DUN LAOGHAIRE ROCK

GRANITE BY THE SEA

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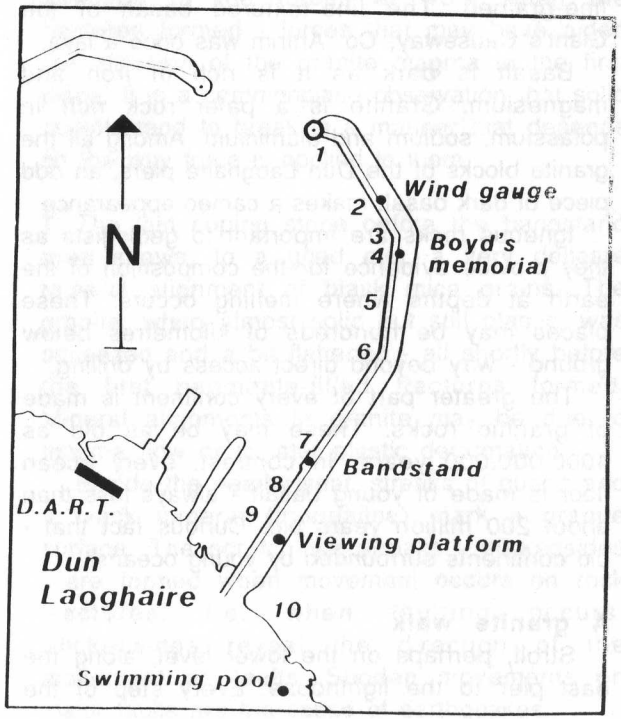
The piers at Dun Laoghaire, on which building started in 1817, are favourite strolling places. They provide an opportunity to make acquaintance with a rock - granite. The granite blocks used in their construction were taken from a quarry near Dalkey where, today, rock climbers are still guided by the marks, and perhaps also by the ghosts, of the quarrymen.

Do not be too distracted by the granite on the piers - you might fall off. Do not, under any circumstances, disturb anybody or anything - you might be thrown off - and deserve to be.



What is granite?

Everybody, surely everybody, has heard of granite. Granite is a pale-coloured, granular rock commonly used where toughness matters, e.g., as a kerbstone, as a cladding on buildings or in the making of piers to shelter a harbour.

Granite is an igneous rock. Igneous rocks originate by cooling of hot liquid rock (magma) forced upward in the earth's outer crust from a hotter place of melting below. Magma, when it flows to the surface (extrusion), is called lava. As a lava cools, crystals grow and a solid rock results. A granite crystallizes in the same way but as an intrusion; the magma stops and cools while still some distance underground.

The individual mineral grains in granite - crystals of quartz, feldspar and mica - are large and easily seen; they grew slowly in a magma enclosed and insulated by other rocks. Extrusive lavas, in contrast, cool rapidly; crystals do not have much time to grow and the resulting rocks, of whatever composition, are fine-grained. The fine-textured basalt of the Giant's Causeway, Co. Antrim was once a lava.

Basalt is dark as it is rich in iron and magnesium. Granite is a paler rock rich in potassium, sodium and aluminium. Among all the granite blocks of the Dun Laoghaire piers, an odd piece of dark basalt makes a cameo appearance.

Igneous rocks are important to geologists as they provide evidence for the composition of the earth at depths where melting occurs. These places may be hundreds of kilometres below ground - way beyond direct access by drilling.

The greater part of every continent is made of granitic rocks. These may be as old as 4000,000,000 years. In contrast, every ocean floor is made of young basalt - always less than about 200 million years old. Curious fact that - old continents surrounded by young oceans.

A granite walk

Stroll, perhaps on the lower level, along the east pier to the lighthouse. Every step of the way is on granite. Walking back on the upper level, a few pauses (**1-10**) reveal some of the essential features of this rock.

1 A granite lighthouse. Granite is an important building stone because it resists weathering and because it tends to break into easily-used blocks along natural fractures called joints.

Across the harbour, the hills are subdued and smoothly curved. Granite or, more correctly, the feldspar in granite weathers easily to produce these typical granite slopes. The eye, roving southwards on a fine day, meets a distant peak - the Great Sugarloaf. Its contrasting pointed profile reflects harder rock - rock with no feldspar but only hard quartz.

Regardless of what passers-by might think - and they will - take a close look at some of the granite blocks around. Various different mineral grains (crystals) should be obvious. Mica occurs as reflecting flakes. Biotite is a dark mica with added iron. Muscovite mica (no iron) is silvery. The quartz is grey and glass-like and contrasts with the white or off-white feldspar which shows, in some blocks, rectangular crystal shapes. It should quickly become clear that any two bits of granite can look very different.

Walk a few yards along the pier towards the opening on the left. Much of the granite about is brown. Granite is often stained brown by the mineral limonite - common rust to you and me.

2 At the seat to the NW of the wind gauge, a block of fine-textured dolerite (basalt) differs from all the granite around in colour and grain-size. You should know already why it is both black and fine-grained. Why did the builder use this lonely piece? There must be a story here.

