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## Chapter 36 Post-volcanic and Pre-Glacial

### Introduction

One of the most impressive lessons, which Macculloch, Sir Archibald Geikie, and Professor Judd derived from their study of Mull, is the immensity of the erosion that has affected the district since the extinction of its volcanic fires. It is clear that its typical West Highland scenery has been fashioned during Tertiary and Post-Tertiary times; for its earliest lavas are of Eocene date. The testimony is all the more striking because the texture of many of the Tertiary rocks involved proclaims that they consolidated under considerable cover. The Ben Buie Gabbro, which can be examined through a vertical thickness of more than 2000 ft., is a case in point.

The maturity of the erosion is remarkably evident. The mountainous region of Central Mull stands up above the rest, because it is constituted of relatively resistant intrusions and indurated lavas, which in Ben More reach the highest altitude met with in the Hebrides, 3169 ft. Another feature of maturity is the failure of faults to step the scenery. The best example of this is afforded by the Inninmore Fault, of 1000 ft., or so, downthrow. This dislocation, as Judd realized, introduces a new type of scenery ( (Figure 26), p. 182), without affecting the general surface-level of the ground. Other examples can be drawn from faults of the Gribun Peninsula, one of them with a downthrow of 400 ft. (p. 183). The exposures of the Loch Don Anticline, south of Loch Don ( (Figure 25), p. 174) supply a variant of the same story. Instead of the Tertiary lavas of this anticline towering above their neighbours of the adjoining synclines, they have been entirely stripped away; the whole district has been reduced to an uneven surface, seldom more than 500 ft. above sea-level; and subsidiary ridges and hollows have been developed according to the strength or weakness of the various rock-groups with which erosion is at the present time confronted.

All this is in keeping with what has been established in the other Hebrides, Skye, Rum, etc. It is also at one with the well-known fact that the valley-system of the neighbouring mainland is cut through a great number of Tertiary dykes.

These general statements will now be followed by a consideration of relics of an Early Drainage System, certain Obscure Plateaux, well-marked Notches and Caves of Marine Erosion between 100 and 160 ft. above High-Water-Mark, and the Gribun Landslip.

### Early drainage-system

Mr. Cadell, Sir H. J. Mackinder, Dr. Peach, Dr. Horne, Dr. Bremner and others, including the present writer, have attempted to piece together relics of an old drainage-system which constantly obtrude themselves upon observers in the Western Highlands and elsewhere in Scotland.<ref>For references and discussion see *Geology of Ben Nevis and Glen Coe*, Mem. Geol. Surv., 1916, p. 4.</ref> Such relics undoubtedly occur in Mull; but they present great difficulty of interpretation, owing to the island itself being a mere fragment, isolated by erosion combined with general subsidence. Under these circumstances, there is very little to gain from detailed discussion; but a brief statement of certain facts and hypotheses may be of interest.

A 'through-valley' is traceable from the mouth of Loch Scridain (Sheet 43) east-north-east across the valley-bottom-watershed of Glen More (650 ft), where the road passes north-west of Loch an Ellen (Sheet 44); and thence, past Ishriff almost to Torness. Here, Glen More, followed by its road, takes a right-angled bend, and accompanies the Lussa River to Loch Spelve. Obviously, however, this Torness bend is a mere 'subsequent' development along the 'shatter-belt' of the Port Donain Fault (p. 183). The direct, and almost certainly original, continuation of the Ishriff segment of Glen More is northwards across an almost imperceptible valley-bottom-watershed, and so on into Glen Forsa. The connection between Glen More and Glen Forsa is with little doubt due to a river having once flowed across the site of the now intervening valley-bottom-watershed. The significance, however, of the continuity of Glen More from Loch Scridain to Ishriff is more uncertain. In this latter case, the valley-bottom-watershed may be interpreted, either as a watershed in course of development, interrupting a previously continuous river-bed, or as a watershed in course of demolition. Tentatively, we adopt the former alternative, and shall now sketch the tributary

drainage-system attaching to our hypothetical Scridain-Forsa trunk-river. Even though the trunk may eventually prove to be double, instead of single, this will not seriously affect what is stated below in regard to the tributary system. E.B.B.

