Chapter 4 The Orkney Islands

Introduction

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Perhaps surprisingly, in view of the position of the Orkney Islands (Figure 4.1) between the North Sea and the North Atlantic, the Quaternary deposits and landforms there have been little studied. Early work addressed whether Orkney had been glaciated or not (A. Geikie, 1877; Laing, 1877), but it was Peach and Horne (1880) who first established the essential outlines of the glacial history of the islands. Following up the ideas of Croll (1870a, 1875), Peach and Horne proposed that at the period of maximum glaciation, the North Sea had been inundated by ice from both Scandinavia and Scotland and that the combined ice masses flowed into the Atlantic Ocean in a westerly or north-westerly direction across the northern isles of Scotland. Hence the principal themes of studies of the glaciation of Orkney have been the direction of ice movement, the types of erratics found in the glacial deposits and, in particular, whether these erratics were derived from Scotland or from Scandinavia. Only minor attention was paid to the possibility of local glaciation, and it is only in recent years that a small amount of palynological information has become available on the history of the vegetation of the islands.

No organic interstadial or interglacial deposits have been reported from Orkney. The stratigraphically earliest Quaternary deposit is a raised cobble beach exposed in the north of Hoy (see Muckle Head and Selwick). The beach occurs at 6–12 m above present sea level and rests on the inner margin of a marine abrasion ramp. No erratic material and no fossils have been observed in the beach, which is overlain by a head deposit and then a till deposited during the last regional glaciation (Wilson *et ed.,* 1935; D. G. Sutherland, unpublished data). The age of the beach is unknown.

A fundamental theme in studies of the glaciation of Orkney has been the movement of ice from the floor of the North Sea westwards and north-westwards across the islands. This model derived initially from studies on the Scottish mainland in Caithness (Jamieson, 1866; Peach, 1868 (cited by Croll, 1870a); Croll, 1870a, 1875) and was later substantiated by detailed mapping on the Orkney Islands themselves (Helland, 1879; Peach and Horne, 1880; Wilson *et al.,* 1935; Mykura, 1976; Rae, 1976). The glacial features in Orkney relate closely to those in Caithness in terms of ice-movement patterns, the presence of shelly tills and inferred chronology. The main glacial deposits of Orkney, like those of Caithness, have generally been ascribed to the last glaciation, but recent interpretations suggest that they may relate to Early Devensian glaciation and that Orkney was largely unglaciated during the Late Devensian (Sutherland, 1984a; Bowen, 1989, 1991). However, the issue is far from resolved and recent work by Hall and Whittington (1989) and Hall and Bent (1990) provides support for the former model.

In an early account, Laing (1877) argued that Orkney had not been glaciated. This view was challenged in a reply by A. Geikie (1877), who adduced the presence of roches moutonnees, striations, till and moraines, and concluded that the ice moved from south-east to north-west. From their investigations on the Shetland Islands, Peach and Horne (1879) concluded that Shetland had been glaciated by ice originating from Scandinavia and that during the glacial maximum convergent ice streams from the Scottish mainland and Scandinavia moved north-west across the floor of the North Sea and the Orkney Islands. Subsequently (Peach and Horne, 1880), they elaborated on this model and in support provided detailed field evidence from Orkney for the pattern of ice-sheet and, later, local mountain glaciation; Helland (1879) independently reached similar conclusions. Striations and roches mouton-nees showed conclusively that ice moved to the north-west and north-north-west, from the North Sea to the Atlantic. Further evidence of such ice movement was provided by the presence of shell fragments in the till at numerous locations and systematic changes in the lithological composition of the till on several islands. Erratics included a number of rock types foreign to the islands: limestones (including chalk), igneous lithologies, and the famous Saville Boulder, which has been argued to be of Scandinavian origin (Heddle, 1880; Flett, 1898; Wilson *et al.,* 1935). Other supposedly Scandinavian erratics were noted by Saxton and Hopwood (1919), although Rae (1976) considered that they could equally well have been derived from the Scottish mainland. Peach and Horne (1893c) later provided further details of shelly till and erratics on North Ronaldsay. They concluded that some of the material could have been derived from Aberdeenshire, the eastern Highlands and Fife. Peach

and Horne's work remained the definitive study of Orkney for nearly a century and it has provided a basis for most regional syntheses.

Wilson *et al.* (1935) elaborated on Peach and Horne's results, suggesting that Orkney was crossed initially by Scandinavian ice moving from east to west and then by Scottish ice flowing at first towards the north-west and then towards the north. Charlesworth (1956) placed the limit of his Stage A (Highland Glaciation) across the Mainland, based on the distribution of morainic mounds. However, there is no convincing evidence that these are ice-marginal deposits and the current view is that they relate to ice-sheet wastage (Rae, 1976). Godard (1965) followed the interpretation of Wilson *et al.* (1935), but believed that the last ice-sheet movement probably correlated with Charlesworth's Scottish Re-advance, a concept that is no longer tenable.

