The Geomorphology of the kalamaluka-Tamar Valley

1. Formation of the Tamar Graben

The kalamaluka-Tamar Valley is the product of 200 million years of geological evolution.

The story begins at a time when the old super-continent of Gondwanaland began splitting up, Antarctica was separating from Australia and the Tasman Sea was opening up. Tasmania was very much in the middle of these two movements when the SE part of the Australian continental plate was being stretched both from north to south and from east to west.

About 180 million years ago, at the beginning of the Jurassic Period, the tensions created by these movements allowed lava to intrude through weaknesses in the crust and spread out below what are now the central, western and southern parts of Tasmania. It cooled slowly, well below the surface, to form a very hard rock called dolerite. Over the next 80 to 90 million years the rocks above the dolerite were gradually worn away until it was left as a hard erosion-resistant cap, which tops many of Tasmania's mountains today. To the east and west of the dolerite were the older rocks which still form the north east and western parts of Tasmania, including the Narawntapu Mountains.

From 95 to 65 million years ago the splitting of the Australian continent from Antarctica created a series of earth movements. There was a rapid uplift of Tasmania by some 1000 metres. Then earthquakes began to split up the dolerite capped plateau, creating a trough. This *graben*, stretched from central Bass Strait through central northern Tasmania into the Midlands, with high plateaux or *horsts* on either side. These are today the Western Tiers, and the Eastern Tiers of Ben Lomond, Mt Barrow and Mt Arthur.

The central trough was split into two main valleys, separated by a central horst. The rivers draining the mountains flowed into the valleys, creating two huge lakes, stretching from near Tunbridge out into Bass Strait, all of which was above sea level. Tasmanian geologist Samuel Carey named them Lake Tamar, which occupied the present valley of the South Esk and Tamar rivers, and Lake Cressy, which occupied the Norfolk Plains and entered the Bass Basin between Devonport and Port Sorell.

For the next 10 million years streams eroding the highland areas flowed into the lakes and deposited their sediments, filling the two lakes with clay, sands, gravel and boulders to a depth of up to 800 metres. About 47 million years ago these lakes were breached and drained, to create the Midland and Norfolk Plains.

The central horst is represented by the Hummocky Hills, near Epping Forest, Mount Arnon and the Devon Hills north of Perth and Longford, and the dolerite escarpment of the West Tamar. It was not continuous. There were areas where the two lakes joined and sediments completely buried the horst.

Today the Midland Plain stretches as far north as Evandale, Perth, Longford and Hadspen. Originally the plain stretched much further north down the Kalamaluka-Tamar Valley, and from west of Westbury to Port Sorell and beyond.

With the disappearance of the lakes, the South Esk River now drained the eastern side of the graben, while the Lake and Meander rivers drained the western side. Today the Midland Plain stretches as far north as Evandale, Perth, Longford and Hadspen. Originally it reached the graben much further north, down the kalamaluka-Tamar Valley and from west of Westbury to Port Sorell and beyond.

For the next 8 million years The South Esk River eroded down into the lake sediments, creating a deeper valley. The sediments were not consolidated into hard rock and much of it was clay. Undermining the slopes was easy and the river carried the debris downstream and out into the Bass Basin, which was well above sea level.

2. The Beginnings of the kalamaluka-Tamar Valley

The remains of the upper reaches of this valley can be seen north of Evandale. Today it is drained by Roses Rivulet. This insignificant little stream flows through a deep and wide valley to join the North Esk River at Corra Lynn. The valley is generally accepted by geologists as an early course of the South Esk River.

There is much evidence to support this. First, the deepness and width of the valley is far greater than this little creek could have accomplished. Secondly, the geological map of the area shows the same structure as the kalamaluka-Tamar Valley, with dolerite hills to the west and east. One fault line is the continuation of the Glen Dhu fault, which runs along the edge of the hill at Trevallyn and Riverside, and forms the western side of the valley. The eastern fault line continues along the eastern side.

