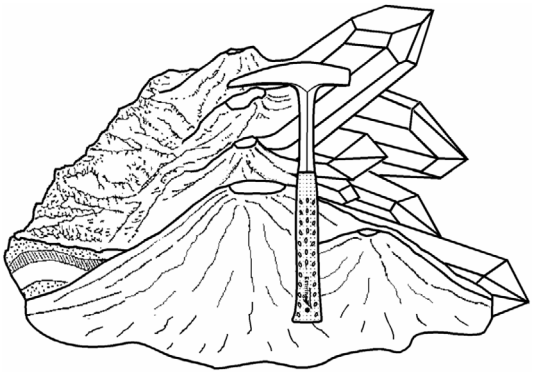


Geocene

Auckland GeoClub Magazine
Number 27, October 2021

Editor: Jill Kenny

Editor – This issue of Geocene has been updated. One image on page 14 has been removed to minimise possible copyright issues. An explanation and reference to the deleted image has been added to its vacant space.

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Geocene is a periodic publication of Auckland Geology Club, a section of the Geoscience Society of New Zealand’s Auckland Branch.

Contributions about the geology of New Zealand (particularly northern New Zealand) from members are welcome. Articles are lightly edited but not refereed.

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THOUGHTS ON GRANITOID ORBICULE FORMATION

Ian Simpson

In November 2020, the Auckland Geology Club (Auckland Branch of the New Zealand Geoscience Society) visited Northwest Nelson and exposures of orbicular granite in Separation Point granitoids on the coastline adjacent to the first part of the Abel Tasman Coastal Track. Weathered orbicules were also seen on the track itself (Fig. 1) (Hayward, 2021). Members on this field trip discussed the possible genesis of these structures but no firm conclusions were reached. I decided to do further reading around this topic to explain the mechanism of orbicule formation. The literature is voluminous and made more difficult because of complex melt thermodynamics. I have tried to simplify this without losing the important concepts involved. As well as Separation Point granitoids on the coast, boulders of orbicular granite have been found near Murchison and Karamea (Figs 2 & 3). These sites have recently been described by Hayward & Sagar (2020) and Hayward (2020, 2021).

Orbicules are spherical or distorted spherical structures in plutonic rocks, most commonly granitic, such as granodiorite, tonalite and diorite. They are uncommon but have been reported in many countries. They are rarely found in gabbros and other mafic rocks. Orbicular granitoids are said to occur on the outer margins of the parent pluton or in separate enclaves or pockets. The orbicules consist of concentric shells of minerals found in the parent granitic magma. They vary in size, composition and in the number and distribution of shells. They also vary quite markedly at, and between, the sites where they are found.

The core may be based on plagioclase feldspar phenocrysts, orthoclase feldspar megacrysts, xenocrysts (foreign inclusions), fragmented orbicules, or other minerals from the parent magma, both felsic (silica-rich) and mafic (silica-poor).

The petrography of the Separation Point Pluton orbicular granitoids has been extensively described by Kobe (1988), who noted “the complexity of features to consider in a future genetic interpretation of orbicular fabric”.

I had thought that the answer might rest with the melting temperatures of the various minerals making up the orbicules and the surrounding matrix of the parent granitoid. While melting temperatures of the minerals in the magma melt would be expected to have a part to play, this does not explain orbicule formation. The literature on the formation of these structures does not provide unequivocal answers but has provided more information about the processes that appear to be involved.

Magma is derived from the upper mantle where temperatures are insufficient to cause melting. Melting can occur when the temperature is raised by mantle plumes at hotspots, by reduction of pressure that occurs at divergent plate boundaries, or by fluxing with water at convergent plate boundaries that melts the overlying mantle wedge.

Magma ascends because it has a lower density than the solid crust and may or may not erupt at the surface. It will consist of the liquid constituents and always some crystals. Melt that is not erupted, cools slowly in a thermodynamic equilibrium, and crystallises into a plutonic solid. The crystallisation will be influenced by the rate of cooling, melt viscosity, the latent heat of crystallisation, loss of dissolved and incorporated water and other volatiles,



Fig.1. Weathered orbicule on first part of the Abel Tasman Coastal Track. The finding on the pathway some 20 m above the shoreline indicates that the orbicule area was quite extensive (Locality 1 of Hayward, 2021).

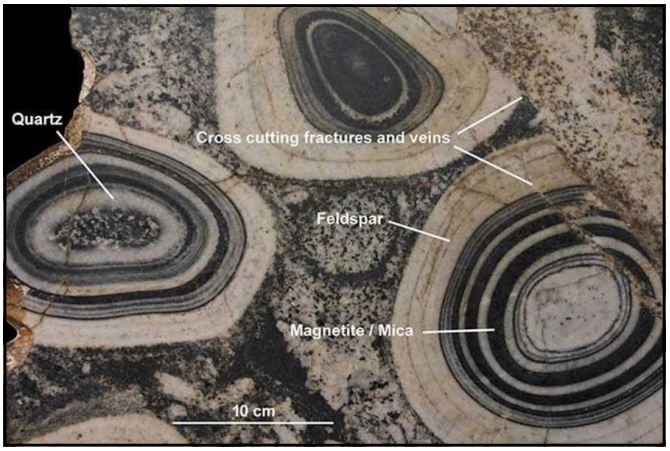


Fig. 2. Auckland War Memorial Museum specimen of orbicular granite from a Karamea boulder. The orbicules have numerous shells of dark mafic and lighter unspecified feldspar and quartz shells. The Separation Point orbicules are very weathered and have only a few shells. Photograph from Grenfell & Fleming (2016).



Fig. 3. Orbicular granitoid boulder from Separation Point pluton in the grounds of the Department of Conservation office, Motueka township. There is a variety in orbicule size and makeup with some cores mostly pale plagioclase and others with a predominantly mafic core that is probably biotite or amphibole. The matrix appears to be a mixture of both.

the rate of heat loss into the surrounding crustal rock and the mineral constituents of each melt. For plutonic magma bodies, the cooling process is slow and has been calculated to take hundreds of years or longer (Klein & Philpotts, 2017).

How felsic magma arises from what was mafic magma is a different question and will not be discussed here. Felsic magma might collect in mushroom-shaped chambers and become a pluton. Crystals are formed as cooling progresses. These first crystals tend to slowly sink to the bottom of the chamber and form cumulates or crystal mush.

A Canadian Geologist, Norman L. Bowen, was an early 20th Century geologist who studied igneous rocks. He showed that the common igneous minerals crystallise from magma at different temperatures. The Bowen Reaction Series (Bowen, 1928) is a concept, first propounded by Bowen, which explains how minerals can respond to the changing equilibrium conditions when a magma is cooled. Bowen suggested a series of these reactions that might take place during the cooling of a basalt magma, but pointed out that the series was a simplification of very complex reactions and could be misleading if taken at face value. The specific reaction series for magmas was never intended to become a general reaction series for all magmas. The Reaction Series is shown in Figure 4.

Earle (1915) explains the series succinctly. “Of the common silicate minerals, olivine normally crystallizes first, at between 1200° and 1300°C. As the temperature drops, and if some silica remains in the magma, the olivine crystals react (combine) with some of the silica in the magma to form pyroxene. If there is silica remaining and the rate of cooling is slow, this process continues down the discontinuous branch: olivine to pyroxene, pyroxene to amphibole, and (under the right conditions) amphibole to biotite. At about the point where pyroxene begins to crystallise, plagioclase feldspar also begins to crystallize. At that temperature, the plagioclase is calcium-rich [or more anorthite-like - my addition]. As the temperature drops, and providing that there is sodium left in the magma, the plagioclase that forms is a more sodium rich variety” [or more albite-like - my addition].

