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ORIGINAL ARTICLES.

I.—ON THE THEORY OF SEASONAL MIGRATIONS DURING THE
PLEISTOCENE PERIOD.

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(PLATE IV. FIG. 1.)

IN a paper recently read before the Geological Society,¹ Mr. Dawkins has re-stated his views concerning the climate of the Pleistocene period, and has replied to certain objections to his theory brought forward by myself in former numbers of this *MAGAZINE*.² After carefully reading the paper referred to, I find no reason to alter or modify what I have written upon this question. Mr. Dawkins has unfortunately missed the point of my objections; and my argument, as it seems to me, remains unanswered. But as that gentleman has introduced some new matter into his own argument, I shall endeavour as briefly as may be to review his position.

In his former papers Mr. Dawkins contented himself with stating his opinion that the appearances presented by our river-gravels and cave-deposits were only explicable on the assumption that something like a Siberian climate had characterized Europe during Pleistocene times. He did not, however, tell us how such a climate was induced or could be induced under the physical conditions which are inferred to have obtained during the last continental state of the British area. He now informs us that the climate he postulates was brought about by "the extension of a large mass of land from the equator to the polar circle. Such a mass of land extended from the range of Atlas northwards to the snowy regions of Scandinavia during the Pleistocene age, the Mediterranean being reduced to two land-locked seas, and the mainland of Africa being continued on the one hand into Spain, and on the other, by Malta and Sicily, into Italy, and Greece extending so far south as to embrace Candia. Such an extent of land," he continues, "is surely an exact parallel to the two cases which I have quoted above (*viz.* North America and Northern Asia); and climatal extremes must necessarily have been the result of the substitution of land for such a large area that is now covered by the sea." This is a wonderful conclusion, and one which I feel

¹ See *Quart. Journ. Geol. Soc.*, 1872, vol. xxviii., p. 410.

² *Geol. Mag.*, Vol. IX. pp. 164, 215.

MAP OF EUROPE WITH ISOTHERMAL LINES OF JULY.
(Reduced from D^r A. Petermann's Memoir on the Gulf-stream:
Geographische Mittheilungen 1870.)

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Fig. 1. — To illustrate M^r Geikie's paper.
Fig^s 2 & 3. To illustrate Prof. H. Alleyne Nicholson's paper.

quite sure no physicist will adopt. But I shall come to that presently. Meanwhile, geologists may well ask what are the grounds upon which they are invited to believe that during the period of local glaciers, when Britain formed part of the continent, the whole area of the Mediterranean stood some 3000 feet higher than at present? The only fact adduced in support of this hypothesis is simply this:—remains of *Hippopotamus Penlandi* occur at Megalopolis in the Morea, and in Crete.

But before this fact can become of any service whatever to the "migration" theory, it will be necessary to prove that the remains in question really belong to late Pleistocene times (*i.e.* our local glacier period). For aught any one can say, however, the Candian hippopotamus may date back to the early Pleistocene or even to the Pliocene. We know far too little as yet about the synchronism of later Tertiary deposits in different parts of Europe to justify us in at once fixing the precise age of the little hippopotamus. *Hippopotamus major* is believed to have lived in Europe during Pliocene times, and there is certainly no *a priori* reason why the smaller species should not have occupied the same area at approximately the same time. It may belong exclusively to late Pleistocene times, but at present the evidence does not entitle us to hazard this assumption.

Again, those who believe in the wonderful powers of locomotion ascribed to the Pleistocene pachyderms, may be excused if they should ask whether so great an elevation of the Mediterranean area as 500 fathoms, is really required by the circumstances of the case. Might not an active animal have swum across from Greece to Candia, by way of Cerigo, Cerigotto, and the little islets in their neighbourhood? The distance between Cerigotto and Candia is, to be sure, twenty miles; but that could hardly have been considered a barrier by the enterprising hippopotamus of Pleistocene times. If the voyage, however, should be thought rather too long, even for a Pleistocene wanderer, we might suppose it shortened by a much less elevation than 500¹ fathoms—say 250 fathoms. With this amount of upheaval several islets would appear between Candia and Greece, to serve as baiting places, and the hippopotamus might then have performed its journey in easy stages, *per mare et terras*.

But we do not need to tax the swimming powers of the little hippopotamus in order to show that an elevation of the sea-bed to the extent of 500 fathoms is quite unnecessary to account for the presence of that pachyderm in Candia. An examination of the Admiralty Charts shows no greater depth than 210 fathoms between Candia, Kaxo, Karpathos, Rhodes, and the mainland of Asia Minor. The depth is even ten fathoms less than this, by way of Rhodes, Astropalia, Kos, and Kalimno. Thus by an elevation of only 200 fathoms Candia might, for aught we know,² become connected

¹ The greatest depth between Greece and Candia indicated upon the Admiralty Chart of the Mediterranean is only 300 fathoms. But the actual depth may be more, as the bottom was not reached by the sounding-line.

² It must be understood that the Admiralty soundings are not continuous between these islands any more than they are between Cape Malea (Morea) and Cape Spada (Candia).

with the mainland, and there is no reason why the hippopotamus may not have reached Candia by this route.

