'Geo-Log' 2016

Journal of the Amateur Geological Society of the Hunter Valley Inc.

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President's Introduction.

Hello members and friends.

I am pleased and privileged to have been elected president of AGSHV Inc. for 2016. This is an exciting challenge to be chosen for this role. Hopefully I have followed on from where Brian has left off as he has left big shoes to fill.

Brian and Leonie decided to relinquish their long held posts as President and Treasurer (respectively) after many years of unquestionable service to our society, which might I say, was carried out with great efficiency and grace. They have set a high standard. Thank you Brian and Leonie. We also welcomed a new Vice President, Richard Bale and new Treasurer John Hyslop.

Although change has come to the executive committee the drive for excellence has not been diminished. Brian is still very involved with organising and running activities as if nothing has changed. The "What Rock Is That" teaching day Brian and Ron conducted (which ended up running over 2 days) at Brian's home was an outstanding success. Everyone had samples of rocks, with Brian and Ron explaining the processes involved in how these rocks would have formed, and how to identify each sample, along with copious written notes and diagrams.

We also welcomed a number of new members into the club that has only enriched the knowledge base. Roz and Shane Kerr, new members whose qualifications are well known in geology, dove into the deep end and conducted a very informative activity at Crabs Beach near Swansea Heads. It turned out to be the most number of participants that we have had on an excursion. Such is Roz Kerr's reputation.

Each year the challenge to introduce new and exciting activities into our agenda seems daunting. However, the dedication and talent in which our members display in developing and delivering educational outings continues to amaze. This past year we experienced an astronomy night held at Kurri Kurri, a mystery car rally through the Hunter Valley, classroom style teaching days, field excursions to beaches and a three-day exploration of the Lower Manning River Valley.

The annual Safari this year was held in Victoria and South Australia. It commenced in the Otway ranges, proceeded west along the Shipwreck Coast to Mount Gambier, Hamilton and Camperdown from which the Newer Volcanic Providence, Australia's most extensive was explored. Despite the unusually cold and wet weather experienced on the trip, it was said to be one of the better safaris conducted by our society.

The social committee has done their fair share of work too. Although their work in many cases is unseen, they are a very important element of the society's structure. The Soup and Slide night along with the Christmas party held at Ian and Sue's residence was most enjoyable. The bar seems to being set ever and ever higher.

Thank you to all those members who have put so much effort into the organizing and running activities throughout the year, and to Ron Evans for his tireless and the massive effort he puts into publishing the Geo-Log, which I believe, holds its own amongst publications with vastly better resources.

There are too many more to mention who have contributed our Societies activities. A special thanks to all the people who attend activities throughout the year. Without your involvement, the club would cease to exist.

Chris.

Gloucester Tops

Leader: Ron Evans.
Date: Saturday 30th January 2016.
Attendance: 14 members.

The Society last visited Gloucester Tops, part of the Barrington Tops National Park in 1983, five years after the Society's formation. In 2008 another visit was planned. However a landslide closed the road up to Gloucester Tops necessitating the cancellation of that trip.

A Brief History of the Barrington Tops.

Barrington Tops is a dissected plateau covering an area of approximately 1000 km² with an area of more than 100 km² above 1400 m. Brumlow Top is the highest part of the plateau with an altitude of 1586m. Barrington Tops plateau is the highest tableland outside the Australian Alps.

The plateau is underlain by late Devonian to early Carboniferous metasedimentary rocks which have been extensively folded and faulted. They are intruded in various places by Permian granodiorites. The plateau is capped by a series of Cenozoic basalt flows that now form the eroded remnants of the Barrington shield volcano. Beneath the basalts in old stream channels are commercial deposits of gem-quality ruby, sapphire and zircon.

The plateau is the source of numerous rivers, those flowing west and south being tributaries of the Hunter River, while those flowing east, including the Barrington River, are tributaries of the Manning.

The relief and variety of landscapes have enabled a diverse patchwork of plant communities to flourish. Tall eucalypt forests and rainforest dominate the plateau, with the exception of the high sub-alpine regions where Snow Gum woodland dominates. Mature old growth forests occupy more than 70% of the park.

1. Tilted layers of Devonian/Carboniferous basement rocks.

2. Gloucester River Picnic area.

Cool temperate rainforests occupy the misty heights above 900 m and are dominated by Antarctic Beech *(Nothofagus moorei)* which is at its northernmost limit. Soft tree ferns *(Dicksonia antarctica)* crowd the understory over a ground cover of ferns and mosses.

Warm temperate rainforest, between 600 and 900 m, is scarce around Barrington Tops. It is characterised by Sassafras, Crabapple and Rosewood, but not Coachwood.

Subtropical rainforest grows at around 300 to 600 m and is best developed on or close to valley floors. Yellow Carrabeen, thick-leafed laurel, Bangalow palms and cabbage-tree palms are indicators.

Eucalypt forests occurring on the Barrington Tops are also impressive. Major areas of intact sub-alpine Snow Gum woodland interspersed with Black Sally and Mountain Gum are found at higher altitudes. At lower to mid altitudes tall Sydney Blue Gum, Messmate, White Topped Box, Tallowood and Manna Gum tower as emergent over the rainforest canopy along with Turpentine (not a eucalypt).

The sub-alpine swamps of the region such as Poll Blue Swamp constitute the largest area of swamps in the state after the Kosciusko National Park.

The Trip.

Participants met in Wards River where Ron outlined the activity for the day ahead. UHF radios were distributed and the convey, led by Ron, drove into the Gloucester River Camping and Picnic Area for morning tea. Approaching the National Park, several road cuttings exposed tilted layers of the Devonian/ Carboniferous basement rocks *(photo 1)*. The road also crossed the free flowing Gloucester River in several places necessitating driving through 30 or so centimetres of water that was running over concrete causeways.

Upon reaching the picnic area, cars were parked, morning tea taken *(photo 2)* and toilets visited. The convey then headed up the steep and winding Gloucester Tops road for 18km, climbing over 800m.

3. Chris waiting for the group to catch up at the start of the Beech Forest walks.

5. Small cascades observed along the walk. Note the moss-covered rocks and the soft tree ferns.

First stop was the parking area for the Antarctic Beech Forest Track. After getting organized, the group set out along the track. The airy sub-alpine woodland of Snow Gums through which we walked leaving the carpark suddenly gave way to the dark cool world of the cool temperate rainforest dominated by Antarctic Beech. Ron and Chris outlined the nature of the rainforest and explained why remnant rainforest of Antarctic Beech still exists today. We turned left at a track junction *(photo 3)* following the short loop track, an easy 1 km circuit. The high dense canopy of Antarctic Beech *(photo 4)* shades the ground enabling soft tree ferns and damp carpets of moss to flourish.

The track led past a small creek where some mossy cascades were present *(photo 5)*. We eventually returned to the track junction back to the cars.

A short drive took us to the Gloucester Falls picnic area where tables and toilets were present. After lunch, Ron led the group on the Gloucester Falls track which passes through Snow Gum woodland until the Andrew Laurie Lookout is reached *(photo 6)*. This is located on the eastern edge of the escarpment enabling views down the Gloucester River Gorge over forested ridges to cleared farmland in the distance *(photo 7)*. Tall Brown Barrels and Messmates surround the lookout.

Leaving the lookout, the track went down a steep forest ridge through stands of rainforest *(photo 8)* to a rocky spur *(photo 9)* where a view overlooking the Gloucester Falls on its 400 m plunge off the plateau was obtained *(photo 10)*. Unfortunately trees partially blocked the view of the falls.

Leaving the spur, the track continued upstream until it reached the top of the falls. Some adventurous people climbed down a short steep track to the top of the falls. The river here flows over hard granodiorite thus forming the falls. Softer metasedimentary rocks further downstream have eroded more rapidly to form the Gloucester River Gorge and valley.

From the top of the falls, the track took us uphill out of the rainforest and back to the cars. This ended the organized part of the day and some folk chose to leave for home.

Before leaving, four of us decided to find Munro Hut *(photo 11)* which is situated a short distance from the eastern end of the link track. After driving along the link track to the locked gate, we walked west some 500 m before turning north along a faint trail that took us to

4. Tall Antarctic Beech trees.

6. Andrew Laurie Lookout.

7. Gloucester River gorge and valley from Andrew Laurie lookout.

8. Chris leading the way down to a rocky spur overlooking the Gloucester Falls.

9. Having a rest on the rocky spur overlooking the Gloucester Falls situated on the left.

Munro Hut. The hut is well hidden from the main link trail.

Munro Hut was built by the Newcastle Bush Walking Club between 1962 and 1964. It is named after Arthur 'Darby" Munro, a keen bush walker and naturalist.

10. Gloucester Falls flowing over an outcrop of hard granodiorite.

11. Munro Hut built by the Newcastle Bush Walking Club.

Report by Ron Evans.
Photographs by Ron Evans.

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Archaeology at the Rocks

Leader: Sue Rogers.
Date: Thursday 11th February 2016.
Attendance: 12 members.

The designated meeting place was Lang Park in York Street but most of the participants had met up on the train journey down to Sydney. It was just as well we elected to travel in a non-quiet carriage. After exiting Wynyard Station we found Lang Park situated on what was known as Church Hill as it was bounded by Anglican, Catholic and Presbyterian churches. The first of the three churches was the original St Phillip's Anglican Church that was commenced in 1798 and named after the colony's first Governor, Arthur Phillip. The church was completed in 1810 and survived until 1856 at which time the new St Philip's on the opposite side of York Street took its place.

Lang Park is named after Dr. John Dunmore Lang who arrived in Sydney in 1823 and was the first ordained minister of the Presbyterian Church. He remained minister for 52 years until his death in 1878 and built the first Scots Church opposite the park in 1826. Lang was one of the most outspoken men in Australian public life. He edited a newspaper, the "Colonist", wrote many pamphlets, was a member of parliament, was constantly active in encouraging the immigration of Scottish and German artisans and farmers to Australia, took a leading part in effecting the separation of Victoria and Queensland from New South Wales, and persistently advocated an Australian republic and Australian independence from Britain. The Scots Church was demolished in 1926 due to work on the Harbour Bridge approach roads. It was replaced by a new 5-storey building in 1929. In 2005 that was converted to the Portico Apartments with the addition of a 22-storey tower building.

