Devil's Punchbowl

[TL 878 892]

Highlights

The Devil's Punchbowl is a fine subsidence doline. It is the deepest and most spectacular of the many dolines developed on the covered chalk karst of the Norfolk Breckland, just north of Thetford.

Introduction

The sandy heathlands of the Breckland in Norfolk (Figure 7.1) are pock-marked by dozens of small dolines or depressions, often partially filled with water. These depressions and meres are devel oped on a thick cover of boulder clay overlying the chalk. The Devil's Punchbowl is the clearest example of these depressions. Its morphology is especially interesting as it is intermediate between the conical collapse dolines and the larger shallower subsidence basins both of which are common in the Breckland. The origins of the Devil's Punchbowl and the many other pits and depressions in Norfolk were discussed by Clarke (1903), Marr (1913), Jones and Lewis (1941), Prince (1962, 1964) and Sparks *et al.* (1972), and were reviewed by Day and Goudie (1978) and Goudie and Gardner (1985).

Description

The dolines of East Anglia are particularly numerous north and east of Thetford, in the area of heaths known as the Breckland. The chalk is overlain by up to 30 m of Anglian (and possibly 'Wolstonian') till which is mainly of sandy composition; nowhere is rock exposed at the surface. Scattered across the plateau are many dolines, with their surface forms entirely developed within the glacial drift. Most of these are steep conical depressions, up to 20 m across, but there are also about ten larger, shallower, saucer-shaped depressions up to 150 m across and covering up to 12 ha. These normally contain small lakes or meres.

The Devil's Punchbowl is one of the finest of the Breckland dolines (Figure 7.13). It has the profile of a shallow inverted cone, 6 m deep with sides sloping at up to 18°; almost perfectly circular, the doline has a surface diameter of about 150 m and its lake covers an area of about 0.6 ha. The lake level fluctuates by 2–3 m with changes in the groundwater level, in the aquifer which is contiguous between the chalk and the permeable till; the fluctuations are not simply seasonal, as the Punchbowl may be dry for many yead at a time and then contain water for several years. The position of the doline is independent of the local valleys and surface streams.

Interpretation

Jones and Lewis (1941) described the circular Breckland meres as swallow holes due to the solution of the chalk and, in some cases, the collapse of the surface into underground cavities. Acidic drainage from the peaty heathlands has percolated through the glacial drift and dissolved the chalk below, causing subsequent settlement of the overlying glacial drift and subsidence on the surface. This mechanism characterizes the many forms of subsidence doline formed by ravelling and surface lowering in poorly consolidated clastic cover materials overlying cavernous carbonates. Analogies may be drawn with dolines in Dorset (Sperling *et al.,* 1977) and the widespread shakeholes in the till of the Yorkshire Dales karst.

The form of the Devil's Punchbowl appears to be intermediate between the small, steep conical collapses developed by ravelling into a single chalk fissure, and the larger shallow depressions formed by subsidence over a broader zone of rockhead solution; the Punchbowl may therefore provide the genetic link between the two styles of Breckland doline. The main group of Breckland meres, including the Devil's Punchbowl, all lie on a local dome, about 8 m high, in the water table (Day and Goudie, 1978), demonstrating the importance of downward seepage through their floors. This infiltration,

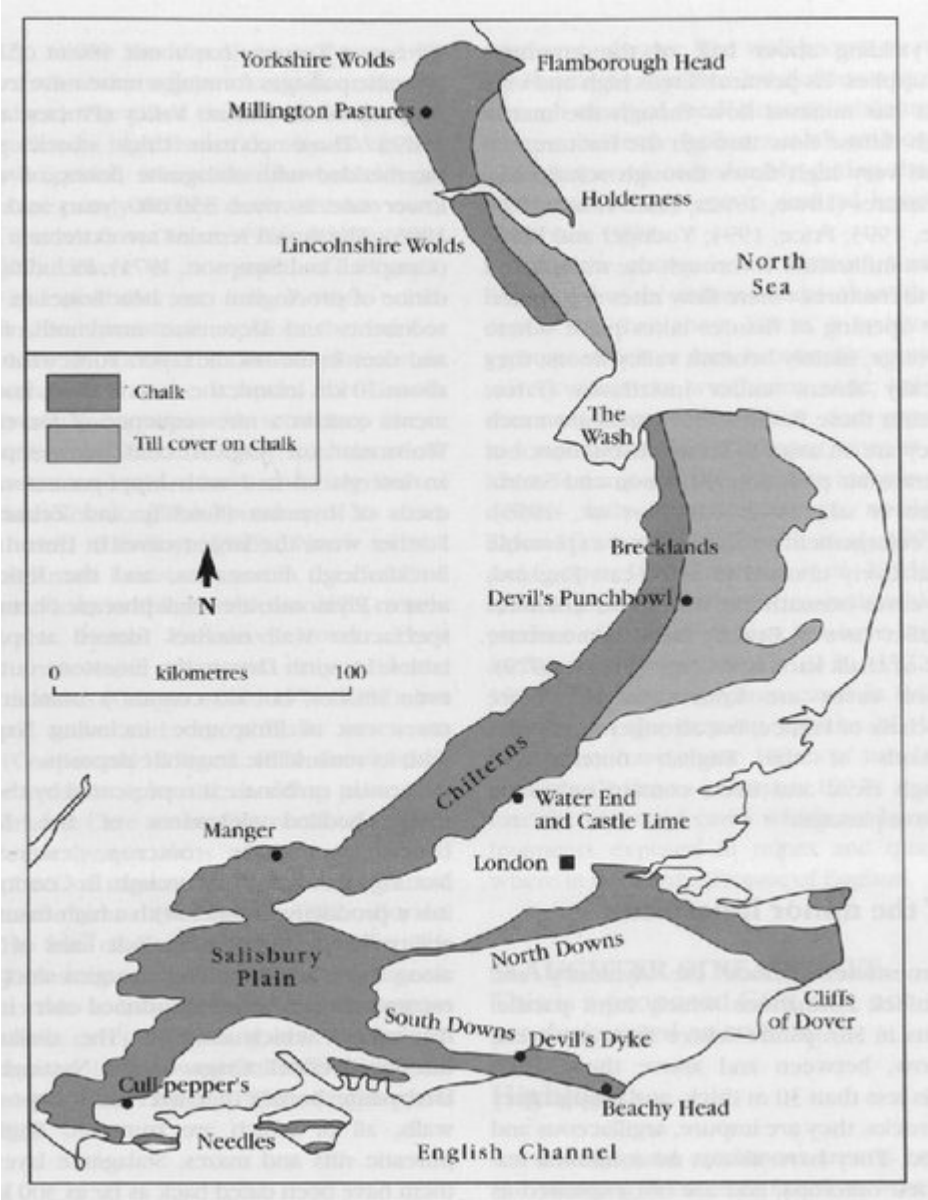
and downwashing, is very slow, as the mere levels fluctuate with a time lag of some months behind the rainfall patterns. The age of the Breckland dolines is unknown, except that they postdate the glacial drift in which they are formed.

