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ARTICLE VIII.

PRIMITIVE MAN IN THE ICE AGE.

BY WARREN UPHAM.

[For its bearing upon the antiquity and early condition of man, the discovery so fully and clearly reported upon by Mr. Warren Upham in the accompanying communication is certainly one of the most important which have ever been made. It is proper to remark, also, that the company of savants who conducted their investigations together, and who are named in this communication, represent more combined wisdom relating to this subject than could be found anywhere else in the world. For the statement of facts their report may be taken as final. But the question of the absolute length of the epochs described is one which can at present be settled only tentatively;—as their distinguished author would most readily grant. After a personal study of the conditions in the vicinity of Lansing, and comparison with a similar discovery at Kief, in Russia, and with the conditions in Asia to which reference has been made in another article (see p. 710), I will add some comments in the January number.—G.F.W.]

INSTEAD of suddenly complete creative acts, like the old Greek and Roman myth of Minerva, born, full-grown and clothed in armor, from the head of Jupiter, the geologist, zoölogist, and botanist, through their studies in the last fifty years, have learned to regard the creation of the earth and all its living things, plants, animals, and man, as a slow and gradual progress. Time, which by the majority of the Christian world a half-century ago was thought of as a period of about six thousand years, has vastly expanded, with the increased knowledge of the earth's stages of change and with the record of past forms of plant and animal life, until now our vision extends back to an antiquity of probably a hundred million years, or more, for the beginnings of life on our globe. Even for mankind, the latest and highest product of the Creator's thought and

work, a dim antiquity is now seen through the wonderful history of the Ice age, dating from the beginning of the snow and ice accumulation in Europe, probably about a hundred thousand years ago. In America traces of man's presence during the closing stage of the Ice age, probably 7,000 years ago, have been known many years; and in February of this year a skeleton of one of these primitive Americans was found near Lansing, Kansas, belonging to a stage of the northern glaciation considerably preceding its end. Man was created in the last of the six days of Genesis; but each of these days, in the light of scientific investigation, is known to represent a very long part of the geologic record.

Previous to the discovery mentioned in Kansas, the earliest evidence of prehistoric man in America, in such relation to drift deposits of the Glacial period that its date could be approximately estimated, was found in 1887 at Claymont, Delaware, by H. T. Cresson, being an implement of slate from a gravel bed excavated in building a railroad. Its age is that of the Columbia formation, gravel, sand, and clay deposits, older than the gravel and sand beds, belonging to the end of the Ice age, in which many stone implements, of slate, chert, and quartz, and artificially flaked quartz chips, have been found, occurring in the Delaware valley at Trenton, N. J., in valleys of Southern Ohio and Indiana, tributary to the Ohio river, and in the ancient Glacial floodplain of the upper Mississippi river at Little Falls, Minnesota. These stone implements and flakes show that men lived in the northern part of the United States when the vast ice-sheet, which had covered the northern half of our continent, stretching south to the Ohio river and somewhat beyond the Missouri river, was finally melting away, leaving the bouldery drift accumulated along its receding boundaries in belts of knolls, hills, and short ridges, called marginal moraines. For details of

these formerly known evidences of man contemporaneous with the end of the continental glaciation, the reader may be referred to Prof. G. F. Wright's "Ice Age in North America" (1889) and his "Man and the Glacial Period" (1892).

According to the computations and estimates of Prof. N. H. Winchell, Dr. Edmund Andrews, Prof. G. F. Wright, and others, based on the rates of recession of waterfalls, of the accumulation of beach sands, and of erosion and deposition of sediments by streams and lakes, the time since the moraine hills were amassed, and since men lost their implements in the gravels and sands of the valleys flooded from the latest ice melting, has been about 7,000 years. Many independent estimates of the length of this Postglacial period have been made both in America and Europe, which agree together so well that this measure of the lapse of time since the Ice age may be accepted with confidence.

But the discovery noted at Claymont, Del., and the human skeleton recently found beneath the fine silicious and calcareous silt called loess in the Missouri river valley about two miles southeast from Lansing, Kansas, belong to a considerably earlier time, probably about twice as remote as the end of the Ice age. In other words, according to my interpretation of the sequence and duration of the various stages that made up the Ice age, some 12,000 or 15,000 years have elapsed since the man of Lansing was entombed at the base of the loess; and nearly an equal time, but probably no more, has passed since man lost his oldest known implement in Delaware.

