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ARTICLE VI.

GEOLOGICAL CONFIRMATIONS OF THE NOACHIAN DELUGE.[1]

BY G. FREDERICK WRIGHT.

THE DIRECT CIRCUMSTANTIAL EVIDENCE.

ACCORDING to the account of the Flood in Genesis, while it was so extensive as to need special arrangements to preserve the animals associated with man, the catastrophe was, as geologists reckon time, of short duration. Still, if we can consider the one hundred and twenty years of warning which was given to Noah as covering a period of subsidence, culminating in the final catastrophe described by the sacred writer as of a year's duration, we should have a progress, in the main, so slow and gradual that it could scarcely be observed from year to year, though very likely producing the most wide-spread destruction of animal species which so evidently took place about the close of the glacial period; while the more rapid rise of the land, intimated in the biblical story by the short duration of the flood, would account, as we shall see, for a large class of phenomena, which we are about to describe.

But the influence of such a brief subsidence must be looked for, not in the general phenomena connected with the fossils in the ordinary rocks or with the dislocation of mountain strata, but in those superficial deposits of gravel, sand, loess, and clay which everywhere girdle the shores, border the valleys, and mantle the upland plains of the continents. To discriminate in these superficial deposits

[1] Concluded from page 556.

between those which are due to the slow action of existing agencies and those which are the result of a wide-spread movement is by no means always an easy matter; yet much has been done in this direction during the last twenty-five years, with the remarkable result, that, whereas existing local causes are seen to be sufficient to account for the larger part of the erosion of gorges and river valleys and the deposition of sediment of various degrees of coarseness over broad plains, a large residuum of phenomena demands the presence of causes which have now either altogether ceased their activity, or have so diminished their force as to be inadequate for the explanation of the facts.

I have perhaps been as active as any one in efforts to discriminate, in the superficial deposits in the northern part of North America and in Northwestern Europe, between those which are the direct result of the great ice invasion of the glacial period,[1] and those which are the effects of local and more limited causes, and have, therefore, been strongly predisposed to attribute as much as possible to direct glacial agency, especially as it so easily accounts for the larger part of the gravel deposits over these areas which were earlier attributed to a submergence of the continent or to the action of floating ice. But longer and wider study of the facts of surface geology reveals more and more clearly a considerable residuum of phenomena which indicate a brief postglacial submergence, since man's advent, of a large part of Europe and Asia.

EVIDENCE FROM EUROPE.

The residual facts pointing to this conclusion in England and the continent of Europe have been very fully stated by the late Professor Joseph Prestwich, one of the

[1] See Ice Age in North America, and its Bearings upon the Antiquity of Man (pp. xl, 648), and Man and the Glacial Period (pp. xvi, 385), both published by D. Appleton & Co., New York.

most eminent, cautious, and unerring of recent geological observers.[1] The conclusions of Professor Prestwich we have already given with considerable fullness in the BIBLIOTHECA SACRA,[2] and still more clearly in "Scientific Aspects of Christian Evidences."[3] For our present purpose, it will be in place, however, briefly to recapitulate. But, fully to appreciate the force of the facts, one needs to go carefully through Professor Prestwich's elaborate monographs referred to, or, better still, follow him, as I have done to some extent, over the fields described.

The evidence is classed under three heads, namely, The Rubble-drift of Southern England and Northern France; The Ossiferous Breccias of the Continent; and The High-level Loess of France and Central Europe.

1. *The Rubble-drift.*—At numerous places over the southern counties of England and on the south side of Dover Strait, in France, there are deposits of angular gravel, bearing no relation to the present drainage systems of the country, and containing paleolithic implements and the bones of extinct animals associated with prehistoric man. This drift is found as far inland as the vicinity of Oxford, and at an elevation on the Cotteswold Hills of about nine hundred feet. It differs in important respects from all ordinary gravel, such as is found along river courses or on the beaches of oceans and lakes, in—

(1) The angularity and sharpness of the harder constituent débris. Evidently the material has been moved but

[1] "The Raised Beaches, and 'Head,' or Rubble-drift, of the South of England," Quart. Jour. of the Geol. Soc., Vol. xlviii. pp. 263–343; "The Evidences of a Submergence of Western Europe, and of the Mediterranean Coasts, at the Close of the Glacial or so-called Post-glacial Period, and immediately preceding the Neolithic or Recent Period," Phil. Trans. of the Royal Soc. of London, Vol. clxxxiv. pp. 903–984; "On Certain Phenomena belonging to the Close of the Last Geological Period and on their Bearing upon the Tradition of the Flood."