The Scridain segment receives an interesting set of 'beheaded' tributaries;—Gleann Seilisdeir from the north (Sheets 43, 44); the Beach River, Glen Leidle, and the Abhuinn Loch Fhuaran from the south (Sheet 44). It is quite clear that this tributary system has been restricted, since its initiation, through the retreat of the Gribun and Carsaig cliffs, and a diagrammatic example of beheading, with development of obsequent streams, has resulted. The modern valley-bottom-watershed of Gleann Seilisdeir is, a delta-watershed, or 'corrom', as is so often found to be the case in beheaded river-valleys. E.B.B. E.M.A.

The Ishriff segment of our hypothetical trunk receives a prominent beheaded tributary from the valley of Loch Airdeglais.

The Glen Forsa segment is joined from the south-west by through-valleys passing Tomsleibhe and Goadhail Cottages respectively. It is quite possible that both these valleys originally headed on the south-east of the Loch Bà. and Glen Cannel hollow, and that they have been subsequently cut across by this great scenic feature of Central Mull along the line where erosion first met the Glen Cannel Granophyre of Chapter 31.

A little beyond its present mouth, the Forsa valley joins with the Loch na Keal hollow and Glen Aros.

The old drainage-system of the West Highlands antedates any parcelling up of the country into 3000-ft., 1000-ft., etc. plateaux, such as is contemplated in the next section. For instance, if a river once flowed from Loch na Keal down Glen Forsa to Salen, it must have started at a time when Mull did not possess a central mountain-group.

## **Obscure plateaux**

There can be little doubt that Mull was an island long before Glacial Times: on the one hand, Late-Glacial and Post-Glacial marine erosion has had but a trifling share in shaping the coastline, and this little has almost been undone by a comparatively recent elevation of the district; on the other hand, Mull stands boldly up from the Continental Platform, a thing apart. The contrast is evident when comparison is made between the Ordnance Survey Map and the Admiralty Chart. Most of Mull rises well above the 500 ft.-contour, whereas a depth of 500 ft. is only met with in the surrounding seas in restricted areas, which themselves appear to be hollows over-deepened by ice-erosion.

To some extent the abrupt rise of Mull from the Continental Platform is due to the fact that its coastal cliffs locally correspond with the escarpment of the Tertiary lavas, particularly along the south-east coast. Such, however, cannot be urged as a general explanation: in the neighbourhood of Ulva, for instance, the Tertiary lavas reach far under sea to Staffa and the Treshnish Isles (Sheet 43); while, in the coastal cliffs south-west of Gribun, gneiss rises as high as 700 ft.

There is evidence of much oscillation in the late Tertiary sea-level. On the mainland, a considerable part of the South-West Highlands is included within the 800 ft. to 1000 ft. Plateau of Lorne. The summit-level of the Lorne Plateau is comparatively independent of geological structure, and is generally supposed to be in close connexion with the position of the sea during some stage of the Pliocene. It is difficult to resist the view that the eastern corner of Mull, extending a mile inland from the road connecting Loch Don and Loch Spelve, is a rather low continuation of the Lorne Plateau—unless much of it be referred to the lower platform of the Ross discussed in the following paragraph. Its interior margin cuts right across the course of many important Early Basic Cone-Sheets. Perhaps, indeed, it is not too much to claim that the greater part of Mull, with the exception of the central mountains and the Gribun peninsula, bears testimony to the same base-level of erosion as is responsible for Lorne. It has already been pointed out that central Mull rises above peripheral Mull on account of its greater hardness; but some additional factor is required to explain why peripheral Mull so often approximates to the summit-level of the Lorne Plateau.

At a level distinctly lower than that of most of peripheral Mull, the western extremity of the Ross (Sheet 43) constitutes a rocky flat-topped ridge rarely rising more than 300 ft. above the sea. The greater part of this ridge is constituted of old gneiss and granite; and it is tempting, at first sight, to see in it a relic of a resistant platform, from which Mesozoic sediments and Tertiary lavas have been stripped. This, however, cannot be the case, for the margin of the low ground is

cut well within the lava-country, and includes the Ardtun Peninsula along with a strip reaching thence south-east towards Shiaba, E.B.B.

## **Notches and caves, 100–160 ft. above High-Water-Mark**

( (Figure 65), p. 395).

