The limestones of Scotland v.1 — Chapter 3 Industrial uses

In Scotland the principal industries in which limestone has up till now been utilized are agriculture, building, paper-making, stone-dusting in coal mines, and iron and steel manufacture. These, and some other potential uses of Scottish limestone, are reviewed below.

Agriculture

The addition of lime in some form or another to cultivated soils is essential to ensure the satisfactory growth of most crops. Its usefulness is due in part to the improving effect it has on soil tilth and in part to the fact that the calcium it contains is an essential plant nutrient. Where the soil is deficient in lime this is usually remedied by adding some form of calcium carbonate (marl, ground limestone) or burnt or slaked lime. Marl contains calcium carbonate in finely divided form which reacts readily with sour soils and soon becomes available to the plants, but even when pure it is bulky, especially if undried, and relatively large amounts must be used. It is therefore costly to transport it any distance. On the other hand, burnt- or quick-lime has twice the 'strength' of calcium carbonate (weight for weight) and on slaking breaks down into a fine state of subdivision, in which form it reacts readily with the soil.

As marl is not abundant in Scotland it was the common practice, until a little less than 100 years ago, to work and burn limestone locally. This meant that in districts which were poor in limestone attention was given to deposits of the most meagre description, and it is not uncommon in some areas to find lines of old excavations along the outcrops of beds of impure limestone only a foot or two in thickness. With the development of railway and road transport it became more convenient and cheaper to obtain supplies of lime from a distance, and local lime-burning was soon abandoned in most places. Now, the cessation of liming does not lead to an immediately obvious deterioration in the land, since there are usually accumulated reserves of lime in the soil. In consequence there was a general decline in the habit of liming the land, and large areas of ground were greatly impoverished in course of time. When this was realized strenuous endeavours to encourage the resumption of liming were made. In the meantime, refinements in roadstone work and the demand for limestone dust for use in coal mines had led to the installation of grinding plant at limestone quarries and mines. Now, finely ground limestone is in a state of subdivision in which it can readily react with the soil, and it has certain advantages over lime itself (Ogg, 1942).

It is not caustic; it needs the taking of no special precautions in transit or storage; it can be applied at any convenient time during the year; it can be produced locally and in places where lack of fuel makes the cost of lime-burning prohibitive; it does not require the employment of the specialized skilled labour of the lime-burner. Moreover, the grain of the ground limestone is not uniform, so that the fine dust is dissolved in the ground and used up quickly for immediate plant needs, whilst the coarser grains go into solution more slowly, thus extending the period over which the supply of lime added to the soil is made available and avoiding alternating periods of excess and deficiency such as may result from irregular application of lime itself. In favour of lime, it can be said that the amount of material to be transported and distributed is only about half that in the case of limestone. This consideration, however, is seldom powerful enough to outweigh the advantages to be obtained by the use of ground limestone.

In view of what has been said it will be noted that it is not necessary, or indeed advisable, to grind limestone very fine. Enough powdered limestone for immediate assimilation by the soil is provided by crushing the rock so that all of it passes an ■ in. mesh and 40 to 50 per cent. is below 100 mesh size.

Building industry

Lime for mortar and plaster was formerly produced locally for the most part, and a considerable amount is still produced in areas convenient to the districts where the demand exists.

In building, as in agriculture, however, transport facilities have led to the closing down of many small limeworks and to increased importation from outside sources.

The data published in Wartime Pamphlet No. 13 during this investigation were submitted to the Building Research Station (Department of Scientific and Industrial Research) for such comments as might be useful in planning of post-war building schemes. The following observations bearing upon the geological aspect of the problem are made in the light of these comments.

Limes which can be used in building may be classified as follows:

1. High-calcium limes containing usually more than 80 per cent. of CaO and MgO on the ignited sample. Limes made from the Mountain Limestone development of the Carboniferous Limestone Series in England and Wales may often have 95 per cent. CaO or higher.