The Bowen Reaction Series has been succeeded by more specific ternary plots of magma components and a modelling programme called MELTS (Ghiorso & Sack, 1995), which takes account of more variables in magma makeup. The Bowen’s series is still helpful as a concept for this paper.

How does this relate to orbicule formation? Kobe (1988) provides extensive petrology of the Separation Point batholith. There is detailed geochemistry of the core and the first shell of orbicules at seven sites. Most orbicule cores are plagioclase or plagioclase and biotite, often with some quartz. The first shell is biotite, magnetite, plagioclase, orthoclase, or combinations of these. The matrix surrounding the orbicules is more inhomogeneous than the parent granitoid, but is made up of the same minerals. Minor quantities of epidote, titanite, ilmenite, muscovite, quartz, and haematite are found in the cores, shells and matrix and could alter melting temperatures. The predominant constituents of the cores and shells (plagioclase and biotite) have very similar crystallisation temperatures (as shown in Figure 4 relating to the Bowen Reaction Series). Orbicule formation in Separation Point granitoids must have occurred when biotite and plagioclase

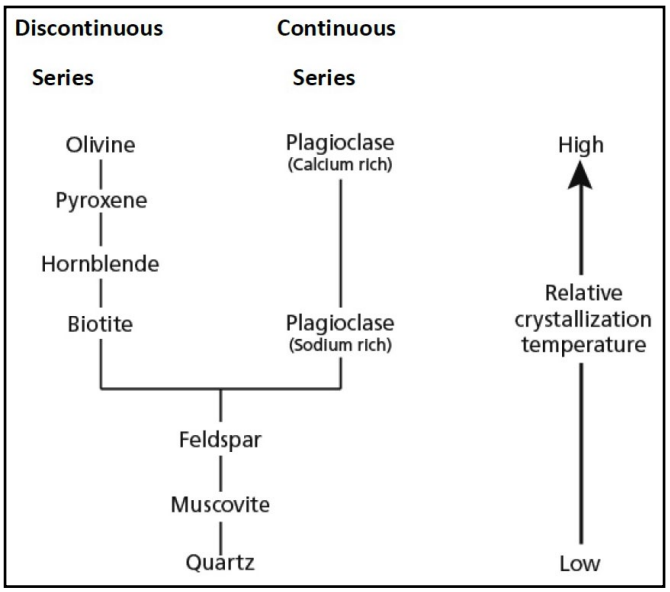


Fig. 4. The Bowen Reaction Series illustrating responses of minerals to changing equilibrium conditions as magma cools (Bowen, 1928).

could crystallise in a way that was quite separate from that of the parent pluton. In addition, conditions for orbicule formation must be rare as compared with those for the rest of the pluton.

Vernon (1985) described how this unusual condition allowing orbicule formation could occur. At the margin of the pluton, or in a segregated enclave or pocket, there needed to be destruction of most of the melt crystals and nuclei necessary to initiate crystal formation in the enclave. This could occur through the addition of a burst of new hot magma or by injection of water. This would cause melting of most of the nuclei, which produces a significant degree of undercooling, delaying further crystallisation. In petrology, the term 'undercooling' signifies that crystal growth is inhibited to below supersaturation and below the temperature when crystallisation is expected to occur. The undercooled melt in the enclave is metastable and when crystallisation is initiated, it occurs relatively rapidly on any remaining large crystals not melted by the superheating or the addition of water. This crystallisation will form the core of the orbicule. The first crystals are often radial and later become bounded by the first shell, which tends to be tangential. As the core develops, there will be a relative depletion of some of the constituents of the melt, which will allow the first shell to be made up of a constituent that is now relatively concentrated. Biotite or plagioclase are common as the first shell of the Separation Point pluton orbicules.

If the conditions remain suitable, other shells may be added, but it is more common for there to be only one shell and an abrupt boundary with the matrix. The matrix is of the same composition as the parent pluton. Variations on the above schema have been described at other sites of orbicule formation. I have outlined three of these that follow.

Smillie & Turnbull (2014) described orbicular granitoids from 8 sites in the Bonney Pluton, Southern Victoria Land in Antarctica. They discuss orbicule formation at these sites in some detail. The Bonney Pluton orbicules have been derived from a more mafic melt than those at Separation Point. They have highly diverse cores, but hornblende is the dominant mineral comprising the orbicule core, with plagioclase crystals forming radial spokes out from the hornblende core, as well as forming thin concentric shells.. They infer that initial orbicular growth is from pockets of water-rich silicate melt from the crystallizing pluton, because many of the orbicule cores are textually identical to the Bonney Pluton. Thereafter, introduction of hot mafic magma, probably more than once, caused superheating and destruction of nuclei in the melt pocket, allowing undercooling. The undercooling could have been enhanced by exsolution of water requiring the latent heat of vaporisation. The alternation between shells could be explained by changes of melt composition at the crystallization boundary. Eventually equilibrium crystal growth occurred and orbicule growth ceased.

Grosse *et al.* (2010), in describing the genesis of orbicular granitoid of the Sierra del Velasco in Argentina, noted that the cores contain K-feldspar (orthoclase) megacrysts. They postulate a pocket of orbicular melt with a high concentration of water, which caused effective superheating of the melt, as water will lower the melting temperature and cause destruction of nuclei and smaller crystals. Rapid undercooling occurred, caused by nuclei loss and enhanced by exsolution of water and volatiles. Orbicule core and shells then formed rapidly around the remaining megacrysts. The whole process was estimated to be complete in about 35 days.

A slightly different approach is taken by McCarthy & Muntener (2016), Fisher Lake site, Sierra Nevada. They suggest that in adiabatic (without loss of heat) ascent of moderately hydrous mafic melt, decompression will have the effect of superheating, with remelting of crystals and destruction of nuclei. On reaching a shallow depth, the superheated melt will remobilise existing crystal mush in the cooling pluton, which will form the cores of orbicules. When water exsolves because of further decompression, there will be heterogenous crystallisation of plagioclase forming orbicules. In this model, adiabatic ascent must be rare.

In summary, the genesis of orbicules requires superheating of a pocket of melt from new hotter magma, adiabatic ascent of magma, or the injection of water from the pluton. There is then melting of nuclei and undercooling of the melt, which may be further enhanced by exsolution of water and other volatiles. Rapid crystallization then occurs to form the core, with concentric layers determined by local concentrations of reactants.

These formulations are my interpretation of some recent literature on orbicule formation. It is in no way definitive but could prove helpful conceptually.

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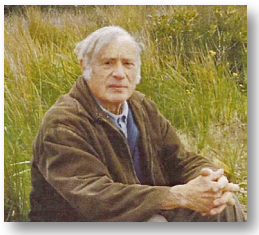
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DR KOBE AND HIS ORBICULES

Bernhard Spörli



Dr Kobe (Huko) contributed significantly to the study of orbicular granites in New Zealand. The purpose of this note is to also show his world-wide interests and research on these spherical bodies. For 27 years, Swiss-born and multi-lingual Dr Kobe was an admired and popular lecturer in mineral deposits at the Auckland University Geology Department, where he and his graduate students added considerably to the knowledge of mineral deposits in New Zealand and elsewhere.

The foundations of his geology had been laid in a very rugged area of high- grade metamorphic rocks of the southern 'root zone' of the European Alps. Rocks of this kind and meticulous observation continued to play an important role throughout his scientific career, and the orbicules are a part of this thread. One could add that with Huko's talents in the arts, there was undoubtably also an aesthetic side to his love of orbicules. The office in his home became a colourful mini-museum of his exploits.

During his retirement Dr Kobe was an enthusiastic member of Auckland Geology Club. He died in 2013. The illustrations for this note come from a commemorative Geoclub talk given by the author in 2019 for Huko. Orbicule samples collected by Huko were bequeathed to interested members of the club.



