
Excursion 8 Drumcarrow and Dura Den

Time	Half day
Maps	OS 1:50,000 map, sheet 59 GS One-inch, 1:50,000, sheets 41, 49
Excursion map	(Map 13)
Walking distance	3 km of track and rough road.
Purpose	The main objects of this excursion are to examine: (1) some of the Upper Old Red Sandstone sediments in Dura Den; (2) Lower Carboniferous sediments at about the level of the Lower Ardross Limestone (see (Table 5)); (3) the Drumcarrow Olivine–Dolerite Sill; (4) the Blebo Hole Quartz–Dolerite Sill and its contact effects upon the adjacent shales; (5) two small volcanic necks within Kinninmonth Den. Owing to the complex structures and lack of exposures, the Carboniferous rocks have not been subdivided on the Excursion map.
Route	Leave St Andrews on the B939 from the West Port and fork left at the University playing fields 1 km further on. Continue past Craigtoun Park to Claremont crossroads [NO 461 146] and there turn left (south then south-west) for 1.5 km along an unclassified road before forking right (west) for 120 m to the track leading up to a quarry on the south face of Drumcarrow Craig. The top of the hill carries a radio mast and a television relay mast.

1. Drumcarrow Craig [NO 45977 13135]: olivine-dolerite sill

The quarry is cut into the Drumcarrow Olivine–Dolerite Sill which is 1.5 km long from east to west and up to 450 m wide from north to south. The majority of exposures of the sill show a well developed columnar jointing while small scarps on the hillside are due to an almost horizontal jointing at right angles to the columnar jointing. In the quarry itself, columnar jointing is prominent and large joint planes normal to the columns (parallel to the intrusion surface) dip steeply southwards. Towards the northern margin of the sill these joint planes are inclined gently north, while at the southern margin they are steeply inclined south. This sill has been classified (Forsyth and Chisholm 1977, p. 141) as a non-ophitic olivine-dolerite, one of a small group in East Fife. In the quarry the rock has a conchoidal fracture and yellow olivines can often be seen on fresh surfaces. Old mining records indicate that the southern side of the sill is strongly transgressive to the local sediments (Forsyth and Chisholm 1977, p. 142).

Ascend to the summit of Drumcarrow Craig, 90 m north of the quarry, for a view of the surrounding geology. The olivinedolerite sill of Denork, also showing good columnar jointing, lies 400 m north-west where it is well exposed in Denork Craig. The low ground to the east is scarred by small tips and shafts from old ironstone workings centred on Denhead and dating from the 19th century. The ironstone, in the Lower Limestone Formation, lies in a faulted NE–SW trending syncline. Apart from the sills, exposure in this area is generally poor. On Drumcarrow Craig east–west glacial striae may be noted on some of the less deeply weathered crags of olivine-dolerite.

2. Ladeddie [NO 44279 13250]: volcanic vent

Return to the bus and continue west for 1.5 km. The western end of the Drumcarrow Sill is cut by an olivine-basalt plug and agglomerate filled vent, just north of Ladeddie Farm. Old quarries in the field are situated where, on a much smaller scale than that of the sill, columnar jointing occurs in the fine-grained basalt.

3. Blebo Hole: glacial lakes, drainage channel, quartz-dolerite sill

Continue to the T-junction at Backfield of Ladeddie then turn westwards across the bed of a former postglacial lake. The high ground to the north and south of the lake bed is capped by quartz-dolerite sills which form bluffs and crags in several places. At Blebo Hole [NO 423 134], just over 1.5 km west of Backfield of Ladeddie, park at the old farm building and follow the grass track south for 90 m to a quarry in a steep west-facing scarp. To the west is a wide expanse of level ground extending almost to the village of Ceres. This is probably where a mass of dead ice melted forming Glacial Lake Ceres. What was a drainage channel from this lake, now dry, passes the old farm buildings at Blebo Hole, continues north for 400 m, crossing the B939, runs past Blebo House and ultimately joins the Ceres Burn near Kemback. If this interpretation is correct, the present gorge of the Ceres Burn in Dura Den must be a postglacial feature. The burn in the gorge of Kinninmonth Den most probably drained the post-glacial lake to the west of Backfield of Ladeddie.

In the quarry, note the rich yellow-brown soil and subsoil passing down into poorly jointed, spheroidally weathering quartz-dolerite. The rock is coarse grained and contains numerous pink segregation patches. The form of weathering is perhaps the most obvious difference between this quartzdolerite and the olivine-dolerite of Drumcarrow. In addition, iron pyrites is nearly always visible in the hand specimen of the quartz-dolerite, but is rarely seen in the olivine-dolerite (Irving 1929). The segregation patches are notably poor in ferromagnesian minerals.

