
WEST COAST OF JURA

A.G. Dawson

OS Grid Reference: NR636969

Highlights

The coastal area of western Jura contains a remarkable assemblage of raised shoreline landforms. These include shore platforms and the best-developed spreads of Lateglacial shingle ridges in Britain which provide valuable information for understanding changes in relative sea level. The area is also noted for a medial moraine formed by the Late Devensian ice-sheet.

Introduction

This site comprises a *c.* 37 km long stretch of the west coast of Jura, between Glengarrisdale Bay (NR 659985) in the north, and Rubha Aoineadh an Reithe (NR 448751) in the south, and also a small area (*c.* 0.2 km²) at Inver (NR 442724). It is one of the classic localities in Great Britain for raised coastal landforms, most notably spectacular unvegetated spreads of Late Devensian and Holocene raised beach shingle. The area also includes excellent examples of three raised shore platforms, the High Rock Platform, Main Rock Platform and Low Rock Platform. Also represented in Sgriob na Caillich (NR 475765) is the finest example of a medial moraine in Great Britain.

There is only a limited amount of published information on the Quaternary features of this area. The raised shingle spreads were first described by officers of the Geological Survey (Wilkinson, 1900, 1907; Peach *et al.*, 1911), and Ting (1936, 1937) gave further details of the ridges. The first major study of the raised beaches was by McCann (1961a, 1964), who sought to describe and explain the origin of the western Jura shingle spreads and relate them to patterns of Lateglacial relative sea-level change. In a later paper, McCann (1968) extended his discussion to include the raised coastal rock platforms. More recently, the raised shorelines of western Jura have been investigated in detail by Dawson (1979a). The results of this research are published in a number of later papers (Dawson, 1980a, 1980b, 1982, 1983a, 1984, 1988b, 1991).

High Rock Platform

A high rock platform and associated cliffline are almost continuous between Shian Bay (NR 530875) and Ruantallain (NR 505833). In this area the platform has an average width of 350 m and in places is as wide as 600 m; the backing cliffs are typically 5–15 m high although they reach a maximum of 50 m at Loch an Aoinidh Dhuibh (Figure 11.11). The inner edge of the platform is only visible in two stream sections and hence the altitude of the feature is only known for these locations: north of Shian Bay (NR 53858915) at an altitude of 34.1 m OD and 150 m north of Bhrein Port (NR 50948415) at 32.1 m OD. Along this stretch of coastline the platform possesses an average seaward slope of about 4°, its gently sloping surface having provided an environment favourable for the later deposition of the overlying Late Devensian shingle spreads.

