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*SCIENCE AND THE FLOOD.*

THE tradition of a flood was formerly accepted by most geologists and still finds a few advocates. None indeed would assert, in the literal sense of the words, that "all the high mountains that were under the whole heaven were covered," or the destruction of everything "in whose nostrils was the breath of life," but they would maintain the submergence to have been extensive enough to be fatal to at least one race of men and to several conspicuous species of animals. That was the opinion of both the late Sir J. W. Dawson and Sir J. Prestwich, and it is still maintained by Sir H. H. Howorth. The last-named—particularly in the volume entitled *The Mammoth and the Flood*—displays so much research and learning and such forensic skill in handling his materials, that it would be, I think, impossible to make out a better case for the diluvialists. But I am prevented, for reasons which I will endeavour to explain, from joining their ranks. I admit that they may fairly use the wide prevalence of the historical tradition as an argument in their favour. The story of the flood in the Book of Genesis is a version—and the changes are most significant of a tradition—whether Semitic or Sumerian in origin we do not know—which was already current among the Chaldeans many centuries before the birth of the great Jewish law-giver. This tradition travelled far in Asia, for traces of it may perhaps be found even in China, and is not restricted to Semitic or Turanian races. The Rig Vêda contains a deluge-story which assumes more complicated forms in later writings; Greece has its Deucalion legend, and that of the submerged Atlantis may bear a like interpretation. There are traditions, seemingly independent, among the Lithuanians, Welsh and Norsemen; among the Lapps and other isolated tribes of the old world. Nor is the story re-

stricted to this hemisphere, for it is found among the Esquimaux and Indian tribes in both North and South America, on Pacific Islands and even in Australia. Its variations are many and the local colouring is often strong, which, however, may fairly be reckoned as evidence for the antiquity of the tradition. Though not quite universal—no trace of it, for instance, having been found among the Egyptians—it is very widespread, and the principle of no smoke without fire often holds good with a legend, viz., that though its details may be exaggerated, distorted or even false, it generally rests on some basis of fact. So I admit that the advocates of the flood-story are entitled to count its wide prevalence as a point in its favour. But another line of argument seems to me worth very little: citations of scientific writers no longer living are much more valuable as records than as interpretations of facts. Observations may be accurate, and yet inferences from them be erroneous, for the latter are so largely influenced by current ideas. Perhaps, also, the earlier school of geologists, for obvious reasons, were anxious to minimize the discrepancies between their science and the Mosaic record, and thus rather too ready to catch at any inferences from the former which seemed to corroborate statements in the latter. This led them to regard a number of superficial deposits as *Reliquiæ Diluvianæ*, and some geologists still use the term Diluvial, though to them it is no better than a meaningless survival. So I do not dispute that until about three quarters of a century ago many leaders in geology believed in a universal or nearly universal deluge, and ascribed to its action phenomena which now receive a different interpretation. In like way astronomers once supposed their observations to be favourable to a geocentric theory of the solar system; so that multiplying quotations from the older authors proves no more in the one case than it does in the other. No court of final appeal can exist in Science as it

does for Law, because cases must constantly be re-tried as fresh evidence is obtained, and when a later court reverses the decision of an earlier one this does not imply that the first conclusion was not justified by the evidence then available.

The advocates of a widespread very destructive flood are now generally agreed (and this fortunately limits our inquiry) that it was fatal to Palæolithic man and to several large quadrupeds which were his contemporaries. The mammoth, and perhaps four other species of elephant, two at least of rhinoceros, a pigmy hippopotamus, not to mention more, then vanished from the earth, and others, though they manage to survive, never reappeared in their old haunts. Though it is not asserted that only eight persons escaped, yet, so widespread was the destruction of the makers of rude instruments in stone or bone, that long years elapsed before the parts of the earth best known to science were re peopled, and when that happened the pioneer race in Europe had learnt how to polish their stone weapons, to make pottery and to domesticate animals. With the Neolithic people, as these are called, the ethnological history of Europe begins, as well as that frequent westward movement of races on the earth's surface, which is not yet ended.

