All the difficulties of a geological survey sometimes meet in the space of a single flint. The gradated softness of edge in belts widened by oblique section is however usually an instant means of recognising them; but in this stone the material is so fine that the oblique edges are as sharp as the vertical ones.

I could not without tediousness proceed farther in the description of this stone; it presents other phenomena peculiar to itself; but, resuming the points hitherto stated, we may define the family of agates, which it represents, as consisting of at least two formations enclosed by quartz; the inner formation being affected by dislocations which do not pass into the outer one. Generally their colour is brownish red and white, and their main material opaque and jasperine; their chalcedony developing itself subsequently and subordinately. The crimson veins and striæ, which in some examples traverse the inner formation, will furnish us with a study of separate interest after we have obtained determinate types of other large and typical groups: the minor details in each may then be examined with a better field for comparison. For convenience sake I shall in future refer to the group described in this paper as "Dipartite jaspers." Their division may, indeed, be into more than two coats or formations, but the operation of a contractile force in one, which does not affect another, sufficiently justifies the term for general purposes.

III.—FORMATION OF VALLIES. A DESCRIPTION OF HEUDESHOPE.

By S. R. PATTISON, F.G.S.

THE Heudeshope beck is a small feeder of the Tees, running swiftly down a steep valley into the main stream, at Middleton Teesdale. It is wholly in the lead-measures (Carboniferous limestone), which are here nearly horizontal, undisturbed by trap, and shew only a few faults, so small as not to affect the surface. The great Teesdale fault operates on the other side of the main valley. The Heude beck flows north and south. Its source is in the table-land, forming the water-shed, between Weardale and Teesdale, whence four or five streams issue in different courses. It is unobscured by the drift beds, which characterize the opposite lower slopes of the Tees valley. It is excavated down to the solid rock, the banks have been quite undisturbed by cultivation. It passes through forty-three distinct alternations of grit, shale, and limestone, to each of which the miners have given a distinct name; it falls about 1,000 feet in the six miles of its course. In the hope that a tramp down by the side of its brawling rivulet, during the short hours of a winter day, might illustrate some theory of valley-formation, I devoted one of the last days of the year to the task.

The summit of the table-land is formed by grit beds, called Firestone, stratigraphically just below the Millstone grit. The gorge begins by two scoop-like hollows, springing from the level. These are covered with sharp blocks of unrolled, unscratched stone. There is no nick in the table-land, no change of strata, no fault.

The plateau bears no mark which offers the slightest reason why the four or five tiny streams should have originally flowed in one direction rather than another. But the crust of the plateau has been broken up in the direction of the valleys, and the uppermost reaches are incumbered by untravelled blocks of the grit which have been somehow broken in situ and then left. What effected this operation? Certainly not denudation, not rain or rivers, not atmospheric agency. These are minor polishing agencies, but they could never originate the basis of their operations. Not ice, for there is no trace of glacial grinding action. Looking from this summit level at the diverging lines of ruin, one would say, here we are at the spot where force has come to its vanishing point. Some great pounding and crushing and disturbing operation has radiated from the line of the river vallies below, and spent itself in the everlasting hills; the maximum of the force was displayed at the base, in the main valley below, and its minimum up here at the summit; the intervening wedge of material was shattered and loosened, leaving to rain and rivers the operation of its removal. The latter have done the barrow-work, but the powder-work was first done. After descending through about 100 feet of grits we come to the shales (Plate and grey beds), in which the stream becomes more peaceful, we then re-enter a sandstone sill, down a succession of steps, in which the perpendicular is formed of shales and the steps of grit, the former constantly yielding and the latter breaking, so as to deepen the gorge, now in one place and then in another. Crossing the thin fell-top limestone, we came into a well-marked succession of slate sills and grits. On looking around we see that the tiny rivulet has, and has always had, a definite course. True, it skips about, now here and now there, within limits of a dozen yards, now coursing down one channel and then another, as its broken ledges, or as floods determine, but its course is at the bottom of the gorge, and is quite distinct from the gorge itself, which has sloping sides; it is a water staircase, like the celebrated Cascade at Chatsworth, but with smooth inclined side walls. The whole dip of the strata is eastward, and therefore if the valley had been excavated by water or by rain it would have gone in the direction of the first shale bed, and been marked by an overhanging cliff of grit in its down eastward course. On reaching the limestone, which is here called the Great Limestone (the cliffs of which gives name to the middle of the little valley, the Skears, but which is not the Scar limestone of other districts) we find a beautiful development of the cutting-back power of the water. The beds of the limestone have first been worn quite smooth, leaving the corals and Brachiopods in excellent relief, the spray has hollowed out the shales beneath, the limestone has given way, the rivulet has suddenly acquired a new level, the old bed with its lips and pot-holes and curved lines is left dry, like a broken well-dish. This action is confined to the staircase; it does not extend back into the side slopes, The amount of river bed thus acted on is very considerable. Judging from rough calculation, it must have been going on for ages before the Boulder-

clay. This trituration, with its step-like results, is quite distinguishable in its effects from the phenomena of the slopes extending upwards on either side of the actual present and past channel. The limestone forms, as usual, a terrace in the side of the fells, and shews picturesque cliffs. Below this we get pale flaggy beds with shale, the former exhibiting fine markings of two species of *Crossopodia*. Through these the burn descends past the village of Middleton down to its junction with the river, in the four fathom limestone.

I closed a pleasant day's ramble in the conviction that we had not made much progress in the valley question since the days of Hutton, simply because a physical fact once ascertained becomes an axiom. What more can be said than the following:—"The original inequalities of the surface, and the disposition of the strata, must, no doubt, have determined the water-course at first; but this does not hinder us from considering the rivers as having modified and changed those inequalities, and as the proximate causes of the shape and configuration which the surface has now assumed."—*Playfair, Illustrations of the Huttonian Theory*, p. 357.

IV.—ON THE ALBIAN, OR GAULT, OF FOLKESTONE.

By C. E. De RANCE, of the Geological Survey of England and Wales.

FROM the proposition of Professor Forbes, that a species once extinct never reappears, it follows that when a species recurs, it must have existed elsewhere during the whole of the time occupied by the deposition of the strata between the deposits containing it. In viewing the distribution of species through the chief stages of the Lower Cretaceous system, it appears that the same species reappear when there is a recurrence of the same or similar physical conditions,—the Neocomian and Albian clays having more species in common than the intervening Aptian; and the Aptian and Cenomanian sands, being more closely allied than the intervening Albian clay. An examination of the latter, at Folkestone, appears to allow of its being divided into eleven lithological stages or beds which have been more or less recognized by all geologists and fossil collectors who have visited the district. To these beds provisional names have been assigned expressive either of their colour, position, or characteristic fossils. But in tracing all the recurring species from their genesis in one stratum to their extinction in another, these beds are found to have no great palæontological value, but to resolve themselves into two groups divided by a junction bed, in the same way as the "junction bed" separates the Albian from the Upper Aptian. Beds i. to iii. forming an Upper, beds v. to x. a Lower Albian, beds iv. and xi. being the two phosphate junction beds,

As Mr. Judd,¹ in his admirable paper on the "Speeton Clay," has adopted D'Orbigny's term, "Neocomian," for that formation, the

¹ GEOL. MAG. Vol. V. p. 141.