3. The Diversion of the South Esk River.

So why does the South Esk River not flow that way today? The faulting which created the basin was followed by further volcanic action. Three major periods of vulcanism action occurred between 47 and 23 million years ago. The lava flowed onto the surface, cooling faster than the dolerite, forming a different rock – basalt. Volcanic action was not confined to the Lake Tamar Basin. It occurred in areas right across the north of Tasmania. Basalt flows completely blocked off the northern end of the Lake Cressy plains, diverting the Meander River towards the east to join up with the Lake River.

35 million years ago, lava erupted from a vent at the Cocked Hat Hill, near present day Breadalbane. It flowed to the south east, blocking the South Esk River near Evandale. The South Esk was diverted along the edges of the basalt barrier and the dolerite of the Mt. Arnon area as far as present-day Perth, where it was forced to flow south and west, eventually flowing into a tributary of the Macquarie/Lake River. Its waters joined those of the Macquarie and Lake Rivers, flowing down past present day Longford towards the headwaters of Cataract Gorge.

Evandale sits on the watershed between the South Esk River and Roses Rivulet. The valley of the rivulet is some 100 metres lower. At one point the divide is barely 15 metres above the South Esk, which is slowly eating its way towards the divide. In the 1929 flood it came close to breaching the divide and overflowing into Roses Rivulet. In a matter of a few hours, according to geologists, the river would quickly have carved a permanent course for itself through the soft sediments and continued on to once again join the North Esk at Corra Linn.

It is only a matter of time before another flood will see the South Esk overflowing into the valley of Rose's Rivulet and resuming its old course.

4. Cataract Gorge

Cataract Gorge is formed from dolerite. The combined rivers of the Midland Plain are here joined by the Meander River, which drains the entire northward facing tiers of the Central Plateau. Blocked by the basalt flows, these rivers overflowed the blocking hills and have been able to force their way through the dolerite north of Hadspen. They followed through structural weaknesses and widened them to create the gorge. Seeing the gorge in flood, one can easily understand how the river could have done this.

During floods the waters from the gorge are destructive and they bring a lot of silt into the estuary. Yet at other times they are not a major cause of siltation. The dolerite floor of the gorge resists erosion and at its head it acts as a dam, preventing the incoming rivers from carving deeper channels into the Midland Plain. Instead, for the last 35 million years they have meandered their courses across the plain, depositing much of their silt before they enter the gorge. As such, they are preventing the removal of sediments out of the Midland Plain into the kalamaluka-Tamar Estuary. Such would not be the case if the South Esk were to resume its ancient course. It would continue to eat into the Midland Valley, and siltation of the estuary would be considerably increased.

5. The North Esk River

The North Esk River has also been able to force its way through the dolerite into the Kalimaluka-Tamar Valley, by means of Corra Lynn Gorge. It has also captured many rivers flowing along the valleys of the foothills of Mt. Barrow, including the St Patricks River. On its approach to Corra Lynn the North Esk flows in an entrenched valley across the dolerite. It then plunges steeply through a short gorge to the bottom of the valley to join Roses Rivulet and become the main stream in the northern part of the valley. Near Killafaddy, south of Hoblers Bridge, the river becomes tidal. There probably were times when the river was tidal as far as Paterson Island at the mouth of Corra Lynn.

The high slopes of East Launceston, which form the western side of the North Esk Valley, are not dolerite but lake sediments They continue south through Kings Meadows and Young Town. Once that level would have stretched across the North Esk Valley to Ravenswood and St Leonards. They are drained by Kings Meadows and Young Town rivulets, which rise on the slopes of the western graben and flow through these suburbs to drain into the North Esk River.

A view west from across the North Esk from Ravenswood shows the valley of North Esk River, the steeply climbing hill of old lake sediments, and in the background a continuation of the dolerite horst on the western side of the graben. North from here, the kalamaluka - Tamar Valley floor has been eroded several hundred metres lower than of the Midland Plain. It is quite staggering to see how much sediment has been taken out of the valley and deposited out in Bass Strait. The sediments in Bass Strait are several hundred metres thick.

So why has the East Launceston – Kings Meadows area remained while downstream the lake sediments have been largely eroded away? The main reason is that one of the fault lines runs through this area parallel to the North Esk Valley, bringing dolerite close to the surface. The

Young Town and Kings Meadows rivulets cross the dolerite as they flow towards the North Esk, The harder rock prevents them from cutting deeper into the sediments. Sections of tis barrier can be seen at the Punch Bowl Reserve and in Young Town Park.

