Excursion 4: Corrie Shore

((Figure 9), localities 1 to 12)

The main purpose of this excursion is to examine the Carboniferous rocks of Arran in an area that is readily accessible and where the succession of rock types is clearly displayed. The succession on the Corrie shore is illustrated diagrammatically in (Figure 10). The thickness of the Carboniferous sedimentary rocks present is very approximately 295m, made up of Coal Measures, about 75 m; "Millstone Grit" (Passage Group), perhaps 9m; Carboniferous Limestone Series, about 120m; and Calciferous Sandstone Series, about 90m. A group of basaltic lavas, approximately 115 m thick, is intercalated near the base of the Calciferous Sandstone Series.

The excursion also offers an opportunity of examining the junctions of the Carboniferous strata with the underlying Old Red Sandstone and the overlying Permian.

1. [NS 0209 4449] Examine at this locality the exposures of red, cross-stratified and often coarse-grained sandstones belonging to the Upper Old Red Sandstone, dipping to the southeast at angles of between 24° and 30°. Note that the dips steepen locally in the vicinity of small crush-lines or faults. At the roadside there is a huge erratic block of granite known as the Cat Stone (Gaelic, Clach a'Chait); its dimensions are approximately 4.3 m high, 5.5m long and 2.75 m wide.

2. [NS 0212 4441] A band of reddish conglomerate, 21 m or so thick, outcrops here, and is followed in upward succession by a series of red cross-stratified sandstones, sometimes showing on their upper surfaces many irregular ridges which may represent infilled mud-cracks. These sandstones continue along the shore until another red conglomerate band is reached underlying the lowest cornstone bed (*b*)of locality 3. The Upper Old Red Sandstone in the vicinity of localities 1 and 2 shows a derivation from the south to south-southeast.

3. [NS 0233 4415] Examine the upward succession of rock types exposed at this locality and note their variable and often disturbed character. Succeeding the red sandstone at locality 2 is a second band of red conglomerate 12 to 15 m thick, which is followed by some 9m of strata which include three bands of nodular cornstone. The sequence from above downwards is approximately as follows:

(e) Cornstone, pale-coloured, sandy, nodular, about 75cm.

Gap in succession, say 90cm.

(d) Cornstone, nodules in red shaly matrix, about 4.5m. (c) Mudstones, red, with bands of pale-grey sandstone, about 1.2m.

——Line of disturbance——

(b) Cornstone, pebbly, associated with calcareous sandstone, 1 m.

(a) Conglomerate, massive, reddish, up to 15 m.

Gunn (1903, p. 38) regarded bed (a) as the highest member of the Upper Old Red Sandstone and the junction with the pebbly cornstone (bed b) was taken by him as "clearly an unconformable one". The writer considers that the junction between the two systems may be drawn more fittingly just above (e).

4. [NS 0235 4407] The highest of the three cornstones is succeeded by a series of generally pale-coloured sandstones inclined to the southeast at angles of about 25° to 28°. These sandstones, 6m or so thick, are followed by a coarse agglomerate of at least 15m in thickness made up of fragments of basalt lava similar in type to the lavas of localities 5 and 6.

5. [NS 0408 3403] Examine at this locality the lower part of the lavas (Volcanic Group of Calciferous Sandstone Series), showing dark-blue to purplish olivine-basalts with phenocrysts of augite, olivine and occasional plagioclase feldspar. Good examples illustrating weathering into spherical masses can be seen here. Note the large granite boulder known as Clach an Fionn on the shore side of the Corrie road.

6. [NS 0467 3376] The upper part of the lava succession is made up of purplish olivine-basalts, generally fresh and providing excellent specimens for microscopic examination. A section of a sample collected from the shore opposite the schoolhouse is reproduced in plate II (fig. 9). A search should be made for the slaggy, decomposed, amygdaloidal tops of individual flows. Thin ramifying veins of calcite are common near the top of the group.

The lavas are overlain by reddish sandstones and shales, including a 46cm red limestone bed which dips southeast at about 25°. Some of the sandstones carry small fragments of volcanic ash. These beds are followed in turn by a band of purplish basalt lava 3.0 to 3.6m thick, much veined by carbonates.

