'Geo-Log' 2013

Journal of the Amateur Geological Society of the Hunter Valley

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President's Introduction.

Hello members and friends,

Every year seems to be more successful than the last and 2013 was no exception. Our membership reflects a continuing enthusiasm amongst the general community for the earth sciences and related activities. A background in geology is never a requirement for acceptance into the Society and every member is strongly encouraged to take part regardless of their level of knowledge.

Although the original aim of our Society was the exploration and understanding of Hunter Valley geology and how it defines landforms and other aspects of natural history, we continue to widen our coverage well beyond the confines of the Hunter Region. Despite this it is becoming increasingly challenging to include new activities in the program each year. But our membership is growing and new members bring new ideas and new experiences from which everyone can benefit. Occasionally old areas are revisited, either for the benefit of new members or where the availability of new information has allowed a greater understanding of an area, as was the case in this year's Diamond Head excursion. Sadly two trips had to be cancelled this year due to unforeseen circumstances. A return to the Stockton sand dunes was thwarted when the leader became unavailable and in November the planned visit to Burragurra and Yengo National Park was prevented by bushfires and floods (yes on the same day). The scheduled walk up Alum Mountain was replaced by a weekend trip to the Warrumbungle National Park to witness the new geology revealed by the Wombelong Wildfire and subsequent floods last January after Barry Collier had spoken to Warrumbungle Shire Mayor Peter Shinton. Alum Mountain will be rescheduled once access over the new Buladelah By-Pass has been completed.

Our first extended field trip covering the geology of the Flinders Ranges in 1995 was so successful that similar trips have since taken place annually. This year's program included a nine day exploration of the geology and landforms of Flinders Island in Bass Strait. We found this to be a place of diverse and spectacular scenery despite its relatively simple geology, but the best this island has to offer can only be appreciated by exploring it on foot. However, a few participants found Mount Strzelecki more challenging than expected!

Very special thanks go to the Social Committee for their rarely acknowledged input at events throughout the year, especially the soup and slides night and the Christmas meeting. Thanks to Sue and Ian Rogers who made their home available for the Soup and Slides night and to Lyn and Brian Stocker who hosted the Christmas social. Grateful thanks also to our Treasurer Leonie Mills who diligently keeps our finances in order and who also bore the brunt of preparations for our Flinders Island trip without complaint. Our Secretary Ian Rogers continues to get our very informative newsletters out in plenty of time for members to plan ahead and also oversees the Society website which provides a window into our activities and continues to attract much interest.

Thanks to those members who took part in organizing and running our activities and who contributed to this journal and especially to Life Member Ron Evans for his determination and dedication in putting together another great addition of the Journal that we can all be proud of and which continues to draw accolades from both the scientific community and general public. I believe it has become the best journal of its type in Australia.

With very best regards,

Brian.

Pinny Beach

Saturday 12th January 2013

Leader: Chris Morton.

Attendance: 18 members; 1 guest.

A hot, humid summers day of around 37°C greeted our members for our excursion this afternoon, but with a promised cooling southerly change predicted, our members were eager to continue with our adventure.

It is assumed that the rocks exposed here belong to the Reid's Mistake Formation, which represents the stratigraphic interval that separates the Lower and Upper Pilot Seams.

The stratigraphic succession in the excursion area consists of the Lower Pilot Seam in the rock platform, Reid's Mistake Formation in the cliff fronting the coast and the upper Pilot Seam in the upper part of the cliff. The escarpment above comprises massive conglomerates and sandstone layers belonging to the Belmont Conglomerate Member. These rocks lie within the Boolaroo Sub-Group of the Newcastle Coal Measures.

Many coalified and silicified tree stumps protrude from the top of the Lower Pilot coal into the overlying tuffaceous rocks and have been preserved in growth positions. Preservation of these fossil trees was recorded by Edgeworth David who suggested *"The oldest forest growth which went to form the lowest seam, was killed off suddenly by being buried under dense showers of volcanic ash "*.

The Reid's Mistake Formation consists of vitric to crystal tuffs in thin blocky beds. The bedforms preserved in this sequence include parallel lamination, ripple bedding, mega-ripples and massive beds. These convoluted tuff beds were laid down around 275ma and came from volcanoes located around 20 km off the present day coast.

Greetings, warnings and a brief summary of the geology of the area complete, we set off in a southerly direction past the controversial Murrays and Pinny Beach development site. Along this track the keen observer can find abundant fossils and one of our group did find a very nice rock with *Vertebraria (Photo 1). T*his was passed around while we spoke for a short time on the proposed housing development that has been the subject of so much debate and controversy. Then as predicted the southerly change came through, dropping the temperature to a comfortable 25°C.

1. Vertebraria, a plant fossil.

We continued south down onto Pinny Beach to where anchoring points for a wire, which was used for mining gravel from the surf zone and the beach were located. The gravel was used for decorative concrete. These anchors are embedded into the rock platform central to the beach and the rock shelf cut by wave action on the southern headland. A short time was spent discussing the origin of the gravel and the stratigraphy of the area *(Photo 2)*. A short walk to the north brought us onto the rock platform, where fossilised tree limbs and stumps (probably the species *Dadoxylon*) are found *(Photo 3)*. This proved to be very time consuming as many features demanded explanation. Eventually we moved further north onto the headland that overlooks the coastline.

The vistas to the north and south are magnificent and worth the walk alone. At this point there is a great view of Spoon Rocks, where there was a failed operation in the 1970's to build a breakwall to form a deep-water entry for the transport of local coal by boat. A local entrepreneur by the name of Art Mawson (said to be grandson of Douglas Mawson the famous Australian geologist and explorer) quarried the rocks for the breakwall from the escarpment behind the beach. Art is said to have run into trouble with the local authorities, which in the end saw the project run out of money and not be completed.

2. Conglomerate, as it erodes, forms gravel beds.

4. NE facing cylindrical siderite structures.

Jo Taylor, one of our members who is living in the Caves Beach area, pointed out an unusual feature on the rock platform below that had everyone intrigued. The structures consisted of reddish brown, long cylindrical structures all aligned in a north-easterly direction, as if someone had laid a series of telegraph poles on the rock platform *(Photo 4)*. This seemed most unusual and deserved closer investigation. A short walk down the stairs to an eroded track that led us onto the beach was soon completed.

The rock platform on the southern side of the breakwall is very interesting, comprising vitrified tuff formed from the base surge of a pyroclastic flow *(Photo 5)*. There are many silicified and coalified tree trunks protruding from the Lower Pilot Seam (which underlies the tuff). These have been preserved in growth positions *(Photo 6)*. The tuffaceous rock has been eroded by wave action, creating some very interesting patterns that kept the photographers in our group enthralled.

From the rock platform looking back northwards to the quarried cliff face, the Upper Pilot Seam that overlies the Reid's Mistake Formation can be clearly seen. Overlying the coal seam is the quarried conglomerate that was used for the breakwall. This area is now swathed in Bitou Bush or Boneseed.

A little further south on the rock platform are the strange features that we could see from the top of the escarpment. The rock platform proved to be an eroded continuation of the base surge pyroclastic flows and ash fall underlying the Upper Pilot Seam. This section could be seen in the cliff face just north of the rock platform *(Photo 7)*.

The cylindrical features that we could see from above the escarpment appear to be situated between two base surge events and have an orientation of 30°, with the volcanically derived material coming from the southeast. The ash fall and coal seam that overlaid these strata is still evident a short distance away and has fossilised tree stumps in situ. A very nice end view of fossilised Vertebraria was also noted. There have been a number of core holes drilled in the ash fall and the base surge strata, suggesting that studies on paleomagnetism have been carried out in the past.

After spending so much time examining, discussing and trying to explain this strange phenomenon, we noticed that time had passed us well and

3. Wood petrified by both silica and siderite replacement.

5. Convoluted vitrified tuff, a base surge deposit.

truly by and we had only completed a third of our planned walk. So it was decided that we should postpone the rest of the activity to a later date and adjourn to John and Alison Hyslop's house where they had generously volunteered their home to our weary explorers for some prearranged refreshments and a chance for some friendly banter and discuss the days proceedings.

Thank you John and Alison! Also to Jo Taylor for her directions in finding many of today's features and to Brian England and Winston Pratt for their valuable time in returning to the area for further investigation.

Chrysanthemoides monilifera:

There are two subspecies of Chrysanthemoides monilifera: bitou bush (subsp. rotundata) and boneseed (subsp. monilifera).

Bitou bush is an introduced plant in NSW. It was planted widely along the NSW coast between 1946 and 1968 to reduce dune erosion, but spread rapidly. It is now found along 80% of the state's coastline. The north coast, in particular, is heavily infested. In some cases, the weed has spread up to 10 kilometres inland. Bitou bush is also listed as 'noxious' in all coastal districts

Boneseed, a closely related species to bitou bush, is also a weed in NSW. However it is only established in a small number of areas, including Sydney and the Hunter regions. It grows 2-3 m tall, has toothed edges to its leaves and flowers with 4-8 petals (bitou Bush is a sprawling 1-2m shrub, has smooth leaves and flowers with 11-14 petals).

Native to South Africa, bitou bush invades native coastal heathlands, grasslands, woodlands and forests. It grows quickly and forms dense stands, replacing native plants and destroying the habitat of native animals. Numerous threatened species and plant communities have been affected.

6. In-situ petrified tree stump within a tuff deposit.

7. Convoluted base surge, ash fall and Upper Pilot Seam exposed in a cliff behind the rock platform.

Report by Chris Morton and reviewed and edited by Brian England.
Photographs by Ron Evans and Brian England (8 and 9).

References:

Geo- Log 2010, p9.

NSW ENVIRONMENT AND HERITAGE; Bitou Bush and Bond Seed.

http://www.environment.nsw.gov.au/pestsweeds/BitouBush.htm

Spoon Rocks Platform Re-visited.

Chris, Winston and Brian returned to Spoon Rocks a few weeks later to have a more detailed look at those enigmatic structures. Their findings are outlined below by Brian England.

"The structures bare no relationship to any joint sets we could see and show no branching indicative of intersecting joints. Some of these structures reach 15 metres in length and complete bodies have spindle-like terminations. All are either circular or horizontally oblate spheroid in transverse cross-section and appear to have been torn from a single once-continuous sheet, remnants of which are present on the southern end of the outcrop (Photo 8). These remnants actually show pull-apart structures which have the appearance of boudins in horizontal section, but they are not boudins.

The structures are a mixture of major siderite (iron carbonate) and minor evenly dispersed calcite (calcium carbonate) so may be a chemical precipitate from river or sea water caused by a change in pH and/or temperature. Carbonate grain size is uniformly sand-sized throughout the bodies and they contain no bedding

structures, but do contain occasional concentrations of plant remains. All occur at or very close to the interface between an initial base surge layer and a second overlying base surge deposit (Photo 9), which was followed by an ash fall layer, then coal (the Upper Pilot Seam). So the originally continuous putty-like carbonate layer could have been torn apart and the fragments rounded by the very abrasive and turbulent second ash flow to produce the structures we see today. That would also explain their parallel occurrence, unassociated with joints. The host tuff contains disseminated particles of carbonate, which may or may not have resulted from abrasion of the structures. More work, including rock thin section and XRD studies, needs to be done at this locality to prove or disprove this hypothesis".

Additional Report: Brian England.

8. Remnant of once continuous siderite sheet

9. Siderite layer at the interface between base surge deposits.

Seal Rocks
Saturday 16th February 2013

Leader: Barry Collier.

Attendance: 15 members.

On 16th February, I headed for Seal Rocks with much trepidation. The weather bureau forecast was for 5 successive days of showers, with the 16th supposedly the wettest. I had contacted Brian to see if he thought it should be postponed, but he said "don't worry, they will all have raincoats".

Participants turned up at No. 1 Beach for morning tea in cloudy conditions with a shower passing close by. It then started to clear and by lunch time we were enjoying the most beautiful, cloud free conditions. Somebody up there likes us. I looked at the radar next morning and thought they would have had at least 50mm the following day.

As it was Seal Rocks and some had not been there before, we headed for the lighthouse, with spectacular views of the coastline both north and south. While there, we met the caretaker who said that the seals had just about disappeared, but were showing signs of returning.

Immediately west of the lighthouse was a spectacular gorge opening into a basin with a tunnel going right through the headland. I had intended leading the more experienced walkers down to the western end of the basin, but then we found a well worn track down to the eastern end of the basin, so most people were able to go down for some interesting rock formations and a closer look at the gorge and the tunnel *(Photos 1 & 2)*.

We then headed to Treachery Head *(Photo 3)* and had lunch in the carpark at the head of the public track out onto the headland. After lunch we walked out to the end of the headland, where the fitter members climbed down to near the water's edge and found some spectacular tessellation *(Photo 4)*.

The remaining end of the headland was then explored before we returned to the cars, with a detour to twin gorges on the southern side of the headland, one of my favourite fishing spots back in my fishing club days, 50 years ago.

It was then decided to head out to Yagon Head. There are some amazing seashell fossils on that headland, but they are on the northern side, while the only track leads out to the southern side. However, we were able to find a number of fossils including a spectacular crinoid fossil *(Photo 5).*

From there it was back to home after a very enjoyable day with spectacular weather and views *(Photo 6).*

Report by Barry Collier.
Photographs by Barry Collier.

3. Tilted strata at Treachery Head.

1. Gorge below Seal Rocks Lighthouse.

4. Unusual tessellations at Treachery Head.

5. Fossil (mould) of a crinoid stem, Yagon Head.

2. Tunnel below Seal Rocks Lighthouse through folded strata.

6. Sugarloaf Point from Treachery Head.

Fingal Head to One Mile Beach

Saturday 9th March 2013

Leader: Brian England.

Attendance: 23 members.

Participants assembled at the car-parking bay in Anzac Park, opposite the retirement village in Shoal Bay Road Shoal Bay, at 10am. Following the traditional bring-your-own morning coffee and an introductory talk on the nature and geology of the area *(Photo 1)* to be covered by the day's walks in Tomaree National Park, the group drove off in convoy down Government Road past Fingal Bay township to Pacific Drive on the southern side of Fingal Bay.

Almost directly opposite the Squire Street intersection the track out to Fingal Head was found leading over a large log and off through the dense coastal forest. Here it was pleasing to see that National Parks had carried out significant track upgrading, including the addition of signage and track maps.

A short diversion to the edge of the bay was made a few hundred metres in to overlook a spectacular narrow deep chasm carved back into the coastal cliff by marine erosion along a fault *(Photo 2)*. Out on Fingal Head there were superb views to the north over Fingal Bay, Fingal Spit and Yacaaba Head. Carefully climbing down onto the exposed rocky headland we were able to closely examine the ignimbritic nature of the Nerong lavas and various stages in the development of boulder beaches from joint blocks plucked from the adjacent sea cliffs *(Photo 3)*.

Apart from occasional sandy beaches, the coastline from Tomaree Head south to Morna Point comprises rocks of the Nerong Volcanics within the Carboniferous Kuttung Series. Pleistocene bedrock-mantling dune sands obscure much of the solid rock geology away from the narrow coastal strip.

2. Cobble beach formed in a chasm eroded along a fault.

The Nerong Volcanics comprise dacitic ignimbrite containing phenocrysts of quartz and K-feldspar with large weathered lithic fragments and rare large (>1metre) mafic blocks metamorphosed to epidote/chlorite greenschist. There is lesser toscanite (rhyodacite), hornblende andesite, mudstone, tuffaceous sandstone and conglomerate. In the northeast these volcanics grade into dacitic pebble to cobble conglomerates, due to erosion of the volcanics in the south. In peripheral areas the Nerong Volcanics are absent from the sequence due to erosion.

The Nerong Volcanics are the only real expression of genuine Carboniferous volcanic rocks that possibly represent a Devonian-Carboniferous magmatic arc forming part of the southern New England Orogen (Buck, 1988). Based on U-Pb radiometrics the age of the Nerong Volcanics can be given as 338.6 +-3.8 Ma (Roberts, et.al., 1995).

1. Brian outlining geology of area.

3. Admiring the views from Fingal Head.

The ignimbrite lavas were erupted from the Port Stephens Volcanic Centre on the Stroud Platform, a region of shallow water cross-bedded marine sands which developed into a continental domain as volcanism spread into the region. This volcanism followed widespread uplift in the region.

The Nerong Volcanics are overlain by cross-bedded quartzose or lithic sandstone (the Booti Booti Sandstone) derived by their weathering and deposited by a northeast-flowing river system which was retreating in the face of a marine transgression.

Underlying the Nerong Volcanics are sandstones of the Conger Formation, which in turn are underlain by the Wooton Beds, which were examined in detail on the Seal Rocks excursion.

Differential weathering of the minerals in the ignimbrites along the shoreline has left the quartz and feldspar phenocrysts standing proud of the surface, giving both fishermen and walkers a non-slip surface to walk across. Jointing in the rocks has formed bold blocky outcrops, which are a prominent feature along the coastline. Above the surf zone there are large expanses of smooth flat rock formed by exfoliation, caused by expansion and contraction induced by changes in temperature. This process results in thin flat sheets of rock lifting away from the surface. Within the high energy surf zone mechanical erosion by abrasion and hydrostatic pressure along joints releases blocks of the ignimbrite which roll around in the surf over time to produce rounded boulders which during storms are thrown up along the shoreline to form some of the finest examples of boulder beaches to be seen anywhere.

Before returning to the vehicles some in the group ventured south along the coastal track, but it showed no sign of providing access to the coast and so was abandoned after a few hundred metres. Back down Pacific Drive at the magnificent Barry Park, where shelters and gas barbecues are provided for picnickers, we sat around and enjoyed a leisurely lunch overlooking the bay, Fingal Spit (now covered by a rising tide) and the islands of Cabbage Tree and Boondelbah beyond to the north. All the while we were watched by in eager anticipation by a large goanna, ready to make a raid on any food left unattended.

Lunch over, we drove down Boulder Bay Road to a point midway between the last house and the sewerage treatment works at the end of the road. Here the Tomaree Coastal Walking Track continued off to the south through beautiful bushland developed over the coastal sand dunes. Several unofficial sidetracks were found leading off through dense scrub to spectacular bare coastal outcrops of the Nerong Volcanics, which provided the photographers with plenty of opportunities. The low rocky headlands along this stretch of coastline are interspersed with text book examples of boulder beaches *(Photo 4)*, some showing crude lateral sorting of boulders reflecting decreased energy as storm waves moved inland. Despite the many small inlets there is a complete absence of sandy beaches until Samurai Beach is reached, some 3 kilometres west of Boulder Bay as the crow flies.

We hadn't intended to walk the entire distance, but were enjoying the walk so much that Big Rocky Island *(Photo 5)* was eventually reached 3 kilometres from Boulder Bay Road. This section of the coast is especially scenic with probably the most extensive boulder beach in the region, beyond which unusually high sea cliffs (for this area) displayed well-developed columnar jointing in the volcanics *(Photo 6)*. And the sun was in just the right place for the best photographs.

4. Boulder Bay from Big Rocky Walk.

5. Big Rocky Island.

6. View north from Big Rocky - columnar jointing in rhyolite

By 4:15pm the group had retraced the path back to the vehicles and with some hanging out for coffee, a brief stop was made at Murray's Brewery on the way home.

Report by Brian England.
Photographs by Ron Evans.

References:

BUCK, M.D. (1988). Lower Carboniferous Ignimbrites in the southern New England Orogen. *Department of Earth Sciences, Macquarie University, Sydney (Unpublished).*

HASHIMOTO, T.R. and TROEDSON, A.L. (2008). Nelson Bay 1:100 000 and 1:25 000, *Coastal Quaternary Geology Map Series. Geological Survey of New South Wales, Maitland.*

ROBERTS, J.; CLAOUE-LONG, J and JONES, P.J. (1995). Australian Early Carboniferous time. In: BERGGREN, W.A. and KENT, D.V.; AUBRY, M.P.; HARDENBOL, J. (Editors). *Geochronology time scales and global stratigraphic correlation. Society of Sedimentary Geology (SEPM), Special Publication, 23-40.*

Stratigraphy of the Eastern Myall Block. In: *Geology of the Cumberland, Dungog and Buladelah 1:100 000 sheets.*

The Wollombi Valley and the Great North Road

Saturday 4th May 2013

Leader: Winston Pratt.

Attendance: 11 members; 5 guests.

On Saturday 4th May 2013, a crisp morning heralded a fine sunny day and 11 club members and 5 visitors set out from the village of Wollombi.

Geology.

The geology of the excursion area is relatively simple. A plateau of Triassic Narrabeen Group fluviatile sediments, capped by a veneer of Triassic fluviatile Hawkesbury Sandstone, has been dissected by the valleys of the North and South Arms of the Wollombi Brook and their tributaries.

The floors of these valleys are covered with Recent deposits of unconsolidated sediments, mostly sand and silts.

The Narrabeen Group sediments in the Wollombi Valley area lie between the massive sand and conglomerate Munmorah and Widden outwash fans from the New England Highlands with additional input from the more quartz rich detritus from the Lachlan Fold Belt in the Widden fan. In the Wollombi Valley area the sediments, being distal to the outwash fans, are finer grained and comprised predominantly of massive to thin bedded lithic to quartz sandstone with minor interbedded conglomerate and siltstone.

Geomorphology.