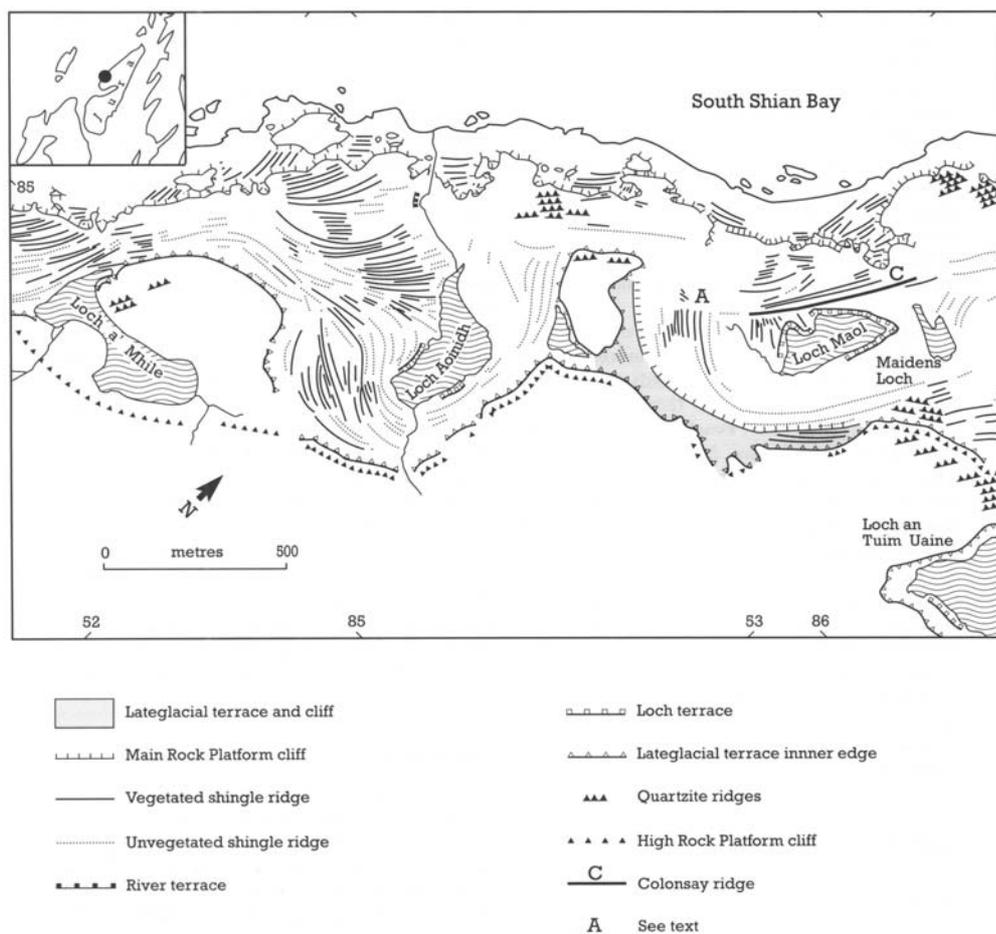


Figure 11.11: Geomorphology of Western Jura in the area of South Shian Bay.

The western Jura platform pre-dates one period of general glaciation, since at two locations it is separated from the overlying raised beach sediments by lodgement till. First, at Bhrein Port (NR 50688405) 1 km north of Ruantallain, a wedge of orange lodgement till is embedded in a platform depression between two inclined ridges of quartzite and is overlain by thick accumulations of shingle. Second, on the banks of a stream channel 150 m north of Bhrein Port (NR 50948415) the inner edge of the platform is choked by 2.5 m of creamy lodgement till beneath shingle. Additional evidence for glaciation is the occurrence of an ice-moulded and striated bedrock sea stack immediately north of Loch a'Mhìle (NR 51398501). It is also possible that the exceptionally low altitude of the platform surface at Shian Bay may be due to the effects of glacial erosion.

The rock platform described above is considered to correlate with the classic High Rock Platform of northern Islay (Dawson, 1979a). The High Rock Platform has not been found, however, along the intervening south-west Jura coast probably due to the presence in that area of great thicknesses of till.

Main Rock Platform

Between Shian Bay and Ruantallain the seaward edge of the High Rock Platform forms the cliffline of a lower platform 50–150 m wide (Figures 11.11 and 11.12). The inner edge of this platform occurs at 3–5 m OD. It is locally overlain by Holocene raised beach sediments and, along its length, the cliffline is indented by numerous raised sea caves. The platform is unglaciated and is characterized by inclined and jagged quartzite ridges; the cliffs are typically crenulate and are usually 10–15 m high. The platform is also continuous between Shian Bay and Glendebadel Bay (NR 622951), where it is locally associated with cliffs up to 100 m high.



Figure 11.12: View south along the west coast of Jura between Shian Bay and Ruantallain. Lateglacial shingle ridges extend across a high rock platform and to the west of Loch a'Mhile (centre). The loch was formerly a marine inlet prior to the deposition of the shingle ridges. Note also a prominent rock platform and backing cliff (the Main Rock Platform) seaward of the high shingle ridge 'staircases'. Holocene shingle ridges also cover the Main Rock Platform. (Photo: John Dewar Studios.)

