

great disturbing forces which broke the strata along the lines of vein fissures and rock dykes. The following remarks are intended to show that symmetrical divisional planes, such as joints and cleavage, are due to other causes than disruption of the strata.

1. It is a fact, that from divisional planes ranging for many yards or even hundreds of yards, and separated by wide intervals, to the fine parallel, almost invisible, *cleavage* of coal (called "cleat"), and of clay slate, there is an almost perfect gradation of structures, which have a definite relation to the different nature of rocks, while subject to the same mechanical pressures and movements. In coal, shale, clay slate, and laminated limestone, it is in vain to attribute these regular divisions to any thing but the molecular arrangement which explains the structure of basalt.

2. In different beds of rock, as shale, limestone, and gritstone, which alternate, it is not uncommon to find the slopes or inclinations of the joint planes to vary, nearly as in different beds of slate the planes of cleavage will deviate from parallelism.

3. The joints are, for the most part, not continuous through all these alternating strata, but in each rock are characteristic divisions which enter no other.

4. In symmetry, extent, and frequency, joints are not at all less, but rather more, remarkable at points far removed from axes and centres of disturbance of the rocks.

5. Near such axes of movement, many irregular fractures of the rocks occur, and predominate over the natural joints, which appear not uncommonly to have been obscured, closed up, or complicated by irregular pressures and cracks in such situations.

It follows from these considerations, that whatever analogy of direction may appear between the lines of mineral veins and those of the natural structures of rocks, this only indicates the influence which such *lines of weakness* would necessarily exert on the direction of *fractures* produced by mechanical pressure. Now, as, in addition to joints, many other circumstances, as the