Both the South Arm and the North Arm (including its Congewoi Creek tributary) of the Wollombi Brook initially flow northwards. However at Paxton, the North Arm, instead of veering to the north-east through the relatively low country via Pelton and Bellbird to the low country near Cessnock and onto the Hunter River, veers north-west through much higher ground to Cedar Creek where it then veers south-west through a deep and narrow gorge to join the South Arm at Wollombi. The now combined Wollombi Brook then continues northwards through 10 km or so in a deep and narrow gorge before opening out onto more open terrain near Broke. The seemingly easier route through Cessnock traverses the nose

of the south plunging Lochinvar Anticline, a significant structure which was active in the Late Permian. The present configuration suggests that the Wollombi Brook has been flowing in its current route possibly prior to the uplift of the Triassic strata. This is a similar situation to that which occurs in the Nepean River upstream from Penrith where the river enters a narrow gorge cut into the Lapstone Monocline before re-emerging into the lowlands of the Cumberland Basin.

'Yellow Billy's' Cave.

The excursion commenced with a drive along the Wollombi–Millfield Road which follows the North arm of the Wollombi Brook. The first stop was to view 'Yellow Billy's' cave from the roadway.

William (Yellow Billy) White was a 24 year old part aboriginal stockman form Howes Valley (on the now Putty Road). In August 1863 someone broke into the dilapidated Wollombi Courthouse and stole 20 pounds in cash. Yellow Billy was suspected, arrested and held in the Wollombi Lockup, located at the rear of the courthouse, prior to being sent to Maitland for trial. On the night of 10 August 1863, Yellow Billy set fire to the wooden door surrounds of his cell. The fire loosened the metal bolt and cover. Now out of his cell he dug through the back of the chimney in an adjoining room and escaped to begin his bushranging career with an armed holdup of two drovers at Reedy Creek. He was later captured and put back in the Wollombi lockup. This time he removed a slab from his cell wall and climbed the outer fence. However he was recaptured by the police before he could reach the cover of the bush. Yellow Billy was tried at Maitland for the theft of the police horse and sentenced to two years with hard labour. After his release he returned to the Hunter Valley and in October 1865 continued his bushranging career with the holdup of Watts Inn at Warkworth. Yellow Billy often hid in a cave on the Wollombi–Millfield Road. The cave was quite large inside but had a narrow entrance which can now be seen from the road *(Photo 1)*.

Many more incidents followed although some attributed to him were committed by other criminals. Eventually on November 2nd 1866 he was recaptured by the police and sent to the Wollombi lockup. However the new sandstone courthouse and adjoining cells had been completed and there would be no escape. The following year he was found guilty of committing armed robbery and sentenced to 20 years in prison. The exploits of other bushrangers active in the area, including the 'Jewboy Gang' were also mentioned.

Thomas Budd's Headstone.

The next stop along the same road was to visit the headstone of Thomas Budd *(Photo 2).* Thomas Budd was born in 1792 in London, England. On October 1st 1805, at the age of 13, he joined the 31st Regiment of Foot of the British Army. From 27th to 29th July 1809, during the Peninsular War theatre of the Napoleonic Wars, an Anglo-Spanish army was engaged in the Battle of Talavera, against French occupied Madrid. Thomas, aged 17, and his 31st Regiment were heavily involved in this battle, as well as many

1. Entrance to 'Yellow Billy's' cave.


2. Headstone of Thomas Budd.

other battles. There were very heavy casualties on both sides with many hundreds being burnt to death when a grassfire ignited by the cannon and musket fire raced across the battlefield. The end of July is the hottest and driest time of the year in Spain.

In about 1814 Thomas married a young Spanish lady from San Sebastian, Sophia Hozapha Bosquete. Thomas later served in Canada then Sydney where his first son, Thomas William, was born. He then was transferred to Madras, India. Returning to England, he was discharged in July 1826 possibly with the rank of Corporal, although his headstone cites him as Sergeant. His daughter Sophia was born in 1826 at Chatham, Kent, England. Thomas and his wife and children then migrated to NSW where his next daughter, Elizabeth was born in 1829 at Newcastle. Thomas was granted a Soldier Settlement block of about 100 acres in the Wollombi Valley on the North Arm near Sweetmans Creek. He named the block 'Talavera Grove'. These were the first Soldier Settlement blocks in Australia and Hozapha was one, if not the first, women who became known as 'war brides'.

The couple's remaining children, Matilda, Benjamin and Thomas who was born in 1833, were all born at Wollombi.

Also in 1833 Thomas Budd (snr) was listed in the NSW Almanac as a schoolmaster. Unfortunately Thomas was killed that year by falling into a well and his grave is at 'Talavera Grove'.

3. Wollombi Public School (1881).

In 1835 Hoszapha was remarried to William Sweetman who owned a nearby property. The couple had no children. Hozaphia died in 1868 at Millfield and is buried in the Wollombi Cemetery as is her second husband William Sweetman, and her youngest son, Thomas, who was unfortunately drowned in a flood at Laguna at the age of 27 years.

Wollombi Public School and Residence.

The earliest school in Wollombi was a church school and was not housed in a proper schoolhouse. The earliest known schoolteacher was Thomas Budd who is recorded in the NSW Almanac of 1833, the year in which he tragically died. Several denominations ran church schools, some receiving Government assistance. The first government school was opened in 1852, closed the following year, then reopened in 1855 and has remained open since. The first government school building was weatherboard and was flooded in 1857 which led to the school being relocated to higher ground. The present sandstone school, together with the school residence, was constructed in 1881 *(Photo 3).*

The Great North Road.

The group then returned to Wollombi and headed up the South Arm of the Wollombi Brook along the Great North Road.

The Wollombi Valley was significant for agriculture because of its permanent water supply. During a drought in the early 1820's Europeans found ways to drive livestock into the Valley and its tributaries shortly before the Great North Road was built.

The Great North Road was built between 1826 and 1836 and extends 240 km from Sydney to the Hunter Valley. The Colony of New South Wales was expanding rapidly by the early 1820's and more good arable land was needed to supply food for the colony. While suitable land was available in the Hunter River Valley, it was a slow journey from Sydney to the Hunter River by sailing ship, particularly as the colony's livestock was being concentrated more in the fertile lands between Parramatta and Windsor.

In 1825 Assistant Surveyor Heneage Finch surveyed a suitable road route which followed, in many places, routes used by the local aborigines along the ridge lines. Governor Darling assigned convict gangs to build the Great North Road and by 1833 it was almost completed. However the ridge lines were often

desolate, remote and lacked and feed water for travelling stock. An alternative route to bypass this section by using the MacDonald River Valley became more popular with the local graziers and travellers.

In 1832 the first steamships began replacing the sailing ships, making the sea journey to the Hunter River much faster and safer. Fifty years later the railway was opened and in 1930 the Pacific Highway was opened. By the time the Great North Road was completed it was quickly becoming redundant and the more remote section from Wisemans Ferry to Bucketty had little usage and fell into disrepair. The section from Bucketty to Wollombi however became an important road for the local settlers as a road branched at Wollombi to Wallis Plains near Maitland and the Hunter River port of Morpeth. Further north the Road branched at Broke to Patricks Plains (Singleton) or Jerrys Plains. Between Bucketty and Broke the road still follows, apart for a few realignments, the original route and some of the original construction can be seen.

The excursion route to Fernances Causeway, the southernmost stop, passed some side roads with historically significant names.

The Side Roads.

Milsons Arm: Named after James Milson, a successful farmer, who arrived in the Colony in 1806. By 1829 he owned 355 ha of several properties, including 20 ha at Wollombi. He worked this property, 'Byori' at Wollombi with his sons and assigned convicts. His eldest son James became one of Sydney's most progressive businessmen and was one of the founders of the Milsons Point Ferry Co. of Port Jackson.

Blaxlands Arm: Named after John Marquet Blaxland, the nephew of Gregory Blaxland who with Wentworth and Lawson found a route over the Blue Mountains. John Blaxland found a more practical route for cattle from Windsor to the Hunter Valley. The route was about 40 miles shorter, of easier ascent and had better water and feed. The route crossed the Colo River at Howes Track and headed north-east along the Wheelbarrow Ridge to the MacDonald River. The route then ascended to a ridge following the aboriginal Boree Track and then descended through his own property at Laguna to the Wollombi Brook and along the valley to Wollombi.

Murrays Run: Named after Andrew Murray who, along with James Milson and John Blaxland brought cattle here in 1822. They swam the cattle across the Hawkesbury River and headed across country to this area. Andrew Murray was granted title in 1833.

Dairy Arm: Richard Wiseman, son of Solomon Wiseman, received a land grant at Dairy Arm for helping find the route north from the Hawkesbury River and he later bought Laguna House from Heanage Finch, Assistant Surveyor who was in charge of construction around Bucketty and Laguna in 1830-31.

The excursion turned around at Fernances Causeway and headed back towards Wollombi visiting features along the way.

The Roadway Construction Features.

Fernances Causeway: This has now been bypassed by road realignment and has been covered by more material to provide farm access.

Fernances Culvert: This culvert was constructed in 1830 and has a single stone lintel with an arch carved into the block for the outer 300mm, then tapers down for the centre 300mm to the original flat base of the block for the inner 300mm *(Photo 4)*. This is unlike the Murrays Run culvert which has an exit arch formed from 10 long blocks tapered in cross section to the radii of the semi circle of the arch. These blocks are called 'voussoirs'. Originally it was thought that the Murrays Run Culvert was the only culvert on the road built in the style. However recent investigation has shown that the Fernances Culvert was also constructed in this style but the exit of the culvert was subsequently widened by 3 metres, probably about 1850, thus concealing the original voussoirs. The voussoirs were discovered by an investigator crawling inside the culvert.

4. Fernances Culvert with single block lintel (1830).

Murrays Run Culvert: This culvert, together with Fernances Culvert and Thompsons Bridge, was constructed by Road Gangs 25 and 27 and Iron Gang 7 and overseen by the notoriously harsh John McDougall *(Photo 5).*

Thompsons Bridge: Originally 33 bridges of many different sizes were built, their timber decks often supported by elaborate stone foundations. The few which remain are the oldest bridges in mainland Australia. The existing timber on this bridge is obviously not the original *(Photo 6).*

6. Thompsons Bridge with original stonework abutments.

Historic Buildings between Fernances and Wollombi Village.

Laguna House: Laguna House was built on land originally owned by Heneage Finch and later sold to Richard Wiseman. While there is some contention as to whether or not it was built before or after Wiseman bought the property, it was constructed, using convict labour, between 1831 and 1834 and remains the oldest existing stone building in the Wollombi Valley *(Photo 7).* The single story Georgian cottage is of stone tooled to a smooth face and features a raised sandstone verandah that shelters three sides of the house. The roof of this verandah is supported by stone columns. The house has a separate kitchen and outhouse, probably a dairy, and a cellar underneath. Laguna House is private property and is currently occupied.

St Mark's Church of England, Laguna: St Mark's Church of England at Laguna was built in 1884 and most of the timber used in this building is cedar. The cedar is believed to have been donated by local timber getters who would locate the cedar trees growing in the moist and protected deep gullies of the local Wattagan Range by spotting their distinctive colours from the ridge tops *(Photos 8 & 9).* The church was built on the site of the old schoolhouse which had been used as a school, church and post office for about 30 years.

Laguna Public School: A Public School was built on the present site in 1872. The building was of timber and consisted of ironbark slabs (9′ long) on sleepers, roofed with shingles of the same material and floored with sawn spotted gum or stringybark. Due to increased enrolments, a new stone schoolhouse was built in 1881 and remains in use today *(Photo 10).* The School Principal, Ms Chris Davey, gave a short talk about the school, its operation and achievements. Our thanks to her for her valued contribution to our excursion including access to the interior of St Mark's Church.

5. Murrays Run Culvert.

7. Laguna House.

8. St Marks Church, Laguna.

10. Current sandstone Laguna schoolhouse (1881).

In 1942 an American Douglas C47 Dakota aircraft transporting air crew on R & R, crash-landed near Laguna. All on board, except the pilot, managed to bail out but unfortunately the aircraft was too low for the last two, their parachutes did not inflate and both men were killed. The plane crash-landed and fortunately the pilot, thought to be an Australian, survived. In appreciation for the assistance given to the men by the local community who gave first aid and assistance including rescuing several of the crew who were caught up in trees, the American Ambassador presented the community with one of the propeller blades from the wreckage. This blade is mounted on a plinth in the school grounds *(Photo 11)*. Photos taken at the time *(Photo 12)* are displayed in the stone building (School library).

A few weeks before the excursion, it became known that one of the two parachutes which were given to local people had been located. The silk parachute had been made into a bridesmaid's dress soon after the crash. The dress was given by the daughter of the now deceased bridesmaid to her friend who was the daughter of the bride. The bride is still living in the local area. At the lunch stop at Laguna Public School we were honoured by a visit from the then bride, Mrs Ivy Andrews, and her daughter, Mrs Rosamonde Stace, who brought with them the bridesmaid's dress, in perfect condition *(Photo 13)*. The bride, Mrs Andrews, gave us a very entertaining account of life in the area in the pre- and post-WWII days.

Mulla Villa: 'Mulla Villa' (House by the River) is a Georgian house built in 1841 for Mr David Dunlop,

9. Red Cedar interior of St Marks Church.

11. Propeller blade from C47 Dakota.

the first Police Magistrate in the Wollombi and Macdonald area *(Photo 14)*. The building was constructed using convict labour and Mr Dunlop had assigned servants (convicts) who were confined at night in the cellars underneath the house *(Photo 15)*. Sawdust was laid between the cellars and the upper rooms to provide a means of sound proofing.

12. Photo of C47 showing damage to nose and wing.

13. The bridesmaid's dress, front view, with the bride, Mrs Ivy Andrews seated on the left and Mrs Rosamonde Stace, Mrs Andrew's daughter holding up the dress.

14. Mulla Villa House viewed from the north.

15. Mulla Villa servants' cellar room with dungeon cell door on left.

16. Mulla Villa interior hallway.

The building has a central passage with two main rooms on either side. The walls are 2 feet thick and all door posts, architraves and window supports are of solid masonry *(Photo 16)*. The rear portion of the house extends at right angles from the main building and contains servants' quarters, kitchen etc. The stone for the building was quarried on site. The veranda was added in 1927 but there may have been stairs and a small porch leading to the front door. Floodwaters in the 1949 flood reached 500mm up the verandah supports.

We were very fortunate to be invited by the owner to inspect the interior of house which was not occupied as a B&B that day.

Blair Cottage: 'Blair Cottage' was probably built between 1845 and 1855 by Thomas Crothers. The sandstone building was originally sited closer to the Gleghorn Bridge where the huge Bunya pine, planted in the 1870's, stood in the front garden of the original house site. As floodwaters entered the house in severe floods, the then owner, Mr Arthur Andrews, had the house relocated to its present site in 1913. A horse -drawn slide was used to transport the heavy sandstone blocks from one site to the other. The original house that included attics and interior sandstone walls was remodelled and enlarged when rebuilt, with the old interior walls being used to make the exterior of the house larger *(Photo 17).*

17. Blair Cottage with the Bunya Pine planted in the original front garden visible.

18. The headstone of Thomas Budd jnr in Wollombi Cemetery.

The excursion did not intend or have time to visit the many historic buildings in the Wollombi Village but finished at the historic Wollombi Cemetery where many of the graves of characters mentioned during the excursion were visited *(Photo 18).*

Fossils.

After our lunch at Laguna Public School the excursion drove a few kilometres to the property 'Iolanthe' owned by Chris Davey and Annie Heathcote.

At 'Iolanthe', upper Early Triassic rocks of the Narrabeen Group crop out. In these rocks fossil lycopods can be found in a very fine grained indurated quartzose sandstone. This induration appears to result from secondary quartz enrichment as suggested by the secondary crystal growth on the quartz grains. The Division Lycopodiophyta, a subdivision of the Kingdom Plantae, is the oldest extant (living) vascular plant division and includes some of the most 'primitive' extant species.

The fossils are interesting in that plant fossils in the Early Triassic in the Sydney Basin are found mostly in siltstone and claystones. In reconstructions in the literature, the lycopod *Pleuromeia* usually occupies the shoreline while the seed fern *Dicroidium* is established in the backswamp. At 'Iolanthe' the, as yet undescribed, similarly structured but much smaller lycopod is preserved in a very fine, clean and almost pure quartzose sand (unusual for the Narrabeen Group) *(Photo 19).* As most of the fossils appear to be in life position, the nature of the environment in which such small plants could survive in conditions enabling the

19. The as yet undescribed fossil lycopod from 'Iolanthe'.

20. The smile of a successful fossil hunter

removal of silt and clay from the fine sand (e.g. wave, current or wind) is an interesting consideration. On a prior reconnaissance trip the fossils were abundant, but on the excursion, for some unknown reason, they were far less abundant. Nevertheless some of the group were successful *(Photo 20).*

Report by Winston Pratt.
Photographs by Winston Pratt.

Camden Haven and Diamond Head Weekend

Friday 31st May to 2nd June 2013

Leaders: Barry Collier and Brian England.

Attendance: 19 members; 4 visitors.

Barry and Elaine had travelled up to Dunbogan a few days before the start of this excursion to check out walking tracks in the Kattang Nature Reserve and the accessibility of coastal geological features at Diamond Head described in Bob and Nancy's Geotourism website. Everyone else had arrived at the Dunbogan Caravan Park by nightfall on the Thursday.

Friday 31st May

The group met at 9:00am in the grounds of Dunbogan Caravan Park for an introductory talk on the geology of Kattang Nature Reserve and then left in convoy at 9:30 am for nearby Wash House Beach.

The site of this excursion is located on the south-eastern edge of the Lorne Basin. This is an isolated sub-circular depositional basin 35 kilometres in diameter lying between Coopernook and Wauchope on the Lower North Coast of NSW. The main units and structures in the basin were covered in the November 2009 excursion led by Winston Pratt. The floor of the basin comprises Paleozoic (Carboniferous) rocks of the New England Orogen and is overlain by Triassic terrestrial sediments. The sediments have been intruded by Late Triassic to Early Jurassic igneous rocks and later Paleogene volcanics.

1. Perpendicular Point from lookout near Charles Hamey lookout.

Perpendicular Point *(Photo 1)* is crossed by several walking tracks which lead to spectacular viewpoints overlooking coastal cliffs of Early Triassic Laurieton Conglomerate. This is underlain by Camden Head Claystone within the Camden Haven Group, also of Early Triassic age. The conglomerate is conformably overlain by the Grants Head Formation.

The Laurieton Conglomerate *(Photo 2)* is the most prominent and obvious rock unit at Perpendicular Point. It is of limited lateral extend but forms the southern continuation of the outcrop seen at Grants Head on the November 2009 Lorne Basin excursion. It is a very thick and resistant bedded unit of cobble and pebble conglomerate and forms the prominent coastal cliffs in the region. The texture of the rock is poorly to moderately well sorted with rare sandstone interbands. The clasts are mainly sub-angular and comprise abundant chert with lesser amounts of jasper and quartz. This is typical of a New England source area. The rock is a result of rapid deposition in a high energy environment with an abundant source of supply, ie deposition in the main channels of a braided fluvial system subject to periods of major flooding. Perhaps a good modern analogy lies in the rivers draining across the Canterbury Plain on the South Island of New Zealand, with rapid deposition of bed load by braided streams and the high mountains to the west providing an abundant source.

The Camden Haven Claystone can be studied around the base of the cliffs at low tide. It is an upwards-fining sequence ranging from pebble conglomerate at the base, through sandstone to siltstone, with claystone at the top, but is dominated by grey to purple mudstone and is characterized by a reddish-purple colour, a colour completely absent from other Triassic units in the Lorne Basin. This sequence was derived from sheet and channel sands incised into muddy overbank deposits together with laminated

3. Onion-skin weathering (exfoliation) in claystone.

reddish and grey terrestrial plant-bearing silts and clays in a fluvial environment, ie back swamps bordering streams and periodically filled by overbank flooding.

With the tide coming in we first headed along the beach to its southern end where purple claystones of the Camden Haven Claystone are exposed on the rock platform. But with the water rising rapidly there was little time to examine the features here. The rock contains occasional thin carbonaceous bands but is practically devoid of recognisable fossils, apart from isolated patches of compressed plant stems and trunks replaced by bright coaly material (vitrain) with a cross-hatched fracture pattern. There were no leaves present to give any indication of species.

Strolling back towards the breakwall we came upon a small patch of the claystone showing spectacular onion skin weathering *(Photo 3)*. A little further on towards the back of the beach and still well above the rising tide was a low bench made up of rounded pebbles and cobbles cemented by dark brown limonite which had been worn smooth by wave erosion *(Photo 4)*. This low but prominent outcrop also contained scattered clasts of an earlier conglomerate to 0.5

2. Laurieton Conglomerate.

4. Low bench of conglomerate with iron hydroxide cement.

metre across plus angular blocks of cross-bedded sandstone to 30cm. This assemblage appeared quite puzzling until we realized it was detritus which had accumulated along the base of the former cliff line. This material had been cemented, probably over hundreds of years, by iron hydroxide deposited from groundwater springs seeping from the cliffs above. This same process would be seen in present-day operation on the southern side of the reserve later in the day. Similar deposits were also to be seen later at Diamond Head.