To the north of the park is St Patrick's Church that was begun in 1840 as Sydney's second Catholic Church. It was completed in 1844 and is considered to be the oldest Catholic Church as the first Catholic Church, St Mary's Cathedral, was burnt down and rebuilt in 1882. The Church underwent major restoration works in 1999 when it was painstaking restored to its former grandeur. The outstanding features of St Patrick's Church include its imposing high altar which was crafted in Paris and installed in 1889 as well as the impressive stained glass windows which were installed in 1849. Most of the statues located throughout the church date from the early 20th century and were imported from France.

A gas light in the park was installed in 1966 to commemorate the 125th anniversary of first gas lighting in Sydney. The base and column were manufactured in England in 1827.

Our first stop was for toilets and coffee. The cafe operating in the quaint chapel at St Patrick's Church, provided excellent amenities. Following refreshments the group traversed the narrow streets to the YHA building in Carrington Street under which the Big Dig is located. A major archaeological dig occurred on the site in 1994. The site has an on-going historical and educational role as the remnants and artefacts uncovered from the site reveal the style and manner in which people lived in colonial Australia in the 18th and 19th centuries.

The Big Dig Archaeology Education Centre is available for use by domestic and international education groups who are interested in learning about the archaeological and historical significance of the site. This includes schools and tertiary education groups and archaeological and heritage groups, many of whom choose to stay at the hostel above the site. Education Officer, Alison Frappell *(photo 1),* gave a brief talk on the purpose of the centre and then took us up to the roof top for views of the Sydney Harbour *(photo 2).* Alison

1. Education Officer Alison Frappell .

2. Terrace houses along Gloucester Street.

explained the geological development of the Sydney estuary and how it was eroded into the Hawkesbury Sandstone, mainly during low sea levels of the glacial periods. The estuary and its catchment changed soon after Captain Philip landed in Sydney Cove. Early land clearing increased sedimentation in the waterway and rapid industrial growth, located mainly on the waterfront, resulted in increasing contamination of the estuary.

A distinctive feature of the Port Jackson catchment is the beautiful outcrops of Hawkesbury Sandstone into which the estuary is dissected. Most of the high land in the outer catchment is comprised of Ashfield Shale which overlies the Hawkesbury Sandstone. The configuration of Port Jackson drainage system, the orientation of bays and shoreline are all controlled by underlying geological structures. The Sydney estuary is a drowned river valley, which is eroded up to 85 metres into the Hawkesbury Sandstone.

We then visited the observation platform to see the archaeological remnants of George Cribb's house *(photo 3 & 4)*. This was followed by a visit to the Education Centre which consists of two classrooms, each seating up to 36 students. The centre provides a simulated archaeological dig area for primary students.

Our lunch break was at the historic Australian Hotel. On 12th August 1824, The Sydney Gazette announced that the Australian Heritage Hotel was officially opened for business on George Street near where the Museum of Contemporary Art now stands. When the plague hit Sydney in 1900, many buildings were pulled down to prevent further outbreaks, including the Australian Hotel. The license was then transferred to a new building located on the Archaeological site nearby at 116 Cumberland Street. 100 plus years on, the Australian Hotel remains a unique, attractive and well preserved example of Edwardian style architecture with quality and taste present throughout the hotel, from the tiling through to the tap faucets. A number of the original building's features, such as the metal awnings, etched signage and saloon style bar doors remain. The group enjoyed sharing gourmet pizzas and a few drinks *(photo 5)*.

After lunch we walked the short distance to Susannah Place for a 2pm tour. The Museum consists of four terrace houses built by Irish immigrants in 1844. For nearly 150 years these small houses with tiny backyards, basement kitchens and outside wash houses were home to more than 100 families. Against a backdrop of the working harbour and growing city, their everyday lives played out. Remarkably, Susannah Place survived largely unchanged through the slum clearances and redevelopments of the past century and today tells the stories of the people and families who called this place and this neighbourhood home. The one hour guided tour took us through each house, each decorated to a past era. The guide gave an insight into the family that lived in each house in that era.

4. Alison outlining the history of George Cribb.

Our next stop was the Rocks Discovery Museum which is housed in a restored 1850s sandstone warehouse. The museum is home to a unique collection of images and archaeological artefacts found in The Rocks. Four permanent exhibitions have been developed and cover the periods:

- Warrane (pre-1788)
- Colony (1788–1820)
- Port (1820–1900)
- Transformations (1900–present)

We then headed to Circular Quay Station via Cadman's Cottage, the oldest surviving residential building in Sydney, having been built in 1816 for the use of the governmental coxswains and their crews. Water at

3. Foundations of George Cribb's house.

5. Drinks and lunch at the Australian Hotel.

high tide would come within 8 metres of the cottage but due to the reclamation of land during the building of Circular Quay, the waterline has moved about 100 metres away since 1816. Restoration of Cadman's Cottage began in 1972 after it was proclaimed a Heritage site under the National Parks and Wildlife Act. It was named after John Cadman who held the position of government coxswain from 1827 until his retirement in 1845. Cadman arrived in the colony as a convict, working on the government boats from at least 1806, and received a free pardon in 1821.

We caught a city circle train back to Central and then the 4:15 pm Newcastle train for the homeward journey. It was an enjoyable outing that enabled the group to appreciate the historical significance of the Rocks area that was inhabited by the Gadigal People, then the convicts, soldiers, sailors and wharf traders followed by the battlers. Amongst the bustling city streets it is amazing that remnants of past lives and past ways can still be found.

Report by Sue Rogers.
Photographs by Ron Evans.

Seating for visiting groups under the main building.

Artifacts found during the archaeological dig.

Astronomy Night

Leader: Paul Wickham.
Date: Saturday 5th March 2016.
Attendance: 25 members.

In January 2015 I ran two astronomy nights for the community in Pearl Beach where I live, one for kids and another for adults. Chris Morton, who also lives on the Central Coast, saw some of the promotional material for the adult's event and asked me whether I would consider running a similar night for the Geology Society. He managed to convince me that my initial concerns about the obvious dissimilarity of the two subjects, geology and astronomy, were not as pronounced as I had originally thought and we held the event on Friday 1 May 2015 at Ron and Ellen Evans's house at Cameron Park, an event described by Chris in the 2015 Geo-Log.

About 25 people attended. My talk consisted of a breakneck tour of the universe from the solar system to the outer reaches of the universe and Chris Morton inserted a segment on asteroids when we stopped to catch our breath between Mars and Jupiter. Our attempt to do some telescope viewing in Ron and Ellen's backyard afterward was promptly interrupted by rain and cloud so we resolved that we would reschedule another viewing night in the summer.

Due to some complications from shoulder surgery I had in November, and some difficulty finding a good treeless site with 360 degree views of the sky, our rescheduled viewing night didn't happen until ten months later on Saturday 5 March 2016. Our attempt to hold the event a week earlier was again thwarted by rain. On the night we were rewarded with a warm, windless and cloudless night that your average astronomy club would have been envious of. Our good luck persisted with the site that we had access to, which belonged to Col Maybury, the President of the Astronomical Society of the Hunter Valley, and his wife Marcia. Col and

1. Setting up telescopes and waiting for dark.

Marcia have a 15 acre block on the outskirts of Kurri Kurri and at the rear of the property is a large grassy area surrounded by low trees where Col has constructed a small observatory. It is a near perfect viewing site as the light pollution is minimal, there was plenty of parking for the 25 people who attended, and we had very good views of the celestial sphere with no significant obstruction of any of the objects we wanted to look at *(Photo 1)*.

I belong to the Western Sydney Amateur Astronomical Group and the president of that group had provided a long list of delectable astronomical objects to explore. We also had a second telescope there on the night which belonged to Mike Fahey, who had recently joined the club. Mike brought along a 10 inch Meade telescope *(photo 2)* which supplemented my 8 inch Celestron telescope nicely *(photo 3)*. Mike hadn't used his equipment for some time and unfortunately it took him a long time to get it to the stage where society members could enjoy the viewing. However, when he did he gave everyone a good view of the gas giant Jupiter and its four Galilean moons. I was busy on my own scope but from the reports I heard four moons were visible at first but because they move very quickly one of the moons eclipsed another, so only three were visible after that. I looked it up on my "Moons of Jupiter" app which showed that on that night Io was very close to Jupiter and Callisto was the furthest away, while both Europa and Ganymede were very close together at a middle distance. The phone app also shows that Ganymede, which is the largest of the four Galilean moons, eclipsed Europa at about 9:45. Many thanks to Mike for helping out on the night.

It was reasonably easy to choose the most interesting objects from the list I had so we began with the Orion Nebula, which was heading towards the

2. Mike setting up his 10″ Meade telescope.

3. View down Paul's 8″ Celestron telescope towards the mirror.

western horizon. Nebulas are very large gas clouds created by gargantuan stellar explosions called supernovas. The Orion Nebula is the remnant of one of those explosions that happened about three million years ago, roughly the time that Australopithecines were disappearing from the African savannah and being replaced by the genus Homo. This event occurred in our neighbourhood of the Milky Way on the Orion Arm of The Milky Way, where both The Sun and the Orion Nebula are located. The Orion Nebula is only 1,350 light years away from us, which sounds like a pretty long way but in cosmic terms isn't very far at all. For example, one of the other great nebulas in the night sky, the Tarantula Nebula in the Large Magellanic Cloud, a small neighbour galaxy, is almost two hundred thousand light years away. So the Orion Nebula really is a close neighbour.

I did what I always do at the Pearl Beach viewings, which is to start by showing each person the vast sweeping gas cloud that fills the whole viewing field of the telescope. At that magnification I also point out a couple of the star groupings in the gas cloud. I then used my zoom lens to focus in on group of four stars called The Trapezium *(photo 4)* to show each person that there was now a dark patch visible immediately around The Trapezium that couldn't be seen before. That dark patch occurs because all of the gas in that part of the nebula had been used up to build those four stars. What we were looking at was a "star nursery" where new stars are being created out of that interstellar cloud of dust, hydrogen, helium and other ionised gases. In the talk I gave at Ron's place in May 2015 we discussed how solar systems form and how nebula are the first step of creating new stars which attract large swirling disc-shaped clouds of gas and dust that differentiate into planets. The opportunity to see that process happening

with your own eyes is an overwhelming and mind boggling experience.

