The limestones of Scotland v.1 — Chapter 1 Introduction

Limestone, as dealt with in the following pages, comprises all rocks containing calcium carbonate in sufficient quantity to make the presence of that constituent one of the most important characteristics of their composition. It thus includes such contrasting materials as lake marl on the one hand and marble on the other. The range in composition stretches from limestones with 95 per cent. and upwards of calcium carbonate, through argillaceous calcareous rocks suitable for cement making and containing 70 to 80 per cent. of calcium carbonate, to rocks from which rock wool may be manufactured and which may contain as little as 20 per cent. of calcium carbonate.

By increase in magnesium carbonate, limestone passes into dolomite. The mineral dolomite is a double carbonate of calcium and magnesium, the two substances being present in equivalent molecular proportions (54.35 per cent. $CaCO_3$ and 45.65 per cent. $MgCO_3$), and this is the form in which the magnesia is present in the rock called dolomite, any excess of lime appearing as calcite. Thus the rock called dolomite is a mixture of the minerals dolomite and calcite in varying proportions. Nearly all limestones contain a certain percentage of magnesia, but for some economic purposes it is necessary to have as little magnesia as possible, whilst for others the nearer the rock is to pure dolomite in composition the better. For agricultural purposes even a considerable percentage of magnesia is quite unobjectionable as it performs a function similar in some respects to that of lime, and with some very acid soils it is even preferable to have a certain amount of magnesia present in the lime dressing.

A geological survey of limestones is an essential preliminary step to the appraisal of economic prospects; and it is necessary during such a survey to adopt the broad definition of limestone given above rather than a more limited conception bounded by what is thought to be of economic value in the light of evidence available at the time. Most limestones are sedimentary in origin, and each bed was laid down as a definite stratum over a large area of sea-floor under conditions which were favourable to the deposition of calcium carbonate. At one place, under optimum conditions, a thick deposit of nearly pure limestone was formed; at another only a thin bed accumulated; at a third the conditions on the sea-bed were so muddy that only a few shells could grow, and the resultant bed is a more or less calcareous shale; in still another place the limestone bed, after having been deposited, was eroded away again and there is nothing left to show for it. Because of this the stratigrapher lays much greater stress on a recognition of whether such and such a calcareous horizon is in the position of a known limestone rather than on the question of whether it is a good limestone. It is this "limestone position" which is traced from place to place and which is inserted on the geological map.

It may be noted in passing that a rock which appears to effervesce freely in acid is not necessarily a limestone. Some sandstones have a calcareous cement distributed evenly through their mass. Other rocks, such as some dense quartzites, are cracked and jointed, and the cracks are lined with calcite. Because of this they may show abundant effervescence on each face of every fragment broken off with a hammer. Basic igneous rocks, such as basalt, contain lime and on their decomposition calcite is formed which may be disseminated throughout the rock, may line joints, or may form amygdales by filling rounded gas-cavities. "White trap" is a particularly confusing variety of such rocks. Where basalt or similar rock containing a considerable percentage of lime in complex silicates has been injected as a thin sill into carbonaceous strata, the basalt is often bleached owing to absorption of carbon dioxide derived from the surrounding carbonaceous matter and its combination with the lime molecule to form calcium carbonate. Thus the igneous rock is not only impregnated with calcite which effervesces freely, but it also takes on the pale grey to buff colour that is so common in limestones, hence the name "white trap". Again, limestone passes in some places into ironstone by enrichment in ferrous carbonate and, indeed, the greater number of clayband ironstones are more or less calcareous.

