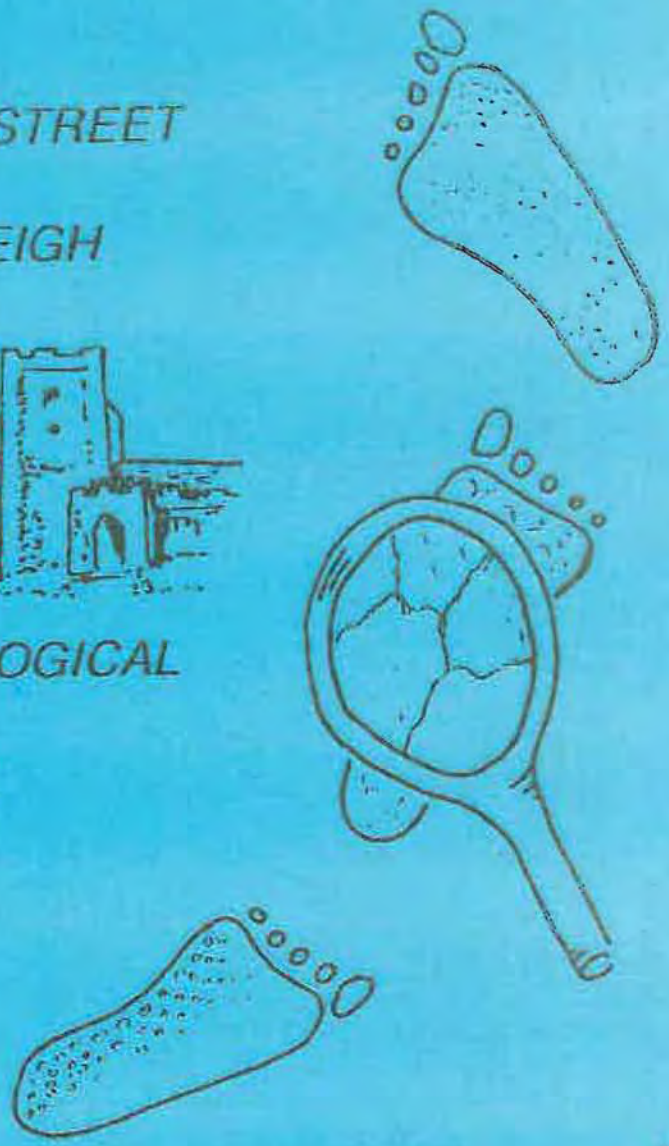
HOLY TRINITY CHURCH

AND

HIGH STREET

RAYLEIGH

A GEOLOGICAL TRAIL



All Proceeds in aid of the Rayleigh Parish Centre Fund

Natural stone has always been, and continues to be, a feature in the construction of buildings, roads and monuments and this can be readily demonstrated at Holy Trinity and in the nearby High Street area. These days, for economic and aesthetic reasons, stone is most often used as facings on banks and shops, disguising to some extent their steel and concrete fabrics.

The area around Rayleigh is practically devoid of natural stone resources, though in past years Eocene London Clay and Claygate Beds (clays, silts and sands), on which much of Rayleigh stands, have contributed to the supply of bricks (good quality bricks are made from a mixture of clay with sand and/or chalk). Consequently, most natural stones you can see have been quarried and brought in from other parts of Britain or from abroad.

Stones, or rocks as geologists call them, can be classified into 3 main groups - sedimentary, igneous and metamorphic.

Sedimentary rocks consist of material laid down by natural processes, such as water-current movements along rivers and in the sea. The individual transported fragments, which can vary in size from large boulders to microscopic grains, include minerals such as grey translucent quartz, creamy white feldspar and sparkling micas. These minerals are said to be detrital in origin, having been derived from some pre-existing source rocks. Typical rocks of this sort are sandstones, best seen as tombstones in the churchyard, but also as a grindstone (or millstone) preserved and mounted just outside Rayleigh Mill Hall. In contrast, some sedimentary rocks - limestones - are composed mainly of the mineral calcite (calcium carbonate), often present in the guise of small broken shell fragments or ooliths, again well seen at Holy Trinity Church. Ooliths are egg-shaped objects about 1mm across formed by chemical precipitation in shallow warm seas. Chemical precipitation plays a very important role in sedimentary processes, commonly leading to the cementing together of all types of particles and forming a hard rock from originally loose and soft fragments. Some cements, such as calcite, are also very susceptible to atmospheric weathering and pollution. The calcite dissolves, weakening the rock considerably. The outer walls of Holy Trinity show this effect in many places.

