all probability deposited under conditions like those of the cold regions of Siberia and North America.

At a higher level, and of more recent date than these—from which they were entirely distinct—were the beds containing Palæolithic implements, formed in all probability under conditions not essentially different from those of the present day. However this might be, we had now conclusive evidence that the Palæolithic implements were, in the Eastern counties of England, of a date long posterior to that of the Great Chalky Boulder-clay.

It must not, however, for a moment be supposed that there were the slightest grounds for believing that the civilization, such as it was, of the Palæolithic period originated in the British Isles. We found in other countries implements so identical in form and character with British specimens that they might have been

manufactured by the same hands. These occurred over large areas in France under similar conditions to those that prevailed in England. The same forms had been discovered in the ancient river gravels of Italy, Spain, and Portugal. Some few had been recorded from the North of Africa, and analogous types occurred in considerable numbers in the south of that continent. On the banks of the Nile, many hundreds of feet above its present level, implements of the European types had been discovered; while in Somali-land, in an ancient river valley at a great elevation above the sea, Mr. Seton-Karr had collected a large number of implements formed of flint and quartzite, which, judging from their form and character, might have been dug out of the drift deposits of the Somme or the Seine, the Thames or the ancient Solent.

In the valley of the Euphrates implements of the same kind had also been found, and again farther east in the Lateritic deposits of Southern India they have been obtained in considerable numbers.

Was this not a case in which the imagination might be fairly invoked in aid of science? Might we not from these data attempt in some degree to build up and reconstruct the early history of the human family? There, in Eastern Asia, in a tropical climate, with the means of subsistence readily at hand, might we not picture to ourselves our earliest ancestors gradually developing from a lowly origin, acquiring a taste for hunting, if not indeed being driven to protect themselves from the beasts around them, and evolving the more complicated forms of tools or weapons from the simpler flakes which had previously served them as knives? Might we not imagine that, when once the stage of civilization denoted by these Palæolithic implements had been reached, the game for the hunter became scarcer, and that his life in consequence assumed a more nomad character? Then, and possibly not till then, might a series of migrations to "fresh woods and pastures new" not unnaturally have ensued, and these following the usual course of "westward towards the setting sun" might eventually lead to a Palæolithic population finding its way to the extreme borders of Western Europe, where we found such numerous traces of its presence.

How long a term of years might be involved in such a migration it was impossible to say, but that such a migration took place the phenomena seemed to justify us in believing.

As yet, our records of discoveries in India and Eastern Asia were but scanty; but it was there that the traces of the cradle of the human race were, in his opinion, to be sought, and possibly future discoveries might place upon a more solid foundation the visionary structure he had ventured to erect.

It might be worth while to carry their speculations rather further, and to consider the relations in time between the Palæolithic and the Neolithic Periods.

At the close of the period during which the valleys were being eroded came that represented by the latest occupation of the caves by Palæolithic man, when, both in Britain and in the south of France, the reindeer was abundant; but, among the stone weapons and implements of that long troglodytic phase of man's history, not a single example with the edge sharpened by grinding had as yet been found. All that could safely be said was that the larger implements, as well as the larger mammals, had become scarcer, that greater power in chipping flint had been attained, that the arts of the engraver and the sculptor had considerably developed, and that the use of the bow had probably been discovered.

Directly they encountered the relics of the Neolithic Period, often, in the case of the caves lately mentioned, separated from the earlier remains by a thick layer of underlying stalagmite, they found flint hatchets polished at the edge and on the surface, cutting at the broad and not at the narrow end, and other forms of implements associated with a fauna in all essential respects identical with that of the present day.

So far as he knew we had as yet no trustworthy evidence of any transition from the one age to the other, and the gulf between them remained practically unbridged. We could, indeed, hardly name the part of the world in which to seek the cradle of Neolithic civilization, though we know that traces of what appeared to have been a stone-using people had been discovered in Egypt, and that what must be among the latest of the relics of their industry had been assigned to a date some 3,500 to 4,000 years before our era. The men of that time had attained to the highest degree of skill in working flint that had ever been reached. Their beautifully-made knives and spear-heads seemed indicative of a culminating point reached after long ages of experience; but whence these artists in flint came or who they were was at present absolutely unknown, and their handiworks afforded no clue to help us in tracing their origin.

Taking a wider survey, we might say that, generally speaking, not only the fauna but the surface configuration of the country were, in Western Europe at all events, much the same at the commencement of the Neolithic Period as they are at the present day. We had, too, no geological indications to aid us in forming any chronological scale.

But, pending the advent of evidence to the contrary, we might provisionally adopt the view that owing to failure of food, climatal changes, or other causes, the occupation of Western Europe by Palæolithic man absolutely ceased, and that it was not until after an interval of long duration that Europe was re peopled by a race of men immigrating from some other part of the globe where the human race had survived, and in course of ages had developed a higher stage of culture than that of the Palæolithic man.

