At Last, a Good Mutation?

There are children who are so prone to infection that, if they survive at all, they have to spend their lives in an artificial 'bubble'. This is the usual fate of those who have inherited two defective copies (one from each parent) of a gene which produces an enzyme called ADA (adenosine deaminase).

Because they are unable to make ADA, toxic substances accumulate in their blood which slowly damage the body's immune cells.

However, in an unprecedented finding, a U.S. boy called Jordan Houghton has spontaneously recovered from his condition.[1] All the evidence indicates that in one line of his immune cells, one of the faulty genes has apparently repaired itself.

Geneticist Hagop Youssoufian at Brigham and Women's Hospital, Boston, says about this 'fascinating' occurrence:

> *We finally have a clear example of a mutation doing something good'.*

'Back mutations', replacing a letter in the DNA sequence which was faulty back to what it originally should have been, are not unknown. They certainly do not show us how significant information can arise *de novo,* as they merely (accidentally) 'restore' what should have been there.

An occurrence like this (encouraging, but exquisitely rare) may actually not be mutational as such, as there are abundant error-checking, proofreading and repair mechanisms in Our genetic machinery.

Youssoufian's 'at last' statement highlights the fact that mutations, random accidental changes in copying hereditary information, are overwhelmingly a downhill process. Geneticists in hospitals are all too familiar with the harm they cause in people who inherit their effects.

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C. Wieland

K-Ar Dating Results in Major Landform Surprises

Theories of landform evolution have been in existence for over 100 years, and yet they are still controversial. Considering the denudation of a highland mass, two general schools of thought have emerged:-

(1) the Davisian school which favours summit lowering, and
(2) the Penckian school which emphasises slope retreat.

The controversy is unresolved mainly because of a lack of quantitative data and because uniformitarianism does not seem to provide a solution:

> *'The critical testing of these rival hypotheses has been thwarted by a lack of quantitative evidence. Short-term observations throw little light on the issue, for determining how landscapes have evolved over enormous periods of time* [uniformitarianism] *requires reliable chronological markers that are absent from many landscapes.'*[1]

So, the hope is that if quantitative data can be garnered then geologists can better understand how a particular landscape has developed over time. By applying radiometric dating to lava flows, this hope is now being realised, but major surprises have resulted.

In south-east Australia, basalt lavas have flowed over the landscape during the Tertiary period of the geological timescale. By dating these lava flows using the K-Ar method, geologists have estimated the rate of landform change. In the Shoalhaven River Gorge, for instance, several basalt flows have been discovered which have flowed down into the gorge when the gorge was first deepening. The flows were about 4 m thick, 100 m wide, and descended about 50 to 70 m below the rim of the gorge, which is now 500 m deep. Presumably, the basalt descended to the depth of the gorge at that time. The basalt has been dated at about 30 Ma.[2] Therefore, according to these calculations, the gorge has deepened at about 14 m per million years, while retreating headward at a rate of around 2.5 km per million years.

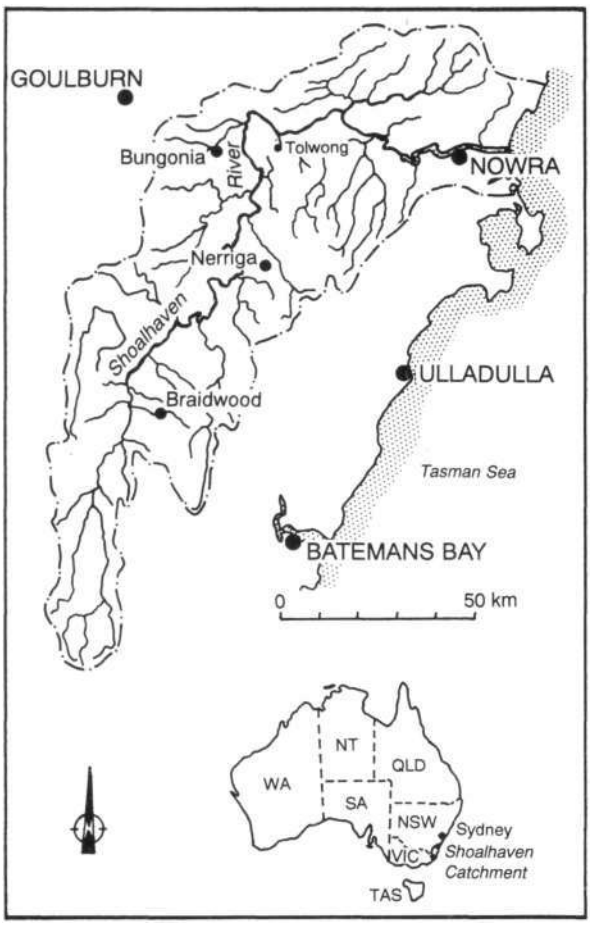
Most surprising, the upper walls of the gorge have receded at only 10 m in 30 million years! This estimate is based on the difference between the width of the gorge when the lava flowed over the top and the width of the present canyon. Not only that, the gorge was unusually wide at the beginning of downcutting. Jonathan Nott, Robert Young and Ian McDougall are mystified:

> *'. . . over the same 30 m.y. period there has been remarkably little retreat of the upper gorge walls. In comparison to its present width and depth . . . the gorge at 30 Ma was remarkably wide (approximately 2.5 km). . We have no definitive explanation for the dominance of vertical incision of the gorge over lateral retreat of the upper gorge walls since 30 Ma . . .'*[3]

At the rate of change measured by K-Ar dating,

> *'. . . it will take well over 100 m.y. before the entire* [Shoalhaven] *catchment develops a so-called youthful landscape.'**

Other studies based on basalt dating in the Shoalhaven catchment



Location of the Shoalhaven River catchment area south of Sydney, Australia.

have also come up with confounding results. For instance, Young and McDougall have dated basalts at about 45 Ma and discovered that there has been very little downcutting by streams (10-40 m in 45 million years) in all that time.[5] They calculated a slope retreat of 12-25 m per million years. Nott has corroborated these slow rates of stream incision.[6] In another study in the area, Young calculated a slope retreat rate of 18-28 m per million years, despite the present-day high rate of erosion.[7] These slow rates of past erosion have been used to justify the 'old', slightly eroded landscapes in Australia.[8]

The above slow rates of slope or cliff retreat contrast with the rate of coastal scarp retreat in south-east Australia calculated at 170 m per million years based on radiometric dating of basalt.[9] In another study, Ian Saunders and Anthony Young have gathered data on the rates of erosion, slope retreat, and cliff retreat from many environments, sources, and methods of measurement.[10] Since many of their rates are based on geological data, caution is needed to interpret their rates. Nevertheless, they estimate cliff retreat at between 10 m and 1 km per million years.[11] General denudation, defined as the mean ground loss from a river basin or area, is variably estimated at between 10 m and 100 m per million years for normal relief and 100 m to 1 km per million years for steep relief.[12] Many present-day denudation rates are based on river load, which are inaccurate, probably giving too slow a rate of denudation. Nevertheless, estimates of present-day and past denudation rates indicate much greater denudation and cliff retreat than reported by Nott, Young and McDougall, as well as others, for south-east Australia. Nott, Young and McDougall do admit that their denudation rate is at least an order of magnitude slower than expected.[13]

What are the so-called quantitative results of Nott, Young and McDougall telling us? Based on present rates of processes, their results indicate that the K-Ar method or landscape evolution models, or both, are way off. Assuming the gorge was only about 70 m deep when the basalt flowed over the rim, the observed data better indicate rapid gorge incision and retreat not that long ago.

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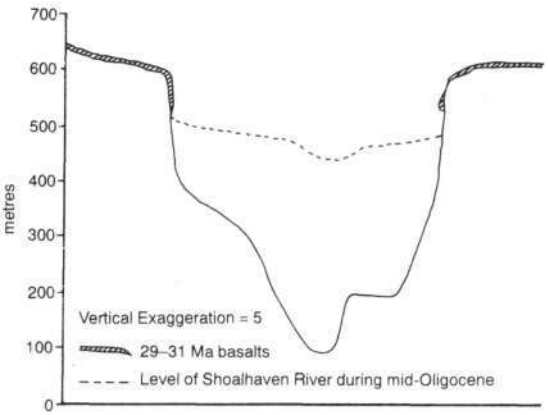
M. J. Oard



Cross-section of the Shoalhaven River Gorge between Bungonia and Tolwong showing the location of separate Oligocene basalt flows on opposite sides and the extent of post-Oligocene incision (erosion).