[2] See Oct., 1895, pp. 723–739.

[3] New York: D. Appleton & Co. See especially pp. 149–165.

a short distance; since both the fragments of stone and the fractured bones retain their sharp angles.

(2) A second peculiar characteristic is that the material is all of local origin, and is derived from the higher grounds of the immediate vicinity. A significant fact, also, in connection with this, is that the drift is arranged around the base of the higher land, as if it had been swept in all directions from it, yet so far from the base that the agency of distribution could not have been running water. In some cases, as on the South Downs, at Portslade, west of Brighton, this drift extends from two to five miles over a comparatively level surface, but the material is not collected in deltas, as would be the case if it were transported by small streams, but is pretty equally distributed around the base, nor does it have any regular stratification, as would be the case if it had been transported by ordinary water action.

(3) There is a total absence in these deposits of marine and fluviatile shells. This has ordinarily been taken as conclusive evidence against the origin of these deposits during a period of submergence. In the opinion of Professor Prestwich, however, it is simply evidence of the brevity of the submergence: the time of its continuance was too short to permit the establishment of colonies of shell-fish of any description.

The only way in which Professor Prestwich finds it possible to explain this distribution of Rubble-drift is on the theory of a submergence followed by a series of paroxysmal periods of elevation.

As direct evidence of the rapidity of the subsidence, Professor Prestwich points to numerous raised beaches and dunes of blown sand, which underlie the Rubble-drift throughout a considerable portion of its extent near the English Channel. These buried dunes show that, after the beach was formed, the land was somewhat elevated so

as to expose it to the wind and so permit the accumulation of the dunes. This elevation was, however, slight. The submergence which followed was so rapid that there was not time for the waves to obliterate the sand dunes, as they would surely have done had the exposure lasted for more than a very brief period. Upon the reëmergence of the land, the Rubble-drift was swept down over the beach, and thereby everything was preserved from further disturbance till the present time.

2. *Ossiferous Fissures.*—The same theory is demanded to explain the "ossiferous fissures" abundant in Southern England and in France, and long ago described by Buckland in his "Reliquiae Diluvianae," but not fully understood by him. These fissures abound in the limestone regions of Southern England. They are not caverns in the ordinary sense of the word, but simply fissures, open at the top and extending down perpendicularly, or at a slight inclination, sometimes a hundred and forty feet. They are filled with angular rock fragments, broken and splintered bones whose fractured edges are unworn and sharp, all cemented together in a matrix of sand, earth, and clay through which lime has filtered, making what is called a breccia. The bones represent the horse, ox, deer, wolf, hyena, tiger, hare, water rat, weasel, boar, and some other animals.

It is acknowledged by all that these fissures have been filled in from above, but it was the opinion of Dr. Buckland that the process had been very gradual, and that the animals had accidentally fallen in from time to time. An unanswerable objection to this theory is, that, though the opportunities for observation have been very extensive, in no case has a complete skeleton of any animal been found, or even scattered bones that would make a skeleton. If animals had fallen in, as Buckland supposed, it is inconceivable that this result should have followed. In the fissure at Oreston, Mr. Cottle collected 1,587 teeth of the an-

imals above mentioned, 147 jaws, 250 vertebræ, and 26 skulls; but there was not a single whole skeleton, nor did any of the bones show marks of wear, such as would appear if they had been rolled along by a running stream of water, nor did any show the marks of hyenas' teeth, which are common upon the fragments in the ordinary caves.

After considering exhaustively all possible modes of accounting for these facts, Professor Prestwich finds himself limited, as before, to the hypothesis of a brief submergence of the land, such as would drive the animals in a heterogeneous mass to the higher lands, where they would be drowned, and their remains scattered over the surface. After time enough had elapsed for their carcasses thoroughly to decay, the reëmergence of the land distributed the bones by the same process that determined the distribution of the Rubble-drift. As the material was swept along by the successive impulses of uplift beneath the water, the fissures along the slopes became filled in the heterogeneous manner described.

