Figures and plates

(Front cover)

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(Figure 1) Map of inferred original Tertiary drainage system (shown in heavy dots) Shatter-belts guide Loch Linnhe, Loch Leven and Lairig Gartain [NN 200 544]. Contour-interval 250 ft, with change of ornament every thousand feet. W, Secondary Watersheds. R, west end of Rannoch Moor

(Figure 2) Section across Appin Fold: Onich shore. 2, Appin Phyllites (youngest); 3, Appin Limestone; 4, Appin Quartzite; 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists; 13 Eilde Flags

(Figure 3) Sketch of Appin Fold sectioned in S.W. wall of Glen Nevis 5, Baked Ballachulish Slates (youngest); 6, Marble of Ballachulish Limestone; 6′, Cale-silicate-hornfels of Ballachulish Limestone

(Figure 4) Section across Appin Fold north of Cuil Bay1, Cuil Bay Slates (youngest); 2, Appin Phyllites; 3, Appin Limestone; 4, Appin Quartzite; 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists

(Figure 5) Section across Appin Fold in Island of Shuna [NM 920 490] and Glen Stockdale [NM 950 490] 0, Lismore Limestone (youngest); 1, Cuil Bay Slates; 2, Appin Phyllites; 3, Appin Limestone; 4, Appin Quartzite; 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists

(Figure 6) View up Glen Nevis from Stob Bàn of Aonach Beag Synform. The Aonach Beag Core of Ballachulish Limestone (6), with Leven Schists (7) above and below, is refolded into a synform well seen in Aonach Beag (4060 ft) and also in Meall Cumhann [NN 178 697] in the middle distance

(Figure 7) Sections: Loch Leven to Glen Coe, and Glen Creran to Glen Etive. E, [NN 075 613] to [NN 197 588]; F, [NN 046 580] to [NN 158 563] G, [NN 053 590] to [NN 170 484] H, [NN 005 509] to [NN 170 488]

(Figure 8) Map showing outcrops in Callert district 4, Appin Quartzite (youngest); 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists; 8, Glen Coe Quartzite; G, Granite

(Figure 9) Section across (Figure 8) showing the relation of the Ballachulish Slide to the Tom Meadhoin Antiform 4, Appin Quartzite (youngest); 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists; 8, Glen Coe Quartzite

(Figure 10) Map of Lower Glen Coe

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(Figure 12) View across Upper Glen Nevis, looking south. 7, Leven Schists (youngest); 8, Glen Coe Quartzite; 9, Binnein Schists; 10, Binnein Quartzite; 11, Eilde Schist; 12, Eilde Quartzite. For slides, see Sheet 53 and (Figure 14), (Figure 16)

(Figure 13) Sketches of current-bedding. Explanation of Figure. 13 — Sketches of Current-Bedding Sketches a, d, e, f and j, which represent current-bedding on a fairly flat surface, are treated as maps with the north point at the top. The remaining sketches, of current-bedding on fairly steep faces, are treated like strike-sections with the main bedding represented horizontally. a. Glencoe Quartzite youngs north-westward, away from Binnein Schist. Eastern side of the mouth of quarry at Rudha Cladaich [NN 122 610], north shore, Loch Leven ((Figure 15), west). b. Glencoe Quartzite youngs downwards, away from Binnein Schist. Southern side of Glen Nevis, almost in a line with a shatter-belt or smash shown on Sheet 53 and (Figure 16). c. Binnein Quartzite youngs downwards towards Binnein Schist. Near northern shore, Loch Leven, half a mile east of Allt Nathrach [NN 160 631] ((Figure 15), east). d. Binnein Quartzite youngs

south-eastward, away from Eilde Schist. Northern shore, Loch Leven, three-quarters of a mile west of Allt Nathrach [NN 160 631] ((Figure 15), east). e. Binnein Quartzite youngs northward, away from Eilde Schist. At junction of these formations, southern shore, Loch Leven opposite Eilean nam Ban [NN 159 619] ((Figure 15), east). f. Binnein Quartzite youngs north-eastward, away from Eilde Schist. Same junction as (e), but half a mile inland along strike and just outside (Figure 15), east. g. Eilde Quartzite youngs downwards towards Elide Schist. Roadside, half a mile northeast of Caolasnacon ((Figure 15), east). h. Eilde Quartzite youngs downwards towards Eilde Schist, but at some distance from the contact. Roadside, 1¼ miles east-north-east of Caolasnacon ((Figure 15), east). i. Eilde Quartzite youngs downwards towards Eilde Schist. Near western junction, a little above deer-stalkers' path, 1½ miles north-east of Am Bodach and 3 miles north of Kinlochleven. j. Eilde Quartzite youngs eastward, towards Eilde Schist. Near eastern junction, close to same deer-stalkers' path as (i), but only one mile north-east of Am Bodach.

(Figure 14) Sections: mostly north of Loch Leven A [NN 166 783] to [NN 280 678]; B [NN 168 707] to [NN 250 621]; C [NN 085 700] to [NN 245 614]; D [NN 080 584] to [NN 250 621].

(Figure 15) (West above, east below). Formations, dip and current-bedding west and east of Caolasnacon.

(Figure 16) Map of Steall, Glen Nevis.

(Figure 17) Map and Section showing the structure of the Highland Schists and the positions of the cauldron-subsidences of Glen Coe and Ben Nevis.

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(Figure 20) View of Boundary-Fault of the Cauldron-Subsidence of Glen Coe as exposed in An t-Sròn.

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(Figure 31) Map and section of Ben Nevis.

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(Figure 35) Map of porphyrite dyke traversing rhyolites at the foot of the northernn fromt of Buachaille Etive Beag [NN 192 548]. The walls of country-rock are counterparts the one of the other.

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(Figure 40) Geological map of the Scottish Highlands to show the present position of the Moine injection complexes, the Strontian and Foyers granites, and the Moine Thrust-plane, after W. Q. Kennedy (Reproduced, by permission, from Quart. Joum. Geol. Sot., vol. cii, pt.i, 1946, fig. 2).

(Figure 41) Map of glacial flow-lines during the maximum stage of glaciation.

Plates

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(Plate 6) Gearr Aonach [NN 160 555] And Aonach Dubh: Glen Coe "sisters" Largely rhyolite lavas.

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(Plate 8) Stob Dearg Rhyolite lavas (crags) on schists (grass covered). Fossils at +.

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(Plate 10) Allt a' Mhuilinn [NN 161 730]: Ben Nevis Volcanics on right, and Inner "Granite" on left, meeting in stream.

(Plate 11) Photomicrographs of Kentallenite, Appinite and rocks connected with the Fault-Intrusion of Glen Coe. × 10 Dia. Explanation of (Plate 11) 1. Kentallenite, type quarry (S7053) [NN 009 577]. Olivine, with black cracks; augite, idiomorphic, grey; felspar, clear; biotite, pale or dark. (photo M.2436; p. 212). 2. Appinite, N. of Leacantuim [NN 117 577], Glen Coe (S11036) [NN 1152 5810]. Hornblende, mainly dark; felspar and quartz, clear. (M.2441; p. 215). 3. Junction of flinty crush-rock (left) with chilled Fault-Intrusion (right) at Boundary-Fault, Stob Mhic Mhartuin (S13403) [NN 207 575]. The minute clear grains in the flinty crush-rock are quartz. The four larger crystals in the same are xenocrysts of felspar derived from the Fault-Intrusion. The four crystals in the Fault-Intrusion are felspar phenocrysts, one showing dark.

(M.2444; p. 162). 4. Junction of pelitic hornfels (upper third of photo) with *lit par lit* vein (remainder) in xenolith in Fault-Intrusion, taken from quenched zone at Boundary-Fault, An t-Sròn (S10311) [NN 136 558]. Due to quenching the vein has completed its crystallisation by developing spherulites — right at bottom corner and left at margin against hornfels. (M.2445; p. 216). 5. Fault-Intrusion (felspar shows grey) detaching quartz xenocrysts (clear) from quartzite xenolith. Permeation area north of Glen Coe (S11517b) [NN 1592 5970]. (M.2440; p. 219). 6. Greatly sheared xenolith of basic lava (right), recrystallised with much minute hornblende. It is enclosed in chilled Fault-Intrusion (left), loaded with clear xenocrysts of quartz, and has been carried just inside Cauldron-Subsidence of Glen Coe at An t-Sròn (S11905) [NN 1362 5502]. (M.2439; p. 217).

(Plate 12) Photomicrographs of Leven Schists before and after contact-alteration. × 21 Dia. A. Not contact-altered, Glen Leac na Muidhe (S11618) [NN 1126 5486]. Porphyroblasts of biotite, garnet and magnetite in well foliated base of muscovite, quartz and magnetite. B. Slightly contact-altered, ¾ mile from Cruachan "Granite", Glen Etive district (S8270) [NN 112 505]. Pseudomorph, largely of cordierite and magnetite, after garnet in well foliated base of muscovite, quartz and magnetite. C. Completely reconstructed to cordierite-andalusite-hornfels, near Ben Nevis "Granite", Aonach Beag (S13837) [NN 1935 7186]. Cordierite, pale, N.W. half; andalusite, darker, S.E. half; biotite and magnetite, dark to black.

(Plate 13) An Steall, The Waterfall of a valley hanging to Glen Nevis Water-worn crags on left due to stream cascading down marginal crevasse; Roche moutonnee, Glen Nevis, by roadside above Polldubh [NN 141 686] Note gap on "sloss" side due to plucking.

Tables

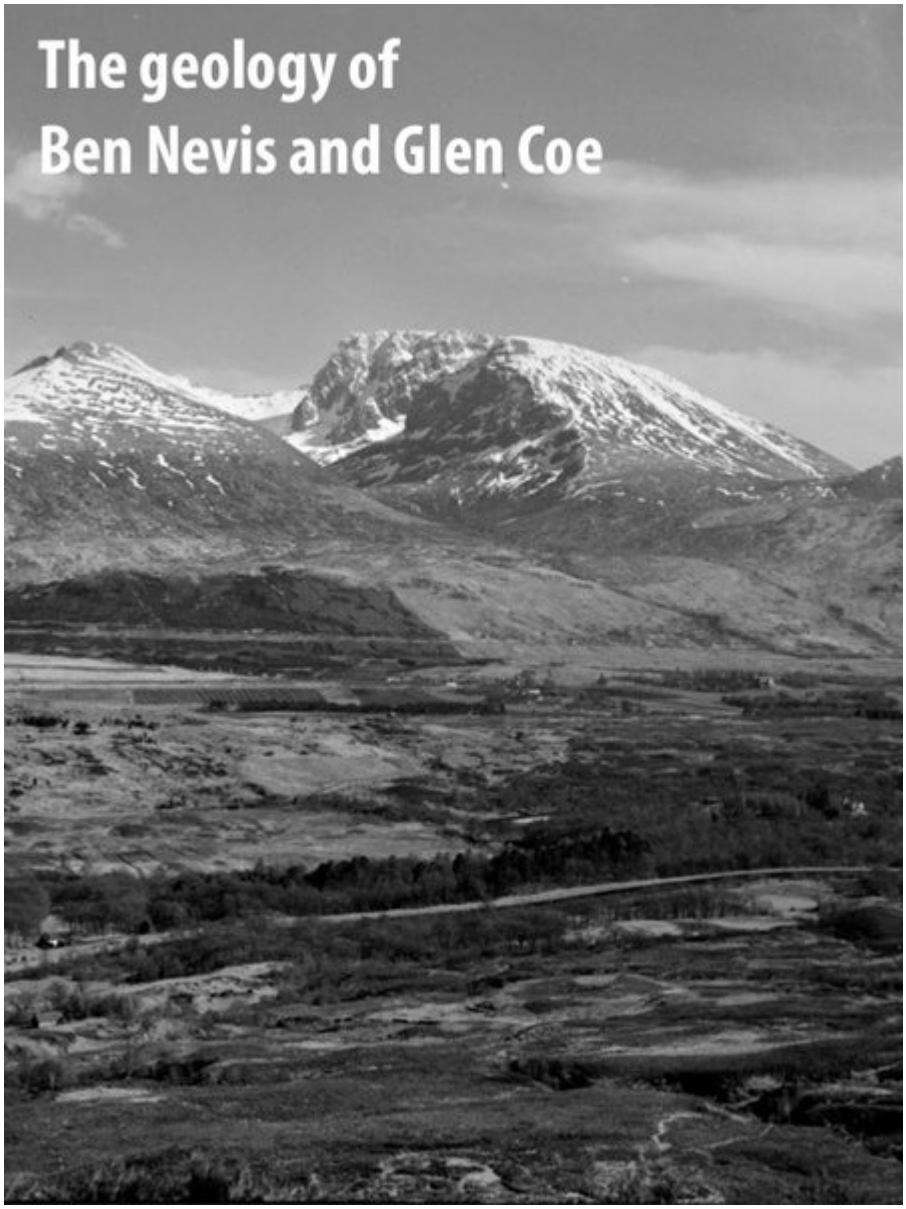
(Table 1) Glen Scaddle "Epidiorite" and "Sillimanite-gneiss".

(Table 2) Analyses of Devonian igneous rocks of sheet 53, 45 and 62 (Geol.).

(Table 3) Analyses of Devonian igneous rocks of sheet 53, 45, 54 and 62 (Geol.) continued.

(Table 4) Analyses of Appin Limestone; Analyses of xenolith and contaminated and normal Ballachulish quartz-diorite.

(Table 5) Analyses illustrating reactions between quartz xenoliths and Ballachulish quartz-diorite.



(Front cover). Ben Nevis from the Great Glen, view from Muirshearlich, Banavie. Inverness-shire. The Ben Nevis Complex, a sequence of granitic intrusions with central cauldron subsidence of Lower Old Red Sandstone lavas and Dalradian metasedimentary rocks.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
MEMOIRS OF THE GEOLOGICAL SURVEY
SCOTLAND

The Geology of Ben Nevis and Glen Coe and the Surrounding Country

(EXPLANATION OF SHEET 53)

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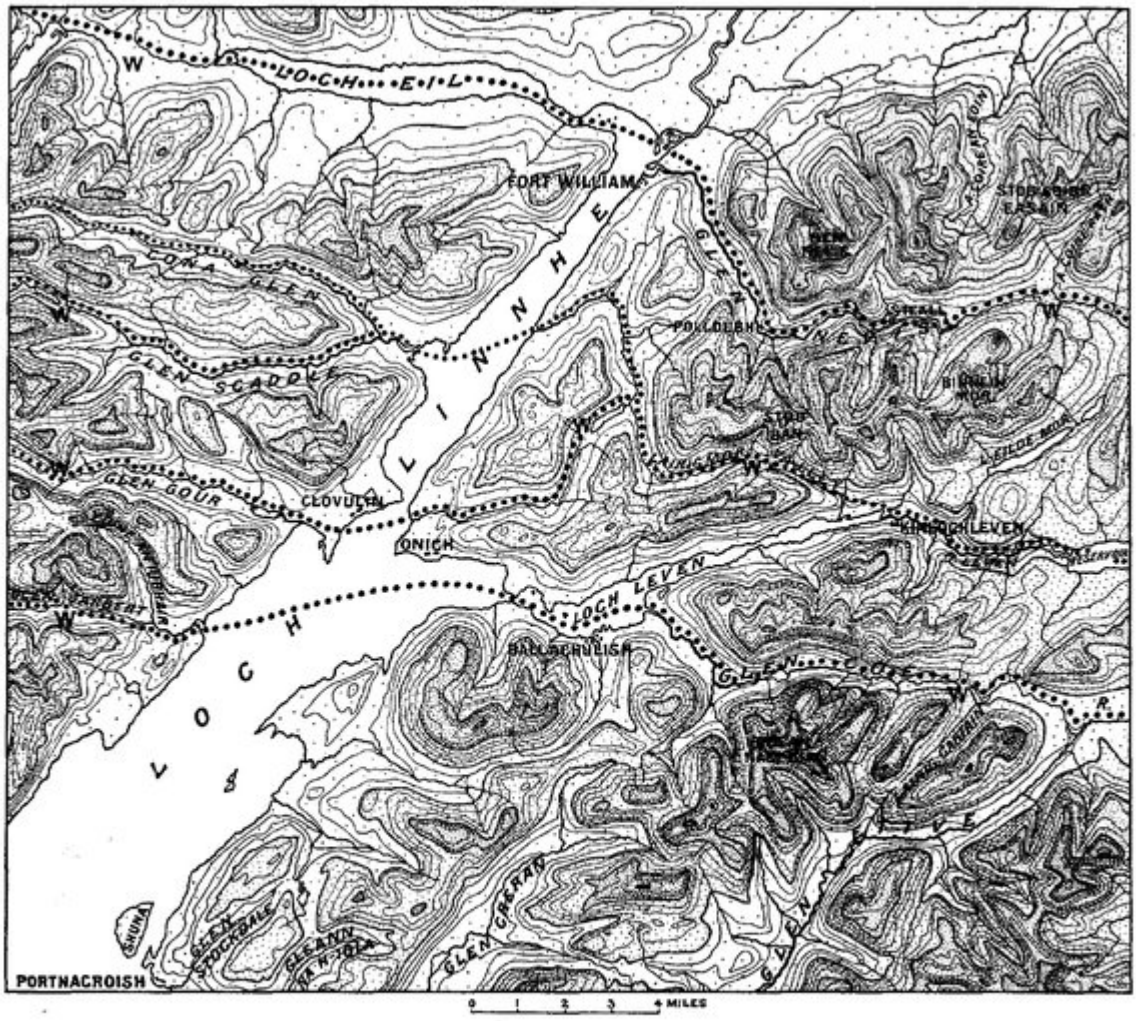

FIG. 1. Map of inferred original Tertiary drainage system (shown in heavy dots)

Shatter-belts guide Loch Linnhe, Loch Leven and Lairig Gartain.
Contour-interval 250 ft, with change of ornament every thousand feet.
W, Secondary Watersheds. R, west end of Rannoch Moor

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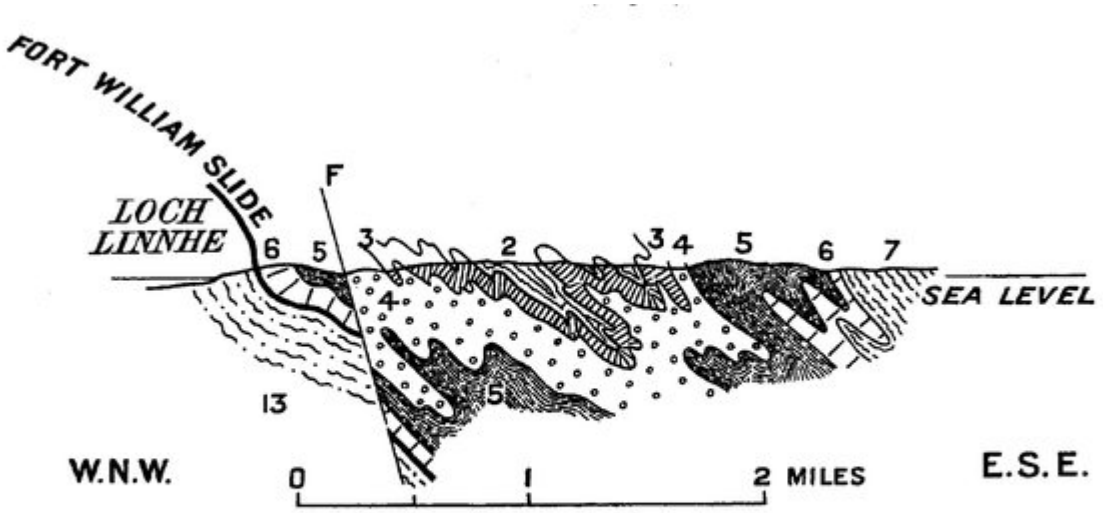

FIG. 2. Section across Appin Fold : Onich shore

2, Appin Phyllites (youngest) ; 3, Appin Limestone ; 4, Appin Quartzite ; 5, Ballachulish Slates ;
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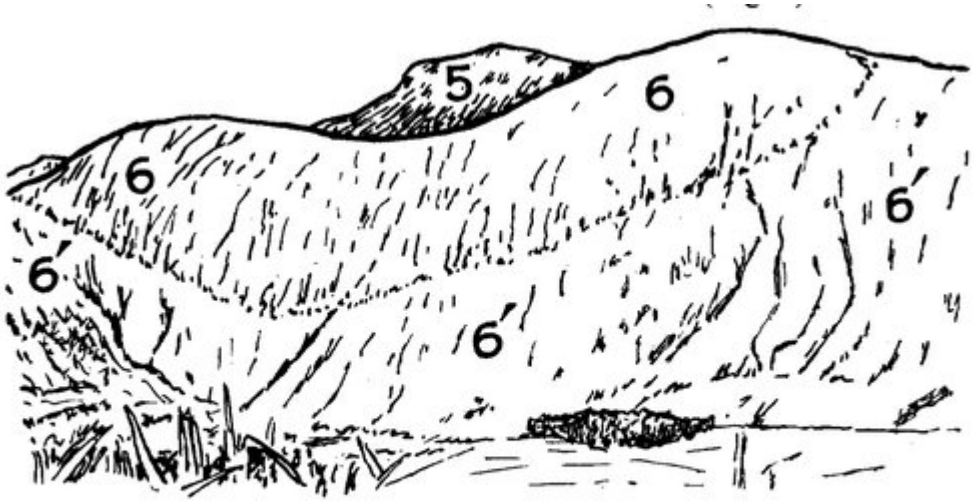

FIG. 3. Sketch of Appin Fold sectioned in S.W. wall of Glen Nevis

5, Baked Ballachulish Slates (youngest) ; 6, Marble of Ballachulish Limestone ; 6′, Calc-silicate-hornfels of Ballachulish Limestone

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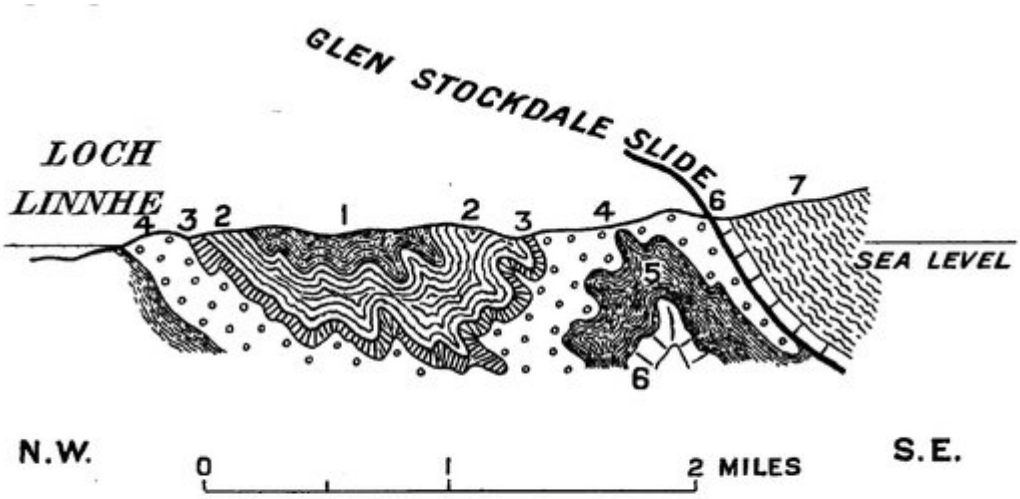

FIG. 4. Section across Appin Fold north of Cuil Bay

1, Cuil Bay Slates (youngest) ; 2, Appin Phyllites ; 3, Appin Limestone ; 4, Appin Quartzite ; 5, Ballachulish Slates ; 6, Ballachulish Limestone ; 7, Leven Schists

(Figure 4) Section across Appin Fold north of Cuil Bay1, Cuil Bay Slates (youngest); 2, Appin Phyllites; 3, Appin Limestone; 4, Appin Quartzite; 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists.

