ROCKS & LANDSCAPE NOTES

GREEN MOUNTAINS - O'REILLY'S

LAMINGTON NATIONAL PARK

by Warwick Willmott

The geological history of the Lamington region is basically the history of two large volcanoes, which erupted about 24 to 23 million years ago. These covered the older hills and valleys of the district with extensive lava flows and built up major new mountainous areas. This leaflet describes some of the history of the volcanoes and what we can see of them at Green Mountains - O'Reilly's today.

Eruption

The *Focal Peak Volcano* was centred to the west near the present Mount Barney about 24 million years ago. The earliest lavas were basalt, which flowed down low valleys towards Beaudesert and Kyogle, and later extended as far as Beechmont in the east (the Albert Basalt). Later the composition of the lavas changed to rhyolite, which has a more viscous or sticky nature, and these flows were more restricted (the Mount Gillies Volcanics).

Towards the end of the activity a large mass of rhyolite melt (magma) solidified beneath the volcano, cooling slowly to give granophyre, a rock with larger crystals, half way in grain-size between rhyolite and granite. In the last stages there was further pressure from below, which thrust this mass upwards, and created circular fractures around it, up which more rhyolite magma was squeezed. Erosion of this mountain (now Mount Barney) then began, spreading a thin layer of gravel over its flanks (the Chinghee Conglomerate).

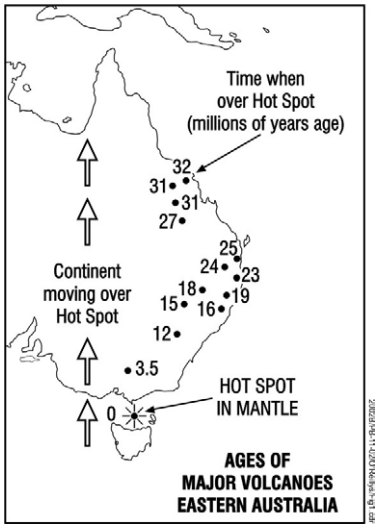
The much larger *Tweed Volcano* (centred over the present Mount Warning in New South Wales) erupted shortly afterwards about 23 million years ago, covering many of the lavas of the Focal Peak Volcano in the west as well as older rocks in the east. It built up a broad, gently sloping dome or shield of mainly basalt lavas, with one major interval of rhyolite (the Beechmont Basalt, succeeded by the Binna Burra Rhyolite and then the Hobwee Basalt). These lavas extended over the present border ranges to at least Tamborine Mountain in the north, Lismore in the south, and Mount Lindesay in the west. The central summit of the volcano is estimated to have reached about 2000m above sea level.

Basalt eruptions are comparatively quiet, and the highly mobile lavas flow long distances from the vents. In direct contrast was the activity that formed the Binna Burra Rhyolite; early eruptions were highly gas charged and explosive, resulting in the ejection of fragments and the accumulation of beds of tuff and agglomerate. The later rhyolite lava itself was viscous (sticky) and covered a more limited area.

Why did the volcanoes erupt here?

During the Tertiary period of geological time (65-2 million years ago), eastern Australia was the scene of extensive volcanic activity, which left as its legacy large areas of basalt. The various volcanoes did not erupt all at the same time; activity was spread over a long period, from at least 32 million years to as little as 4000 years ago.