Among the most interesting and instructive fissures supposed to have been filled in this way is that at Santenay, a few miles south of Chalons, in Central France. This is situated upon an isolated hill connected with the range of Côte-d'Or, 1,030 feet above the valley of the Sâone, which is here six hundred feet above the sea. Two ordinary bone-caves occur upon the opposite sides of the hill, containing remains of the horse, wolf, fox, bear, lion, deer, ox, elephant, and rhinoceros.

But the fissure under consideration is near the summit of the hill, and is filled with a breccia—

"composed of the fragments of the adjacent rocks, embedded in a yellow or brownish earth, with bones which were determined by Professor A. Gaudry to be of the cave lion, lynx, horse, wolf (very abundant), fox, badger, bear, hare, rhinoceros, hog, ox, and deer. These were all 'in a very broken state.' M. Gaudry observes that their accumulation could neither be attributed *to man nor to animals*, for the fractures in no way

resemble those made by man for the purpose of extracting the marrow, and, notwithstanding the abundance of wolves, *none of the bones show traces of having been gnawed by Carnivora.* How then could this collection have been brought together? As M. Gaudry justly remarks, 'Why should so many *Wolves*, *Bears*, *Horses*, and *Oxen* have ascended a hill isolated on all sides?' M. Gaudry further remarks that the deposit seems to have been formed by water precipitating the breccia and the bones into a fissure. 'But whence,' he says, 'have come the waters sufficiently abundant to bring together the bones?' The fissure is so near the top of the hill that there is little gathering ground above it, and had the bones and fragments of rock been carried in by a stream or torrential rains, they must have shown more or less wear, and have lost their sharp angles."[1]

An equally striking application of the theory is found on the rock of Gibraltar, where fissures nearly three hundred feet deep occur, filled with breccia similar to that already described. In the case of Gibraltar, strong additional support to Professor Prestwich's opinion is given by consideration of the smallness of the area at the top of Gibraltar. The animals found in the fissures on Gibraltar are nearly the same as those enumerated at Santenay. It is in the highest degree improbable that all these various wild animals could have at any time or habitually lived together on the rock.

"For these reasons," Professor Prestwich pertinently remarks, "I think this explanation cannot be accepted, and would again revert to the hypothesis of a submergence of the land. This affords a *vera causa* for the association of animals otherwise so little likely to be found together. It could only have been, as in the cases I have before named, a great and common danger, such as that of the gradual encroachment of the sea on the land, that could have so paralyzed their natural instincts as to have driven those various animals to flock together in search of a common place of refuge from a catastrophe which threatened all alike. Under such circumstances the Ruminants would naturally flee from the plain to the higher hills, and when these were isolated, as in this and the other cases I have named, whenever the waters rose above those hills, they were drowned and their limbs dispersed in the manner I have before described."[2]

[1] The Evidences of a Submergence of Western Europe, etc., pp. 936–937.

[2] *Ibid.*, pp. 944-945.

A still more interesting illustration occurred near Palermo, upon the island of Sicily, where there was an ossiferous breccia of a very remarkable and unique character, containing an enormous number of hippopotamus bones, which were so fresh that they were cut into ornaments and polished, and when burnt gave out ammoniacal vapor. More than twenty tons of bones were shipped from this one place for commercial purposes in the first six months after their discovery. The bones were mostly those of hippopotami, with a few only of deer, ox, and elephant, and belonged to animals of all ages down to the fœtus. The bones of the various animals were mixed together without order, and were broken, scattered, and dispersed in fragments, and none of them bore marks of gnawing. The cavern is at San Ciro, about two miles from Palermo, and is at the base of the remarkable amphitheater of hills surrounding the plain on all sides, except towards the sea. The hills are from two thousand to four thousand feet in height. The amphitheater is from two to four miles in diameter, and the elevation of the rock shelter is about two hundred feet above the sea.

"The circumstances, therefore, which led to these remarkable accumulations of the remains of the Hippopotami," remarks Professor Prestwich, "must have been *extraordinary*, and I see no hypothesis which meets the case, so well as the one that I have suggested to account for the bones of Mammalia in the Rubble-drift and in the ossiferous fissures, though the local conditions in this case are peculiar.[1]

Not to pause longer upon the numerous other facts collected by Professor Prestwich bearing upon this point, we turn finally to select one from his many illustrations drawn from

3. *The Loess Deposits of Europe.*—Loess is a very fine loam without any intermixture of sand or gravel, or indeed of any grit, and without any remains of marine or fluviatile shells, which in various regions occurs upon the surface.