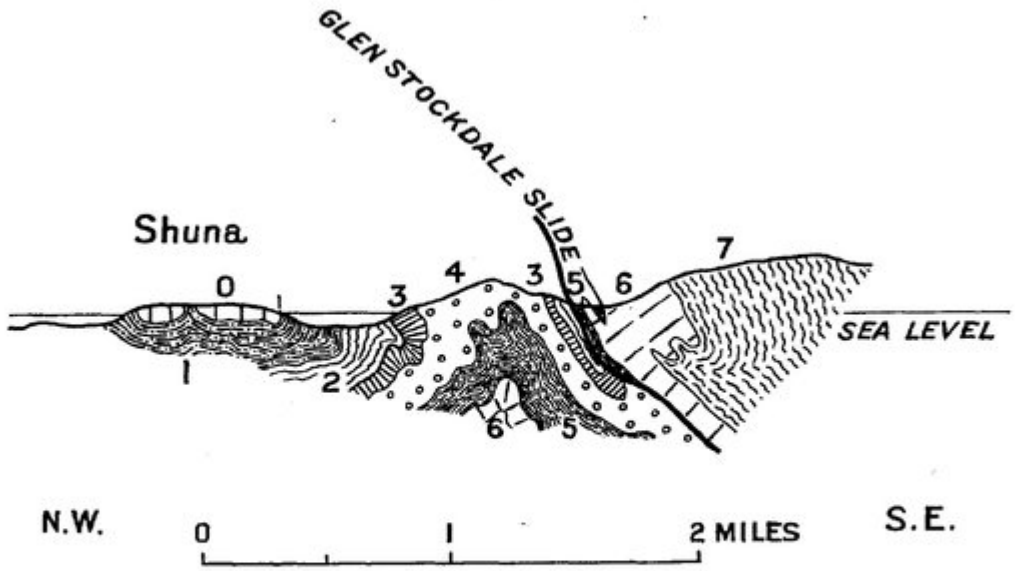

FIG. 5. Section across Appin Fold in Island of Shuna and Glen Stockdale

0, Lismore Limestone (youngest) ; 1, Cuil Bay Slates ; 2, Appin Phyllites ; 3, Appin Limestone ; 4, Appin Quartzite ; 5, Ballachulish Slates ; 6, Ballachulish Limestone ; 7, Leven Schists

(Figure 5) Section across Appin Fold in Island of Shuna [NM 920 490] and Glen Stockdale [NM 950 490] 0, Lismore Limestone (youngest); 1, Cuil Bay Slates; 2, Appin Phyllites; 3, Appin Limestone; 4, Appin Quartzite; 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists.

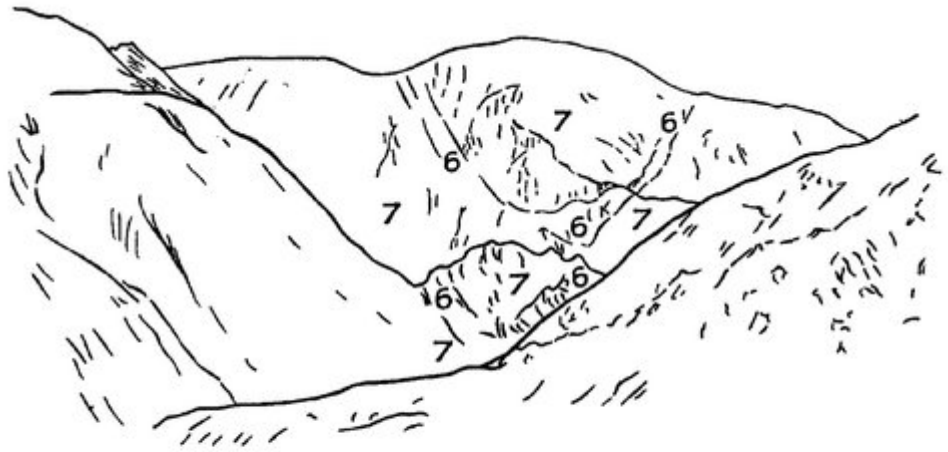

FIG. 6. View up Glen Nevis from Stob Bàn of Aonach Beag Synform

The Aonach Beag Core of Ballachulish Limestone (6), with Leven Schists (7) above and below, is refolded into a synform well seen in Aonach Beag (4060 ft) and also in Meall Cumhann in the middle distance

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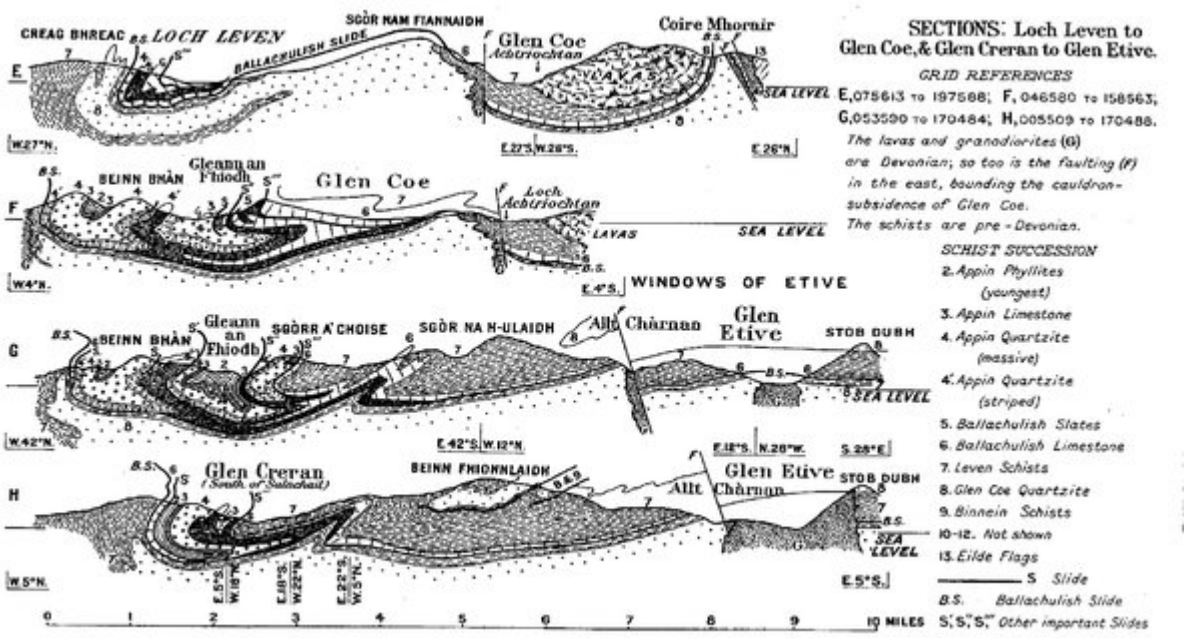

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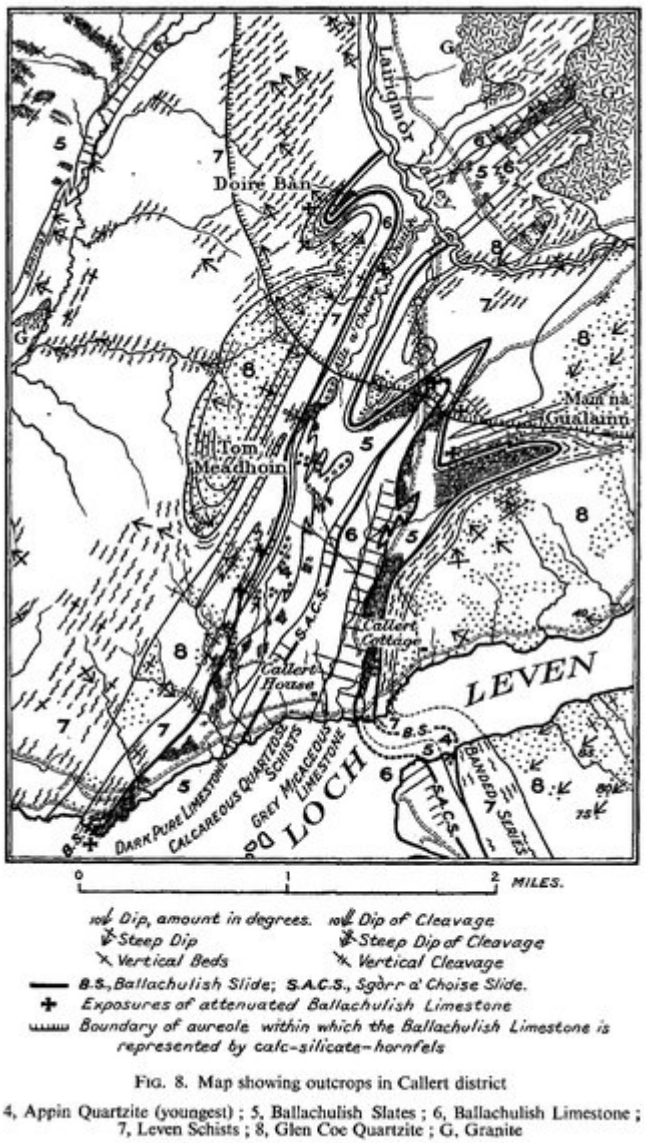

FIG. 8. Map showing outcrops in Callert district

4, Appin Quartzite (youngest); 5, Ballachulish Slates; 6, Ballachulish Limestone; 7, Leven Schists; 8, Glen Coe Quartzite; G, Granite

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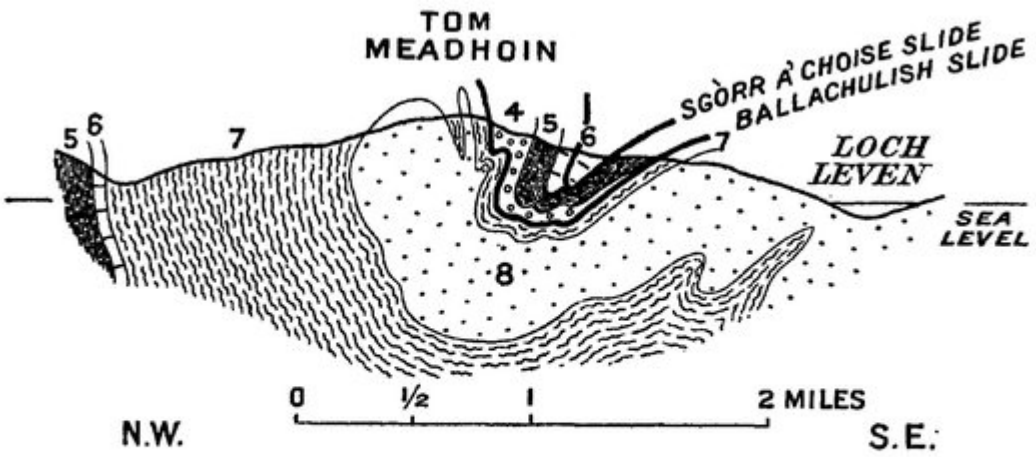

FIG. 9. Section across Fig. 8 showing the relation of the Ballachulish Slide to the Tom Meadhoin Antiform

4, Appin Quartzite (youngest) ; 5, Ballachulish Slates ; 6, Ballachulish Limestone ; 7, Leven Schists ; 8, Glen Coe Quartzite

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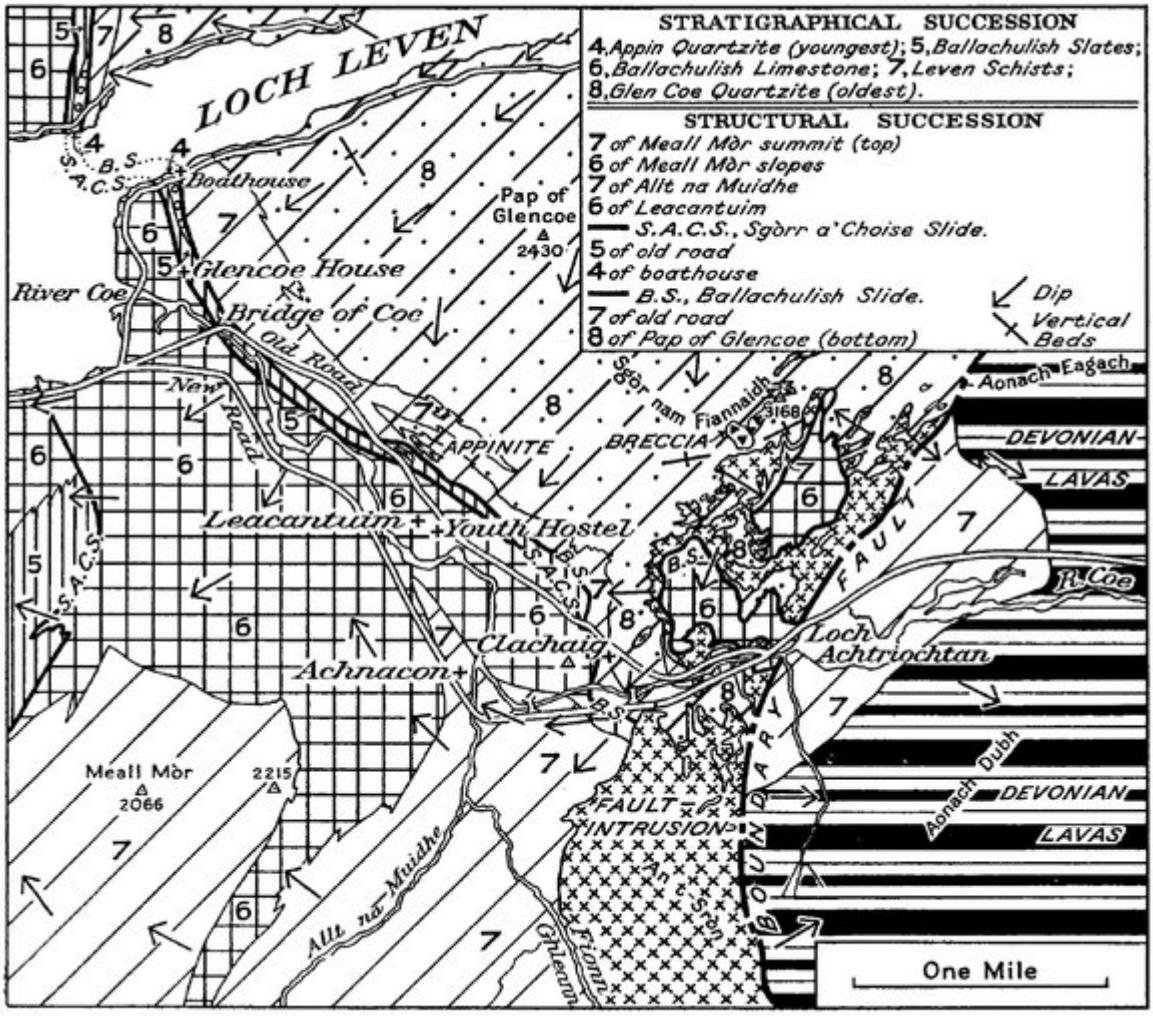

FIG. 10. Map of Lower Glen Coe

(Figure 10) Map of Lower Glen Coe.

FIG. 11. Sketch of Ballachulish Slide on S.W. side of Gleann Chàrnan

Calc-silicate-hornfels (Ballachulish Limestone) lying discordantly, through the intervention of the Ballachulish Slide, upon banded Leven Schists

(Figure 11) Sketch of Ballachulish Slide on S.W. side of Gleann Chàrnan [NN 135 500] Calc-silicate-hornfels (Ballachulish Limestone) lying discordantly, through the intervention of the Ballachulish Slide, upon banded Leven Schists.

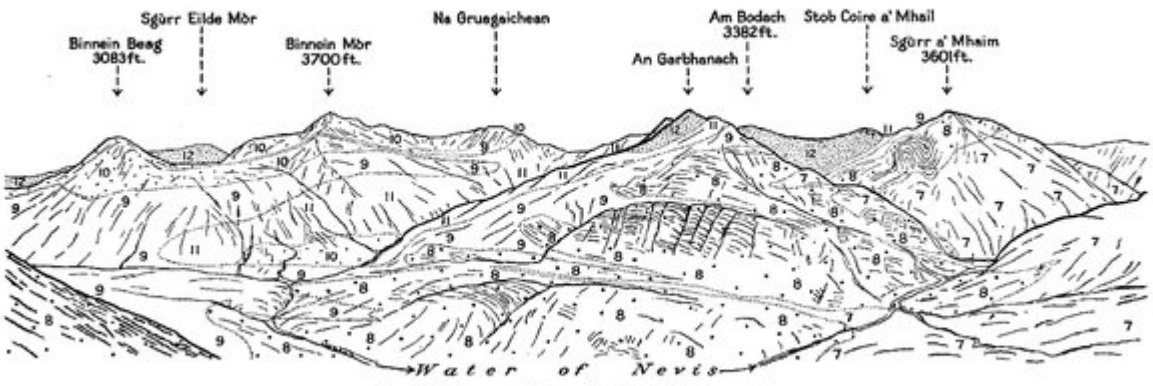

FIG. 12. View across Upper Glen Nevis, looking south

7, Leven Schists (youngest); 8, Glen Coe Quartzite; 9, Binnein Schists; 10, Binnein Quartzite; 11, Eilde Schist; 12, Eilde Quartzite. For slides, see Sheet 53 and Figs. 14, 16

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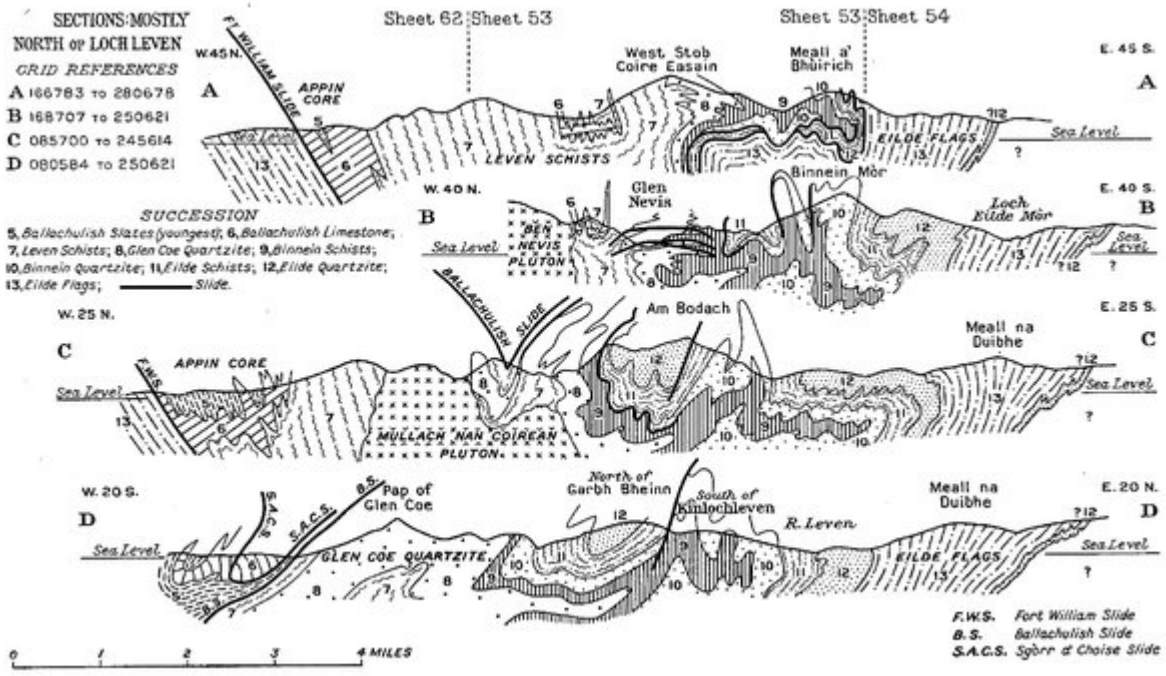


FIG. 14. Sections : mostly north of Loch Leven

(Figure 14) Sections: mostly north of Loch Leven A [NN 166 783] to [NN 280 678]; B [NN 168 707] to [NN 250 621]; C [NN 085 700] to [NN 245 614]; D [NN 080 584] to [NN 250 621].