The locality of the discovery in Kansas is about eighteen miles northwest of Kansas City, and six miles southeast of Leavenworth. It is on the farm of Martin Concannon, who settled there in 1867, building his home on the southeast slope of a ravine tributary to the Missouri river, which flows by at the distance of only a quarter of a

mile eastward. On the 20th of last February, Mr. Concannon's sons, in digging a tunnel into the loess, to be used as a storage cellar for fruit, vegetables, milk, and butter, found, 68 to 70 feet from the entrance of the tunnel, and 20 feet beneath the surface of the ground, a human skeleton, disjointed, partly broken and decayed, but sufficiently preserved to give a good deal of information concerning the racial character of the people who inhabited that region during the loess-forming stage of the Ice age.

The scientific importance of their discovery was not at first suspected by the Concannon family and their farmer neighbors. About a month passed before any newspaper mention of it was published. Then M. C. Long and Edwin Butts of Kansas City, Mo., the former curator of the City Public Museum, and the latter civil engineer of the Metropolitan Street Railway, visited the locality, and obtained the skull and nearly all the bones, with the design of placing them in the museum. In July an examination of the locality and skeleton was made by Prof. S. W. Williston, of the Kansas State University, who wrote a short statement about them that appeared in *Science* for August 1st.

Before this publication, Prof. N. H. Winchell of Minneapolis, president of the Geological Society of America, and myself, in Minnesota, had planned a visit to Lansing, Kansas, which we made August 9th, being accompanied by Prof. Williston and Prof. Erasmus Haworth, of the State University, Lawrence, Kan., and by M. C. Long and others of Kansas City. We all carefully examined the section shown in the tunnel, for which Mr. Concannon and his sons kindly supplied lights; and they also showed us the exact place where the skeleton lay. It was apparently in the upper foot of a deposit of limestone and shale fragments, with much fine earth, which has a thickness of about two to three feet, lying on a floor of nearly levelly

bedded Carboniferous limestone. The débris, in which the lower third of the tunnel is dug, through its entire extent, seems to have slowly accumulated by falling down from adjoining higher outcrops of the same rock that forms the floor of the tunnel.

The skeleton, found about 12 feet above the highest recent flood (in 1881) of the Missouri, was inclosed in the upper part of the débris, or perhaps lay in a hollow of its surface. Next above the débris and skeleton is the fine waterlaid loess, levelly stratified, representing a great change in the geologic conditions. By the somewhat rapid sedimentation of the loess, perhaps at the rate of several inches or even a foot yearly, the bones were enveloped and deeply buried before weathering and decay could destroy them. The same fine loess continues up to the surface, 20 feet, and its irregularly eroded gently ascending slopes, enveloping the Carboniferous limestone, rise to a height of 200 feet, or more, above the river, within a quarter of a mile southeast and south, and somewhat farther distant westward, there attaining the general level of the tops of the river bluffs and adjoining uplands. The thick loess deposit was doubtless gradually built up to this height as a floodplain of the river, extending across the present area of its bottomland and also reaching far away at each side. Since the Lansing man lived, the preglacial Missouri valley was thus filled by loess, and was afterward re-excavated by the river erosion.

Geologists have ascertained that the loess was chiefly deposited in a late part of the Ice age, known as its Iowan stage, when the ice-sheet had retreated from its farthest limit, some thirty miles south of Lansing in northeastern Kansas, but while it still covered northern Iowa and all the country thence northward. Prof. T. C. Chamberlin and some other glacialists have estimated the antiquity of the Iowan stage as five times that of the Postglacial period,

that is, about 35,000 years; which, by a coincidence, was the estimated age assigned to this skeleton by the early newspaper articles describing it. But from my studies of the glacial Lake Agassiz, in the basin of the Red river of the North and of Lake Winnipeg, I think that the duration of that vast ice-dammed lake, with the formation of our most prominent belts of marginal moraines, was no longer than 1,000 years. On the same scale, probably the time from the Iowan stage of glaciation, when the loess in the Missouri valley was deposited, until the end of the existence of Lake Agassiz did not exceed 5,000 to 8,000 years, which would give, with the Postglacial period, about 12,000 or 15,000 years as the antiquity of the Lansing fossil man.