6. The Rivers Meet.

Two million years ago the kalamaluka– Tamar River was invaded by the sea to create an estuary. Sea levels have often changed since then and the kalamaluka-Tamar has alternated between being a river, where the sediments were eroded and carried out into Bass Strait, and an estuary where the sediments were deposited by tributaries into its waters.

At the mouth of the North and South Esk rivers is Invermay Swamp. It is a delta. Here the North and South Esk met the tides and the salt water and deposited much of their load of silt. The North Esk today is tidal further upstream, beyond Hoblers Bridge. The wide flood plain between Hobler's Bridge and Henry Street Bridge is part of the delta. There the expanse of flat land helps the rivers to slow down and deposit their silt. This is not anything new or created by mankind. It is the natural disposition of rivers and estuaries.

While the confluence of the north and South Esk rivers are regarded as the head of the Kalamaluka- Tamar, it is not the head of the river. The tidal wave continues up the North Esk River for another ten kilometres beyond this confluence, resulting in an abnormally long period of slack water before the tide turns. In prehistoric times a large amount of mud would have been deposited in the Mowbray Swamp and upper reaches of the estuary.

Many blame the mud and silt at the head of the Kalamaluka Tamar River on pollution of various kinds. There are memories of a deep yacht basin, and of a sandy beach. They were regarded as a gift of nature. History tells another story.

Surveyor Thomas Scott's map of 1833 shows the junction of the two rivers. The South Esk in those days left the Gorge and immediately flowed past mud banks and over rapids in the middle of what will is now called the Yacht Basin, before joining the North Esk. That river also flowed over rapids – a bar across its mouth consisted largely of gravel. Here the dolerite base of the graben is covered by sediments 70 metres thick.

In November 1804 William Paterson, while exploring the river, had to leave the brig *Lady Nelson* at Tamar Island, while he continued upstream in a longboat.

The river upstream from Tamar Island was naturally quite shallow. It was only the intervention of mankind, with dredging, that ships of any size were able to reach Launceston other than at high tide. Each year for more than 40 years the dredger *Ponrabbel* spent 40 weeks digging out this shipping channel and the yacht basin, having then to repeat the job each year.

7. The Upper Estuary

For the past 35 million years the kalamaluka-Tamar has gone through many phases. For much of the time it was like a normal river, eroding away its sides and cutting deeper as it flowed uncontrolled along its whole length. Its waters flowed into the sea several hundred kilometres beyond Low Head.

There were times when lava flows blocked the river, diverting its channel, protecting the sediments from erosion and creating a series of lakes, the remnants of which we find in the river's wide reaches today.

There were also times in the last 5 million years when the sea poured into the valley and drowned the river up to the Cataract Gorge; even further because at times the sea level was up to 25 metres higher than today.

For much of the upper part of the estuary the kalamaluka Tamar River is shallow. It meanders its way through flat land, consisting basically of sediments. On the eastern side the controlling fault system is complicated. The faulted blocks rise in ever higher steps towards the mountains. Some of these steps have been buried by the sediments. It is not until Dilston that the fault line marking the eastern boundary of the river valley appears. On the western side the valley boundary is clear. The Glen Dhu Fault, which we first saw at Hummocky Hill and Mt Ireh continues as an escarpment through West Launceston and down the western side of the valley as an almost completely uninterrupted escarpment to West Head at the mouth of the estuary.

It is not just the North and South Esk that flow into the kalamaluka-Tamar estuary. Many streams drain the dolerite hills. Cormiston Creek, Barnards Creek and Lady Nelson Creek have all cut their way through the dolerite hills, and have deposited their silt into the estuary. These streams have cut steep valleys and have mud banks and marshes forming deltas at their mouth where they have deposited their silt.