Once everyone had finished seeing the Orion Nebula via a side excursion to Mike's telescope to see Jupiter and its moons I moved my telescope to Omega Centauri, the best of all of the globular clusters in the night sky. But firstly, an explanation of the name Omega Centauri. The stars in all constellations are named from the brightest to the dimmest by the sequence of the Greek Alphabet. The brightest star in each constellation is called Alpha, the first letter of the Greek alphabet, followed by the possessive name of the constellation, which normally ends in *ri*, *ii*, *is* and *ae*. Hence the name Alpha Centauri, the brighter of the two pointers of the Southern Cross and our nearest stellar neighbour, which is the brightest star in the constellation Centaurus, the Centaur. The second-brightest star in a constellation is called Beta, the third-brightest Gamma, and so on. Omega is the last letter of the Greek Alphabet and the designation Omega Centauri was given to a faint, unimportant patch of light in the constellation Centaurus. That faint patch of light is actually a tremendous agglomeration of ten million stars in a tightly-packed array known as a globular cluster. The whole object fits into the viewing field of my telescope and it was truly astounding for each person to consider that they were looking at ten million stars merely by looking through a single eyepiece. Obviously, not all ten million stars are visible because many are obscured by others but the overall affect of the ten million is dazzling to the eye. Sometimes people have difficulty getting their head around what they are looking at through the eyepiece and it seemed to help when I mentioned it resembled a giant dandelion puff-ball in the sky. Omega Centauri is the largest globular cluster in the Milky Way with a diameter of 150 light years. Spectroscopic analysis of the stars in that cluster reveals that those 10 million stars have a total mass equivalent to 4 million solar masses. Astronomers use the mass of our Sun as a measurement to describe the size of other stars, some being much bigger than our Sun, up to 150 solar masses, while others are smaller than the Sun. The fact that the ten million stars in the Omega Centauri cluster only have a combined mass of four million solar masses indicates that most of the stars in the cluster are less than half the size of our star. They are also very old and very, very compact. The cluster is 12 billion years old, only a little younger than the age of the universe at 13.82 billion years, and the stars in the core of the Omega cluster are estimated to average only 0.1 light years away from each other. It is the brightest, largest and at 4 million solar masses the most massive known globular cluster associated with the Milky Way. Of all the globular clusters in the local group of galaxies, only Mayall II, a globular cluster that orbits the Andromeda Galaxy, is brighter and more massive. In 2008 a study of the movements of the stars at the core of the cluster by the Hubble Space Telescope and the Gemini Observatory in Chile suggested that there may be an intermediate-mass black hole at the centre of Omega Centauri. This is a stunningly beautiful massive beast of a thing that almost takes your breath away.

The event was a great success and I've been invited to hold the event again next year. I had about twenty objects on my list of celestial objects in the March sky and this year we only managed to get through three of them using two telescopes. I'm sure we can keep society members captivated with many other objects on that list during our future viewing sessions, beginning in May 2017.

Report by Paul Wickham.
Photographs by Ron Evans.

4. Four young stars forming 'The Trapezium' within the Great Orion Nebula.
Source: Kopernic Space Images.

Woko National Park

Leader: Ron Evans.
Date: Friday 18th to Sunday 20th March 2016.
Attendance: 7 members.

Introduction.

Woko National Park is approximately 30 km north-west of Gloucester. It conserves 8598 ha of regionally significant forest communities including part of one of the most extensive areas of dry rainforest in New South Wales, as well as the habitat for several endangered species *(photo 1).*

It was established in 1984 and is located between the Manning and Barnyard rivers. The park is dominated by the peaks of Mount Myra (1057 m), Vinegar Hill (814 m) and Waikok peak (714 m).

The camping ground next to the Manning River was part of a cattle property and was once extensively cleared even onto the surrounding slopes. The rest of the park has been largely undisturbed due to the ruggedness and inaccessibility of the terrain.

Plant Communities.

Woko National Park conserves several interesting communities.

Dry rainforest occurs on steep, seasonally dry, boulder and scree slopes throughout the park. It covers about 40 percent of the area and usually appears as closed forest with one or two layers of vegetation and sparse ground cover. Vines and epiphytes (perching plants such as elkhorns, staghorns and orchids) are common. Dominant tree species include shatterwood, stinging trees, figs, brush kurrajongs and the yellow tulip tree. The shrub layer includes native holly, brush caperberry, silver croton and orange thorn. Locally, the dry rainforests of Woko are known as 'Curricabark Scrub'.

Subtropical rainforest occurs along sheltered streamlines and in gullies throughout the park. It usually appears as a closed forest, with two or three clearly defined layers of vegetation. Epiphytes and vines are common. The main tree species include black booyong, giant stinging tree, Moreton Bay fig, rosewood and flame trees.

Wet sclerophyll forest occurs on sheltered aspects of the lower slopes and gullies throughout the park. It typically appears as a tall open forest dominated by eucalypts such as white mahogany, Sydney blue gum, white-topped box, silvertop stringybark and brush box. Rainforest species usually form a lower tree and shrub understorey.

Dry sclerophyll forest occurs on ridges and slopes throughout the park. It usually appears as an open forest dominated by angophora and eucalypt species, such as New England blackbutt, Sydney blue gum, grey gum, white stringybark and forest red gum. Forest oaks and wattles are sometimes present as understorey tree species and the ground cover consists of grasses and herbs. Occasionally the forest appears as a closed forest dominated by the scientifically interesting Wollomombi wattle, particularly on steep rocky slopes.

1. Woko NP. The cliffs are formed from Devonian aged jaspers and cherts, part of the Myra beds. The dark green patches of vegetation are dry rainforest with eucalyptus forest on the ridges.

Geology.

Most of Woko NP is situated on rocks belonging to the early Paleozoic (Devonian) Myra beds (Pzm) consisting of chert, jasper, slate, phyllite, minor sandstone and basalts. High pink jasper/chert cliffs dominate the hill on the eastern side of the camping area.

The western boundary of the park borders on a narrow outcrop of younger Permian Giro beds (C-Pg) composed of diamictites, conglomerate, sandstone, mudstone, felsic intermediate volcanics and limestone. Extensive outcrops of these beds are found to the east, south east and north east of Woko NP.

South west of the park (upstream on the Manning River as it flows south west) the Bowman beds (Do) of Devonian/Carboniferous age outcrop. These beds are younger than the Myra beds and overlay them. They consist of laminated siltstone, sandstone and minor limestone.

The whole area is extensively folded and faulted. *(Fig. 1)*

The Outing.

Participants arrived at the camping area in Woko NP Friday afternoon. After setting up caravans *(photo 2),* paying camping fees (self registration) and looking around the camping area, all adjourned to Terry's annex for happy hour.

Ron welcomed everybody and outlined the geology of the area and the program for the next day.

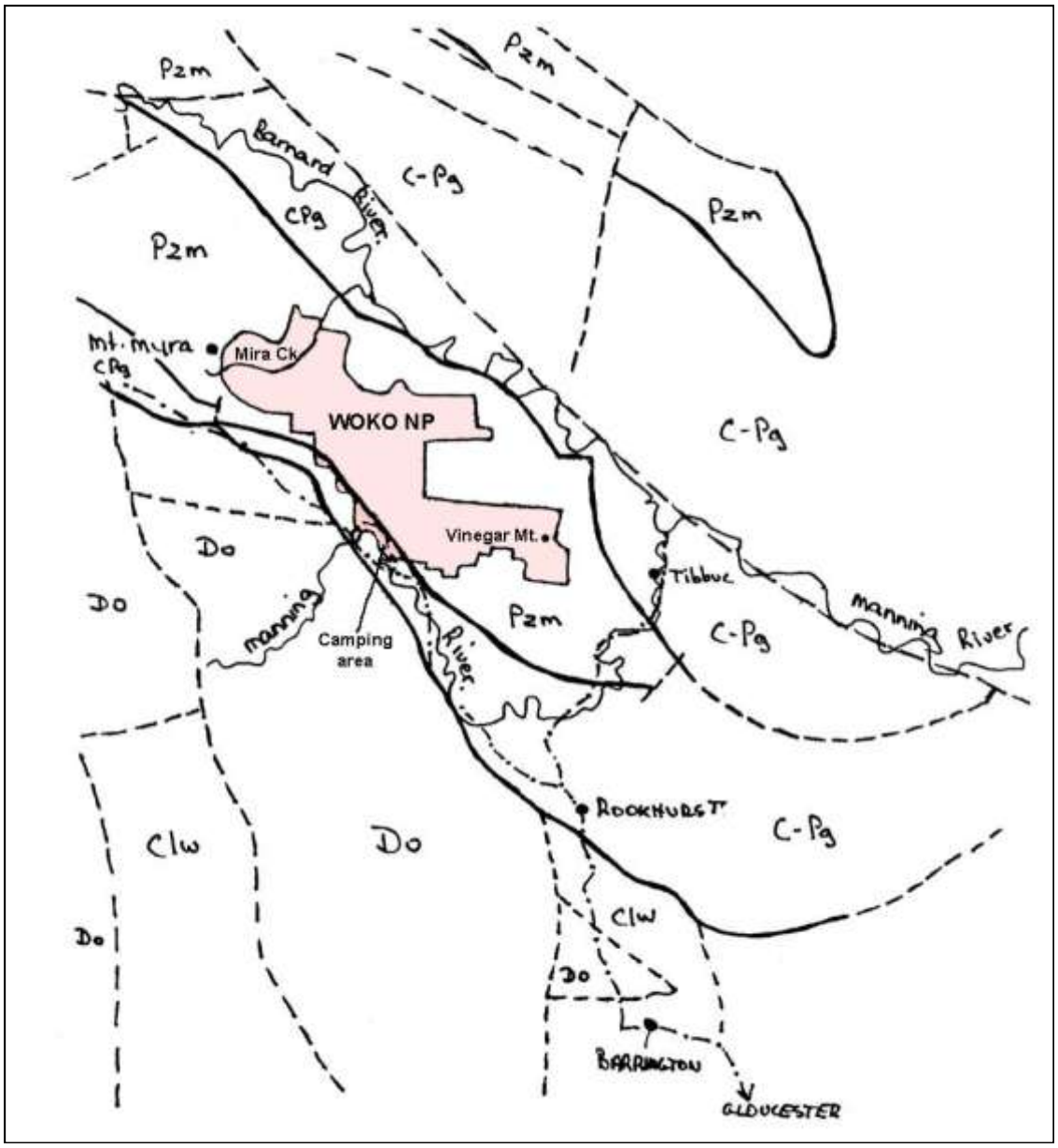


Fig 1. Simplified geology of Woko National Park.