To this cataclysm also the Diluvialists, as they have been called, refer a number of deposits supposed to have been formed by the rush of waters. We have therefore to ask three questions. Does that gap in life-history exist? Are these deposits synchronous with it and were they formed by deluges in the ordinary sense of the term?

As regards the break. Its existence, till quite lately, was rarely, if ever, disputed. But more recent discoveries have shown it to be comparative rather than absolute. Though it seems well marked in Britain, Professor A. C. Haddon<sup>1</sup> writes in regard to Palæolithic man, "There is no reason

<sup>1</sup> *The Study of Man*, p. 81 (1898).

to believe that he became extinct." Dr. Beddoe also believes that "the posterity of the makers of these rudely chipped flint implements still survive in these islands." In France the break is still less sharply marked, according to modern students of ethnology.<sup>1</sup> Some of them recognize four successive types of Palæolithic man, the earliest, or Acheulean, being the makers of the rude flint implements found in ancient river gravels, such as those of the Somme; the latest, or Magdalénien, being inhabitants of the well-known caves of the Dordogne, who not only left better shaped flint tools or weapons but also carvings in bone, ivory and horn, and "graffiti" on the walls of rock, such as might have been made by a race more rather than less skilful than the Esquimaux of Greenland three centuries ago. In their days though the mammoth still existed in Central France, with the wild horse, aurochs, and bison, the reindeer was especially abundant. Prof. Haddon, however, following Dr. Collignon, while admitting the survival of representatives of Palæolithic man, regards these Cave-men of Central France as the earlier Neolithic folk. That opinion is mainly founded on a few fragmental skeletons, but these Prof. Boyd Dawkins<sup>2</sup> regards as not the true Palæolithic Cave-men, but occupants or interments of the later age. Be this as it may, this instance shows that the existence of the break is not so generally admitted as it would have been a few years ago. But stronger evidence has been obtained near the southern part of the frontier of France and Italy. Caves rich in Neolithic relics are not uncommon on the coast of the Western Riviera, some of which, such as those of the Baoussé Roussé, contain skeletons resembling in character those of Cro Magnon and other places in France, or Paviland in Glamorganshire and Brünn in Moravia; in

<sup>1</sup> De Mortillet, *Formation de la Nation Française*, Troisième Partie, Chapitre V.

<sup>2</sup> *Early Man in Britain*, ch. vii.

other words, of the early Neolithic or Iberic type, survivals of which, as I have already said, can still be traced in several parts of Western Europe. These are associated with unsmoothed stone implements of late Palæolithic forms, wrought objects of mammoth ivory, but without pottery or bones of domesticated animals; rhinoceros bone and reindeer antler have also been found, with shells pierced for necklaces, and ochre which had been used for a pigment. In some cases they had evidently been buried very near to the surface, yet they are now overlain by from twenty to as much as forty feet of earth and débris. This depth excludes the idea of a second interment, which was advanced as an explanation of the famous Mentone skeleton, so that Mr. A. J. Evans,<sup>1</sup> after a review of the evidence advanced by M. d'Acy and Prof. Issi, is persuaded that we find in this littoral distinct evidence of the existence of a late Palæolithic race, tall and dolichocephalic, whose essential features reappear in the Neolithic skeletons of the same Ligurian coast, though the more characteristic race of that age was short in stature. Thus the existence of the alleged break is very doubtful, yet the neighbourhood of the Mediterranean is just the place where we should expect it to be most complete, if primæval man and the contemporaneous fauna had perished in a deluge. Prof. Dawkins, however, calls attention to the fact the "molar" of a sheep was found at Reilac in the same layer as bones of Pleistocene mammals (hyæna, reindeer, etc.), and in a Mentone cave those of a goat occurred at a depth of about twenty-five feet, so that he interprets some of these apparent transitions between the two ages as due to an admixture caused by later interments among earlier remains, and others as indications of a race which, though Neolithic, represented the first and more uncivilized representatives of that people. But even this view does much to

<sup>1</sup> *British Assoc. Report*, 1896 (Liverpool), Address to the section of Anthropology.

narrow the gap, while the other one, which finds favour with some very competent judges, actually closes it.

