XXVII. *Notice of some peculiarities observed in the Gravel of Litchfield.*

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THE red sand or gravel (for it may be called by either name) which overspreads the country in the neighbourhood of Litchfield, has presented to me some remarkable appearances; a short notice of which may perhaps without impropriety be offered to the Geological Society.

The principal ingredient in this alluvial mass is quartz, in small roundish grains, mixed rather copiously with scales of silvery mica, and tinged of a brownish red colour by oxid of iron. In some places no other substances than those just enumerated make their appearance, and the soil is a loose incoherent driving sand. More generally however the grains are slightly cemented together by a little red clay, and rounded pebbles of various sizes and qualities are interspersed. I am unacquainted with the thickness of this bed, but excavations to the depth of about thirty feet have been formed in it by the side of the road to Birmingham, about two miles from Litchfield. At this place the pebbles are so abundant as to compose a considerable proportion of the entire mass, and it is here that

the appearances, which are the subject of the present notice, may be most conveniently observed.

The pebbles of granite, of syenite, and of greenstone, are in a state of greater or less decomposition, but present nothing very remarkable, those of schist are usually soft and rotten, have evidently swelled since the period of their having been deposited here, in consequence of which their laminæ have parted from each other, and the interval is not unfrequently filled by calcareous spar, which is occasionally prolonged in the form of thin veins to the distance of a few inches into the sand. The outer surface of the schist is but little changed, but on breaking it, the interior is often found to be little else than a black powder.

The pebbles of quartz, which are numerous, appear to have undergone no change whatever.

The pebbles of limestone are the most abundant of all, and have undergone considerable change. The madrepores and other coralloidal bodies of which the limestone is principally composed, resist the solvent action of the water which percolates through the sand much better than the compact calcareous matter that is interposed between them does; the same is the case with the slender veins of calcareous spar by which the limestone is traversed; hence in those pebbles in which the process of disintegration is only moderately advanced, the surface presents a corroded spongy appearance, the prominent parts being composed of decaying madrepores and veins of calcareous spar, while the interior of the mass is still compact limestone. In other instances, where the decay has proceeded still further, the whole of the interstitial matter is gone, and the madrepores themselves are reduced to a very tender friable mass.

But the substances which have undergone the greatest change are chalcedony and hornstone or chert.

Of the former variety the most abundant is the common nodular agate, or Scotch pebble. In these the central nucleus and other parts composed of pure quartz are unaltered, the flesh-coloured zones, consisting of silex and red oxid of iron, have become more or less adherent to the tongue, have nearly lost their lustre, and have had their hardness much impaired; while the milk-white zones which in the perfect state of the substance were of pure chalcedony, are in every instance reduced to an opaque white earth, yielding generally to the nail, and strongly adherent to the tongue. Many of these nodules cannot be removed from the sand in which they are imbedded, being reduced to a soft smooth pulp, and some even of those specimens, which are now before the Society, might in their moist state be crushed between the fingers with the greatest ease.

Of hornstone I met with several varieties. One exhibits alternate bands of a smoky brown colour and white, with a glimmering lustre, shewing it to approximate to the nature of quartz; yet even in this the white bands are reduced more or less to an earthy consistence.

Another variety is the entrochital hornstone, and this appears to have suffered little if any change.

A third variety is the compact nodular hornstone, of a dull greyish white colour, and often intermixed with chalcedony. The external part of this, to a considerable depth, is reduced to a white earth; the interior is more solid, but even where the chert is but little changed the chalcedony in contact with it is totally disintegrated.

The fourth variety, and the most remarkable of any, appears to have been a madrepore agate, in which the organic part was converted into quartz, while the matter which connected the tubes was chalcedony or hornstone. In this state being subjected to the same violent friction as the other materials of the gravel, it assumed the common figure of a rolled pebble. It has however since that period

been subjected to the solvent action of water under some particular modification, by which nearly the whole interstitial matter (with the exception of a few flakes here and there of quartz chalcedony) has been removed, while the quartz moulded within the tubes of madrepora and representing most perfectly the external form of the zoophyte, alone remains.

The only difference that chemical analysis has detected between quartz and chalcedony, is that the former is silex with perhaps one or two per cent. of water, while the latter contains, besides, about two per cent. of alumine and lime; but this difference appears by no means sufficient to account for the absolute permanence of the one, and the readiness with which the other suffers decomposition under the same circumstances. The moisture contained in the bed is primarily rain water, and it is not easy to see what active agent it can become charged with in draining into the interior of the mass, except carbonic acid or carbonate of lime: any of the stronger acids, such as the sulphuric, resulting from the decomposition of pyrites, would immediately be neutralized by the calcareous matter in which the whole bed abounds. Alternations of moisture and dryness, of heat and cold, to which the decomposition of the exposed surfaces of rocks is so generally attributed, could have little or no influence in this case; since the state of moisture and of temperature at the depth of twenty feet or more in a bed of gravel cannot be supposed to undergo much change.

May I take the liberty of recommending to the well known activity of the members of this Society an examination into the circumstances on which the phenomena mentioned above depend, and which appear to be not a little important both in a chemical and geological point of view?