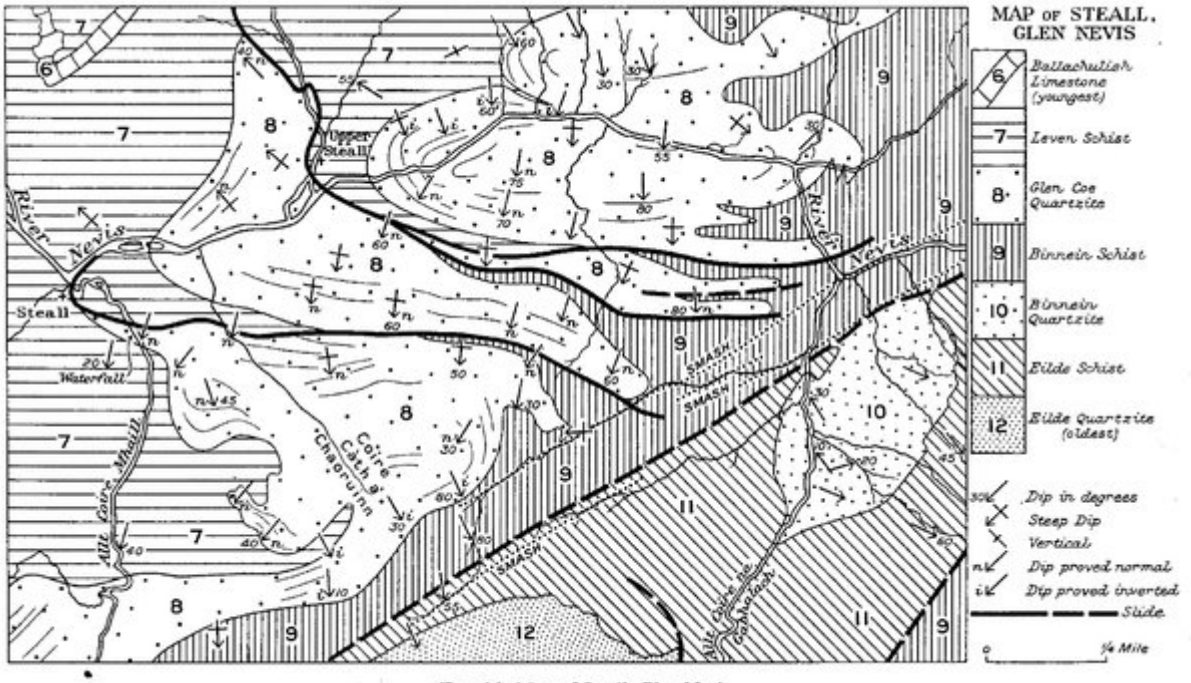


FIG. 16. Map of Steall, Glen Nevis

(Figure 16) Map of Steall, Glen Nevis.

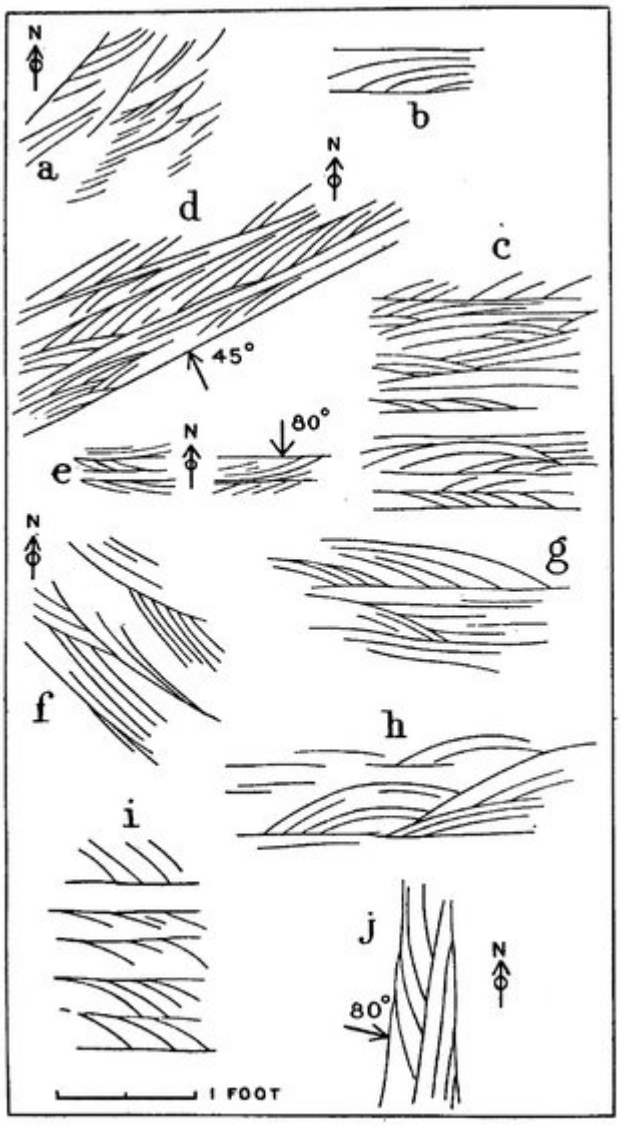


FIG. 13. Sketches of current-bedding

(Figure 13) Sketches of current-bedding. Explanation of Figure. 13 — Sketches of Current-Bedding Sketches a, d, e, f and j, which represent current-bedding on a fairly flat surface, are treated as maps with the north point at the top. The remaining sketches, of current-bedding on fairly steep faces, are treated like strike-sections with the main bedding represented horizontally. a. Glencoe Quartzite youngs north-westward, away from Binnein Schist. Eastern side of the mouth of quarry at Rudha Cladaich [NN 122 610], north shore, Loch Leven ((Figure 15), west). b. Glencoe Quartzite youngs downwards, away from Binnein Schist. Southern side of Glen Nevis, almost in a line with a shatter-belt or smash shown on Sheet 53 and (Figure 16). c. Binnein Quartzite youngs downwards towards Binnein Schist. Near northern shore, Loch Leven, half a mile east of Allt Nathrach [NN 160 631] ((Figure 15), east). d. Binnein Quartzite youngs south-eastward, away from Eilde Schist. Northern shore, Loch Leven, three-quarters of a mile west of Allt Nathrach [NN 160 631] ((Figure 15), east). e. Binnein Quartzite youngs northward, away from Eilde Schist. At junction of these formations, southern shore, Loch Leven opposite Eilean nam Ban [NN 159 619] ((Figure 15), east). f. Binnein Quartzite youngs north-eastward, away from Eilde Schist. Same junction as (e), but half a mile inland along strike and just outside (Figure 15), east. g. Eilde Quartzite youngs downwards towards Elide Schist. Roadside, half a mile northeast of Caolasnacon ((Figure 15), east). h. Eilde Quartzite youngs downwards towards Eilde Schist, but at some distance from the contact. Roadside, 1¼ miles east-north-east of Caolasnacon ((Figure 15), east). i. Eilde Quartzite youngs downwards towards Eilde Schist. Near western junction, a little above deer-stalkers' path, 1½ miles north-east of Am Bodach and 3 miles north of Kinlochleven. j. Eilde Quartzite youngs eastward, towards Eilde Schist. Near eastern junction, close to same deer-stalkers' path as (i), but only one mile north-east of Am Bodach.

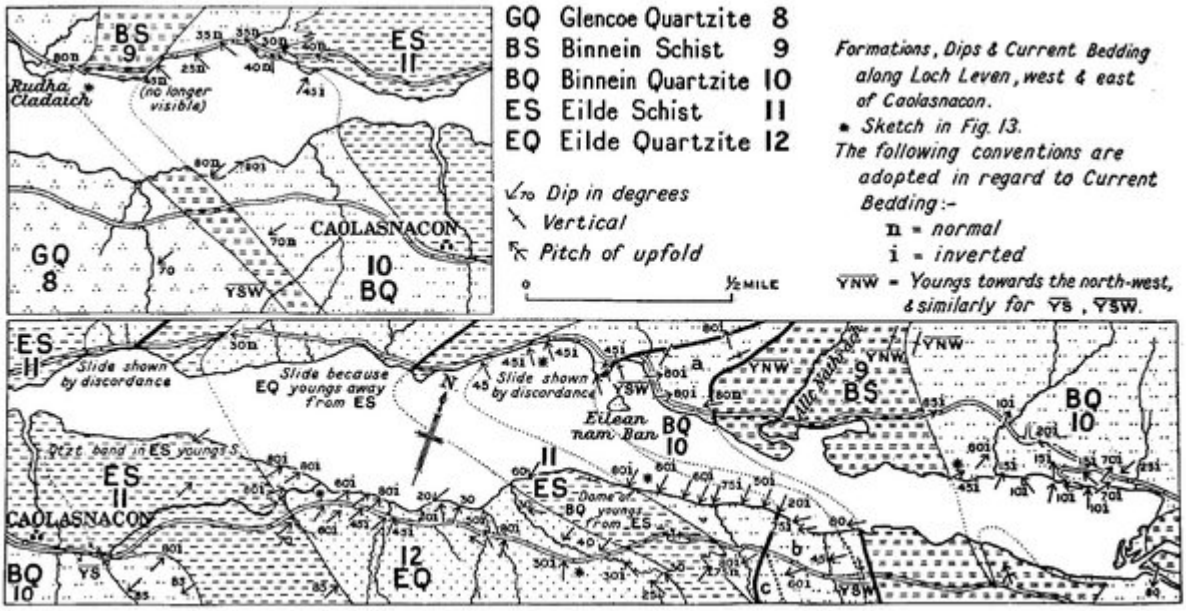


FIG. 15 (West above, east below). Formations, dip and current-bedding west and east of Caolasnacon

(Figure 15) (West above, east below). Formations, dip and current-bedding west and east of Caolasnacon.

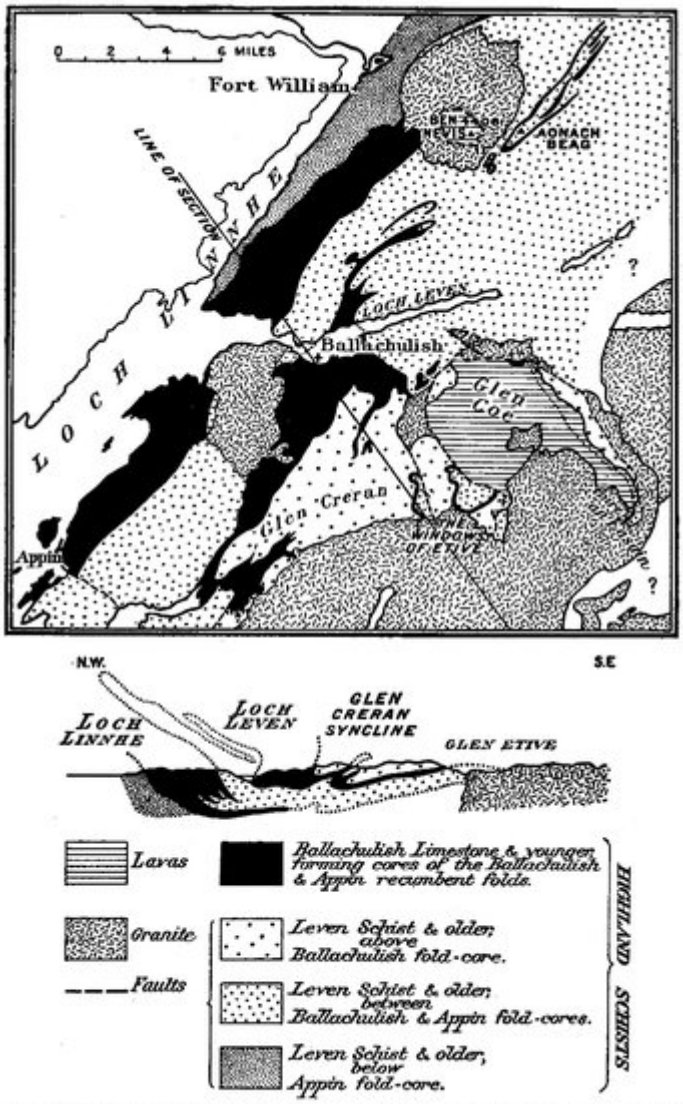


FIG. 17. Map and Section showing the structure of the Highland Schists and the positions of the cauldron-subsidences of Glen Coe and Ben Nevis

(Figure 17) Map and Section showing the structure of the Highland Schists and the positions of the cauldron-subsidences of Glen Coe and Ben Nevis.

VOLCANIC ROCKS: *Ben Nevis, Glen Coe, Lorne*
BASALT, ANDESITE, RHYOLITE.

DYKES: *Mostly of Nevis and Etive Swarms.*
PORPHYRITE, MICRODIORITE, LAMPROPHYRE, PORPHYRY.

INCLINED SHEETS: *Loch Fyne.*
QUARTZ-PORPHYRY.

ULTRA-ACID, ACID and INTERMEDIATE PLUTONS.
GRANITE, QUARTZ-DIORITE: 1 *Ben Nevis*; 2 *Mullach nan Coirean*; 3 *Loch Linnhe*; 4 *Strontian*; 5 *Ballachulish*; 6 *Glen Coe*; 7 *Rannoch*; 8 *Etive*; 9 *Garabal*; 10 *Loch Melfort.*

BASIC and ULTRA-BASIC PLUTONS, *including a few giant xenoliths*
APPINITE, MONZONITIC AUGITE-DIORITE, ETC., including
K = *KENTALLENITE.*

FIG. 18. Map of igneous rocks of South-West Highlands referred to Lower Old Red Sandstone Period

(Figure 18) Map of igneous rocks of South-West Highlands referred to Lower Old Red Sandstone Period.

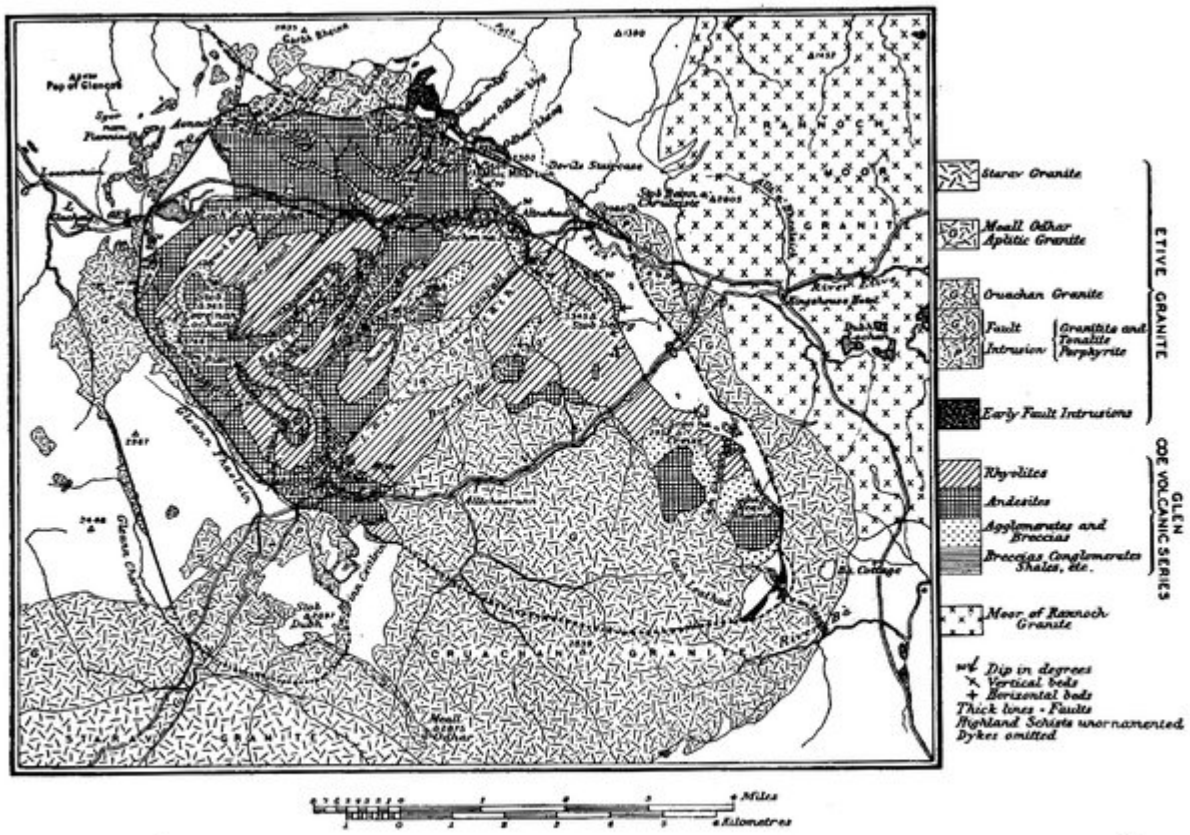


FIG. 19. Map of the Cauldron-Subsidence of Glen Coe and associated igneous phenomena
For new road see Fig. 22

(Figure 19) Map of the Couldron-Subsidence of Glen Coe and associated igneous phoenomena. For new road see (Figure 22).

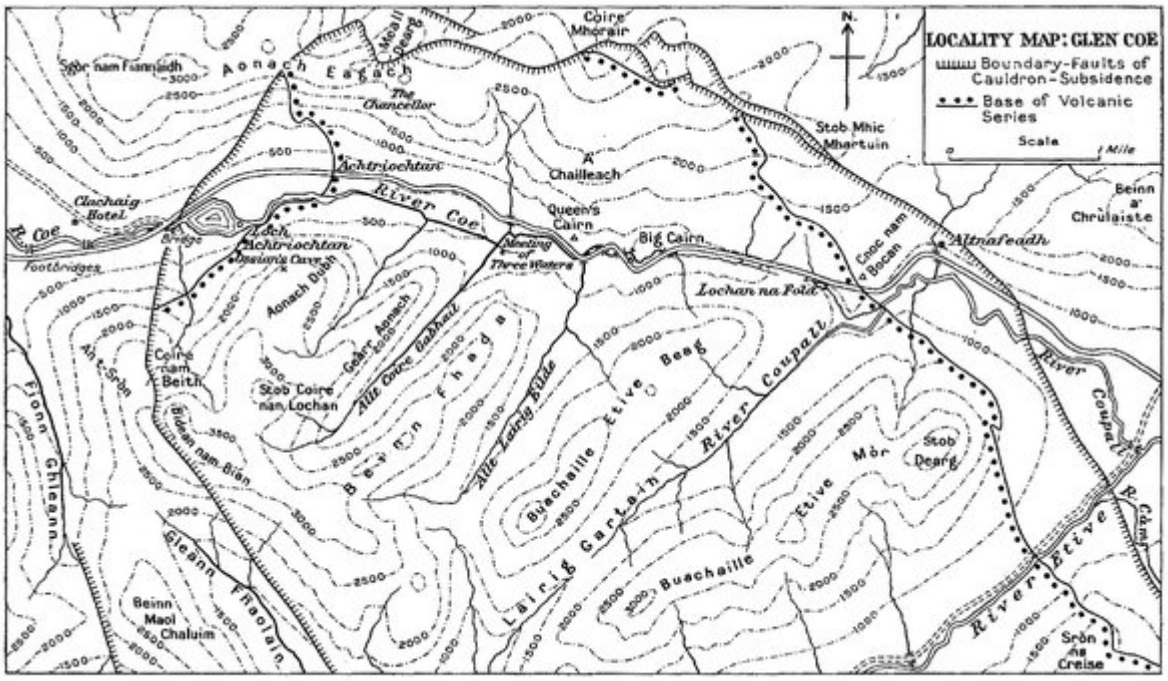


FIG. 22. Locality map : Glen Coe

(Figure 22) Locality map: Glen Coe.