Fig. 1. Huko Kobe (left) in his home office in Mount Eden, Auckland, preparing a conference poster on orbicules, assisted by Prof. Ron Keam. Some of the photos in the poster were published in Huko's 1988 paper (see Fig. 2). The display case shown in Fig. 3 is on the wall above the poster.

Kobe, H. W.1973 The orbicular granodiorite of Quebrada Santa Maria, Chosica, Peru. Boletin de la Sociedad Geologica del Peru, 43, 25-41, in Spanish.

Kobe, H. W.1987 Orbicular granites in the Separation Pt. Batholith, NW Nelson. Newsletter - New Zealand Geochemical Group, 81, 36-37.

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ORBICULITAS

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Orbiculitas , rocas intrusivas plutónicas con orbículos de textura esferoidal (acumulaciones concéntricas de agregados minerales de constitución radiada, esferolítica, y/o tangencial en zonas/cáscaras) se presentan en batolitos por todo el mundo.

Las ocurrencias estudiadas por el autor en el Perú Central (1) y en New Zealand (2) incluyen afloramientos (raros) y rodados (más comúnes) de volumen muy menor del batolito portador y presentadas aquí por vistas y mapas de sus particularidades :

Part of text for a conference in Peru

Fig. 2. Orbicule publications by Dr Kobe, with an example of his output in Spanish.

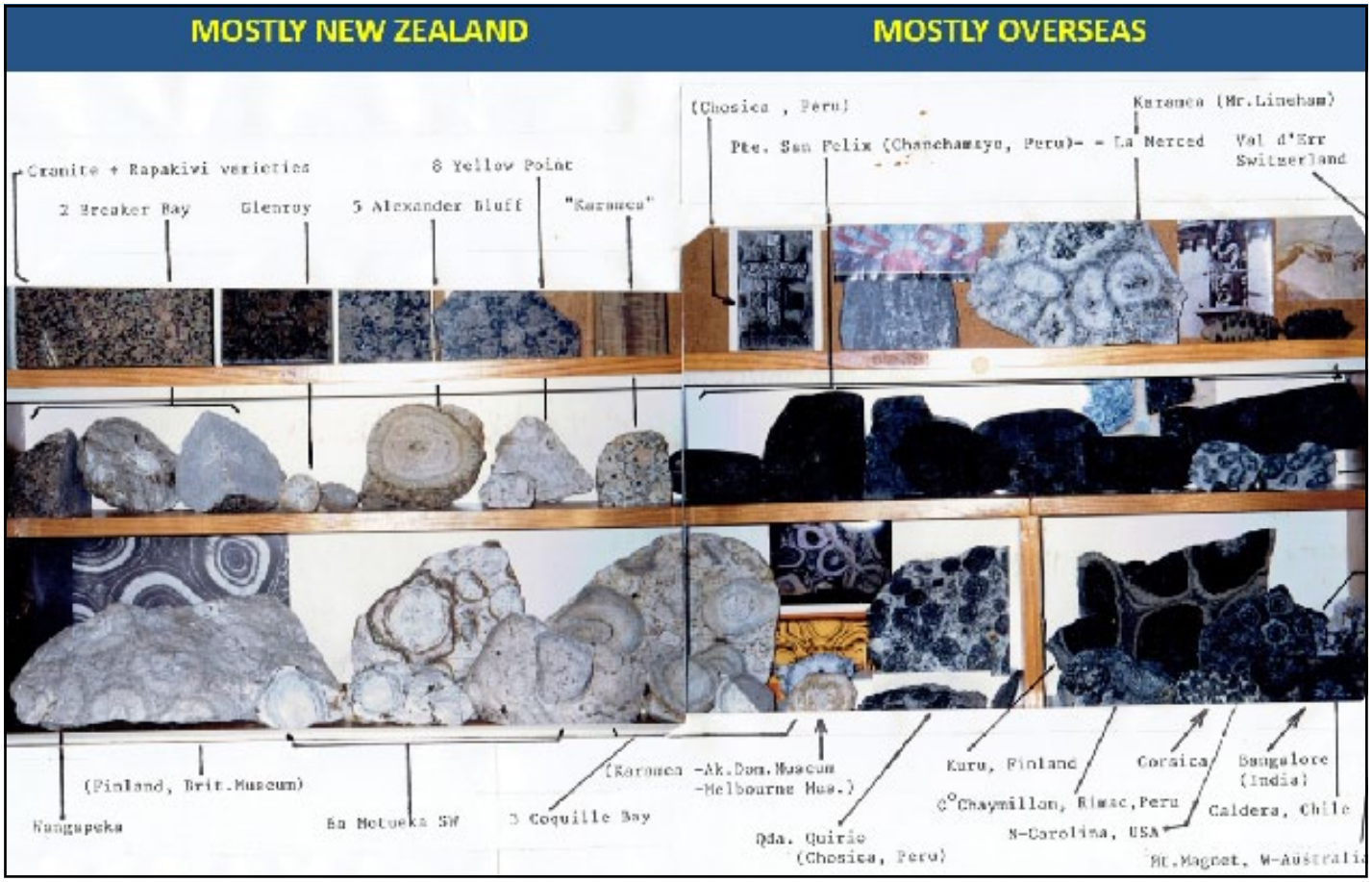


Fig. 3. Dr Kobe's display of orbicules from New Zealand, Australia, Peru, Chile, USA, Corsica, Switzerland, Finland, India.

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MOULDS OF NINE INFERRED KAURI TREE TRUNKS IN BASALT LAVA FLOWS, TAKAPUNA FOSSIL FOREST

Bruce W. Hayward

Introduction

Takapuna Fossil Forest is the best example of a forest that has been overwhelmed by lava flows and its stumps and lower trunks preserved as moulds in the congealed basalt lava. Over the years, Auckland Geology Club has visited Takapuna Fossil Forest on a number of occasions and we have also hosted several public viewings of this forest during the annual Auckland Heritage Festival.

Every time I go to Takapuna Fossil Forest I see something new. This was again true during a recent visit when I recognised the distinctive shape of a large (?kauri) tree mould right on the track around the coast between Takapuna and Milford beaches. I had never seen it before and concluded that the high tide deposit of shelly sand on the track at this point had recently been shifted by a storm, thereby uncovering the mould. I already knew of three other large, upright tree trunk moulds and one lying flat (see later). Finding this extra one set me to wondering whether there were any more that I was unaware of. I returned several weeks later on a low spring tide, determined to undertake a thorough search of the basalt reefs between Takapuna Beach and Thorne Bay and record all the large tree moulds I found.

One of the main features seen by everyone walking around the rocky track between Takapuna and Milford beaches is the large (2 m diameter) cart-wheel grill beside the track. As kids we always thought it was a cover over a well and many members of the public think it has something to do with the sewer line that runs around this section of coast – but it never emits an odour. One of the information panels beside the carpark on Takapuna Reef tells those who care to read it that the grill covers the hollow mould of a kauri tree trunk still in growth position. The mould is made of the solid basalt of a 3.5 m thick flow that flowed around the lower part of the trunks of trees and cooled and solidified in contact with them, before the shape of the trunks was destroyed by burning or incineration (Hayward, 2019). The large diameter of this tree trunk, its lack of branches and the lack of taper strongly suggest that it was a kauri tree.