7. [NS 0243 4375] There is a gap in the shore-section above the last lava of locality 6, a gap possibly representing some 9 to 10.5m of soft beds. The next beds exposed are massive sandstones, pale-grey in colour but locally with a reddish staining. At one time they were quarried along their outcrop both on the shore and for some little distance inland. Overlying the sandstones come soft reddish mudstones, which, however, are poorly exposed and must be looked for carefully. One sample obtained by the writer contained a fragment of a ribbed brachiopod shell. The shales underlie the thick Corrie Limestone of locality 8.

8. [NS 0230 4373] The Corrie Limestone is the basal member of the Carboniferous Limestone Series in Arran (see table, p. 31). It has been excavated to form the old harbour at Corrie, and has also been extensively quarried and mined along its outcrop inland for a distance of nearly 365 m. The present face shows the limits to which quarrying has been carried, and along it a number of day-holes ("ingaun e'es", as they used to be called) indicate entrances to the old underground workings. Good sections of the limestones and of the overlying beds can be seen at various points along the present face, and at the entrances to the mines, **but the visitor should on no account attempt to penetrate the galleries as there is a danger from possible roof-falls**. The limestone is said to have been 6 m thick, but only some 3.6 to 4.3 m of good limestone, forming the upper part of the seam, is actually visible. It is overlain by a cover of reddish siltstones and shales, reaching in places a thickness of 9m.

The limestone is divided into separate beds, or posts, by partings of reddish fossiliferous calcareous shales, and on the upper surfaces of these beds there are numerous shells of the large brachiopod *Gigantoproductus giganteus.* A layer packed with specimens of this species forms a striking feature of the roof of the old workings. Both the calcareous partings and the intermediately overlying shales contain a rich fauna including brachiopods, lamellibranchs, gastropods and cephalopods. A list of species obtained from the shales above the limestones is given in the Arran Memoir of 1928 (p. 62). The limestone was formerly worked and calcined for local use, as well as for export, and the remains of old kilns still exist close to the main road. A bulk sample representing the whole face exposed was analysed some years ago in the laboratories of the Macaulay Institute for Soil Research, Aberdeen, and showed 88.21% calcium carbonate, 1.3% magnesium carbonate and 10.29% insoluble residues (including 7.33% silica).

Note the two thin dykes cutting the limestone, one a little above the old lime-kilns, the second 45 m or so higher up.

9. [NS 0286 3300] Examine the strata that intervene between the Corrie Limestone and the lowest limestone of locality 10, that is, the strata which are regarded as corresponding to the Lower Limestone and the Limestone Coal Groups of the mainland succession. Their thickness may be estimated as about 76m. Following upon the shales and limestones seen above the Corrie Limestone comes a series of thick white or faintly pinkish sandstones alternating with bands of shale. Some of the white sandstones are fine-grained and exceptionally pure, with a high silica content. They can be seen in the rough ground in the wood above Corrie Village, where there are overgrown quarries in which they were worked in the early part of the 19th century. Hard, compact sandstone is also exposed on the foreshore where it forms a large projecting mass of rock which was also quarried to supply large blocks for harbour construction in the Isle of Man. The site of these old excavations was later used as a convenient access and landing stage for the ferry boats from the Brodick steamers and the part of the rock left and used as a jetty was then known as the Ferry Rock. The ferry ceased

operations in 1939. The beds exposed above the sandstone on the shore include a few seat-earths, interbedded with sandstones, shaly sandstones and shales which extend southwards to a little beyond the Ferry Rock, but no trace of coal can be seen.

10. [NS 0185 3321] Note here the reddish limestone, 60 cm or so in thickness, which has been tentatively correlated with the Index Limestone at the base of the Upper Limestone Group of the mainland. It has yielded among other brachiopods, the form *Productus latissimus* together with small gastropods and a few lamellibranchs. Several higher marine limestones, ranging in thickness from 30 to 90 cm and separated by shales and occasional sandstone beds, are present. The strata including them extends southwards to the little bay in front of the hotel. All these beds are placed tentatively in the Upper Limestone Group. Owing to the lack of continuous exposures and to the occurence of small faults or crush-lines, their thickness can only be approximately estimated at about 42m.