The second category of rocks are *igneous* in origin, formed from deep-seated hot molten (magmatic) sources within the Earth's crust. They too can be composed of a mixture of quartz, feldspar and mica, but also commonly contain dark, dull-looking minerals, such as pyroxenes and amphiboles. Understandably, the greater the proportion of dark minerals the blacker the appearance of the rock. In contrast to most sedimentary rocks, the mineral grains interlock very tightly and that, together with the relative durability of the constituents, means that igneous rocks are usually very hard and can withstand considerable physical wear and atmospheric attack. The larger grained varieties, created by the very slow cooling of magma at depth, frequently polish-up well, which makes them very attractive facing stones, as at Barclays Bank and Woolworths.

Metamorphic rocks, the third category, are essentially altered pre-existing sedimentary and igneous rocks, which have been converted by high pressures and temperatures generated in the Earth's crust. Limestones are converted into lime-rich marbles as seen, for example, in the churchyard and in the lower vestibule of Barclays Bank. Certain igneous rocks are converted into gneisses and are characterised by a coarse wavy-banded structure, almost flow-like, caused by the alignment of the variably coloured minerals (feldspars, quartz, amphiboles and micas) during the metamorphic process. As gneisses are very hard-wearing they have been used, together with hard igneous rocks, as stone setts in paved areas or as pavement edging-blocks along the High Street. A more obvious variety of metamorphic rock is grey slate, an altered sedimentary mudstone, presently roofing Amigos Restaurant and a segment of the new Parish Centre, adjacent to and above the entrance facing the car-park.

Holy Trinity Church (locality 1)

The Church and its churchyard at the northern end of the High Street are the ideal starting point for this geological trail, as they exhibit a wide variety of rocks. The church itself stands on a thin mantle of orange Eocene Bagshot Sands, only exposed during excavations.

Starting with **the outside walls of the church**, which are built predominantly of sedimentary rocks, what should be looked for are:

(A) Kentish Rag (or Ragstone):- this is a rather rubbly looking, rough textured, grey limestone (weathering to a pale light brown colour) and forms the bulk of the stone fabric of the church. It was originally quarried in the Sevenoaks-Maidstone area of northern Kent. Geologists have worked out that the rock is of Cretaceous age, about 105 million years old, and that it accumulated in shallow warm seas. The last can be said with some certainty because it is speckled with a typical blackish-green mineral, glauconite, known to be formed only in warm seawater. The glauconite grains can be seen with the naked eye, but a magnifying lens helps considerably. Moreover, if you inspect the nine slabs covering a culvert at the church porch you will find that seven of them are of Kentish Rag and show the traces of the shells of small, shallow water, marine molluscs, known as bivalves. The shells measure about 1 cm across. Look very carefully at the well-worn largest slab leading into the porch where you should be able to pick out the faint traces of oblique tubes. These represent the burrowing activities of soft-bodied marine worms during Kentish Rag times.

Centuries of weathering, more especially since the Industrial Revolution, have taken their toll and many blocks of the Rag in the church walls are now very friable (crumbly) and **should not be touched.** The friability is caused by mildly acid rainwater percolating through the rock and slowly dissolving the calcite cement which holds the glauconite grains and shell fragments together. Certain types of mortar used in the past century, and containing sulphate minerals, also brings about the same effect.

(B) Flint:- this is a hard, grey- and black-cored siliceous rock, commonly of irregular shape, and knapped (broken) to present a smooth outer face. There are excellent old patterned areas at the eastern end of the church, and aesthetically appropriate fresh courses now appear towards the base of the red brick walls of the new Parish Centre, to the rear of the church. If you look at the outer rim of the flints you will see that they are commonly white. This is not mortar adhering to the outer surface, but the residual traces of partly silicified chalk. It indicates that the bulk of these flints were originally quarried directly from the Cretaceous Chalk of East Anglia and Kent, a deep-sea lime-rich sediment laid down 90 million years ago.