Returning to the realms of fact, one fact on which he desired to insist was that of the existence at the present day, in close juxtaposition with our own civilization, of races of men who, at all events but a few generations ago, lived under much the same conditions as did our own Neolithic predecessors in Europe.

The manners and customs of these primitive tribes and peoples were changing day by day, their languages were becoming obsolete, their myths and traditions were dying out, their ancient processes of manufacture were falling into oblivion, and their numbers were rapidly diminishing, so that it seemed inevitable that ere long many of these interesting populations would become absolutely extinct. The admirable Bureau of Ethnology instituted in the United States of America had done much towards preserving a knowledge of the various native races on that vast Continent; and in Canada the annual Archæological Reports presented to the Minister of Education were rendering good service in the same cause.

Moreover, the Committee of the British Association appointed to investigate the physical characters, languages, and industrial and social conditions of the North-Western tribes of the Dominion of Canada was about to present its twelfth and final report, which, in conjunction with those already presented, would do much towards preserving a knowledge of the habits and languages of those tribes.

It was, however, lamentable to notice how little was being or had been officially done towards preserving a full record of the habits, beliefs, arts, myths, languages, and physical characteristics of the countless other tribes and nations, more or less uncivilized, which were comprised within the limits of the British Empire. At the meeting of this Association held last year in Liverpool it was resolved by the General Committee to press upon the Government the necessity of establishing a Bureau of Ethnology for Greater Britain. Wherever such a bureau was to be established, in connection with the British Museum or the Imperial Institute . . . . the question of its existence must of necessity rest with Her Majesty's Government and Treasury, inasmuch as without funds, however moderate, the undertaking could not be carried on. He trusted that, in considering the question, it would always be borne in mind that in the relations between civilized and uncivilized nations and races it was of the first importance that the prejudices, and especially the religious or semi-religious and caste prejudices, of the latter should be thoroughly well known to the former. If but a single "little war" could be avoided in consequence of the knowledge acquired and stored up by the Bureau of Ethnology preventing such a misunderstanding as might culminate in warfare, the cost of such an institution would quickly be saved.

It might be thought that he should have taken that opportunity to discuss some more general subject, such as the advances made in the various departments of science since last the Association met in Canada. These topics would, however, be discussed by more competent



authorities in the various Sections of the Association by means of the Presidential addresses or otherwise. He occupied his position as a representative of Archæology, and was, therefore, justified in bringing before them a subject in which every member of every race of mankind ought to be interested—the antiquity of the human family and the scenes of its infancy.

Others would direct their thoughts in other directions, but the farther they proceeded the more clearly would they realize the connection and interdependence of all departments of science. Year after year, as meetings of this Association took place, they might foresee that “many shall run to and fro and knowledge shall be increased.” Year after year advances would be made in science; and in reading that Book of Nature which was ever open before their eyes, successive stones would be brought for building up that Temple of Knowledge of which their fathers and they had laboured to lay the foundations.

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II.—BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.  
Sixty-Seventh Annual Meeting, held at Toronto, Canada, August  
18–25, 1897.

LIST OF PAPERS READ IN SECTION C, GEOLOGY.

DR. G. M. DAWSON, C.M.G., F.R.S., F.G.S., President.

President's Address.—On the Pre-Cambrian Rocks of Canada.

*Dr. F. D. Adams.*—On the Structure and Origin of certain Rocks of the Laurentian System.

*Dr. R. W. Ells.*—Problems in Quebec Geology.

*Dr. L. W. Bailey.*—Some Typical Sections in South-Western Nova Scotia.

*Dr. E. W. Claypole.*—Palæozoic Geography of the Eastern States.

*J. C. Branner.*—The Former Extension of the Appalachians across Mississippi, Louisiana, and Texas.

*Dr. F. D. Adams and J. T. Nicholson.*—Preliminary Notice of some Experiments on the Flow of Rocks.

*Professor W. J. Sollas, F.R.S.*—Report of the Committee for the Investigation of a Coral Reef.

*E. J. Garwood.*—Report of the Committee on Life-Zones in the British Carboniferous Rocks.

*R. T. Hill.*—The Stratigraphic Succession in Jamaica.

*Professor T. C. Chamberlin.*—A Group of Hypotheses bearing on Climatic Changes.

*Professor T. C. Chamberlin.*—Distribution and Succession of the Pleistocene Ice-Sheets of the Northern United States.

*Professor A. Penck.*—The Glacial Deposits of the Alps.

*Prince Kropotkin.*—On the Asar of Finland.

*H. B. Woodward, F.R.S.*—The Chalky Boulder-Clay and the Glacial Phenomena of the Western-Midland Counties of England.

*Professor A. P. Coleman.*—Glacial and Interglacial Deposits at Toronto.