Some of the group had already walked out along the break wall by the time the stragglers caught up. They reported a variety of interesting rocks amongst the amour stone used to protect the wall. The northern side consisted mainly of large blocks of rhyodacite, but the southern side had quite a different story to tell. Here we found blocks of a coarse granular rock with zones of abundant ripped up varved shale clasts to 20cm across, the sort of texture that occurs when floodwaters suddenly inundate a dried up lake bed. But there also appeared to be zones of lineation caused by flattened pumice lenticles, a texture typical of ignimbrites! Some of the layers showed distinct graded bedding, while others were rich in fresh angular feldspar grains. So do these rocks represent a volcanic ash flow, or a coarse arkose caused by sudden mass flow into a dried up lake bed, or a combination of both? We had to find out where this rock came from and examine the outcrop before a conclusive answer could be worked out. Chris Morton was assigned the ask of contacting local authorities in an attempt to locate the probable source to enable this to be followed up at a later date.

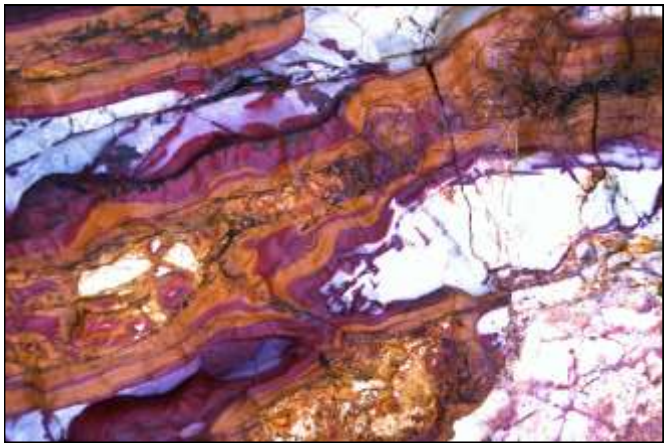
From the end of the break wall we could clearly see the shallow syncline in the Camden Haven Claystone and overlying Laurieton Conglomerate exposed in the north-facing cliffs of Perpendicular Head.

6. Injection dyke weathered to clay.

Following lunch in the picnic area at Wash House Beach we drove south to the Hamey Car Park on the southern side of the Nature Reserve. Taking the sandy track down to the beach we were immediately attracted to a large low outcrop of conglomerate at the waters edge where several enormous dark-coloured slightly-raised ring-like structures were clearly visible. These proved to be concretionary accumulations of dense glassy goethite (iron hydroxide) formed in much the same way as Liesegang rings by groundwater moving in from joints and depositing in the rock pores minerals leached from the overlying rock, long since removed by erosion *(Photo 5)*. This glassy goethite was also present as coatings on pebbles and in veins along joints in the surrounding rocks, which here form the base of the Laurieton Conglomerate.

From here we walked north, climbing gradually up-sequence through the Laurieton Conglomerate and occasionally over layers of fine cross-laminated sand-

5. Concretionary accumulations of Goethite.



7. Zoned concretionary Limonite.

stones representing quieter low-energy channels in the original fluvial depositional environment. The vertical variation in textures within the conglomerate here is spectacular and typical of the type of anastomosing braided stream which laid these sediments down. Reaching the base of the headland we took the well-trodden fishermen's path north up along the edge of the cliff line to a point adjacent to a large overhanging rock where access could be gained to the base of the cliff via a steep and slippery but thankfully short climb.

The climb down to the boulder-strewn shoreline along the base of the cliffs ended on a wide weathered igneous dyke, now almost completely altered to white clay *(Photo 6)*. Here we found spectacular zoned bright orange to dark brown concretionary limonite masses both within and along the margins of the dyke *(Photo 7)*. A little further north we came to the base of the Camden Haven Claystone, here thinly bedded and again totally devoid of fossils.

Returning to the car park we climbed north along the Flower Bowl Circuit up through Casuarina forest and then passing into stands of *Banksia aemula* with an understorey of flannel flowers thriving in the well-drained sandy soil. A short diversion was made down to the Camden Head Lookout overlooking the strange circular features we had visited earlier in the day on the rock platform below. Joining up with the Perpendicular Point Track we passed through patches of brush box forest before taking another detour down the Pebbly Beach Track to another lookout point, but could find no way down to shoreline.

A little further along the Perpendicular Point Track we made yet another diversion, this time down the Fishermen's Bluff Track for a great view across to the southern side of the peninsula and a different perspective on the shallow syncline seen that morning from Wash House breakwall on the northern side. But again there seemed no way down to the coastline. Then we found a very faint track though the grass to the left of the lookout, obviously made by fishermen, which led to even more spectacular views. From our viewpoint we watched in stunned amazement and subdued horror as a lone adventurer clambered over and around the huge boulders at the edge of the pounding surf beneath the cliffs. In the few moments we dared to watch it was easy to imagine the total disregard some people have for their own safety or the safety of those who have to attempt a rescue when things go pear-shaped! He was too stupid to have been a fisherman.

8. Diamond Head headland.

Ambling on towards the end of the peninsula we passed by two very deep narrow chasms carved back into the cliffs, perhaps along a fault or joint. The second of these was actually crossed by the track and was almost missed by some due to the scrubby vegetation around it. This chasm was only around half a metre wide and provided frightening views down to the waves crashing over the rock platform below. The average pebble size in the conglomerate here was much finer than that observed lower in the sequence, indicating lower energy streams and probably a lower elevation source area.

We continued up the rise at the end of the peninsula to the lookout point but were unimpressed with the view, although it would have been a good spot for whale watching. Returning to the cars we were back in camp by 4pm for drinks and nibbles.

Saturday 1st June

The entire day would be spent at Diamond Head, a prominent coastal headland about 10 kilometres south of Dunbogan (*Photo 8)*.

Diamond Head was last visited by the Society in November 1998. At that time very little information was available on the geology of the region and the excursion relied heavily on the geomorphology and wildflowers to provide a meaningful experience. Since then the area has been the subject of several studies and this excursion would take advantage of the information obtained from these to provide a much more detailed geological outline than was available back in 1998.

Also located within the Lorne Basin, Diamond Head is composed of the remnants of a series of volcanic eruptions which occurred during the Late Trias-

9. Natural Arch formed in altered rhyolite.

sic. These lavas were then hydrothermally altered, adding quartz, pyrite and traces of gold. The addition of quartz to the rocks made them more resistant to erosion, thus protecting the headland. Veins in the quartz-rich rocks (altered rhyolite) contain vughs lined with well-formed quartz crystals and it is the abundance of these that supposedly gave Diamond Head its name.

Much of the geological information has been taken from Bob and Nancy's Geotourism website (http://ozgeotours.110mb.com). However on his reconnaissance trip prior to the excursion Barry discovered that many of the listed sites were either too dangerous or too difficult to access for a large group.

We began by driving to the northern car park where a car shuffle was arranged to avoid retracing our route across the headland at the end of the day. The tour began at the southern car park at 10am by walking up the clearly marked track towards the top of the headland. This was a steady climb through dense scrub and patches of brush Kurrajong, a low native shrubby plant commonly seen colonizing areas of bush after fires. At the first cleared grassy patch a track descended steeply to Kylie's Beach and Bob and

10. Liesegang Rings in altered rhyolite.

11. Rhyolite dyke.

Nancy's Stop 11, but after the recent rains this was deemed much too risky and that area would be explored from the beach in the afternoon.

Continuing the steady climb we took the next rough track off to the right and only a little way down the steep slope towards the ocean we came in sight of a massive and visually stunning offshore arch, obviously formed by the collapse of a sea cave long ago (*Photo 9)*. This is Stop 12 on Bob and Nancy's tour guide. The track plunged though grass and stunted native shrubs then continued as a narrow pathway though low ferny vegetation around the side of the ridge above the ocean. To the right, in a wide gully ending in a vertical drop onto the beach, hummocky outcrops of white bleached rhyolite marked with brilliant yellow Leisegang rings took the attention of the photographers. In the cliff on the other side of the gully we could clearly see that this leached rhyolite was underlain by an earlier unaltered rhyolite flow. Further down the track passed over a zone of rusty-looking rocks, the colour due to the precipitation of iron oxides leached from the overlying bleached rhyolite by sulphuric acid formed by the oxidation of disseminated pyrite crystals contained within it.

The track finally came to a relatively flat grassy area directly overlooking the arch. We left our packs where they could be seen and began a detailed look around the rock platform. Here we found magnificent Liesegang rings (*Photo 10)* and a number of rhyolite dykes (*Photo 11)*, one of which showed distinct layering standing as ridges parallel to the dyke margins. Rusted anchor points in the rocks here told of a flying

fox which at one time had provided fishermen with access across to the arch.

Walking along the edge of the pebbly beach to the north we came to another rhyolite dyke, this one projecting down into the back of what was once a small sea cave. The margins of this dyke were rimmed by breccia composed of a variety of rock types, indicating that the conduits for this and maybe many other dykes in the headland (including the one at Stop 3 which was considered too dangerous for the group to visit) were opened by phreatic explosions or very high fluid pressures which fractured the wall rocks. The dyke is also strongly fractured. The bottom of the old sea cave here comprised limonite-cemented cobbles, the cobbles thrown to the back of the cave by the sea then cemented by iron hydroxide leached from the overlying acid-bleached rhyolite. More examples of this process were seen further around the coastline.

At the northern end of the beach stood a vertical wall of dark rock (Bob and Nancy's Stop 16), the true nature of which was not immediately apparent due to a partial covering of lichen and grass. This is the south-eastern margin of a large breccia body enclosed within rings of altered rhyolite, with the degree of alteration and formation of new minerals (pyrite, sericite) gradually decreasing away from the margins of the breccia. The breccia itself comprises blocks of rhyolite and a range of sedimentary rocks from a few centimetres to tens of metres across. These are contained within a matrix of pulverized rock cemented by black tourmaline, quartz, sericite and pyrite. The breccia formed as a result of explosive fracturing caused by high pressure hydrothermal fluids, which also altered the original minerals and introduced the cementing agents.

To proceed any further northwards seemed foolhardy so we left this fascinating site at 11:15am, taking only 20 minutes to return up the steep slope to the main track.

Continuing on towards the trig on top of the headland we took the next rough track to the right, not entirely sure of what we would find. This track was even steeper than the last, but obviously well-used by fishermen. Then ahead we could see another arch in the rhyolite, but this one connected to the base of the cliffs by a narrow isthmus. In the foreground was a huge vertical-walled hole taking up almost the entire rock platform, obviously a collapsed former sea cave (Bob and Nancy's Stop 18). We sat for a while at the edge contemplating the grandeur of the scene before returning to the main track again to continue on towards the northern car park.

The Diamond Head Trig provides a commanding viewpoint in all directions, but most notably towards The Brothers, three prominent rounded hills to the west and north. These are shallow circular Triassic-Jurassic granitoid intrusions now exposed at the surface after 200 million years of erosion.

About 120 metres north along the track from the Trig is a small patch of bare rocky ground. This was one of several prospecting pits dug in an unsuccessful search for gold over 100 years ago along a narrow zone of highly altered rhyolite. A few minutes here on hands and knees delivered a number of small but perfectly formed and water clear quartz crystals, released from the soil by recent heavy rain. But there was nothing like the quantity and quality of crystals that could be collected along the top of the headland 40 years ago. A very few of those crystals collected back then showed an unusual kaleidoscopic effect caused by reflection of internal phantoms from the six faces on the crystal terminations. A fine example of this phenomenon was shown around before setting out that morning.

Continuing on toward the car park and lunch, we kept a lookout for another rough path off to the right which should have led down to the beach and a pair of very unusual sea caves. But this could not be found. It was now downhill all the way through low hilly heath land with scattered native iris and one fringe lilly in flower amongst the grass and scattered banksias.

The group reached the northern car park at 1pm and lunch was enjoyed in the sheltered picnic area with topknot pigeons fighting for scraps under our feet and kangaroos lazing around in the sun oblivious to the approaching dramatic change in the weather. At 2pm we headed off for the Kylie's Beach car park to access Bob and Nancy's Stop 11 via the beach.

From the car park it was only a short distance to the beach, but from there our goal seemed a long way off to the north. In the meantime, a nearby isolated outcrop of Camden Haven Claystone lying just at the water's edge commanded our attention. Two fishermen were so intent on cleaning their catch they scarcely noticed us almost step over them as we clambered up the landward sloping rock face to view some of the finest examples of Liesegang rings imaginable, spread

over the entire surface of the purplish closely-jointed claystone.

A 0.5 kilometre walk north up the beach brought us to the base of the very steep access track we had passed earlier in the day on our way up to the Diamond Head Trig. Here also lay the end of the sandy beach and the beginning of a long stretch of surf-rounded boulders to the next rock platform. Many of the boulders here comprised leached white rhyolite displaying the most magnificent yellow Liesegang rings, some of them looking absolutely stunning amongst the darker boulders of shale, unleached rhyolite and dacite. These leached rhyolite blocks had come from the adjacent cliff, slowly creeping down the steep slope from an outcrop just below the summit, an outcrop continuous with the bleached rhyolite bed seen at Stop 12. Within a few tens of metres we began coming across boulders of fresh and very tough porphrytic dacite, then finally the source dyke cutting through the Camden Haven Claystone at the start of the rock platform. The rock in the dyke was fresh at wave base but strongly weathered and soft in the lower cliff face above. Although the weathered rock appeared spectacular when wet, once dry the large white feldspar crystals (now replaced by kaolinite) blended into the background and became much less visible and the rock far less spectacular!

The foreshore here was quite rough without a well-defined rock platform, but was easily negotiable nonetheless. To access the rest of the area we had to carefully climb down a very slippery and soft clay bank, but none of the group had any problems. Here we found a wide shallow channel, largely devoid of water at low tide, separating the main cliffs from a low sea stack. There were enough boulders in the channel to hop cross without getting wet feet and only one person fell in. In the landward-facing side of the stack we found a narrow vertical rhyolite dyke intruding the purple Camden Haven Claystone and the small platform beneath it displayed yet more magnificent Liesegang rings. More rhyolite dykes were found further on (Bob and Nancy's Stop 11).

We were back at the cars by 3:45pm but light was fading rapidly due to increasing cloud. However everyone decided they deserved coffee before continuing on. Most then went back to camp, but a few followed Stan to a mound of rhyolite just above the rising tide at the southern end of the beach accessed from the northern car park. Here we were shown a number of ancient Aboriginal spear-sharpening grooves. It was easy to imagine the scene back in those early times, the Aboriginal hunters preparing their weapons and spearing fish for their dinner, probably from the same rock. Incidentally, specimens taken from the rhyolite here showed disseminated unaltered tiny cubic pyrite crystals. It was the oxidation of these elsewhere on the headland that released sulphuric acid which bleached some of the rhyolite white and resulted in the spectacular Liesegang rings.

By 4:30pm it was almost dark as we stumbled along the beach back to the cars. At 6:30pm the group assembled at the RSL Laurieton for dinner and then gradually drifted back to the Caravan Park. Rain began falling at around 10pm and it was not looking good for tomorrow. Some of the group had already left before dinner and others were leaving early tomorrow, but a few diehards would stay on to explore the Grants Head area in the morning.

Sunday 2nd June

The weather this morning was cloudy but rain did not appear imminent so 7 adventurous souls made a 9:30am departure for Grants Beach to the north of Dunbogan. But as soon as we arrived in the car park the sky fell in! The more we waited the worse it got, so a hasty retreat was made to a coffee shop in Laurieton where we commiserated till 11:30. A few stopped at The Other Side Gallery and Café near Taree for great coffee and scones. The weather on departure appeared to be clearing with a large patch of blue sky overhead but a few kilometres down the road the sky really fell and this together with violet cross-winds made the trip home quite exciting.

Report by Brian England.
Reviewed by Barry Collier.
Photographs by Barry Collier.

Reference:

PRATT, G.W. (2010). A revised stratigraphy for the Lorne Basin, NSW. *NSW Industry and Investment. Geological Survey of New South Wales. Quarterly Notes No. 134.*

Sandy Hollow & Giants Leap
Saturday 27th July 2013

Trip Leader: Brian England.
Local Guides: Terry and Laurel Kingdon.
Attendance: 17 members; 1 visitor.

The gods must have been well-pleased with us this morning, as the day dawned cloudless and without the usual dust haze or early morning fog. After the weather conditions experienced over the past several days this seemed unreal.

The group assembled at The Gallery Café at Sandy Hollow between 10:15 and 11:00am, arrivals staggered to avoid overloading David and Lorraine. But they handled the mass influx without problem, serving great cappuccinos and tasty treats with such efficiency that we had little time to admire the many outstanding sandstone sculptures and ceramic mosaics that adorned the adjacent garden *(Photo 1).*

With everyone fed and watered to their satisfaction, the group assembled outside the Sandy Hollow Tourist Park at 11:30am for the trek up the hill. Prior permission had been obtained from the park owners to access the start of the track through their grounds. Terry and Laurel were the only members who had done this walk before so were summarily assigned the task of leading the way. The walk began at a little bridge over the creek at the back of the Tourist Park, which fronts onto the western boundary of the Monabalai Nature Reserve.

From here the track was well-marked, almost like a vehicle track for the first 100 metres or so, but then narrowed as it began to climb the gradually steepening slope. Its location amongst the rocky outcrops was marked by small stone cairns erected by local bushwalkers. The track continued ever upwards through open scrubby forest, occasionally becoming little more than a scramble over sandstone ridges made slippery by the presence of leaves, twigs and loose gravel. But these presented only temporary obstacles as we climbed towards Giants Leap *(Photo 2)*. There were only occasional glimpses of the Goulburn River Valley to the west through the trees.

3. Base of massive sandstone bluff forming 'Giants Leap'.

It took just under an hour to reach the base of a massive sandstone bluff, its sides wind-sculptured into shallow recesses exposing fresh pale yellow rock beneath the grey weathered lichen-coated skin *(Photo 3)*. It was only here that the fluvial origin of the sandstone was clearly visible, with well-developed cross-bedding representing the preserved remnants of overlapping point bars laid down by an anastomosing braided stream moving back and forth across its ancient flood plain during the early Triassic. The sandstone was coarse to gritty in places and there were occasional bands of dark brown ironstone; sandstone cemented by limonite (iron hydroxide) precipitated from the river water or deposited later in porous layers by groundwater *(Photo 4)*. Several large round boulders along the base of the bluff contained good

1. Gallery Café and sculpture park, Sandy Hollow.

4. Coarse sandstone with indicators of its fluvial origin.

2. Giants Leap (centre-right). The walking track follows the ridgeline to the top.

examples of tafoni, deep rounded hollows eroded out behind a case-hardened skin.

From the bluff the track became far less distinct, with the occasional cairn often the only guide as it wound to the east around the base of the cliffs to the eastern side of the ridge. Here a narrow rocky gully provided the final 30 metre scramble to the summit.

An hour and ten minutes after beginning the climb, we came out on the flat narrow top of the ridge at an elevation of 385 metres into a patch of dense scrubby bush. But there was no sign here of any lookout point. Nor was there any indication of a track to one. Undeterred, we followed Terry through the grassy forest understorey to a flat sandstone outcrop directly overlooking Sandy Hollow and the Goulburn Valley. But we weren't there yet and were led further to the north along the edge of the escarpment to a second and much larger platform providing an uninterrupted panorama. With no smoke, dust, or cloud the view was stupendous! And there was no wind threatening to blow us over the edge of the 40 metre drop into the forest below. Pushing through the scrub to the northern end of the ridge gave unsettling views over the narrow valley of Melon Creek and across to the massive sandstone wall on the other side. Perhaps this was the Giant's Leap.

5. Sandy Hollow on the edge of the Goulburn River Valley.

There was so much to see and take in from the ridgeline. Most prominent was the view to the west over Sandy Hollow township directly below across to the Goulburn River Valley *(Photo 5)*, it's cleared grassy floor extending off into the distance towards Bylong. Receding lines of north-south ridges on either side hide the dendritic networks of tributary streams deeply incised into the Triassic Narrabeen Sandstone plateau. These tributaries include Baerami Creek and Widden Brook, both of which have been visited on previous trips. These deep cliff-walled valleys expose the underlying Upper Permian Singleton Coal Measures, which in the wider parts are covered by Quaternary alluvium deposited by the present-day streams. On the north side of the Goulburn Valley only a few kilometres away and poking up behind the first sandstone ridge lies Mount Dangar, its 673m summit capped by basalt. This is an isolated outlier of the Paleogene (Tertiary) basalt flows that form an extensive plateau to the north, beginning at Merriwa. This basalt also forms the wide flat summit of Nullo Mountain, its bulk clearly visible above the Narrabeen Sandstone plateau to the southwest. To the south lies a more extensive area of Narrabeen Sandstone capped in the far south by sinuous ridges of Hawkesbury

Sandstone. Views to the east were restricted by bush, but directly below lay the deep densely forested gully of Pheasants Creek. Beyond this lay more retreating ridges of Narrabeen Sandstone covered by dense forest. Out of sight were the lowlands of the upper Hunter Valley where the major rocks are those of the late Permian Singleton Coal Measures.

The second rock outcrop was large enough to comfortably accommodate the whole group for a relaxed picnic lunch. Then it was back down the hill, the return taking between 30 and 45 minutes. The cars were reached at 2:35pm, leaving people with the remainder of the afternoon free. Some decided to head off home, but many stayed on to drive up the Golden Highway through Gungal to the Battery Hill picnic area.

Here, down along the eastern bank of the creek, lies a small but spectacular example of columnar jointed basalt, the columns varying from 3 to 7 sided and averaging around 30cm in width *(Photo 6)*. What is unusual at this site is the steep dip of the columns towards the creek bed. Offset from the outcrop at the picnic area is a similar but less obvious outcrop further upstream on the opposite bank, with the columns again tilted towards the stream bed. Other outcrops are located further up the valley on private land. In all outcrops the basalt extends only a few metres into the hillsides beyond the columnar structures.