2. Semi-hydraulic limes, containing 70 per cent. Or more of CaO and MgO, the remainder being mainly silica and alumina.

3. Hydraulic limes, usually containing between 60 and 70 per cent. of CaO and MgO, and so having a composition similar to that of Portland cement.

4. Magnesian limes, containing over 5 per cent. MgO.

1. High-calcium limes

So far as is known at present there is no deposit so uniformly of the highest grade in Scotland as to be able to produce in any reasonable quantity a fat lime equal in quality to that of the best Mountain Limestone lime, of which the Buxton lime is usually taken as typical.

Of less pure limestones, which would yield a lime with over 80 per cent. CaO, not more than 5 per cent. MgO, and not more than 5 per cent. insoluble residue in acid, there are numerous examples. They are of two kinds, the massive crystalline metamorphic limestones of the Highlands and the sedimentary, usually thinly bedded, limestones of the Midland Valley and the Borders. The best examples of the first class are those of the Fort William district in Inverness (Creag Aoil, Spean Bridge, Tom an Aoil), Blair Atholl in Perthshire (Creag Odhar) and Duff town in Banff (Parkmore). In each of these areas almost unlimited quantities of limestone capable of yielding a good high-calcium lime are available by quarrying, and access is good. The composition of these limestones is such as to yield a fat lime of good white colour. The grains of calcite in the rock, however, are large enough to show a definite crystalline structure in which the cleavage planes of the individual crystals are clearly developed. This tends to cause the crystals to break up during burning and produces in many cases very friable lumps of lime in contrast with the strong lumps yielded by fine-grained sedimentary limestone. In the second class, namely those of the Midland Valley and the Borders, there are two types of deposit. The first includes those of the Lothians and Fife where the high-grade limestones are practically all being mined, as the reserves available for quarrying were long ago exhausted. Examples are Newbigging, Cults, and Roscobie in Fife, Oxwell Mains in East Lothian. Middleton and Straiton in Midlothian.

Some of these limestones are of sufficiently high quality to yield a lime that could be guaranteed to contain over 90 per cent. CaO. Except in one or two cases, however, the size of the reserves and the nature of their disposition make it difficult to see how an industry of more than limited or local importance could be established except by joint working of a number of mining or quarrying units.

In some cases one of the most important reasons why these limestones cannot be classed with the best English and Highland limestones is that they contain enough iron to give a grey colour to the lime instead of the pure white yielded by the latter types.

In addition to those limestones which are of such high intrinsic value that they yield in practice, and without any high degree of care in production, a lime containing well over 80 per cent. CaO, there are many more limestones which, on analysis, show a composition which suggests that they could easily, on theoretical considerations, yield a high-calcium lime. Under common methods of manufacture, however, the lime derived from them cannot be put on the market with a guarantee of 80 per cent. CaO, although according to the Building Research Station it is quite possible that an improvement could be effected by the adoption of some modifications in the manufacturing processes. The point could best be resolved by semi-scale plant trials. On the other hand, where the high-quality seam is thin or is overlain by, or interbedded with, limestone of a poorer character, the output required to make the enterprise profitable may be such as to necessitate the production of a lime of much poorer quality than could be obtained by working only the best limestone. In such a case, best-quality high-calcium lime may be only a minor by-product in a business which could not possibly be run solely for such a commodity.

2 Semi-hydraulic limes

Most of the limestones worked in the past yield lime coming under this heading. They are usually low in magnesia. They contain, however, a rather high percentage of silica and alumina, whence they derive their semi-hydraulic properties. The Building Research Station points out that in the areas in which any given type of lime was produced in the past the builders were familiar with the best method for using it and so could make allowance for its particular characteristics.

At the present time, however, there is always the alternative of using mortars based on a mixture of high-calcium lime and cement with sand. As these constituents can be obtained as standard materials and moreover allow a greater flexibility in the type of mortar which can be produced by varying the relative proportions of lime and cement, there is an increasing tendency for local limes at least to have to share the market, unless they have some very outstanding quality. The lime from the Calmy Limestone of Darnley in Renfrewshire is an instance of a lime with high cementitious properties which has maintained its popularity over a long period.