[1] Evidences of a Submergence of Western Europe, p. 959.

Along the Missouri River from Kansas City far up into Dakota, loess forms the lining bluffs of the valley, having a depth of more than a hundred feet. Large areas in China are covered with it to even greater depths, while its occurrence along the valley of the Rhine accounts for the German name by which it is ordinarily designated.

The anomalous facts connected with its distribution have greatly puzzled geologists. The material is so fine that it is readily blown about hither and thither by the wind, so that Baron Richthofen and others maintain that the loess of China is but the accumulated dust which the westerly winds have brought over from the parched and elevated plains of Mongolia and Thibet. The definite relation, however, of the deposits to water levels in the valleys of the Mississippi and the Rhine makes it certain that in many areas they are due to water action. Still, the facts are so complicated that Professor James Geikie and others think it necessary in Central Europe to bring in both wind and water to account for its distribution. In the glaciated regions of both Europe and America many anomalous local deposits of loess can be readily accounted for by the action of water held in place by ice during the retreat of the continental glacier. No doubt the greater part of the arguments for the Flood drawn from the loess by Mr. Howorth and others are explained by fuller knowledge of the irregularities produced by the slowly melting ice-sheet which covered the northern parts of the continents of Europe and America. But the facts adduced by Professor Prestwich have been carefully selected with reference to this danger of error, and strongly confirm the other evidence pointing so strongly to the occurrence of a recent catastrophe in Western Europe closely analogous to that described in the biblical account of Noah's Flood. A single one of the facts under this head must suffice.

The Channel Islands of Guernsey and Jersey are sur-

rounded by a raised beach which is overlaid by Rubble-drift such as was described under that head. The greater part of the island, however, consists of a plateau of granitic rocks from three hundred to three hundred and fifty feet above sea-level, but without any commanding heights. This plateau is covered very generally by a deposit of loess or brick earth from five to ten feet thick, extending over the highest points of the surface. In character this is identical with that on the mainland.

It is not possible to account for this deposit of loess on any of the theories which are limited to river floods, glacial inundations, or rain wash as the distributing agencies; for—

"there are no rivers in either island, and the water courses are mere small brooks that could scarcely flood the lowest ground, and certainly could never, in present nor past times, have reached the plateau on which the loess occurs. Nor are there any hills, rising above the general level of the plateaux, the wash from which could have been spread over those plateaux. Nor can it be admitted that it was formed when the island was connected with the mainland, and that the loess is due to the extension of the land flood-waters, over what was then part of the continental area; for, unless the loess were older than the raised beaches, it is obvious, as those beaches extended all round the islands, that at the time of the deposition of the loess, the islands were then, as now, detached from the mainland." [1]

Professor Prestwich's summary is limited to the facts connected with Western Europe and the Mediterranean basin. How far this subsidence of which he finds evidence may have extended in a more northeasterly direction he does not venture to say, because of the lack of evidence.

EVIDENCE FROM ASIA.

It was partly to supply this lack that, at the beginning of 1900, in company with Mr. Frederick B. Wright, I set out in my zigzag journey across Asia through China, Si-

[1] Evidences of a Submergence of Western Europe, p. 913.

Itinerary + + + + + + + +
Shaded portion shows Submerged District.

MAP SHOWING THE REGION OF PROFESSOR WRIGHT'S GLACIAL INVESTIGATIONS IN ASIA.

beria, Turkestan, Transcaucasia, Russia, Syria, Palestine, and Egypt.

The expedition was undertaken in expectation of finding in Eastern and Northern Asia signs of the occupation of those regions by glacial ice similar to those which exist so abundantly in corresponding latitudes in North America. But in this we were disappointed. While the ice of the glacial period extended in the United States in an unbroken sheet to the latitude of New York City, on the Atlantic coast, and to the southern part of Illinois, in latitude 38°, in the Mississippi Valley, there was evidently no general occupation of Siberia by glacial ice south of the fifty-sixth degree of latitude. But in place of glacial phenomena we found indubitable evidence of a recent depression of the area, amounting to somewhere from two thousand to three thousand feet.