Mankind's attempts to control the estuary have largely met with failure. In 1912 the Hunter Report for the improvement of the port of Launceston recommended dredging a channel in Home Reach, cutting a canal though Barnes Point and the depositing of silt at Stephenson's Bend and the western side of Tamar Island. The aim was to straighten the river by diverting its water through an artificial channel. The "Hunter Cut" was a disaster. It had to be abandoned because it filled in as quickly as it was dug. Some of the mud on the western side of Tamar Island was also deposited from dredging by the dredge Ponrabbel. Despite 130 years of trying, the dredging of the upper estuary has failed to provide a permanent shipping channel or control silting of the river.

Tamar Island and the Legana peninsula are remnants of the old lake deposits that have managed to evade erosion. It is possible that the estuary as far downstream as Dilston may have been a lake dammed back by the Legana Peninsula at Freshwater Point.

Once around Freshwater Creek, the kalamaluka-Tamar behaves like a true river, meandering its way through width of the valley towards Swan Bay. The outer curve is eating away and eroding its bank, while the inner curve is receiving more silt. Here the river is still shallow. In colonial times Nelson's shoals was a place for livestock to be taken across the river.

8. **The Middle Estuary**

At Windermere the character of the river changes. About 32 million years ago volcanoes were quite active. Basalt up to 40 metres thick covered much of the sediments, protecting them from erosion. These caps still survive at Brady's Lookout and Grindlewald on the West Tamar and at Gaunt's Hill Windermere), and Murphy's Hill, (Hillwood), on the East Tamar.

These caps protected the remaining sediments of Lake Tamar, which remain at approximately the same height above sea level as the Midland Plain.

At Rosevears the river channel begins to deepen. Upstream from this point any channel for shipping was intermittent and in places quite shallow. Before 1921, when the *Ponrabbel* began dredging a shipping channel, the Melbourne to Launceston passenger ships had to wait here for high tide. To meet the timetabled rail connections, passengers would be transferred to river steamers and ferried to Launceston. The steamships would have to wait for high tide before continuing on to their berth. The reverse would happen if a vessel's departure was scheduled at low tide.

The second former lake stretches from Native Point to Whirlpool Reach. It was held back by a barrier of basalt lava on the peninsula that carries the Batman Highway towards the bridge. The barrier was eventually breached through Whirlpool Reach. Despite its size, the lake is quite shallow. The narrow channel of deep water traces the course of the river during t times when the lake was drained and it could cut down into the sediments.

The two halves of the reach are separated by Swan Point, a spit formed possibly after the river was drowned. It shows the effects of opposing currents and winds and the changes of the tide.

In many parts of this area the fault lines come close to the shore, A number of the rivulets flowing into the river have steep sides but they have mud flats at river level. They were sites of an extensive shipbuilding industry from the 1830s to 50s. The Supply River had an important flour mill, powered by water, which had a considerable export trade during the same period.

Beyond Hillwood the eastern fault line has been covered by lava flows, some originating from Murphy's Hill. They form a hilly landscape. Near Craigburn is a quite rugged area where the basalt forms steep cliffs ideal for rock climbing.

Whirlpool Reach is the first really deep section of the estuary. The strong flows caused by water rushing through such a restricted space, have scoured the channel quite deeply and there are sections up to 38 metres deep. On either side of the reach the water has a depth of 20 metres. The reach is fairly dangerous, not just because of the whirlpools, but because of large rocks in the channel.

Here too is the Batman Bridge, its asymmetrical shape illustrating a practical solution to a geological problem. The western side of Whirlpool Reach has dolerite rock, but on the eastern side there are soft sediments, The Bridge has been constructed so that all weight bearing is carried by the western side of the river.

9. The Lower Estuary

The lower part of the valley consists of five sections of old sediments - at East Arm, Rowella, Beauty Point, Clarence Point and Bell Bay/George Town. They are all at the same height above sea level, and were deposited in a lake, probably the original Lake Tamar.

They are at a lower level than the sediments of the Midlands Plain, but of the same age. However, the trough is deeper here, the sediments at Bell Bay reaching 250 metres below sea level. They were deposited more than 34 million years ago. Some of these deposits are later than the lava flows, so in places basalt has been buried in the sediments. This has helped preserve these areas from erosion, but also has also contributed to landslides, which prevail around the shores of much of this part of the river. Clay lying at river level has been washed out, leaving the heavier basalt above to collapse.