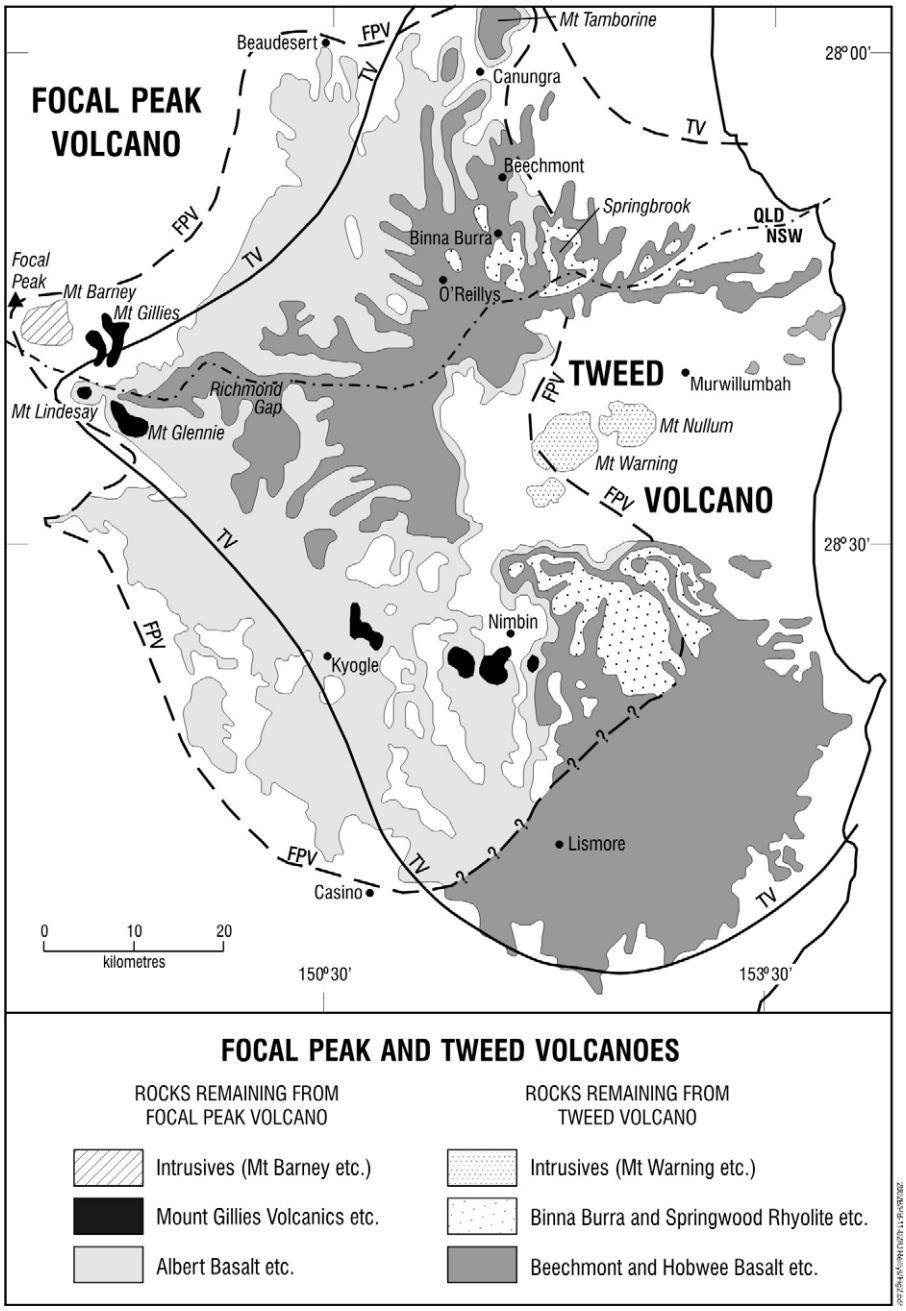
The volcanic magma, at least for the larger shield volcanoes, is believed to have been generated at a "hot-spot" in the Earth's mantle, deep beneath the crust. The age of these larger volcanic centres seems to be related to the drift of the Australian continent northwards towards New Guinea, which has been going on since the early Tertiary. As the continent passed over the stationary hot-spot, basalt lavas were periodically forced up through weaknesses in the crust. The ages of the volcanoes decrease progressively to the south by the amounts expected from the speed of the northward drift of the continent (about 65mm per year). Southeast Queensland apparently passed over the hot-spot about 25-23 million years ago.



The rocks themselves

The basalts are fairly typical of other basalts in Queensland, being generally fine-grained, and dark grey to black. Mostly the individual minerals making up the rock cannot be recognised because of the fine grain size, but in some specimens light-coloured, rectangular crystals of plagioclase feldspar can be distinguished. Under the microscope, minerals such as plagioclase, the dark minerals olivine, augite, and magnetite, and glass fragments can be identified. Chemically the rocks are rich in calcium, iron and magnesium which are the basis of the good soils formed on basalts.

Whilst the basalts are roughly similar in composition, several factors have resulted in considerable variation between individual flows:- the cooling conditions of the lava, the amount of dissolved



gases, and the time interval between successive flows. For instance, very gassy lavas often solidify before gases can completely escape, resulting in a rock perforated by small holes (or vesicles) which greatly enhance its susceptibility to weathering.