This discovery opportunely confirms and supplements the previously known evidences of man's presence in this hemisphere during the Ice age, which had been well set forth by Wright's two important works before cited, published respectively thirteen and ten years ago. The observations there relied upon, as demonstrating that men here were contemporaneous with the northern glaciation, have since, however, been called into question and strenuously disputed by some of our ablest geologists and archæologists. The Late Glacial man of the Mississippi and Missouri region is now made known, and is seen to have been long-skulled, with beetling eyebrows, low and receding forehead, and projecting jaws. His stature, according to measurements of the bones, was about five feet and eight inches, like the average of our people to-day.

As noted in my paper on this subject in the *American Geologist* for September, some of the stone implements of these primitive men have been found in the loess at Muscatine and at Council Bluffs, Iowa. They indicate a stage of culture perhaps as far advanced as the Solutrian and Magdalenian stages of the Paleolithic period in Europe.

The same paper contains a short review of the Ice age, following the nomenclature proposed for its time divisions by Chamberlin, Geikie, Calvin, Leverett, and the late Dr. George M. Dawson. This summary displays the relation of the loess and the Lansing skeleton to the entire history of the glacial drift, as follows.

1. The culmination of the Ozarkian epeirogenic uplift, in the later part of the Lafayette period, the earliest of the Quaternary era, affecting both North America and Europe, raised the glaciated areas to so great altitudes that they received snow throughout the year and became deeply ice-enveloped. Submerged valleys and fjords show that this elevation was at least 1,000 to 4,000 feet above the present height. Rudely chipped stone implements and human bones in the plateau gravel of southern England, 90 feet and higher above the Thames, and the similar traces of man in early Quaternary sand and gravel deposits of the Somme and other valleys in France, attest man's existence there before the maximum stages of the uplift and of the Ice age. The accumulation of the ice-sheets, due to snowfall on their entire areas, was attended by fluctuations of their gradually extending boundaries, giving the Scanian and Norfolkian stages named by Geikie in Europe, the Albertan formation of very early glacial drift and accompanying gravels, described by Dawson, in Alberta and the Saskatchewan district of western Canada, and an early glacial advance, recession, and readvance, in the region of the Moose and Albany rivers, southwest of Hudson bay. In that region, and westward on the Canadian plains to the Rocky mountains, there seem to have been thus three stages recognizable in the glacial results of the epeirogenic uplift, namely, the Albertan early ice accumulation, the later time represented by the Saskatchewan gravels, of abundant glacial melting and extensive retreat, and afterward a vast growth of the continental icefields to their

farthest limit, when they reached south to Kansas. The first recognized stage of glaciation in North America is therefore called the *Albertan stage.*

2. A deposit of glacial drift, the lowest and oldest observed in the Mississippi river basin, probably of Albertan age, stretches south at least to southern Iowa, where it is overlain by interglacial beds, inclosing peat, well displayed in sections at Afton, Iowa. The Aftonian interglacial time, especially notable for its extensive buried forest bed, containing trunks of hardy northern coniferous trees, has been ascertained to be earlier than the Kansan readvance of glaciation. It is therefore probably equivalent with the Saskatchewan stage of Canada, which name it should then displace according to the rule of priority. This second time division of the Glacial period, including a very important recession of the ice border, uncovering the previously glaciated country as far north, probably, as to the southern half of Minnesota, is therefore named the *Aftonian stage.*

During this time, apparently, the Mississippi river in the vicinity of Minneapolis eroded a rock channel which is now mostly filled by the drift of the later glaciation, but is marked by a series of lakes, namely, Cedar lake, the Lake of the Isles, lakes Calhoun and Harriet, and others farther south. Prof. N. H. Winchell, from his study of this interglacial channel of the Mississippi, has estimated the duration of the interglacial stage there as about 15,000 years. It seems to be represented also in the history of the Quaternary lakes Bonneville and La Hontan, respectively described by Gilbert and Russell, as a prolonged stage of desiccation of these lakes under a drier climate, while their earlier and later flood stages are correlated with the Albertan and Kansan stages of glaciation. Near the southern limit of the glacial drift, the Aftonian interval was doubtless much longer than in Minnesota.