3. Hydraulic limes

The comments just made on semi-hydraulic limes apply equally to the hydraulic limes. A very large deposit of uniform composition would be required to establish a hydraulic lime or cement industry. Unfortunately rocks of the requisite composition occur only in relatively thin beds in Scotland, and as far as is known the quantity available in districts sufficiently near industrial areas is quite inadequate to provide a source of a commodity which needs, above everything, to be low in cost.

4. Magnesian limes

The chemical analyses available show that for practical purposes limes produced from Scottish limestones would be either very low in magnesia, usually not as much as 5 per cent., or would be from dolomites and contain over 30 per cent. MgO. As far as is known, lime of the latter type has not been used for building in Scotland unless in a very few local instances. An exceptional type of lime is that which would be yielded by the cementstones of the Lower Carboniferous. These are dolomites in which a variable amount of the magnesia in the dolomite molecule has been replaced by iron.

Cement

In recent years much interest has been shown in the possibility of establishing a cement industry in Scotland on a sufficiently large scale to meet general Scottish requirements. The occurrences of the raw materials for this industry are reviewed below. The economics of the various proposals that have been put forward are not dealt with here, however, and there is no intention of conveying any implication regarding economic possibilities.

In stratigraphical sequences of normal type it is very common for limestone to be closely associated with shale (or mudstone) of such a composition that a mixture of the calcareous and argillaceous materials can easily be adjusted to give the chemical composition of cement. It is therefore tempting to look upon an alternating sequence of calcareous and argillaceous beds as being *ipso facto* a basis for the establishment of a cement industry. Other factors, however, must be taken into consideration, such as the quantity of raw material available, the physical and chemical condition in which it exists, its accessibility, the fuel necessary for the manufacture of cement clinker and the proximity of the market. Most of these considerations are of paramount importance where the material' to be manufactured is of low intrinsic value. Some of the raw materials that have been suggested during recent years are briefly noticed below.

Portland cement was for some time manufactured at Cousland near Dalkeith, Midlothian, from the North Greens Limestone and the overlying shales. The available resources, however, are limited and are almost entirely in depth. This will entail mining. The shale also is not uniform in composition throughout its thickness.

Proposals were advanced some twenty years ago to use the limestones of the Skateraw area near Dunbar for cement along with the silty clays of the Forth carselands. The 100-Ft. Beach clay at Inverkeithing was one that was suggested as being suitable in composition. In this case large quantities of both raw materials are available but they are not in very close association.

The debris from slate quarries in Argyllshire, especially that at Ballachulish and in the islands of Seil and Luing, is such as to make it suitable in composition for use in cement manufacture. In the case of Ballachulish there is the Ballachulish Limestone close at hand, while Seil and Luing are respectively only a few miles north-east and east of the Garvellach Isles, which contain some thick beds of limestone. The island of Lismore in the Firth of Lorne, about half-way between Luing and Ballachulish, is composed mainly of limestone, much of it of high quality, low in magnesia, and proved suitable on test for use along with slate-quarry debris in the manufacture of cement. There are many places in the metamorphic limestone belt between Islay and Banff where a schist of suitable chemical composition for use in cement-making occurs adjacent to limestone, both materials being present in 'unlimited quantity. In all of these the costs involved in transport and in the supply of fuel will require to be overcome if cement is to be made at a competitive price. The manufacturing process would require pre-grinding of the raw materials; there does not exist in Scotland any natural juxtaposition of raw materials comparable with that of the Thames Estuary where the fine mud of the river lies within a very short distance of the chalk hills, and where the finished product is not only near its chief market, but can also be shipped direct from the point of manufacture to other maritime markets.