Lava cooling conditions can also result in a considerable variation in the degree of jointing (fracturing) in different flows. Some basalts may have very few fractures (massive), while some may be highly fractured and thus extremely susceptible to weathering.

Thick flows cool slowly and commonly develop a regular pattern of cooling fractures called columnar jointing. The columns are generally hexagonal in cross section and are a common feature of basalt areas.

Rhyolite is a cream to light pink, very fine grained rock, consisting chiefly of the minerals quartz and potassium feldspar; only a few of the larger crystals can be seen without a microscope. Because the sticky, viscous nature of the lava, fine flow banding is often preserved. Rhyolite tends to form thick localised flows, also with columnar joints, which are resistant to erosion. Their upper and lower margins often cool rapidly to form a black rock glass (perlite). The tuff and agglomerate resulting from explosive eruptions of rhyolite are fine and coarse granular rocks that erode easily.

Weathering

Once exposed to the agents of weathering (water, carbon dioxide, oxygen, and organic acids), the mineral constituents of basalt break down to produce clay minerals and a number of oxides, notably iron. The chemical breakdown goes hand in hand with a physical disintegration of the rock fabric eventually resulting in the formation of soil which is often deep, sometimes black, sometimes red brown, and relatively fertile. Rhyolite weathers to shallow, pale-coloured, poor soils because of its limited and stable mineral constituents.

Erosion

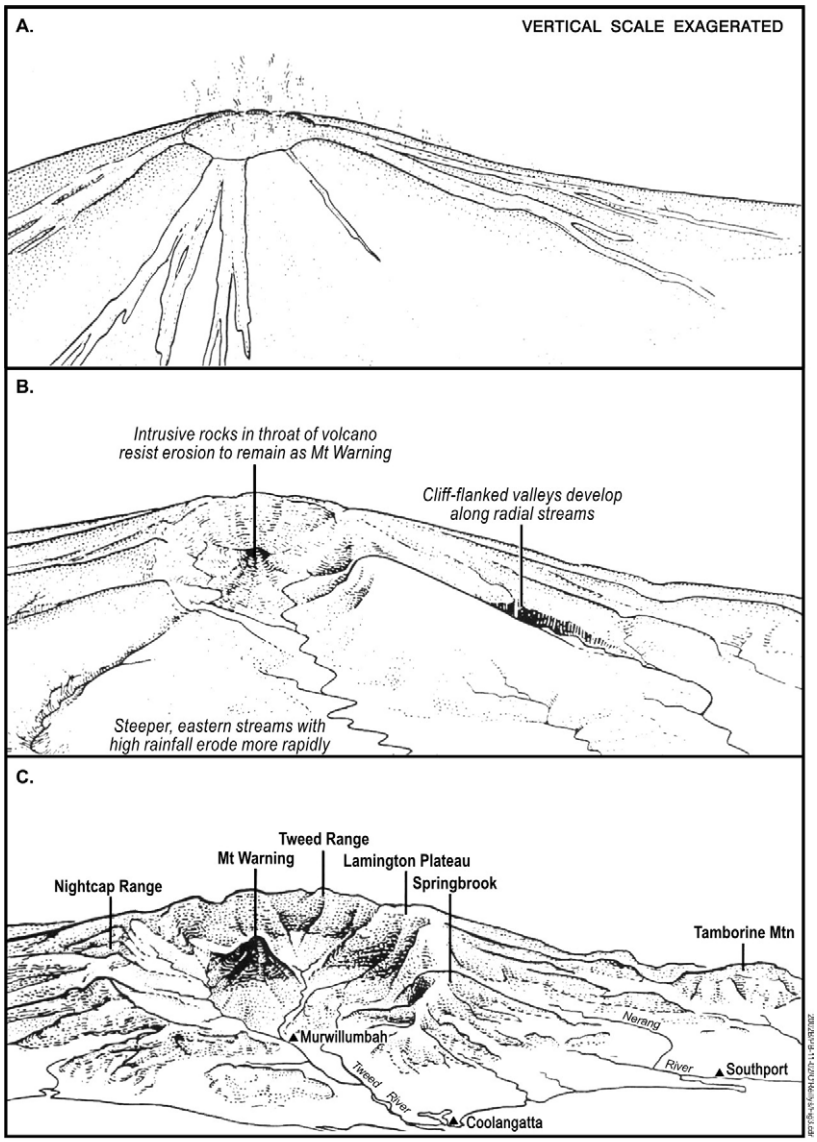
Following the extinction of the Tweed Volcano, the slow but steady process of erosion created the present landscape.