The most detailed recent study of the glaciation of Orkney is that of Rae (1976). He concluded that the earliest ice flow originated from between south and south-south-east. Later ice flowed from the south-east and finally from between east-south-east and east. Although he recognized two distinctive till units and cross striations, Rae concluded that there was no substantive evidence for more than one major ice-sheet glaciation on Orkney (see Den Wick). The age of this glaciation was, however, unconfirmed, but on the basis of an infinite radiocarbon date from Mill Bay, Rae believed that it could have occurred during the Early Devensian.

From his work in Shetland, Orkney, Foula and Fair Isle, Flinn (1978a) proposed two possible models for the glaciation of the islands. The first involved Scandinavian ice crossing the North Sea early in the last glaciation and deflecting Scottish ice across Orkney. Later, as both Scottish and Scandinavian ice waned, an independent ice-cap developed in Shetland. The second model, which Flinn considered more acceptable, placed the Scandinavian ice in an unspecified earlier stage.

In the absence of any known organic interglacial or interstadial deposits on Orkney, dating of the glacial sequence has remained conjectural, with most opinions assigning the main glacial features to the last ice-sheet (Late Devensian) or the ice maximum. In recent years, however, the extent of the last glaciation in Britain has been questioned and attention has re-focused on the possible existence of unglaciated areas in the more peripheral parts of the country. A fundamental problem in interpreting the glacial sequence in Orkney centres on explaining the westerly movement of the Scottish ice. This has generally been attributed to its deflection by Scandinavian ice in the central North Sea. However, offshore studies have shown that during the last glaciation the floor of the central North Sea was unglaciated (Cameron *et al.,* 1987; Sejrup *et al.,* 1987). Therefore, unless the deflection of the Scottish ice relates to an alternative, but as yet unidentified, mechanism, the glaciation of Orkney must have been earlier. Thus, although there is no conclusive evidence as yet, the current weight of opinion favours the interpretation that Orkney was last glaciated by an external ice-sheet during the Early Devensian and was not covered by the last Scottish ice-sheet (Rae, 1976; Synge, 1977a; Sissons, 1981b; Sutherland, 1984a; Bowen *et al.,* 1986). Recently, further support for Early Devensian glaciation has come from the preliminary results of amino acid dating of shells from the tills of Caithness and Orkney (Bowen and Sykes, 1988; Bowen, 1989, 1991). If this hypothesis is substantiated, then it places important constraints on wider palaeoclimatic and glacier reconstructions and also on the nature of landscape change and the impact of periglacial processes on Orkney during the Late Devensian. However, Hall and Whittington (1989) have adduced several lines of evidence from Caithness (see below) to support more extensive glaciation during the late Devensian and a possible ice limit as far north as the Orkney–Shetland Channel (see also Hall and Bent, 1990). Subsequently, Hall and Bent (1990) have suggested that the north-westerly ice movement across Orkney and Caithness might relate to the development of a divergent flow pattern in the Moray Firth, where the ice-sheet moved from a rigid to a deformable bed.

Following A. Geikie (1877), Peach and Horne (1880) recognized a number of moraines on Hoy and the more elevated parts of the Mainland which they inferred to be associated with local valley glaciation. From later work, however, it is apparent that only on Hoy is there clear geomorphological evidence for local glaciation (Wilson *et al.,* 1935; Godard, 1965; Rae, 1976). Rae (1976) concluded that apart from Enegars Corrie, there was no evidence for corrie glaciers in anyof the locations suggested by Charlesworth (1956), and in other localities in the valley of South Burn and the Ford of Hoy it was not clear whether the glacial deposits were associated with local ice or with the decay of the ice-sheet.