11. [NS 0260 4325] Under this locality number are included all the strata seen in the bay a little south of the Corrie Hotel. Concerning these Gunn (1903, p. 41) said: "The beds in this bay are classed with the Coal Measures, as they contain organic remains of Upper Carboniferous facies, but they and the equivalent beds elsewhere may possibly be Millstone Grit." As a result of the research carried out by Leitch during his revision of the Upper Carboniferous rocks of Arran (1942, pp. 141–154), they must now be placed in the Productive Coal Measures. The detailed section recorded by Leitch gives a thickness of 84 m for these Upper Carboniferous strata at Corrie, the lowest bed being a 9 m of massive white sandstone with a conglomeratic base. The sandstone may be equivalent to the upper part of the Passage Group, the conglomeratic base representing the unconformity of early Passage Group times which is known over much of Lanarkshire. The detailed section is reproduced below:

	m
Highly contorted sandstone, forming local top of Coal Measures	2.4
(Thin sill intruded here)	
Cross-bedded and slightly contorted sandstone	1.5
Red shales with "mussels"	3.0
Ribs of cross-bedded sandstone	1.8
Purple shales with "mussels"	3.0
Gap	?
Sandy shales	0.9
Red papery shales with "mussels" at base	7.3
Marl and shaly sandstones	3.0
Red and purple shales	4.0
Fireclay, irregular	2.1
Shales	2.4
(local unconformity)	
Purple shaly sandstone and marls with several fireclays (local unconformity)	15.2
Fireclay	4.9
Clayey, hummocky sandstone	3.0
Sandy shales	1.8
Marls or fireclay	2.7
Sandstone	3.7
Fireclay	1.8
Cross-bedded sandstone	6.1
Shales with plant-remains	0.8–0.6
White sandstone	0.6
Fireclay	1.8
Shales	0.6
Massive, white sandstone with conglomerate at base	9.1

This table shows that at three horizons in the upper part of the succession, beds of reddish mudstone yielded to Leitch non-marine lamellibranchs referable to the *modiolaris* zone of the mainland. The approximate distance of these horizons below the Carboniferous-Permian junction and the "mussels" recorded from each are:

Red mudstones from 4 to 7m below the junction:

abundant small oval shells referable to *Carbonicola aquilina* and C. *elliptica.*

Purple mudstones from 8.8 to 11.9m below the junction:

Carbonicola aff. *aquilina, C.* cf. *phrygiana C.* cf. *regularis* and *Naiadites triangularis.*

Red papery mudstones a little lower down:

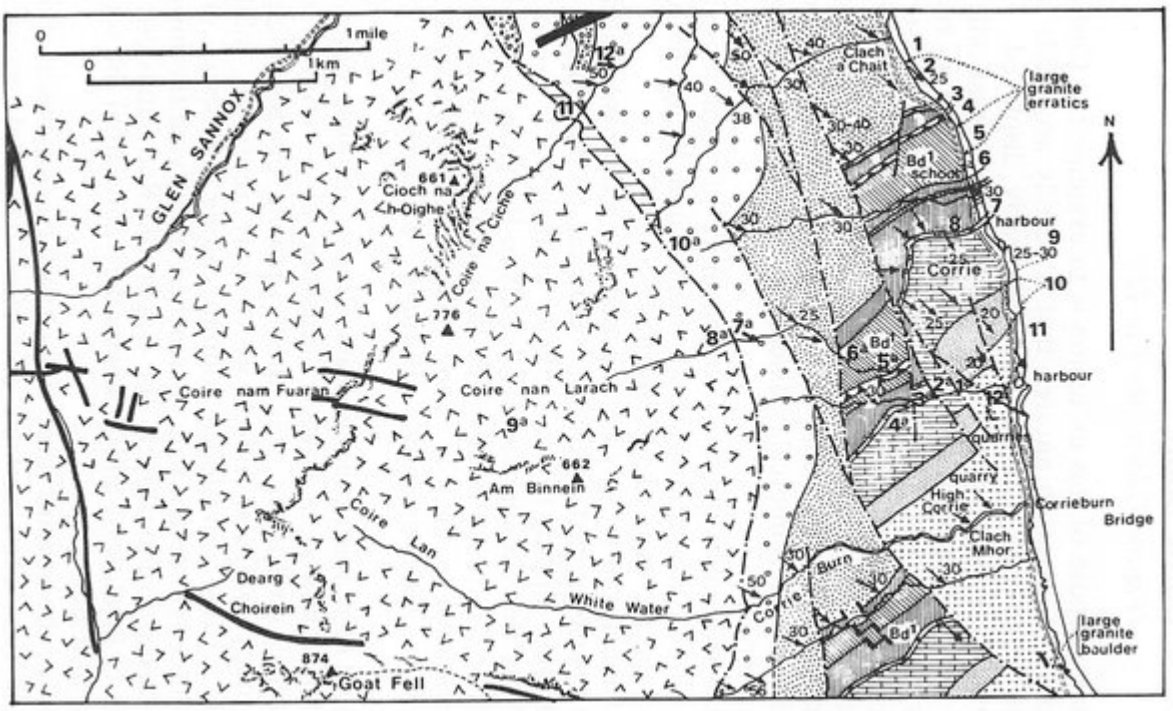
Carbonicola oslancis and *C.* cf. *rhomboidalis.*