We pass on to inquire what deposits are synchronous with the gap in the life-history. Limiting ourselves for the present to Europe, we must reply, All which either contain relics of Palæolithic man or can be shown to be of the same age as these. On this point probably advocates will not be harmonious, but most of them would enumerate among them the ossiferous caves and fissures and the coarse gravels of ancient rivers, with remains of man and an extinct fauna, the loess of north-central Europe, the raised beaches and "head" or "coombe-rock" familiar to English geologists, while some would include even the boulder-clays with their associated sands and gravels as relics of the cataclysm which was the actual foundation of the deluge tradition.

Of these identifications the last-named, though once very generally entertained, now finds but few supporters. The learned author of *The Glacial Nightmare* has said all that is possible in its favour, but his argument appears to me inconclusive. It is perfectly true that a current flowing with a certain velocity can move a granite block of a certain size, and that a paroxysmal elevation to the height of 100 feet from beneath a sea, where it does not exceed 800 feet in depth, might produce a current with a velocity of nearly twenty miles an hour, but we seek in vain for information about the distance to which that velocity will be propagated, what particular area of the earth's surface was thus uplifted, and whether there is the slightest evidence that this area was submerged at the requisite epoch. This flood, or floods (for more than one, if they were produced in this way, would be requisite to overwhelm places so far distant as Europe and Patagonia, or to produce in the former the alternation of boulder-clay and sandy gravel familiar to most geologists) must have been strong enough to transfer heavy materials, and must have

maintained its velocity for scores of miles over a comparatively open country. Therefore, what has sometimes occurred in narrow mountain valleys, is very misleading as a measure of what would happen over such districts as the Eastern counties of England or the lowlands of Northern Germany. However much the extension and the excavating power of ice may have been exaggerated by some glacialists, that does not prove the alternative hypothesis true, and the difficulties of the latter become apparent as soon as we put it to the proof in any particular district. We may take for this purpose the erratics in the northern half of Britain. As the late Mr. Mackintosh clearly showed,<sup>1</sup> one group starting from South-west Scotland is scattered over an area lying between lines drawn roughly south and south-south-east, and coming to an end in the neighbourhood of Lichfield; boulders from the Lake District extend to about as far west on the North Wales coast, but eastwards to the nearer borders of the Pennine range. The peculiar granite from Wasdale crag has travelled northward to a little beyond Penrith, southwards nearly to Lancaster, but eastward as far as the Yorkshire coast, where boulders of it may be found at intervals from Redcar to Holderness, and to reach this they must have crossed hills nowhere lower than 1,400 feet above sea-level, though their highest starting point does not overtop this by quite a hundred yards. Again, erratics from the Arenig district are scattered over a fan-shaped area extending from the valley of the Trent, near Rugeley, to the neighbourhood of Birmingham, and thence to beyond Bromsgrove, in the Severn valley. The Charnwood Hills, and even the basalt plateau of Rowley Regis, are centres of more limited dispersions. Scotch, Lake District, and Welsh boulders mingle together over no small area. But if a cataclysmal rush of water, due to the sudden uprising of each region from

<sup>1</sup> Summarized in my volume entitled *Ice Work*, pp. 151-159.

beneath a shallow sea, hurried away its boulders, the conflict of rushes would have speedily neutralized the transporting force, and the journey of the rocks have come to an untimely end. But how great must that force have been to have carried blocks from North Wales (one of the largest measures about  $4 \times 4 \times 2$  feet) right across the Severn valley, and flung them on to the Clent Hills, some 600 feet above its bed, on a place on which basalt blocks from Rowley Regis Hill may also be seen lying. In many spots on Cannock Chase and the slopes of the Trent valley blocks from the three principal centres of dispersion may be found from three to four hundred feet above the lower ground, across which they have been transported.