The high volcanic peak attracted heavy rain, causing decomposition and erosion of the lavas. Streams began to develop, flowing in a *radial pattern* from the peak; once started they began to erode valleys in the same pattern. Because some of the lava flows are more resistant to erosion than others, the broadening and deepening of these original valleys has resulted in a tiered effect on the present valley walls, with cliff lines formed on the resistant flows. In particular, the rhyolite of the Binna Burra Rhyolite is markedly resistant, and forms the spectacular cliffs on the eastern side of Lamington and on Springbrook.

The clifflines are undermined by erosion of softer material below, and their subsequent collapse leads to further broadening of the valleys. Waterfalls have developed over particularly resistant rocks, and have subsequently retreated upstream to leave cliff-lined gorges.

Landslides also help to broaden the valleys, especially where deep soils or debris occur on slopes. Landslides do occur naturally from time to time, but the frequency is increased by disturbance to the vegetation such as by cyclones and man's clearing of forests.

On the eastern side of the volcano, the Tweed River headwaters have eroded westwards to form the Tweed Valley, while the north-eastern streams created the Currumbin and Tallebudgera Valleys.



Progressive erosion of the Tweed Volcano

The streams to the north have formed the Numinbah, Coomera and Canungra Valleys, while in the north-west and west the Albert River, Christmas Creek and Running Creek valleys have resulted.

Most erosion has occurred in the valleys, and the remnant plateaux of Springbrook, Beechmont and the ridges of the Sarabah Range, Lost World and the McPherson Range are only slightly modified remnants of the actual surface of the northern and northwestern flanks of the volcano.

It is hard to visualise, but nevertheless true, that the deep valleys between these plateaux have actually been carved down into a much larger regional volcanic landscape by the simple effects of streams active over millions of years. On the western side of the Tweed Volcano the radial streams have carved down further into the lavas of the Focal Peak Volcano. In some places, streams have eroded to such a depth that the older rocks beneath the volcanoes are exposed.

The present peak of Mount Warning is a plug of igneous rocks intruded into the vent of the Tweed Volcano, which has resisted erosion more than the surrounding lavas.

To the west, the upthrust mass of granophyre originally beneath the Focal Peak Volcano has resisted erosion to remain as Mount Barney, and the rhyolite in the circular fractures remains as the surrounding peaks of Mount Ernest and Mount Maroon.

Rocks and Landscapes at O'Reilly's

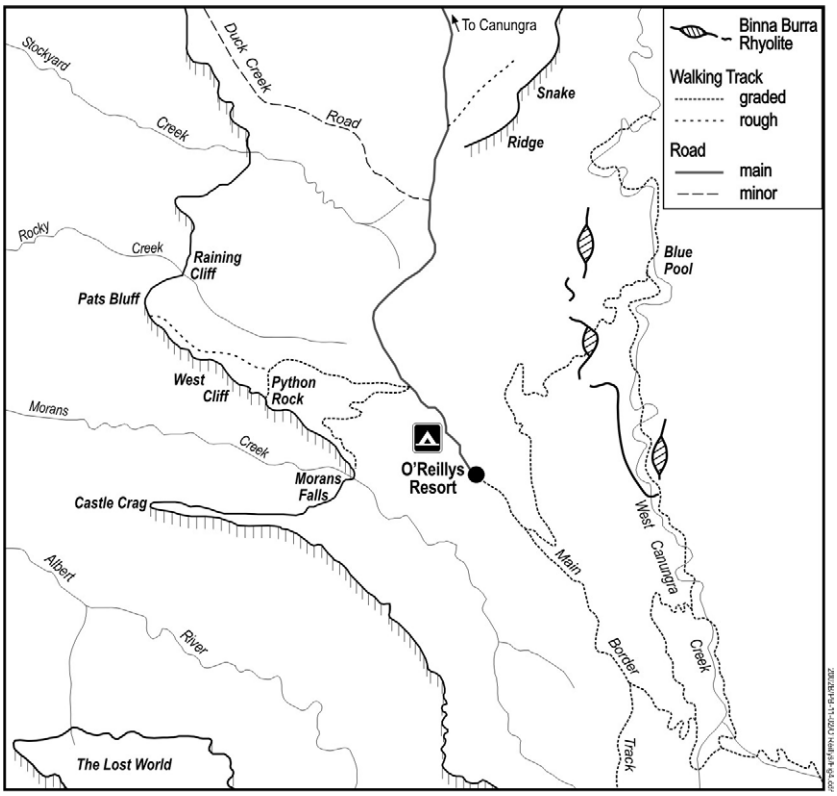
The ridge of Green Mountains on which O'Reilly's is located and all the high country to the south are formed on some of the latest lavas from the Tweed Volcano, known as the Hobwee Basalt. The flat ridge crests approximate the original surface of the northern flank of the volcano; the steep valleys of West Canungra Creek and the Albert River on either side are the result of two radial streams carving down into this side of the volcanic dome.