Finally, it is quite certain that even could we demonstrate that Candia was joined to the mainland in late Pleistocene times, still our demonstration would not prove that all the Mediterranean area stood at the same high level. Unequal movements have taken place contemporaneously within the Mediterranean basin, and it might quite well be, that the western regions of the Mediterranean stood at their present level or were even depressed below it at the very time that Candia formed part of the mainland. It seems to me, therefore, that the Candian hippopotamus is asked to prove too much, and that less questionable evidence must be adduced before we can be expected to believe that during our local glacier period the Mediterranean existed as two land-locked seas.

For the sake of argument, however, I shall admit that all the geographical changes desiderated did actually obtain. And yet, admitting this, I still hold that the climate required by the "migration" theory could not possibly result. We must remember that, in speculating upon the climate of so recent a period as the Pleistocene, we tread upon infinitely surer ground than when we are attempting to discover the conditions under which Silurian, Liassic, or even Miocene and Pliocene deposits were accumulated. At the beginning of Pleistocene times the physical features of our continent were much the same as they are now,—all the great high grounds, all the great drainage-systems, were even then in existence. Denudation, no doubt, helped during the Pleistocene age to modify these features; but, when viewed on the large scale, such modifications of the land's surface may be disregarded. Then, if this be so,—if the changes referred to were, comparatively speaking, so inconsiderable,—we may be very sure that since the disappearance of local glaciers in Britain there has been even less change in the physical features of Europe. This is one important fact to remember.

Again, we know that under the present condition of things, our continent owes the equableness of its climate in great measure to the influence of the Atlantic. This is another important fact that we cannot lose sight of, but which seems strangely enough to have escaped Mr. Dawkins' attention. Were an extensive land-surface to be substituted for that great ocean, there is no reason to doubt that our summers and winters would be as excessive as those in similar latitudes of Asia and North America.

A glance at the map of the world will show that in almost every particular the continent of Europe differs from those of Asia and North America. And as one result of this, the climates are essentially different also. Now the question to be considered is simply this: supposing that the British area were to become continental, and our shores to extend some little distance further into the Atlantic, the Mediterranean at the same time being reduced to two land-locked seas,—and supposing further that all the present glacier areas in Europe were to be considerably increased in size, perennial snow and ice filling the upland valleys of Great Britain and Ireland,

and those of other mountain districts in our continent which are now destitute of glaciers,—would all this result in producing a climate like that experienced in Northern Asia and the temperate latitudes of North America?

The immediate effect produced by the conversion of a large part of the Mediterranean into dry land would be something like the following. The hot dry winds coming from Africa would part with less warmth and suck up less moisture than they do now, and, as a consequence of this, summer in the countries bordering upon the Mediterranean would be hotter and drier. Mr. Dawkins seems to have a decided objection to winds. "All speculations as to the prevalent wind at that remote time in different parts of Europe appear to me," he says, "mere guesses, and nothing else." Perhaps he will tell us how otherwise than by winds the extra warmth derived from his hypothetical land was to be carried north. Either winds brought the warmth north, or they stole away with it in some other direction; but if central Europe was to have its climate influenced by the new-born land, then a southerly wind was the only medium by which such a result could have been effected.

Now we know that in the present economy of things the climatal influence of the Mediterranean in summer-time extends but a very short distance north into Europe. It certainly does not cross either the Alps or the Pyrenees. A line drawn from Bayonne by Viviers and Turin to the head of the Adriatic corresponds to the July isothermal line of $72^{\circ}5$ F. When the same line is continued towards the north-east into Hungary, it suddenly sweeps down to Constantinople; and, circling round the Black Sea, returns upon itself at Odessa, after which it continues for some distance in the normal north-easterly direction. That sudden curve to the south-east is, of course, due to the presence of the Black Sea, and seeing that the Mediterranean does not influence the same isothermal line either in France, Italy, or Austria, it is quite clear that the modifying effect of this large inland sea has nothing whatever to do with the climate of central Europe. South of the line referred to, however, we find the July isotherms violently disturbed. That of 77° F. runs along the shores of the Mediterranean from Barcelona by Perpignan and Montpellier to Toulon. From this place it strikes directly S.S.E. to Cape Spartivento, then curves gently on to Palermo, after which it sweeps round by Messina and the Gulf of Taranto, across Italy, and more than half-way up the Adriatic. It then doubles suddenly back upon itself, skirts the eastern shores of the Adriatic, and crosses the south of Turkey and the Ægean Sea to Mytelene and Asia Minor. This irregularity is just as surely caused by the presence of the Mediterranean as the abrupt curving of the July isothermal line of $72^{\circ}5$ is due to that of the Black Sea. In short, it is perfectly apparent that the isothermal lines in the south of Europe are deflected by the inland seas from their normal direction,—this deflection being confined to the immediate proximity of these basins. But in central and northern Europe all the isothermal lines are pushed south by the overwhelming influence of the Atlantic (see Chart Plate IV. Fig. 1);

while, in the opposite season, all the isothermal lines are swept boldly north and north-east.