We may take one more instance, and from another hemisphere. Here the destruction of the mastodon, megatherium, mylodon and other extinct quadrupeds of South America, is imputed to the sudden rise of the Andes from beneath the sea, which sent a rush of water over the lower land, drowned the ill-fated animals, and swept their bodies, which, however, not infrequently had time enough to become disintegrated, into fissures, caves and the Pampean mud.<sup>1</sup> It now seems doubtful whether the mylodon did not manage to survive its other companions; but letting that pass, we naturally expect to find some proof of this sudden upheap of the Andes, and are disappointed at obtaining nothing stronger than the statement that M. d'Orbigny, who travelled there nearly three quarters of a century ago, held this opinion. That man was a contemporary with certain of these extinct animals, as asserted in the same volume,<sup>2</sup> may be readily admitted, but some at least of the instances mentioned indicate that his representatives belonged to a race "of the same type as the men who were living there when

<sup>1</sup> *The Mammoth and the Flood*, pp. 342-354.

<sup>2</sup> *Id.* pp. 354-359.

discovered by Europeans.”<sup>1</sup> If so, the more natural supposition seems to be that they escaped the cataclysm—perhaps in many canoes, instead of in one ark.

But let us turn from these extensive demands on diluvial waters as transporters and transformers,<sup>2</sup> and turn to the more moderate suggestion of the late Sir Joseph Prestwich. He ascribes the origin of the flood-tradition to a submergence and emergence, sometimes rapid, by which two peculiar varieties of drift were formed, rocks were riven into fissures, and these filled with one of those drifts, together with the bones of various animals and human remains.

Of these drifts, one called by Prestwich the rubble drift or “head” is local in character, a mixture of more or less angular rock-fragments, with a variable quantity of mud. It occurs on many parts of the British coast, and he considers it contemporaneous with the noted breccias of the Rock of Gibraltar. It bears a certain resemblance to the mud avalanches of the Alps and Himalayas, and in some cases may be due, like them, to rushes of water caused by the bursting of dams which have temporarily arrested the course of streams, or by an exceptionally heavy local rainfall; but, while it points to conditions of climate different from the present (for it is not improbable that the surface of the underlying ground was then frozen to some depth) I am unable to find in it any proof of a general cataclysmal action. The other, the loess, which for many years perplexed geologists, covers a wide area of central Europe. Beginning on the French coast at Sangatte, it sweeps eastward across the north of France and Belgium; filling up the lower depressions of the Ardennes; passing far up the valleys of the Rhine and its tributaries, the Neckar, Main and Lahn; likewise those of the Elbe (above Meissen), the

<sup>1</sup> *Id.* p. 356.

<sup>2</sup> The mantle of glacial drift is sometimes from one to two hundred feet thick, occasionally even more.

Weser, Mulde and Saale, the Upper Oder and the Vistula. Spreading across Upper Silesia, it sweeps eastward over the plains of Poland and Southern Russia, where it forms the substratum of the Tchernosem or black-earth. It extends into Bohemia, Moravia, Hungary, Galicia, Transylvania and Roumania, sweeping far up into the Carpathians, where it reaches heights of 2,000 feet and, it is said, even 4,000 or 5,000 feet above the sea.<sup>1</sup>

This sandy clay is not very fossiliferous, but occasionally it contains shells of molluscs, almost all terrestrial, and remains of the mammoth, woolly rhinoceros and musk-sheep, with wild horses, a jerboa, several species of marmot, the saiga antelope, etc. In fact, allowing for some extinct species, the fauna closely resembles that now living in South-eastern Europe and on the South-west Siberian steppes. Man also existed, as is proved by Palæolithic implements. This deposit, if it had been produced by submergence, would require that, as we have already said, to be very great, and Prestwich's ingenious arguments in favour of it, after what I have seen or learnt of the loess, are so unconvincing, that I think Baron von Richthofen is correct in explaining it as a subaerial formation—dust blown about and accumulated by the winds, like those so common in Central Asia and parts of China. Some geologists appeal to the fissures in which bones are found as proofs that the rock has been ruptured. I must say that, while I should admit the possibility of fractures being produced by earth movements, all those that I have seen (and they are many) appeared to have been formed by streams under different conditions of climate, or in a very few cases by the gaping of joints due to a local subsidence<sup>2</sup> and the materials in these and in caves appear to have been

<sup>1</sup> Sir A. Geikie, *Text-Book of Geology*, Book vi., Part v., Sect. ii. § 1.