The time-relations of the comparatively high platforms of the previous sections to the more or less submerged platform, also mentioned as responsible for our present coast-line, provide questions too difficult to be discussed at this juncture. One thing, however, is clear: at a late stage in Pre-Glacial times, when previous erosion had determined much of the present-day coastal form of the island, a submergence took place which has left pronounced traces from 100 to 160 ft. above the modern high-water-mark.

That the 100–160 ft. Pre-Glacial beach-notches of Mull and district are of later date than a much more extensive marine-erosion, with an upper limit more closely approximating the present sea-level, may be inferred from two main observations:

1. In the Gribun Peninsula south of the entrance to Loch na Beal (Sheet 43), and, again, along the -coast of Loch Tuath northward to Caliach Point (Sheets 43 and 51), a Pre-Glacial notch at about 115 ft. above high-water is traceable as a minor, though very striking, feature of the coastal cliff. It is incredible that this notch could have originated as an extensive platform, and then be reduced to its present narrow dimensions by subsequent marine erosion at a lower level, without a much more pronounced loss of continuity. W. B.W., E.B.B.

2. At the head of Loch Scridain (Sheet 44), a Pre-Glacial notch is found at about 160 ft. above high-water cut into obvious pre-existing valley-sides, where it can be followed in and out of tributary hollows which descend below its level. The valley-sides lead down to a pronounced, moulded and striated, rock-platform, a part of which is covered at high tide. E.M.A.

The Pre-Glacial notch at about 115 ft., is more continuously preserved than anything of the same kind at higher elevations. It was originally traced by Mr. Wright with the aid of a grant from the Royal Society of London<ref>W. B. Wright, On a Pre-Glacial Shore-line in the Western Isles of Scotland, Geol. Mag., 1911, p. 97.</ref>. He had previously, in 1907, discovered its counterpart in Colonsay (Sheet 35) during his work there for the Geological Survey. The subsequent examination of the Mull district by various members of the Geological Survey, after Mr. Wright had left Scotland, has confirmed his observations, and added to them three important records, all of which, curiously enough, belong to rather higher levels: these three are the notch at the head of Loch Scridain (Sheet 44), another at Kilchoan, Ardnamurchan (Sheet 52), and the sea-cave of Ulva (Sheet 43), to which last our attention was directed in 1920 by Mrs. Clark of Ulva House. Before considering these last three additions, an account will be given of the more familiar occurrences which seem to group themselves about the 115-ft. level. E.B.B.

At the outset, it is important to state why this bench, or platform, of marine erosion is attributed to Pre-Glacial times rather than to the Late-Glacial submergence which has left such evident traces in the 100-ft. gravels, etc., of many parts of Scotland including Mull:

1. In the following descriptions, it will be shown that striae have been preserved on the cliff behind the notch at Rudha nan Goirteanan, that ice-moulding of the platform is a feature of the Treshnish Isles, and that boulder-clay, capped by 100-ft. Late-Glacial gravel, has been found on the rock-platform at Crackaig. The Rudha nan Goirteanan and Treshnish Isles evidence is in keeping with what is very fully seen in Colonsay outside our area; and the Crackaig evidence is similarly repeated much more clearly in Islay. It must not be considered surprising that so few striae have been found on what is termed the Pre-Glacial notch of the Mull district, for it happens that practically no striae have been preserved anywhere in its neighbourhood irrespective of level.

2. The locally pronounced featuring of the notch is curious when taken in conjunction with its tendency to disappear altogether. The conclusion is forced upon us that the notch has in many places been obliterated by erosion. Now the

Late-Glacial 100-ft. beach-deposits have so often been spared by subsequent erosion, that, if the cliff of the notch we are considering belonged to the same Late-Glacial time, we should expect it to have a comparable distribution—but such is not the case. This evidence is in keeping, of course, with the local discoveries of boulder-clay between the Late Glacial beach-deposits and the Pre-Glacial platform where the two are found together. It is also in keeping with the modification of the cliff behind the notch into a slope (without corresponding scree) in the Dutchman's Cap of the Treshnish Isles.

In describing the 115-ft. notch, we shall begin with its more southerly occurrences in Mull, and, after working our way northwards along the coast, strike out for the islands; these latter, as a matter of fact, are in a sense always with us, prominent objects of the seascape.