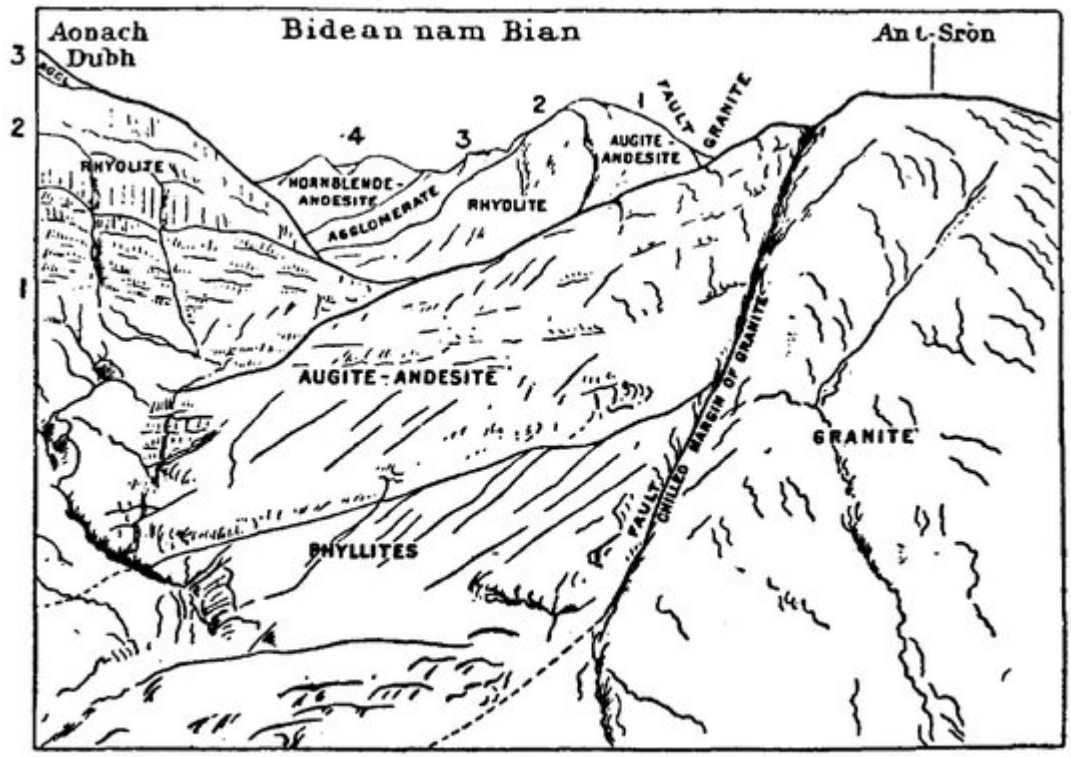


FIG. 20. View of Boundary-Fault of the Cauldron-Subsidence of Glen Coe as exposed in An t-Sròn

(Figure 20) View of Boundary-Fault of the Cauldron-Subsidence of Glen Coe as exposed in An t-Sròn.

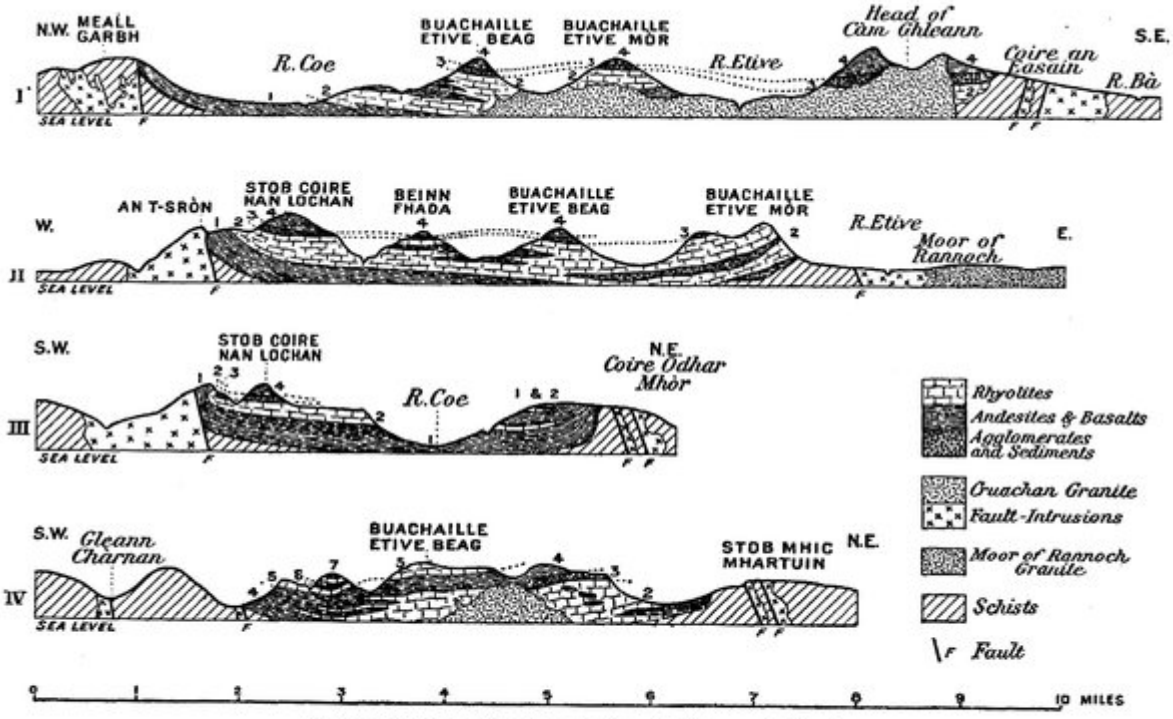


FIG. 21. Sections across the Cauldron-Subsidence of Glen Coe
The numbers 1-7 refer to groups discussed in the text

(At Coire an Easain the boundary-faults incline outwards to S. E., not inwards as shown above)

(Figure 21) Sections across the Cauldron-Subsidence of Glen Coe The numbers l-7 refer to groups discussed in the text (At Coire an Easain the boundary-faults incline outwards to S. E., not inwards as shown above).

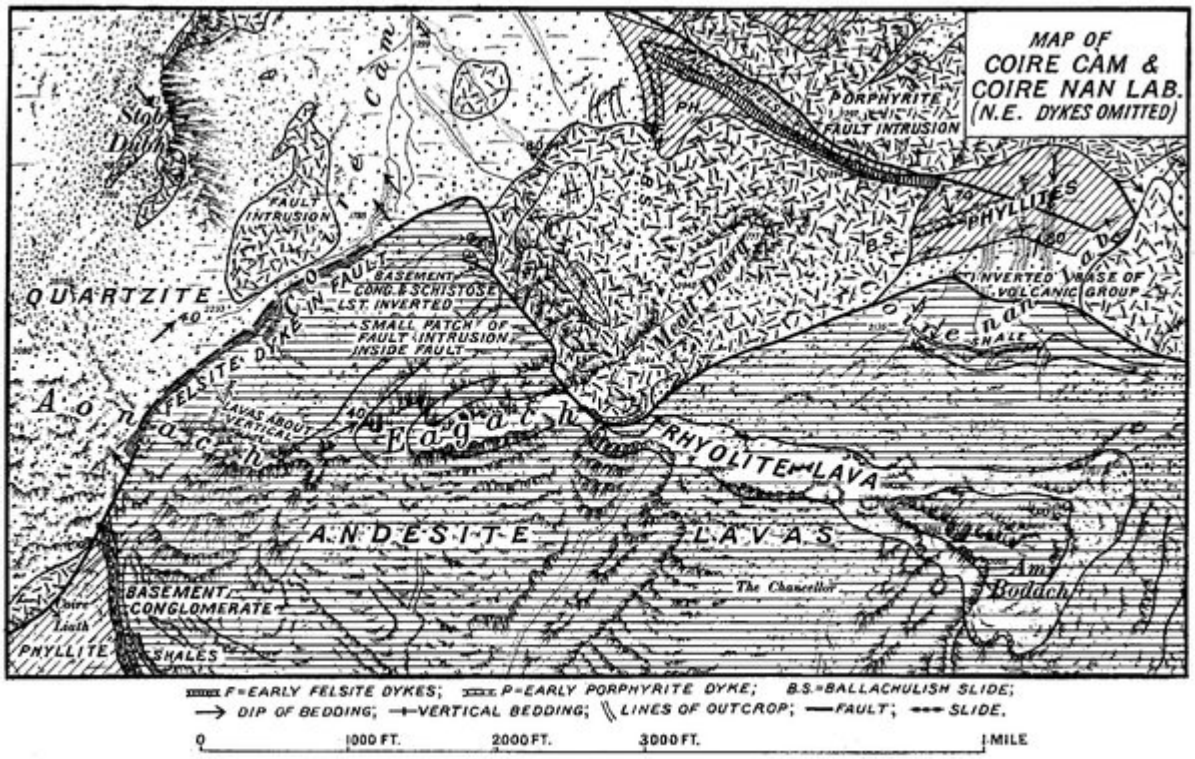


FIG. 23. Map of Coire Càm and Coire nan Lab. North-east dykes omitted. (The Fault-Intrusion is chilled at its contact with the early dykes north of Meall Dearg)

(Figure 23) Map of Coire Càm [NN 154 585] and Coire nan Lab [NN 167 584]. North-east dykes omitted. (The Fault-Intrusion is chilled at its contact with the early dykes north of Meall Dearg [NN 163 585]).

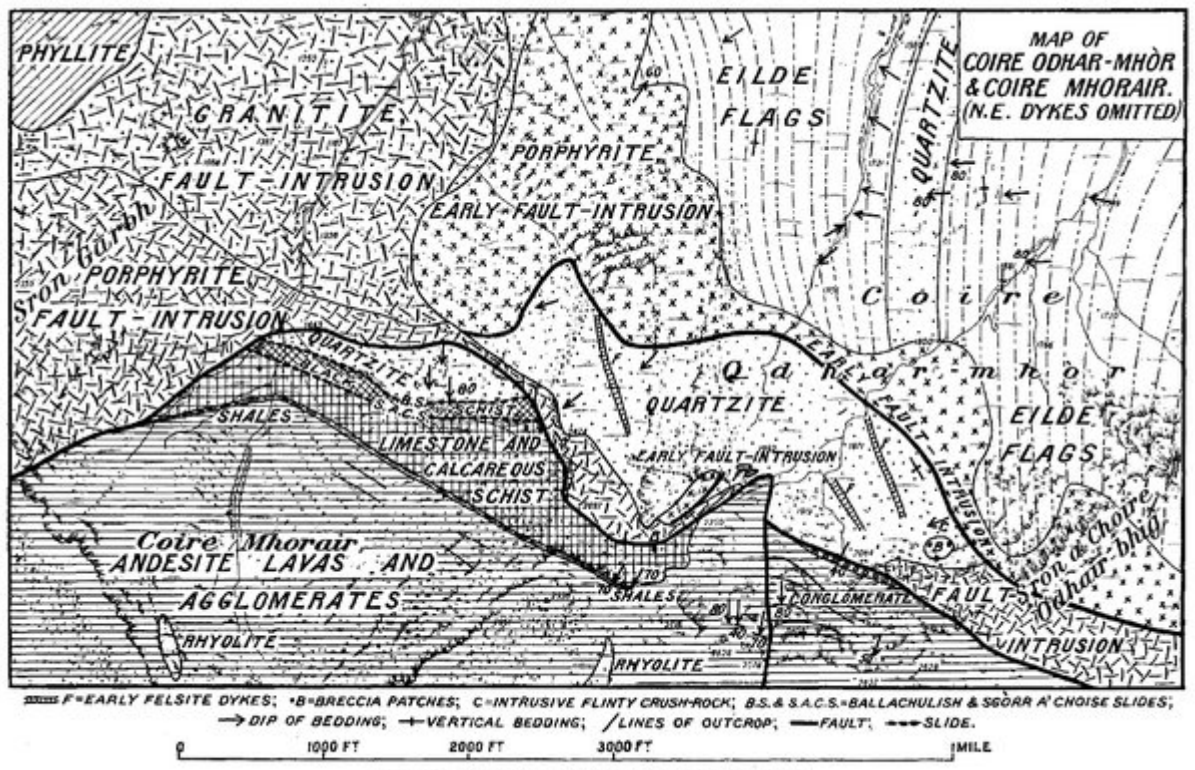


FIG. 24. Map of Coire Mhorair and Coire Odhar-mhòr

(Figure 24) Map of Coire Mhorair and Coire Odhar-mhòr [NN 196 583].

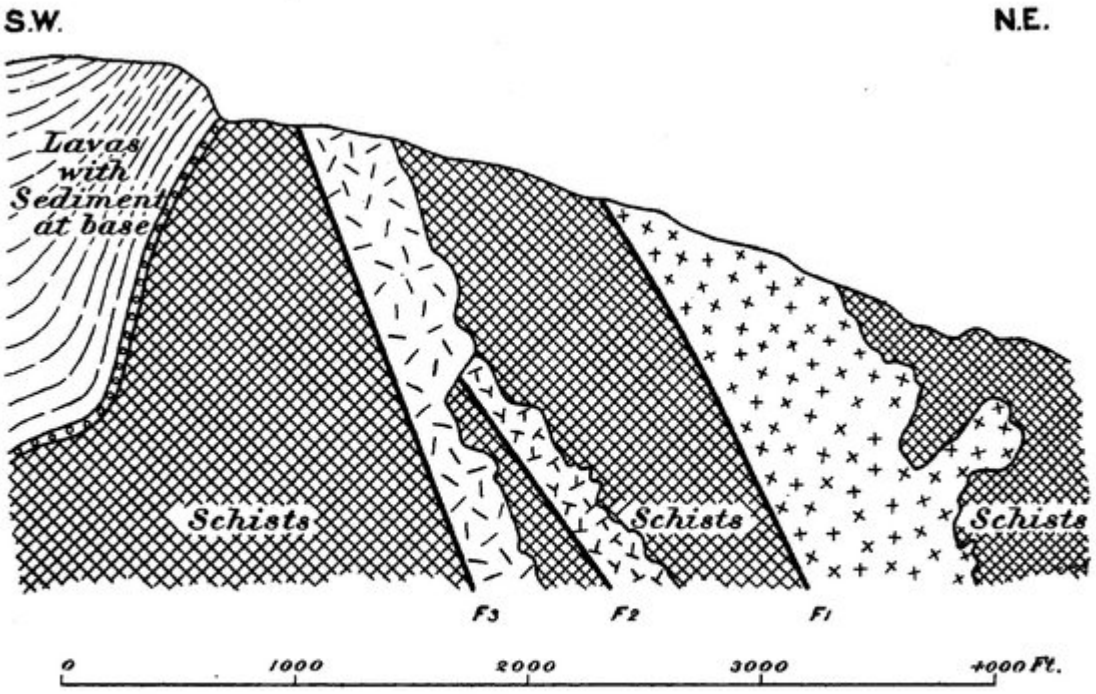


FIG. 25. Section through ridge W. of Coire Odhar-mhòr

F1 and F2 Early Boundary-Faults accompanied by Early Fault-Intrusions. F3 Main Boundary-Fault with Main Fault-Intrusion

(Figure 25) Section through ridge W. of Coire Odhar-mhòr [NN 196 583] F1 and F2 Early Boundary-Faults accompanied by Early Fault-Intrusions. F3 Main Boundary-Fault with Main Fault-Intrusion.

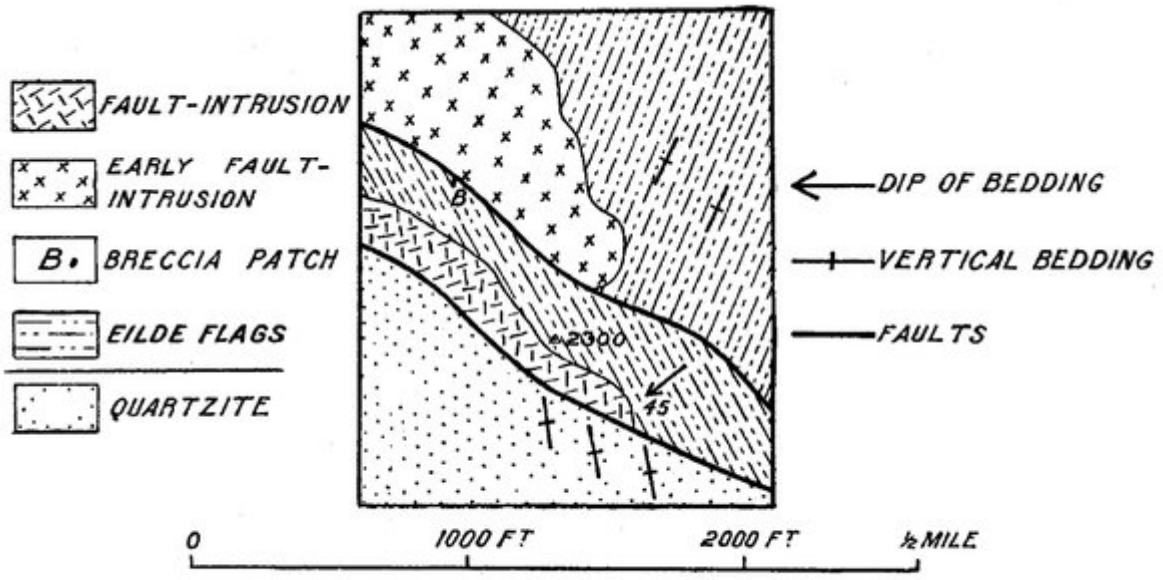


FIG. 26. Map of Stob Mhic Mhartuin. North-east dykes omitted

(Figure 26) Map of Stob Mhic Mhartuin [NN 207 575]. North-east dykes omitted.

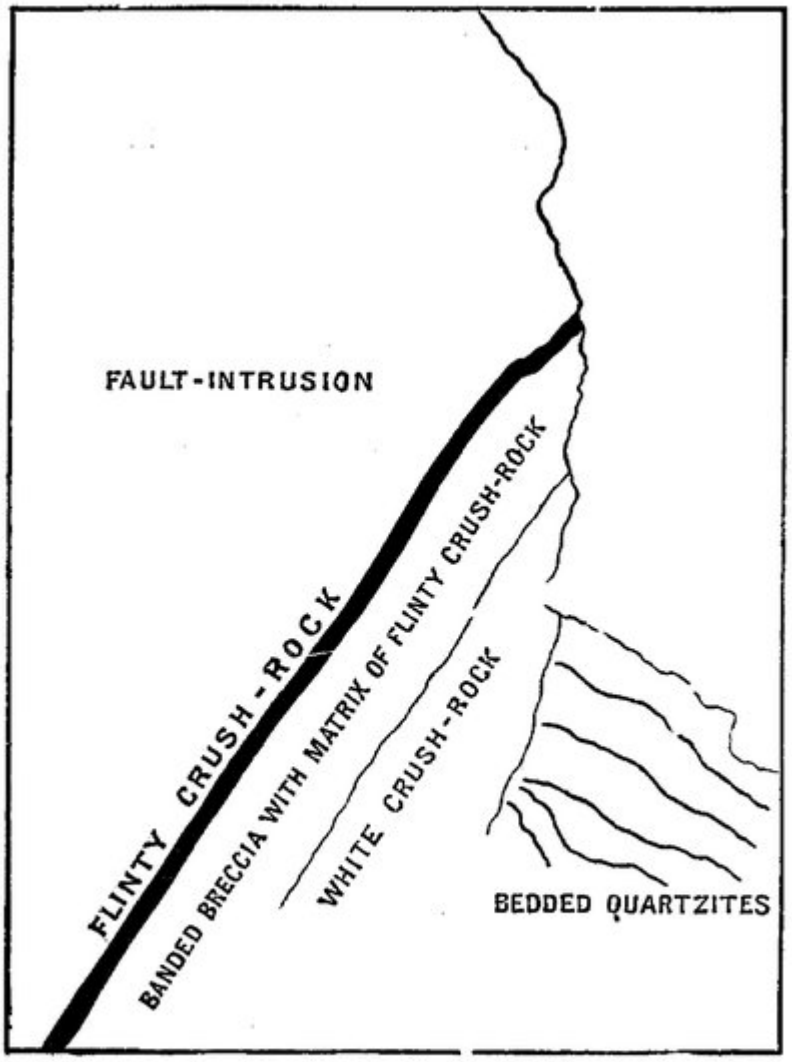
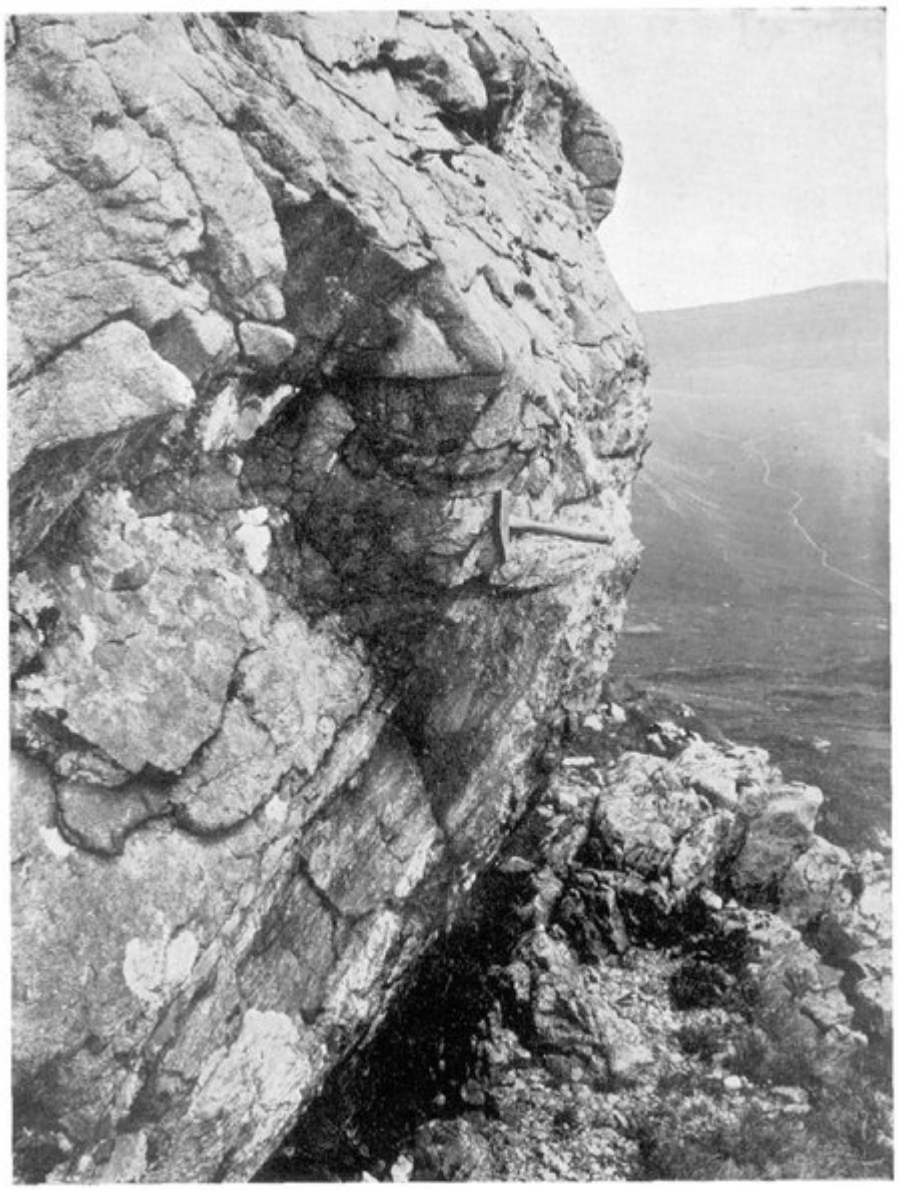


FIG. 27. Diagram explaining Pl. IX

(Figure 27) Diagram explaining (Plate 9). [Glen Coe Fault, Stob Mhic Mhartuin [NN 207 575].].