4. Blebo Hole Marine Band

Ninety metres south of the quarry, just before the wall which passes in front of the quarry reaches the burn, at the base of a small tree, there is a small outcrop of grey shales dipping to the south-east at 12°: the Blebo Hole Marine Band (Forsyth and Chisholm 1977, p. 48). They are hard and have presumably been thermally metamorphosed by the quartz-dolerite sill. This sill forms the scarp 45 m to the north-east. In the baked shales the fossils have been recrystallised and are now very conspicuous, occurring either as white crystalline calcite with a ferruginous stain, or, if the specimen has been long exposed to weathering, as moulds of the original shells, the calcite having been dissolved out. These shales are believed to be at approximately the same horizon as the shales lying just above the Lower Ardross Limestone. The fauna includes *Productus*, *Aviculopecten*, *Nuculana*, *Orthoceras*, *Straparollus*, *Fenestella*, *Lithostrotion* and crinoid ossicles (Craig and Balsillie 1912, p. 12). The marine band is also exposed on the opposite side of the burn, though here it is not as fossiliferous.

5. Blebo Hole: volcanic vents

If time is available, walk up the north bank of the burn past the previously examined quartz-dolerite sill. In the burn are several small outcrops of Carboniferous rocks lying above the baked shales. One hundred and seventy metres upstream from the shales, notice a white trap dyke exposed in the bed of the burn where it follows an S-bend. Three hundred metres upstream are exposures of a small vent 45 m long and mainly tuff filled, the tuff containing a good deal of little-indurated shale (Craig 1912, p. 84). This rock is similar to that in many other vents in East Fife, but the two dykes that traverse it are relatively unusual (the most obvious of these is exposed in the burn just upstream from a tree which has been blown over and now lies on the fence). The groundmass of the dykes is hard, fine grained and highly altered, consisting of a paste of chlorite and calcite. In it are set xenocrysts of anorthoclase up to 5 cm long, clear and colourless when fresh and yellow or brown when weathered. Large biotite xenocrysts are also common, hornblende xenocrysts rare. Fragments of sandstone and shale are also present, the latter usually surrounded by calcite, while pieces of dark grey glass also occur. A second vent filled with a similar tuff is cut through by the stream 55 m further east, but no dykes are exposed in it. Its eastern contact with the country rock can be seen where shales bend abruptly downwards into the vent, a common feature of such vents owing to drag at the close of eruption when material collapsed back into the vent.

Return to the bus and 90 m west of Blebo Hole, join the B939 for 400 m to Pitscottie crossroads. Note the quartz-dolerite sill exposed on the right, 50 m short of the crossroads. Turn right at the crossroads and immediately right again down Dura Den. For the first 550 m the road crosses a quartz-dolerite sill which is exposed in the Ceres Burn. Eight hundred metres from the crossroads a NNE–SSW fault down-throwing on the east brings in 15 m of horizontal, cross-bedded, creamy sandstone belonging to the Sandy Craig Beds of the Lower Carboniferous (Forsyth and Chisholm 1977, p. 12).

Dismount at the weir at Grove Cottage [NO 416 142] and send the bus on for just over 1 km to a small car park past a row of houses and opposite the village hall [NO 416 151].

6. Dura Den, Blebo Quarry [NO 41563 14433]: quartz-dolerite sill

At the roadside north from the weir, another quartz-dolerite sill is split by about 6 m of sandstone which extends east for 400 m. The upper leaf of the sill, now rather altered, may be examined in Blebo Quarry, about 110 m up a narrow path leading north-east from the weir where the path turns sharply right. It is coarse grained and contains pink segregation veins. Now walk northwards along the main road. The sandstone bed which splits the sill crops out on the eastern side of the road, but the contacts with the lower leaf of the sill are not exposed. The first outcrops of the sill are, however, fine grained.

7. Dura Den Fault and upturned beds [NO 41485 14431]

Two hundred and seventy-five metres from the weir, just before a sharp right hand bend in the road, the lower leaf of the sill can be seen upturned against a fault and, beneath it, carbonaceous sandstones with a small coal seam are exposed. Fault drag has increased the dip of these beds to 40° to the south-east in an area of otherwise almost horizontal strata.