Key to Map.

Pzm	Myra beds (Devonian)	C-Pg	Giro beds (Permian)
Clw	Wooton beds (Carboniferous)	Do	Bowman beds (Devonian)

——————— Geological boundaries

– – – – – – – – – Faults

—·—·—·— Roads

Saturday:

The day started by undertaking the Cliff Face Walk at 9:00 am (nice and cool as the walk was on the western shady side of the escarpment). The well formed track led into dry rainforest with its vines and large trees with impressive buttress roots. As the track started to become steeper, jasper blocks that formed the scree slope became common. They had originated from the jasper cliffs above us. Both the slope and steepness of the track increased as we approached the base of the cliffs *(photo 3)*. After reaching the base of the cliffs, the track turned north taking us up out of the rainforest to a ridge covered with eucalyptus forest. Majestic Blue Gums were a feature.

The track then dropped and entered a small stand of sub-tropical rainforest before once again entering eucalypt forest that gave way to more open woodland as we neared the end of the walk. We arrived back in camp for a well earned 'cuppa' after our $2^1/_2$ hour walk.

2. Setting up camp beside the Manning River, Woko NP.

3. Track and slope becoming steep near the cliffs.

After lunch at 1:30, Ron led the group in vehicles north along Curricabark road before turning south on Carters Trail and climbing towards Benny's Top. Because of the small group, only two vehicles were needed for the trip.

The drive north was very scenic as the road follows the Dewitt Creek towards a pass where the road drops down into the Curricabark Creek valley. Along the way, several stops were made at roadside cuttings and small quarries to examine the rocks exposed which were all extensively jointed and tilted to almost vertical, evidence of extensive folding in the area.

The last road cutting before the Curricabark valley was unusual in that the exposed rocks were almost white *(photo 4)*. Upon examining them, they turned out to be mudstones containing abundant small marine fossils, mainly gastropods and a few small brachiopods *(photo 5)*. An obvious feature of the mudstone was the extensive weathering by fretting that was taking place on the exposed surfaces.

A brief stop was made at the pass where Mt. Myra (1057 m) was seen and a great view north into the Curricabark valley was obtained.

Continuing on, Carters Trail was soon reached. Carters Trail wound about following Copper Creek before climbing steeply after a few kilometers to Benny's Top. After parking, we all walked to a small ridge where uninterrupted views of the Barrington Tops plateau was obtained *(photo 6)* where the road branches.

On the way back down Carters Trail, serpentinite outcrops in the road cutting about 1 km from Benny's Top *(photo 7)*. One of the group had observed the serpentinite outcrop on the way up. After parking, we had a good look around and collected a few samples of serpentinite. A spectacular view north over Curricabark was obtained from where we parked the vehicles *(photo 8)*.

Associated with the serpentinite derived soils present (which are nutrient poor shallow soils high in ferromagnesian minerals that have poor water holding properties) were specialized plants such as the giant grasstrees *Xanthorrhoea glauca (photo 9)* and serpentinite oak *Allocassurina ophiolitica*. The exposed serpentine was very fractured and most exposed surfaces exhibited slickensiding.

After collecting samples and taking many photographs, it was decided to drive down to Copper Creek for afternoon tea. After enjoying a 'cuppa' on a shady bank, we returned to camp at 4:15 just in time for the obligatory 'happy hour' at 5:00 o'clock.

Because the strenuous Cliff Face Walk had been conquered in the morning, some decided to do the short Brush Turkey Track at 9:00 am next morning before packing up and returning home.

6. Benny's Top. View south-east over the Barrington Plateau.

4. Outcrop of mudstone. The exposed rock surfaces were extensively weathered by fretting.

5. Small fossil gastropods found within the mudstone.

7. Serpentinite outcrop in road cutting.

8. Looking north from the serpentinite outcrop over the Curricabark Valley.

9. Ancient grasstrees *Xanthorrhoea glauca* growing on the serpentinite-derived soils.

Report by Ron Evans.
Photographs by Ron Evans.

Reference:

Tamworth-Hastings Metallogenic Map. Tamworth-Hastings SH/56 13-14 SI/56 1-2. Department of Mineral Resources, 1987.

Watchimbark Nature Reserve Plan of Management. www.environment.nsw.gov.au

Woko National Park. Environment, Climate Change and Water. National Parks and Wildlife Service, NSW

Bar Beach Geology and the Anzac Walkway

Leader: Terry Kingdon and Brian England.
Date: Thursday 14th April, 2016.
Attendance: 16 members.

Heavy showers accompanied the gathering of participants at the Bar Beach carpark. It did not look good for even a short coastal walk, despite the tide being favourable. But by the time we began the excursion the rain seemed to be clearing although it would remain overcast for the remainder of the morning.

At around 10:00 am we set off to tackle the Anzac Walk from the bottom of the stairway at the north end of the carpark. It was a steep climb up the southern slope of Shepherd Hill and everyone was relieved to reach the horizontal section of the steel walkway.

The first (in this case southern) part of the walk climbed up over fossiliferous shales and sandstones of the Shepherds Hill Formation, stratigraphically lying near the top of the Lambton Sub Group, the lowest of the groups in the Newcastle Coal Measures. Soon after the bridge section is reached the walkway heads over an old quarry beside Memorial Drive *(photo 1)*. This exposes an excellent section through the pebbly Merewether Conglomerate near the base of the Adamstown Sub Group *(photo 2)*. This is one of the broad lenticular conglomerate horizons deposited by braided streams within channels incised into dormant peat bogs during a sea level fall which lowered the water table (Lindsay and Herbert 2002). These are scattered throughout the Newcastle Coal Measures, with probable source area being the New England Fold Belt in the north.

The Memorial Walk is 450m long and includes the 160m bridge built using 1.3km of stainless steel plus a 290m section made from 3.4km of composite fibre. There are three viewing platforms along the walk

2. Eroded pebbly Merewether Conglomerate.

providing superb views to the west over Newcastle City, the harbour and nearby suburbs, and to the south along the coastline from bar beach down towards Dudley *(photo 3)*.

The walk was completed in 2015 to mark the centenary of the opening of the Newcastle Steelworks, officially opened on 2nd June 1915. The steelworks was making rails, shipbuilding plates and munitions for the WWI war effort. Engraved on the rusted steel silhouettes positioned along the walkway are 3,859 family names of 10,947 known Hunter Valley men and women who enlisted in the Australian Imperial Force (AIF), Royal Australian Navy (RAN), Australian Army Nursing Service (AANS) and British and Commonwealth Forces during the Great War of 1914-18. Construction was envisioned to compliment Memorial Drive, dedicated to the memory of fallen soldiers from the Great War.

The walk ends (or starts) at the Strzelecki Scenic Lookout, named after Sir Paul Edmund Strzelecki (1797 -1873), great explored and researcher of the coal deposits during 1839-1845, which greatly influenced development of the Newcastle District. Strzelecki also carried out geological investigations of the Lower Hunter.

The Anzac Walk took just under an hour, after which the groups returned to the Bar beach carpark, then tramped down onto the northern end of the beach

1. Anzac Walkway passing over an old quarry.

3. View south from Bar Beach towards Dudley.

4. Laminated sediments with sand-draped ripples.

6. Standing sand wave preserved in a channel deposit.

to commence a geology walk northwards along the base of the coastal cliffs. This was the Society's first exploration of this section of the coastline.

The rock strata exposed in this section belong to the Bogey Hole Formation, a succession of coastal mud flat deposits crossed by distributary stream channel sandstones lying within the lower part of the Lambton Sub Group at the base of the Permian Newcastle Coal measures.

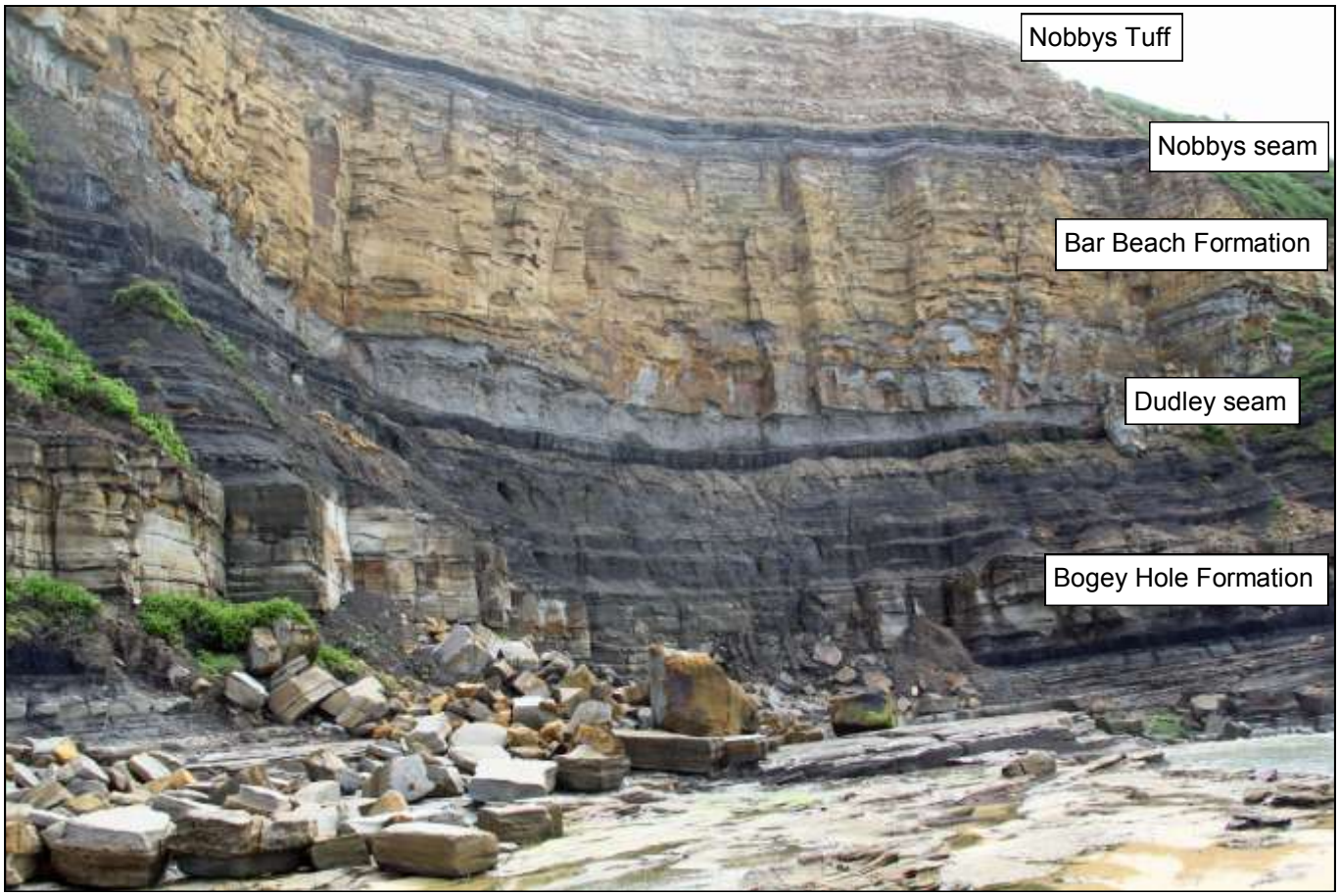
The mud flat sediments are finely laminated and show cross sections of sand-draped ripples *(photo 4)* while the channel deposits comprise cross-bedded sandstones, the preserved remains of point bars. Discontinuous layers of brown siderite showing dehydration boxwork structures were commonly seen between the laminated silts and overlying sandstone beds *(photo 5)*. A series of standing sand waves (large ripples) was also preserved in one of the channel deposits *(photo 6)*. Something never seen before was the presence of three dimensional limonite dendrites on the surface of a sandstone boulder *(photo 7)* and some shale beds showed spectacular dewatering structures *(photo 8)* formed when water was forcibly expelled from underlying wet sediments by pressure from the weight of overlying sediments.