(Plate 9) Glen Coe Fault, Stob Mhic Mhartuin [NN 207 575].

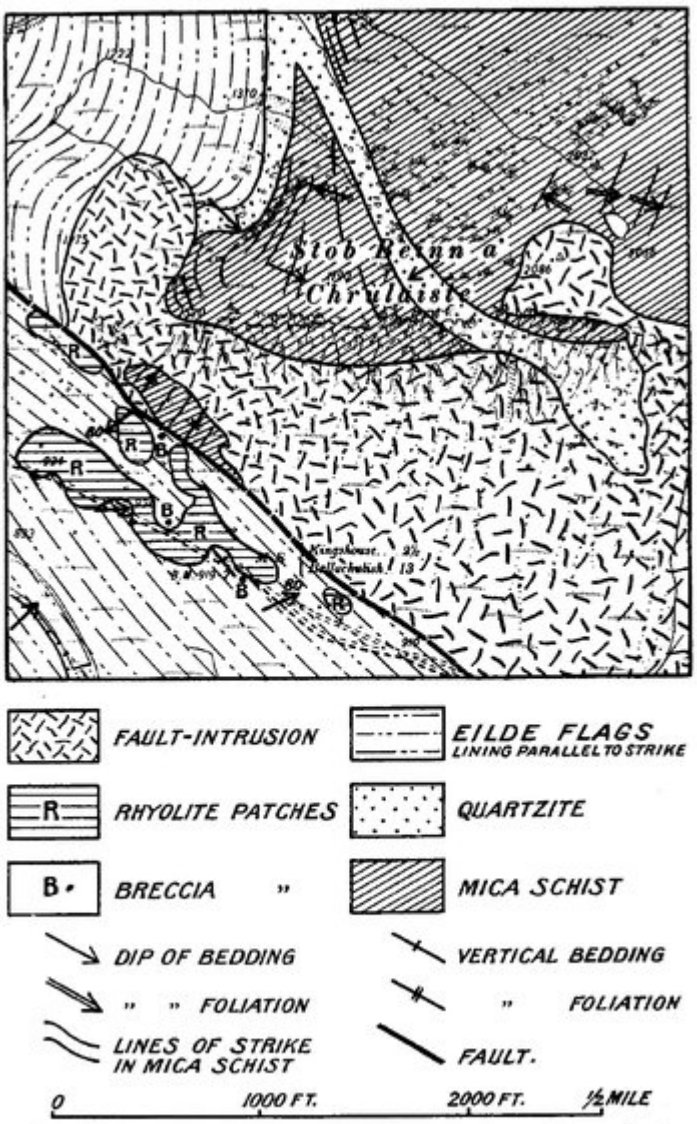


FIG. 28. Map of Stob Beinn a' Chrùlaiste. North-east dykes omitted

(Figure 28) Map of Stob Beinn a' Chrtilaiste. North-east dykes omitted.

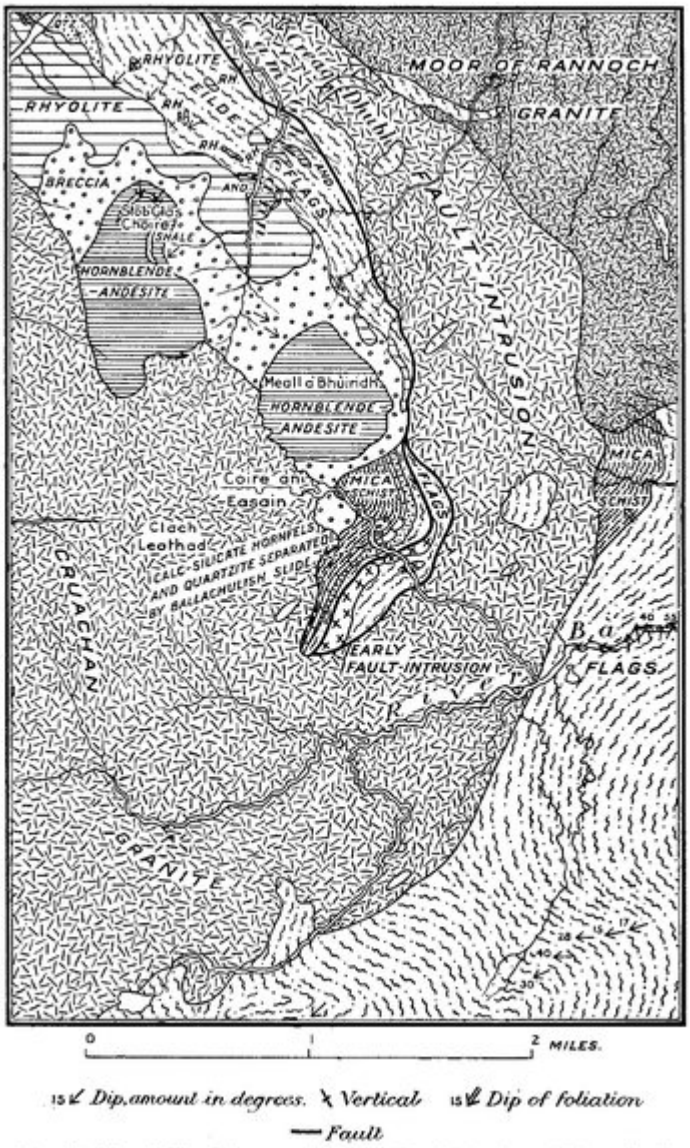


FIG. 29. Map of Càm Ghleann and Coire an Easain. North-east dykes omitted

(Figure 29) Map of Càrn Ghleann and Coire an Easain. North-east dykes omitted.

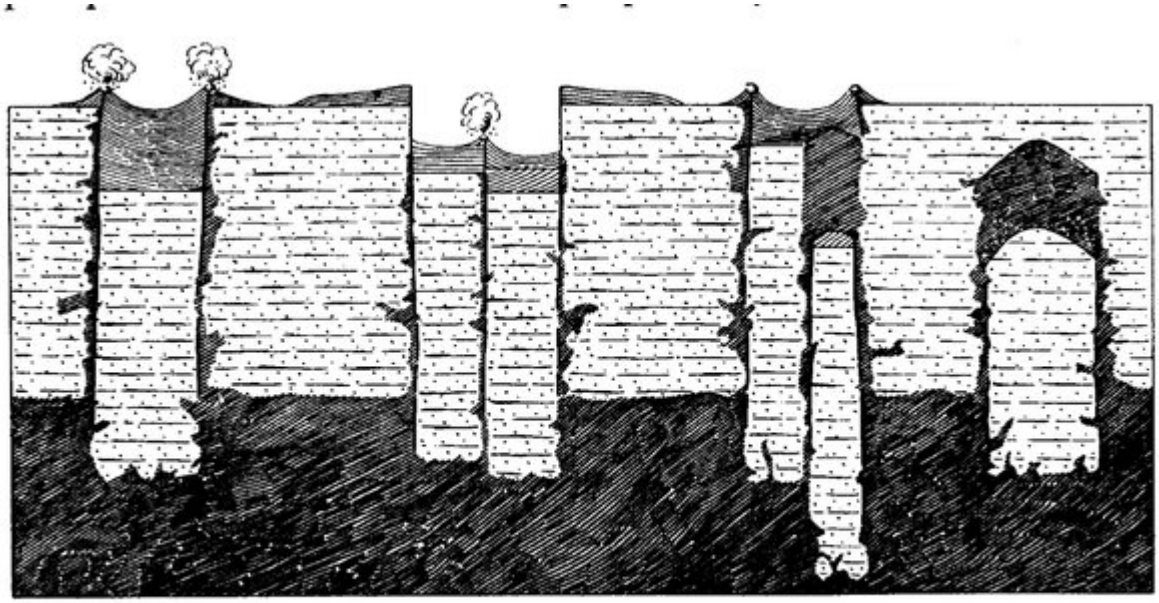


FIG. 30. Diagram of subaerial and subterranean cauldron-subsidences accompanied by volcanic and plutonic accumulations of igneous rocks

(Figure 30) Diagram of subaerial and subterranean cauldron-subsidences accompanied by volcanic and plutonic accumulations of igneous rocks.

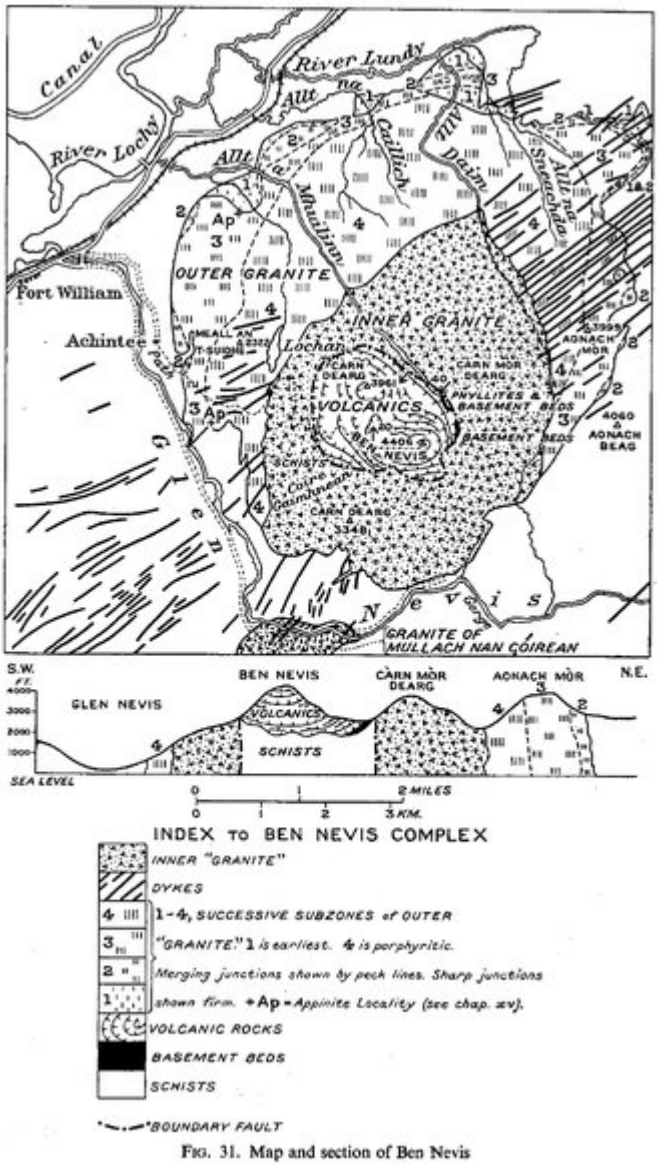


FIG. 31. Map and section of Ben Nevis

(Figure 31) Map and section of Ben Nevis.

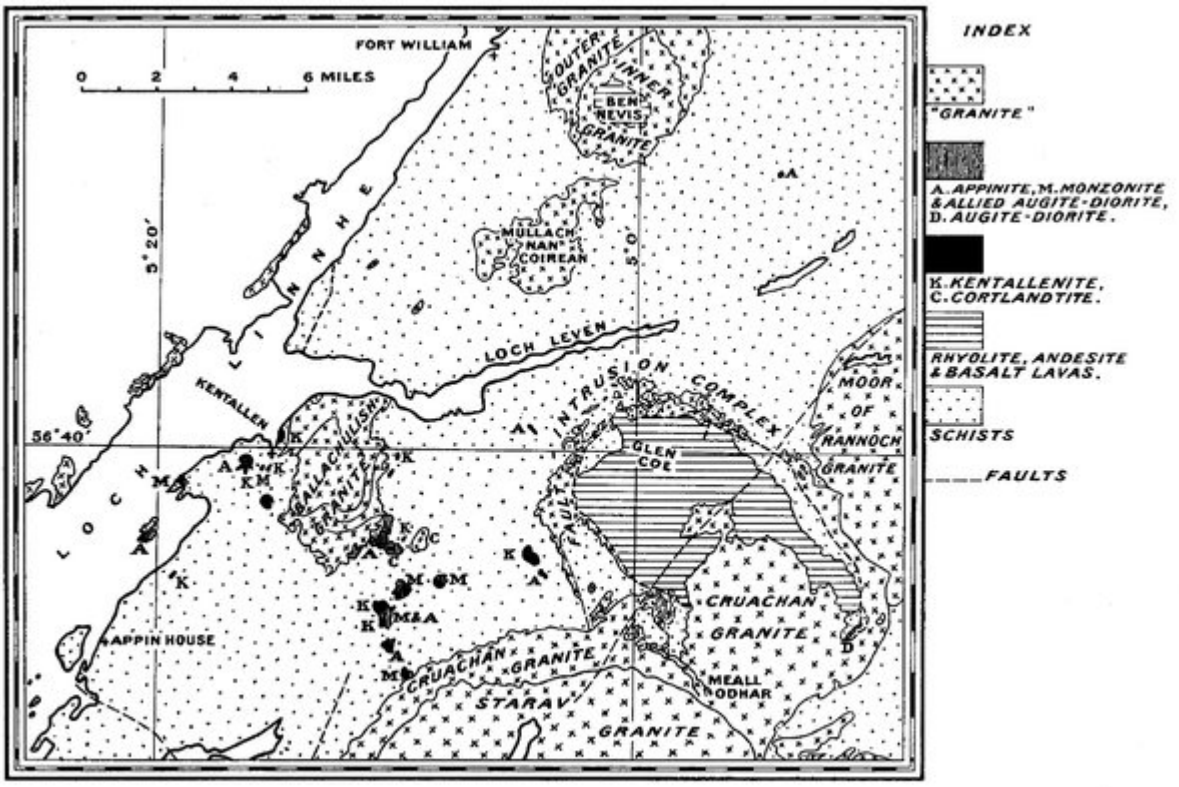


FIG. 32. Map of plutonic and volcanic rocks of Sheet 53 referred to the Lower Old Red Sandstone Period

(Figure 32) Map of plutonic and volcanic rocks of Sheet 53 referred to the Lower Old Red Sandstone Period.

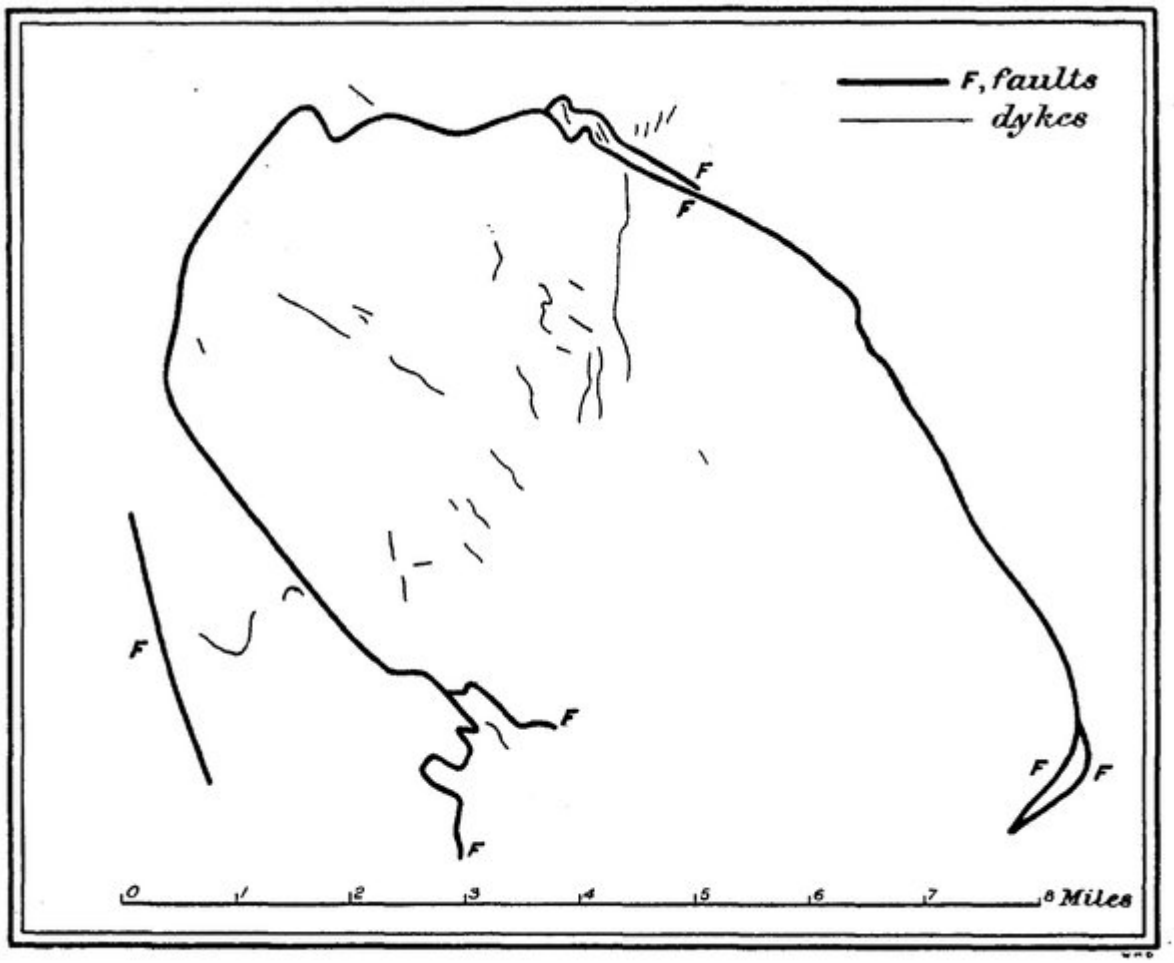


FIG. 33. Map of early felsite and andesite dykes of Glen Coe

(Figure 33) Map of early felsite and andesite dykes of Glen Coe.

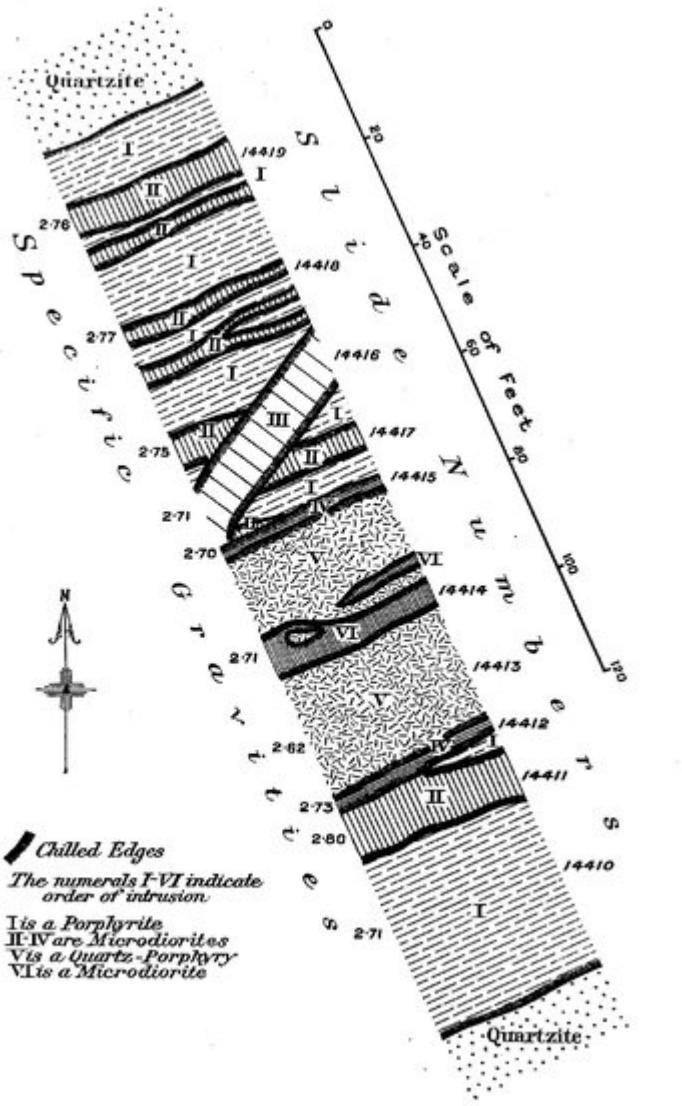


FIG. 34. Map of multiple dyke in the bed of Allt Fhaolain, ½ mile above the bridge, Glen Etive

(Figure 34) Map of multiple dyke in the bed of Allt Fhaolain [NN 158 510], ½ mile above bridge, Glen Etive.