All Northern China is deeply covered with loess. The rivers which empty into the Yellow Sea are overloaded with the sediment which they gather in flowing through this loess-covered area. When forty miles out from land in the Yellow Sea one encounters a sharply drawn line on one side of which is the clear blue water of the ocean, and on the other the turbid water from the Chinese rivers, still densely charged with the sediment brought down from the interior. So rapidly is this process going on that it is everywhere fast silting up all the harbors near the river mouths. In the year 220 B.C. Putai was a seaport on the Gulf of Pechili. Now it is forty miles inland. In the year 500 A.D. Hien-shu-kan was at the mouth of the Pei Ho River. Now it is eighteen miles inland. During the Han dynasty (200 B.C.) Tientsin was a seaport. Now it is thirty miles from the mouth of the river.

In the interior the source of this superabundant sediment is found in vast deposits spread over both the highlands and the lowlands, and attaining in some instances a

depth of more than a thousand feet. Efforts have been made to explain it as a wind deposit, blown off from the Gobi Desert. But, while there can be no doubt that the wind has had much to do in the distribution of the deposit, in many cases it is spread out in such extensive level areas that it would seem necessarily to involve the action of a great body of standing water. Furthermore, as the erosion of the streams is now far in excess of the deposition by the winds, the result is a rapid waste of the deposit in the interior, and a redeposition of it by the streams at a lower level. Its former accumulation at the higher levels must have been at a rate far in excess of that which is now taking place in those regions, and such as would imply the presence of water into which the sediment was brought somewhat as it now is into the Yellow Sea. This would involve a recent vast depression of land to the extent of some thousands of feet.[1]

But, whatever doubts might be raised respecting such a recent depression of land in China, they cannot well exist concerning a corresponding depression on the other side of the great Central Asiatic Plateau facing Siberia and Turkestan. At the foot of the lofty Ala-tau Mountains, which border this plateau on the northwest, the Russian military road runs for five hundred miles along a terrace of loess, from two thousand to three thousand feet above ocean-level, whose constitution is precisely like that of Northern China. To the south the mountains rise in successive peaks to a height of from fifteen thousand to twenty-three thousand feet; while to the north a rapidly descending plain stretches almost without a break more than two thousand miles to the Arctic Ocean. To one who travels this region with open eyes, there can scarcely be any

[1] See my article "Origin and Distribution of the Loess in Northern China and Central Asia," Bulletin of the Geological Society of America, Vol. xiii. pp. 127-138.

question, that, at a comparatively recent period, these waters washed the shores of the Asiatic Plateau at an elevation of three thousand feet above present sea-level. On the shores of this great inland extension of the Arctic Sea are the sites of the present cities of Verni, Pishpek, Chimkent, Tashkent, and Samarkand,—cities which now occupy the very center of the Asiatic continent. Lake Balkash, the Aral and Caspian seas, with innumerable other small depressions, now occupy the desiccated bed of this late oceanic bottom.

Similar extensive deposits of loess occur in the valley of the Araxes, in Armenia, up to the base of Mount Ararat, and characterize other valleys in Northern Persia and in Transcaucasia.

CORROBORATIVE EVIDENCE.

Among the most interesting corroborations of this theory is the occurrence of Arctic seal in the waters of Lake Baikal and of the Caspian Sea. It would seem impossible to account for this remarkable distribution of the species except on the theory that the whole intervening space had been recently covered with salt water, converting Lake Baikal into an oceanic bay. Upon the elevation of the land so as to sever the connection with the sea, this lake would so gradually change its character from salt to fresh water, that the species of seal left in it could become adapted to fresh-water conditions and thus remain as additional evidence of the recent geological changes of level. In the Caspian Sea, closely allied species of seal are also to be found. But nowhere else do they occur so far away from the ocean. The slightness of the changes which have taken place in the species indicates the very recent date of the geologic events which have brought about the wide dispersion and perfect isolation of this curious animal.