### **Mull, Gribun Peninsula**

Outside the mouth of Loch Scridain, above Macculloch's Tree, Rudha na h-Uamha (Sheet 43), a well-marked notch is traceable, cut in the lavas of the sea-cliff, with its inner angle now choked with scree. Levelling by Abney showed it to lie about 110 ft. above high-water-mark of ordinary spring tides; but this was at a point where the narrow platform was passing beneath scree, and its inner angle is probably a little higher, say 115 ft.

Farther north, beyond the great modern landslips of the Wilderness, the notch is manifest again. It is particularly clear at Rudha nan Goirteanan, where it is seen wholly cut in Moine gneiss. The angle is often choked with basalt-scrée from the higher part of the cliffs behind. The only measurement taken for the platform was 98 ft., but the inner angle is probably a few feet higher. When first described, it was only possible to state that the gneiss of both platform and cliffs is somewhat rounded and moulded. Mr. Bailey has since found striae running S.W. on the surface of the cliff. A little farther along the coast, there is another good example of the notch to be seen above Stac Glas Bun an Uisge. It can also be recognized for half a mile east-north-east of Sgeir na Faolinn. In both these localities, the notch is cut in the coastal cliff of Moine gneiss. Farther north-east above Port Uamh Beathaig, Mr. Bailey has traced what he takes to be the inner edge of the terrace for quarter of a mile, until lost sight of beneath a landslip. The notch here is cut in Trias, and its inner angle lies at 135 ft. above high-water-mark as determined by sextant.

### **Mull, north of Loch na Keal**

The same notch reappears as a coastal feature north of Loch Tuath, where it can be followed almost continuously from Port Burg to Treshnish Point, just beyond the north edge of Sheet 43. The cliff above is generally about 200 ft. high, and the cliff below about 100 ft., often bathed at its foot by the sea. The whole is cut in the lava-series, and the level of the notch, like that of the modern shore, is influenced by the relative strength of the gently inclined basalt-flows. Where it is cut in soft slag overlying a massive band, it may reach a comparatively low level at one point, and a comparatively high level at another, depending on the height at which the junction between slag and solid occurs. Such range in level varies from about 100 to 125 ft. above high-water-mark. At the same time, the general persistence of level within these limits, for a distance of about 5 miles, clearly proves the marine origin of the bench. Mr. Richey has found a patch of boulder-clay on the platform at one point, the boulder-clay itself overlain by gravel attributable to the Late-Glacial 100 ft. beach. The locality is marked by a note on the one-inch Map (Sheet 43) just south of Crackaig, and the exposure occurs in the seaward cliff terminating the bench. Opposite a hollow in the Pre-Glacial cliff, east of Rudh' a' Chaoil, the surface of the platform has a distinctly ice-moulded appearance. It is a pity no striae have been found on cliff or platform, but striae are very poorly preserved everywhere in this part of the Mull district.

The southern shores of Calgary Bay (Sheet 51) show only poor remnants of the Pre-Glacial beach serving locally as a platform for the road. On the northern shores, however, the notch resumes the magnificent development exhibited farther south, and this it maintains round the coast of Mornish as far as Caliach Point. It is, in fact, a conspicuous object from the tourist-steamer plying between Oban, Staffa, and Iona. In one or two places, its surface has an appearance of ice-moulding. An Abney-level measurement gave 115 ft. about a mile south of Caliach Point; but similar variations, 105–120 ft. are met with here as farther south. Another estimate at the head of Calgary Bay gave 110 ft. above high-watermark, with variations between 95 ft. and 115 ft.

### **Gometra and Ulva**

Our remaining records lie outside Mull. In Gometra (Sheet 43), the platform is much dissected by hollows and geos, but the remnants of it maintain, on the whole, a fairly uniform level, and the old cliff behind is very well-preserved. The inner angle is distinctly marked for a distance of about a mile and a half around the west and south sides of the island. At its northern extremity, it is finely developed at a height of 105–118 ft. above high-water-mark. On the south coast, on both sides of Gometra House, measurement gave 110 ft. for the inner angle. Traced east, it appears to decline, and successive readings by Abney-level gave 105, 100 and 95 ft. within half a mile of Gometra House. The southern angle of Ulva, reaching out towards Little Colonsay, seems to be referable to the same platform; but much the most important evidence of Pre-Glacial marine erosion in this part of the district is afforded by the Ulva Cave to be described presently.