The walk ended immediately below the Strzelecki Lookout at which point further progress, although possible, was deemed too dangerous. Here the vertical

7. Three-dimensional limonite dendrites.

5. Brown siderite forming boxwork structures.

8. Vertical dewatering structure.



9. Cliff below Strzelecki Lookout showing clearly exposed, two coal seams.

cliff, one of the highest along the Newcastle coastline, provided an uninterrupted section from Nobbys Tuff down through the Nobbys Seam, the channel sandstones of the Bar Beach Formation, then the Dudley Seam and finally the Bogey Hole Formation on the rock platform *(photo 9)*.

The excursion ended with lunch at the Bar Beach kiosk at around 1 pm.

Report by Brian England.
Photos by Brian England (1 to 3) and Ron Evans (4 to 9).

Reference:

LINDSAY, G. and HERBERT, C. (2002) *Coal and Conglomerate in the Newcastle Coal measures – coeval facies or temporally unrelated?* International Journal of Coal Geology, 521, 169-184.

Crabs Beach & Swansea Heads Excursion

Leader: Roz Kerr.
Date: Saturday 6th May 2016.
Attendance: 32 members, 8 visitors.

Location & Access.

Crabs Beach is a small, sandy surfing beach located just south of Illawong Park, Swansea Heads. The beach lies between Reids Mistake Head, the southern headland at the entrance to Lake Macquarie in the north, and Caves Beach in the south *(photo 1)*. Access to the beach is via a sandy track starting opposite 39 Pacific Drive, Swansea Heads.

Background.

A local participant on an excursion I conducted at the Reids Mistake fossil forest site, for Lake Macquarie City Council's Coastal Summer Festival in 2009, informed me of the existence of similar fossil tree trunks and stumps at Crabs Beach, 1.5km to the south.

On the wave-cut rock platform at Reids Mistake, fossil tree stumps are preserved in growth position at the top of the Lower Pilot coal seam, in the upper Newcastle Coal Measures of Late Permian age. Fossil tree trunks lie flat along overlying tuff layers of the Reids Mistake Tuff.

1. Locality map of Crabs Beach with excursion stops. (Google Earth)

2. View of coast north from Illawong Park.

David (1907) described their occurrence and produced a map of the rock platform showing their distribution. In the nearby Government quarry vertical fossil tree trunks rooted in the top of the Lower Pilot Seam penetrate the overlying tuff for up to several metres. David deduced that the Lower Pilot forest swamp was *killed off suddenly by being buried under dense showers of volcanic ash*. Under the microscope, the resulting tuff is made of *minute broken fragments of feldspar crystals interspersed with cusps and triangles, and concave-convex pieces of volcanic glass* (a crystal vitric tuff).

Diessel (1984) reported that most of the trees on the rock platform protrude into the overlying tuff for only 0.5 to 1m. They were snapped off and then buried in volcanic ash. He calculated the mean direction of the fallen trunks as pointing to the west-southwest, (260 degrees). Some stumps are tilted, with a mean tilt to the south west. Diessel interpreted that trees growing in the Lower Pilot peat swamp were snapped off by a directed volcanic blast from the northeast. The horizontal blast killed the forest and later ash falls buried the fallen trees.

He was inspired by the well documented eruption of Mount St Helens in the Cascade Ranges, USA, in May 1980. The very violent initial explosive lateral blast felled the adjacent forest of Douglas firs for up to 27km from the volcano. The fallen trees pointed away from the mountain. The lateral blast was a pyroclastic surge, a huge, dense, rapidly moving cloud of hot gases (steam and carbon dioxide) and pulverised rock. It hugged the ground, sweeping down valleys and climbing ridges, a hot stone wind.

The Society ran excursions to Reids Mistake in 2010 (Morton & Evans) and 2014 (Morton) to examine the fossil forest. Ron Evans measured 60 fallen logs, finding that most pointed in an east-west direction.

The aim of the present excursion was to investigate fossil trees at Crabs Beach, preserved at the top of the Lower Pilot coal seam. Do the fallen trunks have a similar orientation to the ones at Reids Mistake? Also, we were going to investigate interesting outcrops of tuff and coal from Crabs Beach to 'Chalkies' in the

3. Roz giving an introduction, Illawong Park.

5. Stop 1: Well developed jointing in Lower Pilot coal seam.

north, and examine rare fossil leaf impressions of a *Cordaites* tree.

The stratigraphic nomenclature used in this report is that used by Murray Little and Ron Boyd in Boyd, Little & Herbert (1998).

The Excursion.

A perfect sunny, warm and calm afternoon brought out a total of 40 people to Illawong Park, Swansea Heads. We met at 1pm. From this cliff-top park there is a beautiful view of the coast to the north. The rock platform below is capped by 'Chalkies', the local name for a tall white erosional remnant of tuff (Reids Mistake Tuff). Farther north is Moon Island, lying just east of Reids Mistake Head *(photo 2)*. After a brief introduction *(photo 3)* we walked down onto Crabs Beach to the rock platform at the southern end of the beach.

Stop 1.

The top of the wave cut platform comprises the top of the Lower Pilot coal seam. It is only exposed at very low tides, so we visited it at a 0.2m low tide at 1.40pm. Combined with a low swell, an excellent wide expanse of coal was visible *(photo 4)*. The seam dips gently to the west-southwest. It forms part of the eastern limb of the Lake Macquarie Syncline, whose south plunging axis runs down the middle of Lake Macquarie. The coal seam shows well developed jointing, trending southeast, (130 degrees) and southwest (220 degrees) *(photo 5)*.

The rock platform reveals numerous fossil tree stumps with roots attached, in growing position, embedded in the top of the coal *(photo 6)*. Many long, straight fossil tree trunks lie across the top of the coal seam *(photo 7)*. Erosional remnants of the overlying cream coloured, fine grained tuff are draped over the higher parts of the coalified tree remains, highlighting them and providing a dramatic contrast with the black coal beneath.

The well preserved large stump in *photo 6* is 45cm in diameter and displays fine growth rings. Roots radiating out from the stump are curved. *Photo 7* shows fallen tree trunks 11cm and 14cm in diameter and at least 1m long. Their full length is obscured by 'Neptune's necklace' algae *(Hormosira banksii)* growing over them and erosion of the rock platform.

Most participants, unfortunately, did not bring a compass to measure the orientations of the fallen trunks. So, in between explaining features, I managed to make ten measurements, and Ron made one. Directions ranged from west to north. The majority of the trunks

4. Stop 1: Lower Pilot coal seam exposed on rock platform.

6. Stop 1: Fossil tree stump with roots attached in growing position at top of Lower Pilot coal seam. (cm scale)

7. Stop 1: Fossil tree trunks lying on top of the Lower Pilot coal seam.

9. Stop 1: Close up of the conglomerate on photo 8.

measured point to the west-northwest.

On the southern side of the coal platform, next to the beach, a thin layer of tuff overlies the coal seam. This in turn is overlain by pebble conglomerate *(photos 8 & 9)*. Farther south just off the beach is Frenchmans Rock, a large outcrop of this conglomerate *(photo 10)*. This rock was deposited as river gravel by a fast flowing river.

Discussion.

The limited number of measured directions of fallen logs indicates that they fell to the WNW. At Reids Mistake measurements by Diessel (1984) and Evans (2010) indicate a WSW to west direction. So the volcano responsible for the lateral blast lay to the east. Bradley (1993) suggested that the source of the blast and the tuffs that buried the trees was a volcano on the 'offshore uplift', an easterly dipping tilted fault block lying 30 to 40km east of the present coast. It is now buried by Triassic and later sediments, beneath the Tasman Sea. During eruptions in the Late Permian, however, the volcano was on land. The Palaeo-Pacific Ocean lay 400km east of the present coast, with an active subduction zone and associated magmatic arc which was too far east to be the source of the volcanic ash.

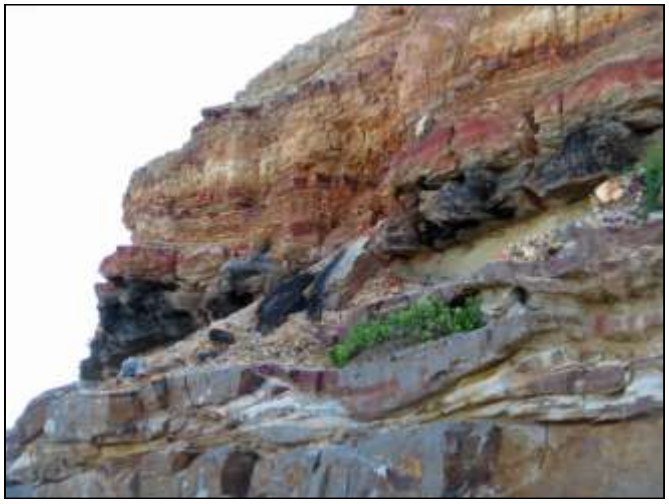
From recent dating of tuffs in the Newcastle Coal Measures (Holmes 2014) Reids Mistake Tuff was erupted about 253 million years ago.