We have already referred to another class of facts point-

ing to the recentness of the great geologic changes in this region, namely, that, contrary to the general rule respecting lakes and seas without outlets, Lake Balkash and the Caspian and Aral seas are less salt than the ocean.[1] The water of the Caspian Sea is only one-third as salt as the ocean, while that of the Aral Sea is so fresh that animals drink it, and that of Lake Balkash is fresher still. This points to a very recent period when the outlets ceased to carry a surplus of water into the ocean sufficient to freshen them. Time enough has not yet elapsed for them to accumulate salt equal to that in ocean water, much less to that in such inclosed basins as Great Salt Lake and the Dead Sea.

MORE POSITIVE EVIDENCE.

But the most definite evidence of a recent considerable depression of this general area arrested our attention at Trebizond, on the south shore of the Black Sea. Here, at an elevation of six hundred and fifty feet above the sea, there is an extensive deposit of beach gravel clinging to the side of the volcanic mass of rocks at whose base the city is built. The appearance of the gravel is so fresh as to compel a belief in its recent origin, while it has certainly been deposited by a body of water standing at that elevation after the rock erosion of the region had been already entirely effected. The gravel deposit is about one hundred feet thick, and extends along the precipitous face of the mountain for a half mile or more. Some scattered gravel was found to a height of seven hundred and fifty feet. But the level summit of the mountain, at an elevation of eight hundred and fifty feet, was completely free from it.

It needs but a glance at a map of the region, in any physical geography, to show that such a depression as would

[1] See *ante*, p. 547.

bring the south shore of the Black Sea down to seven hundred and fifty feet below its present level would produce an uninterrupted sea from there to the Arctic Ocean; thus covering with water all the plains of Southern Russia. Now, it is in just this submerged area of Southern Russia that we find another most extensive and important deposit of loess such as we have described in Northern China and Southern Turkestan. This is known and generally referred to as the "black earth" of Southern Russia, and constitutes its most fertile area. As to the origin of this, the Russian geologists inform us that, in their opinion, as in ours, whatever may be true of the loess deposits in China, not wind, but water, must have been the agency by which that of Russia was mainly distributed.

Beach gravel, of recent origin, similar both in character and elevation to that at Trebizond, occurs along the southern coast of the Crimea; while extensive water deposits on the north side of the Caucasus Mountains indicate recent great changes in relative levels in that region. Mr. Stadling also reports finding near the mouth of the Lena River, six hundred and fifty feet above sea-level, gravel terraces containing fresh driftwood, and others, farther in the interior, with mastodon bones.

REMAINS OF ANTEDILUVIAN MAN.

This brings us to the point of supreme interest. At Kief, on the Dnieper, one of the largest tributaries of the Black Sea, Professor Armachevsky has found human implements and burnt stones, in connection with the bones of extinct animals, at a depth of fifty-three feet below the undisturbed surface of the loess which covers the region. The facts he has fully described in a pamphlet prepared for the World's Geological Congress which recently met in Russia. The professor was so good as to conduct us over the field, and explain the entire situation to us. If there

had been any doubts in our minds as to the significance of the facts before this explanation, there could be none after.

The old camping-place of paleolithic man, with its burnt stones, chipped flint implements, and accumulation of the broken bones of extinct animals, rested on the surface of a glacial deposit containing granitic pebbles from Scandinavia, several hundred miles distant, and was covered by fifty feet of undisturbed loess.

It is beyond legitimate question, therefore, that, since man was a resident in Southern Russia, there has occurred the great subsidence which occasioned the wide-spread and rapid accumulation of loess over that vast area which we have been describing; thus bringing the facts in Southern Russia and Central Asia into chronological harmony with those in Western Europe and North America, where the remains of glacial man have been known to exist.

Early man, therefore, certainly witnessed in the world changes of land-level which have caused floods on a scale with which the race has not been familiar for several thousand years. Observed facts abundantly show that man came into the world before the unstable equilibrium accompanying the Tertiary period and the whole course of the glacial period had given place to the comparative quiet which now prevails.

SUMMARY AND CONCLUSION.