8. Dura Den: fossil fish locality [NO 416 146]

Follow the road downhill until it meets the Ceres Burn again 450 m below the weir. Sandstones in the bed of the burn at this point belong to the Dura Den Formation of the Stratheden Group (see (Table 3)), formerly simply referred to as the Upper Old Red Sandstone. They form part of the famous Dura Den fossil fish locality. The Dura Den Formation here comprises red, green and cream siltstones alternating with cream coloured sandstones, often with ripple cross bedding (Chisholm and Dean 1974, p. 19). Polygonal mud cracks occur too. The locality was extensively quarried by British Museum collectors (Woodward 1915) and seems to have been completely worked out. Commonest among the fish was *Holoptychius flemingi* but several other genera were also present and House *et al.* (1977, p. 74) have correlated these beds with the Upper Devonian (Famennian) beds at Clashbenny Quarry on the northern side of the Tay and with other localities in Scotland and Belgium. At the present day sandstones above the old mill lade on the western bank of the burn yield only isolated scales of *Holoptychius*. Attridge (1956) found a new locality higher in the succession that has yielded *Holoptychius*, but no further discoveries of this kind have been made. No fossils have been recorded from the eastern bank of the burn to date.

9. Dura Den: Dura Den Formation (Upper Old Red Sandstone) [NO 41619 14838]

Higher beds of the Dura Den Formation form a high cliff to the east of the road and can be examined 180 to 275 m downstream before reaching a row of cottages and a telephone box between the road and the burn. There is a rough scramble to reach the base of the exposures in the cliff. In the cliff there are 20 m of fine- to very fine-grained, slightly feldspathic sandstones which are in the main plane-bedded, soft, poorly consolidated, and yellow-brown to cream coloured. Some cross bedding occurs and is generally low angled in sets of around 15 cm. Also displayed are ripple marks. These are generally 2.5–5.0 cm in amplitude and asymmetrical. Climbing ripples are rare. Impersistent, thin (2.5 cm), coarser beds of up to granule grade occur as do much harder 10 cm thick nodular calcareous horizons and red-stained silty sandstones. Local erosion surfaces show undercutting. These sandstones appear to be mainly aeolian in origin. Three metres up the cliff and exposed on the underside of a shelf is a mud-flake breccia. This suggests that waterlaid as well as aeolian sediments are present (Hall and Chisholm 1987, p. 204). The nodular calcareous beds here and those at the village hall suggest incipient calcareous soil or 'calcrete' development analogous to that at Bishop Hill (Excursion 17) and fairly widespread in rocks of this age elsewhere in Scotland.

Now continue down to the waterfall just past the village hall. Here the sandstone again shows low angle cross bedding (but in sets up to 1.5 m thick). The sandstone is fine grained and has numerous veins and nodules of calcite.

Rejoin the bus and continue down Dura Den past the old stone bridge over the River Eden [NO 416 161] and continue east for 2.5 km towards Strathkinness.

On the slopes of Knock Hill there are several old overgrown quarries on both sides of the road. These are located in both the Pittenweem Beds and, above, the Sandy Craig Beds of the Strathclyde Group of the Carboniferous (Forsyth and Chisholm 1977, pp. 42–4) and were formerly worked for building stone, much of which can be seen in St Andrews where Geikie (1902, p. 346) remarked on its poor resistance to weathering. Continue eastwards noticing the fine view on the northern side of the road across the Eden Estuary to the Leuchars–Tentsmuir expanse of blown sand. On entering St Andrews, note the University Playing Fields and Observatory standing on a fluvio-glacial terrace sloping down eastwards from 30 m to 25 m in a distance of around 1.5 km (Cullingford and Smith 1966, p. 37).