The fossil tree trunks and stumps belong to the *Glossopteris* Flora, which characterised the Permian Period in the Southern Hemisphere (White 1986). This group of plants comprised *Glossopteris* and *Gangamopteris* trees and shrubs, *Cordaites*, ferns, tree-ferns, horsetails such as *Phyllotheca*, lycopods and the first conifers, ginkgophytes and cycadophytes. Much of this flora grew in extensive, long living cool temperate swamps. They formed peat that was subsequently buried to form coal seams.

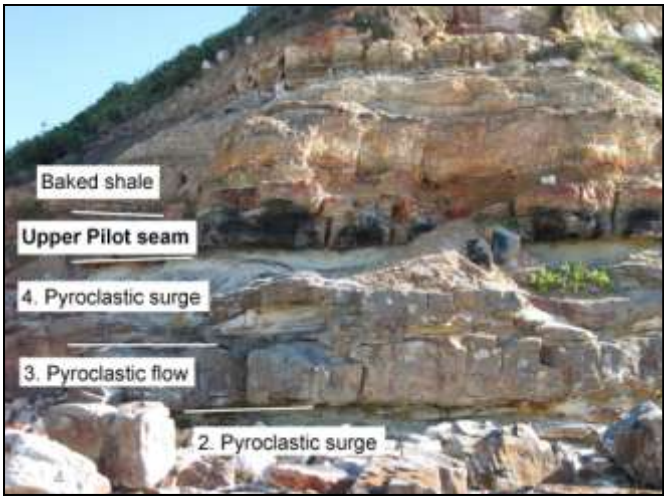
The fossil tree remains at this stop may be from *Glossopteris* or *Cordaites* trees as fossil leaves of both are found nearby.

8. Stop 1: Thin tuff and then pebble conglomerate overlie the Lower Pilot coal seam on the southern side of the rock platform.

10. Stop 1: View of Frenchmans Rock, a large outcrop of conglomerate south of the rock platform.



11. Stop 2: Cliff exposing baked red-stained shale overlying cindered Upper Pilot coal seam, from spontaneous combustion.



13. Stop 2: Cliff section of Upper Pilot coal seam underlain by Reids Mistake Tuff. Pyroclastic units and their interpreted origin after Diessel (1984, 1992). White lines show boundaries of units.

Stop 2.

We walked north along Crabs Beach to the small headland beneath Illawong Park. The cliff face here exposes a layer of bright red stained shale overlying a cindered coal in the Upper Pilot coal seam *(photo 11)*. The shale has been cooked by heat from burning of the underlying coal seam, sometime in the past. When exposed to the air, coal oxidises and the heat of the chemical reaction can cause it to ignite - spontaneous combustion. Burning coal has baked the overlying layers and oxidised iron in the sediments to a bright red iron oxide. Baking has also opened up jointing in these rocks *(photo 12)*. The layers beneath the coal have not been baked.

There are other examples of spontaneous combustion of coal seams in the Newcastle Coal Measures. South of Swansea, Pacific Highway road works for the deviation and straightening of Swansea Bends in the 1990s revealed burning coal in the Wallarah seam in abandoned underground workings of the Normaine Colliery (McNally 2000). Lake Macquarie City Council also records spontaneous combustion in this seam in a planning document for the Wallarah Peninsular development.

12. Stop 2: Close-up of widened joints in cindered coal and baked shale.

In the cliff above Merewether rock platform south of the baths, near an old railway tunnel, grey shale immediately above the upper split of the Dudley coal seam has been baked to an orange brick colour and hardened by spontaneous combustion of the coal beneath.

Beneath the cindered coal of the Upper Pilot seam at Crabs Beach is an excellent exposure of the Reids Mistake Tuff, showing several layers *(photo 13)*. The rocks are white, cream and light grey in colour. They are felsic crystal and vitric tuffs, composed of varying amounts of quartz, plagioclase and biotite crystals and unwelded volcanic glass shards. Coarser grained layers contain a higher proportion of crystals, whereas finer grained layers contain a higher proportion of glass.

In a cliff section at Quarry Beach, 3km south of Crabs Beach, Diessel (1984,1992) identified and described four units within a 7m thick section of the Reids Mistake Tuff. He interpreted their mode of emplacement, considering three mechanisms for their origin: pyroclastic fall, pyroclastic flow and pyroclastic surge. Two types of pyroclastic surges are probably represented here: ground surge and ash cloud surge. However, a base surge origin is considered unlikely as the deposits were laid down a long way from the volcano.

A pyroclastic fall comprises ash particles which have been explosively erupted from a volcano. They fall through the air and settle on the ground.

A pyroclastic flow is a hot, dense flow of explosively erupted ash particles and volcanic gases with a high particle/gas ratio.

A pyroclastic surge has a lower solid/gas ratio than a pyroclastic flow. The particles are carried laterally entrained in turbulent gas as a ground-hugging dilute particulate flow. (For further description, see Diessel

14. Stop 2: Reids Mistake Tuff Unit 2 in rock platform showing hummock bedding.

15. Stop 3: 'Chalkies" showing differential weathering in Reids Mistake Tuff Unit 4.

16. Stop 3: Fossil leaf impression of *Cordaites* in tuff.

1992, page 318.)

In the Crabs Beach cliff section Diessel's units 4, 3 and 2 can be recognised *(photo 13)* and are labelled with Diessel's interpreted origin. The upper section of the Reids Mistake Tuff exposed here is about 3.2m thick. The lower part of unit 2 makes up the adjacent rock platform. Unit 1 outcrops at Stop 1 overlying the Lower Pilot seam on the rock platform. It is interpreted as a pyroclastic fall deposit which buried the fallen trees soon after the initial blast that felled the trees in the swamp.

Features and the possible mode of emplacement of units 4, 3 and 2 are given below.

Unit 4: Immediately below the Upper Pilot coal seam is a soft clay-rich layer. Resistant, thin, fine and medium grained layers draped over bedforms underlie this. Bedding is wavy to contorted with hummock-like surfaces, dunes, antidunes, ripples, cross-bedding, pinch and swell structures. It is interpreted as a pyroclastic surge deposit, formed by an ash cloud surge.

Unit 3: A solid, medium and coarse grained massive tuff 80cm thick underlies Unit 4. It has a relatively flat upper boundary and a slightly irregular base, and consists of about equal proportions of crystals and glass shards. It is interpreted as a pyroclastic flow deposit. As it is not welded it could be the distal end of an ignimbrite.

Unit 2: It is similar to Unit 4 with many bedding structures. The unit is best observed on the adjacent rock platform where distinct hummock-like surface patterns are exposed *(photo 14)*. It is interpreted as a pyroclastic surge deposit, possibly formed by a ground surge.

Stop 3.

From the cliff section at Stop 2 we walked north along the small beach to the next headland. The adjacent rock platform is capped by a tall outcrop of white tuff known locally as 'Chalkies'. Some layers have been altered to white clay, giving a chalky appearance. It is a well-bedded erosional remnant of the Reids Mistake Tuff, Unit 4 *(photo 15)*. It is fine grained and thinly bedded. Some beds are laminated and also have cross lamination.

On the rock platform, just southeast of Chalkies, Shayne located the rare fossil leaf impression of a *Cordaites* tree that he and I had noted on a previous trip *(photo 16)*. It is preserved in an orange iron-stained light grey tuff layer. The leaf is long and strap shaped with parallel venation. It is at least 26cm long and 8cm wide, but its full length and tip are not visible. The tip of the leaf is usually bluntly rounded. There are impressions of smaller leaf fragments, striated stems and woody fragments nearby. *Cordaites* belong to an extinct group of gymnosperms related to primitive conifers, which lived during the Carboniferous and Permian periods. (Kerr, 2010)

A fossil of a large compressed horizontal log is preserved along the bedding on the northern side of

17. Stop 3: Compressed horizontal log in tuff.

18. Stop 3: Vertical fossil tree in conglomerate overlying the Upper Pilot coal seam.

19. Stop 3: Cliff Section. From top: conglomerate and sandstone, Upper Pilot coal seam, Reids Mistake Tuff.

20. Stop 3: Ball and pillow structure in Reids Mistake Tuff Unit 4

Chalkies *(photo 17)*. The wood is coalified in some places and replaced by light brown chalcedony in other parts. The silica has come from breakdown of volcanic glass in the enclosing tuff.

There is an excellent cliff section on the northern side of Chalkies. It exposes the Upper Pilot coal seam overlain by a thick pebble conglomerate and sandstone unit. A vertical fossil tree extends from the top of the coal seam into the conglomerate above *(photo 18)*. The wood has been coalified and replaced by chalcedony in part. Beneath the coal seam is the Reids Mistake Tuff, Unit 4 *(photo 19)*. A piece of tuff that had fallen down from the top of this unit contained accretionary lapilli, similar to that described by Diessel for this unit (Diessel, 1992, p317 & 322). Within the unit the base of a tuff bed displays a large ball and pillow structure *(photo 20)*.

We wandered back past Chalkies down the beach to a track leading up to Pacific Drive, finishing the excursion at 4pm.

Report by Roz Kerr.
Photographs by Roz Kerr (1,2,7,8,9,10,11,13,14,15,17,19) and Shayne Kerr (3,4,5,6,12,16,18,20).

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Caves & Tunnels

Leader: Brian England & David Atkinson.
Date: Saturday 28th May 2016.
Attendance: 9 members.

At 6:30am not a cloud in the sky, although a brisk westerly wind made it feel much colder than it actually was. But by the time the well rugged up attendees had assembled beside George Booth Drive a Surveyors Creek Number 3 crossing just east of the Richmond Vale Road intersection to investigate the caves and tunnels on the abandoned Richmond Vale Railway, the sky had clouded over and light rain threatened.