The explanatory notes accompanying the new Cartoscope geoheritage map of New South Wales (March 2013), state that "*the flow must have been nearly vertical as it cooled from the outside face causing the jointing to propagate inwards in a near horizontal plane*." But there is a more plausible explanation. It is very likely that the basalt flowed (at around 1100^{o}C) down a steep-sided valley to become ponded in a depression. As the mass slowly cooled, networks of cooling centres formed at the top of the flow and along the margins in contact with the underlying rocks. Gradually the cooling rock shrank towards these cooling centres, resulting in polygonal cracks developing between them which gradually extended onto the solidifying basalt at right angles to the cooling surface. The steep walls of the valley in which the lava ponded would have presented sloping surfaces to the cooling lava, so the columns would have formed at right angles to those slopes giving rise to the apparently tilted columns. In the centre of the lava pond the columns would have been vertical, at right angles to the top surface. Erosion has removed the central columns, leaving only the edges of the lava pond exposed. Structures similar to this are commonly seen where lava or ash has flowed down valleys and become ponded. Fine examples exist not far away at Ardglen where Paleogene basalt flows are being quarried for road base.

6. Columnar jointed basalt, Battery Hill picnic area.

7. Fault plane next to the road on top of Spur Hill

No-one could resist another coffee and cake at The Gallery Café before heading off home. South of Denman, as the Golden Highway crossed Spur Hill, a prominent fault in fluvial sediments was examined in the road cutting *(Photo 7)*. Unfortunately the rock exposed on the southern side of this fault has deteriorated markedly since it was first exposed making it impossible to determine the nature of the displacement.

Report by Brian England.
Photographs by Ron Evans.

The Warrumbungle Volcano and Pilliga Forest

Friday 16th to Sunday 18th August 2013

Leaders: Barry Collier and Brian England.

Attendance: 19 members.

THE WARRUMBUNGLE VOLCANO
A BRIEF GEOLOGICAL HISTORY

During the Jurassic (180myr) the region comprised large shallow freshwater lakes extending across a broad structural depression called the Coonamble Basin. Rivers flowing into these lakes deposited thick sequences of sands and muds as a series of coalescing deltas, which subsequently lithified into the Pilliga Sandstone. Features of some of the sandstone beds are discontinuous lenses and nodules of dark brown limonite (iron hydroxides), deposited from river waters as they entered the slightly brackish lake water. Also during the Jurassic, volcanic activity poured out large amounts of basalt, trachyte and breccias known collectively as the Garrawilla Volcanics, mentioned later as the source of World-class mineral specimens. Remnants of this v125olcanic activity include numerous dome-shaped hills in the Mullaley-Garrawilla area and extensive lavas and breccias exposed mainly in the valleys of Garrawilla and Mitchells Creeks.

Just before the Warrumbungle Volcano came into existence, the area was very similar to the region north and east of Coonabarrabran today. It was flat to gently undulating sandstone country that had been geologically quiet for some time. The climate was probably somewhat wetter than the area is today, supporting widespread dense Eucalypt forests. At the time the only active force was erosion, with rivers carving shallow valleys across the sandstone.

One of eastern Australia's many "hot spot" eruptive centres, the Warrumbungle Volcano began activity around 17myr, not long (geologically) after the demise of the Nandewar Volcano 100km to the northeast. By the end of its active life around 13 million years ago, the Warrumbungle Volcano was at least 50 kilometres across and rose at least 1000 metres above the surrounding countryside, forming a huge shield with a base area of around 1200 square km. Since then, erosion has removed most of the eruptive volcanic rocks, exposing the very core of the volcano and resulting in the prominent spires, domes and dykes which today characterise one of Australia's most spectacular volcanic landscapes.

About a million years after it first appeared, eruptions became quite violent. Explosive pyroclastic eruptions ejected vast amounts of ash and shattered rock which smothered the surrounding countryside. Along with these outbursts were flows of viscous trachyte lava. Most of these were confined to lava domes, with a few flowing out as short thick flows. This viscous lava blocked some vents, but others took their place. This combination of lava flows and ash built up what is called a composite volcano. In time the magma became less viscous and trachytic lavas travelled over greater distances to form thick flows. By 14 million years ago the trachyte lavas were being replaced by basaltic eruptions, covering up the earlier trachyte flows.

Prelude to the August 2013 excursion.

The main purpose of this excursion was to observed the "new geology" revealed by the Wombelong Wildfire which devastated 90% of the Warrumbungle National Park around 12th January 2013. All the park amenities including the visitor centre, historic woolshed, toilets and track infrastructure were completely destroyed. The fire began on a day of extreme temperatures (up to 43°C) and strong winds. The cause remains unproven, but human involvement is probable. The fire was followed almost immediately by torrential rain, with over 120mm falling overnight. This stripped the unprotected regolith and sent torrents of sand and mud into creeks where it still forms beds up to a metre thick. Whole hillsides are now devoid of soil, revealing rock outcrops never seen before. The following extract from the Coonabarrabran Times gives some insight into the changes that have occurred.

Stunning geological formations located in the rugged volcanic landscape of the Warrumbungle Range have been revealed for the first time.

The January bushfires that burnt most of the Warrumbungle National Park, near Coonabarabran, have exposed prehistoric remnants that have geologists talking.

Shire Mayor, and former geologist, Cr Peter Shinton, says that now escarpments are denuded of all vegetation, never before seen volcanic outcrops have been recorded, new rock faces have been revealed, along with columnar structures and volcanic dykes and plugs.

1. Timor Rock, a volcanic dome.

"You can now see the margins of the tuffaceous deposits and massive trachytes flows or domes. None of this could be seen before because of the heavy covering of trees and undergrowth.

The view from the air is exceptional, but the average visitor will still find the view from the ground absolutely fascinating.

Post-fire, viewing the primeval landscape is nothing short of inspiring and you don't have to be a geology expert to appreciate the newly exposed escarpments of the Warrumbungles."

Recent good rain has re-growth springing back already."

The Burbie Canyon, Mount Wombelong and Belougery Split Rock tracks in the western part of the National Park were open to the public on the 18th May, after the clearing of fallen timber and dangerous trees. National Parks envisions a staged approach to re-opening the remainder of the Park as areas are made safe and facilities are restored. There are no entry fees while this is being done.

The trip was instigated after Barry had discussions with Warrumbungle Shire Mayor and Geologist Peter Shinton after seeing the above article in the Coonabarrabran times. Peter's contribution to the trip is gratefully acknowledged and it was unfortunate that he could not join us that weekend.

On the evening of **Thursday** 15th August, 15 people turned up at John Oxley Caravan Park opposite Crystal Kingdom in Coonabarrabran to join 4 people already there. After a clear night with no wind or cloud, the temperature at 7:30 the next morning was -2°C, accompanied by a heavy frost. All the hoses leading to caravans froze, but fortunately most had water containers in their van. Those in cabins had no problems. Of course the advantage of the frost was the beautiful clear day that followed.

By 9am **Friday**, everyone had thawed out and we headed off in convoy to the Warrumbungle National Park. Our first stop, 13 kilometres west of Coonabarrabran, enabled some great photographs of Timor Rock in the morning light *(Photo 1)* against a cloudless sky.

Timor Rock falls just within the National Park. It is thought to have originally been a dome subsequently split by a dyke of blue trachyte that now forms the peak 803 metres above sea level and 214 metres above the surrounding plain. The trachyte in the dyke is blue because it contains the blue amphibole mineral arfvedsonite. Some of the other dykes and plugs in the Park comprise green trachyte which contains the green pyroxene minerals aegirine or augite.

As we drove into the area affected by the Wombelong Wildfire, we were able to see through the blackened remains of the forest and for the first time in recent history look at the geomorphology with all shrub and groundcover removed. Most of us had been to the Warrumbungles before, but were astonished at what we could see on this trip. Not only had the fire been so severe, with ground temperatures of over 80°C, but the subsequent torrential rain created massive erosion which uncovered previously unseen rock formations.

Next stop was partway up Blackburn road where we had hoped to look down on what appeared to be a remarkable dyke known as Uncle Ernie's Rocks, named after a member of the Blackburn family who originally owned the Mopra property. From the road the saw-tooth ridges of sodic trachyte appear to be a series of sub-parallel dykes but these rocks are actually the remnants of a volcanic plug measuring 800 by 400 metres, once similar in appearance to Crater Bluff before it was worn down by Shawn's Creek. From the air it resembles a large rotted molar! Unfortunately we found ourselves looking straight into the sun and so were unable to get any appreciation of the structure.

Back on John Renshaw Parkway and just beyond Blackburn Road, we were held spellbound by the views across the valley to Bookshelf Mountain *(Photo 2)*. Before the fire only the top of the vertical columnar jointing capping the mountain could be seen above the trees. But now this jointing stood out as a separate horizontal layer above the spectacular splayed columnar jointing making up the bulk of this

2. Bookshelf Mountain with its columnar jointed capping.

3. Mopra Rock, a basaltic plug. Note landslip below plug.

volcanic plug. The upper jointed layer may represent the final pulse of activity at this vent, where lava formed a small stable lake within the crater and cooled slowly to produce the vertical columns. At the head of the valley and now in clear view stood a remnant of ignimbritic flows that came from this vent early in its active life.

As the Parkway ascends towards the National Park, road cuttings show a series of trachyte and trachytic breccia. Over the next crest we were able to get some great views of Mopra Rock *(Photo 3)*, a spectacular basaltic plug with its pronounced distorted columnar jointing now clearly visible. In the creek bank near the road stood a ridge of basalt, a remnant of flows from this vent. On the grassy slope below this plug is a textbook example of a recent landslip, evidenced by hummocky ground below a gully-like depression in the hillside.

We turned off John Renshaw Parkway up Siding Spring Road and continued on to the Observatory Visitor Centre, arriving just in time for our pre-arranged guided walk up to the Trig Point on Siding Spring Mountain. But with one staff member having failed to turn up for work, confusion rained long enough to enable us to enjoy a welcome coffee before setting out with our guide Amanda at 11:10am.

The Siding Spring Observatory had been extremely fortunate in having escaped the Wombelong Wildfire relatively unscathed, losing only The Lodge which acted as accommodation for the astronomers. This has been temporarily replaced by a row of cabins.

As we followed Amanda along the roadways through areas only rarely seen by outsiders, we were astonished at the array of instrumentation scattered over the top of the mountain *(Photos 4 & 5)*. These included the ROTSE gamma ray camera – one of four in the World; Hat South – A Hungarian automated telescope network used in the search for planets, and the now decommissioned 16 inch and 24 inch ANU telescopes. There was also an Iranian shipping container, the contents of which are unknown to anyone on site. Most of the telescopes are controlled remotely, with astronomers only turning up on site occasionally to make major adjustments.

In the numerous road cuttings along the way we had a chance to briefly examine the mugearite flow making up the top of Siding Spring Mountain. This is a dark grey basaltic rock containing large crystals of glassy sodium-rich plagioclase up to one centimetre long, smaller black crystals of pyroxene (augite) and yellowish-green olivine along with small amounts of magnetite and ilmenite. This rock weathers to a dark red soil.

From the Trig Point the view over the eroded remnants of the Warrumbungle Volcano to the south-west was unbroken and astounding *(Photo 6)*. Most obvious of the newly revealed structures were numerous sub-parallel dykes, probably formed as lava was forced up cracks resulting from partial collapse of the volcanic pile into the emptying magma chamber below. Newly exposed areas of the underlying Pilliga Sandstone could be made out as light-coloured patches amongst the darker volcanic rocks, particularly along creeks. In the foreground, the occasional blackboy stood in stark contrast against the blackened ground around them. Little other vegetation had survived the fire here. There was no smoke or haze and to the north we could clearly see the Nandewar Range on the horizon and in the foreground Wedding Cake and Square Top Mountains as well as the spectacular canyon of Bugaldie Creek.

It was 1pm by the time we returned to the Visitor Centre, where we paused briefly for lunch in the sun,

4. Siding Spring mountain and some observatories.

5. 3.9 m Anglo-Australian Telescope.

then departed to examine some of the outcrops in road cuttings on our way back to John Renshaw Parkway and the National Park. The road down from the Observatory passes through a succession of trachytic lava flows, pyroclastics and lahars which make up the flanks of the Warrumbungle Volcano, becoming older as the roads descends. A brief stop was made to examine some of the pyroclastics, a chaotic jumble of ash and rocks produced early in the volcano's history. In one cutting weathering has left angular rock fragments standing proud of the softer ashy matrix, proving a good illustration of the make-up of the ash flow. A distance of 0.7km from the John Renshaw Parkway intersection we pulled in again to examine a prominent trachyte dyke exposed in the road cutting and as a large pile of boulders to the left of the road. With the vegetation gone this dyke could be visually traced down across the valley floor. The rock is fine-grained and has an unusual silky lustre, as if crystallised under directional stress. Abundant spalling of the rock surface was evidence for the severity of the Wombelong Wildfire.

Back on John Renshaw Parkway we continued down to the White Gum Lookout, named after the prevalence of *Eucalyptus rossii* in this part of the National Park. A 0.5km track from the carpark led to the lookout, which provided an overall view of the central part of the Warrumbungle Volcano *(Photo 7)*. This would be our first encounter with the massive damage caused by the Wombelong Wildfire. Sadly the entire forest here had been reduced to sticks, through which rock outcrops up to several hundred metres away were clearly visible. Surprisingly though, regeneration had already begun with a partial groundcover of a wildflowers coming into bloom amongst the ashes including *Hardenbergia*, *Indigofera australis*, *Brachicomb*, white "early Nancy" (*Wurmbea dioica*), pink *Solanum*, *Indiographa* and several bluebell species. *Macrozamia* and hop bush (genus *Dodonaea*) were also making an appearance. There were also at least two species of orchid. But the old forest remained an eerie mixture of black and white trunks largely devoid of leaves. Where the trees were black only the outer layers of bark had been destroyed by the fire and these were re-shooting as epicormic buds which sprout

6. Grand High Tops from Siding Spring Trig.

7. Heart of Grand High Tops from White Gum Lookout.

from behind the unburnt bark. According to our resident botanist Barry, the white trunks had lost all their bark and now can only re-shoot from the base as lignotubers. The native pines had been completely destroyed and will not regenerate.

Following afternoon tea in the carpark we ventured further into the National Park along John Renshaw Parkway, hopefully to observe close-up an enormous slope of Pilliga Sandstone visible from the lookout. But the road proved to be too far below the exposure, so we headed back to the Caravan Park.

Saturday began with a brief storm at daybreak. At 9:30am we walked across the Highway to Crystal Kingdom, a spectacular World-class exhibit of local minerals and fossils owned and operated by Wolfgang and Nola Bredereck *(Photo 8)*. They had bought the Museum from Brian and Janet Head 17 years ago. The Heads built the original museum to house their large collection of superb zeolites (stellerite and heulandite) from the Warrumbungle Range, largely sourced from the Jurassic Garrawilla Volcanics to the northeast of the National Park around Mullaley and Tambar Springs. This was the first one-locality museum opened in Australia. After their purchase the Brederecks greatly extended and upgraded the exhibition space, which now includes World-class fossils from the Jurassic Talbragar Fish Beds, cod-like fish beautifully preserved in diatomite from the nearby Bugaldie Chalk mine and Permian age fossil leaves from near Dunedoo. At the time of our visit, Crystal Kingdom was up for sale.

At the Museum Nola Bredereck gave us a 40-minute talk on the surrounding geology and what had been found in the region. Then an hour was spent admiring the various specimens and some of the fossil fish available for sale.

8. Part of the mineral display in Crystal Kingdom.

9. Hickey Falls on Wallumburrawang Creek.

We then drove off in convoy down the Newell Highway towards Gilgandra past hills terraced by lava and pyroclastic flows from the Warrumbungle Volcano, up to 5 being evident in some places, before stopping off for morning coffee at Hickeys Falls *(Photo 9)*. From the picnic area there it was only a short walk up a rocky creek bed to the base of the falls where Wallumburrawang Creek fed into a plunge pool enclosed by a spectacular thick columnar jointed trachyte lava flow.

The next stop was in the park at Tooraweenah for lunch. We then drove back through the centre of the National Park to the Burbie Canyon parking area. The Burbie Canyon Track is one of the very few walking tracks opened to the public since the fires and winds up Burbie Creek for a kilometre to meet up with the Mount Exmouth (Wombelong) Track near the base of Split Rock. Along the track grass and ground plants had made a dramatic comeback and we also found patches of greenhood orchids. The canyon itself is quite short and comprises sheer walls of cross-bedded Pilliga Sandstone *(Photo 10)*. Burbie Creek clearly showed the aftermath of the heavy rains that followed the fires. It was still choked with almost a metre of silt washed from the adjacent slopes.

At the completion of the Burbie Canyon walk most of the group made their own way back to Coonabarrabran. Barry, Elaine and Brian decided to pause at Timor Rock for a quick walk around its base. Finding a track through the tall regrowth proved somewhat difficult but we eventually made it around to the western side, the effort rewarded by some spectacular photographs of columnar structures in the afternoon light *(Photo 11)*.

The Imperial Hotel was chosen as the venue for dinner. This gave the group a chance to celebrate Ron's birthday, complete with two cakes provided

10. Burbie Canyon walk.

12. Pilliga Forest Discovery Centre.

independently by Elaine and Ellen. So Ron had the onerous task of blowing out two sets of candles!

Sunday morning dawned to reveal another heavy frost on the ground, but the sky was clear of cloud. Deciding to have a break from geology we headed north to Baradine where we called in to the National Parks and Wildlife Pilliga Forest Discovery Centre *(Photo 12)*. Barry certainly has influence here, the Ranger running out to put up the "Open" sign just as he walked up to the front door! Everyone agreed that this was one of the very best visitor centres we had come across, with so much of interest and so beautifully laid out. Opened in 2009 the displays covered the flora, fauna and Aboriginal cultural heritage, and a time line around the wall lists the major events in the region's history. Sadly, geology hardly gets a mention, apart from stating that the Jurassic Pilliga Sandstone underlies the entire area. These sands were deposited in a series of freshwater lakes around 150 million years ago and now form beds up to 300 metres thick stretching for over 400 kilometres from near Dubbo north into Queensland. The Pilliga itself comprises low lines of hills up to 500m in the east, with the land falling gently to wide sandy plains in the west. The Pilliga hills separate two great rivers of the Northern Plains, the Namoi and the Castlereagh. The Pilliga Sandstone weathers to an infertile sandy soil which was never much good for farming or grazing.

The Pilliga Forest changes abruptly from cypress pine to ironbark to scribbly gum to box and back again within just a few hundred metres and massive river red gums line the sandy creek beds. It is the largest natural forest area west of the Great Dividing Range.

The township of Baradine was proclaimed in 1865. By 1908 the state railways were booming and sleeper cutting in the local hardwood forests was a major local industry. The railway reached Coonabarrabran in 1917 and Gwabegar (north of Baradine) in 1923. But the last passenger train to Gwabegar ran in 1975. For most of our journey north from Coonabarrabran we had seen the decaying remnants of this abandoned line.

Tearing ourselves away from the displays at 10:30 we headed off to the Dandry Gorge Aboriginal Area in the centre of Timmallallie National Park, reached off Top Crossing Road east of Baradine. Here we had morning tea in the new extraordinarily well-

11. Columnar jointing Timor Rock, in afternoon light.

13. Dandry Gorge picnic area.

appointed picnic area *(Photo 13)* before setting off on the two-kilometre Gorge Walk. Calling the area a gorge is somewhat of a misnomer. At its most spectacular it is simply a wide steep-sided valley with occasional discontinuous cliff lines of cross-bedded Pilliga Sandstone up to 20 metres high. The well-constructed pathway leads along the top of the valley, passing five sculptures reflecting the cultural history of the Pilliga *(Photos 14 & 15)*. It then plunges down onto the valley floor to follow the base of the cliff line back to the car park and picnic area.

The walk took longer than expected and the picnic area was so good that we departed from the program and had lunch there before moving on to the Sandstone Caves in the 85,000 hectare Pilliga Nature Reserve, where we arrived at 2:30pm. The general public are excluded from the Reserve, except for the road from Baradine and Sandstone Caves area at its southern edge. A 1.7 kilometre loop track leads around the base of a large block of Pilliga Sandstone to the caves along its western side. The location of the caves area is not signposted at the request of the elders of the local Gamilaraay People.

The sedimentary structures exposed in the cliffs along the track were interesting enough but the caves came as a complete surprise to those who had not been there before. Here pillars and archways, with floors of fine sand pockmarked by hundreds of ant lion traps, connect an astonishing series of deep cathedral-like openings along the cliff line *(Photo 16)*. Evidence of Aboriginal occupation is present in the first cave which contains grooves on a stone slab *(Photo 17)*, and in the last cave where peckings of emu tracks can be seen. Both these caves are protected by steel mesh, with a viewing platform constructed at the last cave. The area is enclosed within open woodland dominated by *Eucalyptus*, *Angophora* and *Callistrus* species. But the abundant and brilliant hop bushes

15. "Yundu Yundu," representing old and new axes.

resplendent in new crimson bracts seen on our previous visit were gone, replaced by dense impenetrable stands of young pines.

The formation of the caves was outlined on an explanatory sign at the start of the track. Moisture seeping through the sandstone dissolves salts and cementing agents making the rock soft and friable. Wind and rain then erode the loose sand particles and the softer overlying rock falls away from harder overhanging layers. The presence of curious tube-like cavities to 10 centimetres in diameter in the sandstone has been explained by Pilliga Nature Reserve Ranger Michael Murphy as "phreatic tubes created below the water table *(Photo 18)*. Water flows through lines of weakness under pressure, eroding in all directions evenly to produce round cross-sections. Mineral deposition on the inner surface results in case hardening." But at least one of these enigmatic structures contains fossil wood.