The range and distribution of the non-marine lamellibranch zones in Arran are briefly discussed on p. 35. It should be noted that while the *modiolaris* zone of the mainland succession includes a number of workable coal seams, there are no traces of coal anywhere in the Corrie section. Apart from the fossiliferous mudstones already mentioned, the sediments consist of thin-bedded sandstones, sandy shales, and fireclays or manly fireclays carrying rootlets. The sedimentary structures present, such as small-scale cross-bedding, contorted bedding, flow bedding and minor unconformites or non-sequences point to deposition on a deltaic platform. Leitch (*ibid.,* p. 151) has suggested that the absence of coals in the "Coal Measures" of Arran is "presumably due to the marginal position of these areas in relation to the main coal basin of Carboniferous sedimentation". It is certainly remarkable that coals of workable thickness (up to 1.7 m) occur in the Productive Coal Measures at Machrihanish, 43 km or so southwest of Corrie as well as on the Ayrshire coast, some 23 km to the east. It would seem that conditions at Corrie were never sufficiently stable to allow the growth of swamp-forests.

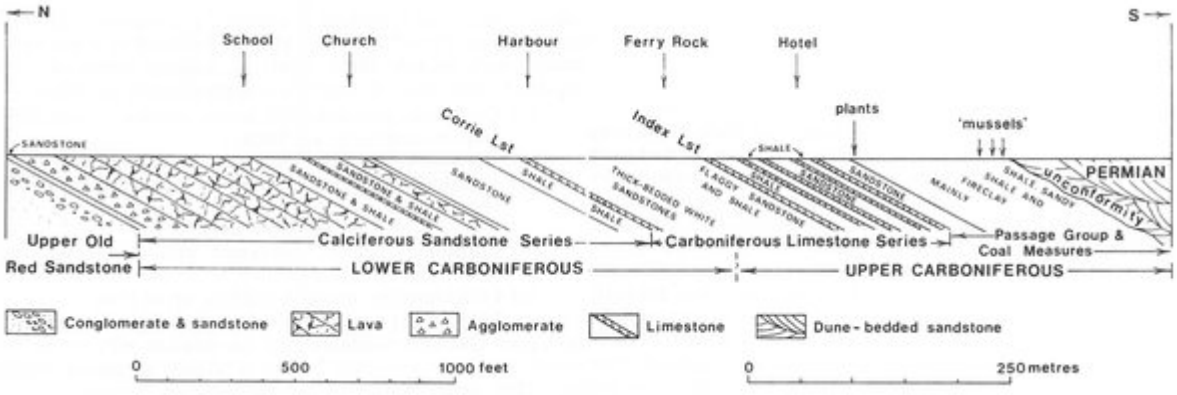
12. [NS 0258 4296] The unconformable junction of the Carboniferous beds with the Permian (Corrie Sandstone) at this locality should be carefully examined. Note the sudden contrast in rock types across the line of junction and that the line of junction is roughly parallel with the bedding of the Carboniferous sediments. Bailey (1926a) has described it as marked by scattered, minute pebbles of vein-quartz and iron pan mixed with rounded quartz grains. It should be noted also that at Corrie the Permian rests on beds assigned to the *modiolaris* zone, while in the Merkland Burn at Brodick it overlies strata assigned to the higher *similis-pulchra* zone (see p. 35).

The opportunity should be taken to visit the old quarries in the Corrie Sandstone south of the village where the cross-bedding and the rounded quartz grains characteristic of aeolian deposits can be examined. (Plate 2), (Figure 1), is a drawing of a micro-section made from a specimen from the quarries here. These quarries supplied much building stone both for local use and export.