3. During the *Kansan stage* the ice-sheet attained its farthest extent in the Missouri and Mississippi river basins, and in northern New Jersey. It is correlative with the Saxonian stage of maximum glaciation in Europe. The area of the North American ice-sheet, with its development on the Arctic archipelago, was about 4,000,000 square miles; and of the European ice-sheet, with its tracts now occupied by the White, Baltic, North, and Irish seas, about 2,000,000 square miles.

4. In the *Helvetian stage*, named by Geikie from its recognition in Switzerland and elsewhere in Europe, the ice-sheets receded from their Saxonian and Kansan boundaries. The Buchanan gravels and sands, as named by Calvin in Iowa, were deposited during the retreat of the Kansan icefields; and this time is also represented by the Yarmouth weathered zone and erosion of the Kansan drift, noted by Leverett in Iowa and Illinois. The greater part of the drift area in Russia was permanently relinquished during this stage by the much diminished ice-sheet, which also retreated considerably on all sides.

5. The *Iowan stage* was marked by renewed accumulation of snow and ice, extending over a part of the country that had been laid bare by the preceding retreat. Before the farthest extension of this glaciation in Iowa, on the west side of the Wisconsin driftless area, the ice-lobe east of that area advanced from Illinois into the edge of southeastern Iowa, giving an Illinoian stage of glaciation which somewhat antedated the maximum of the Iowan, though not probably by a wide difference of time. Between the retreat of the Illinoian ice-lobe and the deposition of the Iowan loess, Leverett notes interglacial deposits and a zone of weathering, the records of his Sangamon stage. Iowan time seems correlative with the Polandian stage of renewed growth of the European ice-sheet.

In this late part of the Glacial period the northern lands,

which had long stood at greater altitudes than now, sank at last under their very heavy ice load until they mostly were somewhat below their present heights. This Champlain depression, as it is called, permitted the glacial drift of coastal regions to be covered by fossiliferous marine beds, which through later re-elevation range up to 300 feet above the sea in Maine, 560 feet at Montreal, 300 to 400 feet from south to north in the basin of lake Champlain, 300 to 500 feet southwest of Hudson and James bays, and similar or greater altitudes on the coasts of British Columbia, the British Isles, Germany, and Scandinavia.

Glacial melting and recession from the Iowan boundaries was rapid under the temperate (and in summers warm or hot) climate belonging to the more southern parts of the drift-bearing areas when reduced from their great preglacial elevation to their present height or lower. The finer portion of the drift, swept down from the icefields by the abundant waters of their melting and of rains, was spread on the lower lands and along valleys in front of the departing ice, as the loess of the Missouri, the Mississippi, and the Rhine. In or just beneath the basal beds of the Missouri loess was the Lansing fossil man, belonging thus to the culmination or beginning of decline of the Iowan stage of glaciation.

6. Moderate re-elevation of the land took place during the *Wisconsin stage*, in the northern United States and Canada advancing as a permanent wave from south to north and northeast. The ice border continued mainly in a wavering retreat along most of its extent, but attained its maximum advance in southern New England. This last well-defined stage of the Glacial period was characterized by slight fluctuations of the ice front and the formation of prominent marginal moraines. Great glacial lakes were held by the barrier of the waning ice-sheet on the northern borders of the United States. At the same time

the Mecklenburgian stage in Europe was attended by the formation of conspicuous moraine accumulations at the gradually receding ice boundaries in Sweden, Denmark, Germany, and Finland.

It is clearly seen, from this review of the Ice age, that the Lansing skeleton and the deposition of the loess are referable to the later part, when the high land elevation that caused the growth of the vast sheets of snow and ice was succeeded by the Champlain depression, which brought the period of glaciation to its end. Man at Lansing was contemporaneous with the beginning of the filling of the Missouri valley with loess, probably a few thousand years before the very remarkable moraines in Wisconsin, northern Iowa, Minnesota, and all our northern states, as well as in Canada, were formed on the boundaries of the departing ice-sheet.

My estimates of the duration of earlier parts of the Ice age would assign about 10,000 years for the growth of the icefields during the Iowan stage, before the Champlain subsidence caused them to melt and supply the loess in its chief abundance; about 10,000 years for the preceding Helvetian or Buchanan glacial retreat, giving thus some 25,000 years before the end of the Ice age as the time of the Kansan maximum glaciation; a previous slow ice accumulation and transportation of the Kansan glacial drift, that is, the Kansan stage of the Ice age, also about 25,000 years; the previous Aftonian stage of glacial recession, another such allowance of about 25,000 years; and, earliest of all, the Albertan stage of ice accumulation and formation of its drift deposits, likewise about 25,000 years. All the Ice age I would thus comprise within about 100,000 years. This estimate seems to harmonize well with the geologic time ratios of Dana, Walcott, and others, which indicate about a hundred million years as the duration of life on the earth.