Because of the weathering to deep soils, the basalts are not well exposed on the ridges, but they can be seen in the creek beds. Some thicker more resistant flows form bouldery outcrops in places; around O'Reilly's some of these are notable in containing numerous large rectangular crystals of plagioclase feldspar.

The best place to gain an appreciation of the volcanic mountain and its landscapes is at *Pats Bluff on the Western Cliff*. Looking to the south from here we see the eroded northwestern flank of the Tweed Volcano. In the middle ground the numerous layers of individual basalt lavas can be seen in the ridges of Castle Crag and the Lost World. Note how the thicker, more resistant flows form small clifflines. In the far distance, the gentle westerly slope that can be seen on the McPherson Range on the New South Wales border is the original slope of the western flank of the volcano.

The Western Cliff itself is formed on a particularly thick flow which has resisted erosion by the tributaries of the Albert River. It is being eaten back however at Morans Falls and Bridal Veil Falls (between Pats Bluff and Lukes Bluff) where a softer flow beneath is allowing undercutting. Because of the thin soil formed on top of the flow and the drying effects of the western sun, a strip of eucalypt forest has developed along the cliff line, instead of rain forest.

In the lower country to the west, a small light coloured cliffline that can be seen on several ridges is rhyolite of the Mount Gillies Volcanics. This represents the last lavas from the Focal Peak Volcano; note how they appear to slope up to the west



towards their source. All the rocks above this layer came from the subsequent Tweed Volcano.

To the far southwest, the isolated castle-shaped peak of Mount Lindesay is an erosion remnant of a thick rhyolite flow of the Mount Gillies Volcanics, which is at a much higher level there. Farther to. the north is the bulk of Mount Barney, formed on the body of upthrust granophyre which was intruded beneath the Focal Peak Volcano and since exposed by erosion.

The *Border Lookouts* (Wanungra, Bithongabel, Cominan, Echo Point) overlook the valley of the Tweed River, which has almost removed the eastern flank of the Tweed Volcano and begun to eat back into the upper part of the western flank as well. In the far distant future this major escarpment will move father westwards and northwards, revealing the upper gorges of the present northward flowing streams such as the Albert River and West Canungra Creek, which will then become gaps in the escarpment. In the centre of the valley is Mount Warning, formed on resistant rocks of a major plug beneath the throat of the volcano.

To the north of O'Reilly's the rough track along *Snake Ridge* is on the top of a particularly thick and resistant basalt flow. Because of the thin soil on top of it and the exposure to winds, an unusual strip of eucalypt forest has developed within the surrounding rainforest. This flow is one that contains numerous large crystals of plagioclase feldspar.

On the *West Canungra Creek track* there are some small exposures of rhyolite, agglomerate and tuff which belong to the Binna Burra Rhyolite unit, beneath the Hobwee Basalt. These rocks are much thicker at Binna Burra and Springbrook, where they form major cliff lines, but it seems some of them extended as far west as O'Reilly's.

A little over half way from Picnic Rock to Blue Pool the walking track passes through a small cliffline of agglomerate of rhyolite and perlite cobbles and boulders, with finer tuff towards the top, and possibly some rhyolite lava. The agglomerate also occurs in the creek bed upstream. These rocks also outcrop at the same elevation on the opposite side of the valley on the Blue Pool Track, but they are not well exposed there. Two-thirds down the rough track on Bull Ants spur there is a small cliffline of cream, flow-banded rhyolite, again at the same elevation.

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