<sup>2</sup> The deepening of valleys must sometimes affect the equilibrium of adjacent rock-masses.

introduced by the same agency when the waters were swollen either by melting snow or by exceptional rainfall. It seems to me impossible to suppose that either the contents of the Dordogne caves, which apparently accumulated while they were occupied by man, or those in Kent's Hole, Torquay, could have been introduced by floods. The conditions of climate at that epoch were undoubtedly very different from the present, but there is little or nothing for which we cannot still find a parallel in some parts of the world. Occasionally facts occur which are difficult to explain, such as the abundance of hippopotamus bones in the caves near the northern coast of Sicily between Termini and Trapani ; but Sir J. Prestwich's hypothesis<sup>1</sup> that these animals were driven into a rocky *cul de sac* by the rising waters, and then were drowned, does not seem to me entirely in harmony with Dr. Falconer's description,<sup>2</sup> and the hippopotamus, it must be remembered, is a fairly good swimmer. The fissures, however, in the Montagne de Santenay, near Châlons-sur-Saône<sup>3</sup> are generally quoted as it is in favour of the diluvial hypothesis, so that it may be well to make a few additions from the original papers to those hitherto given. The Montagne de Santenay is a plateau of Lower Oolite limestone, which forms an advanced bastion of the Côte d'Or, rising to a height of 1,640 feet above sea level, and overlooking the valley plain (900 feet below in round numbers), and sloping down rapidly on three sides. Bones have been found at three localities on the upper part, at Pointe de Bois, the Grotte de St. Jean and the Grotte de St. Aubin. The first was discovered in working a yellow sand for glass. It was, if I understand the description rightly, a sort of tunnel which opened out into an irregular-

<sup>1</sup> *The Tradition of the Flood*, p. 50.

<sup>2</sup> *Quart. Jour. Geol. Soc.*, vol. xvi. (1860), p. 99.

<sup>3</sup> Prestwich, *Op cit.*, pp. 37-39. Howorth, *The Mammoth and the Flood*, p. 216. Gaudry, *Bull. Soc. Geol. France*, Ser. 3, vol. iv. p. 681 (1876), with other communications from Didelot and C. Lory.

shaped chamber; the one being wholly, the other, which also communicated with a fissure, only partially filled with an ossiferous breccia, and this breccia seems to have occupied a subterranean chamber, for it is expressly stated not to have been accessible by man or even by animals. The bones were much broken, but not by the hand of man or the tooth of beast. The Grotte de St. Jean is a horizontal gallery, which had apparently been used as a bear's den, for the remains of this animal are abundant, and on the northern or opposite slope of the mountain is the Grotte de St. Aubin. From Pointe de Bois have been obtained remains of the cave-lion, lynx, wolf (abundant), fox, badger, horse, *Rhinoceros Merckii*, wild boar, *Equus caballus* (usually old animals), more than one species of *Bos* (? *primigenius*), and a variety of *Cervus elaphus*. The Grotte de St. Jean contains lion, wolf, fox, stag, as above, one of the *Bovidae* about the size of *Bos taurus* and a bear between *Ursus spelæus* and *U. ferox*. From the Grotte de St. Aubin come large bears, oxen, horse, elephant, rhinoceros, and an antler of *Cervus megaceros* was found in sand outside.