By now some people were showing symptoms of coffee deprivation so we headed off in haste at 3:40pm for the Pilliga Pottery nearby, desperately hoping it would still be open when we arrived. Nested at the edge of the Pilliga Forest 30 kilometres north of

14. "First Lesson," a bronze statue, Dandry Gorge.

16. Spectacular section of the 'Sandstone Caves.'

17. Examining aboriginal carvings.

Coonabarrabran, this is Australia's most famous bush pottery. It was established in 1983 on Barkala Farm by Richard and Maria Rickert and has evolved into a sprawling village with a European atmosphere. The pottery designs are European-inspired using iconic Australian floral and faunal designs. Clays are sourced locally. After watching one of their artists deftly create designs on a freshly thrown pot *(Photo 19)* we walked through to the Blue Wren Cafe for excellent coffee and tasty treats, a great way to finish a great trip.

Report by Brian England and Barry Collier.
Photographs by Ron Evans.

18. Phreatic drainage tubes showing 'hardened' edges.

19. Demonstration of pot making, Pilliga Pottery.

Additional reading can be found in the following references.

The Pilliga Forest. NSW National Parks and Wildlife Service. First Edition 2008.

Warrumbungle National Park Tourist Map. NSW National Parks and Wildlife Service. Second Edition 2003.

DUGGAN, M.B. and KNUTSON, J. (1993). *The Warrumbungle Volcano. A geological guide to the Warrumbungle National Park*. Australian Geological Survey Organisation.

FAIRLEY, A. (1977). *A complete guide to the Warrumbungle National Park*. Murray Child & Company.

FOX, P. (1996). *Warrumbungle National Park Guidebook*. NSW National Parks and Wildlife Service. The Beaten Track Press.

FOX, P. and SHELLEY, P. (2010). *Warrumbungle National Park Guidebook*. Second Edition. NSW National Parks and Wildlife Service. The Beaten Track Group Pty. Ltd.

MULLINS, B.; MARTIN, M. and BAGLIN, D. (1976). *Warrumbungle National Park*. A.H. & A.W. REED.

WHITEHEAD, J. (2010). *The geology of the Warrumbungle Range. Warrumbungle National Park, Coolah Tops National Park, Liverpool Range, Garrawilla Volcanics, Liverpool Plains, Pilliga Scrub, Forests and Nature Reserves*. Published by the Author.

WHITEHEAD, J. (Undated). *The Warrumbungle Volcano. A geological guide to the Warrumbungle National Park*.

Barraba, Bingara, Manilla & Mt. Kaputar National Park Excursion

Thursday 10th to Monday 13th October 2013

Leaders: Chris Morton and Ron Evans.

Attendance: 24 members.

Geological Summary of the Region.

Extract from Geological History of the Barraba, Bingara Manilla Region.

Notes compiled by Bob Brown, Geologist.

The Bingara-Barraba Manilla district straddles two major and very different groups of rocks, which are separated by the Peel Fault. This major dislocation of the Earths crust is exposed for several hundred kilometres from Forster on the coast, to Warialda to north of Bingara *(Fig. 1).* ***Those rocks west of the fault are referred as the Tamworth Belt, whilst those on the eastern side are regarded as the Central Block.***

The older rocks present in the Barraba-Bingara area occur in the Central Block. These represent what were slices of deep ocean seafloor during the Cambrian period. They were mainly igneous in origin and were formed to the east of a young Australian continent. The igneous sea floor rocks were progressively covered with silty and clay sediment and basaltic lavas at great depths below sea level. This process took place until the Early Carboniferous, about 330 Ma.

Further westward toward the continent landmass, in what is now the Tamworth Belt, chains of volcanic islands rose above sea level depositing vast amounts of lava and ash into the surrounding seas. The sea was initially very deep, preserving muddy and sandy sediments, which show little evidence of disturbance by currents, and certainly not by wave action. Woody fossil traces, particularly of the late Devonian plant *Leptophoem australe*, are locally abundant in these older rocks. Shelly fossils became increasing abundant as the sea shallowed and became more populated by bottom dwelling organisms.

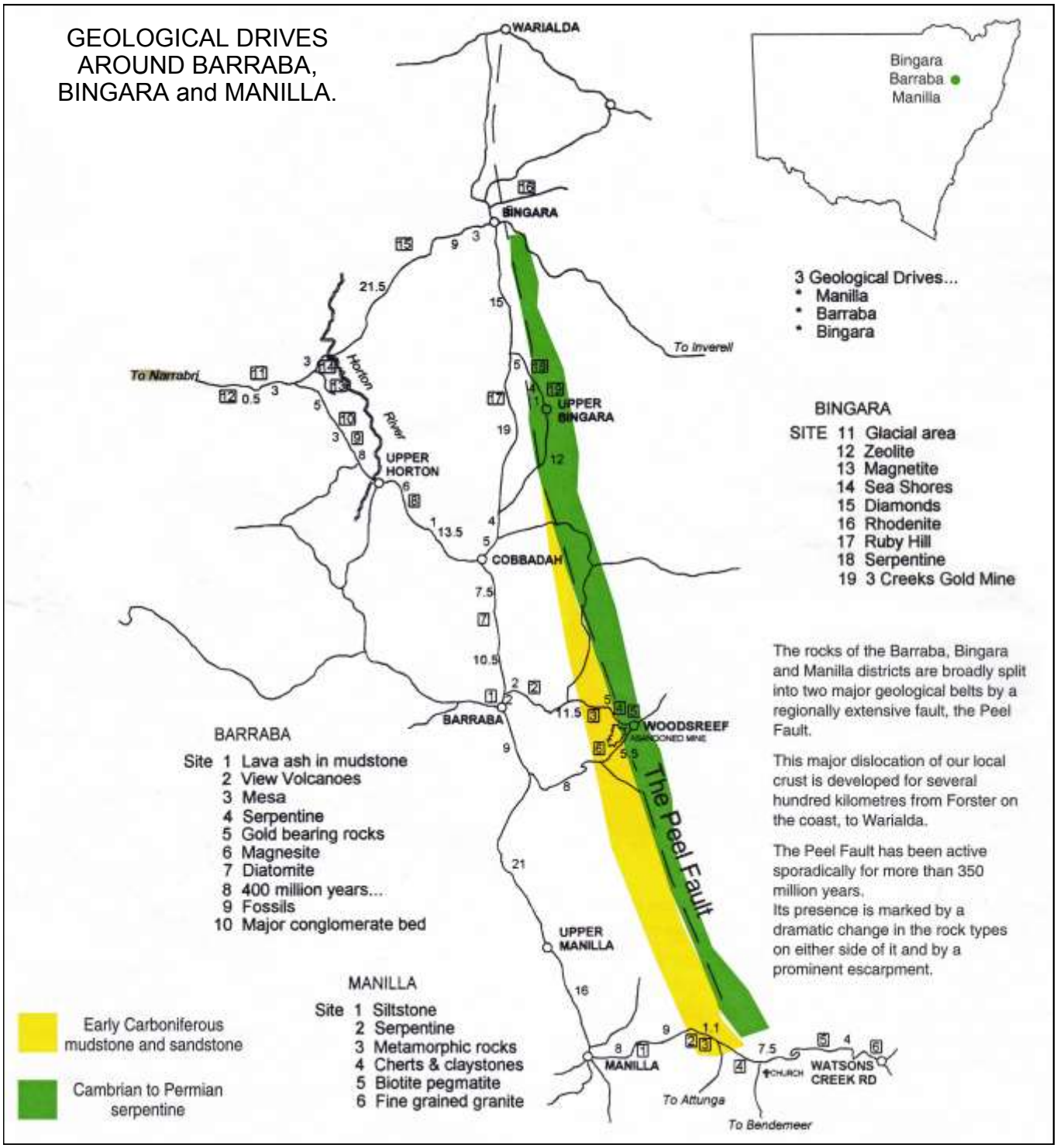
Meanwhile, the ancient ocean floor rocks of what is now the Central Block were deformed and altered, with rocks of many different ages being stacked as slices amongst one another. Serpentinite (serpentine) was formed from the alteration of the igneous seafloor rocks, and began its progressive intrusion upward into the shallow rocks.

As the sea continued shallowing into something resembling our present continental shelf, simple reefs formed about the margins of the volcanic islands. By about the mid Carboniferous, about 310 Ma, continued uplift of the seafloor resulted in the migration of the shoreline from west through to the present Tamworth Belt. Rivers and swamps developed on this newly formed part of eastern Australia, creating deposits of sand and gravel which are present today as extensive belts of tough sandstone and conglomerates forming prominent ridges running through the western edge of the Barraba-Bingara area. During this mid to late Carboniferous period, volcanic activity somewhere in the west produced vast volumes of lavas and ash. Only the ash deposits are preserved here, both as wind blown deposits, and as spectacular ash flows, which travelled as rapidly moving sheets of hot ash for many tens of kilometres from their source (similar to deposits formed by Mount St. Helens during its recent explosive eruption).

During the Late Carboniferous, plate tectonics moved the Australian landmass into subarctic latitude. This is evidenced by the preservation of glacial deposits, which can be seen at Rocky Creek Glacial area.

A major episode of deformation and uplift about 300Ma resulted in the formation of new depositional basins, including the coal-bearing Gunnedah Basin about 100 km to the west. The Peel Fault became active and formed a zone of weakness for the migration of serpentinite, and subsequently a conduit for gold bearing fluids. Deep oceanic sediments from the east were thrust against their shallower counterparts, forming the major geological structural blocks of today: the *Tamworth Belt* west of the Peel fault, and the *Central Block* to the east. The first major granite bodies resulted from melting of the crust as a result of the deformational process.

The Gunnedah Basin was superseded by the Great Australian Basin (also known as the Great Artesian Basin) during the Triassic and Early Jurassic about 170-230 Ma.



The Paleogene period saw two major episodes of volcanic activity at 34-36 and 17-20 Ma. The volcanics were erupted from fissures, small volcanoes, and the major centre of volcanic activity at Kaputar (west of Bingara). Paleogene rivers and lakes were widespread, many of the rivers dispersing gold and diamonds from the source rocks into alluvial gravels.

From the Paleogene to the present, the region has experienced alluvial deposition and occasional activity from the Peel Fault.

The rocks of the **Barraba area** are split into two major geological belts by the regionally extensive Peel Fault. This fault has been sporadically active for over 350 million years. Its presence is marked by a dramatic change in the rock types on either side and by a prominent escarpment. The tour passes eastward from Barraba toward Woodsreef, crossing the Peel Fault with sites clearly marked by signs.

Introduction.

This activity was designed for a better understanding of the development and effects that the New England Fold Belt has had on Eastern Australia, and the ancient seabeds that were prominent in the Tamworth Trough and Gunnedah Basin. Two days were allowed for travelling to and from Barraba, and another 4 days to tour and examine some of the geological features found in the area.

Day 1. Thursday 10th

After participants were settled into their accommodation, they were invited to attend a meeting in the camp kitchen at 6:00 pm. During the meeting, Ron (leader until Chris arrived on Friday) outlined:

1. The purpose of the trip that was to investigate and examine the general and specific geology of:
◊ The Tamworth Trough (Carboniferous)
◊ The Central Block to east of the Peel Fault with associated serpentinite/asbestos at Woods Reef.
◊ Metamorphic rocks east of Manilla and the lower Permian Bundarra Granites exposed in Warrabah National Park, and
◊ Paleogene Volcanics of the Mt. Kaputar NP at Waa Gorge.
2. Car pooling and convoy rules. Importance of lowering tyre pressure on rough tracks. Keeping up with convoy. Punctuality.
3. Use of UHF radios on the trip to keep people informed of stops, road conditions and so on.
4. Meeting each night at 7.00 pm in camp kitchen to outline the next days events and answer questions.
5. DVD and photo presentation on glaciation at 7:00 pm Friday in camp kitchen.
6. Excursion dinner, Sunday night at RSL. Numbers and time.

Day 2. Friday 11th

A convoy of 4x4 vehicles departed 8:00 am for Waa Gorge travelling north east via Upper Horton and west from Rocky Creek until reaching the northerly turnoff for Terrergee Road. By using this back road, we reached Waa Gorge in 24 km rather than 71 km on the normal roads.

Morning tea was taken at the recently constructed visitors car park at Waa Gorge picnic area. with its toilets, information board, covered picnic tables and gas BBQ's .

1. Starting to climb up Waa Gorge with its U-shaped bottom.

We then walked to Waa Gorge along a reasonably well-marked track that crossed the creek several times. It took a little over half hour to reach the gorge.

Waa Gorge is a short, steep gorge with a smooth U-shaped bottom that has been polished by sediment-laden water rushing down the gorge after heavy rain. Towering cliffs of pinkish rhyolite form the gorge walls *(Photo 1)*. Some layers show columnar jointing.

The group slowly climbed up the gorge (possible because the smooth bottom was dry) to the top where the two walls met at a vertical cliff *(Photo 2)*. Large potholes were weathered into the rock at the top of the gorge in a cleft where the water flows into the gorge.

Of interest were two bowl-shaped depressions (like shallow cirques) at the top of the gorge. They have been formed by sediment-laden water dropping down into the gorge and rebounding up as it hit the bottom, abrading out a circular depression in the rock (in lieu of a deeper plunge pool found at the base of most waterfalls). The water being flung up into the air by impact with the bottom then dropped again, abrading a smaller depression below the first.

From the second depression, the water flowed around a slight right hand bend smoothing the surface and undercutting the cliff above it.

Upon reaching the bottom of the gorge water loses energy rapidly as evidenced by the pile of rock

debris deposited (like a terminal moraine) which blocks the creek that then flows away from the gorge.

Two large blocks of columnar jointed rhyolite were found at the top of the gorge. They have fallen from the columnar jointed flows above the gorge when the cliff was undercut by abrasion *(Photo 3)*.

On the return walk, we stopped to look at Mill-Bullah Waterholes formed by pothole erosion and water plunging over a small waterfall. Above the pools, polygonal jointing was observed in volcanic rock through which the waterholes have eroded.

During lunch, several new members stated that they had not been to Sawn Rocks *(Photo 4)*. It was decided to take the long way home past Sawn Rocks. Before the walk into Sawn Rocks, Brian gave an explanation of the processes involved in forming polygonal columns in stationary cooling flows.

As we were behind schedule, we decided to return to Barraba via Trevallyn, a scenic drive over well-formed unpaved road. Ian having a flat tyre and then a detour due to road works near Barraba held us up on the way back to camp. It had been a long day, but very enjoyable.

A presentation delivered by Ron Evans on glaciers was held in the camp kitchen of the caravan park after the evening meal. This proved to be of great interest to our group. Ron started with a half hour lecture from The Nature of Earth: An Introduction to Geology, by Professor John J. Renton followed by images of glaciers from around the globe which Ron & Ellen had the pleasure of visiting. This was very beneficial for our trip the next day to Rocky Creek Glacial Area, giving the members of the group that did not quite understand the mechanics of glacial processes a better chance to appreciate the 290Ma (Carboniferous Period) glacial area we planned to visit the next day.

2. View north up Waa Gorge.

3. View down Waa Gorge over fallen blocks of rhyolite.

Day 3 Saturday 12th

On a fine cool morning with the promise of a warm day, members turned up to the camp kitchen bright eyed and eager, ready to begin our adventure for the day. Our first stop was at the end of a short walk to the Manilla River Bridge beside the caravan park. Here, the riverbank comprises an excellent exposure of Mandowa Mudstone. This consists of layers of bedded mudstone and siltstone. Thin white beds are present in the rocks. They formed from wind blown volcanic ash ejected from a volcanic island chain (fore arc basin) that was active to the west during the Upper Devonian.

The exposed rocks are fractured by joints and covered with angular pieces of rock, the result of fretting. Several faults, commonly thrust faults (due to compression) and normal faults (due to extension) are

4. Sawn Rocks from the viewing platform.

5. Thrust fault, ash beds, concretions, Mandowa Mudstone.

7. Rocky Creek fluvio-glacial conglomerate.

present *(Photo 5)*. Secondary minerals filled some of the fault planes and calcium carbonate concretions were present in some of the thicker mudstone beds. Quite a lot of time was spent at this site explaining the many remarkable features here. The underlying Upper Devonian marine Baldwin Formation (dominantly brown mudstones) was exposed along the riverbed below the outcrop of Mandowa Mudstones.

After walking back to our vehicles, we drove north through Upper Horton to our second stop for the day. Site 10 on Bob Browns Geo Tour brochure says *"Road cutting in steeply dipping Late Devonian mudstones, with a major conglomerate bed. The steep bedding here is due to local faulting which has tilted the strata. This conglomerate represents a regionally extensive bed of boulders and cobbles derived from shallow waters near a shoreline. The conglomerate was probably deposited here as a result of a major earthquake, which detached enormous volumes of sediment."* The deposition by a major earthquake down a sloping sea floor was a contentious issue with one or two of our members. However without definitive information on the geology in this area, this theory was left in abeyance *(Photo 6)*.

Our next stop was Rocky Creek Glacial Area where morning tea was enjoyed before we continued our explorations. We ventured into the glacial area with its stunning scenery. A beautiful stream tumbling over differentially eroded fluvio-glacial conglomerate nestled between Eucalypt and Cypress Pine hillsides, along with the blue skies and the different colours in the conglomerate was a photographers delight.

The first rock encountered was a massive fluvio-glacial conglomerate (diamictite) composed of rounded to sub-angular rocks cemented by rock flour *(Photo 7)*. Most of the inclusions were igneous rocks suggesting the origin of the boulders was from the north in the present New England area, which consists of many plutons composed of varying types of igneous rock. Deposition would have occurred in an outwash plain that forms beyond the terminus of continental glaciers.

In some places sheet fractures and erosion by plucking and abrasion has taken place leaving a smooth surface exposing cross-sections of the contained rocks. Some mistakenly believed the surface was the result of a glacier grinding the surface down, but the glacier itself probably never reached this area.

As we traversed rock shelves crossing the creek

6. Excursion participants in road cutting, Upper Horton.

8. Varved layers surrounding angular dropstones.

upstream from the conglomerates, many types of fluvio-glacial rock become apparent. Exposures of varved shale consisting of rhythmically banded muds and silts from seasonal glacial melt water were found *(Photo 8)*, along with dropstones that have settled and deformed the fine sediments *(Photo 9)*. Dropstones are blocks, cobbles or pebbles that have dropped from the base of an ice raft.

Before leaving the glacial area car park it was decided that there would not be a better spot to enjoy lunch. After lunch we drove west towards Narrabri. Just past Hell Hole Creek we found a small quarry on the left hand side of the road. With geology picks in hand, it soon became apparent that some rocks here were tillite. Then a short walk back along the road in a low cutting, a layer of muddy red zeolite rich rock was found. Apparently this is an altered tuff deposit.

On the move again with time against us, we headed east to Coroda Station and Site 13 on Bob Browns Geo Tour. Here, on a low sparsely vegetated hill 150 m off the track to the right, a small magnetite quarry was found *(Photo 10)*. This occurrence is typical of shorelines where sorting of heavy minerals occurs. The winnowing effect of the restless water and wind left a small deposit of magnetite in the sandstone. A description of how this process occurs and the experience of handling the unexpectedly heavy samples were of great interest. Above the quarry scattered amongst the Cypress Pine trees, many fine specimens were found.

A short drive further east brought us to the western side of the Horton River Bridge, where some limey sandstone (marl) was found on both sides of the road. Corestones exposed in the cutting by spheroidal weathering showed excellent examples of small scale cross-bedding *(Photo 11)*. This is Bob Browns Geo Tour site 14. This sandstone was laid down in a shallow sea during the early Carboniferous (290Ma).

10. Looking for Magnetite, Corda Station.

Much more time would have be spent here, but a short sharp rain squall hit without warning, sending us all scampering to our cars trying to protect valuable cameras and remain dry. With every cloud comes a silver lining; the rain was pleasant relief from the very warm 33 °C conditions that we were experiencing.

Moving further east through Bingara, we drove to the Rhodonite mine *(Photo 12)* along Whitlow Road with a stop to examine a road cutting containing fractured red jasper. This gave the group the chance to hear how jasper is formed from siliceous ooze at the bottom of the ocean along with minerals such as iron oxides etc. This site also demonstrated the enormous pressures brought to bear in fracturing a competent material like jasper.

Rhodonite, which is a calcium manganese silicate ($CaMn_4SiO_5O_{15}$))is a member of the pyroxenoid group of minerals. The mine was opened to extract manganese oxide used for the core of dry cell batteries and other metallurgical uses. Some good examples of manganese (pyrolusite, cryptomelane) were found in situ, however the rhodonite was of questionable quality.

9. Large angular dropstone within a tillite.

11. Cross-bedded sandstone exposed in a corestone.

Time was becoming a problem along with the warm conditions, so it was decided a comfort stop at the park beside the Gwyder River in Bingara was in order, where a magnificent very old River Redgum can be found. The soil around its root system has been progressively eroded away by successive floods; the roots have extended their growth downwards and thickened to create a fabulous playing area for children. The adults admired this phenomenon and wished for their childhood again. This lovely park is sandwiched between the Gwyder River and Halls Creek, and along with the ornate iron bridge that overlooks the area, provided a nice interlude. Someone had mentioned ice cream, so we dragged ourselves away and invaded the local ice cream parlor. Old style double scoops on a single cone really hit the spot. I think we really made the owner's day. Could you imagine 23 hot, ravenous big kids in a small town that at best would do well to see that many people all day.