References



(Figure 9) Geological sketch-map of the Corrie area to illustrate Excursions 4 and 5. For key see Figure 5.



(Figure 10) Diagrammatic cross-section of the rock succession on the Carrie Shore.

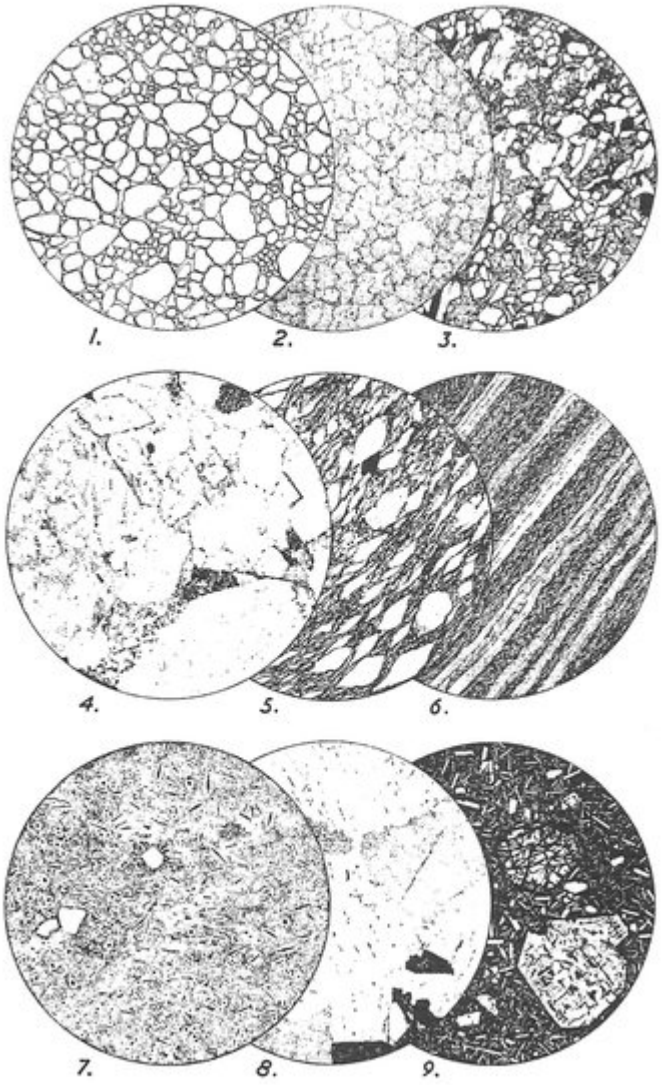
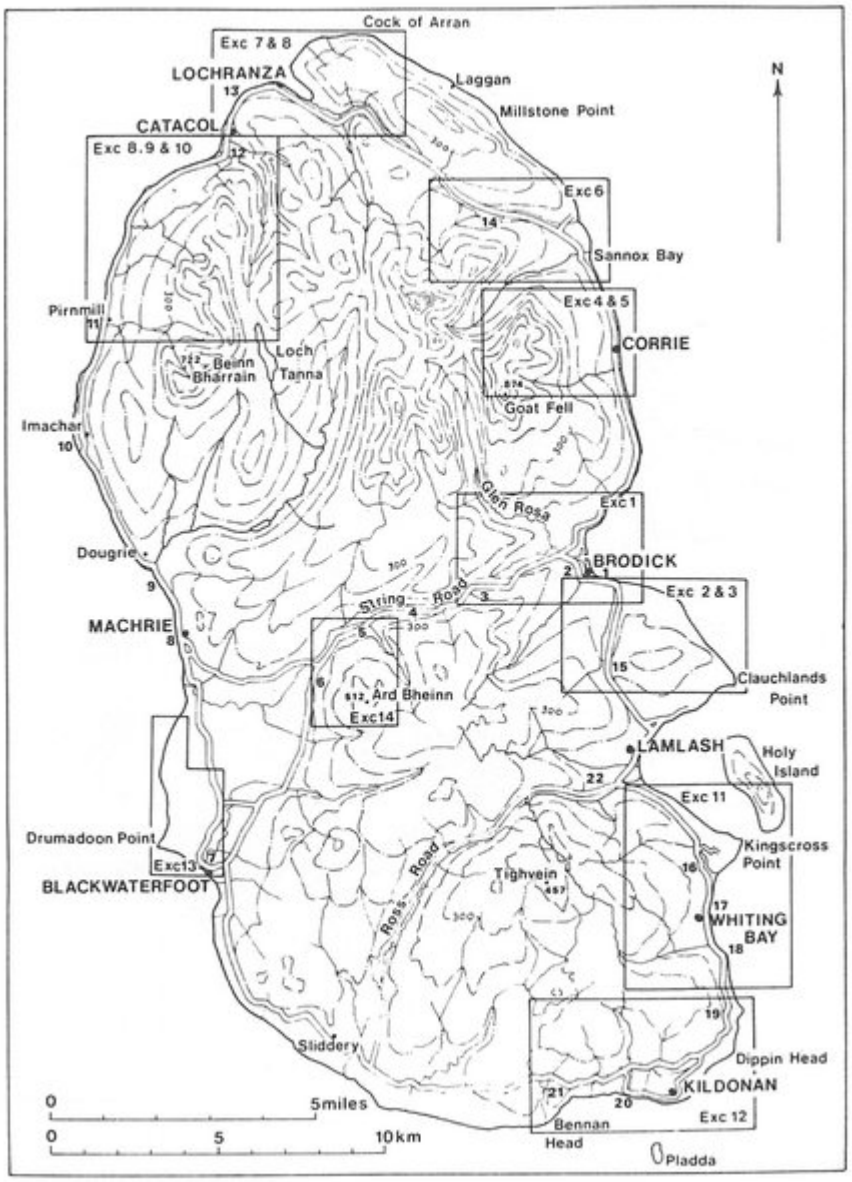