Previous records

In a search of the previous literature written about Takapuna Fossil Forest, I found that Bartrum (1941) seems to have been the first to mention the presence of fossil tree moulds at Takapuna, including a large vertical one, presumably the one under the grill. Searle (1964, p.54) briefly mentions the fossil forest, which he writes was formed "when thin lava flows surrounded large standing trees which became standing torches. None of the timber now remains but many circular holes in the lava flow show where the trees stood". He makes no mention of any large, potentially kauri, tree moulds. Allen and Smith (1991) presented a more detailed description of the fossil forest and a novel interpretation, which is confusing because they seem to have muddled their terminology of moulds and casts. On p. 55, they mention "a vertical cast (sic) with a diameter of 1.3 m and a depth of 3 m". This presumably refers to the well-known mould beneath the grill.

Hayward and Hayward (1995) recognised the fossils on Takapuna Reef to be 0.3–0.5 m thick moulds formed by cooling of basalt lava around the base of standing trees before the remaining molten lava flowed away leaving the moulds upstanding. Characteristic of these moulds are the concentric laminae of vesicles captured in the cooling basalt as the mould grew thicker and thicker away from the trunk. Hayward and Hayward (1995, p. 131) refer to two 3+m high, 1.6 m diameter, straight-boled tree moulds "presumably kauris" preserved close together (one covered by the grill) in a 3 m thick solid basalt flow. No other large tree moulds were recorded by them.

On a map showing places of interest, Hayward (2019, p. 81) shows the location of: "the mould of a 1-m-diameter felled kauri tree trunk" (= tree mould 9 in this article); "an upright kauri tree trunk under grill" (= tree mould 3); and a "shallow circular tide pool being the mould of a vertical kauri tree trunk" (= tree mould 7). A photo of the felled trunk appears on p. 79 and of the circular tide pool on p. 80. Thus the location of the moulds of three vertical, large tree trunks and one felled trunk have previously been recorded.

Records of large diameter, presumably kauri, tree moulds

There are many depressions and holes in the intertidal basalt reefs of this section of coast. Some are blisters or lava tubes or hollows eroded out by storm wave activity and I checked them all out for evidence that any were actually tree moulds. The best confirming evidence for the presence of a tree mould was the presence of the circular laminae of vesicles formed as the lava congealed and solidified around the cold tree trunks. In this 2021 survey (Fig. 1, Table 1), I easily relocated the three previously recorded vertical moulds (tree moulds 2, 3, 7) and the fallen trunk (tree mould 9) but also recognised five more, large diameter (>1 m) moulds of vertical, in-situ trees (presumably kauri) (Table 1). All these tree locations are shown in figure 1.

Tree mould 1 (Figs 2, 3)

This is located on Takapuna Reef among hundreds of other moulds of smaller trees. This is the second smallest of the large tree moulds identified.

Table 1 Location and diameter of ?kauri tree moulds in basalt lava, Takapuna Fossil Forest (Figs 1–14).

Tree mould 1.	36.783681S	174.776982E;	1.2 m diameter
Tree mould 2.	36.781737S	174.776899E;	1.45 m diameter
Tree mould 3 .	36.781701S	174.776915E;	1.6 m diameter, 3.5 m deep
Tree mould 4.	36.779716S	174.778145E;	1 m diameter
Tree mould 5.	36.779522S	174.777964E;	1.6 m diameter
Tree mould 6.	36.779305S	174.777919E;	1.5 m diameter
Tree mould 7.	36.779162S	174.778067E;	2 x 2.2 m
Tree mould 8.	36.778733S	174.777728E;	1.7 m diameter
Tree mould 9. Rafted tree trunk	36.783387S	174.777036E,	1.4 m diameter and 12 m+ long



Fig. 1. Map of the coastline between Takapuna Beach and Thorne Bay showing the locations of the moulds of large (?kauri) trees.



Fig. 2. The northeast portion of Takapuna Reef showing the precise locations of vertical tree mould 1 and fallen tree mould 9.



Fig. 3. View north over the western part of Takapuna Reef showing large tree mould 1 (foreground). The mould is about 0.5 m high above the surface of a second smaller lava flow and has a tide pool in the depression where the tree incinerated away and had previously been filled and buried by tuff.

Tree mould 2 (Figs 4, 5)
This is a circular depression in the track between the ends of Brett Ave and Oneills Ave. It has been filled with rubble and rough concrete many decades ago but the concave inside of the mould is clearly obvious on the landward side. It is located 4 m south of the well known tree mould covered by a cart-wheel grill (tree mould 3).

Tree mould 3 (Figs 4, 6)
This is beside the coastal track and best known because of the cart-wheel grill that prevents people from falling down into the 3 m deep shaft left by the incinerated tree trunk. The outer seaward side of the mould is unstable because of quarrying that took out a large area of basalt along this section of coast, over 100 years ago. A small tunnel that the sea had eroded through the soft tuff and sandstone underlying the lava flow used to be present when I was younger and could be negotiated to get inside the mould. The tunnel was filled with basalt blocks about 20 years ago to prop up the seaward side of the basalt

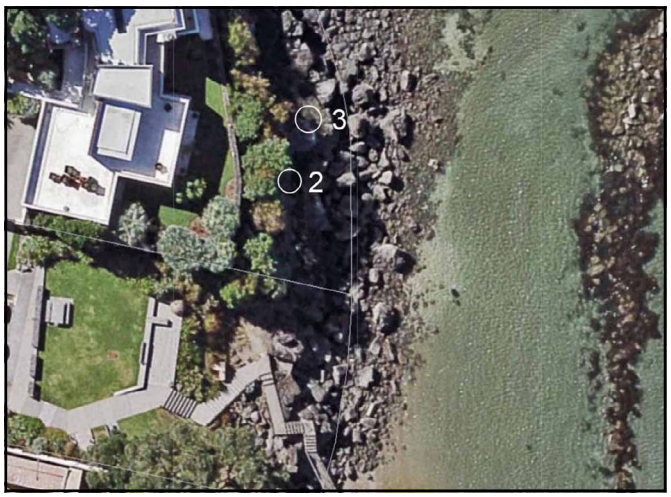


Fig. 4. Location of vertical tree moulds 2 and 3, 6–10 m north of the small grassy reserve at the end of Brett Ave.



Fig. 5. Tree mould 2 has been filled with rubble and broken up concrete directly beneath the walking path.



Fig. 6. Tree mould 3 is beside the coastal track and best known because of the cart-wheel grill over the top of it.

mould that was threatening to fall outwards into the sea because of the erosion beneath it. There is a crack right through the mould along which the seaward side would have broken off. It has not opened up any more in recent years, but one day I am sure it will give way.

Tree mould 4 (Figs 7, 8)

This is the smallest of the large tree moulds (1 m diameter) and consists of a raised mould on the seaward side and three boulders inside the depression. It is located about 8 m seaward of a gate in the fence behind the small high tide beach on the point between the ends of Oneills and Minnehaha avenues.



Fig. 7. Location of tree moulds 4 and 5, on and close to the coastal track around the point between the ends of Oneills and Minnehaha avenues.

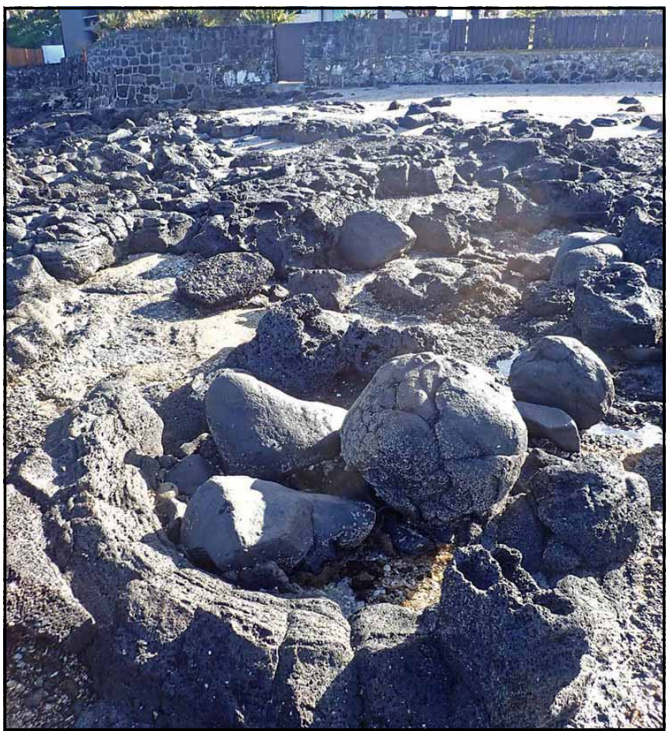


Fig. 8. Tree mould 4 is the smallest of the large trees (1 m diameter) and has a raised mould on the seaward side.