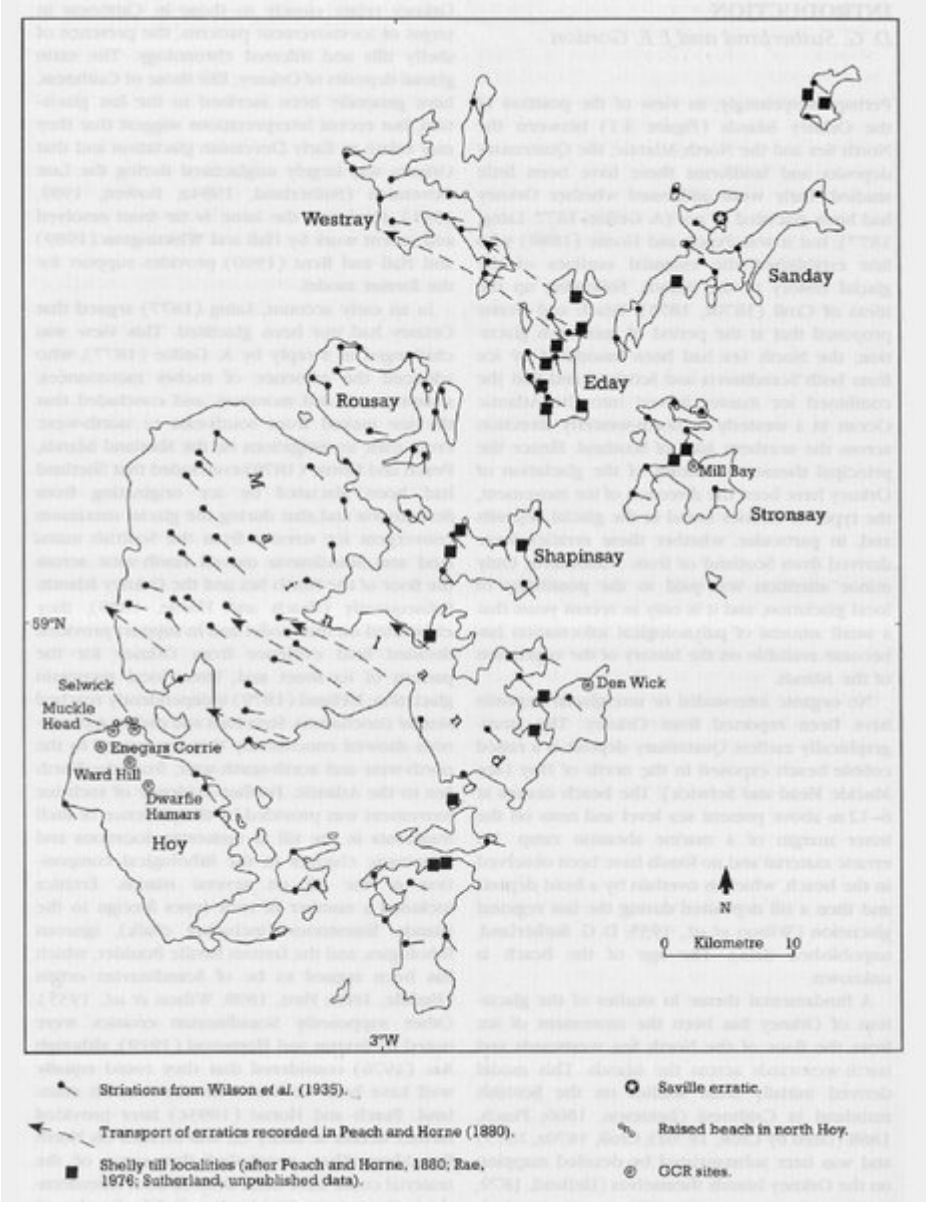
A number of arcuate end moraines occur, however, for example at Dwarfie Hamars and Enegars Corrie (D. G. Sutherland, unpublished data). Although not directly dated, these possibly relate to the Loch Lomond Readvance and

represent the last minor phase of glaciation on Orkney. These small glaciers formed in favoured localities and had equilibrium line altitudes of approximately 150 m OD.

The hills of northern Hoy are the only ones in Orkney to give rise to significant areas of ground above 350 m OD and they are especially notable for the development of periglacial features (see Ward Hill) (Goodier and Ball, 1975). It seems probable that the periglacially weathered detritus that mantles the summits of these hills was produced during the Late Devensian (and conceivably earlier), but the periglacial features observed today were all apparently produced during the Holocene. The sand sheets ('dunes') on Ward Hill, in particular, seem to preserve a record of changing Holocene environments in the form of buried soil horizons.

Despite the pioneering work of Erdtman (1924), there have been few detailed pollen analytical studies of the vegetational development of Orkney. The only study of Lateglacial profiles is that of Moar (1969a), who indicated that the vegetation at that time was very restricted in its development. During the early to middle Holocene a dwarf-shrub vegetation developed with possibly only isolated patches of birch and hazel scrub (Moar, 1969a; Keatinge and Dickson, 1979). From the middle Holocene onwards there has been considerable human impact on the vegetation (Moar, 1969a; Caseldine and Whittington, 1976; Davidson *et al.,* 1976), and it may be that grazing pressure contributed to the spread of blanket bog in the later Holocene (Keatinge and Dickson, 1979).

References



(Figure 4.1) Location map and principal features of the glaciation of Orkney, including patterns of striations, directions of transport of erratics and shelly till localities (from Sutherland, 1991b).