Were the Mediterranean to be converted into two land-locked seas, the isothermal lines in that area would then be less disturbed, and would preserve the general south-west and north-east trend which they follow in central Europe. The summers in Italy, Turkey, and Greece would thus be somewhat hotter and drier, but the general summer temperature of Europe would remain unaffected. The winds flowing from the south would no doubt be warmer, but they would also carry less moisture. When they reached the Alps, they would part with their warmth and moisture, just as they do now; but since they would bring more of the one and less of the other than at present, the snow-fields and glaciers on the south side of the Alps would tend to shrink back. Again, the isothermal chart shows that the supposed increase of land would not produce any appreciable climatal effect beyond a short distance into Spain and France, while not a trace of its influence would reach England. The Continent, laved along its entire western borders by a wide ocean, would be cooled over an immense area by the winds blowing from west and south-west; such is the case now,¹ and it must have been equally so in late Pleistocene times. Nor can we forget that the presence of great snow-fields and glaciers in every mountain district would tend still more to keep down the summer temperature. Thus, even had the warmth derived from the Mediterranean area been ten times greater than we can conceive it to have been, its effect would, nevertheless, be counterbalanced, and far more than counterbalanced, by the influence of the Atlantic and the presence of the glaciers and snow-fields. Mr. Dawkins, however, thinks, that "the inference that the summer temperature would be lower than at present in Britain, because there were glacier-areas in the north and in the higher districts in Central Europe, is inconclusive, since the mere existence of a glacier tells us nothing of the summer heat of the surrounding regions. Could we predicate, for instance, the temperature of the Subhimalayas from the contemplation of the glaciers of the central ridge? or the summer heat of Lombardy or of Provence from the glaciers of the Alps?" I confess I do not see the force of these remarks. Britain is not in the latitude of northern India, neither is it in that of Lombardy; while, in comparison with the Alps and the Himalayas, our mountains are mere monticules. We are not discussing the climate of some hypothetical land in the planet Mars, but are treating of that of a well-defined region, the geographical and physical conditions of which during late Pleistocene times have been definitely enough determined. The causes that render the summers of Europe much less excessive than those of Asia and North America were assuredly in existence during the period referred to. We are perfectly justified, therefore, in holding that with snow-fields and glaciers in our area it is absolutely impossible that our summers could have been so warm as they are

¹ See Professor Coffin's elaborate memoir on the "Winds of the Northern Hemisphere," *Smithsonian Contributions*, 1853.

now. It would be a different matter indeed could we suppose the Atlantic to have been obliterated at the same time as the Mediterranean! But under such geographical and physical conditions as did actually obtain in north-western Europe during our local-glacier period, it is quite clear that the summers in Britain must have been miserably ungenial, and the vegetation poor and scanty. The Arctic sun, instead of shining as in Asia upon flat snowless plains, would strike its rays in the extreme north of Europe over extensive snow-fields, where all the heat would be taken up in melting the snow, and consequently any wind that reached our latitudes from the north would be cold and ungenial.

In winter-time, supposing the Gulf-stream to have flowed then as it flows now, the cold would be ameliorated over all western Europe. But should the presence of the Gulf-stream be objected to, then, in the absence of this great heat-bringer, our winters would indeed be excessive, and our summers dreary in the extreme. In short, we may conclude that so long as Europe exposes a vast line of coast to the Atlantic, and so long as her physical features endure, just so long will her climate continue to differ from that of either Asia or North America, no matter whether or not the British Islands become continental or the area of land in the Mediterranean basin be increased. And as it is in the present, so also it must have been in the past. No mere obliteration of our inland seas could neutralize the influence of the outlying ocean. If the summers of Europe are at present rendered less excessive by the presence of the Atlantic, the same must have been the case during the last continental condition of our islands, and that to a much greater degree, owing to the presence of more numerous and larger snow-fields. For this, if for no other reason, it seems to me that the theory of seasonal migrations during the Pleistocene period must be abandoned.

In illustration of Mr. Geikie's paper, see Pl. IV. Fig. 1, Map of Europe, with Isothermal lines of July, Reduced from Dr. A. Petermann's Memoir on the Gulf Stream, *Geographische Mittheilungen*, 1870.

II.—DESCRIPTIONS OF TWO NEW SPECIES OF FOSSIL TUBICOLAR ANNELIDES.

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(PLATE IV. FIGS. 2 AND 3.)

IN a recent paper (*American Journal of Science and Arts*, vol. iii., March, 1872), I founded a new genus, under the name of *Conchicolites*, for the reception of some singular Tubicolar Annelides found growing upon the shells of *Orthocerata* in the Lower Silurian of the North of England. The following were the characters which I ascribed to the genus, and to the single species upon which it was founded:

CONCHICOLITES, Nich.—Animal social, inhabiting a calcareous (?) tube, attached in clustered masses to some solid body. The tube conical, slightly curved, attached by its smaller extremity. The wall of the tube thin, its external surface devoid of longitudinal striæ. The tube thin, composed of short imbricated rings, but appa-