(C) Ironstones:- there is only a thin scattering of these rocks, but they can easily be picked out because of their distinctive colouring. Probably the best place to look initially is the wall between the 3rd and 4th buttresses, to the right of the porch. One variety has a dark chocolate-brown core surrounded by light brown to orange zones. The colour changes are caused by weathering and involve the conversion of an iron carbonate (siderite) core into a mixture of iron oxides and hydroxides (limonite) around the edges. The iron is often spread further by rainwater, staining adjacent rocks. Ironstone of this type occurs in nodular form in the local London Clay. For example, it can be seen in low cliffs just to the west of Burnham-on-Sea. The second variety of ironstone has a black core with a red periphery. It originates from Kent and Surrey where it is known as carstone. It is really an iron-shot sandstone of Cretaceous age.

In the churchyard other varieties of rock can be seen.
Please exert appropriate sensistivity when looking at them closely and do not disturb anything.

There are several headstones and plinths formed of an orange-brown micaceous, quartz-rich sandstone, known in the trade as Yorkstone because it is quarried in the Leeds-Bradford area (locality 2; the cedar tree). In the quarries the sandstones slabs can be easily split into thin layers suitable for paving purposes, hence they are also known as flagstones. Unfortunately, the headstones begin to disintegrate over time because of rainwater filtering down mica-rich planes. If the water freezes in winter the flaky rock begins

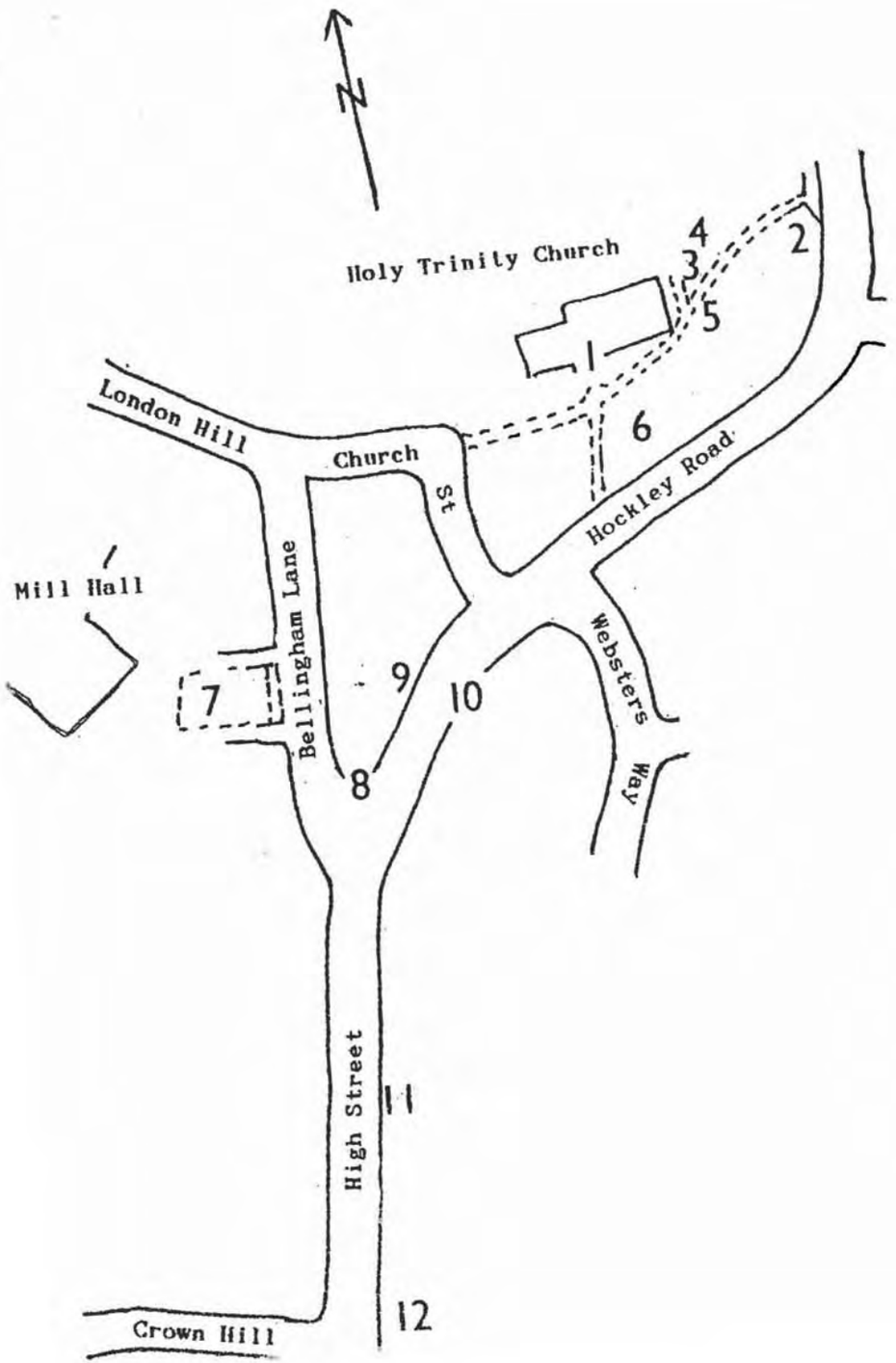
to spall-off readily. At the same time, chemical changes of the iron-rich cementing materials convert the original light brown colour to a deep brown and black. Yorkstone is of Upper Carboniferous age and is about 310 million years old.

