Devil's Dyke

[TQ 26 11]

Highlights

The Devil's Dyke is the largest, and perhaps the most famous, of the combes developed on the chalk karst of England's downlands. Its sheer size provides ample evidence of the effectiveness of the solifluction and other periglacial processes which operated during cold stages of the Pleistocene.

Introduction

Many short, steep-sided, dry valley, or combes, are cut into the scarp face of the Cretaceous Chalk escarpments of southern England. The Devil's Dyke, incised into the northern side of the South Downs, north of Hove (Figure 7.1), is probably the largest, most spectacular and most well known of all the chalk combes. Its unusually large size is partly due to its two stages of excavation, but it still provides an excellent example of the scale of periglacial activity in the chalk karst.

Debate over the origins of the Devil's Dyke and the many other chalk combes has been extensive. The main hypotheses have centred on either spring sapping and normal stream erosion in temperate climates (Chandler, 1909; Fagg, 1923, 1954; Sparks and Lewis, 1957; Small, 1962, 1964), or erosion under periglacial conditions by solifluction and surface run-off (Reid, 1887, 1892; Bull, 1936, 1940; Kerney *et al.,* 1964; Sheail, 1971). Specific studies of the Devil's Dyke include those by Martin (1920), Sherlock (1929), Wooldridge (1929), Bull (1936) and Small (1962, 1964).

Description

The Devil's Dyke is incised into the north-facing scarp face of the South Downs; it cuts through most of the Lower and Middle Chalk, and finishes in the Upper Greensand. The valley is just over 1000 m long, is 400 m wide at its rim and reaches a depth of over 80 m (Figure 7.10). Its head lies close to the crest of the scarp, and it descends over 130 m to debouch onto the clay vale to the north. It begins as a steeply descending, steep-sided combe with an initial gradient of about 25%, but soon develops a flatter floor. The valley cross-profiles are broadly V-shaped, but are slightly asymmetrical, with steeper slopes on the southern, downdip side. The valley walls are unusually steep, locally exceeding 30°, before flattening sharply to gentle convex profiles in their upper parts. A ribbon of soliflucted chalk debris, known as combe rock, follows the thalweg of the dry valley.

The combe heads north-east, until it swings to the north, and flattens and widens considerably below a marked step. Lower down, the dry valley again steepens, and ends at the foot of the scarp above a powerful group of springs. A tributary valley on the south at its lower end is the only one to enter the combe; its head lies at a col over into a large dry valley system cut in the dip slope (Figure 7.10). Their is no trace of any related valley feature in the clay vale to the north.

Interpretation

Early claims that the Devil's Dyke was excavated by glaciers (Martin, 1920; Sherlock, 1929) were refuted by Wooldridge (1929) and Bull (1936) who proposed that it was incised by meltwater flowing from melting snow caps during periglacial periods.

Fagg (1923, 1954) suggested that the chalk dry valleys were cut by normal stream action, and were then desiccated by scarp retreat when new springs caused a fall in the local water table.