Thus the occupants of the several recesses are not all the same, though perhaps this difference cannot be pressed; but we must not forget that the entrance in one case at least after the deposit of the ossiferous material appears to have been sealed up by sand which we suppose must also be due to diluvial action, and must thus imply a change in the material. In regard to the transport of the bones Sir. J. Prestwich quotes the question asked by Professor Gaudry, "Why should so many wolves, bears, horses and oxen have ascended a hill isolated on all sides?" but does not give his reply (p. 684). "Il faut supposer beaucoup de pluie, ou plus probablement beaucoup de neige pour expliquer l'affluence des eaux sur un monticule isolé," and suggests the possibility of floods being caused by obstruction of the

waters of the Soâne at the epoch when the alpine glaciers extended down to Lyons. Mons. C. Lory also accepts this view, and thinks the inundations caused by this barrage would be intermittent and progressive, driving the wild animals from the lowlands to hills like Santenay, where they would find refuge from the water but insufficient food. These floods would be most likely to occur in spring and autumn, the seasons of the setting in and the melting of the snow, when pasturage is scanty, and the animals most likely to perish. Rivulets of water, swollen by the heavy rains and melting snow, would wash the plateau and carry carcasses into fissures, which might even serve as traps when covered by snow. Of the geologists who studied the locality on this occasion no one appeared to think the phenomenon called for any special explanation. One point, however, is mentioned by Prof. Gaudry which apparently the English authors have overlooked, though it strikes me as important. He says the fauna of Santenay is rather different from that of deposits not far distant, such as Solutré and the Grotte de Germolles, it is also "assez différente de celles qu'on a dressés pour la plupart des gisements quaternaires," for it includes neither man nor reindeer. The bear is peculiar, wolves take the place of hyænas, and *Rhinoceros Merckii* of *R. tichorhinus* (or *antiquitatis*). The large stag, resembling *Cervus elaphus*, differs from the small race of Solutré. These differences lead Prof. Gaudry to suggest that the remains may belong to "le grand epoch glaciaire du 'boulder clay.'" Deposits like those of Solutré, which French archæologists assign to the third of the four epochs into which they subdivide the age of Palæolithic man, contain "elaborately chipped lance-heads, leaf-shaped implements and scrapers," similar to those found in the upper strata of the Creswell Crags caves,<sup>1</sup> and the fourth or Magdalénien, are well represented in the Dordogne caves,

<sup>1</sup> Boyd Dawkins, *Early Man in Britain*, ch. vii. p. 201.

in which the reindeer is very abundant. It may be that this classification of the remains of Palæolithic man is rather too precise, but we are justified, I think, in inferring that "Cave-man" in general shows an advance in art in River-drift-man, and that in the age of the former the reindeer was very abundant, the mammoth and its associates having become rare; thus if the osseous breccia of Santenay were produced by a flood, that cannot have been contemporaneous with the one which closed the career of Palæolithic man.

Several other difficulties in the deluge hypothesis are brought to light on examination of these ossiferous caves and fissures. The débris is often transported into galleries and underground fissures in a manner suggestive of the repeated action of engulfed streams rather than of a single and tumultuous rush of waters, the waves of which, at Santenay, must have been not less than about 700 feet deep, and have risen more than 1,600 feet above sea-level. It would have been difficult for such a wave to transport so much material into the subterranean fissures of Brixham and the galleries of Kent's Hole. Apart from any resistance offered by compressed air, when water had once filled these no more could enter, so the contents must have been transported by the first rush. But if that were so highly charged with mud and bones, the surface of the earth must have been in a very untidy condition, as at the end not at the beginning of a deluge. It is also singular that the deposits<sup>1</sup> show some signs of stratification, suggestive of a time succession. Even an open swallow hole, like that of Windy Knoll, near Castleton, Derbyshire, presents difficulties. In this Prof. Boyd Dawkins<sup>2</sup> tells us the pipe at the bottom was plugged up with limestone and other débris, and covered by an unfossiliferous yellow loam, about four feet thick; to that

<sup>1</sup> For instance, Kent's Hole, Cresswell Crags and Robin Hood's Cave.

<sup>2</sup> *Early Man in Britain*, ch. vii. p. 188.

succeeded a yellow clay with rock débris and bones<sup>1</sup> the whole being covered with clayey material, probably rather modern. This spot is 1,600 feet above sea level and would not be easily filled by diluvial waves, and Prof. Dawkins' explanation that it was formerly a pool, lying in the path of migratory herds of deer and bison, which was frequented as a drinking place, and sometimes proved fatal, seems far more simple.