It was regrettably decided because of time constraints that we would have to bypass Ruby Hill, a small plug of Jurassic basaltic breccia comprising fragments of rocks from the earth's mantle. It is rich in red garnet, mistakenly thought to be ruby. This area could be explored on Sunday afternoon in free time. Instead we drove to Bells Mountain diatomite mine just north of Barraba. Diatomite is a soft lightweight white rock made of the accumulation of the siliceous skeletons of microscopic aquatic plants known as diatoms.

All NSW diatomite deposits are Paleogene in age, and apart from Middle Flat near Cooma, contemporaneous with volcanic activity. Diatomite deposition took place in lacustrine environments formed within topographic lows. Diatomite properties make it ideal as a filter for separation of suspended solids and filtering water, dry cleaning fluids, pharmaceuticals, liquor, beer, juices, fats, oils and chemicals. It can also be used as absorbents in pet litter and commercial spill absorbents.

12. Looking for samples of Rhodonite in abandoned mine.

We arrived back at camp around 5pm where 'happy hour' was arranged. Details for meeting times and departures the next day were discussed along with many a story of past experiences. Most drifted away for showers and meals by 6:30pm and a well-earned rest.

Day 4. Sunday 13th

A pleasant morning greeted us. It had been much warmer overnight and the day promised to be somewhat milder. Our first stop was Adams Lookout on the Bundarra Rd. The lookout provided a magnificent view over Barraba and to the west overlooking the faulted, folded mudstones, siltstones and volcanic rocks that developed along the eastern margin of Australia 300-400 Ma, while the area was under the sea *(Photo 13)*. This was the perfect place to study a geological map, so the Manilla Geological Map (SH56-9) was placed on the picnic table so the local topography could be explained and put into perspective.

13. View west over Barraba and Tamworth Trough sediments from Adams Lookout.

14. Harzburgite nodule encased in schistose serpentinite.

16. Woodsreef asbestos mine pit, now abandoned.

As we drove east towards Ironbark Creek, small mesas capped with Paleogene basalts were pointed out and it was explained how the resistance to weathering of the basalt protected the underlying sandstone to create these features. At the western side of Ironbark Creek in a road cutting, we examined schistose serpentinite that has a flakey character. Schistose serpentinite is rare in eastern Australia. It is an intensely altered metamorphosed and deformed igneous rock. The original ultrabasic rock formed in the crust below the deep ocean about 550 Ma. Under intense pressure and in the presence of abundant water the original olivine and pyroxene in the ultrabasic rock has been hydrated and converted to serpentine group minerals making up the rock serpentinite. Serpentinite acts as a lubricant along faults and is squeezed through these fractures like toothpaste. A number of nodules (composed of harzburgite) from the original oceanic crust in a state of transition to serpentinite were discovered in the rock wall *(Photo 14)*, which brought a fair bit of excitement to our geologists. These bodies are called phacoids. Some chert, as well as other exotic rocks were also noted. We crossed the bridge to the eastern side where more nodules and exotic rocks were found *(Photo 15)*. Given the dramatic change in topography from one side of the creek to the other it was assumed we were very close to the Peel Fault. This stretches from Warialda to Forster and sporadically exposes the serpentinite.

15. Schistose serpentine containing Harzburgite nodules.

A short drive up the hill brought us to an area where we could park and have a good overview of the Woods Reef asbestos mine *(Photo 16)***.** This was a very interesting site where tailings from the mine had been used to fill the gully the road spans to stop water from the pit escaping. It is said 90% of the asbestos was captured by vacuuming the crushed rocks. However there is still plenty of asbestos in the tailings to be found beside the road and in gigantic fines dumps near the plant.

"Asbestos was first mined at Woodsreef, on a site of 400 hectares also near Barraba, from 1919 to the 1980s. The Chrysotile Corporation of Australia carried out large-scale mining at the site from 1970 to 1983. The open-cut mine produced approximately 500,000 tonnes of chrysotile, or white asbestos, from 100 million tonnes of mined material.

The mine closure left a 75-million tonne waste rock dump covering an area of approximately 117 hectares. A 25 -million tonne tailings dump also remains, covering approximately 43 hectares. This tailings stockpile has an average height of 45 metres, reaching a maximum height of 70 metres".

"Economic chrysotile asbestos in the Great Serpentinite belt of New South Wales is restricted to a deposit in the bifurcated Woodsreef Serpentinite. Although the Woodsreef Serpentinite is dominated by schistose serpentinite, large bodies of partially serpentinized harzburgite and massive serpentinite, as well as tectonic inclusions of dolerite, gabbro, and rodingite, occur immediately south of the Slice (the minor arm of the bifurcation) in the central part of the ultramafic body. This central area has suffered a unique stress -strain history and the asbestos deposit is localized in heavily fractured massive serpentinite that is cut by narrow S_1 and S_2 zones of schistose serpentinite. Six types of asbestos

veins are recognized: all are localized in stress-induced openings--either mineralized fractures, in extension cracks, in dilation sites in folds and kink bands, or along cleavage planes in bastite grains. Within these cracks, fibre formation took place by solution and recrystallization. As growth kept pace with the opening of cracks, the fibres became elongate parallel to the direction of maximum elongation in the XY plane of the strain ellipsoid. This fiber growth took place during S_1 and S_2 formation in the surrounding schistose serpentinite and is thus an integral part of the deformation in this part of the body."

A short walk down the road from this dramatic scar on the countryside is Site 15 on Bob Brown's Geo Tour. At this point there is a gravelly deposit atop a road cutting *(Photo 17)*. This is the remnant of a Paleogene riverbed, one of many preserved in the surrounding hills. These Paleogene riverbeds have the possibility of carrying low concentrations of gold. This feature sits on top of schistose serpentinite. There are also a number of magnesite veins present in serpentine exposed in the cutting. These are the result of weathering processes. It was also noted that there was a large exotic block of rock on the western side of the cutting, probably secondary sediments from the Paleogene riverbed that is perched above.

17. Paleogene riverbed deposits over weathered serpentine.

18. Woodsreef asbestos processing plant, now abandoned.

19. Section of the enormous fines dumps at Woodsreef.

20. Caliche nodule.

Continuing on we turned into Crow Mountain Road where we stopped to look at the asbestos-processing mill *(Photo 18)* and spoils dump, now eroding badly *(Photo 19)*. Where rainwater had eroded the side of the road, here was a well defined rodingite dyke cutting almost fresh harzburgite containing abundant crystals of bastite which flashed in the sunlight. Bastite is not a mineral, but a term used for serpentine minerals replacing enstatite and orthopyroxene.

From here we continued along Crow Mountain Road where we came across some magnificent Xanthorrhoeas in full bloom; there were many photo's captured. We then drove to the end of Crow Mountain Road where magnesite (magnesium carbonate) deposits can be found. These deposits result from weathered serpentine, but remain suspended in the soil above the serpentinite *(Photo 20)*. A short time was spent there before heading west to Glen Riddle Recreation Reserve. This saw the end of the day's organized activities, leaving everyone to have a free afternoon before we went to dinner at the Barraba RSL Club.

After a lovely meal that was washed down with a relaxing wine or cool ale, much banter was enjoyed. Brian Redmayne, a new member and dentist by profession, was called upon by Ron Evans (life member) to give a speech on how dentistry can relate to geology. Brian, who had not been forewarned about this ambush, did an outstanding job on relating how col's in dentistry have an analogy to mountain glaciation.

Day 5. Monday 14th

After a very cold night, (0.3°C was noted at 5am), there was an 8 am gathering in the camp kitchen. Before heading out on the days trip, it was decided to conduct a short lesson on how to read a geology map, due to one or two members mentioning that they found the geological map confusing. After this exercise we headed south to Manilla where some supplies were acquired for our end of trip BBQ that night. This task achieved, we set off along Halls Creek Road for around 18km to Site 3 on the Manilla Geo Tour *(Photo 21)*. Here there is a road cutting displaying strongly cleaved metamorphic rocks, phyllites and some chert. The absence of bedding planes in the rocks that were deposited in a deep ocean environment was obvious, leaving us to consider the enormous forces involved in contorting this rockmass.

Our next stop was some 4km along the Bendemeer Road where there is a substantial road cutting (Site 4 on the Geo Tour) exposing very confused and strongly contorted bedding planes *(Photo 22)*. The rocks consisted of cherts and claystones on the western end and jasper towards the eastern end. The cherts and claystones are indicative of a deep-sea environment. Bob Brown comments "*Sea floor volcanic activity introduced basaltic lavas amongst the clay and produced iron-rich and manganese-rich deposits. Cherts that received larger iron intake have formed jasper.*" Some faulting was evident, however due to the very confused state of the rocks here it was determined that it would take more time than we had to properly describe this site.

22. Strongly contorted cherts and claystones.

Driving on, some large jasper boulders in the fields were pointed out. Our next stop was along the very steep and precipitous Watson's Creek Road (a dirt track would be a better description) where we had a biotite dyke to find. Great care was taken on this track. At one point we had to delegate a traffic warden to stop traffic so the front vehicle could make a U-turn to proceed up the hill at a switchback. We were fortunate that there was no other traffic ascending or descending the road as we had the single lane track blocked for 30 minutes or so with six vehicles while we examined the biotite rock *(Photos 23 and 24)*. This zone of coarse biotite mica lies immediately adjacent to the margin of the Bundarra Granite and is flanked on either side by tough fine-grained hornfels (contact metamorphosed shale). The biotite-rich rock is therefore most likely a skarn.

Given the situation we thought it prudent to continue on to the top of the hill where refreshments were enjoyed. Heading back the way we came towards Manilla, our next destination was Warrabah National

21. Phyllites, strongly cleaved vertically.

23. Biotite skarn at the margin of the Bundarra Granite

Park. After arriving at about 1:15pm it was decided to have lunch beside the Namoi River in the picnic area *(Photo 25)* before we indulged ourselves in the sights of the park. After lunch we drove the 4x4 track to Billy's Hole Walk-in Camping Area Carpark where we ventured down the walking track to the river *(Photo 26).* The area is very scenic as the Namoi River has eroded the Bundarra Granites into a series of pools, rocky shelves and cascades. We spent a short time here until someone raised the issue of time, which was quickly getting away from us. With a 90 minute drive back to Barraba it was decided to head home, promising to return to this idyllic spot.

24. Biotite skarn rock - note crystals of shiny black biotite.

25. Namoi River next to Warrabah NP picnic area.

26 . Pools amongst granite boulders, Billys Hole.

We arrived back to camp in time to ready ourselves for the end of trip BBQ that evening. At the BBQ, there was one more task to perform. After visiting Woods Reef Mine, there had been much debate on how the mine area had been left without any remediation. We coerced Terry Kingdon into giving us a presentation on the remediation of mines. This ended in constructive debate which everyone enjoyed and we thanked Terry for his excellent delivery. Then with all the thank you and pleasantries out of the way it was agreed that the expedition was a great success and up to our usual standards which we consider very high.

A lot of planning and research was needed to make this expedition a success. Winston Pratt gave 4 days of his time to do a survey that became very humorous at times and very enlightening. Ron and Ellen Evans spent 4 days as well touring the district identifying sites, and Ron at short notice had to lead the activity when Chris was called away for family reasons.

Thanks guys.

Report by Chris Morton and Ron Evans.
With additions and corrections by Brian England
Photographs by Ron Evans

References:

Barraba, NSW.; Woodsreef Asbestos mining and aftermath. *http://en.wikipedia.org/wiki Barraba,_ New_ South_ Wales*

BROWN, R.E. (Bob); VICKERY, N.M. (Nancy); Bob and Nancy's Geological Tour Site. Barraba-Woodsreef Tour, Barraba-Bingara Tour, Manilla, Nandewar Volcano. *brovey.yolasite.com/free-self-drive-geological-tours.php*

GLEN, R.A.; BUTT, B.C.; (2006) Chrysotile Asbestos at Woodsreef, New South Wales. (http:// economicgeology.org content/76/5/1153.abstract)

Flinders Island - Geology and Landforms Geological Safari 2013

Monday 1st April to Monday 8th April 2013

Trip Leader: Brian England.

Trip Organisers: Ian Rogers and Leonie Mills.

Attendance: 18 members.

Members made their own way to Sydney Airport for the Monday departure to Melbourne and on to Flinders Island. Some travelled down by train to Central then by bus to the Ibis Motel at St. Peters on the Sunday afternoon to ensure their arrival at the Airport was not delayed by problems on the F3 Freeway or with the trains in the early hours of Monday morning, as often happens. Those who travelled down early had time to explore the dramatic transformation of the old St. Peters Brickworks and clay pit to a public park complete with historic crushing machinery, kilns, coke ovens and majestic brick chimneys all preserved as an integral part of an extensive recreation area. They also enjoyed a great dinner that night at the Southern Cross Hotel just down the road.

Monday 1st April.

All 12 members booked on the Virgin flight to Melbourne arrived well in advance of the 10am departure time. After an uneventful flight our Boeing 737-800 touched down at Tullamarine just on 11:35am. Anxious to transfer to Essendon Airport for the flight to Flinders Island as soon as possible, we caught two maxi-taxis across to the Sharp Airlines terminal. There were no services here and no-one at the booking counter when we arrived. The only snack and coffee shop in the terminal was closed. But a chocolate machine and nearby Subway Bar ensured that no-one went hungry. Half an hour before the departure time the booking-in counter was at last manned by none other than our two pilots, in fact the same pilots whom I'd flown down with on the Aldinga Tours trip two years ago!

1. Sharp Airlines Fairchild Metro aircraft.

Our little plane *(Photo 1)* lifted off the tarmac at 1:30pm and travelled east along the Victorian coast before turning south over Bass Strait just beyond Wilsons Promontory. Once away from the coast cloud cover became quite thick and, perhaps fortunately, views down onto the ocean were obscured. Little of the island could be seen through the cloud as we came in to land at Whitemark Airport. We touched down at 2:35pm and emerged from the relative comfort of the aircraft into air at a chilly 15°C, with a strong wind and rain squalls frequently passing over the airport.

Only two of the four hire cars pre-ordered for the group were at the Airport and these were used to shuttle people to their accommodation at the Interstate Hotel and the two houses on the waterfront in Whitemark. Being Easter Monday, nothing was open. Although inconvenient this gave us time to settle in and relax, with our exploration of the island beginning tomorrow.

Tuesday 2nd April.

The morning had been set aside as free time to explore Whitemark and stock up for the next few days. Whitemark is the largest of the Island's few towns and is the civil and commercial centre with a bakery, supermarket, petrol station, garage, newsagency, Post Office, Westpack agency, butcher, café, Council Offices, gallery, gem and crafts shops and Police Station. Here also are branches of the DPI and Government Tourist Information Centre. The Interstate Hotel, an imposing concrete building of 32 rooms, was constructed in 1911/12 by John Neehan to provide hospitality for shipwrecked sailors, mutton birders, fisherman, Government officials, businessmen and tourists. In the early days a list of Australian hotels listed the Flinders Island Interstate as "the most isolated pub in the country".

Some people visited Doreen's Gallery and were treated to a watercolor tour of the Island's landscapes.

As well as the brightly coloured paintings there were several spectacular examples of driftwood collected from the east coast beaches. Doreen also had on display small trays of well-formed quartz crystals collected in the Killiecrankie area.

At 1pm the group assembled in the Hotel carpark and set off in convoy to Walkers Lookout, accessed by a formed dirt road leading off Memana Road northeast of Whitemark. At an elevation of 411 metres this is one of the highest points on the Island and provides a 360° view from Mount Tanner and Killiecrankie in the northwest to the coastal plains and wetland lagoons of the east coast, around to spectacular views down through the boulder-strewn granite peaks along the spine of the Darling Range towards Strzelecki Peaks *(Photo 2)*, then west across Whitemark and Parry's Bay. The air was perfectly clear, a rare occurrence, but the westerly wind on this exposed peak was strong and relentless.

A small cutting at the base of the communications tower provided one of the few exposures of the Silurian Mathinna Beds on Flinders Island, here somewhat weathered and cut by narrow veins of white quartz. But although rich gold-bearing specimens of vein quartz assaying up to 32 ounces to the ton have been found between here and Thule Road to the south there was not even the faintest gleam of the yellow metal in the rocks here!

The photographers well satisfied, we drove on to Sawyers Bay at the end of the Sawyers Beach Road *(Photo 3)*, off the Palana Road about 14 kilometres north of Whitemark on the western coastline. Parking at the end of the road on the edge of the steep grassy slope down to the beach we began walking to the southwest along the coast, changing from beach to granite outcrops as accessibility demanded.

Along the beaches we found abundant mussel shells along with cone shells, limpets, bryozoans and other marine relics scattered along the tide marks on the coarse barely-rounded white quartz sand. Unfortunately, being close to high tide, the spectacular granite tors covered with orange lichen which are the most spectacular feature of the bay were largely submerged, but we would return later in the week at low tide as a special treat for the photographers.

The granodiorite here is relatively fine-grained and would be uninteresting but for the presence of numerous aplite (leucomicrogranite) dykes and mafic enclaves (xenoliths) from a few centimetres to over two metres across. These often show differential erosion, the softer mafic minerals (hornblende, biotite) weathering and eroding more quickly to leave the enclaves as shallow depressions in the more resistant granodiorite host. Exfoliation, developed along horizontal joints caused by relief of confining pressure as the overlying rocks were removed by erosion, was also evident on some of the larger expanses of granodiorite. Also found were examples of a coarse pink K-feldspar/quartz pegmatite and quartz veins with crystal-lined vughs in the granitic beach cobbles.

Further along the walk we had to negotiate hedgerows of spiky African boxthorn, the fruit a favourite of green rosellas. In the early colonization years *Lycium ferocissimum* was used as cheap and effective fencing for stock paddocks but birds soon spread the seeds, resulting in large areas being taken over by this aggressively thorny weed.

Our progress around to Settlement Point was eventually barred by an electric fence leading down to high water level amongst an impossible pile of granite boulders. So an earlier than expected return to the vehicles was unavoidable, but the coastal views along this relatively easy stroll had been spectacular, with

2. Walkers Lookout looking south towards Mt. Strzelecki.

3. First view of Sawyers Bay - mad keen photographers.

4. View back to Sawyers Beach from end of walk .

5. Stone Chapel at Wybalenna.

the Strzelecki Peaks constantly visible across the bay in the distance to the south and coastal tussock grass and granite boulders providing exceptional foreground *(Photo 4)*.

So with time to spare we drove further to the north through Emita to the Wybalenna Chapel *(Photo 5)* and graveyard to add a little unscheduled local history to the program.

The story of Wybalenna is one of a sad and unsuccessful attempt to establish a settlement for the protection of the last of the Tasmanian Aboriginal people, whose forebears for years up till then had been shamefully and ruthlessly exterminated as a people who were regarded as sub-human, of little use and without rights. The man behind this scheme was English builder and bricklayer George Augustus Robinson. With Missionary-like zeal he gave up his profitable business to become Conciliator for Aboriginals on Bruny Island.

In 1831 the all-European Aboriginal Committee decided that the remaining Aboriginals (around 500 in all) should be rounded up and moved to Vansittart Island as a means of getting them out of the way. Robinson, with a small party and Truganini as guide and interpreter, travelled the wilds of Tasmania in search of the remaining Aboriginal people. But he found that most of the women and girls had been abducted by sealers and used as slaves. The people captured on these journeys were initially taken to Swan Island, then to Vansittart, but the island lacked game and a water supply. In 1832 13 women and 26 men were sent via the brig Charlotte to The Lagoons on the southwestern coast of Flinders Island, where they hunted, fished and ran sheep given to them by sympathetic local settlers. They were able to sell wool to buy food.

In February 1833 Commandant William Darling (Darling Range) found a more suitable site at Pea Jacket Point, later called Wybalenna, and a permanent settlement was established. Although 33 Aboriginals died during the first year, Robinson continued to send in more. When Darling left to rejoin his regiment in India, there were 30 Europeans and 110 Aboriginals on the island. They had endured continual abuse and their women were being used as prostitutes. Food was short and the meager water supply was never upgraded for the increasing population.

Robinson himself arrived in 1835 to take charge of the community, bringing with him another 17 Aborigines, almost the last of the true Tasmanians. He also brought with him stores and provisions for a now almost destitute settlement. A school was set up for the boys and those who could read and write were encouraged to set up the fortnightly news sheet "The Flinders Island Chronicle". The money earned by selling mutton birds, wallaby skins and wool was paid into a special fund and the people were taught how to use money and to respect and value private property. They were given instruction in Christian principles in a vain attempt to replace their culture with European values and work ethic, all completely beyond their comprehension. And still they died!

To improve conditions Robinson had houses, barracks, a hospital, goal and a chapel built in brick and timber, plus 20 thatch-roof cottages for the natives. During Robinson's term as commandant 60 natives died. Discouraged, he left the island to become Protector of Aborigines at Port Phillip, again with disastrous results. In his absence, and now at the mercy of a string of uncaring superintendants, the remaining Aborigines returned to their old tribal customs. Of all the strong healthy people brought to Flinders Island, only 46 remained by 1847. These were moved to Oyster Cove near Hobart and soon after all had died, having

been reduced to hopeless and helpless lives.