Low Rock Platform

In south-west Jura, low intertidal rock platform fragments are conspicuous along long stretches of coast. These are typically 100 m wide and are best developed on the foreshore between Rubh'Aird na Sgitheich (NR 476793) and Allt Bun an Eas (NR 458763). At several locations, the continuity of the platform surfaces is interrupted by numerous Tertiary dolerite dykes. The platform surfaces are locally ice-moulded; throughout most of the area the platforms pass inland beneath till. Between Rubh'Aird na Sgitheich and Glenpatrick (NR 518801) the platform is overlain by considerable thicknesses (up to 15 m) of Late Devensian raised beach gravels.

Late Devensian raised beaches

The coastal zone of western Jura is dominated by conspicuous raised beach terraces and 'staircases' of unvegetated beach ridges, the widespread occurrence of which first attracted the attention of the Geological Survey (Wilkinson, 1900, 1907). Although discussed by Ting (1936, 1937), the most detailed studies of these raised coastal features are by McCann (1964, 1968) and Dawson (1979a, 1982).

In western Jura, raised coastal terraces can be traced almost continuously southward from Shian Bay as far as Inver (*cf.* Dawson, 1991, figure 5). Additional areas of raised coastal terrace occur at Corpach Bay (NR 568917) and Glendebadel. In most areas the raised marine deposits are ridges of unvegetated quartzite shingle (Figure 11.12). In western Jura the highest coastal terraces decline in altitude from north-east to south-west, from 40 m OD at

Corpach Bay to 24.5 m OD at Inver. The raised beach terraces and shingle spreads were produced in association with the deglaciation of the Late Devensian ice-sheet in western Scotland and their altitudes reflect the effect of subsequent glacio-isostatic uplift.

The Sgriob na Caillich medial moraine

On the western side of the Paps of Jura, there occurs perhaps the finest example of a fossil medial moraine in the British Isles (Dawson, 1979b). It is 3.5 km long and trends approximately NW–SE. It originates at 450 m OD at the western foot of Beinn an Oir (NR 498750) and descends gently to an altitude of 330 m OD before passing over the rock outcrop of Cnoc na Sgrioba (360 m OD). Seaward of this ridge, the boulder belts of the moraine lie on top of a thick till cover, until at 30 m OD, they are truncated by a low cliff and raised coastal platform, both of which are cut in till (Figure 11.13). At the junction of the till platform and the boulder belts is a small lochan (Loch na Sgrioba), impounded by a suite of raised shingle ridges which mantle the platform.