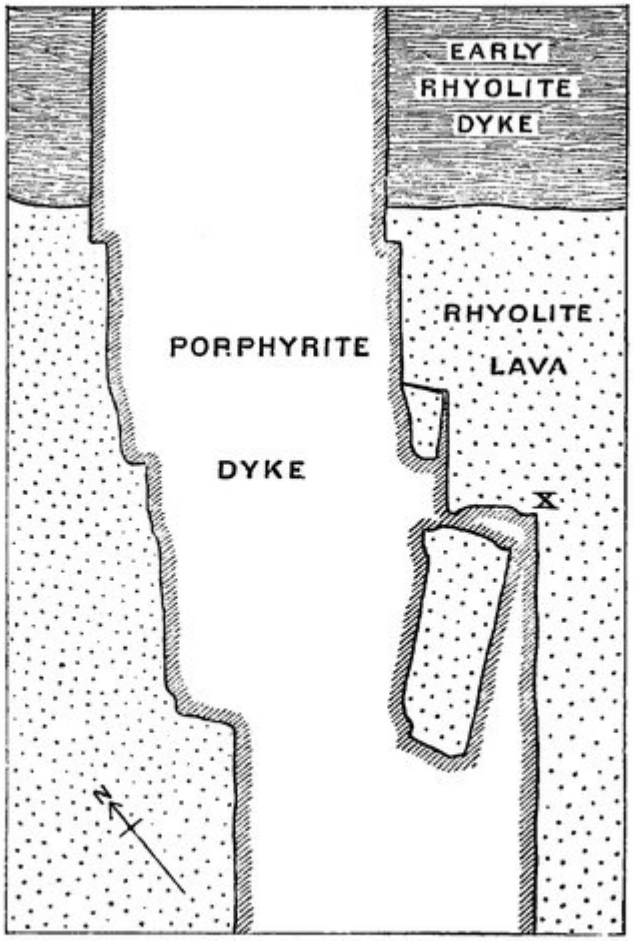
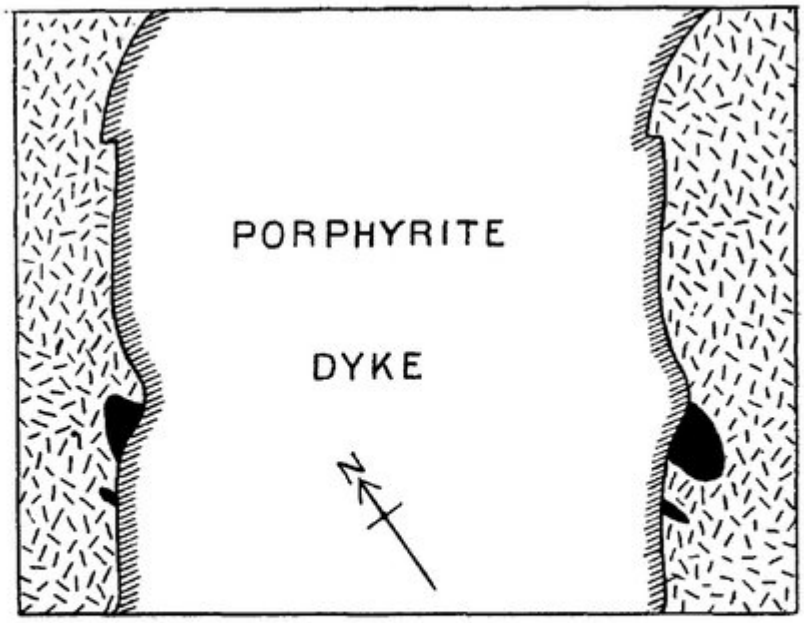


FIG. 35. Map of porphyrite dyke traversing rhyolites at the foot of the northern front of Buachaille Etive Beag

The walls of country-rock are counterparts the one of the other

(Figure 35) Map of porphyrite dyke traversing rhyolites at the foot of the northernn fromt of Buachaille Etive Beag [NN 192 548]. The walls of country-rock are counterparts the one of the other.



(about $\frac{1}{2\frac{1}{4}}$ natural size)

FIG. 36. Map of porphyrite dyke traversing Moor of Rannoch "Granite" in bed of River Etive, 500 yd above Kingshouse (Sheet 54, Geol.)

Two basic lumps have been bisected

(Figure 36) Map of dyke, River Etive, bisecting two basic lumps in Moor of Rannoch "Granite" in bed of River Etive 500 yd above Kinghouse (Sheet 54, Geol.) Two basic lumps have been bisected.

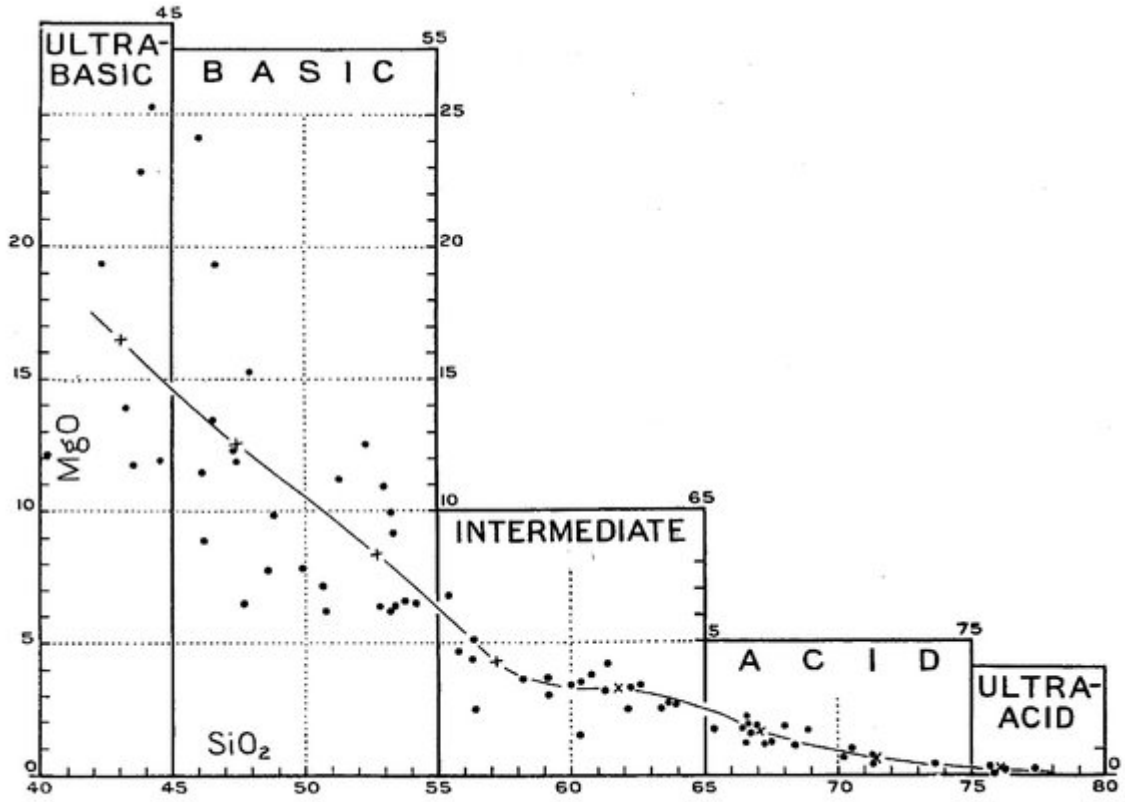


FIG. 37. Graph comparing MgO and SiO_2 percentages of individual Devonian igneous rocks of South-West Highlands. Crosses correspond with averages used in Fig. 37

(Figure 37) Graph comparing MgO and SiO_2 percentages of individual Devonian rocks of S.W. Highlands. Crosses correspond with averages used in (Figure 37).

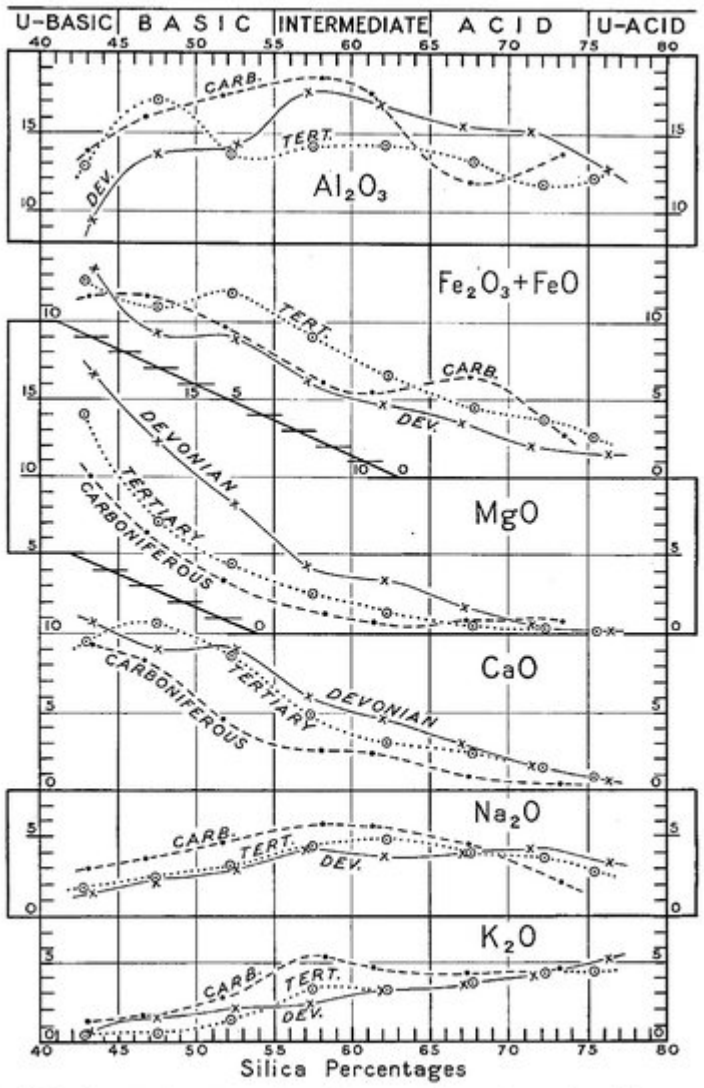


FIG. 38. Graphs comparing average analyses of igneous rocks spaced according to SiO_2 percentages. Tertiary and Carboniferous for all Scotland, Devonian for South-West Highlands

(Figure 38) Graphs comparing average analyses of Scottish Tertiary, Carboniferous and Devonian igneous rocks, the last-named restricted to S.W. Highlands.

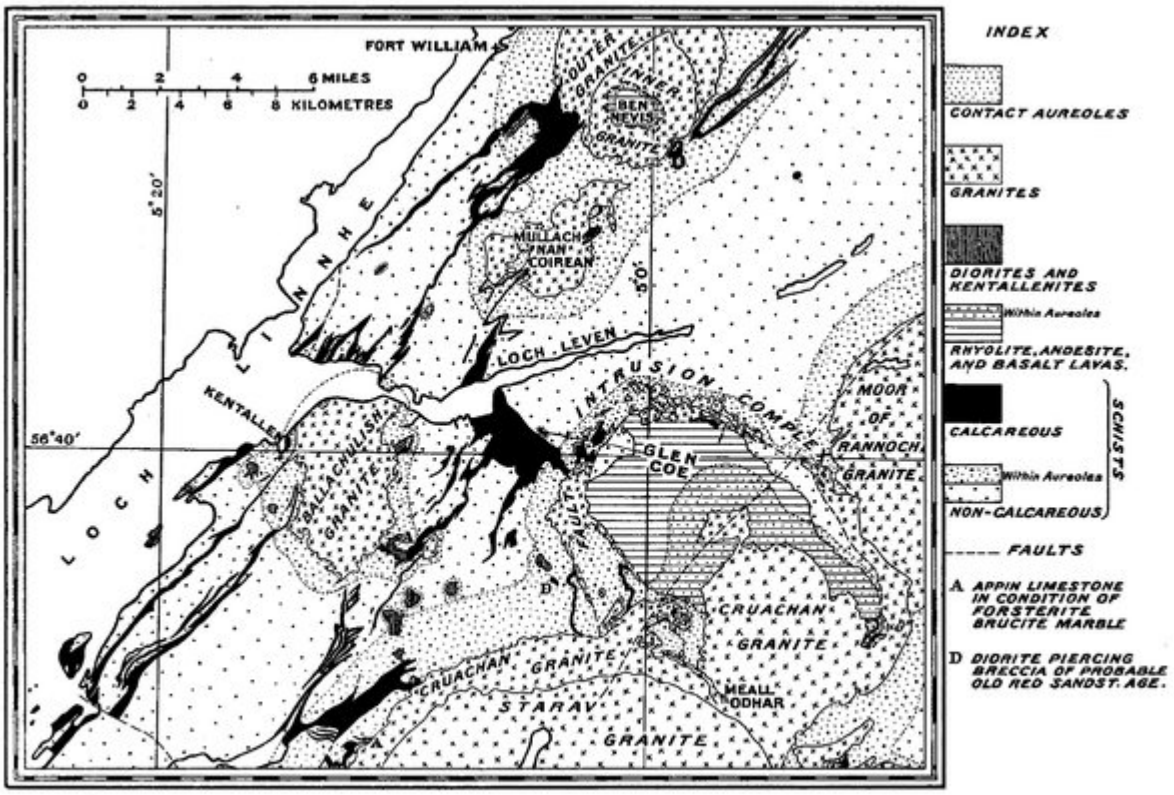


FIG. 39. Map of contact-aureoles south-east of Loch Linnhe
The limits drawn include alteration sufficiently intense to convert impure limestone into calc-silicate-hornfels

(Figure 39) Map of contact-aureoles south-east of Loch Linnhe. The limits drawn include alteration sufficiently intense to convert impure limestone into calc-silicate-hornfels.

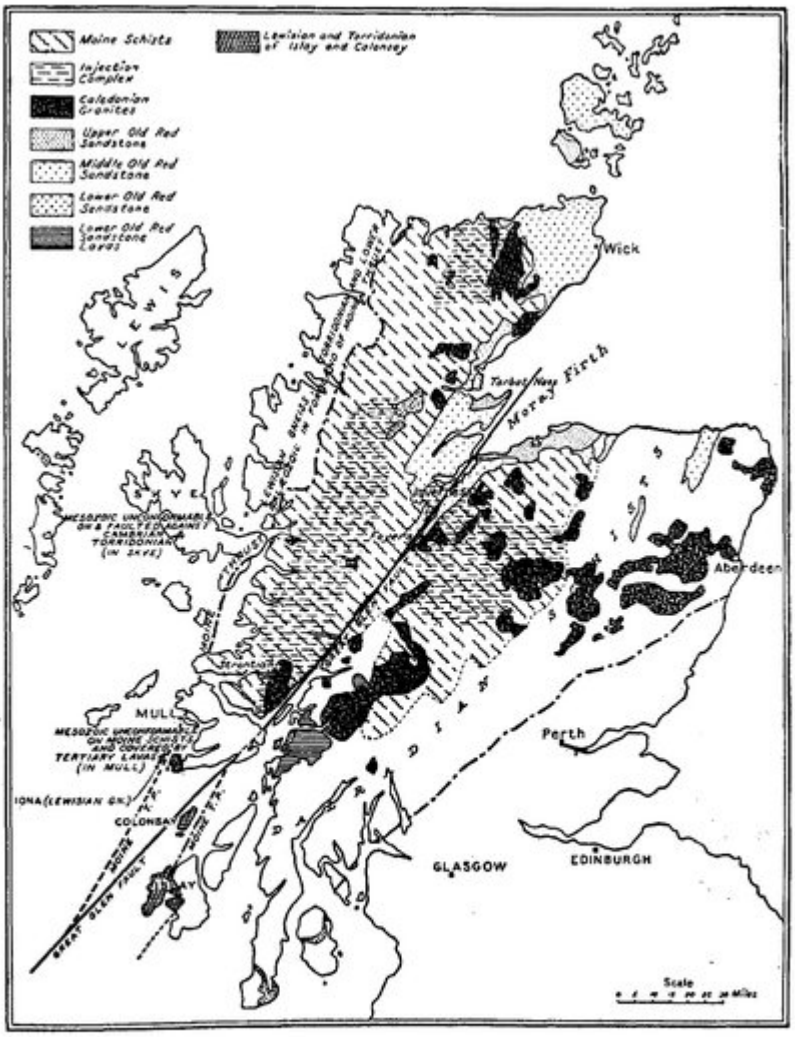


FIG. 40. Geological map of the Scottish Highlands to show the present position of the Moine injection complexes, the Strontian and Foyers granites, and the Moine Thrust-plane, after W. Q. Kennedy

(Reproduced, by permission, from *Quart. Journ. Geol. Soc.*, vol. cii, pt.i, 1946, fig. 2)

(Figure 40) Geological map of the Scottish Highlands to show the present position of the Moine injection complexes, the Strontian and Foyers granites, and the Moine Thrust-plane, after W. Q. Kennedy (Reproduced, by permission, from Quart. Joum. Geol. Sot., vol. cii, pt.i, 1946, fig. 2).

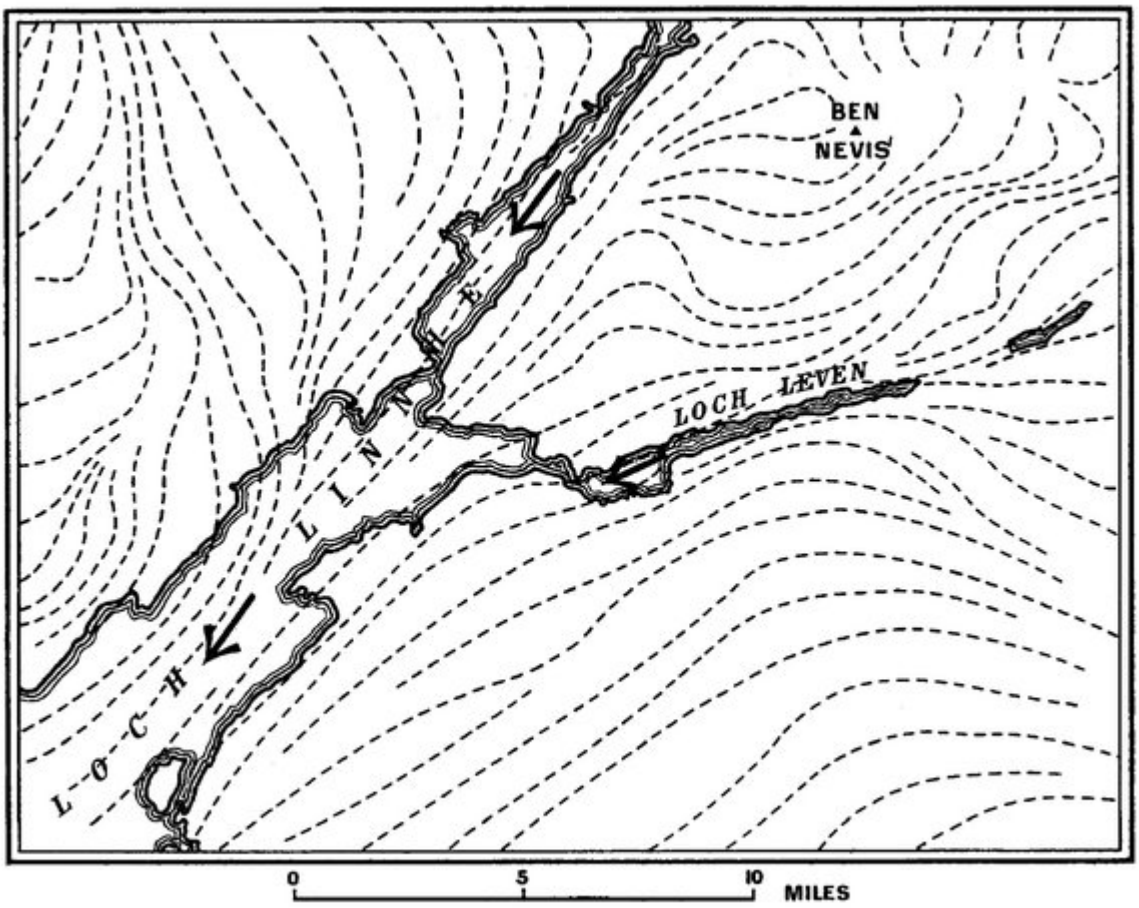
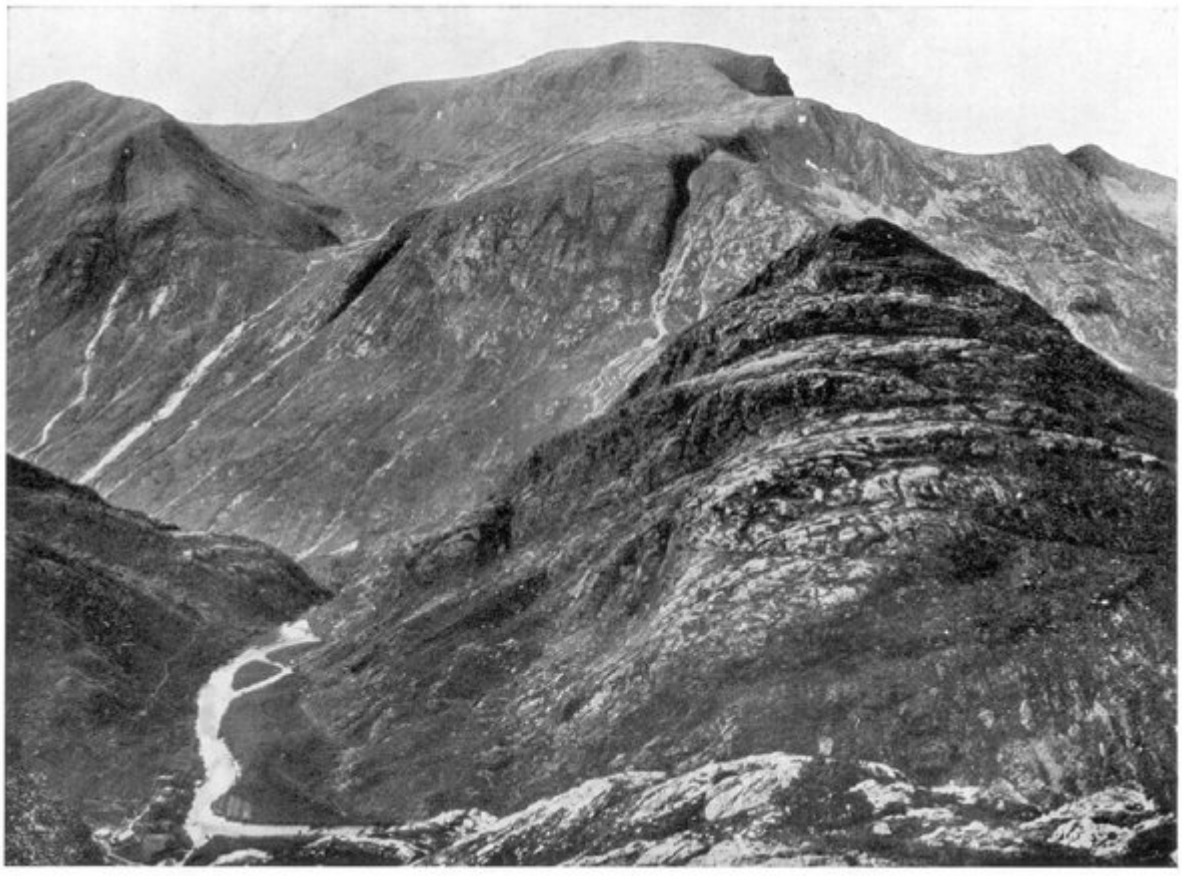