## Treshnish Isles

Of the Treshnish Isles (Sheet 43), only two, the Dutchman's Cap (Bac Mòr, the equally descriptive Gaelic name, means Great Shield) and Lunga, rise high enough to show the Pre-Glacial shore-line.

In the Dutchman's Cap, a broad platform, belonging to the Pre-Glacial beach, forms the rim, and a central eminence, rising 284 ft. above O.D., forms the crown. The platform includes more than two-thirds of the whole, and is almost entirely below the 100 ft. contour. The platform slopes gently, and is higher at the north end. It tends to follow the surface of successive resistant lava-flows dipping gently towards the south or south-west. Measurement from the upper limit of *Balanus* on the rocky modern shore gave 75 or 80 to 90, or possibly 95 ft. for the inner angle of the platform round the south edge of the central hill. The general level of outlying portions of the platform here was 70 to 75 ft., rising nearly to 80 ft. in Bac Beag. At the north end, the inner angle lies at from 90 to 95 ft.; and, at the extreme north end of the island, the platform is about 97 ft. above the *Balanus*-limit. Everywhere, the platform is remarkably ice-moulded. No striae have been observed, but *roches montonnées* are obvious; they indicate ice-flow from the north-east or east-north-east.

Lunga, the largest of the Treshnish Isles, has a still more extensive platform. At the north end of the island, this platform tends to follow the top of a very massive lava. Its inner angle, at the ruined houses, is just 100 ft. above high-water-mark. Southward along the east side of the island, it rises steadily to 110 ft. or more. It then abandons the massive lava mentioned above, and starts again, south of Cruachan, at a lower horizon in the volcanic series, and only reaches to 80 or 85 ft. above high water. Along the north, east, and south of Lunga, ice-moulding of the platform from the north-east or east-north-east is very pronounced; though no striae have been found.

## Iona

Somewhat indeterminate traces of the platform reappear in Iona. W.B.W.

The remaining occurrences to be noted all seem to occur at an unusually high level. The significance of this characteristic is at present doubtful. There is clearly opportunity for a difference of judgment in taking measurements of rather ill-defined features, such as inner angles of marine platforms; and there is also the possibility that the features under consideration may not belong all to the same epoch, or that, if they do, their subsequent history of elevation may differ in detail.

## Loch Scridain

A beautifully ice-moulded and striated rock-notch can easily be followed for about a mile along the hill-side north of Loch Beg at the head of Loch Scridain, where its course is laid down on the one-inch Map, Sheet 44. What is evidently the same notch can be picked up again as a scenic feature on the south side of the loch, above the Hotel, but is less well-defined, and has not been inserted on the one-inch Map. Readings with a sextant gave 160 ft. above high-water-mark. This is higher than any corresponding observation in the Hebrides, including even the floor-level of the Ulva Cave. The notch evidently marks an old beach-line because of its horizontality. It cannot be attributed to a glacial lake, as there is no corresponding deserted outlet which could have determined a persistent lake-level at this height. Moreover, it is incised in particularly hard rocks, demanding a length of time for its formation which seems out of keeping with a lake-hypothesis—it will be remembered that the Parallel Roads of Glen Roy are merely fashioned in morainic cover, not rock. The striae which cross it conform with the striae at a higher level, and are evidently the work of land-ice.

It can scarcely be claimed that the beach is of Late-Glacial age, affected by a readvance of the land-ice of the period. Late-Glacial raised beach-deposits at about the 100-ft. level, are well-known in Mull; indeed, they occur at Rossal Farm close by; but Mr. Wright has pointed out that these high-level Late-Glacial Leach-deposits are never found in any but accidental connexion with rock-notches of appreciable dimensions. The Rossal gravels just mentioned, are, for instance, obviously later than the glaciation of the notch occurring west of their position. E.M.A