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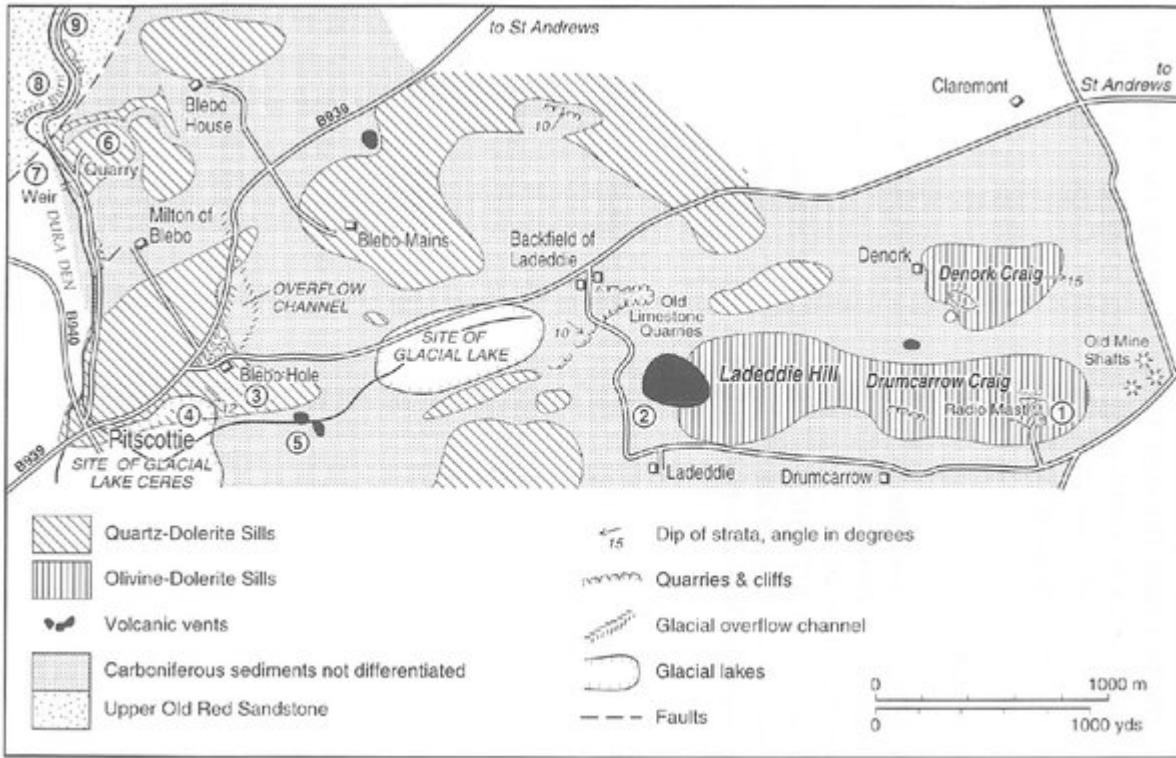
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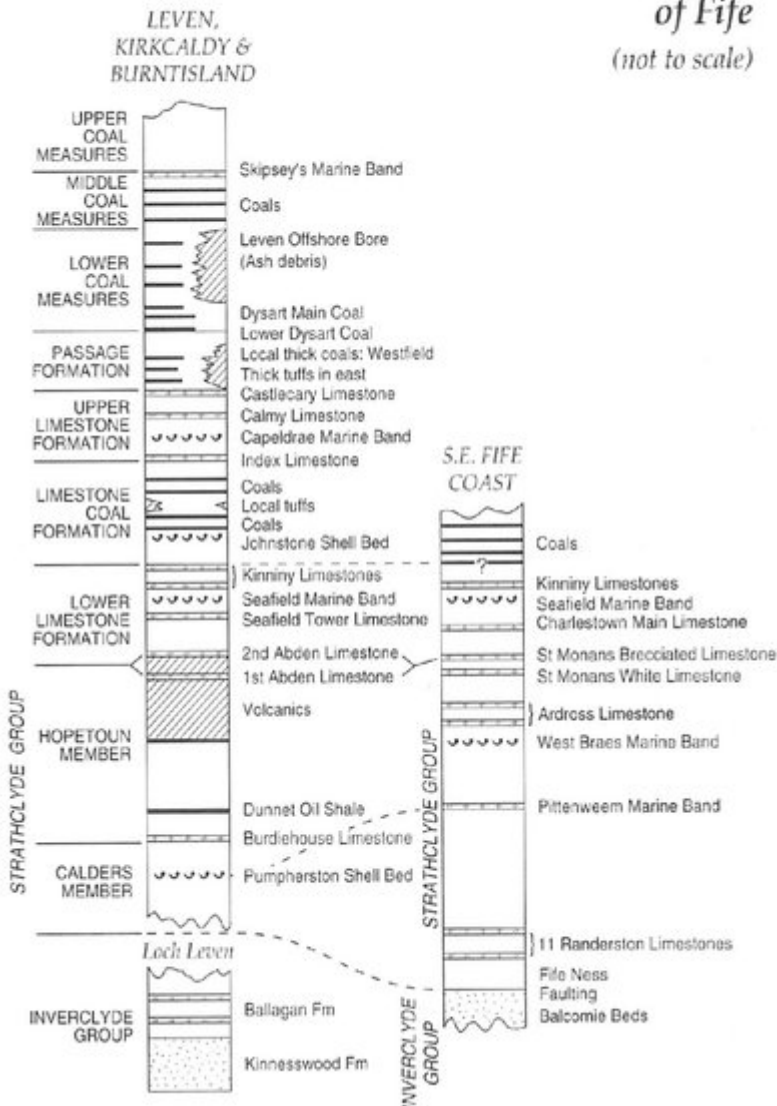
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(Figure 7) The flat fields are the site of a former glacial lake near Ceres, seen from Blebo Hole, Pitscottie.