Tree mould 5 (Figs 7, 9)
This is on the coastal track and until recently was buried by high tide shell sand. It is only 2m from gates on the boundary of two private properties.

Tree mould 6 (Figs. 10, 11)
This is a circular high tidal rock pool, located 3 m from the southeast corner of Minnehaha Reserve.



Fig. 9. Until recently, tree mould 5 was buried by high-tide shell sand. It is located right on the coastal track.



Fig. 10. Location of tree moulds 6–8 close to the landward side of the basalt reef off the end of Minnehaha Ave.

Tree mould 7 (Figs 10, 12)
This is the largest of the tree moulds with diameters of 2 and 2.2 m. It is a high tidal pool floored with hard tuff that would have filled the empty mould following the incineration of the tree trunk. It is located 10 m seaward of the steps down from Minnehaha Reserve.

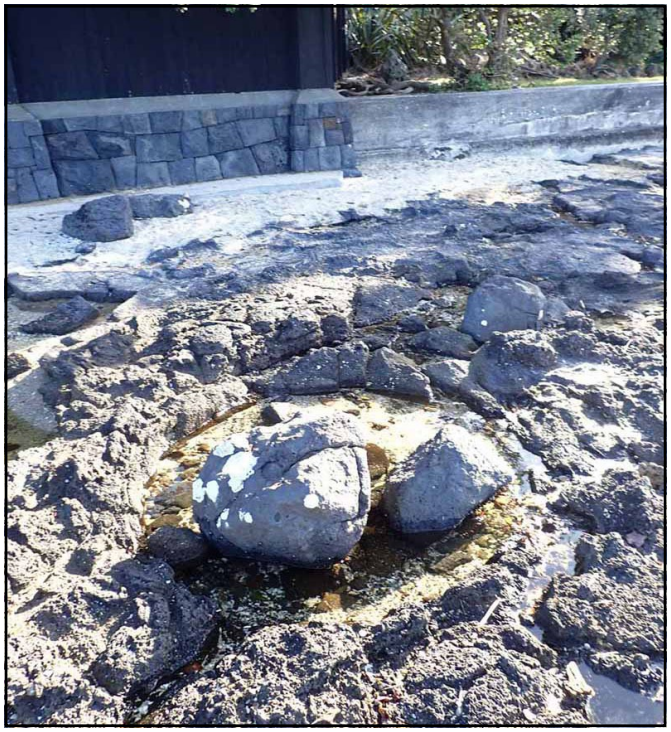


Fig. 11. Tree mould 6 is located 3 m from the southeast corner of Minnehaha Reserve, in the background.



Fig. 12. Tree mould 7 is the largest of the tree moulds with a diameters of 2–2.2 m. The tide pool is floored by a thin veneer of shell hash overlying a fill of hard tuff. In the background are steps from Minnehaha Reserve.



Fig. 13. Tree mould 8 is a high tide circular pool with a floor of shell sand over tuff.

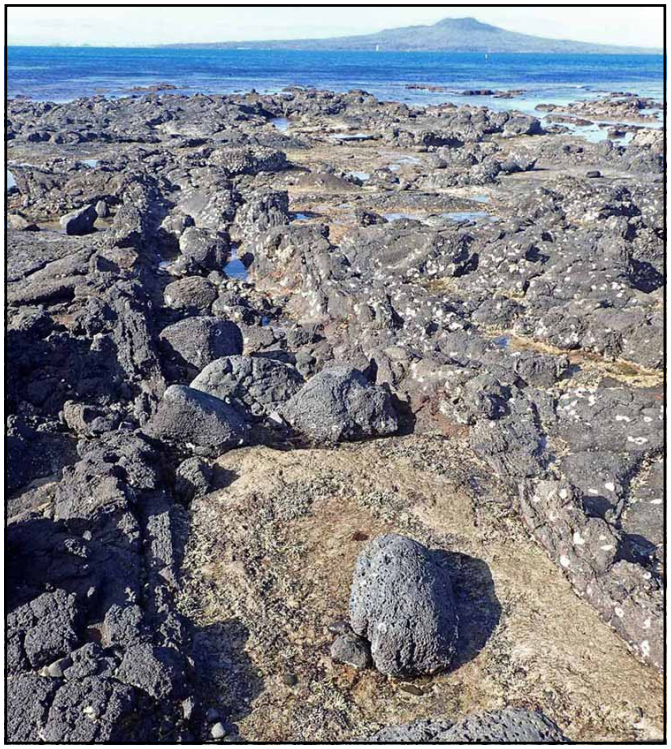


Fig. 14. The mould of the trunk of a large diameter kauri tree (9) on Takapuna Reef is partly filled with tuff that buried it and the whole lava flow after the moulds had been fully formed.

Tree Mould 8 (Figs 10, 13)
This is the northernmost of the large tree moulds. It is 6 m seaward of the coastal path and consists of a shallow circular high tidal pool floored by a layer of shell hash over the tuff filling.

Felled tree mould 9 (Figs 2, 14)
This canoe-like mould is located in the northwestern part of Takapuna Reef at mid tide level. The trunk has a diameter of at least 1.4 m and is at least 12 m long. Unlike the other large trees this one has been knocked over presumably by the lava flow and rafted along in the top of the flow before coming to rest and burning away. The mould was filled and buried by volcanic ash after the tree had been completely incinerated and most of the soft tuff has eroded out since the Holocene high stand of sea level in the last 7000 years, but some is still present in the mould at its landward end.

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SERPULID TUBEWORM "ROCK" (POLYCHAETA: SERPULIDAE) FROM THE HOKIANGA COAST, WESTERN NORTHLAND, NEW ZEALAND

Seabourne Rust

Walking along from Waimamaku Beach on the wild west coast of Northland one sunny spring afternoon, my partner Diane spotted what looked like a large piece of pumice cast up on the shore. Upon closer inspection we soon realised that it wasn't pumice at all! The "rock" we had found (Figs 1–3) weighs 1.0 kg and appears to be wholly comprised of a dense accumulation of hundreds of tiny coiled worm tubes, each approximately 1 mm across, resembling miniature macaroni - we wanted to know more!