At intervals during the past 40 years it has been suggested that the deposits of shell marl in some of the Caithness lochs could be made the basis of a cement industry. Within the past year or two detailed investigation of a typical deposit near Thurso has shown that the marl and the argillaceous mud which accompanies it are suitable raw materials. Each of them occurs in finely divided form, thus requiring no preliminary grinding. The principal difficulty is that the particular deposit investigated is not large enough to provide raw material to feed a kiln of economic size for more than a few years, and that other marl-bearing lochs are not likely to yield appreciably greater amounts. The marl would therefore have to be brought to a central plant from a number of different localities, many of them some miles distant. Fuel would also have to be brought from the south.

The cement clinker at present produced from Scottish raw materials is made from high-grade Carboniferous limestone and blast furnace slag, with the addition of sand to bring the silica up to the required proportion.

Chemical and allied industries

Limestone is one of the most important raw materials in the calcium carbide and paper-making industries, and also in a number of other chemical processes with commercial applications. Usually the demand is for quicklime of a definite quality and showing particular characteristics on slaking; though for many purposes a hydrated lime is equally serviceable.

For first-quality calcium carbide a limestone containing 97.5 per cent. $CaCO_3$ (54.6 per cent. CaO) and less than 1.05 per cent. $MgCO_3$ (0·5 percent. MgO) is required. It will be seen from the data given below that no deposit of such a quality large enough to provide a commercial source of limestone for this purpose has so far been found in Scotland in areas deemed sufficiently accessible for profitable exploitation.

In paper-making, and in other industries where lime is used in the production of caustic liquor, a lime of the very highest purity is not so essential. The need is for a lime which will slake uniformly and completely within a given time and which is of such a character that flocculation and settlement of the precipitated calcium carbonate are both rapid and uniform. With a limestone of sufficiently high calcium carbonate content to give a lime with 90 per cent. CaO, and low in insoluble residue and in iron, the question of producing a satisfactory product for paper-making and similar purposes is a matter which concerns the burning and processing rather than the original composition. There are many deposits of limestone in

Scotland from which raw material of the necessary grade can be obtained.

Dolomite

Dolomite is of use as a refractory in steel manufacture, and as a source of magnesium. The most important occurrences in Scotland, from an economic point of view, are those in the Durness (Sutherlandshire), Skye (Inverness-shire), and Duror (Argyllshire) districts. Typical samples of the Durness dolomite have been examined by Mr. W. Barr, of Messrs. Colvilles, Ltd., as to their suitability for the hearths of basic open-hearth furnaces. The material is considered by him to compare very favourably with the Durham dolomite at present in use. The dolomite in Skye is of the same geological age as that at Durness, and will probably be found to be of similar quality.

The distribution and character of the Cambrian dolomite of Durness and Eireboll were investigated recently, and it was shown that large quantities of high-grade dolomite were easily procurable (Knox, 1941; *see also* Kennedy, 1940). The Duror (Appin Limestone) dolomite is also of high grade in some localities. At Ballachulish it is very friable and falls easily to a fine powder, in which condition it is an excellent abrasive and polishing medium. The chief occurrences of dolomite in the N.W. and W. Highlands are situated on the sea-board, an important point in connection with the use of dolomite and sea-water in one of the well-known processes of manufacture of magnesium.

The Carboniferous dolomites are on the whole not so pure as those mentioned above. The Carham dolomite, for example, showed about 6.5 per cent. of silica, making it unsuitable for use as a refractory in steel manufacture. Most other dolomites in the Carboniferous are only a few feet in thickness, and so do not occur in sufficient quantity to be of economic use.

Iron and steel manufacture

The amount of limestone used as a flux in iron-smelting is not a large part of the Scottish output, but the total quantity so used in the past has made large inroads into the reserves of workable stone in the Midland Valley, and at the present time much of the highest-grade limestone in Fife and the Lothians is used almost exclusively for this purpose, leaving stone of poorer quality on the average for other purposes. For steel manufacture and other metallurgical operations the highest grade of limestone is imported from England.