PLATE II. Micro-sections of some typical Arran rocks.

(Plate 2) Micro-sections of some typical Arran rocks. Fig. 1. Permian sandstone, old quarries at Corrie. x12. Grains of quartz, felspar and quartzite, the surfaces of which have been rounded by wind abrasion ("millet seed" grains), are coated and cemented loosely by limonite. Fig. 2. Lower Carboniferous Sandstone, south side of String Road, 915m SW of Brodick Church. x13. Angular grains of quartz (dusty with fluid inclusions) and of decomposed felspar and siliceous rock are loosely cemented by clay. Fig. 3. Lower Old Red Sandstone, shore cliff, 800m S of Dougrie. x 11.5. Angular and unsorted grains of quartz (clear), decomposed felspar (grey) fragments of mudstone, igneous rocks and oxidized iron ore are compactly cemented by the fine-grained waste of similar material. Fig. 4. Pebbly grit, Dalradian, near SE end of Creag Ghlas Laggen, North Arran. x 10.5. Fig. 5. Cleaved grit, Dalradian, shore 69m ESE of Loch Ranza pier. x9–5. The rock has been sheared. Quartz and quartzite pebbles have been deformed and ground away until their long axes lie parallel to the schistosity which is strongly developed by parallel orientation of the chlorite and muscovite flakes of the matrix. Fig. 6. Slate, Dalradian, old quarries on hillside 2.4km E of head of Loch Ranza. x 13. The paler and darker bands represent more silty and more clayey alternations of the original strata. Within the paler bands the effect of shearing can be seen in the development of a lenticular schistosity on a microscopic scale. Fig. 7. Pitchstone dyke, Schoolhouse, Brodick. x12. Small euhedral crystals of quartz lie in a matrix of rock-glass from which numerous crystallites of pyroxene have grown. In other parts the rock contains euhedral prisms of zoned plagioclase and pyroxene which are not shown in this figure. Fig. 8. Granite, Glen Rosa. x12. The rock is composed of oligoclase (showing straight cleavage lines), orthoclase (turbid), quartz (clear, with tiny inclusions and cracks), and biotite (dark, with straight close cleavage). A small prism of zircon lies on the left side of the topmost biotite). Fig. 9. Olivine basalt lava, Lower Carboniferous, Corrie shore opposite schoolhouse. x10.5. Euhedral phenocrysts of purplish augite (bottom right) and olivine serpentinized along cracks (centre) lie in a matrix composed mainly of plagioclase laths, augite grains, and iron ore granules.



(Figure 1) Simplified physiographic map of Arran showing areas covered by the excursion itineraries. Road log localities indicated by numbers. Contour interval 100 metres.