When a district has been fully mapped the data regarding each limestone can be reviewed. In a given area a limestone may be shown to be of good quality and thickness; in one direction, however, it may show progressive thinning, or deterioration through admixture of argillaceous matter or of volcanic detritus; in another direction it may be found to have been cut out by erosion shortly after its deposition; whilst in a third direction a progressive sandy contamination and the appearance of oolitic grains may indicate the proximity of the shore-line of the sea in which the limestone was deposited. The characteristics just mentioned refer to the bed of limestone as originally deposited. Superimposed upon these are factors dependent upon the folding, fracturing and denudation that the whole series of rocks has undergone between their formation and the present day. From the completed map we deduce the areas in which the limestone stratum crops out, even when concealed under drift; the areas in which it is at a considerable depth; and the way in which it has been affected by folds and faults. From all the above data an estimate of reserves can be made, and , an opinion can be expressed regarding the chance of quality, thickness, etc., being maintained.

The above notes apply primarily to the comparatively thin beds of limestone found in the Carboniferous strata of the Midland Valley of Scotland. They also apply in essentials to such massive limestone formations as are to be found in the Cambrian strata of Sutherland and Skye and the Mountain Limestone Series in England. In these formations the individual beds are in many cases of great thickness and succeed one another in unbroken succession without the intervention of rocks of a different character. They are nevertheless ordinary, unaltered sedimentary strata; and deductions can be made regarding them of a character similar to those that are applicable to limestones which occur in a stratigraphical succession built up mainly of non-calcareous beds.

Another important type of limestone deposit in Scotland is represented by the metamorphic limestones of the Highlands. Originally these altered rocks were sedimentary strata similar in character to those described above and were situated in a sedimentary sequence consisting of a variety of different types of rock. During at least one period in their history, however, the whole region in which they lie was subjected to high temperatures and to very high pressures and strong differential stresses. Under such conditions calcite becomes to a very marked degree pseudo-plastic, and during the folding which took place in the whole series of rocks owing to the high stress imposed upon them the more calcareous beds behaved in some respects like a viscous fluid, being moulded, twisted and pulled out to a greater extent than the rather more rigid rocks with which they were interbedded. As a consequence of this the main limestone horizons, though maintaining with more or less definiteness their general character and trend for a stretch of 50 miles or more, are lenticular in development or even discontinuous, whilst the intensity of the folding to which they have been subjected has resulted in much irregularity and patchiness of outcrop.

Under the conditions of temperature and pressure prevailing during this period of metamorphism the calcite composing the limestone was recrystallized, producing a completely crystalline marble instead of the aggregate of calcite grains cemented by secondary calcite which makes up the normal sedimentary limestone. At the same time the impurities, which in the original bed consisted of fine particles of sand, silt, mud, mica, etc., underwent a change. Their constituents combined with one another and with the lime in the calcite, producing new compounds which as a group are often referred to as calc-silicates. These calc-silicates crystallized out as definite minerals included in the limestone and in some cases they account for an appreciable amount of the lime which was present in carbonate form in the original rock.

Thus metamorphic action has altered the chemical, physical and structural characters of limestone to a marked degree, and so has affected either for better or for worse their suitability for different economic purposes and their amenability to exploitation by quarrying or mining.

In addition to the two main types of limestone discussed above there are several other varieties worthy of attention. They include the cornstones of the Old Red Sandstone and Trias, present-day shell beaches, freshwater lake marls, calcareous tufa, vein calcite, calcareous fault-breccia and brucite marble.

Cornstones are nodular or small-scale lenticular masses of fine-grained limestone. They are generally considered to be chemical precipitates laid down in seasonally or periodically flooded continental depositional areas, and in many cases the limestone thus formed is of high quality. It is fine-grained and dense in texture with a rather conchoidal fracture. Cornstone horizons extend over considerable areas in some instances. Unfortunately their nodular character, with the silty material between the nodules, and their general thinness and lack of continuity, usually rule them out for other than local use.

Shell beaches, where reasonably accessible, are a convenient and sometimes a valuable source of lime. In Scotland, unfortunately, such deposits are chiefly to be found on the western and northern islands; and, though valuable locally, they are not within easy reach of the main agricultural districts. They are also usually of small extent and thickness and are subject to disturbance, and even to complete removal, by storms. The shell sand at John o' Groat's in Caithness is exceptional, being not only of great extent but also very conveniently situated both for road and coastwise transport. Pure shell sand has a very high content of calcium carbonate, but beach deposits vary so rapidly from place to place and are so liable to admixture with other rocks that the average content of samples, taken from a large number of beaches in Scotland which could reasonably be described as composed of shell sand, worked out at only about 60 per cent. $CaCO_3$ on the dried sample.