Marble

The metamorphic limestones of the Scottish Highlands are marbles in that they are granular aggregates of crystalline calcite with mosaic texture. Most of them, however, are dull-grey in colour; and many are too irregular in texture or not sufficiently coherent to be used for building or ornamental work. Ornamental types of marble are only known in a few parts of Scotland, the chief occurrences being in the islands of Tiree, Iona and Skye, in Glen Tilt near Blair Atholl, and at Ledbeg and Loch Ailsh in the Assynt district of Sutherland.

The Tiree marble (1-in. Sheet 42) is partly of a dull-pink colour, fine in grain and containing abundant crystals of a green calcium-iron pyroxene (coccolite). There is also an outcrop of white, fine-grained, dolomitic marble. The principal occurrences are on the shore of Balephetrish Bay, on the north side of the island, but they are very limited in extent and, according to Mr. V. A. Eyles who surveyed this area, there are no reserves which could be worked on a commercial scale.

The Iona marble (1-in. Sheet 43) lies at the south-east corner of the island. It forms a nearly vertical band about 20 ft. to 30 ft. in thickness and about 100 yds. in length (Anderson, E. M., 1925, pp. 14, 99). Nearly all the valuable stone is now worked out. The marble consists of fine-grained, white, granular calcite, with greenish-yellow mottling and streaking due to the presence of serpentine.

The marble of Glen Tilt (1-in. Sheet 55) lies about 4 miles up the valley of the Tilt from Blair Atholl, near Marble Lodge. It is a banded rock of medium grain composed of granular calcite mottled with dull yellowish-green serpentine. It has been produced by contact metamorphic action of a granitic intrusion on a band of limestone belonging to the Blair Atholl ' Group.' The marble lies near a fault zone and is rather broken, so that the material, though perhaps sufficient in amount for economic exploitation, could only be obtained in the form of fragments suitable for use in terrazzo work.

The Skye and Sutherland marbles are products of contact metamorphic action by igneous intrusions on the dolomite and limestone of the Durness Limestone formation. In most places they are brucite-marbles formed by alteration of dolomite. In texture they vary from dense, compact types to medium-grained granular aggregates of calcite and brucite crystals. Usually they are white to light-grey in colour, but show slight mottling, chiefly in yellowish and greenish tints, due to serpentine. Rarely, a pale, bluish-coloured variety is found. In addition to the mottling, there is in most localities a good deal of serpentinous veining.

In Skye the marmorization is due to granitic and other intrusions of Tertiary age. The most important area lies on the north side of the Beinn an Dubhaich granite between Broadford and Torran (pp. 120–122). Owing to the narrowness of the metamorphic aureole the degree of marmorization is very variable, even between two adjacent exposures. The rock is for the most part light-grey in colour, and finely but distinctly granular in texture. It is so traversed by joints that it is not possible to obtain sound blocks of any size, and the main use of the rock is for terrazzo chips. It has been worked for this purpose, and there are abundant reserves. The Durness Limestone in this area is made up of alternating bands of dolomite and non-dolomitic limestone. On exposure to the atmosphere the brucite in those marbles which have been derived from dolomitic beds is gradually converted to hydro-magnesite, which forms a thin white chalky crust. This might limit the usefulness of the stone for exterior work.

The marble of Ledbeg (1-in. Sheet 101) and Loch Ailsh (1-in. Sheet 102) is within the metamorphic aureole of the Cnoc na Sroine syenite and is of much greater extent than the Skye occurrence. It is accessible near Ledbeg on the Lairg–Lochinver road, and also on the side road leading from this main road north to Loch Ailsh. In general character and appearance the material is similar to that in Skye, except that here all the original rock was dolomite. Types containing brucite, diopside, tremolite and forsterite are found, the minerals developed depending upon the original character of the limestone and upon the degree of metamorphism it has undergone. So far this marble has only been used on a small scale, for local road work.

