times solidified, and that subsequent emissions of lava rose through rents in the crust, and flowed down the outside of the vent.

The fragmentary materials in necks consist mainly of different lava-form rocks imbedded in a gravelly *peperino*-like matrix of more finely comminuted débris of the same rocks; but they also contain, sometimes in abundance, fragments of the strata through which the necks have been drilled. When occasionally, as in some of the Maare of the Eifel, these non-volcanic fragments constitute most of the débris (p. 417), we may infer that after the first gaseous explosions, the activity of the vent ceased, without the rise of the lava-column or its ejection in dust and fragments to the surface. So unchanged are many of the pieces of sandstone, shale, limestone, or other stratified rock in the necks, that they have evidently never been exposed to any high temperature. In some cases, however, considerable alteration is displayed. Dr. Heddle, from observations in Fife, concluded that the altered blocks in the tuff there must have been exposed to a temperature of between 660° and 900° Fahr.[37]

Among the numerous vents of central Scotland, pieces of fine stratified tuff not infrequently appear in the agglomerates. This fact, coupled with the not uncommon occurrence of a tumultuous, fractured, and highly-inclined bedding of the tuff with a dip toward the centre of the neck (Figs. 298, 299), appears to show that the pipes were partly filled up by the subsidence of the tuff consolidated in beds within the crater and at the upper part of the funnel. Further indication of the probable subaerial character of the

[37] Trans. Roy. Soc. Edin. xxviii. p. 487.