- Dr. J. W. Spencer.*—On the Continental Elevation of the Glacial Epoch.
- F. B. Taylor.*—The Champlain Submergence and Uplift, and their Relations to the Great Lakes and Niagara Falls.
- G. K. Gilbert.*—Remarks introductory to the Excursion to Niagara Falls and Gorge.
- Bailey Willis.*—Drift Phenomena of Puget Sound and their Interpretation.
- Professor C. H. Hitchcock.*—The Southern Lobe of the Laurentian Ice-Sheet.
- Professor N. S. Shaler.*—On the Origin of Drumlins.
- R. Chalmers.*—The Pre-Glacial Decay of Rocks in Eastern Canada.
- Sir William Dawson, F.R.S.*—Note on certain Pre-Cambrian and Cambrian Fossils supposed to be related to Eozoon.
- A. C. Seward, M.A.*—On the Possible Identity of *Bennettites*, *Williamsonia*, and *Zamites gigas*.
- J. F. Whiteaves.*—Note on a Dendrodont Fish-tooth from Silurian Rocks of Nova Scotia.
- H. M. Ami, D.Sc.*—On some new or hitherto little known Palæozoic Formations in North-Eastern America.
- Dr. G. F. Matthew.*—Some Characteristic Genera of the Cambrian.
- Professor T. Rupert Jones, F.R.S.*—Report of the Committee on the Fossil Phyllopora of the Palæozoic Rocks.
- J. Milne and A. J. Jukes-Browne.*—Report of the Committee on the Secondary Fossils of Moresat, Aberdeenshire.
- M. l'Abbé J. C. K. Laflamme.*—Influence d'un éboulement sur le régime d'une Rivière.
- Captain S. G. McDakin.*—Report of the Coast Erosion Committee of the East Kent and Dover Natural History Societies.
- H. N. Ridley.*—Report of the Committee on the Fauna of Caves near Singapore.
- P. F. Kendall.*—Report of the Committee on the Erratic Blocks of the British Islands.
- A. E. Barlow, M.A., and W. F. Ferrier, B.Sc.*—On the Relations and Structure of certain Granites and associated Arkoses on Lake Temiscaming, Canada.
- P. M. C. Kermode.*—Report of the Committee on the Irish Elk Remains in the Isle of Man.
- Professor W. G. Miller.*—On some Nickeliferous Magnetites.
- J. J. H. Teall, F.R.S.*—Differentiation in Igneous Magmas as a result of Progressive Crystallization.
- J. B. Tyrrell, B.Sc.*—The Glaciation of North-Central Canada.
- Dr. E. Gilpin, Jun.*—The Geological Horizon of some Nova Scotia Minerals.
- W. F. Ferrier, B.Sc.*—The Minerals of the Elæolite-syenite near Montreal.
- W. L. Goodwin and Professor W. G. Miller.*—Some Economic Minerals of Ontario.
- Professor H. Le Roy Fairchild.*—Glacial Geology of Western New York.

Professor J. Milne, F.R.S.—Second Report on Seismological Investigation.

O. H. Howarth.—Earth Strains and Structure.

Professor W. W. Watts.—Report of the Committee for Collecting Photographs of Geological Interest.

Dr. Otto Hahn.—Exhibit of Photographs and Sections of Meteorites.

Papers bearing upon Geology and Palæontology read in other Sections, namely :

*Section A.—Mathematical and Physical Science.*

Lord Kelvin.—On the Fuel-Supply and Air-Supply of the World.

*Section B.—Chemistry.*

F. T. Shutt.—The Composition of Canadian Virgin Soils.

Professor W. H. Ellis.—Analyses of some Pre-Carboniferous Coals. Report of the Committee to inquire into the Proximate Chemical Constituents of the various kinds of Coal.

*Section D.—Zoology.*

Professor H. F. Osborn.—On a Restoration of *Phenacodus primævus*.

Professor H. F. Osborn.—On Skeletons and Restorations of Tertiary Mammalia.

J. F. Whiteaves.—On new Sepiadæ from the Lower Cretaceous of the South Saskatchewan.

Professor C. S. Minot.—The Origin of Vertebrata.

Professor H. F. Osborn.—The Origin of Mammalia.

*Section E.—Geography.*

J. B. Tyrrell.—The Barren Lands of Canada.

Charles D. Walcott.—The Geographical Work of the United States Geological Survey.

J. White.—The Geographical Work of the Canadian Geological Survey.

*Section H.—Anthropology.*

JOINT DISCUSSION WITH SECTION C, GEOLOGY.—*Subject*: “The First Traces of Man in the New World.”

Professor F. W. Putnam.—The Trenton Gravels.

Professor E. W. Claypole.—Human Relics in the Drift of Ohio.

The President.—Exhibition of Lance-headed Implements of Glass from North-West Australia.

F. H. Cushing.—The Genesis of Implement-Making.

Professor A. C. Haddon.—Adze-Making in the Andaman Islands.

*Section K.—Botany.*

A. C. Seward.—Lecture on Fossil Plants.

A. C. Seward.—Notes on Fossil Equisetaceæ.