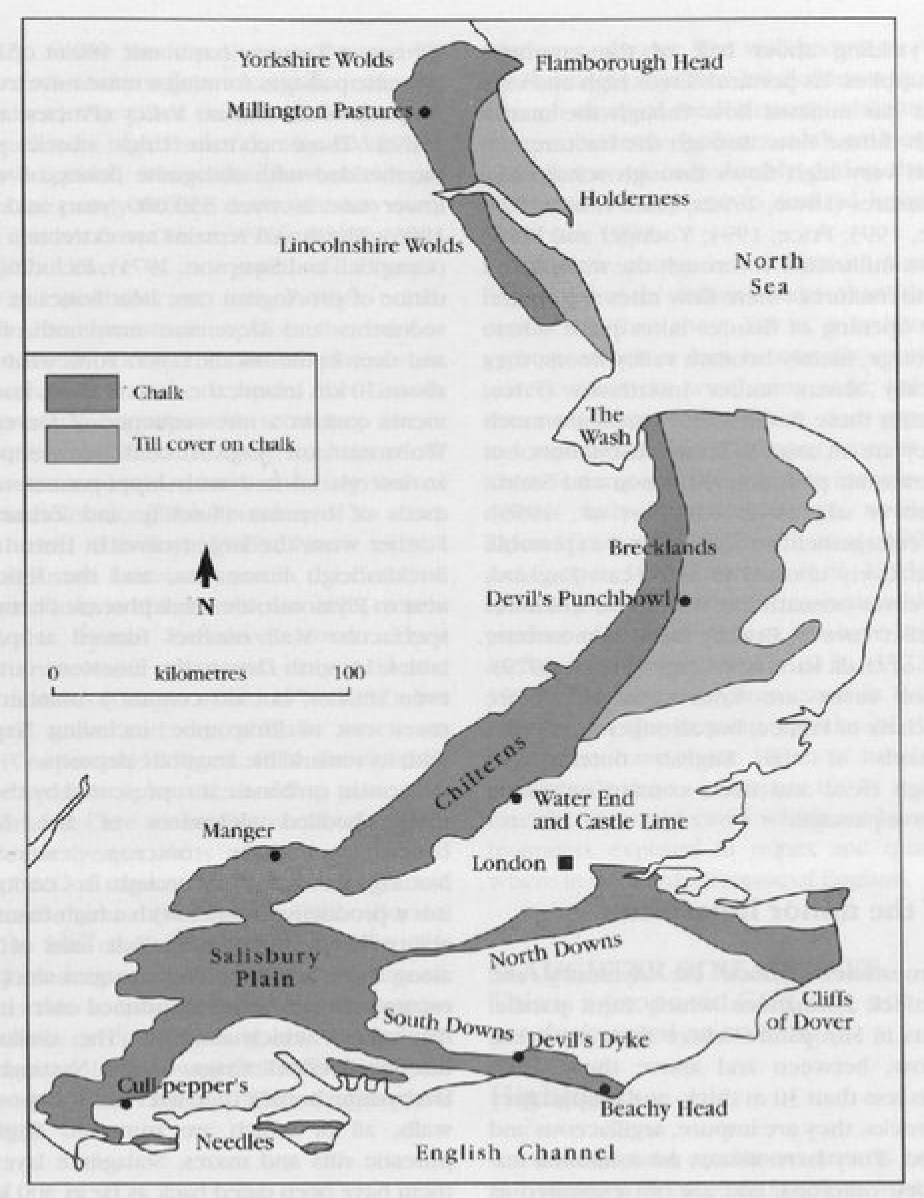
Small (1962) suggested that the Devil's Dyke was originally the upper segment of Saddlescombe, which was captured by headward erosion in a scarp face valley. The sharp bend in the combe may be regarded as the elbow of capture, and the saddle on the small spur just to the east may be a remnant of the original valley floor (Figure 7.10). Following capture, the new steeper gradient caused the valley to become overdeepend. Small proposed that this was due in part to spring sapping and associated stream erosion, a mechanism which has also been put forward for the formation of several other chalk dry valleys such as the Manger in Oxfordshire (Arkell, 1947; Sparks and Lewis, 1957). He also noted the role of erosion by snowmelt run-off during periglacial episodes, and speculated that a former impermeable capping of clay-with-flints may have caused surface drainage under wetter conditions.

The chalk is very susceptible to frost shattering in its weathering profile, followed by erosion by surface run-off and solifluction processes, under periglacial conditions (Paterson, 1977). Valley excavation in the chalk thereby progressed during each cold stage of the Pleistocene, and became dormant when underground drainage resumed during each subsequent warm stage. About half the depth of the Devil's Dyke was cut when it was a high tributary of the Saddlescombe valley system on the dip slope. Probably very late in the Pleistocene, it was rejuvenated when it was captured by the scarp face valley, and periglacial processes were enhanced on the new, steeper slopes. Even though it appears to have a two-phase history, the Devil's Dyke represents an excellent example of the massive scale of periglacial activity on the chalk downlands.