As the forecast showers seemed to be coming very close to reality an executive decision was made to reverse the planned itinerary. So we set off in two vehicles to a small clearing back west along George Booth Drive which provided access to the eastern end of the cutting leading into the number 3 Buchanan tunnel (on the Richmond Vale Railway. The group then set out on foot along the old permanent way to the impressive remains of the trestle rail bridge over Surveyors Creek. Rampant vegetation hid much of the structure where it joined the rail embankment, with only the massive timber beams that once supported the rail bed visible. Fortunately a power line runs along the southern side of the railway and the tall grass beneath it had been recently slashed to minimize the possibility of fires, providing easy access to the sandy creek bed below the bridge. Only here could the engineering behind this magnificent structure be fully appreciated *(photo 1)*.

1. Abandoned trestle bridge over Surveyors Creek.

The brick buttress at the western end of the bridge had collapsed and been washed down the creek but the eastern side was in good condition. What at first appeared to be areas of burnt timber proved to be zones blackened by termite activity. Even so the bridge had been so well built that there was little danger of collapse any time soon.

Back at the cars we pulled on our wellies, brought to combat the mud we expected to encounter in the Buchanan Tunnel as we walked westward through it. The purpose was to view some exceptional geology just beyond the west portal.

Surveyors Creek marks the boundary between the Newcastle Coal Measures to the east and the underlying (older) Tomago Coal Measures to the west, with a thin bed of Waratah Sandstone lying immediately east of the creek bed. However this important geological boundary is here buried by soil.

Walking along the cutting leading to the tunnel portal we took note of the alternating beds of cross-bedded sandstones and shales with occasional dropstones and ironstone bands. These rocks dip gently to the east *(photo 2)* and belong to the Dempsey Formation, the upper unit of the Permian Tomago Coal Measures. This is a sequence of tidal to estuarine sediments deposited in a climate that allowed ice rafts to unload drop stones at the end of cold winters (Herbert and Helby, 1980).

A few metres east of the portal is an unconformity between the Dempsey Formation and the underlying Lower Tomago Coal Measures which meets the base of the Dempsey Beds at an angle of 15 degrees. A lenticular basal conglomerate rests on the erosion surface, forming the unconformity interface. The Dempsey formation was transgressive over the Lower Tomago Coal Measures, with a tectonic event in between that caused uplift resulting in erosion. West of the tunnel it grades into the underlying (older) Mulbring Siltstone of the marine Maitland Group that has eroded to form a wide valley.

2. Gently dipping beds of the Dempsey Formation east of the Buchanan Tunnel.

3. Steeply dipping beds of the Dempsey Formation immediately west of the Buchanan Tunnel (view looking north).

Now back to our adventure. We pushed ahead into the tunnel with Diane charging ahead in eager anticipation of the geological surprise that lay ahead. But as we reached water two thirds of the way in she abruptly stopped, frozen in her tracks. "I'm stuck" she yelled in astonished disbelief. And she really was! The glutinous brown ooze had swallowed her wellies and no way could she pull herself out. The more she squirmed the deeper she sank. Bits of timber and rocks were hurriedly carried in to support the rest of the group as we made a seemingly futile attempt to pull her out. Over 30 desperate minutes passed before one boot came free, suddenly throwing Diane off balance and into the mud. But the other boot refused to budge. We could have all ended up in tangled mess of congealed mud, a mystery for some future paleontologist to speculate on, but then the remaining foot burst free, minus the boot.

Our fist goal had been thwarted! West of the Buchanan Tunnel the beds of the Dempsey Formation dip very steeply to the east *(photo 3)* in stark contrast to the gentle dip at the eastern portal. This sudden change in dip is due to the Buchanan Monocline which lies on the eastern side of the Lochinvar Anticline and was formed by the underlying north-south trending Buchanan Thrust Fault, which is not visible on the ground surface until north of the M15 Motorway.

Back at the cars we changed into clean shoes and drove to Surveyors Creek for a well-earned coffee, hoping our exploration of the Jewboy Cave would be less problematic.

After recovering from that potentially serous incident in Buchanan Tunnel we drove three kilometres to the east along George Booth Drive to reach the best access point for the Richmond Vale Railway. A locked gate across the sealed access road here meant parking within sight of the main road and walking about 700 metres down to a point on the railway midway between number 1 and number 2 tunnels. From here a dirt road follows the north side of the railway, here marked by a deep cutting in conglomerate. This area lies within the

Sugarloaf State Conservation Area administered by National Parks NSW, while the railway remains the property of Coal and Allied.

Just as the dirt road plunges into the next gully, a short vehicle track off to the north leads to a parking area above the flat sandstone bed of Blue Gum Creek. The cement block wall of the M15 Hunter Expressway lay only a few metres to the north and the continuous roar of traffic was very evident over the relative silence of the bush we had just walked through.

To the east of the parking area Blue Gum Creek dives over a small waterfall into a dark and very rocky canyon almost hidden by rainforest. There is no well-defined access down to the cave, but by pushing through the forest on the southern side of the canyon a way down to the boulder-chocked creek bed below the falls can be found through the huge sandstone boulders swathed in native orchids. The cave was not immediately evident until we reached the small plunge pool at the base of the falls and looked across to the north wall of the canyon.

Boulder hopping across the bed of the creek brought us to the opening of a surprisingly deep horizontal cleft that to the right led into a low but very deep cave. Squatting inside the main cave one could easily imagine how this could be a perfect hiding place for escaped convicts and bushrangers *(photo 4)*. Back in those days the cave would have been very difficult if not impossible for troopers to find, hidden as it is by piles of massive boulders and dense rainforest *(photo 5)*.

This surprising cave system is almost solely the result of stream erosion. As Blue Gum Creek gradually cut downwards it encountered a bed of less resistant sandstone sandwiched between conglomerate beds. Once this more easily eroded rock layer was reached, the creek was able to erode laterally, carving out the deep cleft and cave we see today. Eventually the creek deepened its bed in the more resistant conglomerate to leave the cave perched on the side of the canyon. However during heavy rain Blue Gum Creek can still flow through the cave (Powell, 2003). Groundwater seeping through the rocks above the cave has formed three calcite columns at the back of the cave, the calcium carbonate coming from the cementing material in the rocks.

4. Jewboy Cave. The main part of the cave lies beyond the people

5. Stream erosion cut down the stream bed before laterally eroding softer rocks to form the present cleft and cave.

Back on the main track we continued east past Burrenjim Dam, a small concrete wall structure built to service the steam engines on the Richmond Vale Railway. It is completely enclosed by dense bush, making access almost impossible, even though it is only 50 metres or so down in a gully to the north of the road.

For the moment we ignored Number 2 Tunnel, the cutting leading into it blocked by huge boulders holding back a deep trough of muddy water. At Number 1 Tunnel we walked through the eastern portal before returning to the cars. The tunnel lining is a masterpiece of bricklaying, its double brick construction revealed by recent 10cm diameter drill holes. Also present were several anchor points for laser beam detectors set up during construction of the M15 to detect any potentially harmful movement which could have seriously damaged the integrity of the tunnel construction. The M15 passes directly over this tunnel. A few cracks in the brickwork of the eastern portal appeared quite old and not due to recent roadworks. Steel gates erected at the portals of all the tunnels to keep out 4WD vehicles had been pushed aside and mangled.

Geologically our exploration of Jewboy Cave and the rail tunnels had proved a bit disappointing. The rocks east of Surveyors Creek lie within the Lambton and Adamstown Sub Groups, The outcrop of these rocks curves around the nose of the north-south trending Macquarie Syncline, the major structure in this area. These sub groups are much thinner here than on the coast due to the fact that to the west they lap up against the Lochinvar Anticline. Unfortunately the rocks of the Newcastle Coal Measures along our route were often poorly exposed, except in rail cuttings. Fine

pebble conglomerates containing fossil driftwood impressions and cross-bedded sandstones were common. However we found it impossible to differentiate the various stratigraphic components without the assistance of detailed geological maps.

On the way back some people ventured up the muddy cutting to the east portal of Number 2 Tunnel.

A brief history of the Richmond Vale Railway.

The history of the Richmond Vale Railway (RVR) began in 1857 when John Eales completed construction of a railway to carry coal from his mine at Minmi to the coal loader at Hexham. When Eales' pit flooded James and Alexander Brown purchased the Minmi operation, including the railway, very cheaply. This was to become the first section of the RVR.

In 1891 a shaft was sunk on Richmond Vale. John Brown purchased the site around 1896 when coal prices had fallen dramatically and by 1908 had started work on the new mine. In 1911 this became the Richmond Main, which later developed into a showpiece for the J and A Brown empire.

In 1900 J and A Brown was given permission to construct a railway between their Minmi to Hexham railway and their new Richmond Vale lease. This did not include a line to link their Pelaw Main mine, but they went ahead anyway! The Hexham to Pelaw Main railway was completed in 1905 and the Richmond Main section in 1906. Thus the RVR was born.

John Brown died in 1930 but his railway lived on for some time. Pelaw Main and Richmond Main mines closed in 1961 and 1967 respectively and the RVR closed beyond Stockrington, so that only the 15 kilometre section across Hexham Swamp between Stockrington Colliery and Hexham remained. Even in the late 1980's scenes on the remaining section of line could have come from any time in its 130year history. Old wooden steel-framed hopper wagons were still being used, some dating from the end of the 19th century. They were hauled by engines built before the 1930's.

The RVR was the last commercially operating steam railway in Australia. Road haulage of coal in parallel with the railway began in 1986, with the rail only operating at night when the trucks were banned from the roads.

It was finally announced that on 22nd September 1987 the final rail haulage of coal across Hexham Swamp would take place in order to clear some empty hoppers from the line. The railway would then close for good.

Stockrington Colliery did not last long after the railway closure and shut down in June 1988. Four 10 class locomotives were donated to the Richmond Vale Mining Museum and were hauled there by truck from Hexham in 1989.

The line across Hexham Swamp was never taken up and the rails remain in place along with points, etc.

The Jewboy Gang.

Who were they? On 12th August 1840 John Everett, John Marshall, Francis Knight, John Wilson and William Brown escaped from Hyde Park Barracks in Sydney. The first four men had been assigned convicts in the Hunter Valley before being sent back to Sydney for further crimes. On 19th August 1840 the gang reached Wisemans Ferry and then travelled up the Great North road to Warrawong and thence to the Wollombi Plains.

When Brown left the gang the others went to Mount Sugarloaf and then on to the upper Hunter. Marshall and Everett returned to Sugarloaf where John Shea joined them. This group committed several misdemeanors in the Lake Macquarie district, including Swansea, where they met up with Henry Denny and Michael John Davis, both emancipated convicts. Davis was an educated man of Jewish persuasion who had been sentenced to 7 years transportation for obtaining goods fraudulently. He had arrived in Sydney in 1830. His wife Hannah and 5 of his eight children joined him in 1831. Meanwhile their son Edward (Teddy the Jewboy) was in Newgate Goal (England) on a charge of theft and was later transported to Sydney.