The basalt also controls much of the lower course of the river, channelling its way between Rowella and East Arm. The river then follows the now prominent eastern fault, known as the Tippogoree Hills, as far as Bell Bay. There is a deep channel in East Arm that keeps close to the eastern shore. The rest of the widening estuary is quite shallow.

Between Bell Bay and Beauty Point the estuary reaches its widest point. Three arms – East Arm, Middle Arm and West Arm join to form what Flinders called The Basin. It is the remnant of a lake formed after a basalt blockage of the original channel between Bell Bay and Clarence Point. Here the original lake breached its western wall. And flowed into the Bass Basin between West Head and Badger Head.

Eventually the blockages were breached, allowing the river to return to its earlier channel, which flowed between present day George Town and Clarence Point. It is a narrow channel similar to Whirlpool Reach. It has whirlpools and it is quite deep, in some places to 38 metres. From here the river flows towards the sea, through more recent deposits, largely wind-borne sand deposited over the last two million years.

We see the effect of the crust sagging we approach Bass Strait. The combined effect of stretching under the stresses of continental drift and the weight of sediments brought in by rivers caused the crust to sag. The sea invaded the Bass Basin about 20 million years ago and eventually poured into the kalamaluka-Tamar. The sagging may explain the lower heights of the five sediment plains. It may also explain the lowering height of the western and eastern dolerite mountains as they approach the coast.

The high Narawntapu Mountains west of the lower reaches of the valley are not part of the rift valley system. They are not dolerite, but of older, mineralised rocks, akin to those of Western Tasmania and the North East. Beaconsfield is also west of the dolerite hills,

The western dolerite edge of the basin becomes lower and lower, finally ending in Ralston Hill and Shag Head, Here the dolerite of the western escarpment is buried in the sediments, rising to form the Stockyard Hills behind Kelso, and finally ending at West Head. The eastern dolerite also disappears, forming Mt George and the Buffalo as a last gasp, before disappearing below the sediments and having a final show at Low Head.

10. The River Channel

The final part of this story deals with the effects of the Ice Ages on the river. Over the past 2 million years there have been at least three ice ages Each caused the lowering of sea level, draining Bass Strait and the estuary. In times of lower sea levels, the kalamaluka-Tamar River actively cut into the soft sediments, deepening its channel by up to 50 metres. This has provided a shipping channel which allows ships up to 40,000 tonnes and more to berth at Bell Bay and Long Reach. The channel is almost continuous upstream as far as Rosevears.

The river is also affected by unique tides. The configuration of the coast line brings the tide into the river in such a way that the tidal difference in the river is greater than at other places in Bass Strait. The strength of the tide is also remarkable. A 7-knot current makes it difficult for large ships to safely navigate the estuary except at slack tide.

The kalamaluka-Tamar heads out to sea past a series of reefs., The channel can be clearly seen on the charts as far out as Hebe Reef before it becomes indistinct. Did it ever join up with the Yarra? I doubt it. During the Ice Ages a lake formed in the centre of the dry land bridge. There is evidence of a delta where streams flowed into the lake from the south, but no evidence of an outlet. It was like Lake Eyre. Moreover, there is an underwater rift valley between the Otway Coast and north of King Island, through which the Yarra River probably did flow.

Conclusion

It is important that we understand that the kalamaluka-Tamar is not really a river, but an estuary. It does not follow the same erosion and depositing cycle of a normal river. We must not lay too much blame on the farmers of the Midlands for our silt. Cataract Gorge and Corra Linn both act as natural dams, causing the main tributaries to deposit much of their silt before entering the estuary. It is not only the North and South Esk rivers that bring silt into the valley. Other streams on both sides of the valley that are also bringing in silt. Tidal influences also are distributing the silt over the entire estuary.

Attempts by humans to control this have been fairly futile. The Hunter Cut and dredging the upper reaches of the estuary are examples of that. Moreover, artificial changes to the course of the river have unintended consequences throughout the entire estuary. We Many estuaries throughout the world have seen disastrous and unexpected consequences from human attempts to control them. We have to be very careful what we do.

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