### **Ulva Cave**

The Ulva Cave lies 300 yds. south-west of the summit of A' Chrannag, at the foot of a conspicuous basalt-lava escarpment. Its presence cannot be attributed to any local weakness in the basalt. It is manifestly a sea-cave. Its entrance is at present 10 ft. high and 25 ft. wide, and is partially blocked by a fall from the cliff. Inside, the cave is roughly circular in plan and is 48 ft. deep, measured inwards from the mouth, and 42 ft. broad. At its eastern end, it is 25 ft. high. The floor was examined by digging a trench 6 ft. long, and the same deep, about its middle. Boulder-clay was encountered immediately below a thin layer of animal-manure, and continued without change to where it appeared the rock-floor was reached—there was no intervening gravel. The included stones range exceptionally to a foot in diameter, and are subangular, a few showing striation. They consist of basalt, gneiss, granite, and Lower Lias fossiliferous limestone, in about equal proportion: so that, altogether, foreigners from the Sound of Mull and Morven far outnumber basalt derivable from Ulva or Mull. The matrix of the deposit varies from clay to loam. The clay-matrix often shows slickensiding, especially near stones; and rootlets have frequently penetrated along the resultant smoothed surfaces. The height of the partially blocked cave-entrance, measured by sextant, is 155 ft. above high-water-mark. The floor, where met in the trench, is at 147 ft.

### **Little Colonsay Cave**

A much less striking cave occurs 100 yds. north-west of the summit-cairn of Little Colonsay, at the foot of a prominent lava-scarp. Accurate measurement of level has not been made, but a fair approximation gave almost the same figure as for the Ulva Cave.

The dimensions of the cave are 15 ft. deep, 8 ft. broad, 3½ ft. high. No boulder-clay was noticed. G.A.B.

### **Kilchoan, Ardnamurchan**

A level rock-notch is a conspicuous feature of the hill-slopes above Kilchoan on the Sound of Mull (Sheet 52). At its north-east end, it was found to stand 145 ft. above O.D., measured with reference to a convenient bench-mark. This might mean rather less than 140 ft. above high-water-mark, but still a few feet higher than is common on western Mull. The Pre-Glacial date of the notch, which was first investigated in 1921, follows with probability from the following observations:

1. No gravels are preserved in connexion with the notch. The highest gravels are those of the Late-Glacial 100-ft. beach exposed, for instance, at the Free Church Manse.
2. The platform of the notch has- suffered a remodelling by erosion, which does not seem to have affected the Late-Glacial and Post-Glacial beach-gravels, occurring as well-preserved flats at lower levels. A.E.R.

### **Gribun Landslip**

Mull includes several considerable landslips. The majority are clearly of Post-Glacial, or Late-Glacial, date, and are accordingly treated in the following chapter. The most massive landslip, however, is almost certainly Pre-Glacial. The Gribun road traverses its slopes a little north of the stream at Balmeanach (Sheet 43). The mass is in large measure a coherent rock-slip consisting of lavas and mesozoic sediments. Its total length is little under half a mile. Its Pre-Glacial age seems certain from the fact that it has lost all trace of landslip-featuring, although its tilted and somewhat broken constituents afford a striking enough scenic contrast to the escarpment from which they have broken away.