Lake marl is a calcareous mud deposited in freshwater lochs under favourable conditions. It may form a bed several feet thick. Conditions suitable for the formation of a sufficient quantity of marl to be of economic use are practically confined to the northern portion of Scotland. Even there the deposits are few in number, though some are of high quality, analyses of four different marls showing an average of 87 per cent. $CaCO_3$. Locally it is a valuable commodity.

Brucite-marble is a rock produced by the metamorphism of dolomitic limestone in contact with igneous rock. When a pure dolomite is marmorized under low pressure it is dedolomitized. The dolomite molecule is broken up, yielding calcite, periclase (magnesium oxide) and carbon dioxide. In the presence of water vapour the periclase is converted into brucite (magnesium hydroxide). The total amount of magnesia is unchanged, and the final result is a rock consisting of calcite and either periclase or brucite. When impurities are present, however, the magnesia enters with their constituents into the formation of other minerals such as forsterite, diopside, etc.

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List of quarries and mines working limestone in 1947

County. Name of Quarry or Mine	Locality	Operating Individual, Firm or Authority	Geological Classification	Main Products	Page

ABERDEEN					
Deecastle	5½ miles W. of Aboyne	Aberdeen County Council	Dalradian	Roadstone	47
ANGUS	None				
ARGYLL					
Askomill	½ mile E.N.E. of Campbeltown	N. McArthur, Meadowburn, Campbeltown	Dalradian	Lime and Ground Limestone	54
Ballygrant	Ballygrant, Islay	Dunlossit Estates Ltd., Ballygrant, Islay	Dalradian	Ground Limestone	57
Kilchrenan	1 mile N. of Kilchrenan	Argyll Limes Ltd., Kilchrenan, Taynuilt	Dalradian	Ground Limestone	55
Ronachan	West Loch Tarbert	Mrs. G. N. Pollok, Ronachan, Clachan, Tarbert	Dalradian	Ground Limestone	54
AYR					
Craighead	1½ miles N.N.E. of Old Dailly	R. Mitchell & Sons, 23 Hamilton Street, Girvan	Ordovician	Roadstone	61
Dockra	1½ miles S.E. of Beith	Dockra Lime Co., Ltd., Beith	Carboniferous	Ground Limestone	75
Hessilhead	2 miles E. of Beith	J. Reid & Co., Ltd., Lugton Lime Works, Lugton, Ayrshire	Carboniferous	Ground Limestone and Roadstone	74
Nettlehirst	2¼ miles S.S.E. of Beith	Crawford Lime Co., Ltd., Sunnyside of Auchenmade, Kilwinning	Carboniferous	Lime	74
Tormitchell	2¼ miles N.E. of Pinmore	R. Mitchell & Sons, 23 Hamilton Street, Girvan	Ordovician	Ground Limestone and Roadstone	61
BANFF					
Boyne Bay	Boyne Bay, E. of Portsoy	Boyne Bay Lime Co., Ltd., 61 Richmond St., Aberdeen	Dalradian	Ground Limestone	81
Craighaulkie	1 mile W.N.W. of Tomintoul	Banff County Council	Dalradian	Roadstone	80
Drummuir	1¼ miles N.N.E. of Drummuir station	H. Wishart, Pitarrow, Keith	Dalradian	Lime and Ground Limestone	79
Glenisla	Keith	Keith Town Council	Dalradian	Roadstone	78
Goukstone	5 miles N.E. of Keith	Banff County Council	Dalradian	Roadstone	78
Hillockhead	2½ miles W. by S. of Keith	Banff County Council	Dalradian	Roadstone	78
Limehillock	1¼ miles N.E. of Grange station	'Northern Agricultural & Lime Co., Ltd., Waterloo Quay, Aberdeen	Dalradian	Lime and Ground Limestone	80
Lochpark	3 miles N.E. of Dufftown	Banff County Council	Dalradian	Roadstone	80