From this survey of facts, it appears that the supposition of a wide-spread submergence of Europe and Asia which continued for but a brief period and occurred since man came into the world, so far from presenting any insuperable difficulties to the well-informed geologist, relieves him from a great number of difficulties, and gives a reasonable explanation to a large and accumulating class of facts which refuse any other explanation. In conclusion, it will be profitable briefly to state the theory anew,

and summarize the facts so readily resolved by it. The scientific supposition in conformity with the general statements of the Bible concerning the Noachian Deluge would be about as follows:—

In connection with the instability of the earth's crust accompanying, and probably caused by, the accumulations of ice during the glacial period and its subsequent melting, with the return of the water to the ocean bed, there was a wide-spread depression of Europe and of Northern, Central, and Western Asia, which, though gradual at first, culminated in a catastrophe of more rapid subsidence, followed by a still more rapid emergence of the continents, with numerous successive sudden uplifts over various portions of the submerged area. Such a continental subsidence, amounting to about fourteen hundred feet in Western Europe and about three thousand feet around the heaviest continental masses of Central Asia, would fill the Jordan Valley with oceanic water, would temporarily convert all European Russia, except the Ural Mountains, in company with the great Aral-Caspian Depression and all Western and Northwestern Siberia, into a sea, would make Lake Baikal an arm of the ocean, and would let oceanic water through the Sungarian Depression, southeast of Lake Balkash, into the Desert of Gobi, and there fill a basin in the center of Asia larger than the Mediterranean Sea. Corresponding results would naturally follow in the entire valley of the Euphrates and about the borders of Armenia. This depression of the land, followed by a spasmodic emergence, would readily account for the following puzzling facts:—

1. The Rubble-drift of Great Britain and Western Europe, with its widely dispersed boulders from local elevations which were not centers for the accumulation of glacial ice, and which could not have generated local streams of water sufficient to produce the results.

2. The filling of the numerous ossiferous fissures in Western Europe with an indiscriminate mixture of the separate bones of widely diverse species of animals, mingled with angular fragments of rock and with earth without stratification, and containing occasional stone implements made by the hand of man. These could not have been filled gradually, because there are no entire skeletons of animals, and none of the bones are gnawed. But they were evidently filled by the indiscriminate action of a wave of translation sweeping everything before it.

3. The distribution of loess not only over the elevated portions of the continent, but over the highest elevations in such islands as that of Guernsey in the English Channel, separated by many miles from the continent.

4. The enormous accumulations of the bones of hippopotami in the cave of San Ciro, near Palermo, on the Island of Sicily, where whole herds of this animal, which now lives only in Southern Africa, evidently sought refuge from rising water in an extensive cave at the base of the rugged cliffs of Monte Grifone.

5. The recent silting up of the Jordan Valley, resulting in a vast accumulation of fine sediment, in some places hundreds of feet in thickness, up to a level of seven hundred and fifty feet above the Dead Sea. The recentness of this accumulation is evident from the fact that only a limited amount of it has yet been washed down into the Dead Sea to fill it up. The supposition that this former enlargement of the area of water in the Jordan Valley was due to the glacial period is without evidence, as no signs of former glaciers appear, at any rate in the southern portion of the Lebanon region.

6. The accumulation of extensive beach gravel of recent date at an elevation of seven or eight hundred feet above the ocean at various places along the Black Sea.

7. The accumulation of extensive gravel deposits in

the northern part of the Lena Valley and adjacent country several hundred feet above the ocean, containing fresh vegetal deposits and the bones of the mammoth.

8. The existence of Arctic seal in Lake Baikal two thousand miles from the ocean, and 1,680 feet above it.

9. The many geological evidences of a recent great extension of water over the region now generally known as the Desert of Gobi.

10. The historical Chinese tradition of the existence of such a vast body of water in the same region, known as the Han Hai.

11. The recent great climatic changes which have taken place in Central Asia, indicated by the freshness of the water in the Caspian and Aral seas and Lake Balkash, and by the former vastly increased volume of the ancient Oxus and Jaxartes rivers and of numerous other streams coming down from the mountains of Central Asia. For, only the temporary inclusion of such an interior sea as would be formed in the Desert of Gobi, would furnish the required evaporating surface to secure the enlarged rainfall; and its gradual desiccation would bring about the return of the present arid conditions, thus furnishing a perfect solution of one of the most complicated problems of climatic changes that have ever been presented, accounting for all stages in the progress of events, even the limited enlargement of the glaciers which formerly existed in the surrounding mountains.

12. The constancy with which the pressure of population has tended to disperse the tribes and races which have occupied Central Asia. To some extent this may have been due to the natural tendency of man to increase in geometric ratio, but, doubtless, partly to the loss of fertility consequent upon the diminution of rainfall, of which there are innumerable signs.