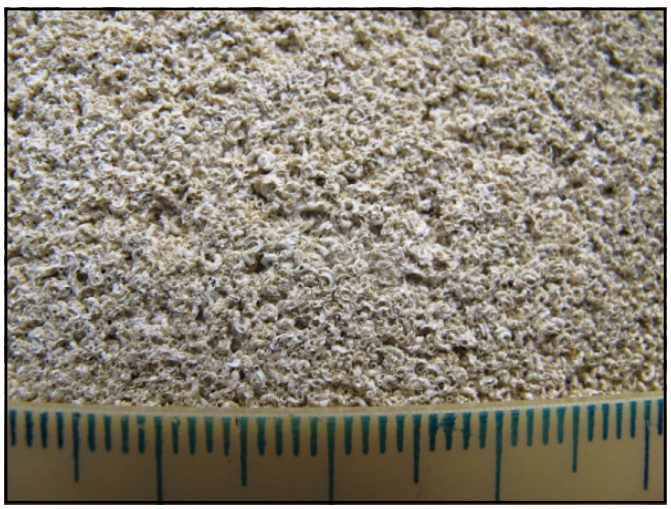
I was familiar with tubeworms (Phylum Annelida, Class Polychaeta) of the Family Serpulidae: sessile (fixed) polychaetes producing calcareous tubes, and a member of this group seemed the best explanation. As Geoff Read from NIWA notes -

> *"This includes the Spirorbinae, formerly Spirorbidae. The serpulid calcareous tube, hard and long-lasting, makes this family one of the most noticeable polychaete groups, and one that is also economically a problem worldwide when after colonial settlement large masses of tubing build up as 'fouling' on boat hulls or inside industrial pipes. The serpulid body is similar to that of sabellids with its thoracic and abdominal regions and crown of radioles, but more specialised. Serpulids never leave their tubes and unlike sabellids the crown used for filter-feeding is rarely cast off or lost in handling. Instead it is retracted into the tube in an instant and the tube mouth blocked by an operculum, here a modified radiole bearing an ornamented plug at the end."*
>
> *"The spirorbine sabellids are small, coiled, filter-feeding worms, the asymmetrical inhabitants of spiral, calcareous tubes. One side of the spiral is cemented flatly against the material the worms have chosen to settle on as larvae. They occur on many hard surfaces, but are conspicuous either scattered loosely or in dense aggregations on the underside of stable rocks in intertidal pools, or spotted like white dots across the fronds of large algae such as Macrocystis kelp. An examination of the operculum and the tube is the easiest way to begin to identify serpulids, but a look at any group of specimens will reveal that the ornamentations on these structures can have substantial natural variation."* Read (2004).

Our washed-up specimen, however, comprised only a mass of dead worm tubes worn by abrasion. No live filter-feeding worm bodies or opercula were present. The mass certainly must represent a piece of very thick encrustation or piece of a local "reef" formed by self overgrowth of the tubes. We suspected it must be from a fairly local source, distance transportation, while possible (for example entrapped in something else earlier, like an algal holdfast or a boat!), seemed less likely.







Figs 1–3. Different views of the "rock" comprising a mass of dead worm tubes.

In the hope of identification of the species involved, I sent a few photos of Diane's find to some very helpful marine biologists who study Polychaetes. After some research and discussion, the expert opinion was that it might be an aggregation of the species *Paralaeospira levinseni*. This species forms smooth round tubes up to 2.5 mm across (Knight-Jones & Walker 1972). *Paralaeospira levinseni* tubes may exhibit regular sinistral coiling on a substrate or be somewhat more loosely spiralled and ascending in crowded conditions. Knight-Jones & Walker (1972) also noted that - "*dense aggregations are often formed as the young settle on or alongside adult tubes of their own or even other species* [of serpulid - see Fig. 4 a]". Besides several localities in New Zealand, the species is known from localities across southern oceans including Patagonia, South Africa and Antarctica, and is commonest in shallow waters up to 30 m depth (Vine, 1977). This is the first record from Waimamaku Beach and is an unusually dense aggregation!

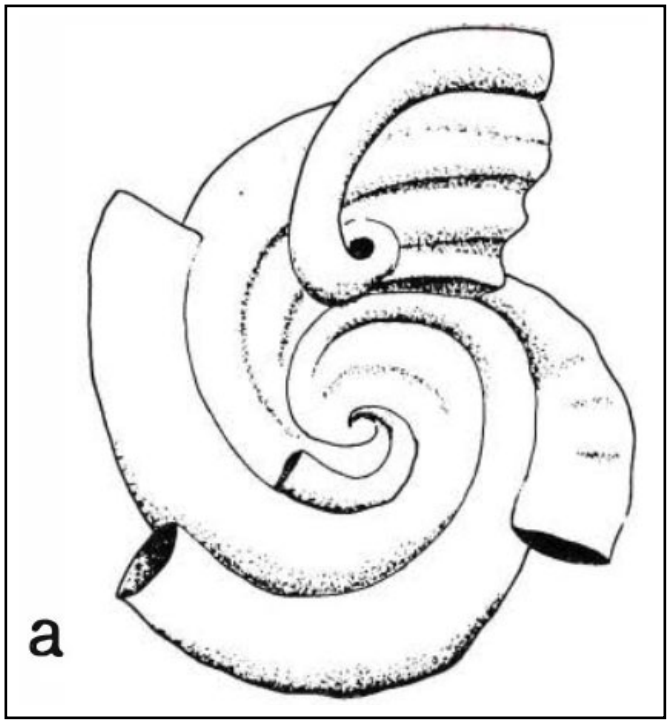


Fig. 4 a : *Paralaeospira levinseni* tubes (lacking strong longitudinal ridges) growing on a ridged tube of another serpulid species, *Romanchella solea*, from the Poor Knights Islands as illustrated by Vine (1977).

Acknowledgements

My sincere thanks to the marine biologists who shared their time and expertise - especially Geoff Read, Tom Massué, Peter Vine, and Abby Smith.

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CONTINENTAL DRIP

Jill A. Kenny

One of my geology supervisors at the University of Auckland, Dr Peter Ballance, once mused about the concept of Continental Drip. I thought he wrote something on it, but I can't find it anywhere. While looking, I found various articles written by others. They are from the 1970s, and maybe Peter had seen them. "Continental Drip" is obviously a play on the words "Continental Drift", back then still a relatively new concept.

It does seem to be true, at least as far as continents and large peninsulas are concerned. Think of Africa, India, South America, Greenland, Norway/Sweden, the Iberian Peninsula, Italy, Greece, Malaysia, Korea, Kamchatka, Baja California and Florida. The only north-pointing peninsulas, but of smaller scale would be Denmark, Cape York (Queensland, Australia) and the Antarctic Peninsula. Of course, in New Zealand we have mini versions - the Coromandel Peninsula and Northland.

Ormonde de Kay first made this observation in a 1973 tongue-in-cheek article (de Kay, 1973). He wrote that - *"Continental drip is the tendency of land masses to drip, droop, sag, depend, or hang down - like wet paint in the Sherwin-Williams trademark - except that they cling to the Earth's surface below the equator instead of falling off into space."* Fig. 1. (Sherwin-Williams is a Cleveland, Ohio-based company manufacturing paint and coatings.)

The concept gets more bizarre - there is a scary explanation using astrophysics! Professor Gorice, in a lecture at Michigan State University, Tolkien Memorial Lecture (Blogspot 2014), used the Sherwin/Williams illustration to suggest that - *"The Earth's motion through the Galaxy, as we orbit the Sun, tends in the direction very roughly correlating with North"* (Fig. 2). Although admitting it is

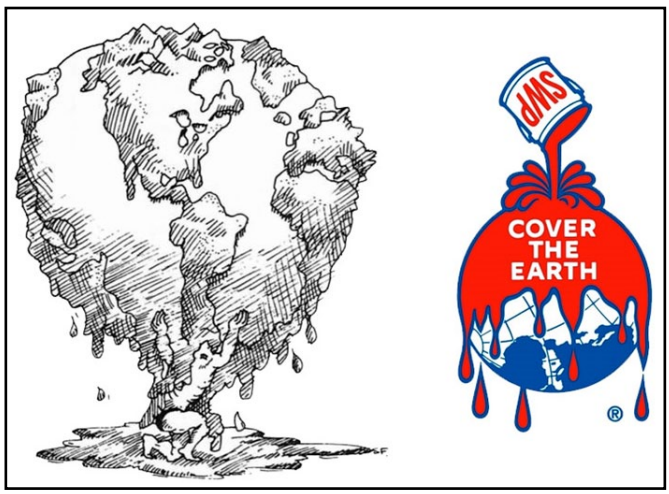


Fig. 1.Ormonde de Kay's diagram of Continental Drip on a globe compared to the Sherwin-Williams trademark pouring paint logo. From de Kay, 1973.