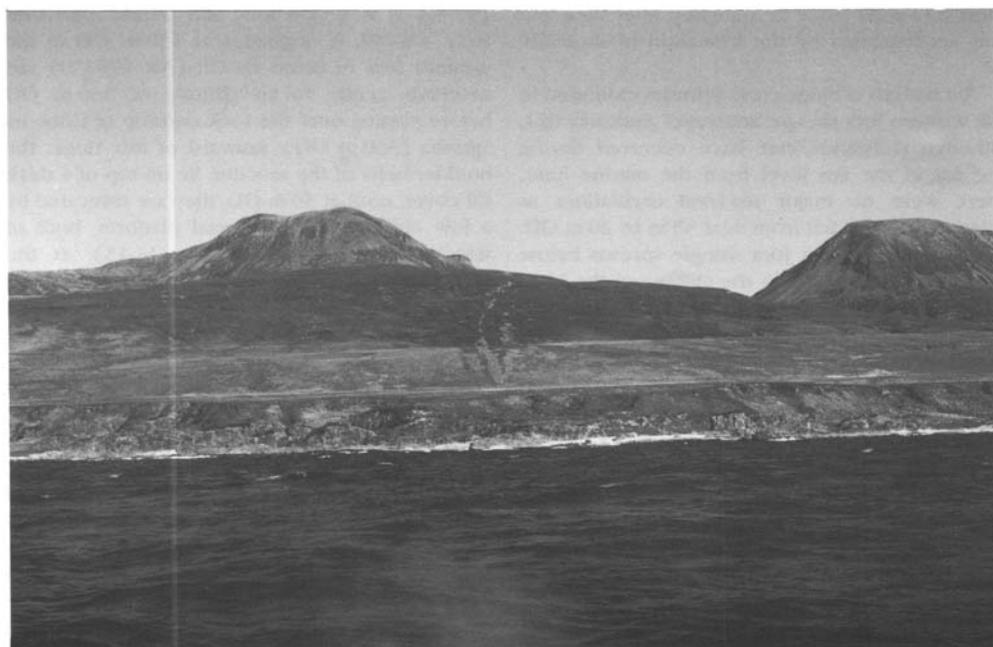


Figure 11.13: West coast of Jura. The Sgriob na Caillich medial moraine (centre) descends to the level of a high raised shoreline. (Photo: D. G. Sutherland.)

The boulder complex is composed in places of up to four parallel lines of angular blocks, each line rarely exceeding 27 m in width and 2.5 m in vertical thickness. The boulders in the belts, almost entirely of Dalradian quartzite (the local bedrock) though occasionally of slate and phyllite, bear no evidence of striation or ice moulding. They range from 0.2 m to 1.3 m in length and contrast markedly with the generally smaller quartzite blocks that are found in local till exposures. Additionally, the mean diameter of boulders measured at 500 m intervals along the feature decreases seaward by 0.07 m km⁻¹.

For most of its length the junction between each belt and the vegetation cover exhibits little variation in relief, though in places it is characterized by small boulder 'cliffs' up to 2 m in height. The main boulder belts are oriented parallel to each other; they are separate units which rarely merge. Coalescence of the belts is limited to the crest and flanks of Cnoc na Sgrioba, where the entire orientation of the feature changes slightly.

Holocene raised beaches

Throughout western Jura, most Holocene beach accumulations mantle the rock surfaces of the Main and Low Rock Platforms. Relatively few raised coastal terraces are present and those that occur exhibit a gradual decline in altitude on Jura from near 10 m in the north-west to 8.5 m in the south-west. Most coastal areas, however, are characterized by banks of shingle and by

shingle ridge 'staircases'. The most spectacular suite of Holocene shingle ridges occurs north of Inver, south-west Jura, where 31 unvegetated raised beach ridges descend from 12.3 m OD to the modern beach (Dawson, 1979a, 1991).

High Rock Platform

The High Rock Platform of the southern Inner Hebrides (see also Northern Islay) was first described by Wright (1911). Although he did not describe the Jura platform, Wright considered that the platform was 'pre-glacial' in age. Later, McCann (1968) provided the first description of the western Jura platform and suggested instead that it was 'interglacial'. Dawson (1979a, p. 161) accepted an interglacial origin for the western Jura (and also the northern Islay) platform but considered that the shoreline had been warped by neotectonic activity. A contrary view was expressed by Sissons (1982b), who proposed that the platforms that comprise the High Rock Platform were produced by cold-climate shore erosional processes and that the features exhibit glacio-isostatic tilting. On that view, the various platform fragments are part of a series of tilted shorelines. However, the available altitudes from the West Coast of Jura and northern Islay do not demonstrate any tilt to the platform, which is therefore regarded as a single feature. Thus there is at present no general agreement on their origin and age. Dawson (1983a) has argued on several grounds that formation of the western Jura platform by cold-climate shore erosion would have taken a minimum of 8000 years. Relative sea-level stability of such duration during a single period of cold climate is unlikely due to glacio-isostatic instability of the land surface and glacio-eustatic changes in sea level. It would therefore appear that the western Jura High Rock Platform represents the product of several periods of Pleistocene coastal erosion.