Alternative modes of origin for the many depressions in the Norfolk landscape include min eral workings, marl pits, and thaw sinks, besides the karstic landforms (Marr, 1913; Prince, 1962, 1964). No single explanation could account for the large numbers and uneven distribution, but the artificially excavated pits are recognizable by their small and irregular forms. The hypothesis of the thaw sinks has been applied to the Devil's Punchbowl and other Breckland meres (Prince, 1964; Sparks *et al.,* 1972). A pingo is formed by ice expansion within the shallow soil layers, and a soil cover may then slump off its domed surface so that a subsequent thaw leaves a depression: this cover sliding may leave marginal ramparts, but the Breckland meres have none of these features, which are recognized at other Norfolk sites.

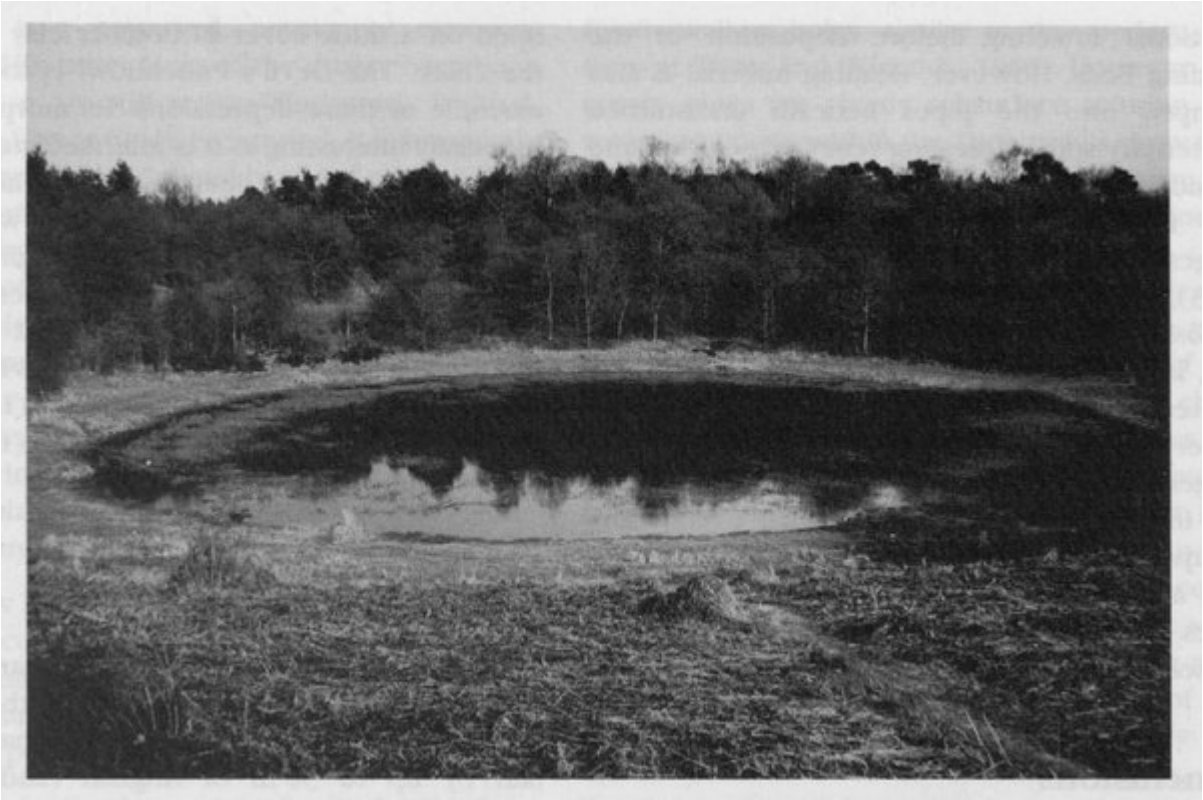
Conclusions

The Devil's Punchbowl is the most spectacular of the many dolines developed in the covered chalk karst of the Breckland. Its origins have been strongly debated, but it is a fine example of a subsidence doline caused by subsurface solution of the chalk and subsequent settlement of the glacial drift cover. Its morphology suggests a genetic link between the large shallow basins containing meres and the smaller, steeper conical dolines, both of which are common in the Breckland.

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 7.13) The Devil's Punchbowl doline with a lake on its floor in April 1982. (Photo: A.C. Waltham.)