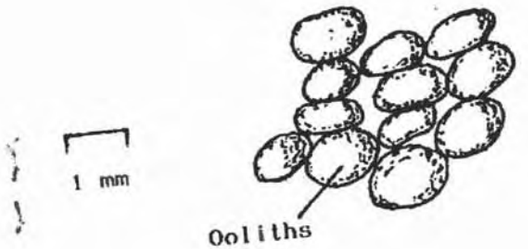
Another common type of headstone, easy to pick out, is formed of creamy white oolitic limestone of Jurassic age (about 170 million years old) and either quarried in the Stamford area of the East Midlands or in the vicinity of Bath. You really need to look hard at a clean surface to see the ooliths, preferably with a magnifying lens. You will find that most of the slabs have a crusty coating of modern lichens, these varieties clearly liking a calcareous environment for their development. Some of the lichens have a minute disc-like structure which should not be confused with the oolith structure of the limestones.

Just to the right of the church porch, surmounting a red brick tomb associated with the Whiting family, is a horizontal slab of a different variety of limestone. It is non-oolitic in character, but rich in very small, broken marine shell fragments. The slab has weathered considerably to a mottled light grey colour since it was emplaced in 1727, but when freshly cut and inscribed was dark grey, almost black, due to the presence of iron sulphides and decayed organic matter. Together with two other similar capping-slabs in the churchyard, it is probably of Lower Carboniferous age (about 325 million years old) and would have been quarried from an area such as the Peak District.

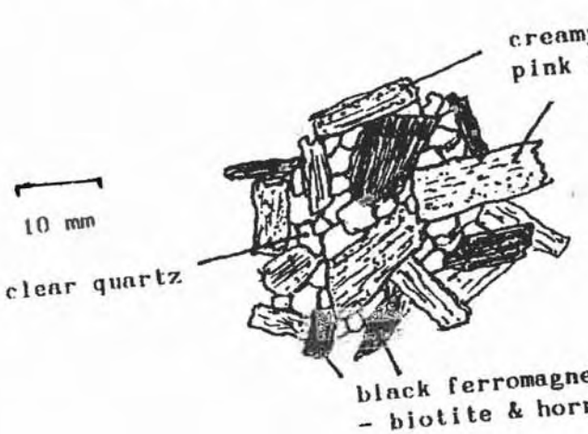
At the eastern end of the church there are both igneous and metamorphic rocks either as plinths or as tablets inlaid into the grass (locality 3).

The Nockells tomb consists of a medium grained grey granite, probably from the Dalbeattie area of the Southern Uplands of Scotland. If you look closely you will see small dark patches, known as xenoliths (or 'heathen' to the old quarry men), which are fragments of shale or slate caught up and severely baked in the hot igneous magma. There are two tablets nearby of medium and coarse grained granite from Scotland, one of grey-blue Dalbeattie type and another more grey-black typical of the Rubislaw quarries in