Mathinna (Mathinna Beds) was born on Flinders Island, the daughter of a chief. She was taken at age 6 to live at Government House by Sir John and Lady Franklin but was later sent to the Hobart Orphans Home. She was one of those later moved from Flinders Island to Oyster Cove where, accepted by neither black nor white society, she was found dead at the age of 21. Truganini, another of the people moved to Flinders Island and regarded as the last of the true Tasmanians, died in Hobart in 1876. Edgecombe (2007) eloquently sums up the failure of this venture:

"Robinson's grand vision of saving the race failed as much through lack of understanding of their psychological needs as of their physical and medical needs. Firmly believing that to Christianise was to civilize, he tried to change these forest-dwelling, hunter gatherers into God-fearing peasant cultivators and, despite the frequency and persistence with which they continued to die, could not face up to the flaws in his philosophy".

For many years the Chapel was used as a shearing shed until it was purchased in 1973 by the National Trust. Restoration was carried out using bricks salvaged from nearby ruins and similar bricks brought in from Tasmania. The vestry was added later using bricks from the demolition of an old Launceston building. The mantelpiece came from an old home on Badger Island. Parks and Wildlife Service took over management of the site when the Flinders Island branch of National Trust closed. The Aboriginal Land Council of Tasmania has held title over the site since 1999. Now only the Chapel, cemetery and low piles of broken bricks mark the site of this infamous settlement.

We spent time exploring the Chapel inside and out and then walked up to the historic cemetery where the graves of some of the early settlers can be seen and where many of the Aborigines who died on the island also lie. There are also recent internments, showing that this sacred site is still being used.

To end the day a short walk was undertaken by some of the group from the Emita Beach picnic area south around the top of the headland to a small bay rimmed by granite boulders. A very picturesque area which demanded more detailed exploration later in the trip.

Wednesday 3rd April.

The group assembled in the Hotel carpark at 8:30 am in preparation for the first full day of exploration. At 8:45 am we headed off in convoy to Killiecrankie, 40 kilometres to the north. The obligatory morning coffee break was held in the picnic area overlooking magnificent Killiecrankie Bay and Mount Killiecrankie beyond; its slopes a tortured patchwork of green scrub and bare grey granite. At 10:15 am we set off on foot for the 4 kilometre trek up to Stacky's Bight and Old Mans Head, heading east up Killiecrankie Beach and crossing Killiecrankie Creek where it formed a shallow narrow channel across the white quartz sand. Beyond lay the long crescent shape of the main beach, curling around to the bouldery shoreline at the foot of Mount Killiecrankie *(Photo 6).*

Local residents were also out on the beach, walking their dogs or just enjoying the ambience of the bay on such a magnificent morning. Some were eager to talk, passing on useful information on the final leg of the track to Old Mans Head and of course where to find Killiecrankie diamonds.

North of Killiecrankie Creek the keen photographers began to fall seriously behind, struggling to digitally record the astonishing patterns laid out in the sand by fresh-water springs seeping from rain water pooled behind the line of low sand hills backing the beach as the falling tide exposed the ever widening intertidal zone. Our carefully-placed footsteps would momentarily destroy some of these patterns as we searched out patches of firm wet sand to ease our progress.

Two thirds of the way up the beach stood a spectacular line of low cliffs of Quaternary calcarenite (calcareous sandstone) composed largely of wind-deposited fragments of marine shells and quartz sand.

6. Killiecrankie beach towards Old Mans Head.

7. Angular unconformity in calcarenite deposit.

9. Stacky's Bight.

Thinly bedded and steeply dipping, the rock here is characteristic of the dune limestones found sporadically along the west coast. One section displayed a magnificent example of an angular unconformity *(Photo 7).*

Another few hundred metres brought us to a bouldery granite foreshore which would continue right into Stacky's Bight and eventually Old Mans Head *(Photo 8)*. Local people back down the beach had advised us to avoid the scramble over the granite outcrops of Diamond Gully and take the 4WD track up past the Quoin Manager's house. This led up over the sand blows at the base of Mount Killiecrankie and provided a short stretch of easy walking. The only drawback was that we would be diverting around the topaz-producing area down on the foreshore.

Within a few hundred metres the 4WD track swung away from the coast. At this point a narrow but well-defined pathway through dense tea-tree scrub led on around the coastline, passing beneath some spectacular tafoni in granite boulders scattered along a ridge extending down from the Killiecrankie summit. While we had now entered private land, the owners allow bushwalkers through unimpeded these days, although past Quoin Managers had met intruders with a loaded shotgun! The path eventually petered out in dense scrub and the only way forward seemed to be by sliding down onto a sloping granite shelf exposed only at low tide. But a crude continuation was found marked by a small stone cairn a few metres further up the steep sandy slope. Another 50 metres or so of scrub bashing brought us to a length of rope which led down to the rock platform at the eastern side of the beach at Stacky's Bight.

8. View from track towards Old Mans Head.

As we stepped onto the sand what a magical scene unfolded before us! Here was a tiny pristine white sand beach, unmarked by any prior human presence, with granite cliffs on the eastern side and a huge natural arch in cross-bedded calcarenite on the west, with views across Killiecrankie Bay towards Mount Tanner *(Photo 9).* The beach was well-sheltered from any winds and a perfect place to relax, enjoy lunch, and allow our minds to absorb some of the most magnificent surroundings in the known universe!

Low tide had exposed the rock platform around and under the arch, the wet and craggy limestone supporting dense colonies of unusual seaweeds draped over it like strings of dark green pearls. Venturing through the arch took us to fascinating outcrops of coarse biotite-rich granitic rocks beyond, with scattered crystals of K-feldspar to two centimetres across and numerous pegmatite veins carrying coarse crystals of pink feldspar and white quartz. Here in the pegmatites were crystal-lined pockets and tantalizing traces of pale blue topaz.

We had lost sight of Old Mans Head a few hundred metres back down the coast but climbing the steep sandy path to the top of the next headland brought it abruptly into view and only a few hundred metres away. There were no defined paths here, but bashing through the tall scrub brought us to two ap-

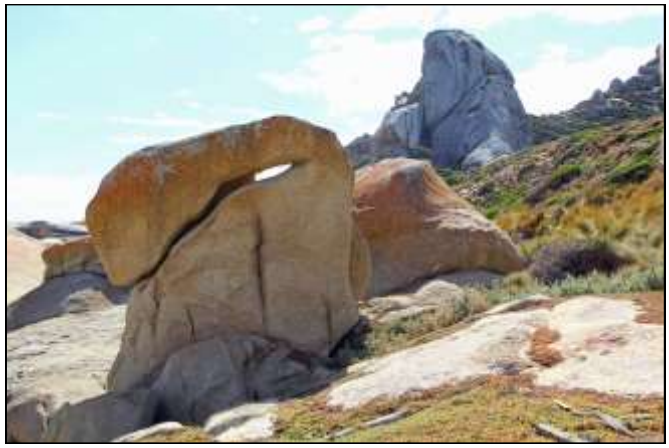
parently abandoned huts used in the past by rock climbers. One was made from corrugated iron, the other being a circular construction from locally felled logs and open to the elements. It was crammed with a variety of stuff in complete disorder and in various stages of disintegration. It was obvious that neither of the huts had been used for a very long time. The land we were entering south of Old Mans Head was also privately owned but walkers are tolerated as long as nothing, including the vegetation, is disturbed.

A short scramble through the scrub brought us to the top of a series of sand-draped calcarenite ridges directly overlooking Old Mans Head *(Photo 10)*. This enormous pile of bare granite boulders has the uncanny appearance of an elderly Chinese gentleman complete with well-defined face, eyes, neck, hunched shoulders, and a chin resting thoughtfully on a clenched granite fist *(Photo 11)*. No rock sculptor could have done better on such a scale.

We slid down onto the massive granite slabs along the shoreline to discover more great pegmatite veins and pockets, many with vughs which once held well-formed crystals that were now too battered by the pounding ocean to be of any use to collectors. There were few mafic enclaves in the granitic rocks here. As we scrambled further north along the coast the massive isolated headland we had come to see looked less and less like the old Chinese man we had first seen from the top of the ridge.

Trekking another few hundred metres north along this rugged coastline would have brought us to "The Dock", one of the most magnificent places on the Island and otherwise only accessible by a rough 4WD track in from the Palana Road. But at 2pm the group began to head back, returning along the same route. There would be no chance to search for the elusive topaz, but these days that requires considerable time

10. Old Mans Head.



11. Unusual weathering along a joint in a boulder.

and effort in excavating sand from beneath the huge granite boulders at the back of the beach. Too much work for our liking! Two days after returning home I had to attend a meeting of collectors and mineralogists in Canberra and there met Tony Forsyth who as a youngster had done many trips to Diamond Gully and other places on Flinders Island in search of topaz. Each of those trips would yield up to 3Kg of the "diamonds", including many crystals. But that was a long time ago.

So far we had seen none of the infamous tiger snakes Flinders Island is renowned for but local intelligence told us that the mating season had just finished and these reptiles were now entering the hibernation stage of their life cycle.

We were back at the vehicles at 3pm and spent a few minutes recording the views over the coastal rock platform and Nobby's Rock offshore across the bay towards Mount Killiecrankie in perfect afternoon light. Such spectacular views would be difficult to equal anywhere. In the trees near the picnic area a flock of yellow-tail black cockatoos took flight on our arrival and a few magpies searched around the tables for scraps. Although The Bay coffee shop in Killiecrankie Village opens on request for anyone desperate for coffee, we decided to return to Whitemark.

On the return trip most took the 7km of formed dirt road to the 331m summit of Mount Tanner, the highest peak in the north of the island, for extensive views over Killiecrankie Bay and Mount Killiecrankie now resplendent in the perfectly clear air *(Photo 12)*. The microwave repeater station here came into service in 1967, linking Tasmania as well as Flinders Island to the world outside. The tower has been superseded by fibre optic cable laid across Bass Strait, but has been retained as backup.

12. Mt. Killiecrankie and Killiecrankie Bay from Mt. Tanner.

14. Off on a supposedly a 5 hr return walk to the top of Strzelecki Peak.

Wallabies were now out in large numbers and the roadside was littered with the corpses of those without any road sense. It was amusing to notice families of ravens perched on roadside power lines at strategic points, intently watching the passing traffic and obviously waiting for fresher road kill to gorge themselves on.

Whitemark was reached at 4:45pm in time for that perfect mug of cappuccino at Freckles Café opposite the bakery. It had been a perfect day. The 22°C temperature had made for comfortable walking and the air was as clear as it could possibly be, with just sufficient cloud to provide visual balance for some incredible landscape photography.

Thursday 4th April.

The forecast promised another perfectly clear and sunny day with no cloud. So we could postpone it no longer. Today the infamous Mount Strzelecki had to be faced *(Photo 13)*! We were prepared for a moderate three-hour climb and two hour descent, giving us time to explore the Trousers Point Track after lunch and return to Whitemark in time for coffee. But that was not to be!

It was 9:40am when we climbed over the style at the side of the Trousers Point Road opposite Carena Park Homestead 12 kilometres from Whitemark *(Photo 14)*. The guide books warned of a moderate to hard climb but we were soon to learn this was a gross understatement for a group of people such as us not at their peak level of fitness. Some would handle the climb better than others, and some would choose to turn back short of the summit, 2.8 kilometres from the starting point.

The track started out as a two metre wide tunnel through dense casuarina forest beside a delightful creek, at first climbing only gradually. But it soon narrowed considerably as the first creek crossing was reached. The creek was flowing but carefully placed stepping stones provided a dry crossing. A rock pool just upstream had been deepened by adding a concrete flume and a black plastic pipe led downhill, probably to supply water to the local farm. Then the track began to climb ever more steeply around the stony ridges, flattening out to provide some respite only occasionally and then only over a few metres. A

13. Strzelecki Peaks from Whitemark.

15. Looking north towards Whitemark.

16. Trousers Point, Mt. Chappell and Badger islands.

18. Barbara having a well earned rest

large flat rock in a small clearing in the dense scrub provided a good viewpoint *(Photo 15)* and an excuse to rest briefly. Soon afterwards it plunged into a small deep creek bed filled with tree ferns and moss. We had been warned to expect leeches, but saw none even though the creek bed was wet. The track ascended into a small patch of eucalypt and wattle, then narrowed even further and really began to climb, weaving between and over large angular granite rocks on what seemed to be an overgrown scree slope. Occasional clearings through the scrub gave stupendous views over the surrounding bare granite peaks and back over Trousers Point *(Photo 16)* now several hundred metres below. Higher up the mountain we climbed through moss forest with an understorey of ferns, lichens and tree ferns, with the exposed roots of larger trees sprawling over the rocks in search of cracks for anchor points, soil and water. This area has the highest rainfall on the island, although over the past few months the weather had been unusually dry.

By now the group was well spread out, each person taking on the mountain at their own pace. While it remained well-defined, the track became extremely rough as it switched back and forth up the very steep slope beneath gigantic sheer granite walls. The climb

17. As far as we climbed - view towards Trousers Point.

now seemed never-ending! Then at last we came to the final steep scramble up a rocky gully over towered by massive granite walls towards the summit, but at no point could we actually see our final goal. But ahead I could hear Laurel and Sue chatting away so I knew it was not far off. They had made the climb in 2½ hours, but I was happy enough to have made it in three; the average recorded time. Over the next hour or so the remainder of the summit group appeared from the scrub.

The end of the track opened out onto a wide flat granite saddle at an elevation of 756 metres *(Photo 17)*, not the highest point in the Strzelecki Peaks, but high enough and exposed enough to afford stupendous views down through the valleys towards Cape Barren Island and over the edge down onto Trousers Point and Fotheringate Bay. In every direction monstrous grey granite peaks protruded from the dense green forest cloaking their lower slopes. Mobile phone reception was good here so several people rang home. The track seemed to continue on over the saddle and down into a scrubby gully but could only be traced for a few hundred metres before it merged into the forest.

Plant communities change dramatically with altitude on Strzelecki Peaks. Above 500 metres manna gums and Tasmanian bluegums give way to mountain pepper, dogwood, blueberry ash and privet mock olive. In the more sheltered gullies, large spring-flowering sassafras rises above a diverse community of ferns. Towards the windswept summit low heath predominates.

After a rest *(Photo 18)*, light snack and liquid refreshment it was time to go down. Oh Hell!! How on earth did we climb this! A few hundred metres down and my knees began to complain in earnest, pleading with me to stop this self-torture. It became so easy to

overbalance and take the quick way to the bottom, especially in places where the risers on the path were over a third of a metre high. But part way down the steepest section we came upon a rare sight which forced us to take a break. Beside the track we disturbed a white echidna *(Photo 19)*, and it wasn't at all camera-shy! Then the torture continued, the only goal now to complete the trek and survive relatively unscathed so we could explore the rest of the island over the next several days.

So intense was the effort now that taking in the magnificent surroundings no longer seemed important, although down near the first creek I did notice hundreds of common brown butterflies flapping around in a quest for water. The further we went the more painful progress became, forcing some to walk down backwards where possible to relieve pressure on the knees.

Most of the group who reached the summit were back down by 1:45pm in various stages of exhaustion, but it would be 5pm before the last person down finally appeared. In the meantime we rested, drank coffee and reflected on the trek up (and down) the mountain. We had completed the climb in absolutely perfect conditions. But this mountain certainly demands respect. To climb it in strong winds or under a cover of cloud would be nothing short of irresponsible. How athletes competing in the Three Peaks Race tackle this track at night, in the dark, and running up from Lady Barron beggars the imagination!

Friday 5th April.

A partly cloudy day and a maximum temperature of 22°C had been forecast and that's exactly how it turned out. Cloud in the east resulted in a brilliant sunrise. It would be another perfect day for walking.

20. Meeting in front of the Interstate Hotel, accommodation for many safari participants.

We left the Hotel *(Photo 20)* carpark in convoy at 9am, heading north along Palana Road and turning off into Emita within sight of Castle Rock. Some of the group had explored the road down to Allports Beach on Wednesday and had passed a large blue sign "Start of the Emita Beach and Castle Rock Track". So naturally this is where we had planned to start our leisurely walk along the beach to Castle Rock. Morning coffee was called in the grassy carpark just off Allports Beach Road, where explanatory signs erected by National Parks outlined the range of wildlife which might be encountered in the area.

At 10am we began our walk through casuarina forest to the coast, only to be confronted by a trek over several rough rocky headlands, with our goal far off in the distance! This would certainly not be the easy beach walk described in the guidebook and after the pain and suffering associated with yesterday's climb we felt unable to continue. So backing off and returning to the cars *(Photo 21)* we drove back to the Emita Beach Road and continued down to the picnic area at its end, just above the clean white sand of Emita Beach. From here the walk to Castle Rock would be shorter and much much easier.

In an attempt to shorten the walk even further one

19. Endemic white Echidna beside track.

21. Returning to the cars across a rough cobble beach.

22. Looking back along Emita Beach to start of walk .

group drove up Palana Road to look for a direct vehicle access route marked on the 1:100 000 topographic map, but were confronted by a locked gate and a rough sandy track beyond. Strictly 4WD only!

A deteriorating weather-worn wooden stairway led down to the beach *(Photo 22)* from the picnic area and it was just a short walk along the firm wet sand to the next headland, where a short sandy track led to the top. Up there it was flat and relatively easy walking.

From the track the rocks on the next headland looked interesting and demanded closer inspection. So we carefully made a path down the rocky slope at the southern end of the small un-named beach. In our somewhat fragile condition the climb down was painful but nowhere near as challenging as the mountain yesterday.

Down on the beach the geology immediately hit us in the face with its stunning variety and complexity. The granite exposed on the northern side of the first headland north of Emita Beach was fine grained and crowded with spherical nodules of coarse-grained black tourmaline up to 5 centimetres across *(Photo 23)*.

23. Fractured granite containing tourmaline nodules.

24.

25.

This unusual rock extended south around a wall of craggy pinnacles for several metres to a point where it terminated abruptly at a sharp undulating contact with underlying "normal" granite dipping gently to the north. What we had found seemed to be a massive dyke-like body whose upper contact had been removed by erosion.

The same rock outcropped at the northern end of the beach, this time as bold vertical cliffs cut by closely spaced vertical fractures forming an unusual and dramatic background for photographs across Marshall Bay towards Mount Tanner. Even on the falling tide it was not possible to continue north around the base of the cliffs, forcing a short scramble up to the top of the headland to rejoin the Castle Rock Track. But even up here the rock was interesting, chiselled by the weather into a myriad of weird shapes.

Stranded and sheltering on the seaward side of a granite pinnacle we found a lone lost penguin forlornly looking out over the water, perhaps searching for a missing mate; all perfectly sculptured in granite by nature *(Photo 24)*! A few metres north a massive deep narrow chasm had been gouged into the granite, perhaps along a fault or shear zone. Here the granite surface, blackened by centuries of weathering, showed closely spaced irregular light-coloured spall marks as if thin patches on the surface had been blasted away *(Photo 25)*. I thought this may have been due to the impact of rocks thrown up by very rough seas (admittedly extremely rough) while others preferred to explain these marks as due to the effect of heating on areas of sub-surface salt water, or simply crystallisation of salt itself.

The walking track continued to curve around the top of the headland at the edge of a flat grassy plain *(Photo 26)*, eventually descending to the southern end of Castle Rock Beach. Here more granite was exposed,

26. Looking towards Castle Rock from the headland.

28. Approaching Castle Rock.

but completely different in texture to any we had seen before. Scattered throughout a relatively fine matrix of K-feldspar, quartz, biotite and plagioclase were well-formed phenocrysts of K-feldspar up to five centimetres diameter showing pronounced colour zoning and a ring of biotite inclusions a few millimeters in from the crystal boundaries. A pronounced lineation seen in the K-feldspar crystals here is probably the result of convection currents set up in the still-fluid magma. The formation of large zoned crystals may be due to repeated circulation of some crystals through various stability zones within the magma while these convection currents were active. Also exposed here were several sub-parallel aplite dykes *(Photo 27)* up to 10 centimetres wide and aligned roughly east-west.

Hayes Creek had to be crossed at the south end of the beach but there were sufficient well-placed rocks to act as stepping stones. Ahead lay the 1.5 kilometre trek along the beach to Castle Rock. As on Killiecrankie Beach, the sand here was marked by astonishing flow patterns formed by water seeping through from freshwater lagoons behind the sand ridge backing the beach. We reached the base of Castle Rock at 11:30am *(Photo 28).*

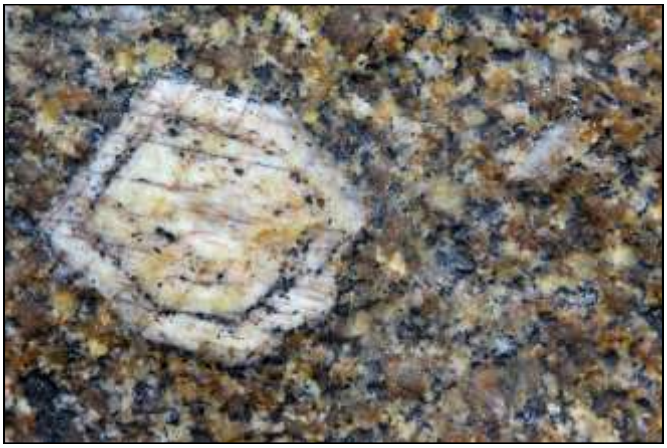
Up close this Flinders Island icon seemed a little less than impressive. We had seen so many big granite rocks already on this trip, although none so isolated! It was the granite outcrops along the foreshore that took most of our attention. Coarse K-feldspar/quartz pegmatites were common *(Photo 29)* and at the base of the big rock a large boulder displayed an extraordinary colour-zoned K-feldspar crystal, hexagonal in outline and enclosing a sharply-defined ring of biotite inclusions *(Photo 30).*

We left Castle Rock at 11:45am and followed the track back to Emita Beach, diverting from it on the northern side of that first headland to walk beneath the tourmaline granite pinnacles and take an easier path up over a sloping granite shelf and down onto Emita Beach. We reached the cars at 2pm.