Parkmore	Dufftown	Parkmore Limes, Ltd., Dufftown	Dalradian	Lime and Ground Limestone	80
Richmond	Dufftown	Banff County Council	Dalradian	Roadstone	80
Rinaitin	Glen Rinnes	Banff County Council	Dalradian	Roadstone	80
BERWICK	None				
BUTE	None				
CAITHNESS	None				
CLACKMANNAN	None				
DUMBARTON	None				
DUMFRIES					
Harelaw Hill	3 miles N.E. of Canonbie	Harelaw Lime and Coal Co., Harelaw Garden, Canonbie	Carboniferous	Lime	90
EAST LOTHIAN					
East Saltoun (Blance Bridge)	¾ mile E. of East Saltoun	Scottish Co-op. Wholesale Soc., Shieldhall, Glasgow	Carboniferous	Ground Limestone	94
Oxwell Mains	2½ miles S.E. of Dunbar	Coltness Iron Co., Ltd Newmains, Wishaw	Carboniferous	Cement	96
County. Name of quarry or mine	Locality	Operating Individual, Firm or Authority	Geological Classification	Main Products	
FIFE					
Cults	4 miles S.S.W. of Cupar	Cults Lime Co., Springfield, Fife	Carboniferous	Lime and Ground Limestone	108
Roscobie	3 miles N. of Dunfermline	Charlestown Lime Co., Ltd., Harbour Place, Dunfermline	Carboniferous	Lime and Ground Limestone	102
INVERNESS					
Torlundy	5 miles N.E. of Fort William	Highland Lime Co., Ltd., Prestonhill, nr. Inverkeithing	Dalradian	Ground Limestone	113
KINCARDINE	None				
KINROSS	None				
KIRKCUDBRIGHT	None				
LANARK	None				
MIDLOTHIAN				.	
Clippens	Straiton	Shotts Iron Co., Ltd., 1 Castle Street, Edinburgh	Carboniferous	Lime and Ground Limestone	143
Esperston	2½ miles S. of Gorebridge	Esperston Limestone and Roadstone Quarrys, Gorebridge	Carboniferous	Lime and Ground Limestone	146
Harburn	2½ miles S.E. of West Calder	Glasgow Iron & Steel Co., Ltd,, Wishaw	Carboniferous	Cement and Limestone for fluxing	143
Middleton	2½ miles S.S.E. of Gorebridge	W. T. Bathgate, Gorebridge	Carboniferous	Lime and Ground Limestone	146

Upper Side (Toxside)	2½ miles S.W. of Temple	G. Langley, Gorebridge	Carboniferous	Lime	146
MORAY	None				
NAIRN	None				
ORKNEY	None				
PEEBLES	None				
PERTH	None				
Shierglas	1 mile S. of Blair Atholl	W. Lind & Co., Ltd., 156 Main Street, Elderslie	Dalradian	Ground Limestone and Roadstone	157
Wester Bleaton	2 miles E. of Kirkmichael	Keir & Cawder Ltd., 109 Hope Street, Glasgow, C.2	Dalradian	Ground Limestone	154
RENFREW					
Upper Darnley	1 mile S.E. of Nitshill Station	A. Kirkwood, Ltd., Arden Lime Works, Nitshill, Glasgow	Carboniferous	Cement	161
ROSS and CROMARTY	None				
ROXBURGH	None				
SELKIRK	None				
SHETLAND					
Girlsta	6½ miles N.N.W. of Lerwick	C. G. Arthur, Girlsta, Lerwick	Metamorphic	Ground Limestone	173
STIRLING	None				
SUTHERLAND	None				
WEST LOTHIAN	None				
WIGTOWN	None				