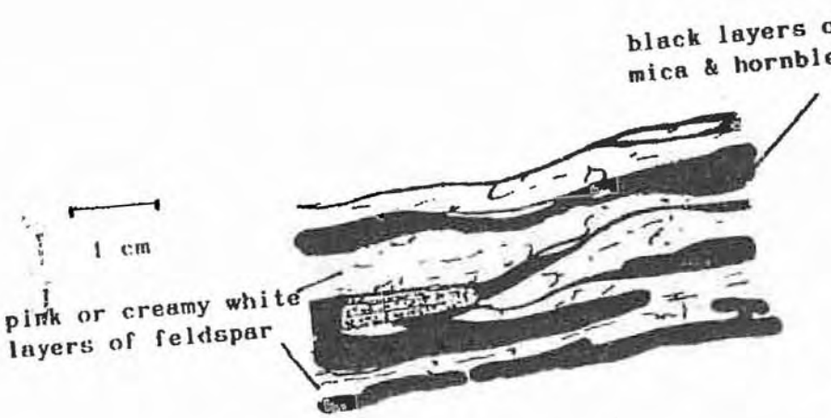




Oolitic limestone



Granite



Gneiss

Aberdeen. The Bright monument is also dominantly made of granite.

Marble of the clean white Carrara-type, quarried in north-central Italy, forms the Hatch tablet and nearby is the Day tablet, a pale brown limestone carrying lots of broken-up shells and looking as though it originated from Jurassic rocks quarried on the Isle of Portland. The Alabaster family tomb (locality 4), in the same part of the churchyard, is worth inspecting as it consists of a creamy white marble from the Mediterranean region, possibly Egypt. Curiously enough, the colour and texture of the tomb slab resembles certain forms of genuine alabaster, a gypsum-rich rock, but there is no doubt that it is a variety of marble.

There are additional 'exposures' of marble, again of the white Carrara-type, forming the Boosey plinth surround and the Moore/Gale tablet on the south side of the pathway leading off to the Hockley Road (locality 5, near the cedar tree). In contrast, note the Brackley tablet on the same side which is quite dark-looking because it contains a high proportion of dark pyroxene minerals, containing iron and magnesium, intermingled with creamy feldspars. This is another coarse grained variety of igneous rock, which cooled slowly in the earths crust. It is known as gabbro.

Nearly opposite, on the other side of the pathway, are another series of inlaid tablets, two at the road end made of coarse grey-white Dalbeattie granite with, on the Lovewell, grains of white plagioclase feldspar up to 3 cm in length. Note the aligned nature of the feldspars indicating flow movements within the cooling magma. There is also one granite with a very distinctive colour due to red feldspars. In the trade this is known as Balmoral, but the name is misleading as to its origin because it is quarried in south-central Sweden under the name of Swedish Imperial Granite. It began to be imported into Aberdeen in the 19th Century, where it was suitably dressed before being pressed into commercial use. All these granites, incidentally are of Devonian age, that is they were emplaced about 370 million years ago.

Before leaving the churchyard note, but **do not touch**, the good quality slate on the roof of the Old Church Hall, now Amigos

Restaurant (locality 6). Slate is formed by the extreme compression of fine grained sedimentary rocks, known as mudstones and shales. Slates form in areas of acute mountain building such as North Wales about 400 million years ago. Slate is also used as part-roofing for the new Parish Centre.

Rayleigh Mill Hall (locality 7)

The prime geological exhibit, mounted in the paved island area fronting the Mill Hall, is a genuine millstone, a pale brown,coarse grained, gritty sandstone consisting predominantly of quartz grains with a few feldpars and brown micas, all tightly cemented together by an iron and siliceous cement. Also present are a few small quartz pebbles. Quartz is a hard mineral, hence the suitability of this sedimentary rock for grinding purposes. The millstone, aptly enough, was almost certainly acquired from Millstone Grit quarries in the Pennines. The rock itself was originally laid down in ancient Carboniferous deltas some 320 million years ago. The adjacent artificial millstones appear to be made-up of recycled quartz, feldspar and mica, set in a man-made cement. Note that the 'real' millstone is ornamentally surrounded by well rounded flint pebbles, contrasting with the angular ones of Holy Trinity Church, and that they are also practically devoid of any white patina. These differences indicate that they were first removed from the Chalk of southeast England by natural processes, transported by ice, rivers and the sea, and finished-up in some fairly modern river terrace, beach or even off-shore. During this prolonged history of movement the angularity was lost and the relatively soft chalky patina was worn away.

While you are at the Mill Hall walk across and examine the shallow-rise, but broad, step leading into the foyer. This is paved with slate, but of a more durable type than is used for roofing purposes. Most slabs are grey, but a few are purple due to having a higher iron content. If you look closely at some of the slabs you will see a thin banding (or lamination) indicating a slight variability in the constituents. The lighter coloured bands are relatively rich in very fine grained quartz and it is this mineral which makes the rock hard-wearing. This slate looks as though it has a Lake District origin.