13. The final distribution of loess in broad, level, ter-

race-like belts bordering both Northwestern China and Turkestan; for, however much wind may have had to do in slowly accumulating the material about the bases of the mountains, it is clear that some more general force than local streams or any other slowly acting causes has determined a large part of the final readjustment of the material.

14. The occurrence of human remains in connection with those of extinct animals of the glacial period at Kief, in Southern Russia, six hundred feet above the sea, and fifty feet below the continuous deposit of loess which covers the entire region.

15. The wide-spread traditions of a flood found among the peoples of nearly every portion of the globe.

16. The more definite and restrained account evidently free from absurd legendary accretions which occurs in the book of Genesis.

OBJECTIONS ANSWERED.

In conclusion, we may reply to numerous objections that may arise, by quoting a few paragraphs from Professor Prestwich's closing remarks:—

"A preliminary objection to a submergence of the character described in the foregoing pages, that will no doubt occur to many, must not be passed over in silence. I allude to the entire absence of marine remains in the different phases of the Rubble-drift over the area supposed to have been submerged. In reply it has to be observed that for marine remains to have been located on the submerged land, certain conditions would be indispensable. In the absence of those conditions, we could not expect to meet with such remains. It is not to be assumed, because the waters of the sea have for a time covered the land, that marine remains should be found there. If the submergence were slow, the advance of the waters would not have force sufficient to carry before them any of the objects on the

shore; or, if any living object were so floated, the turbidity and deoxydized state of the waters resulting from the uprooting of the surface soil with its vegetable matter would be fatal to animal life, and their remains, if any, would decay on the surface and be lost.

"But it may be asked, why after the submergence, and before the return upward movement, should not the fauna from adjacent undisturbed areas have migrated on to the submerged land surface? This would no doubt have taken place had the submergence been of long duration; but, short as the general evidence leads us to suppose it to have been, such a migration was not possible. The muddy state of the waters would also for a time be a hindrance to the existence of animal life.

"The *physical evidence* is to the effect that the advancing waters had little erosive power, since they failed to destroy the beaches over which they passed, or to wash away the dunes or blown sands which overlie the Raised Beaches on the north coast of Devon and Cornwall. At the same time, the advance of the waters was progressive, as, had they been long stayed, they would not only have destroyed these surface features, but would have left their mark on the land surface, either in the form of a beach, or by a line of water-erosion on the rocks at the level at which they remained for the time stationary. The inference is that the waters rose slowly and continuously, charged merely with the mass of sediment derived from the soil and rocks over which they passed. This sediment, which was deposited either at the high tide of the waters or at intervals as they subsided, forms the mantle of loess so conspicuous in Central Europe, and of the slighter deposit of red earth so widely spread on the lands bordering the Mediterranean.

"That there was but a short lull when the submergence reached this stage is to be inferred from the fact that the Rubble-drift rests immediately on the Raised Beach. Had

there been any long interval, there would have been some form of sedimentary deposit between the Beach and the Head or the blown sands; but there is none. With the commencement of the elevatory movement, effluent currents at once came into play, and, according to their varying velocity, carried down, sometimes the surface soil or the freshly deposited loess, and at others the coarse surface detritus. The conclusion from this is that the upheaval was by fits and starts, or rather by a continuous movement, sometimes very slow and at others more or less rapid, and ending with one of greater rapidity. Where hollows or cavities existed on the surface, the débris fell into them. Open fissures were filled to the brim by the passing débris, while the current, acting as a broom, brushed off any projecting débris on the top of the fissures, and at the same time swept bare the adjacent more exposed surfaces.

"We judge from these conditions that the submergence took place slowly and continuously. I do not mean by slow, that it took years, but so slow possibly as on the whole to be hardly apparent to the spectator of the scene, or, may be, it would give him the reverse impression, such as that experienced when one's own train at a railway station makes a noiseless start and another train is standing still alongside, that that train was moving and your own stationary, or *vice versa*. So, in this case, the land would seem, to one standing on it, as though it were immovable and stationary, and that it was the waters that were in movement and rising."[1]

[1] On Certain Phenomena belonging to the Close of the Glacial Period and on their Bearing upon the Tradition of the Flood (London: Macmillan & Co.), pp. 64–67.