(Map 13) Drumcarrow - Dura Den.

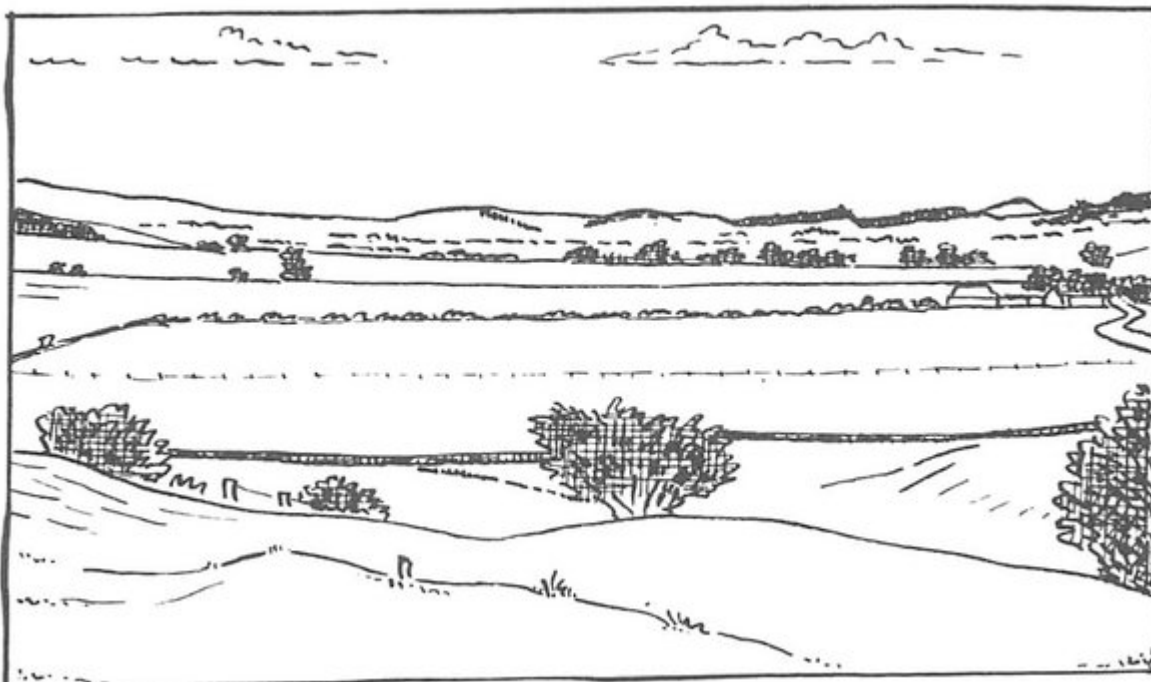
Carboniferous Rocks of Fife (not to scale)



(Table 5) Carboniferous rocks of Fife.

Ages	Stages	Kincardineshire	Perth	Dundee	Fife
360 My top of ORS	FAMMENIAN	Upper Old Red Sandstone (<60m)	↑	Clashbenny Fm (600 - 900m)	Stratheden Gp Knox Pulpit Fm (170m) Dura Den Fm (30m) Glenvale Fm (500m+) Burnside Fm (120m+)
375 My base of U. ORS	FRASNIAN	↑	↑	↑	↑
	GIVETIAN	Missing	Missing	Missing	Missing
	EIFELIAN	Missing	Missing	Missing	Missing
Base of middle ORS	EMSIAN	↓	↓	↓	↓
(385 → My)	SIEGENNIAN	Strathmore Gp (2000m) Garvock Gp (1500 - 2000m)	Taith Fm (1200m+) Cremix Fm (300 - 450m) Scone Fm (1900m)	Arbroath Ss Fm (360m+) Auchmithie Cgl (0-240m) Red Head Fm (450m)	(sandstones)
	GEDINNIAN	Arbuthnott Gp (2000 - 3000m) Crawton Gp (670m) Dunnotar Gp (1600m)	Ochil Volcanic Fm (2400 - 90m)	Dundee Fm (2000m) Montrose Volcanic Fm (40m)	Ochil Volcanic Fm (2000m)
400 → My	INFRA-GEDINNIAN = PRIDOLIAN (U. Silurian)	Stonchaven Gp (1550m)			
		Highland Border Complex (Ordovician)			

(Table 3) Correlation table for the Old Red Sandstone of Kincardineshire, Tayside and Fife.



(Figure 7) The flat fields are the site of a former glacial lake near Ceres, seen from Blebo Hole, Pitscottie.