Through the nearby opening, Howth, over the bay, resists the sea. Like the Great Sugarloaf, Howth is made of hard stuff - quartz rock.

3 Five metres townward from the corner, a block shows the same grey quartz, off-white feldspar and shiny mica as does granite but in a much coarser rock - pegmatite. The minerals grew very slowly from the dregs of fluid still remaining when the bulk of the original magma had crystallized to granite. These left-over fluids tend to be especially rich in substances that remain as liquid or gas (volatiles) down to low temperatures - for magmas that is.

4 At foot level, two metres from the Boyd memorial, a vein of glassy quartz cuts brown granite. Which side? - you can find it surely. This vein formed from an even later and lower-temperature (about 250^{o} C) residual fluid than did the pegmatite of the previous stop. Quartz veins like this one may contain metals such as lead, zinc, copper and gold All of these metals were mined in Co. Wicklow in the past , e.g., at Avoca, at Glendalough and not too far away at Ballycorus where the well-known chimney is.

Metal pins in the granite here have rusted and stained the rock - limonite again. Rain and sea does this to iron nails and to iron-bearing rock.

5 To the left of the opening where the wall changes height, a block displays a texture that you may have seen earlier - relatively large rectangular crystals of pale feldspar set in a finer-grained background. Large crystals like these are called phenocrysts. They are large and regularly shaped because they grew early in a liquid magma. Crystals growing later find only irregular spaces in an increasingly solid mush.

Phenocrysts may show a common alignment. Are they aligned parallel to one another here? If they are, it may be evidence that the granite magma flowed. Any mineral alignment in granite is usually very imperfect as granite magma tends to be rather sticky - not at all like the basaltic lavas often seen on television.

A vein of coarse pegmatite cutting the next block to the left contrasts with a vein of white, fine-grained aplite in the block above. Though aplites and pegmatites differ in texture, both

form from similar 'left over' liquids - the dregs again - at about the same time late in the cooling history of a granite magma.

Left again, the next block shows, if you look closely, small scale compositional and textural differences in the one granite piece. All of it contains the usual granite minerals but in varying proportions and grain sizes. Did different granite magmas mix and were they incompletely stirred before all went solid?

6 Moving on, two parallel aplite veins may be seen in a single block near the next corner. What are veins and why they parallel? Veins are fractures filled with aplite, pegmatite and/or quartz. These fractures could only have formed at a time when the bulk of the granite had become essentially solid. Liquids do not fracture. The fact that these veins, and many later unfilled joints, define regular patterns on real granite outcrops (below) reflects the direction of the forces at work when the fractures formed - forces that may have aided the intrusion of the granite magma in the first place. It is a commonplace observation that solid objects tend to break in a manner that depends on the way force is applied to them.

7 The last coping stone before the bandstand area shows, to a good eye, a very delicate mineral alignment of black mica grains. The granite, when almost solid but still plastic, was squeezed and a bit flattened - all shortly before the first pegmatite-filled fractures formed. Mineral alignments in granite may be due to magma flow or to later plastic deformation.

Beside the nearby seat, streaks of quartz and a black mineral (tourmaline) mark a granite surface. The scratch-like streaks - slickensides - are formed when movement occurs on rock fractures, i.e. when faulting occurs. Slickensides reveal the direction of the movement on faults. Sudden movements on major faults are the cause of earthquakes.

8 West of the bandstand area and about midway between two openings, you will find a striking pegmatite rich in crystals of black tourmaline. The pegmatite is, as always, coarse textured. The tourmaline is but one of many unusual volatile-rich minerals that many pegmatites (and aplites) contain.

9 Two metres from the end of the wall on the left, a small mica-rich patch contrasts in mineralogy and texture with its enclosing granite. This is a xenolith ('strange stone'). Xenoliths are fragments ripped from solid rocks invaded by an intruding granite magma. They tend to be relatively abundant, therefore, near the margin (contact) of a granite intrusion.

10 From the viewing platform, you can see the quarries on Dalkey Hill from where all of the granite that you have seen came. Having done so, walk southwards towards the nearby swimming pool along the path at the water's edge and out along the first of the short concrete ramps - if it is safe to do so.

The real thing. These are granite outcrops - part of the earth's crust. Outcrops like these extend along the coast past Sandycove to a contact with other rock at Killiney. All show the jointing that is typical of granite.

This rock was intruded about 400,000,000 years ago. It solidified, perhaps, 5-10 kilometers below ground as it was then. Where has all the covering rock gone? All of those millions of years - and the energy of the sea nearby - may give a clue.

Behind, a different rock - a dark limestone carted in from afar by the local council - has been used to make paths up to the road and away. It makes a contrast with the granite.

You may care to walk the pier again or, for a change, the west pier. Or you might stroll along the road to Sandycove. The granite about will not remain unseen now or ever again. And the walk will be good for you. I'm off.