FIG. 41. Map of glacial flow-lines during the maximum stage of glaciation

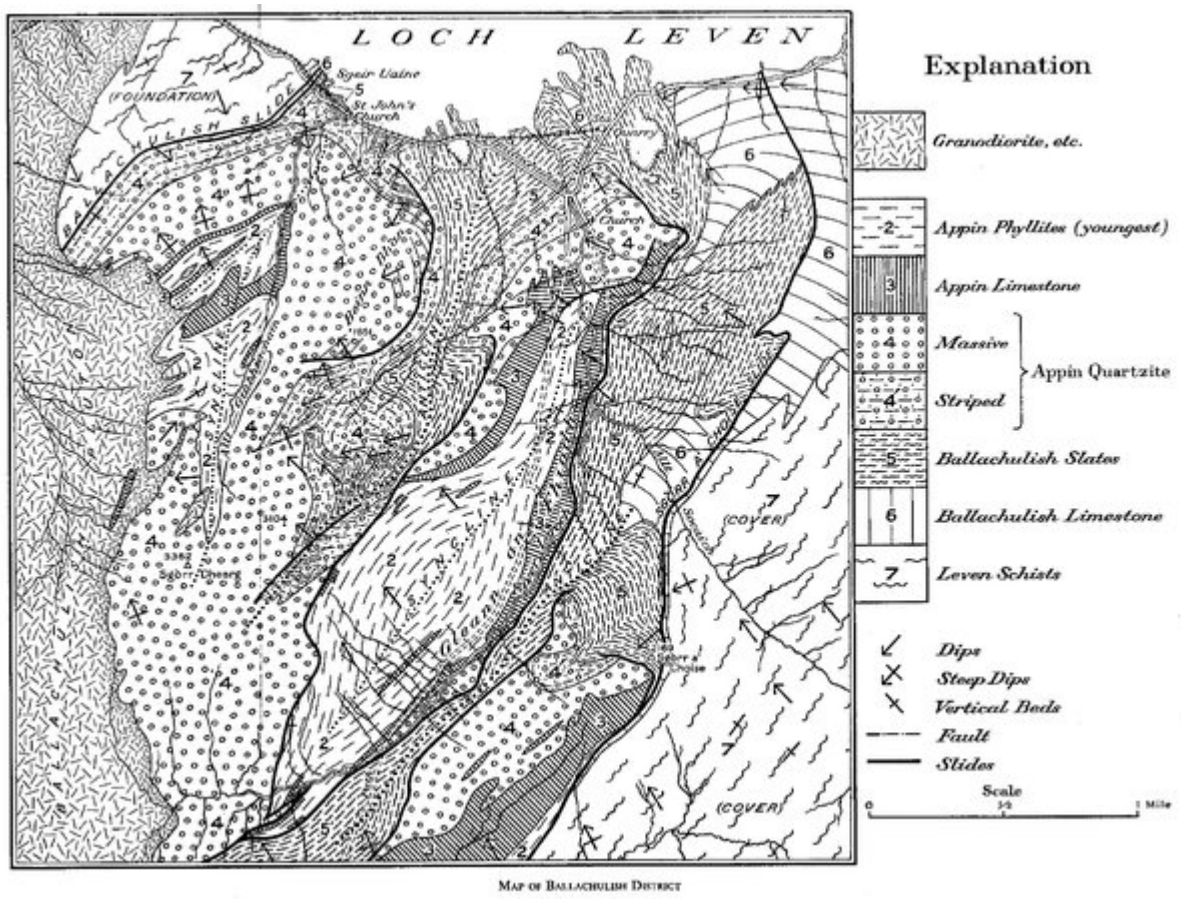
(Figure 41) Map of glacial flow-lines during the maximum stage of glaciation.



(Plate 1) Ben Nevis with hanging corrie and River Nevis [NN 200 680] disappearing into Nevis Gorge.

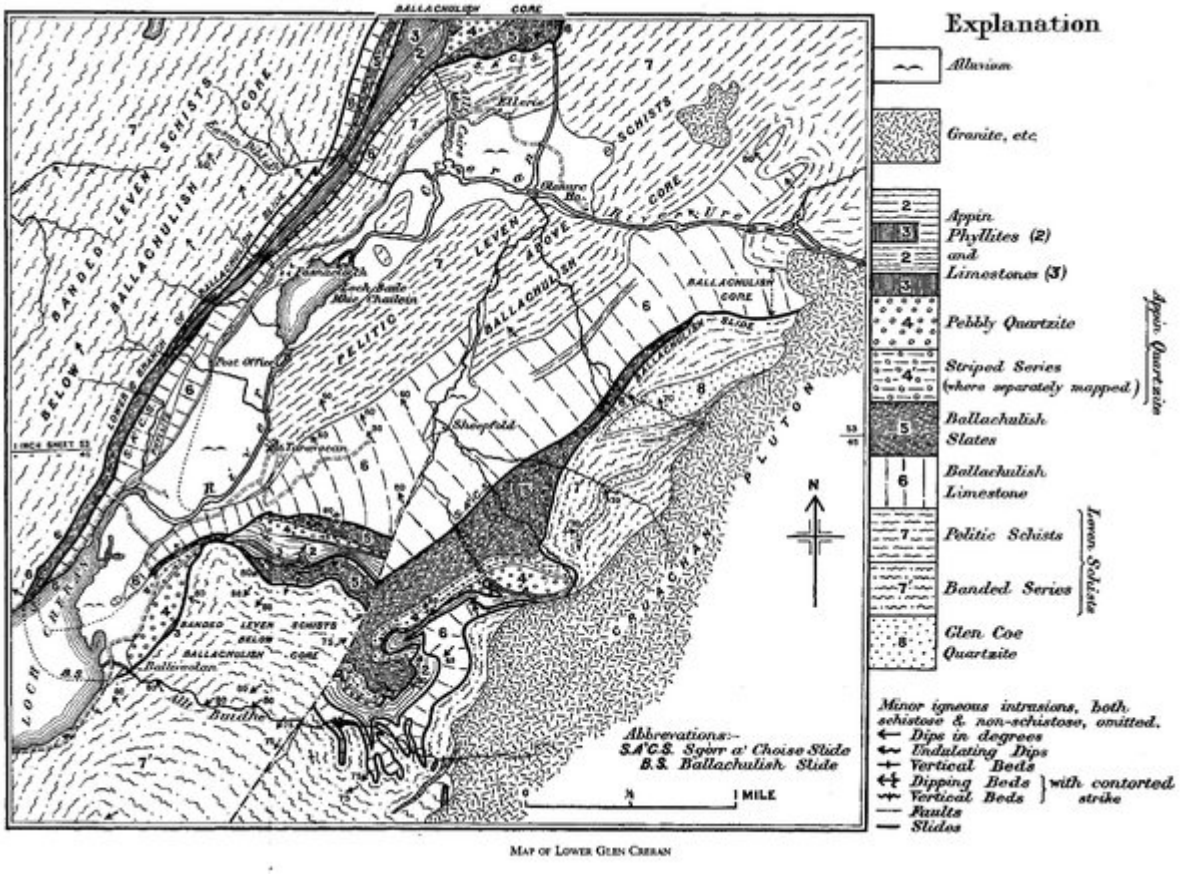
1. Hanging portion of River Leven with dam site of Blackwater Reservoir

(Plate 2) 1. Hanging portion of River Leven with dam site of Blackwater Reservoir [NN 250 605]. 2. Stob Bàn, Near Watershed of Lairigmòr Valley, showing comparatively recent landslip.



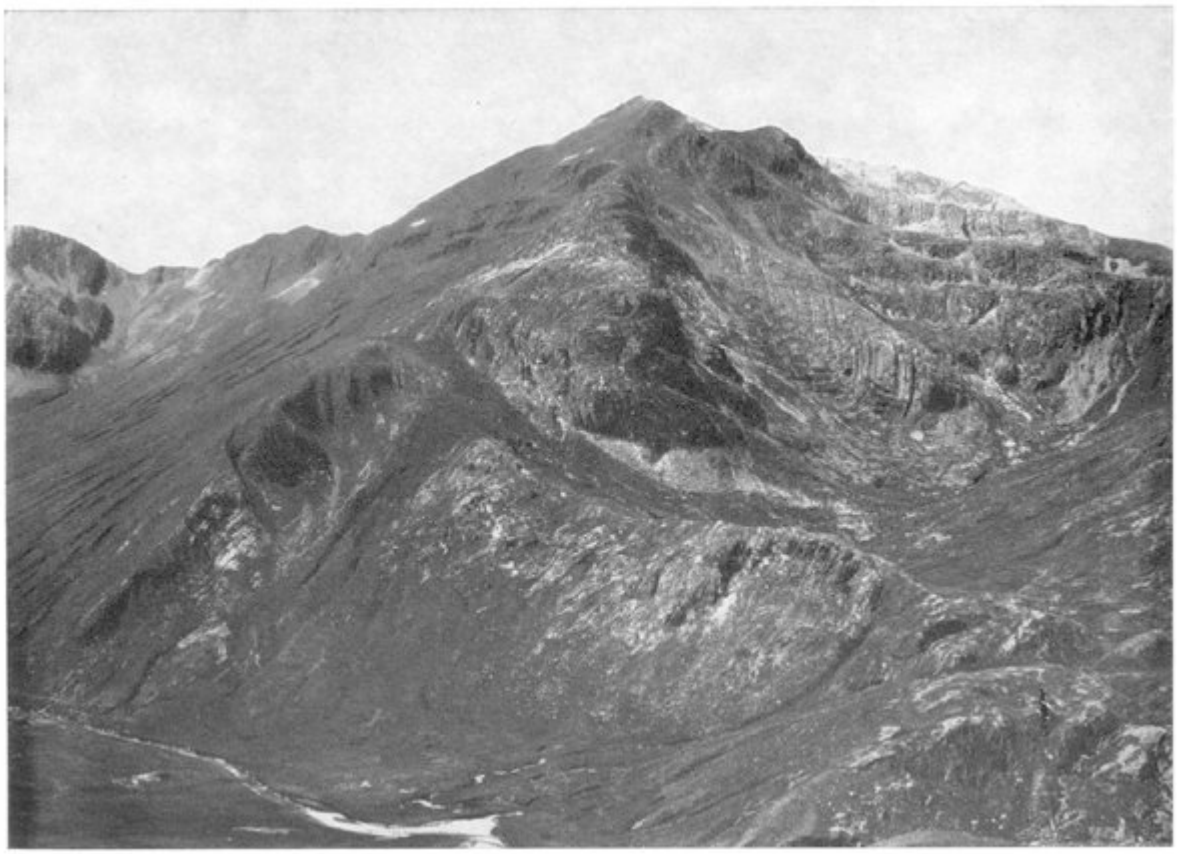
Map of Ballachulish District

(Plate 3) Map of Ballachulish District.



Map of Lower Glen Creran

(Plate 4) Map Of Lower Glen Creran.

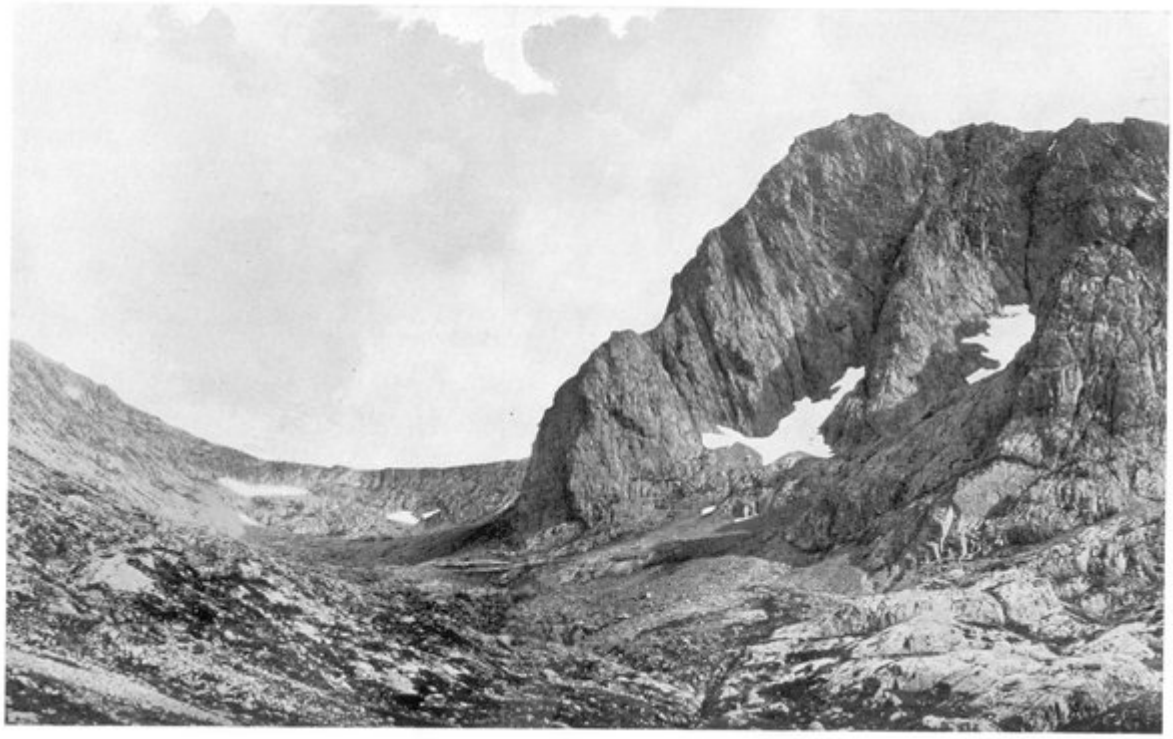


(Plate 5) Sgùrr A' Mhàim across Allt Coire A' Mhail Folded Glen Coe Quartzite.

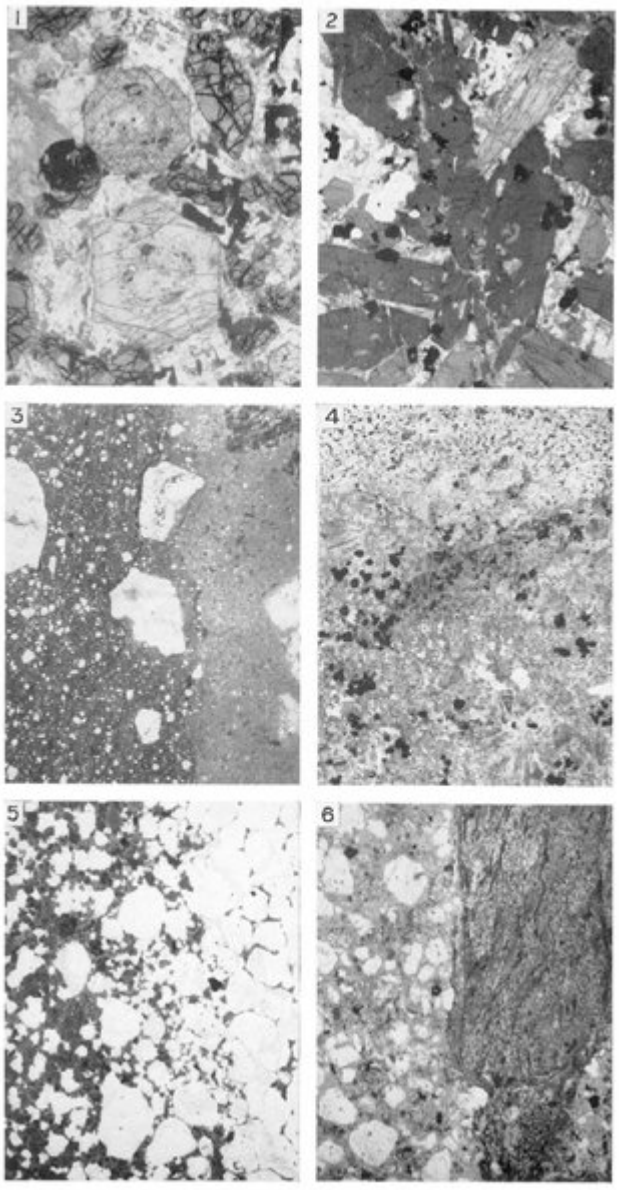
(Plate 6) Gearr Aonach [NN 160 555] And Aonach Dubh: Glen Coe "sisters" Largely rhyolite lavas.

(Plate 7) Melting of Three Waters, Glen Coe; and Rock-Fall, Allt Core Gabhail.

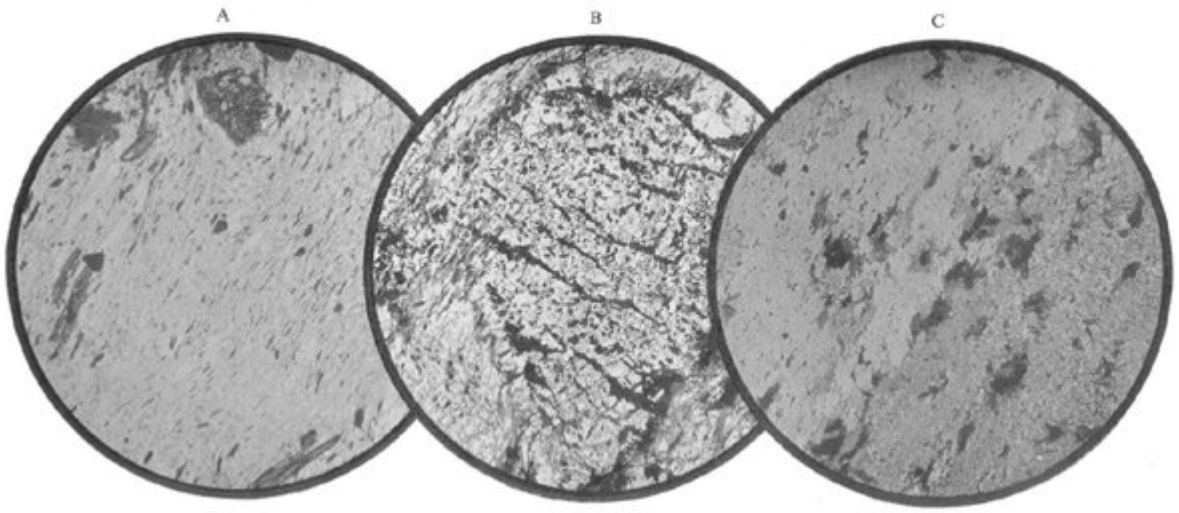
(Plate 8) Stob Dearg Rhyolite lavas (crags) on schists (grass covered). Fossils at +.