Main Rock Platform

The platform constitutes part of a glacio-isostatically tilted shoreline that declines in altitude to the south-west, from 6 m OD in northern Jura to sea level in northern Islay (Dawson, 1980b). The shoreline gradient is 0.13 m km⁻¹ and this, together with its rock-cut nature, general altitude and freshness of form, indicates correlation with the Main Rock Platform Gray, 1974a, 1978a). McCann (1968) suggested that this feature exhibited evidence of glaciation, although Dawson (1980b) did not report such evidence, and considered that McCann's evidence for glaciation related to the Low Rock Platform (see below). The origin and age of the Main Rock Platform in western Scotland have been discussed at great length in numerous publications (for example, McCann, 1968; Sissons, 1974d; Gray, 1978a, 1989; Dawson, 1979a, 1980b, 1983a, 1988a, 1989; Sutherland, 1984a). However, the occurrence of the regionally tilted Main Rock Platform in western Jura is of particular significance since it is in this area (and also northern Islay) that this platform merges with and crosses the regionally horizontal intertidal Low Rock Platform (Dawson, 1979a, 1980a) (see below).

Low Rock Platform

Intertidal ice-moulded rock platforms also occur in north-west Jura, northern Islay and neighbouring Colonsay and were first described by Wright (1911) as representing a "...preglacial plain of marine denudation...". Dawson (1980a) referred to the Jura and Islay feature as the Low Rock Platform and explained its regional horizontality as having been produced by marine processes during interglacials. The shoreline is also of considerable significance since the glaciated platform fragments of south-west Jura, northern Islay and Colonsay were considered by McCann (1968) to demonstrate glaciation of the Main Rock Platform.

Late Devensian raised beaches

Analysis of the regional altitude variations of the highest raised beach terraces on the western Jura coast suggest the existence of two shorelines. The older of these (shoreline L1) declines in altitude to the south-west, from 40 m OD at Corpach Bay to 34 m OD at Bàgh Gleann Rìgh Mòr, 1.5 km east of Ruantallain. This raised shoreline is also thought to occur in northern Islay; it has a regional gradient of 0.56 m km⁻¹ (Dawson, 1982). A separate and slightly younger shoreline (L2) is considered to be present in south-west Jura. This shoreline declines in altitude to the south-west, from 31 m OD at Glenpatrick to 24 m OD at Inver and has a regional

gradient of 0.53 m km⁻¹. It was therefore inferred by Dawson (1979a, 1982) that south-west Jura remained ice-covered while shoreline L1 was formed between Corpach Bay and Shian Bay, and also on the northern Islay coastline. Dawson (1979a, 1982) also concluded that, owing to the drop in the marine limit between Corpach Bay and Glendebadel, north-west Jura was also ice-covered during this period. Deglaciation of south-west Jura took place at a slightly later date and was accompanied by the formation of shoreline L2.

The pattern of ridge-crest altitudes exhibited in the western Jura shingle 'staircases' indicates that, although stillstands may have occurred during the fall in the sea level from the marine limit, there were no major sea-level oscillations as relative sea level fell from near 35 m to 20 m OD. Most of the western Jura shingle spreads below this altitude terminate at the cliffline of the Main Rock Platform and consequently patterns of sea-level change lower than 20 m OD cannot be established. One exception, however, occurs at South Shian Bay, where owing to the exceptionally low altitude of the High Rock Platform, raised beach gravels descend to almost 11 m OD (Figure 11.11:A). McCann's (1964) proposal that a major sea-level oscillation is represented in this area by the Colonsay Ridge (a shingle spit) (Figure 11.11) may be correct and, if so, suggests that a pause in the overall fall in sea level occurred when relative sea level at South Shian Bay was at about 19 m OD (see Dawson, 1983a) (Figure 11.11). The other exception is at Lochan Maol an t-Sornaich (NR 547805) where a relative marine transgression is suggested, the sea rising from around 9 m to 14 m OD

The presence on the west coast of Jura of extensive spreads of Late Devensian raised shingle is primarily due to the glacio-isostatic uplift of shoreline L1 and its altitudinal relationship with the till-covered High Rock Platform. Thus upon deglaciation, the maximum level of the sea along this stretch of coast (34–40 m OD) stood several metres higher than the inner edge of the High Rock Platform. Marine erosion of the till cover during the ensuing fall in relative sea level resulted in extensive shingle deposition. This process would have undoubtedly been promoted by the gentle seaward slope of the underlying platform surface and also by the exposure of the coastal zone to the effects of Atlantic waves.