Roadstone

In some parts of Scotland limestones are used on a fairly large scale as roadstones. While limestones possess neither the high degree of hardness nor of toughness characteristic of many igneous rocks, they have certain compensating advantages. Thus, they bind very readily with tar, and on second-class water-bound roads their dust has considerable cementing value. Furthermore, as most limestones are greyish or whitish in colour, they make a light-coloured road surface of a type preferred by many drivers, especially at night.

The properties which render a limestone suitable for roadstone are mainly of a physical rather than of a chemical nature. Thus it is essential that the stone should possess at least a moderate degree of hardness and of toughness, that it should not be porous, and that it should not split into flaky fragments. Such properties may be expected in the more massive, fine to medium-grained types of limestone in which the bedding planes are fairly widely spaced and shaly partings infrequent. The presence of cracks and fissures, or of thin calcite veins, is undesirable as tending to weaken the stone.

As calcite is a rather soft mineral, impurities are often an advantage in a limestone used for roadstone. In this connection quartz is particularly valuable in adding to the hardness of the stone, and some of the calc-silicate minerals in lending toughness. On the other hand clay mineral impurity is definitely undesirable as it greatly weakens the stone in the presence of moisture (Knight, 1939, p. 55).

Of the non-metamorphic limestones probably the most extensively used in Scotland are the tough, compact Ordovician limestones of South Ayrshire (Craighead and Tormitchell). Some of the Carboniferous limestones of the Midland Valley have also been used, but only on a small scale owing to the abundance of igneous rocks of good quality in the same region. In Caithness and Orkney impure limestones or limy sandstones belonging to the Middle Old Red Sandstone are the main local source of roadstone. In the North-West Highlands the limestones and dolomites of the Durness Limestone have also from time to time served to meet local requirements. The Jurassic and other post-Carboniferous limestones of Scotland are not generally suitable for roadstone.

As might be expected, metamorphism frequently has the effect of enhancing the qualities of limestone as roadstone by rendering it harder and more compact and by bringing about the combination of the calcite with impurities to form calc-silicate minerals. Where, however, a coarsely crystalline rock has been produced by metamorphism it is often found to be unsuitable for roadstone owing to the manner in which the large calcite crystals break along the cleavage-planes. Moreover, metamorphic rocks with a strongly marked schistose structure or with many partings of mica-schist do not make good roadstones.

Extensive use of metamorphic limestones as roadstone is made in Banffshire, where a considerable proportion of the total requirements is met by this type of rock. It is interesting to note that the average insoluble residue (mainly quartz) of limestones belonging to the Sandend Group from five quarries worked for roadstone is 13.8 per cent., against 3.7 per cent. for limestones belonging to the same group from three quarries worked for agricultural purposes.

In the neighbouring county of Aberdeen the Deeside Limestone, an impure type rich in calc-silicate minerals, has proved suitable for roadstone. Metamorphic limestones have also been worked for roadstone on a considerable scale in both Perthshire and Argyllshire, and in fact in almost every Highland county in which they are present.

Rock wool

Rock wool is an insulating material consisting of a woolly aggregate of fine fibres of rock glass. It is analogous in character to slag and glass wools, and has in some countries, notably America and India, been used extensively for insulation purposes in buildings. A report on rock wool with special reference to supplies of suitable raw material in this country has been recently published (Guppy and Phemister, 1945), and to this the reader is referred for a general account of the nature of the raw material, the method of manufacture and the uses of the product. It is sufficient to say here that the rocks most suitable for use in rock wool manufacture are impure limestones in which the ratio of SiO_2 + Al_2O_3 + Fe_2O_3 to CaO MgO lies within the limits 3 to 4 and 4 to 3. In practice such rocks as shaly limestone or dolomite and calcareous or dolomitic shale are those that usually show a suitable composition.

In Scotland, so far, the rock wool industry is in its infancy; and any growth that may take place will depend partly upon the suitability of such material for use in the types of building that are chosen for large-scale house-building projects, and partly upon whether a comparatively unknown substance such as rock wool takes the fancy of builders and architects.