Man in the Somme valley and other parts of France, and in southern England, made good paleolithic implements fully 100,000 years ago, according to my estimate of the length of the Ice age. When the earliest men came to America cannot probably be closely determined. It was during the Glacial period, or possibly earlier. The Lansing skeleton affords probably our oldest proof of man's presence on this continent; but it is only a third, or, as I think more probable, only about an eighth, so old as the flint hatchets of St. Acheul and other localities in the Old World.

The first people in America appear to have migrated to our continent from northern Asia during the early Quaternary time of general uplift of northern regions which immediately preceded the Ice age, being its principal cause, and which continued through the early and probably the greater part of that age. Then land undoubtedly extended across the present area of the shallow Bering sea. It is not improbable, too, that another line of very ancient immigration, coming by a similar early Quaternary land communication where now are wide tracts of the sea, passed from western Europe by the way of the Faroe islands, Iceland, and Greenland, to this continent. The very distant and dim antiquity of these migrations, however, will perhaps always forbid our looking back with clear and certain view, to trace their relative importance and their respective contributions to prehistoric American industries, traffic, customs, myths, and racial characters.

An objection against migrations of primitive man to this western hemisphere during the Glacial period may be based on the ice-covered condition of North America at that time, wholly enveloped by an ice-sheet upon its northern half, northward from the Ohio and Missouri rivers, excepting the greater part of Alaska. If the preglacial and early Glacial altitude of the continent had been the

same as now, this objection would be valid, and we should be obliged to refer these ancient migrations wholly to a time before the accumulation of the North American ice-sheet, which reached both east and west beyond the present coast lines. But the land elevation then, as known by old river valleys submerged beneath the sea and by marine shells of littoral and shallow water species dredged at great depths, was 3,000 to 8,000 feet greater than now. During the epoch of ice accumulation and culmination, its boundaries probably failed to reach generally to the coast line of that time. Along the sea border, where food supplies such as savages rely upon are most easily obtained, preglacial and Glacial man may have freely advanced on a land margin skirting the inland ice, as along the present borders of Greenland. It was only in the Champlain epoch, closing the Glacial period, that the ice-burdened lands sank to their present altitude or lower, bringing the edges of the ice-sheet beneath the encroaching sea.

Six great eras comprise all geologic time, as follows:

1. The Azoic or Early Archean era, without life.
2. The Eozoic or Late Archean era, with the dawn of life.
3. The Paleozoic era, with old types of life.
4. The Mesozoic era, with intermediate types of life.
5. The Cenozoic or Tertiary era, with new types of life.
6. The Psychozoic or Quaternary era, with soul life.

Each of the three eras first named was exceedingly long. The fourth was probably only a quarter as long as either of those preceding, but in turn it is estimated to have been about three times as long as the fifth era. Lastly, the Psychozoic era, extending to the present time, has been comparatively very short. But this short era has the greatest significance to us, because then, as its name implies, "man became a living soul," the crowning glory of the animal kingdom. Geologically, this era has been char-

acterized by very exceptional movements of grand continental uplifts and subsidence, with glaciation of northwestern Europe and half of North America.

Writing on this theme for the readers of this quarterly, including students and teachers of the revelation of God in the Bible and in nature, I am moved by an earnest wish and prayer, like Milton in beginning his great epic,

> "That to the height of this great argument
> I may assert eternal Providence
> And justify the ways of God to men."

My faith rests in an assurance that the Creator has exercised infinite power, wisdom, and love, through his ordained physical, chemical, dynamic, and biologic laws, in bringing the earth and all its floral and faunal life, including mankind, to their present complex and orderly development. But I cannot fully understand many parts of his works, nor know his purpose in many events, just as the little child of a statesman is unable to comprehend many of his father's great plans. My finite mind cannot grasp and solve many of its questions. Science learns a little, but not the whole, of God's laws and purposes; for he has said, "As the heavens are higher than the earth, so are my ways higher than your ways, and my thoughts than your thoughts."