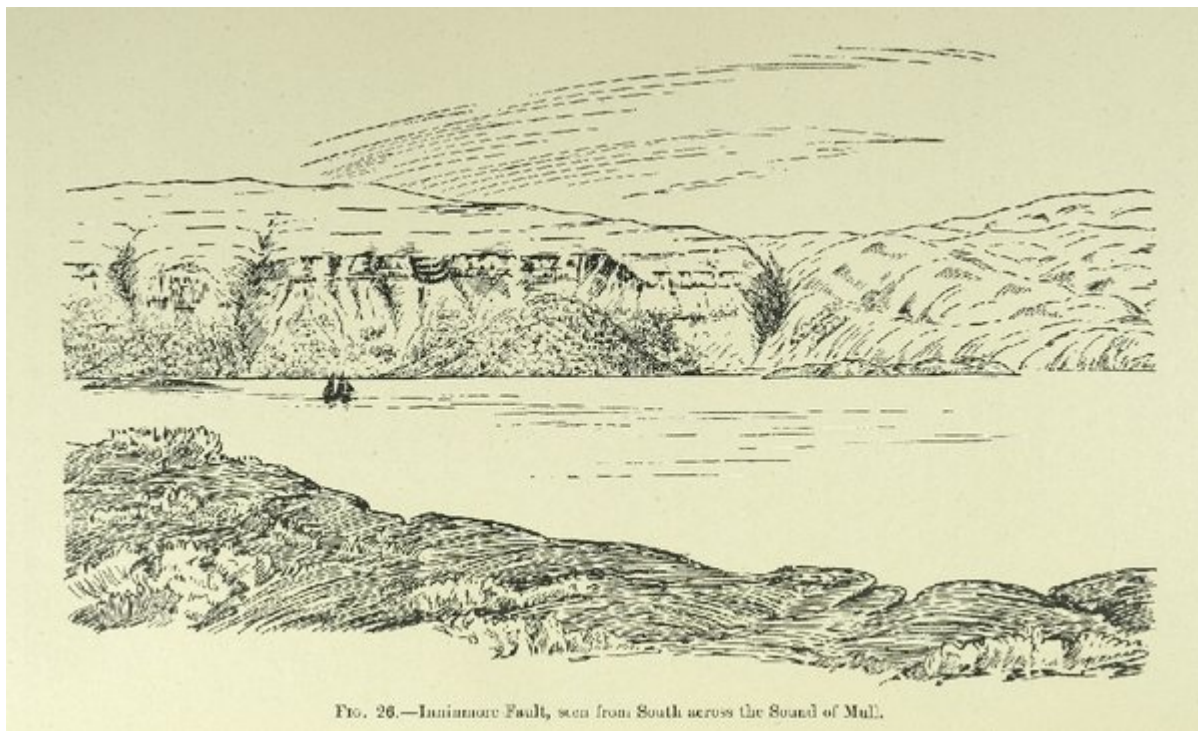
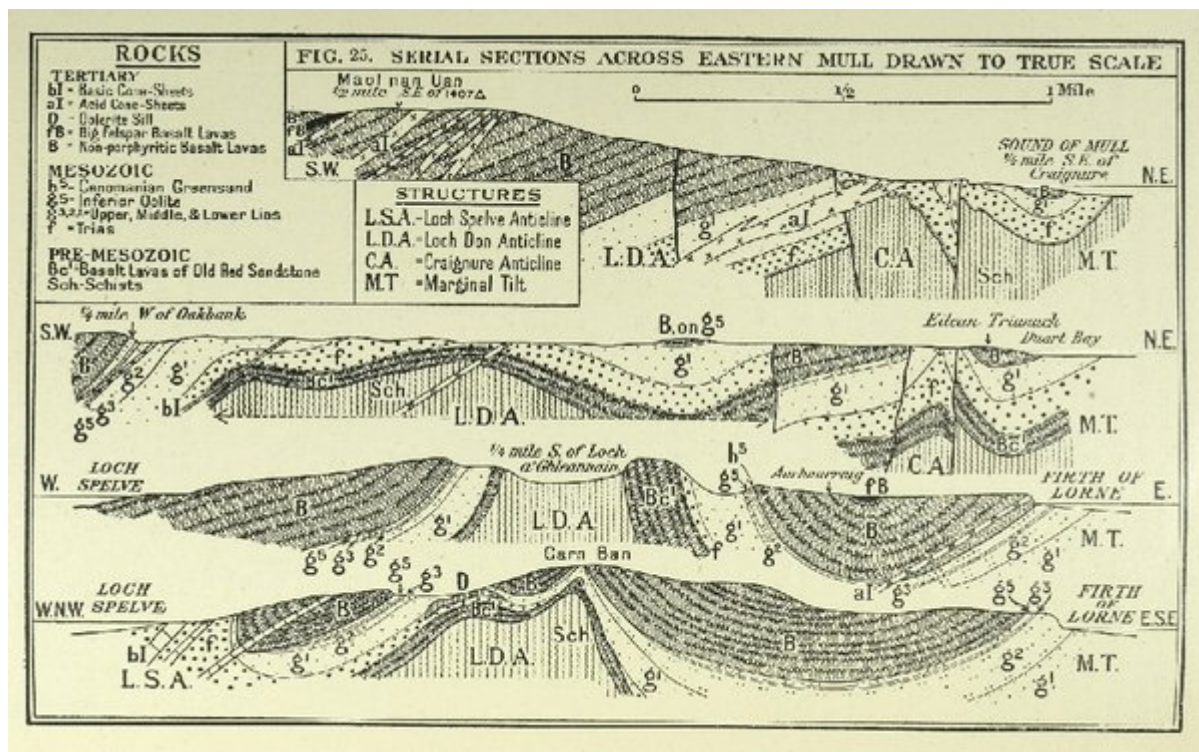


FIG. 26.—Inninmore Fault, seen from South across the Sound of Mull.