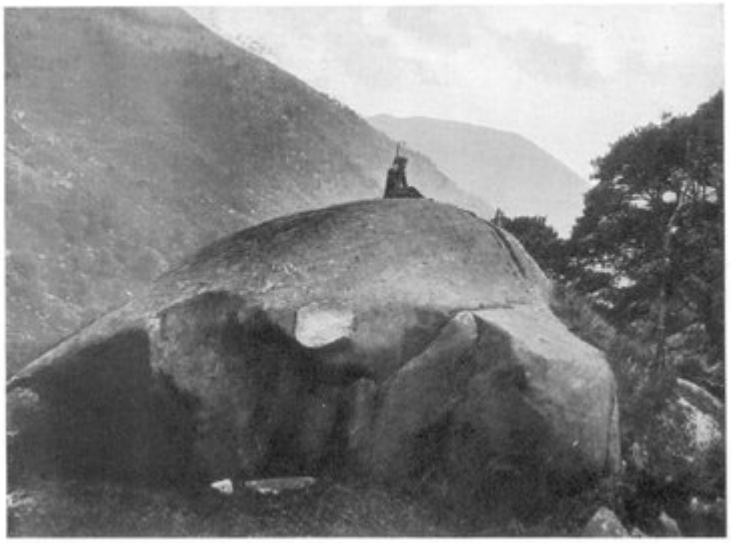
(Plate 10) Allt a' Mhuilinn [NN 161 730]: Ben Nevis Volcanics on right, and Inner "Granite" on left, meeting in stream.



(Plate 11) Photomicrographs of Kentallenite, Appinite and rocks connected with the Fault-Intrusion of Glen Coe. × 10 Dia. Explanation of (Plate 11) 1. Kentallenite, type quarry (S7053) [NN 009 577]. Olivine, with black cracks; augite, idiomorphic, grey; felspar, clear; biotite, pale or dark. (photo M.2436; p. 212). 2. Appinite, N. of Leacantuim [NN 117 577], Glen Coe (S11036) [NN 1152 5810]. Hornblende, mainly dark; felspar and quartz, clear. (M.2441; p. 215). 3. Junction of flinty crush-rock (left) with chilled Fault-Intrusion (right) at Boundary-Fault, Stob Mhic Mhartuin (S13403) [NN 207 575]. The minute clear grains in the flinty crush-rock are quartz. The four larger crystals in the same are xenocrysts of felspar derived from the Fault-Intrusion. The four crystals in the Fault-Intrusion are felspar phenocrysts, one showing dark. (M.2444; p. 162). 4. Junction of pelitic hornfels (upper third of photo) with lit par lit vein (remainder) in xenolith in Fault-Intrusion, taken from quenched zone at Boundary-Fault, An t-Sròn (S10311) [NN 136 558]. Due to quenching the vein has completed its crystallisation by developing spherulites — right at bottom corner and left at margin against hornfels. (M.2445; p. 216). 5. Fault-Intrusion (felspar shows grey) detaching quartz xenocrysts (clear) from quartzite xenolith. Permeation area north of Glen Coe (S11517b) [NN 1592 5970]. (M.2440; p. 219). 6. Greatly sheared xenolith of basic lava (right), recrystallised with much minute hornblende. It is enclosed in chilled Fault-Intrusion (left), loaded with clear xenocrysts of quartz, and has been carried just inside Cauldron-Subsidence of Glen Coe at An t-Sròn (S11905) [NN 1362 5502]. (M.2439; p. 217).



(Plate 12) Photomicrographs of Leven Schists before and after contact-alteration. × 21 Dia. A. Not contact-altered, Glen Leac na Muidhe (S11618) [NN 1126 5486]. Porphyroblasts of biotite, garnet and magnetite in well foliated base of muscovite, quartz and magnetite. B. Slightly contact-altered, ¾ mile from Cruachan "Granite", Glen Etive district (S8270) [NN 112 505]. Pseudomorph, largely of cordierite and magnetite, after garnet in well foliated base of muscovite, quartz and magnetite. C. Completely reconstructed to cordierite-andalusite-hornfels, near Ben Nevis "Granite", Aonach Beag (S13837) [NN 1935 7186]. Cordierite, pale, N.W. half; andalusite, darker, S.E. half; biotite and magnetite, dark to black.



(Plate 13) An Steall, The Waterfall of a valley hanging to Glen Nevis Water-worn crags on left due to stream cascading down marginal crevasse; Roche moutonnee, Glen Nevis, by roadside above Polldubh [NN 141 686] Note gap on "sloss" side due to plucking.

TABLE 1

Glen Scaddle "Epidiorite" and "Sillimanite-Gneiss"

	I	A	II	III
SiO_2	51·79	51·75	54·02	60·28
Al_2O_3	11·88	13·7	22·15	18·72
Fe_2O_3	0·67	9·5	0·77	0·30
FeO	10·66		6·64	6·03
MgO	8·51	9·2	2·22	2·68
CaO	7·92	8·5	1·54	2·44
Na_2O	2·37	2·0	2·14	3·43
K_2O	1·22	1·0	5·93	2·60
H_2O+	0·70		2·68	1·45
H_2O-	0·30		0·75	0·65
TiO_2	2·92	c.1·2	1·06	1·07
P_2O_5	0·64		tr.	tr.
MnO	0·19		0·16	0·15
CO_2	—		—	—
Total	99·77		100·06	99·80
Sp. Gr.	3·00		2·78	2·73

Analyses I, II, III by W. H. Herdsman, quoted from Drever (1940, pp. 153, 157).

I. "Epidiorite," Glen Scaddle.

A. Corresponding "average rock" of Devonian igneous series deduced from graphs, Fig. 38, p. 205.

II. "Sillimanite-gneiss" marginal to "epidiorite," Coire nam Muc.

III. "Sillimanite-gneiss," mixed from Coire nam Muc and Coire Dubh.

(Table 1) Glen Scaddle "Epidiorite" and "Sillimanite-gneiss".

TABLE 2

Analyses of Devonian Igneous Rocks of Sheet 53, 45 and 62 (Geol.)

	Ult.-B.	Basic						Intermediate										
	1	2	3	4	5	6	7	8	9	10 (see 13)	11	12	13 (see 10)	14	15	16	17	18
SiO_2	40·26	48·00	49·86	50·60	50·73	53·05	53·22	56·25	56·50	59·11	59·25	59·43	60·05	60·45	60·80	61·49	61·50	62·21
Al_2O_3	15·74	12·52	16·33	14·67	17·08	16·96	17·20	16·30	21·15	17·85	17·30	17·24	18·55	19·89	16·25	14·98	17·35	14·43
Fe_2O_3	3·44	8·74	3·62	2·81	4·59	2·95	2·64	1·60	1·55	1·78	1·15	2·58	0·93	1·76	1·70	1·51	1·27	1·77
FeO	7·95		4·34	6·47	4·06	5·40	4·84	5·05	3·70	3·24	4·07	3·24	3·41	2·27	3·38	3·84	3·87	3·65
MgO	12·09	15·26	7·80	7·04	6·12	6·15	6·33	5·12	2·55	3·85	3·60	2·92	3·46	1·54	3·72	3·22	4·22	5·66
CaO	12·03	7·94	6·47	10·05	7·32	7·45	6·79	6·55	6·15	5·05	4·95	5·14	5·44	4·04	4·75	4·56	3·80	4·43
Na_2O	2·25	3·11	3·42	3·13	3·55	3·36	2·38	4·13	4·37	4·10	4·45	4·11	3·84	4·77	4·05	3·59	2·38	2·65
K_2O	1·36	2·68	2·10	2·65	1·18	1·45	4·12	2·02	2·56	3·06	2·50	2·53	2·72	3·53	3·05	2·80	2·94	2·75
H_2O+	1·75	1·36	2·77	0·50	2·00	1·10	0·61	0·95	0·65	0·73	0·50	0·84	0·35	0·70	0·60	1·68	1·00	0·66
H_2O-	0·48		1·25	0·30	0·33	0·60	0·19	0·10	0·15	0·11	1·00	0·33	0·05	0·45	0·30	0·23	0·50	0·40
TiO_2	2·42	0·22	1·06	1·25	1·90	0·92	0·69	0·90	0·45	0·30	0·70	1·11	0·42	0·30	0·90	0·96	0·75	0·88
P_2O_5	0·04	—	0·54	0·24	0·35	0·54	0·28	0·40	0·22	0·14	0·21	0·26	0·29	0·23	0·28	0·32	0·17	0·20
MnO	0·03	—	0·40	0·23	0·20	0·20	0·25	0·40	tr.	0·05	0·15	0·20	0·16	tr.	0·10	0·21	0·07	0·23
CO_2	0·03	—	0·23	nil	0·82	nil	0·57	nil	nil	—	nil	0·06	—	nil	nil	0·92	nil	0·06
Cl	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·03	—	—
S	nil	—	—	nil	—	—	—	—	0·08	0·19	—	—	—	tr.	—	—	—	—
(Ni,Co)O	—	—	nt. fd.	—	nt. fd.	—	nt. fd.	—	—	—	—	nt. fd.	—	—	—	nt. fd.	—	nt. fd.
BaO	—	—	—	0·10	—	0·07	—	0·08	—	—	0·23	—	0·13	—	—	—	0·11	—	0·07
ZnO	—	—	—	—	—	—	—	—	—	—	—	—	—	0·27	—	—	—	—	—
Li_2O	—	—	tr.	—	nt. fd.	—	tr.	—	—	—	—	nt. fd.	—	—	—	nt. fd.	—	nt. fd.
Total	99·87	99·83	100·29	99·94	100·30	100·13	100·19	99·77	100·08	99·70[1]	99·83	100·12	99·94	99·93	99·88	100·45	99·82	100·05
Sp.Gr.	3·19	2·95	2·76	3·00	2·82	2·86	2·85	2·81	—	—	2·71	2·75	—	2·64	2·76	2·71	2·76	2·76

[1] After subtracting 0·09 for S

1 : Appinite ; Ardsheal Hill. **2** : Kentallenite ; Kentallen. **3** : Olivine-basalt with orthoclase ; lava, Taynuilt, Lorne. **4** : Olivine-basalt with orthoclase ; intrusion, Ardsheal Hill. **5** : Hypersthene-basalt ; lava, Glen Coe. **6** : Biotite-diorite with hornblende and augite ; basic phase of Beinn a' Bhuiridh (Cruachan Quarry) Diorite. **7** : Monzonite ; Glen Creran. **8** : Banatite ; Inner non-porphyritic Subzone 3 of Outer "Granite," Ben Nevis. **9** : Tonalite ; intermediate phase of Beinn a' Bhuiridh (Cruachan Quarry) Diorite. **10** : Tonalite ; Outer "Granite," Ballachulish (see **13**). **11** : Banatite ; Outer non-porphyritic Subzone 1 of Outer "Granite," Ben Nevis. **12** : Banatite-porphyrite ; Fault-Intrusion, Glen Coe. **13** : Tonalite ; Outer "Granite," Ballachulish (see **10**). **14** : Hornblende-porphyrite ; dyke, Ben Nevis Swarm, W. of Ballachulish Pluton. **15** : Banatite ; Mid non-porphyritic Subzon e 2 of Outer "Granite," Ben Nevis. **16** : Hornblende-andesite ; lava, Glen Coe. **17** : Hornblende-andesite ; lava, contact-altered in Beinn a' Bhuiridh screen. **18** : Kersantitic microdiorite ; dyke, Etive Swarm, Glen Etive.

(Table 2) Analyses of Devonian igneous rocks of sheet 53, 45 and 62 (Geol.).

TABLE 3

Analyses (continued), Sheets 53, 45, 54 and 62 (Geol.) — *Norwegian*

	Acid													Ultra-Acid		Trondhjemites		
	19	20 (see 25)	21	22	23	24 (28, 30)	25 (see 20)	26	27	28 (24, 30)	29	30 (24, 28)	31	32	33	A	B	C
SiO_2	65·30	65·72	66·50	66·71	66·91	67·30	67·78	68·02	68·40	70·27	71·35	71·70	73·70	75·71	76·14	70·30	71·95	72·11
Al_2O_3	15·20	15·49	15·15	15·33	15·09	16·50	16·64	14·16	17·21	15·52	13·68		13·62	12·25	11·91	15·36	15·76	15·25
Fe_2O_3	2·49	2·35	1·34	1·46	1·70	1·20	1·07	1·82	tr.	0·90	1·75	16·81	0·48	1·23	1·26	0·56	0·76	0·64
FeO	2·41	2·07	2·39	2·26	1·95	1·98	1·74	1·95	0·92	0·94	0·97		1·28	0·31	0·25	2·37	0·03	0·84
MgO	1·80	1·23	1·88	1·53	2·02	1·27	1·19	1·91	1·03	0·67	0·84	0·47	0·32	0·20	0·13	1·03	0·31	0·38
CaO	3·05	2·69	3·15	2·72	3·27	2·85	2·38	2·81	3·05	1·60	1·85	2·42	0·94	0·61	0·47	3·52	1·65	1·98
Na_2O	4·13	4·49	3·90	3·67	4·16	4·70	4·27	3·90	4·48	4·45	3·75	9·00	4·05	3·79	3·37	4·30	6·63	5·43
K_2O	3·37	4·38	3·68	3·96	3·16	2·75	3·48	3·92	2·88	4·16	4·36		4·85	4·73	5·30	1·45	2·22	2·04
H_2O+	0·81	0·49	0·90	0·28	0·56	0·50	0·48	0·56	0·30	—	0·51	—	Nil	0·52	0·30	0·79	0·42	0·66
H_2O-	0·19	0·12	0·20	0·88	0·14	0·20	0·30	0·20	0·12	—	0·19	—	0·55	0·08	0·36	0·05		0·03
TiO_2	0·83	0·61	0·55	0·69	0·67	0·30	0·36	0·63	0·28	0·31	0·47	—	0·36	0·21	0·15	0·35	0·08	0·17
P_2O_5	0·23	0·43	0·18	0·19	0·17	0·16	0·12	0·16	0·14	0·17	0·11	—	tr.	0·06	0·05	0·12	—	0·06
MnO	0·12	0·04	0·10	0·18	0·18	nil	--	0·22	—	0·04	0·18	—	nil	0·10	0·19	0·04	—	0·02
CO_2	tr.	—	nil	0·15	nt. fd.	nil	—	nt. fd.	—	—	nt. fd.	—	nil	0·19	0·26	0·13	—	0·22
S	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0·03	—	0·06
FeS_2	—	—	—	—	—	—	—	—	1·08	—	—	—	—	—	—	—	—	—
(Ni,Co)O	nt. fd.	—	—	nt. fd.	nt. fd.	—	—	nt. fd.	—	—	nt. fd.	—	—	nt. fd.	nt. fd.	—	—	—
BaO	0·11	0·19	—	0·10	0·05	—	—	0·06	—	—	0·05	—	—	0·08	0·01	tr.	—	0·03
Li_2O	nt. fd.	—	—	?	nt. fd.	—	—	nt. fd.	—	—	tr.	—	—	?	nt. fd.	—	—	—
Total	100·04	100·30	99·92	100·11	100·03	99·71	99·81	100·32	99·89	99·03	100·06	100·40	100·15	100·07	100·15	100·40	99·81	99·92
Sp. Gr.	2·70	—	2·68	2·69	2·69	2·67	—	2·69	—	—	2·65	—	2·62	—	—	2·71	2·64	2·68

19 : Biotite-hornblende-porphyrite ; Early Fault-Intrusion, Glen Coe. **20** : Granite ; Inner Granite, Ballachulish (see **25**). **21** : Granite ; porphyritic subzone of Ben Nevis Outer "Granite". **22** : Hornblende-porphyrite ; dyke, Etive Swarm, Glen Etive. **23** : Trondhjemite ; Moor of Rannoch "Granite". **24** : Trondhjemite ; Inner "Granite," Ben Nevis (see **28, 30**). **25** : Granite ; Inner Granite, Ballachulish (see **20**). **26** : Adamellite ; Northern Lobe, Cruachan "Granite". **27** : Trondhjemite ; "White Granite," Ballachulish. **28** : Granite ; Inner "Granite," Ben Nevis (see **24, 30**). **29** : Granite ; Starav Granite. **30** : Trondhjemite ; Inner "Granite," Ben Nevis (see **24, 28**). **31** : Binary Granite ; referred to Meall Odhar Granite. **32** : Rhyolite ; lava, Glen Coe. **33** : Quartz-porphyry ; dyke, Etive Swarm, Glen Etive. **A, B, C** : Three Norwegian Trondhjemites to compare with **23, 24, 27, 30.**

Further details regarding Tables 2, 3 are given on pp. 208-9.

(Table 3) Analyses of Devonian igneous rocks of sheet 53, 45, 54 and 62 (Geol.) continued.

TABLE 4

Analyses of Appin Limestone

	1	2	3	4	5	6	7	8	9	Dolomite
SiO_2	3·4	13·9	1·9	1·3	3·5	3·3	25·9	3·7	—	—
Al_2O_3	1·2	5·3	1·8	—	2·1	—	5·0	—	—	—
Fe_2O_3	—	5·1	1·3	—	3·3	—	1·8	—	—	—
FeO	0·2	—	—	—	—	—	—	—	—	—
MgO	9·0	8·0	18·5	20·0	17·1	21·8	5·4	20·9	18·4	21·8
CaO	42·5	33·7	31·7	30·7	29·7	29·1	28·9	28·9	26·7	30·4
CO_2	43·1	34·3	44·6	45·9	44·0	46·8	29·3	45·6	41·1	47·8
Etc.	0·5	0·2	0·9	—	—	0·6	4·1	—	13·1	—
Total	99·9	100·5	100·7	—	100·2	—	100·4	—	—	100·0
$MgCO_3$	18·8	15·2	38·0	41·8	35·7	45·7	11·4	43·8	38·6	45·7
$CaCO_3$	75·6	60·0	56·4	54·8	52·9	52·0	51·6	51·6	47·6	54·3
Surplus MgO	0·0	0·8	0·4		0·0		0·0			0·0
Surplus CO_2	0·0	0·0	0·0		2·1		0·9			0·0

1. Waterfall in stream 50 yd E. of Kentallen railway station (contact-altered). Anal. I. D. Muir.
2. Onich shore, 400 yd W. by S. of church (S 15376). Anal. B. Lightfoot.
3. Three hundred yards above path S.W. of Sgòrr a' Choise (contact-altered, S 15379, 15380). Anal. B. Lightfoot.
4. Dalnatrat, near Duror station. Supplied by Stewarts and Lloyds, Ltd.
5. Hillslope, 200 yd N.E. of Portnacroish (Appin station). Anal. B. Lightfoot.
6. Dalnatrat, near Duror station. Supplied by Steetley Lime and Basic Co., Ltd.
7. Marble Quarry, pathside, River Laroch, 660 yd S. of Laroch Bridge, Ballachulish. The full analysis by A. Muir and H. G. M. Hardie (1956, p. 20) shows Na_2O 1·95, K_2O 1·00.
8. Tributary of River Laroch, 660 yd S. 23°W. of Laroch Bridge, Ballachulish.
9. East of Duror railway station.
Pure dolomite is quoted for comparison.

Analyses of Xenolith and of Contaminated and Normal Ballachulish Quartz-Diorite

	A	B	C	D	E	F
SiO_2	54·73	59·24	62·51	59·81	59·11	51·61
Al_2O_3	7·42	20·80	19·10	16·61	17·85	2·18
Fe_2O_3	1·71	0·29	0·65	1·50	1·78	1·04
FeO	5·03	0·99	0·41	2·80	3·24	9·28
MgO	8·11	1·20	0·23	2·49	3·85	11·29
CaO	18·32	7·13	2·01	3·20	5·05	22·86
Na_2O	2·35	7·47	2·18	3·49	4·10	0·43
K_2O	1·19	0·85	11·47	7·92	3·06	0·07
Etc.	1·05	2·22	1·50	2·05	1·66	1·09
Total	99·91	100·19	100·06	99·87	99·70	99·85

Analyses by I. D. Muir (1953a).

A. Xenolith of Appin Limestone transformed through immersion in Ballachulish quartz-diorite (see E. below). The specimen was taken 50 yd from **1** of previous Table.
B. Plagioclase zone enveloping **A**, and 1-2 inches thick.
C. Potash syenite zone enveloping **B**, 3 inches.
D. Augite-syenite zone enveloping **C**, a few inches.
E. Quartz-diorite of Ballachulish Pluton unmodified by Appin Limestone.
F. Diopside from **D.**

(Table 4) Analyses of Appin Limestone; Analyses of xenolith and contaminated and normal Ballachulish quartz-diorite.

TABLE 5

Analyses illustrating Reactions between Quartz Xenoliths and Ballachulish Quartz-Diorite

	I	A	II	B	III	IV	C
SiO_2	59·94	49·71	59·43	46·30	62·53	59·11	45·15
Al_2O_3	5·04	2·85	5·54	8·60	16·49	17·85	8·10
Fe_2O_3	2·00	2·76	4·63	2·78	1·82	1·78	2·10
FeO	4·97	7·45	7·08	10·16	2·99	3·24	12·97
MgO	8·30	13·35	7·89	13·15	2·80	3·85	13·30
CaO	14·72	22·36	9·05	13·55	4·78	5·05	12·84
Na_2O	1·87	0·60	1·65	1·05	4·17	4·10	0·66
K_2O	0·14	0·04	0·58	0·48	2·12	3·06	0·32
Etc.	2·52	1·13	4·55	3·82	2·53	1·66	4·10
Total	99·50	100·25	100·40	99·89	100·23	99·70	99·54

All analyses by I. D. Muir.

I. Augite-rich inner zone of corona.
A. Augite from **I.**
II. Hornblende-rich outer zone of corona.
B. Hornblende from **II.**
III. Modified **IV**, 2 inches outside corona.
IV. Normal Ballachulish quartz-diorite.
C. Hornblende from **IV.**

(Table 5) Analyses illustrating reactions between quartz xenoliths and Ballachulish quartz-diorite.