Editor – Image removed for copyright reasons.
The image was a composite showing cartoons of continental drip. It can be viewed in https://rewinn.blogspot.com/2014/11/theory-of-continental-drip-explained.html

Fig. 2. Research by Professor Gorice uses astrophysics to explain Continental Drip. From Blogspot, 2014.

much more complicated than that, he explained that - *"Every day we collide with trillions of particles large and small with a slight bias towards a North-to-South collision. The effect is slight, but the result is an obvious orientation in the Earth's visible landmasses, as particles of every size down to the sub-atomic rain down upon us with a pronounced orientation, kicking up the dirt slightly more often to the South."*

Professor Gorice contends that the effect is *"less pronounced"* for masses under the ocean. *"Water impacts don't impact with the same impact as dry land impacts. Fluids are displaced but backfilled by the rest of the fluid in the same body of water. Dry land doesn't do that, and thus the effect."* Peter Daymond-King would have loved that!

Gorice asks why hasn't this been noticed before? *"The effect is complicated by many factors. Earth's techtonic* (sic) *plates move around and obscure the effect of galactic motion. As greenhouse gasses* (sic) *wax and wane over the eons, the sea level rises and falls, shielding different areas from the effect. But the long-term result is as clear as a map. Ultimately, all our dry land will lump together at the bottom. Of course, we'll all be dead by then."* Now I can imagine that Peter Daymond-King will be turning in his grave!

I'm sure Peter Ballance just referred to the notion that more landmasses point southwards than towards the north, but it seems the southwards projections are also supposed to be tear-shaped. John Holden (Holden, 2001, reproduced from 1976) contended that there was - *"a very important dimension missing in the new theory* [of plate tectonics and continental drift] . . . *the shapes of the earth's continents and their bearing to past drift motions. . . . The outlines of all continents are tear-drop shaped with the pointed ends trending south indicating directions from which they have come. This startling concept is called 'continental drip' and is the essential concept of 'fake tectonics', the acronym for Final Answers for the Knowledge of Earth tectonics."*

Holden continued - *"Actually, fake tectonics can be traced back to the early historical development of continental drift when Wegener (1929) referred to the continent's flight away from the poles, or 'polarfluchtkraft. A step in the right direction was made by Dietz and Holden (1970) when they recognized that there was only a 'sudpolarfluchtkraft' (south polar fleeing force)."*

There is more. Holden suggested that - *"The concept has great heuristic value. For instance, because the continents appear to flow north we can finally recognize that our place in the solar system has been topsy-turvy - that planets revolve around the sun in a clockwise (not counterclockwise) manner and that the south pole should be at the top of the globe and the north pole on the bottom because, as we all know, drips should always flow down."*

Holden uses a cylindrial map projection from Deetz & Adams (1945) (Fig. 3) to show that - *"all continents are fundamentally drip-shaped. Some show a multiple drip aspect: the subdrip of Arabia being a good example (A). The open drip symbol of New Zealand is based on its submerged continental outline and must be considered as a drowned drip."* While it is admirable that Holden is even aware of New Zealand, let alone its vast continental shelf (remember his original article was written in 1976), I don't agree with him. I think the extent of what we now call 'Zealandia' tapers more to the north. He continues - *"The anti-drip of Ceylon (Cy) is interesting and is included as it is the exception that proves the rule."* So I suppose Zealandia would be in this category as well. I wonder what he would do with Denmark and Cape York Peninsula? Are Madagascar and Borneo also 'anti-drips'?

What would Holden do with the northward-pointing Antarctic Peninsula? To me it looks a bit like a stalagmite under the stalactite of Patagonia. He has an interesting explanation, remembering that his globe is upside-down

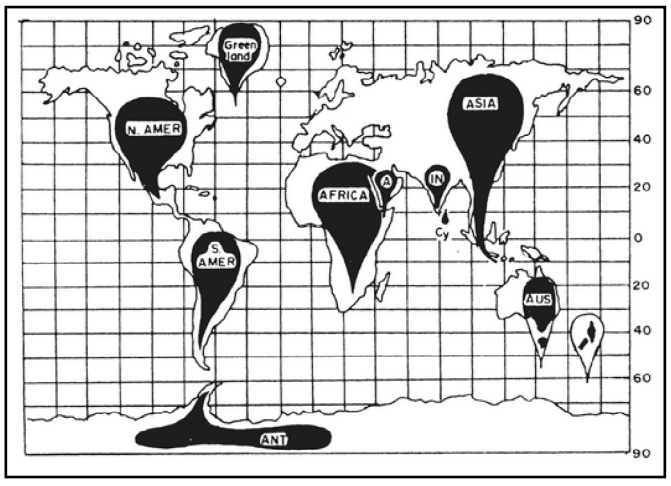


Fig. 3. Continental shapes reveal the evidence for continental drip, especially when this figure is viewed upside-down. From Holden (2001 [1976], Fig. 1.).

- *"The anti-drip of Antarctica is due to the fact that Antarctica being situated at the top of the globe has not yet made up its mind which way to flow hence that continent has drifted round and round but never down."* I wish he had used some commas!

Holden's final revelation - *"Considering that the universal landmass of Pangaea broke up some 200 million years ago, and that the continents are now better than halfway dispersed from the original nucleus at the south pole, the time of their re-uniting at the other end of the world can easily be predicted. Based on computer analyses of the northward vector sums for continents now in motion, this event will occur on Tuesday morning at 9:00 a.m. 1,786,379 A.D. The resulting new universal landmass (excluding Antarctica) is called 'Pangooy' and the event is termed 'continental splash'; the final coalescence of continental drips. Insofar as Antarctica is perfectly balanced on top of the globe, it is highly unlikely that this continent will ever join the others on their trek down under."* Fig. 4.

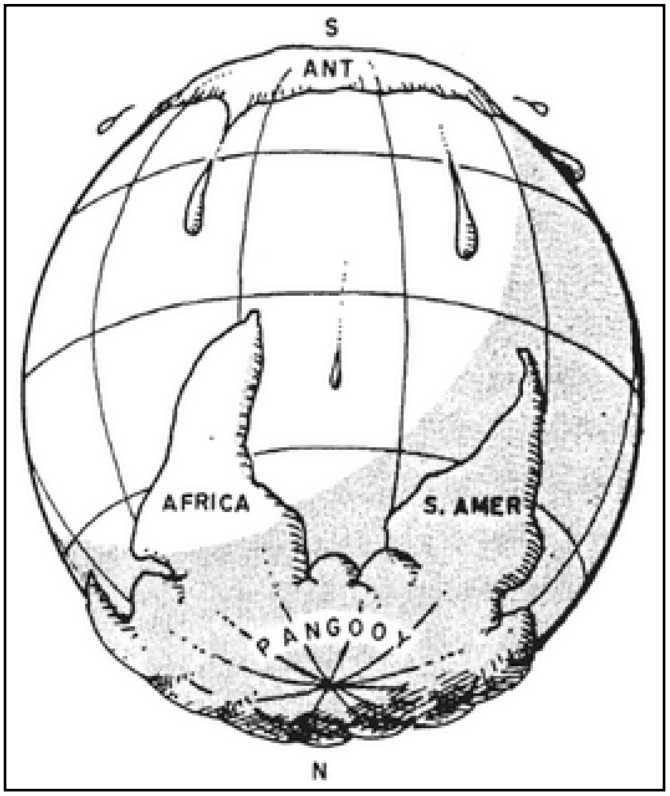


Fig. 4. The inevitable Pangooy outcome of continental drip. From Holden (2001 [1976], Fig. 2.).