The authors mentioned above have reviewed the analyses published in Wartime Pamphlet No. 13—The Limestones of Scotland. They are careful to point out that the analyses available are nearly all of material selected as being limestone, not as being rocks which would appear in the field to be of suitable composition for rock wool manufacture. Amongst rocks showing a bulk composition suitable for rock wool are the Appin Limestone (Argyllshire), the Deeside Limestone (Aberdeenshire), the dolomitic fault-rocks associated with the Highland Boundary Fault at Aberfoyle (Perthshire) and Balmaha (Stirlingshire), and the cementstones at Ballagan (Stirlingshire) and Murroch Glen (Dumbartonshire). The Carboniferous limestones of the Midland Valley and the Borders are in nearly every instance associated with thick beds of shale and sandy shale, and a mixture of suitable composition could easily be made. Indeed owing to the natural alternation of sedimentary strata of various types most limestones are closely associated with rock suitable for mixing with them to produce rock wool. The problem is in nearly all respects similar to that of the cement industry, except that much greater latitude in the proportion of the constituents is allowable and that magnesia is not deleterious. The remarks above on the raw materials for cement manufacture should be read in this connection.

Further investigation is desirable, and until this is carried out it is not possible to make any definite statement regarding the relative suitability of the calcareous beds in different areas, either used alone or in combination with such local shales, sandstones, etc., as would be needed to give a wool within the required range of composition.

Rock wool is a very bulky and fragile product, and this makes the transport of the manufactured article a more serious problem than that of cement. For this reason rock wool manufacture stands a better chance of success as a local rather than as a centralized industry; and it has been suggested that the application of hydro-electric power to its production in Scotland might be worth investigation (Robiette, 1945, p.36).

Stone-dusting in coal mines

In Scotland considerable amounts of ground limestone are used in coal mines for diluting or covering up fine coal-dust which might otherwise be dangerous as a potential source of coal-dust explosions. For the purposes of the Regulations under the Coal Mines Act (1945 edition) it is necessary to grind the limestone so that all of it passes through a 60-mesh sieve and not less than 50 per cent. nor more than 75 per cent. by weight passes through a 240-mesh sieve.

Annual production

The annual outputs of limestone from mines and quarries in Scotland as a whole, and in the four most important limestone-producing counties individually, during the period from 1921 to 1946 are shown in the accompanying table. For the data from 1939 to 1946 inclusive we are indebted to the Statistics Directorate of the Ministry of Fuel and Power.

Limestone output in tons

Year	Scotland Total	Midlothian	Fife	Ayr	Banff
1921	193,096	72,766	36,426	10,901	14,026
1922	272,929	122,195	50,972	14,981	17,670
1923	329,185	128,185	59,222	19,424	16,567
1924	319,819	127,392	70,103	24,794	19,076
1925	241,477	54,314	68,695	30,567	18,716
1926	222,213	84,108	46,661	28,220	20,999
1927	267,659	98,264	68,580	31,294	25,339
1928	226,486	69,954	68,067	28,284	28,026
1929	283,342	80,698	82,011	38,778	34,950
1930	312,382	111,535	88,719	36,564	23,251
1931	291,569	83,576	66,938	40,720	40,894
1932	324,296	88,634	48,835	43,849	72,665
1933	311,864	98,886	55,590	43,640	54,854
1934	321,578	95,167	68,873	41,822	53,782
1935	333,556	118,482	70,757	45,669	45,549
1936	370,113	127,301	67,399	54,407	52,350
1937	432,212	153,492	91,289	63,981	58,243
1938	480,614	158,768	98,281	68,468	59,134
1939	459,402	142,836	90,057	76,538	59,814
1940	425,562	138,133	99,374	70,289	45,862
1941	360,299	129,992	79,496	83,034	22,330
1942	373,519	123,328	68,836	78,544	17,199
1943	326,453	123,845	71,984	66,812	19,524
1944	379,523	118,389	63,995	90,447	23,153
1945	335,516	107,178	58;902	80,758	32,891
1946	435,108	113,658	54,870	102,404	85,667