Bellingham Lane (locality 8)

The hard-wearing stone setts in the pavement surrounding the Rayleigh Civic Notice Board are predominantly formed of a fine grained variety of lava, known as an andesite, in which can be observed larger tabular creamy grains (phenocrysts) of feldspar up to 4 cm long. There is also a sprinkling of small black rock inclusions (xenoliths or 'heathen'). The rocks are rather dark-looking because they contain a relatively high proportion of black pyroxene and amphibole minerals. These ancient lavas are quarried in the Lake District, North Wales and in the Midland Valley of Scotland and are of Ordovician and Devonian age, that is about 470 and 360 million years old respectively. Incidentally, if you wish to look at rather coarser grained equivalents of the andesites look at the setts on the other side of the main road, near to the pedestrian crossing.

Woolworths Store (locality 9)

The facing stone is of a bluish-grey, coarse grained igneous rock, known as 'Blue Pearl' larvikite, named after the place where it is quarried, Larvick, near Oslo in Norway. Its chief attractive characteristic is the blue metallic reflection from feldspar crystals at certain angles of the light. This is caused by minute aligned inclusions within the feldspars. The overall dark colouration is due to black pyroxenes, amphiboles and iron ores. Quartz is absent.

Curbstones adjacent to Byfords the Butchers (locality 10)

This location is representative only, as rock curbstones are dominant along the full length of the High Street, unfortunately often so mud-streaked that identification is difficult. This particular stretch, over a distance of about 15 metres, is interesting in including three examples of metamorphic gneiss interspersed among mottled black- and white-looking granites, all probably of Scottish Highlands or Scandinavian origin. The diagnostic feature of the gneisses is a coarse banding picked out by red and white feldspar-rich layers

alternating with black amphibole- and mica-rich layers. Because of the way in which the curbstones have been cut you will find the banding running at right-angles to the pavement edge. These very hard rocks are formed under extreme pressures and temperatures generated in the deep core of mountain chains during their elevation.

Barclays Bank (locality 11)

The facing stones at first sight resemble the larvikite at Woolworths, but closer inspection shows that the peculiar metallic reflection of typical larvikite is absent. The polished faces are of a coarse grained igneous rock, known as gabbro, a variety of which was first seen first seen in tablet form in Holy Trinity churchyard. This particular one is darker looking, coarser grained and probably came from the Precambrian (more than 550 million years old) of South Africa. In the trade it is known as Bon Accord. Note the large, fine grained black xenolith adjacent to the right-hand money machine.

A quick glance inside the vestibule of the bank, at the bottom of the escalators, will show you a cladding of creamy-white Carrara-type marble. This has a marked mottled appearance caused by recrystallisation of calcite grains in the original limestone during subsequent metamorphism. Note the graph-like, zig-zag features on some slabs. These form in all limestones and marbles when the rocks are squeezed tightly, and are known as stylolites (*stilus*, Latin = pointed implement).

Martyr's Monument (locality 12)

This is formed of coarse grained varieties of granite, some polished so you can just about make-out the pink and creamy feldspars, quartz and sparkling micas, other more rough-cut and rather greyer-looking. They are probably of Scottish origin.

OTHER SOURCES OF INFORMATION

Geology in the Churchyard.

Leaflet published in 1992 as part of the 'Living Churchyard Project' and available from Church & Conservation Project, Arthur Rank Centre. National Agricultural Centre, Stoneleigh Park, Warwickshire CV8 2LZ (Tel. 01203 696969 Ext.339) or The Geologists' Association, Burlington House, Piccadilly, London W1V 9AG (Tel. 0171 434 9298).

Earth Science Conservation.

A series of free leaflets and booklets published by English Nature, Northminster House, Peterborough PE1 1UA.(Tel. 01733 340345).

Building Stones of Oldham: walk.

An excellent explanatory pamphlet costing 20p and available from the Oldham Museum (Tel. 0161 6784649) and useful for any part of Britain, especially churchyards.

Passmore Edwards Museum,

Romford Road, Stratford. London E15 4LZ (Tel. 0181 519 42960). It has a qualified geological curator.

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