One group stayed at the picnic tables above Emita Beach to enjoy their picnic lunch. Others returned to Whitemark for coffee at the Bakery or to collect lunch from the Hotel. But all met up in the Trousers Point picnic area by 3:30pm and then drove to the small carpark at the southern end of the Trousers Point Track. By then there were heavy clouds about and the threat of showers loomed, but big sunny patches ensured

27. Sub-parallel aplite dykes intruding granite.

29. Brian describing pegmatite formation.



30. Zoned orthoclase crystal.

32. Calcarenite deposit on top of basement granite.

conditions would be perfect for some spectacular coastal photography.

While waiting for everyone to arrive I took those already present down to the tiny beach below the car-park to investigate a patch of cross-bedded calcarenite overlying littoral granite boulders. Here the thin zone of sandy loam in which the boulders had once sat prior to deposition of the calcarenite had been washed out by the ocean, leaving them suspended spectacularly in shallow caverns. The granite exposed at the southern end of Trousers Point is truly spectacular in its own right, extremely coarse-grained with K-feldspar crystals to six centimetres across and a distinct lineation in the texture. Collecting samples was very tempting but may have induced the wrath of National Parks and would have certainly resulted in overweight baggage on the flight out!

The Trousers Point Track initially wound through dense casuarina forest well away from the shoreline. But at a well-rusted and mostly missing explanatory sign where the track turned north we left the well-worn pathway and carefully made our way down the sandy slope to the rock platform, taking care not to trample the native grasses or the occasional pigface and *Correa*. This coastline proved to be spectacular in the extreme, with extensive granite outcrops worn into fanciful shapes *(Photo 31)* and views south across Franklin Sound to Cape Barren Island. All the while the bare granite domes of the Strzelecki Peaks lay behind us, lit up in the late afternoon light. This provided dramatic photographs, with dark green coastal forest punctuated by low granite mounds in the foreground. At one point we came upon an extraordinary pegmatite vein, with black books of biotite to 4 centimetres across and crystals of schorl tourmaline scattered through a very coarse matrix of pink K-feldspar and grey quartz, with individual crystals to over 10 centimetres!

Further north, remnant patches of cross-bedded calcarenite lay on top of the eroded granite surfaces *(Photo 32)* and in places small caves had been eroded beneath them. At the walking track sign *(Photo 33)* we turned east towards the Fotheringate Bay parking area, the path exiting through the coastal strip of casuarina forest. From here it was a long 1.5 kilometre walk back to the picnic area, but most were fortunate in being given a lift back by those who had not ventured far from the starting point. We were back in Whitemark by 6pm.

31. Deep pot-hole eroded into side of granite dome.

33. Walking track looking towards Strzelecki Peaks .

Saturday 6th April.

This morning was free to catch up, recuperate, and explore the few places in Whitemark that were open, including the gem shop, bakery, newsagency and supermarket. But all had closed by 12:30pm. Some enjoyed coffee at the bakery or a short walk up the Bluff Point track, on the way disturbing flocks of yellow-tail black cockatoos feasting in the casuarinas.

At 1pm the group met in the Hotel carpark for the short drive to North East River and later on to Palana. The weather forecast had promised a partly cloudy day with long sunny breaks and again a maximum of 22°C. There had been some light showers early in the morning.

We drove in convoy directly to North East River. The road in was littered with wallaby carcasses plus the occasional wombat. In the last few kilometres we drove through a dense forest of casuarina, blue gums and banksias, much of which had been clear-felled along the ridges east of the road. This explained the log trucks on the Palana to Lady Barron road. After morning coffee in the picnic area we beach combed for an hour or so, finding interesting shells (cone shells, brachiopods, cowries and limpets) and a variety of bryozoans left on the white sand beach by the falling tide. Here the North East River enters the sea *(Photo 34)* between the northern end of Foochow Beach and the thin finger of land that extends into the ocean as a granite rock platform littered with enormous rounded boulders. At low tide the river becomes a blue vein across an enormous area of sandy shallows.

On the way out we passed flocks of black swans *(Photo 35)* assembled on the river bank beside the road and away from the coastal strip Cape Barren geese searched for grass seeds in paddocks grazed by large

35. Flock of black swans, North East River mud-flats.

numbers of black beef cattle.

We took the five kilometre diversion into Palana and continued to the boat ramp at the end of the road on the west side of the town *(Photo 36)*. From here there were good views to the east over Blyth Bay and Palana Beach, with a foreground of granite shelves and boulders. Two WW2 concrete bunkers can be seen here and a now dilapidated timber WW2 barracks was passed on the way in. We could find no trace of the "Flinders Trail" marked on the 1:100 000 topographic map around to Blyth Point and its majestic granite outcrops.

Heading south we once again drove into Sawyers Bay for views of this dramatic coastline at low tide. The change in scenery here as the tide recedes is astonishing. Mount Strzelecki was capped by cloud, making for exceptional photo opportunities. We left Sawyers Bay around 5pm for Whitemark.

Sunday 7th April.

We had to all remember that daylight saving ended last night. Barry desperately wanted to return to Trousers Point to retake photographs his digital cam-

34. Mouth of North East River.

36. Looking towards Palana from boat ramp.

37. Granite shoreline near Fotheringate Beach carpark.

39. Undercut calcarenite strata, Fotheringate Beach.

era somehow ruined. Elaine, myself, Ron and Ellen decided to tag along to fill the vehicle. The others split into groups to go off in different directions, but all would meet up again at Patriarch Inlet and then work south to Lady Barron where dinner had been booked at the Furneaux Tavern for 6pm.

At the Fotheringate Beach carpark on the northern end of Trousers Point *(Photo 37)*, Barry and Elaine went south to re photograph the spectacular scenery while at the recommendation of Martin (2008) I went north to the far end of the peninsula. There was no track here so I simply took the easiest path, sometimes over the granite rocks along the shoreline, at other times carefully threading my way across the sandy ground away from the granite, taking great care not to disturb any sleeping tigers.

The spectacular granite shoreline we'd seen beside the official track continued right to the end of the peninsula. But here the granite had changed character yet again to a fine-grained texture containing randomly disseminated K-feldspar phenocrysts to 8 centimetres across, often showing simple Carlesbad twinning. This was quite different from the spectacularly coarse granite to the south around the picnic area adjacent to Trousers Point Beach. There were only small patches of cross-bedded calcarenite here; most having been removed by erosion leaving the remnants perched precariously on the granite.

However, around the point and a few hundred metres towards Fotheringate Beach *(Photo 38)* calcarenite became the predominant rock in the coastal cliff line. Undercutting of this sandy limestone had produced some interesting shapes but this exposure was not all that spectacular *(Photo 39)*. Further towards the beach the low scrub became very thick and it was impossible to find a clear path through it. So, only a hundred metres or so short of the beach I retraced my route back to the walking track where I found the others on their way back to the car.

Lurking in the casuarina forest a few tens of metres from the carpark Ron had disturbed another white echidna (*Tachyglossus aculeatus setosus*, a subspecies with short spines and a pale colour) and managed some exceptional photographs before it took off to hide from these strange invaders *(Photo 40)*. It wasn't about to show itself again for those who came in late!

After morning coffee at the Trousers Point picnic area adjacent to the beach we drove off at 11:15am up

38. Fotheringate Beach, Trousers Point.

40. Shy white echidna.

41. Patriarch Inlet mudflats, home to millions of Soldier Crabs.

Memana road, returning briefly to Walkers Lookout to take advantage of the calmer weather. Then on to Patriarch Inlet, 9 kilometres up a formed dirt road from the junction at Memana, on the way passing large numbers of black beef cattle grazing in grassy fields cleared from the native forest. Near the inlet the road passed through dense eucalypt forest, with an understorey of grass trees apparently loving the limy sandy soil.

Patriarch Inlet is a confusion of braided streams and a picturesque body of water at high tide located at the southern end of Foochow Beach. Here we were in for a surprise, one of nature's spectacular displays. The tide was falling, exposing wide mudflats across which thousands of tiny soldier crabs could be seen moving in unison like an undulating red tide towards the receding lagoon water *(Photos 41, 42)*. We could actually hear their little legs marching across the wet sand! On the way out our vehicle skidded to a stop just short of a large copperhead snake playing chicken with the passing traffic. This was the only snake seen on the entire trip.

Continuing south down Lackrana Road we turned into the Patriarch Wildlife Sanctuary located at the end of Lees Road between Middle and South Patriarch. Lying within a few kilometres of each other North, Middle and South Patriarch are the only three granite hills on the eastern side of the island and were named by Matthew Flinders.

Just before reaching the Sanctuary we took a one kilometre detour to the top of Middle Patriarch for what we were told was a great view. But there were too many trees and little could be seen. Back down on Lees Road we continued through dense casuarina forest to a stone wall marking the boundary of the Sanctuary, then on for another hundred metres to the A-frame shelter.

Near the shelter we made good use of the stone-walled barbecue area for lunch. Within minutes the first of the little pademelons came in to investigate this new batch of tourists and soon more than a dozen were nosing around our feet begging for food *(Photo 43)*. Usually a drum filled with dry food is kept in the shelter, but we found it empty so most of out little friends had to go hungry.

The Sanctuary was set up in 1980 as a conservation area and refuge for Cape Barren Geese, the sec-

42. Marching Soldier Crabs.

43. Hungry pademelons Patriarch Wildlife Sanctuary.

ond rarest goose species in the World. The shelter was built by volunteer labour, with Comalco donating the aluminium roof and the Marine Board contributing the mast of the Lady Jillian, which was used as the main beam supporting the roof. It now acts as an information centre and shelter for bushwalkers and is one of the very few free shelters on Flinders Island.

Back on Lackrana Road we continued driving south, turning off to the east again into Cameron Inlet. At the northern end of the lagoon we walked across low swampy sand hills to the vast lonely expanse of Planter Beach, the island's second largest beach. Thousands of birds nest, feed and breed here and other similar spots along the desolate east coast, but we saw very few. The wide stretches of sand are a haven for beachcombers and some of the things we turned up included abundant cuttlefish bones, dried seahorses, weed balls woven by the sea from fibres around the base of the sea grass *Posidonia*, and abundant rounded pebbles of pumice, probably brought by the East Australia Current down from Lake Taupo in New Zealand. In the scrub at the back of the sand swamps we found patches of *Correa alba* in flower.

Logan Lagoon, the last of the accessible wetland areas north of Lady Barron, was completely dry and so totally devoid of bird life. The last kilometre in to the edge of this State Reserve was very sandy and not really suitable for 2WD vehicles, but Barry was driving and no problems were encountered, apart from occasionally shaving off the grassy mounds in the middle of the track!

In Lady Barron we drove out along Pot Boil Road to its end and then back to the picnic area and toilets at the south end of Yellow Beach *(Photo 44)*. Here we had views out over Little Green Island and Great Dog Island in Franklin Sound, which separates Flinders Island from Cape Barren Island. Back in Lady Barron

44. Yellow Beach, Lady Barron.

45. Turbidites within the Silurian Mathinna Beds.

we found the store closed (it was after 3pm) and no-one was home at the privately-owned rock display just down the street.

With the end of daylight saving this morning there was now little time left for exploring and we had to abandon the planned walk around the town and shoreline. Lady Barron, named in 1911 after the wife of Sir Henry Barron, then Governor of Tasmania, provides the only sheltered deep water harbour on the island. The port is managed by the Launceston Ports Authority and is serviced by the 35-metre stern loading vessels (SLV) Matthew Flinders and Southern Condor based at Bridport. These ships can carry 250 cattle or 1000 sheep, three loaded semi-trailers or 13 containers plus 12 passengers and their vehicles. However there are no beds, only a coffee room!

Some people decided to drive west along the Coast Road and out to Badgers Point to have afternoon coffee in the picnic area mentioned in the guidebook. The tide was falling in Petrifaction Bay, exposing ever widening mud flats peppered with black cobbles of Paleogene (Tertiary) basalt. We followed the Badger Corner Road to what we thought was Badgers Corner, but found no facilities. In the failing light it seemed foolish to venture any further so we had our coffee out of the car boot.

The rocks down on the point proved quite interesting. Here we found a superb vertically tilted exposure of turbidites within the Silurian Mathinna Beds showing the full Bouma graded bedding cycle *(Photo 45)*. Such beds are typically laid down by turbidity currents. These are large volume rapid downslope currents often generated by seismic disturbances which cause slumping of sediment on subaqueous slopes which begins a flow of sediment and water moving at high speed down onto subaqueous plains. Here the sediment settles out in the waning

current (Pettijohn, 1975, pages 114-5). The resultant deposits comprise a thick basal graded unit which fines upwards, followed by a series of characteristic units (all of which are not always present) which also fine upwards and ending in a usually relatively thin layer of laminated dark grey pelagic shale. Some of the basal units at this location contain rounded shale clasts ripped from the top of the underlying pelagic layer.

With the light fading rapidly by 5pm, the entire group gradually assembled in the foyer of the Furneaux Tavern to relax over coffee. Before moving down into the dining room for dinner, book presentations were made to Ian and Leonie (in her absence) in appreciation for their time and persistence in dealing with the tour organisers on Flinders Island. We had all left the Tavern by 8:30pm for the short but quite foggy drive back to Whitemark.

Monday 8th April.

Although the day began fine, as soon as we ventured outside there was obviously something wrong, very wrong! Normally clearly visible to the south, Mount Strzelecki had vanished behind a thick veil of smoke!

Early in the morning I'd eventually been able to contact someone from the Furneaux Museum at Emita and arrange for a curator to come out and open up for us at 1pm. So in convoy we headed north along Palana road to Emita, all the while the smoke haze becoming worse and worse, eventually reducing visibility to less than a kilometre. Neither Castle Rock nor Mount Killiecrankie could be seen from the Emita turnoff.

Looking for a short but interesting walk before assembling at the Museum, it had been decided by the group leader to attempt the walk along the coast from Allports Beach picnic area south to Cave Beach. The track up the ridge from the lower car park led around the top of the headland to a small granite inlet, then on to a huge pile of rounded granite boulders, some balancing precariously. Some of the granite here showed very pronounced flow banding. Thin bands of calcarenite lapping against the granite sheltered caves up to three metres deep where the underlying soft layers had been eroded out.

46. Smoky view towards Port Davies.

47. Lichen covered granite boulders near walking track.

Looking to the south it became obvious that the glorious views we had expected would be completely ruined by the ever worsening smoke *(Photo 46).* Most of the group decided to go no further, but Barry, Elaine and I continued on past two more coastal granite outcrops, where many of the boulders were coloured bright orange by lichen *(Photo 47)*. The first of these granite outcrops contained a spectacular embayment and would have, in clear weather, provided exceptional views down the coast towards the calcarenite exposed in the cliffs at the southern end of Cave Beach. The granite here also contained an unusual textural feature – a patch of mafic enclaves associated with pegmatite. The next granite outcrop jutting out into Port Davies was another chaotic pile of enormous boulders, one showing quartz veins containing patches of black prismatic tourmaline crystals.

Looking at our watches, Barry and I thought we may as well try for the southern end of Cave Beach and so set out down the long crescent-shaped stretch of sand. The tide was now well out and ours would be the only footprints on the beach.

A few hundred metres down the beach we came upon a small fossil forest; the calcified remains of tree roots left behind as the softer white calcarenite around them had eroded away beneath a dark resistant soil layer. A wind-rippled dune of white sand lapped at

their base. From here it seemed only half a kilometre to the far end of Cave Beach so we continued on for another 15 minutes, time enough to reach the spectacular outcrop of steeply dipping thinly bedded calcarenite overlain by dune sand at the area known as "The Caves". Here we found two deep caves carved back into the headland plus a small coastal arch and an offshore calcarenite mushroom. Two small boats had anchored just offshore and ahead through the smoke we could make out ghostly outlines of people and cars on the sloping granite rocks beyond the calcarenite cliffs, evidence that both the beach and caves were easily accessible by vehicle.

With little time to explore we headed quickly back up the beach, the soft wet sand and unusually high humidity making for an enervating trek. But the effort had been well-rewarded. It took an hour to return to our cars, followed by lunch in the picnic area.

We arrived at the entrance to the Furneaux Museum *(Photo 48)* at 12:45pm, in plenty of time to assemble before our guide turned up at 1pm. Before being let loose on the exhibits our guide gave an excellent introduction to the Museum, its history and its purpose. He had only recently set up the agricultural display taking up the exhibition space in the new hall *(Photo 49).*

The range and quality of exhibits is extraordinary for a regional museum, covering every aspect of natural and human history on the islands of the Furneaux Group. Of particular note is the research room where every bit of literature available has been meticulously sorted into blue folders, each appropriately labelled on the spine for easy reference. The only area lacking any meaningful organisation and labelling was the disappointingly small geological section, confined a dozen or so rock specimens arranged haphazardly in a beautifully made wooden cabinet fitted with sliding drawers.

48. Furneaux Museum.

49. Agricultural exhibition in the museums new hall.

The original building was the home of W.H.B. Lyall, a graduate of Cambridge University who came out to tutor Robert Blyth's children on Inner Sister Island. Between 1912 and 1922 the front room became his private school and later the first Government subsidized school on Flinders Island. In 1964 Richard Fowler and a few friends founded the Furneaux Historical Research Association (FHRA) and a museum was set up in the old schoolroom. The collections grew rapidly with donations and acquisitions and a number of other buildings have been added to the site over the years. In 2006 a new central building now used for receptions, meetings, offices and records store as well as special exhibits was added with support from the Tasmanian Community Fund and the Australian Government. Members of the FHRA maintain and staff the Museum and it is to their very great credit that it has become one of the best regional museums in Australia. The exhibits certainly kept us enthralled.

We left the Museum at 2:30pm and arrived back in Whitemark in time for a relaxing coffee at Freckles Café, bringing to an end our exploration of Flinders Island.

The source of that incredible smoke haze, which ruined chances for any decent photography, remains a mystery. There were certainly no major fires on Flinders Island or in Tasmania, but the wind direction suggested unreported hazard reduction fires in eastern Victoria.

References:

BOTTRILL, R.S.; WOOLLEY, E.N. and FORSYTH, A.B. (2003). Topaz from Killiekrankie (sic), Flinders Island, and other Bass Strait Islands. *Australian Gemmologist, 22(1), 1-9.*

EDGECOMBE, J. (2007). Flinders Island and Eastern Bass Strait. Second Edition. *Published by the Author.*

LOVEGROVE, D.H. and SUMMERS, S. (2001). A walking guide to Flinders Island and Cape Barren Island. *Third Edition. Flinders Council.*

MARTIN, K. (2008). Walks of Flinders Island. *Fifth Edition. Bas Publishing Pty. Ltd.*

PETTIJOHN, E.J. (1975). Sedimentary rocks. *Third Edition. Harper International Edition.*

Report by Brian England.
Photographs by Ron Evans.

Elvstan Cottages, accommodation for 9 safari participants.

Sunset from front windows of Elvstan Cottages.

Elvstan Cottage guests having a 'happy 'hour' at the end of the Flinders Island Safari.

Social Activities 2013

The Social Committee continues to be an integral part of our Society once again organizing and supervising our two main social functions, Soup and Slides and the Christmas Party.

Soup and Slides were held this year in the home of Ian and Sue Rogers. Various members contributed to the evening, each person being limited to 50 photographs and/or 10 minutes of presentation. A very large flat screen TV was used to show the photographs and a video.

A diverse selection of photographs were presented from activities such as trips to Canada, Mexico and the Middle East, as well as club outings. An interesting video on a train trip to Copper Canyon in Mexico was fascinating.

This years **Christmas Par**ty was held for the first time in the home of Brian and Lyn Stocker which overlooks LT Creek, a small tidal creek that flows into Fennell Bay. The 36 members who attended were served hot entrees followed by a selection of meats and salads, all freshly prepared by the Social Committee. The evening finished with desert, tea and coffee. All in attendance enjoyed both the social aspect of the evening as well as wonderful food.

A very big thanks goes to the members of the Social Committee and to Brian and Lyn for making their home available.

One other important activity follows the AGM each year. This is the **program meeting** where the elected executive and volunteer members gather in the home of Ron and Ellen Evans to prepare a program for the year. Suggestions made by members at the AGM are discussed, activities and leaders organized and the yearly program finalized for distribution to all members. Thanks to all involved.

Publication Acknowledgements.

As in past years, 'Geo-Log 2013' was compiled and produced by Life Member Ron Evans. The publication has been printed by Lakemac Print, Speers Point, NSW.

Activities undertaken this year had a strong geological base. This required much preparation in the form of research and often exploratory trips to sites before the activity occurred. Trip leaders were thus well prepared and knowledgeable.

A special thanks to the trip leaders for their prompt submission of reports for inclusion in Geo-Log 2013. This meant that the compilation was ongoing, preventing the need for a rush to prepare and publish at the end of the year.

A special mention goes to President Brian who diligently vetted each report for geological and factual accuracy, and to his sterling effort in editing Geo-Log 2013.

Finally, thank you to the members (including several keen new members) of the AGSHV Inc. for attending activities. Only with continued support can our society continue to flourish.