(Figure 26) Inninmore Fault, seen from South across the Sound of Mull.



(Figure 25). Serial sections across Eastern Mull drawn to true scale. Rocks, Tertiary: bl = Basic Cone-Sheets al = Acid Cone-Sheets D = Dolerite Sill fB = Big Felspar Basalt Lavas B = Non-porphyrific Basalt Lavas. Mesozoic: h<sup>5</sup> = Ceitomanian Greensand g<sup>5</sup> = Interior Oolite g<sup>3,2,1</sup> = Upper, Middle, & Lower Lias f = Trias. Pre-Mesozoic: Bc<sup>1</sup> = Basalt Lavas of Old Red Sandstone; Sch = Schists. Structures: L.S.A. = Loch Spelve Anticline. L.D.A. = Loch Don Anticline. C.A. = Craignure Anticline M.T. = Marginal Tilt.

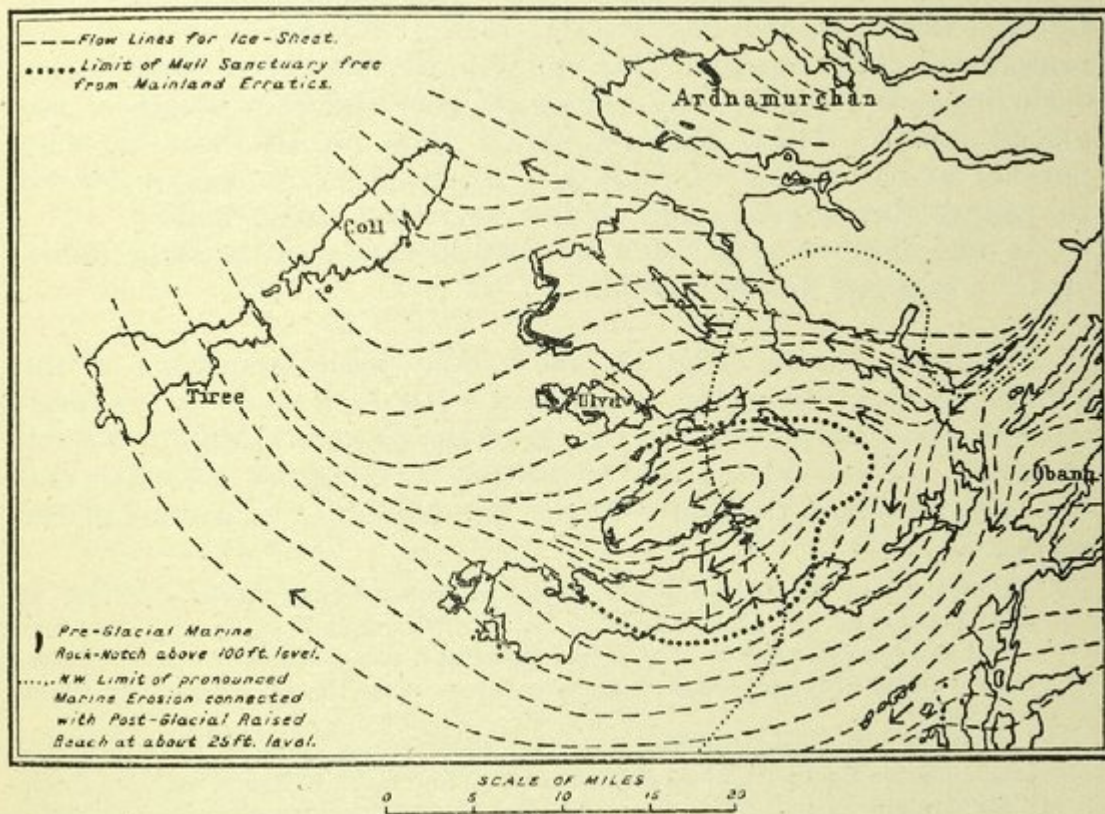


FIG. 65.

(Figure 65) General Glaciation of District, and some Raised-Beach phenomena.