

The origin of these gravels has always been a difficult question, but a suggestion which Mr. Darwin some years ago (1876) did me the honour to communicate gives what appears to be the true explanation of the somewhat puzzling phenomena. Having since had an opportunity of testing the value of the suggestion referred to, I have found it extremely helpful, and believe that my co-workers will agree with me in this opinion. Mr. Darwin, after remarking that his observations were made near Southampton, writes as follows:—"I need say nothing about the character of the drift there (which includes Palæolithic celts), for you have described its essential features in a few words (*Great Ice Age*, p. 506). It covers the whole country, even plain-like surfaces, almost irrespective of the present outline of the land. The coarse stratification has sometimes been disturbed; and I find that you allude to 'the larger stones often standing on end,' which is the point that struck me so much. Not only moderately-sized angular stones but small oval pebbles often stand vertically up, in a manner which I have never seen in ordinary gravel-beds. This fact reminded me of what occurs in my own neighbourhood in the stiff red clay, full of unworn flints, over the chalk, which is no doubt the residue left undissolved by rain-water. In this clay flints as long and as thin as my arm often stand perpendicularly up, and I have been told by the tank-diggers that it is their 'natural position'! I presume that this position may safely be attributed to the differential movement of parts of the red clay, as it subsided very slowly from the dissolution of the underlying chalk, so that the flints arrange themselves in the lines of least resistance. The similar but less-strongly marked arrangement of the stones in the drift near Southampton makes me suspect that it also must have slowly subsided, and the notion has crossed my mind that during the commencement and height of the Glacial Period great beds of frozen snow accumulated over Southern England, and that during the summer gravel and stones were washed from the higher land over its surface, and in superficial channels. The larger streams may have cut right through the frozen snow, and

deposited gravel in lines at the bottom. But at each succeeding autumn, when the running-water failed, I imagine that the lines of drainage would have been filled up with blown snow, afterwards congealed; and that owing to the great surface-accumulations of snow it would be a mere chance whether the drainage, together with gravel and sand, would follow the same lines during the next summer. Thus, as I apprehend, alternate layers of frozen snow and drift in sheets and lines would ultimately have covered the country to a great thickness, with lines of drift probably deposited in various directions at the bottom by the larger streams. As the climate became warmer the lower beds of frozen snow would have melted with extreme slowness, and during this movement the elongated pebbles would have arranged themselves more or less vertically. The drift would also have been deposited almost irrespective of the outline of the underlying land. When I viewed the country I could not persuade myself that any flood, however great, could have deposited such coarse gravel over the almost level platforms between the valleys."

Mr. Darwin writes me again recently to say that subsequent observations near Southampton and elsewhere have only tended to strengthen him in his conclusion. Referring to the structure of his own neighbourhood (Beckingham, Kent), he says the chalk-platform slopes gently down from the edge of the escarpment (which is about 800 feet in height) towards the north, where it disappears below the Tertiary strata. "The beds of the large and broad valleys, and only of these, are covered with an immense mass of closely-packed, broken, and angular flints, in which mass remains of the musk-sheep and woolly elephant have been found. This great accumulation of unworn flints must therefore have been made when the climate was cold, and I believe it can be accounted for by the large valleys having been filled up to a great depth during a large part of the year with drifted frozen snow, over which rubbish from the upper parts of the platforms was washed by the summer rains and torrents, sometimes along one line and sometimes along another, or in channels cut through the snow all along the main course of the broad valleys."