The Sgriob na Caillich medial moraine

Dawson (1979b) argued that the medial moraine was produced during the waning of the Late Devensian ice-sheet. He suggested that the boulders of the moraine were deposited supraglacially from the Beinn an Oir nunatak on to a relatively thin, yet dynamically active, ice mass. Its preservation in the landscape as a series of unvegetated quartzite boulder belts is remarkable. Other medial moraines have been described from former Loch Lomond Readvance glaciers (see for example, Beinn Alligin). Only one similar feature, near Strollamus on Skye (Ballantyne, 1988; Benn, 1991), has been ascribed to the Late Devensian ice-sheet. No other medial moraines in Scotland compare with Sgriob na Caillich in either size or complexity.

Holocene raised beaches

The highest ridge appears to have been produced during the culmination of the Main Postglacial Transgression. Hence the staircase of 31 ridges and intervening swales are likely to have been produced during the last 6000–7000 years, largely as a result of decreasing rates of glacio-isostatic uplift during this period.

Summary

The West Coast of Jura is therefore outstanding for its assemblage of raised coastal landforms and deposits. Both the range of features and their extent and degree of development are exceptional. The interest includes not only examples of the three major rock platforms recognized in western Scotland, the High, Main and Low Rock Platforms, but also spreads of unvegetated Lateglacial and Holocene shingle beach ridges unparalleled elsewhere in Scotland for the length of their morphological record of sea-level changes. The latter features, in particular, distinguish the West Coast of Jura from northern Islay (see above). Elsewhere in Scotland, there are notable sequences of raised shingle ridges at Spey Bay and Tarbat Ness on the Moray Firth coast (Ogilvie, 1923). Those at Spey Bay are comparable in their scale of development to the Jura features but occur in a different geomorphological process environment, being associated with a major river (the Spey) and significant longshore drift.

Moreover, they have not been studied in comparable detail to the features on the west coast of Jura.

Conclusions

The coastline of western Jura is one of the classic localities in Britain for raised beaches (formed by isostatic uplift – see Northern Islay above). It is characterized by a variety of well-developed coastal landforms, of which the spectacular, unvegetated spreads of raised beach shingle (formed during the last 14,500 years) are without parallel in Britain and have allowed a detailed pattern of relative sea-level changes to be reconstructed. The area also includes excellent examples of raised platforms cut in bedrock as well as the finest example of a medial moraine in Britain, a ridge of boulders deposited by the last ice-sheet (approximately 15,000 years ago).