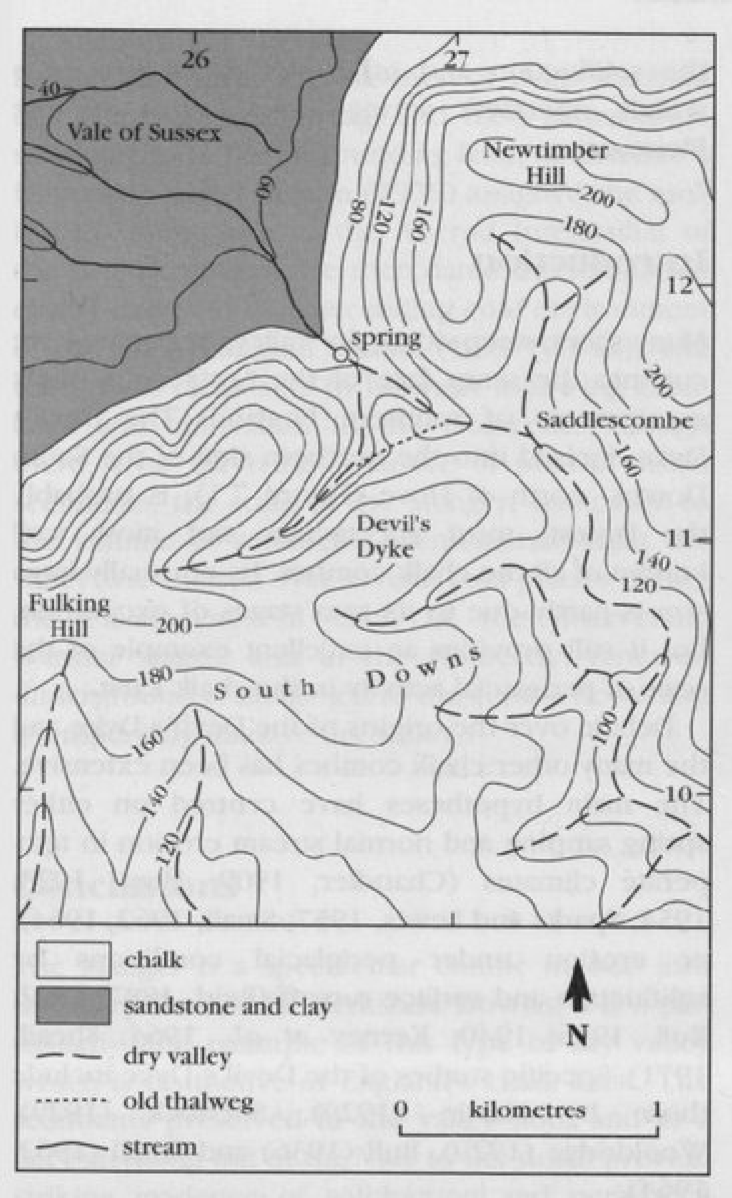
Conclusions

The Devil's Dyke is the largest and most impressive of the many combes incised into Britain's chalk karst. Its origins are complex, with capture and rejuvenation creating its present overdeep-ened form. The dimensions of the valley have important implications for ideas on the scale and effectiveness of solifluction and meltwater run-off on the chalk downlands of England during periglacial stages of the Pleistocene.

References



(Figure 7.1) Outline map of the chalk karst of England, with locations documented in the text. Superficial deposits occur on many parts of the Chalk outcrop; only the large areas of glacial till are distinguished on this map, as they mask most topographic expression of the karst.



(Figure 7.10) Topographic map of the Devil's Dyke and the Saddlescombe dry valleys on the South Downs.