You might also like to contemplate why landmasses are not seemingly affected by the Coriolis Effect. And would they be tapering east to west or west to east?
Have a think.
(Turkey and Alaska point west, and eastern Siberia points east, but I suppose the Effect would be most pronounced nearer the equator. Papua New Guinea extends in both directions. Would the shape of islands in the Caribbean help your decision?)

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A proof that engineers and scientists can never make as much money as administrators or salespeople.

1. Power = work/time.
2. Knowledge is power.
3. Therefore knowledge = work/time.

4. Time is money.
5. So knowledge = work/money.
6. And money = work/knowledge.

7. Therefore as knowledge tends to 0, money tends to ∞ regardless of the amount of work done.

8. Conclusion: The less you know, the more money you make.

LES KERMODE – CO-FOUNDER OF AUCKLAND GEOLOGY CLUB

Bruce W. Hayward

Les Kermode (affectionately known to many in Geoclub as Sir Les) co-founded the Auckland Museum Geology Club (fore-runner of Auckland Geology Club), together with me, in 1992 (Hayward, 2021). Les had recently retired from New Zealand Geological Survey where he spent most of his career studying the geology of Auckland and the limestone and caves around Waitomo. After leaving school, Les trained as a Primary School teacher and gained a BA in music from the University of Auckland. He taught at a number of schools around the Waikato and south Auckland until 1962. In 1963 he joined the New Zealand Geological Survey office in Otara as a technician and later was promoted to geologist.

Les became the most knowledgeable geologist on Auckland's volcanoes and Auckland geology with his 1:50,000 map of Auckland geology published in 1992, after he retired. This expertise led him to an interest in the visit of Hochstetter to New Zealand, on which he became an authority in the 1990s. In the latter part of his life, Les became active in agitating for the protection of geological sites and particularly the volcanoes of Auckland. He was a member of the Auckland Conservation Board for three years in the 1990s. In his last few years Les was employed part-time by Auckland City Council to help locate, map, assess and document the geoheritage of the city and was doing just that on Rangitoto Island when his fatal heart attack struck in January 2002, aged 69.

When the Geology Club was formed, among its first members was a core of avocational geology enthusiasts who had caught the geology bug from Les, through his University Extension classes in geology that he had been giving over the previous few years. Les enjoyed sharing his geological knowledge with anyone who was keen enough to listen and he particularly liked doing it in the field. He led many Geology Club field trips and came on most others. He and I really enjoyed verbally sparring at various outcrops as we struggled to come up with credible explanations or hypotheses for what we were seeing. In this way, the field party gained an appreciation of looking more carefully at what was in front of them and thinking more about what it all might being telling us. In the ten years he had with Geology Club, Les took us to every one of Auckland's volcanoes that were known at that time (49) and shared most of his life-long collection of information about them.

Besides geology, Les Kermode's other passion was speleology. He had become New Zealand's leading scientific expert on both lava caves and of the limestone caves of the Waitomo area. For many years he was editor of the New Zealand Speleological Bulletin and Chairman of the Auckland Speleo Group. Les led Geology Club on its first weekend trip in 1993 to Waitomo, where we visited several caves and he explained in detail the speleothem varieties and their formation. He also led the club into Stewarts Lava Cave in Landscape Road and even encouraged some to follow his contortions to make their way into the inner sanctum on the lower level. A few years later he did the same in Wallaby Lava Cave on Rangitoto. Needless to say, I did not follow him on either occasion. Unfortunately, permission for Geology Club to enter Wiri Lava Cave was not possible during the 1990s, but I did have the opportunity to join him and several officials when Wiri was created a Scientific Reserve in 1998.

Les presented the inaugural evening lecture to Geology Club in November 1992 on "Do it yourself geological trips around Auckland," which he used as a sales pitch to encourage those present to be the first to join up to a Geology Club in Auckland. He followed this with a lecture on the geology of Waitomo and Kiritehere in April 1993, prior to his leading the first weekend trip of the club (to Waitomo and Kiritehere). He also led a discussion on Auckland's volcanoes the following month. Over the years he also gave lectures on Auckland's Volcanoes (1994), North Shore Volcanoes (1996), caves and karst (1998) and Hochstetter in New Zealand (2000).

During his time with Geoclub, Les led or co-led trips to Motuihe Island (1993), Waitomo and Kiritehere (1993), Auckland's building stones (1993, 1995), Stewarts Lava Cave (1993), Takapuna Fossil Forest (1993), Tongariro geology weekend (1994), Mangere Mountain and Ihumatao Fossil Forest (1994), Tamaki's forgotten and disappearing volcanoes (1995), Musick Point (1995), North Shore volcanoes (1996), Rangitoto (1996), Three Kings volcanoes (1997), western Hunuas and Franklin volcanoes (1997), Waikato Basin geology (1999), Mt Eden volcano (1999), Mt Wellington volcano (2000) and One Tree Hill volcano (2001).

Most of us, who were part of Geoclub in the 1990s, have our own particular memories of our times with Sir Les, like the time he led a group of thirty or so straight up the face of the old quarry on the side of Maungawhau/Mt Eden. It was almost vertical and the older members of the group were flabbergasted that he expected them to follow, which they did although some took some time. I also recall the field trip, recorded by the October 1995 Geoclub Newsletter, in which "Les led 22 of us plus a local cat on a damp but pleasant jaunt around Musick Point."

Les Kermode was a member of the first Geology Club committee and was still an active member of it when he suddenly died in 2002. The Februrary 2002 Geoclub Newsletter started with the following item:

"FAREWELL SIR LES AND MANY THANKS

Many of you will have heard the sad news of Les Kermode's passing on Rangitoto in late January and the

GeoClub was well represented at his funeral. “Sir” Les was a co-founder of our Geology Club, and gave the first lecture in which he was enthusiastic about all the different and varied places such a club could visit around Auckland. We have been fortunate and truly blessed to have benefited from his exceptional knowledge over the past 10 years, during which time he has presented a lecture to us almost every year and led and actively participated in dozens of field trips. We will miss his wisdom, his geological debates and his humour, which one could rely on to brighten up even the dullest outcrop and wettest day. The Club sends its condolences to “Lady” Theresa and the family with whom we share the great loss.”

More information about Les’s life and career are available in the following references:

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Fig. 1. Les Kermode in field gear, about 1992, when Geoclub was founded.

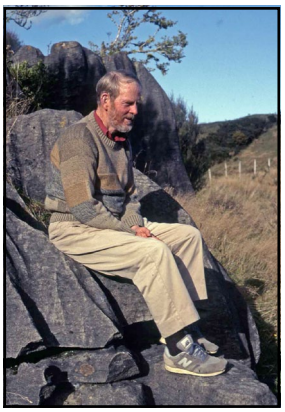


Fig. 2. Les Kermode led the first overnight Geology Club trip to Waitomo and Kiritehere in 1993. Here he sits on fluted limestone as he discusses the surrounding geology with the group.



Fig. 3. Les Kermode flanked by Hugh Grenfell (right) and Trevor Clarke (left) on a Kawau Island Geology Club trip, 1993.



Fig. 4. Les Kermode lectures to Geology Clubbers at lunchtime in his outdoor auditorium on Sturges Park, Otahuhu, 1995.



Fig. 5. Les Kermode talks to Geoclubber’s George Wingate (far left), Murray Baker and Garry Carr (right), at Paritutu, New Plymouth, 1999.



Fig. 6. Les Kermode explaining the intricacies of the eruption of Maungarei/ Mt Wellington, on a Geoclub trip in 2000.

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HYPERLINK INSTRUCTIONS

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