Reference list

- Ballantyne, C.K. (1988) Ice-sheet moraines in southern Skye. *Scottish Journal of Geology*, **24**, 301–4.
- Benn, D.I. (1991) Glacial landforms and sediments on Skye. In *The Quaternary of the Isle of Skye: Field Guide* (eds C.K. Ballantyne, D.I. Benn, J.J. Lowe and M.J.C. Walker). Cambridge, Quaternary Research Association, 35–67.
- Dawson, A.G. (1979a) Raised shorelines of Jura, Scarba and NE Islay. Unpublished PhD thesis, University of Edinburgh.
- Dawson, A.G. (1979b) A Devensian medial moraine in Jura. *Scottish Journal of Geology*, **15**, 43–8.
- Dawson, A.G. (1980a) The Low Rock Platform in western Scotland. *Proceedings of the Geologists' Association*, **91**, 339–44.
- Dawson, A.G. (1980b) Shore erosion by frost: an example from the Scottish Lateglacial. In *Studies in the Lateglacial of North-West Europe* (eds J.J. Lowe, J.M. Gray and J.E. Robinson). Oxford, Pergamon Press, 45–53.
- Dawson, A.G. (1982) Lateglacial sea-level changes and ice-limits in Islay, Jura and Scarba, Scottish Inner Hebrides. *Scottish Journal of Geology*, **18**, 253–65.
- Dawson, A.G. (1983a) *Islay and Jura, Scottish Hebrides: Field Guide*. Cambridge, Quaternary Research Association, 31pp.
- Dawson, A.G. (1984) Quaternary sea-level changes in western Scotland. *Quaternary Science Reviews*, **3**, 345–68.
- Dawson, A.G. (1988a) The Main Rock Platform (Main Lateglacial Shoreline) in Ardnamurchan and Moidart, western Scotland. *Scottish Journal of Geology*, **24**, 163–74.
- Dawson, A.G. (1988b) Western Jura. In *Field Excursion and Symposium on Late Quaternary Sea Levels and Crustal Deformation* (eds A.G. Dawson, D.G. Sutherland and D.E. Smith). INQUA Subcommittee on Shorelines of NW Europe. Coventry, Coventry Polytechnic, 44–67.
- Dawson, A.G. (1989) Distribution and development of the Main Rock Platform, western Scotland: reply. *Scottish Journal of Geology*, **25**, 233–8.
- Dawson, A.G. (1991) Scottish landform examples – 3. The raised shorelines of northern Islay and western Jura. *Scottish Geographical Magazine*, **107**, 207–12.
- Gray, J.M. (1974a) The Main Rock Platform of the Firth of Lorn, western Scotland. *Transactions of the Institute of British Geographers*, **61**, 81–99.
- Gray, J.M. (1978a) Low-level shore platforms in the south-west Scottish Highlands: altitude, age and correlation. *Transactions of the Institute of British Geographers*, N.**3**, 151–64.
- Gray, J.M. (1989) Distribution and development of the Main Rock Platform, western Scotland: comment. *Scottish Journal of Geology*, **25**, 227–31.
- McCann, S.B. (1961a) The raised beaches of western Scotland. Unpublished PhD thesis, University of Cambridge.
- McCann, S.B. (1964) The raised beaches of north-east Islay and western Jura, Argyll. *Transactions of the Institute of British Geographers*, **35**, 1–16.
- McCann, S.B. (1968) Raised shore platforms in the Western Isles of Scotland. In *Geography at Aberystwyth. Essays Written on the Occasion of the Departmental Jubilee 1917–18 – 1967–68* (eds E.G. Bowen, H. Carter and J.A. Taylor). Cardiff, University of Wales Press, 22–34.
- Ogilvie, A.G. (1923) The physiography of the Moray Firth coast. *Transactions of the Royal*

Society of Edinburgh, **53**, 377–404.

Peach, B.N., Wilson, J.S.G., Hill, J.B., Bailey, E.B. and Graham, G.W. (1911) The geology of Knapdale, Jura and north Kintyre. (Explanation of Sheet 28, with parts of 27 and 29).

Memoirs of the Geological Survey of Scotland. Edinburgh, HMSO, 149pp.

Sissons, J.B. (1974d) Lateglacial marine erosion in Scotland. *Boreas*, **3**, 41–8.

Sissons, J.B. (1982b) The so-called high 'interglacial' rock shoreline of western Scotland.

Transactions of the Institute of British Geographers, NS, **7**, 205–16.

Sutherland, D.G. (1984a) The Quaternary deposits and landforms of Scotland and the neighbouring shelves: a review. *Quaternary Science Reviews*, **3**, 157–254.

Ting, S. (1936) Beach ridges and other shore deposits in south-west Jura. *Scottish Geographical Magazine*, **52**, 182–7.

Ting, S. (1937) The coastal configuration of western Scotland. *Geografiska Annaler*, **19**, 62–83.

Wilkinson, S.B. (1900) In *Summary of Progress of the Geological Survey of the United Kingdom for 1899*. Memoirs of the Geological Survey. London, HMSO, 163–4.

Wilkinson, S.B. (1907) *The Geology of Islay, Including Oronsay and Portions of Colonsay and Jura*. (Explanation of Sheets 19 and 27, with the western part of Sheet 20). Memoirs of the Geological Survey of Scotland. Glasgow, HMSO, 82pp.

Wright, W.B. (1911) On a preglacial shoreline in the Western Isles of Scotland. *Geological Magazine*, dec. 5, vol. 8, 97–109.