We are told that the position of these ossiferous fissures (as at Santenay), makes it impossible to appeal to the action of flooded streams. But fissures and swallow holes are abundant in every limestone district, and in themselves a proof of rain action; though when we examine them they, like not a few caves, which must have been the work of streams, are commonly quite dry. But in a heavy rain-storm copious rivulets can flow from a small area, and it is generally admitted that during the age of Palæolithic man, rain and rivers, partly owing to melting snow, were more potent than at present as agents of denudation in North-western Europe. The occasional occurrence of the choked-up fissures or chambers on an elevated knoll or plateau is a difficulty with either hypothesis, for if the diluvialist demur when an unbeliever appeals to isolation and other changes wrought by subsequent denudation, the latter may fairly retort that a deluge would sweep most of its heavier débris into the bottoms of valleys, and could hardly bring more than a few inches of mud to the tops of hills.<sup>2</sup>

Animals, we must remember, perish in large numbers by other means than a flood. Quagmires prove death-traps, as at Big-bone Lick in Kentucky. Probably the imperfectly frozen surface of the Siberian tundra was often a snare to

<sup>1</sup> The animal remains include the bison, reindeer, bear (*U. ferox* and *arctos*), wolf, fox and hare.

<sup>2</sup> If the mud were already there, rain could do the work as well as a flood.

the mammoth and the rhinoceros. Large numbers of wandering herbivora tumble into open fissures and shafts.<sup>1</sup> Drought as in South Africa, frost as in Patagonia, prove fatal to hundreds of animals which gather around the watering-places to perish when the supply fails.<sup>2</sup> No doubt floods occurred in the days of Palæolithic man, as they still do; and perhaps for the reason already mentioned, they may have been more frequent and slightly more extensive; but to bring a deluge over the Santenay hill, or Windy Knoll, would require convulsions so portentous that we may reasonably demand very strong evidence before venturing to appeal to them as a *Deus ex Machinâ*.

There is yet another difficulty—the selective destruction of this post-palæolithic flood. Certain creatures were exterminated, we are told, together with Palæolithic man. How then are we to explain the survival of others which were indubitably his companions? How did the lion, the brown bear, the lynx, the glutton, the wolf, the bison, the urus, the reindeer, not to mention others, escape? for all these are, or were, living in Europe, and all, except the first-named, in Britain with Neolithic man. The mammoth, the rhinoceros, and the hippopotamus are clumsy, but their living representatives can travel a fair pace, and the last is amphibious. *Hyæna crocuta* must have been involved with these and man in a common ruin; but had it, with hippopotamus, already established colonies in Africa beyond the reach of this Deucalionic deluge?

I have barely touched upon the difficulties presented by the flood hypothesis so soon as we begin to study the beds which it supposed to have formed. If we include those generally called glacial, we encounter a host of perplexities,

See for a very striking account of these in Kentucky, and the way they lure animals to death, Shaler, *Some Aspects of the Earth*, p. 103.

<sup>2</sup> See for striking instances, Prichard, *Through the Heart of Patagonia*, pp. 89, 203, 254.

one or two of which have been mentioned in passing ; if we restrict ourselves to the gravels and other deposits containing the remains of man and the mammoth, these are generally connected with existing river systems ; they occur at various levels, from some thirty to over one hundred feet above the present water line, just as they would do if left by strong streams which were gradually lowering their beds, but at the same time dropping *débris* where the water moved more slowly, and the remains found in their drifts correspond with those which occur in the lower deposits of certain caves, where the higher contain better finished implements. These and other relics indicate a progress in civilization of the race or races to whom they belonged, a change in the fauna, perhaps corresponding to some alteration of climate, and a gradual disappearance of extinct, with an incoming of living forms, so that the idea of a universal deluge, or even of closely connected but local deluges on a large scale, cannot, I think, claim any real support from geology.

T. G. BONNEY.