In November 1840 up to 14 convict escapees from Sugarloaf (Including the gang of 3) raided the Maitland area. Marshall and Shea then moved on to the Upper Hunter and Liverpool Range, where on the 10th November 1840 they were joined by Jewboy Davis who had absconded from a droving party near Murrurundi.

After Jewboy Davis joined the gang they began dressing in manilla hats decorated with red or pink ribbons, red scarves and leather leggings. Although they were called the Jewboy Gang, Marshall was the leader, not Davis (Roope and Gregson, 2002).

There is no actual evidence that the gang ever made use of the cave which now bears their name.

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HERBERT, C. and HELBY, R. (1980). *A Guide to the Sydney Basin.* Geological Survey of NSW, Bulletin 26.

POWELL, G. (2003). *Hunter Valley Bushwalks.* Kingsclear Books, 44-47.

ROOPE, C. and GREGSON, P. (2002). *An Organised Banditti - The story behind the Jewboy Bushranger Gang.*

Notes on the Richmond Vale Railway provided by David Atkinson.

Report by Brian England.
Photographs by Brian England.

What Rock is That?

Presenters: Brian England & Ron Evans.
Organiser: Brian England.
Date: Sundays 10th & 24th July 2016.
Attendance: 23 & 17 members.

A workshop on the field identification of rocks.

Excellent workshops on mineral and rock identification had been held for Society members in the past, the last one being on 10th October 2009 at Ron and Ellen Evans home. At the last AGM it was decided that a refresher workshop was needed, especially for those who had joined the Society since the last workshop.

The workshop this time was held at the England residence with each participant bringing their own chair, table and lunch. While only 14 people were expected, 23 eventually assembled, with tables spilling out onto the driveway and giving the neighbours something to talk about for days! This time the organiser had set out a different, more interactive format requiring participants to be directly involved in the discussion. Streamlining the process allowed a more comprehensive coverage than had been possible previously. A distinct advantage of the new venue, despite the obvious crowding, was the direct access to over 700 catalogued reference specimens in one of Australia's best private collections.

The main difference compared to previous workshops was the provision of sets of typical mineral and rock samples for each participant to handle and examine, rather than passing around individual specimens, which in the past had proved time consuming. The samples in each set were identical and typical as possible of the minerals and rocks under discussion. This was a huge undertaking by the organiser, but proved vey successful.

The workshop began at 10:00 am. After a brief introduction by Brian, Ron spent the morning describing and demonstrating 9 of the principal rock-forming minerals, emphasising the diagnostic properties of each, including colour, shape, twinning, cleavage, hardness etc.

After a late morning tea break, Brian followed with an outline of the three divisions of igneous rocks (plutonic, intrusive, extrusive or volcanic), with Ron following up with detailed descriptions of the examples in the igneous rock sets. A brief outline was given of the sedimentary rocks in the sample sets.

At 2:00 pm it became obvious that the workshop could not be completed in one day without extending into the early evening, so it was decided to complete it on another Sunday not too far away.

The second session was programmed for Sunday 24th July with 17 hardy souls turning up in freezing conditions on the day to complete the workshop. The previous day had been extraordinarily windy and cold. Material set out for the workshop had been blown all over the place and the venue was ankle deep in leaves requiring a hasty clean up before participants arrived.

The second workshop was better organised, with detailed summary posters prepared for each of the rock divisions, and a large number of labelled specimens set out on a table to demonstrate features that it was not possible to show in the sets. A folder containing a comprehensive revised set of notes was given to each attendee. This included copies of the summary posters, lists of minerals typically found in each igneous rock type, and a check list of the observations and tests required for identifying an unknown rock and determining its origin.

Blankets were provided for those who really felt cold. The temperature never rose above 12°C but thankfully there was no wind which would have made conditions even more unpleasant.

Again, Brian presented the introductory sessions covering sedimentary and metamorphic rocks, plus weathering products and an overview including the importance of weathering and erosion in producing the materials required for forming new sedimentary rocks as well as some of the most important ores of iron and aluminium (the laterites). Ron again followed up with descriptions of the examples of sedimentary and metamorphic rocks provided in the sets. Additional explanations were provided by Brian.

Participants of both sessions showed an unexpected thirst for knowledge demonstrated by a steady stream of intelligent questions asked of the presenters throughout proceedings.

The second workshop concluded around 2:00 pm, with people retreating to wherever they knew it was warm!

Report by Brian England.
Photos by Brian England (rocks) and Ron Evans (people).

Hardy participants preparing for the second workshop to commence.

Brian summarising information presented to very cold participants.

Labelled rock specimens that illustrated features not observable in the specimen sets.

A fine specimen of Laterite, the ore of aluminium.

The Third Great Numbat Mystery Reconnaissance Tour

Leaders: David Atkinson, Brian England.
Date: Saturday 20th August, 2016.
Attendance: 10 members, 2 visitors.

Early showers cleared to a partly cloudy day with a cold wind. Participants assembled at Walcha Water Works at 9:00am *(photo 1)* where David presented a brief history of the works before the 6 participating vehicles departed, each following the same set of instructions handed to the designated drivers. Each vehicle was also issued with an answer sheet on which to record their group's findings.

The occupants of only one vehicle showed their superior navigation and team skills very early in the day by not becoming hopelessly lost on the way across the river flats to the first assigned stop at the old Morpeth Railway Station *(photo 2)*. As well as recording a fact of local history members were also expected to apply their artistic talent (if indeed any existed amongst the group) to record on the answer sheet a remnant of the days of horse-drawn transport. The Polish tall ship in question was the Dar Mlodziezy which visited Morpeth in 1988.

A brief pause was made at Stuart Park in Hinton to allow everyone to catch up. There were several stragglers, not lost, just slow! Here was also a chance to break out the morning coffee and cakes, and commiserate over just where each of the drivers had gone wrong over such a short distance with such clear

1. Intrepid leader David imparting knowledge to the assembled masses.

2. Winston diligently recording information at the old Morpeth Railway Station.

4. Grave and headstone to John Pearce.

3. Sarah Gilmore's grave.

5. Seaham Nature Reserve with a fine example of intraformational folding.

and concise instructions. On arrival Barbra announced she was "going to make a Bolt for the toilets" – a clever pun in reference to a famous runner at the Rio Olympics which sadly went over everyone's head.

At the nearby Hinton Cemetery (one group got the wrong one) the question relating to Sarah Gilmore's age when she died challenged some people's mathematical reasoning *(photo 3)*.

The question on John Pearce's headstone caught a few out. It turned out that there were two John Pearces buried here with separate headstones, a fact that had not been noted by the survey team! The correct one (or the one intended by the leaders) is made of larvikite, a labradorite (Feldspar) rich plutonic igneous rock sourced from Norway *(photo 4)*. An added feature of this monument was the grass-covered pathways a colony of small black ants had made over its polished surface. David was embarrassed here by the unsolicited attention of a large black Labrador from across the road. He left the site with quite conspicuous slobber over the front of his pants.

The next scheduled stop was the Samuel Foster and Sons Great Northern Power, Broom and Brush Manufactory in nearby Wallalong, where two stone lions

guarded the gate. Jan Atkinson commented that the lions lay in parallel (ie two parallel lines)! Jan was also in great form that day!

After turning right onto the Seaham-Woodville road most drivers sailed straight past the turn into the Seaham Nature Reserve, despite the lead vehicle waiting conspicuously at the corner. But eventually everyone found the right spot and some time was spent discussing and drawing the features in the varved shales exposed in the small quarry *(photo 5)*. This locality had considerably degraded since our last visit. In a nearby cutting on the East Seaham Road a coarse unsorted clastic sedimentary rock had participants pondering over its origin. This rock is a tillite formed by a terminal glacial moraine which dammed the lake in which the varved shales in the nearby quarry and road cutting were deposited. Very few people got this one right, but further up the road most people correctly identified the stuff in the cutting as the volcanic rock dacite, thanks to the rock identification course held in July.

Further north along the East Seaham Road we drove along the western edge of the Gilmore Range which gave its name to a local sequence of Carboniferous intermediate to acid lavas and tuffs. The Society undertook the unexpectedly arduous climb of this range back in the dim distant past. Strangely, it was never put on the program again!

Few had any problems locating the plaque in Clarencetown Wetlands Reserve commemorating the construction of Australia's first steam ship, the William IV *(photo 6),* after a pleasant walk along the banks of the Williams River. The actual site of the former shipyard is located on private land 500 metres upstream of the memorial. Some took a short rest stop before returning to the Gray Street Reserve for a picnic lunch at 12pm.

We found the Clarencetown Museum closed but

6. Plaque commemorating the construction of the steamship, William IV.

7. David and Barbara searching for fossils on the banks of the Williams River.

there were a few historical items in the grounds, including a set of stocks, a well and old sandstone troughs.

Moving on towards Dungog the instructions required a u-turn outside Johnsons Farmgate Veges and Good Milk at Glen William. Fortunately, no-one realised at the time that this was due to an error made by the survey party who missed the turn down over the bridge across the nearby Williams River. This is one of the very few low-level timber deck bridges remaining in the Hunter Valley. The objective here was to search the boulders in the river bed under the bridge for marine fossils and to examine and explain the perched gravels in the south bank *(photo 7)*.

The final official stop for the day was at the Coffee Bean Cafe in Dungog where the following awards were presented to those participants who had well and truly earned them, one way or another.

Best Fossil: Jenece McDonald for her Carboniferous brachiopods.
B*est Total Score:* Janece McDonald/Laurie Henderson and Winston Pratt (40).
Best Drawings: Winston Pratt. Obviously excelled at Colouring-in 101.
Best Geology: Terry Kingdon for the most innovative (incorrect) answer.
Lowest Score: Terry and Laurel Kingdon.
Being last: Terry and Laurel Kingdon (first and most often).
Exemplory Leadrship: David Atkinson, with many unmentionable reservations!

Report and photographs by Brian England.

Wallabi Point and Lower Manning River Valley Geology

Leader: Winston Pratt.
Date: Wednesday 14th to Thursday 15th September, 2016.
Attendance: 24 members.

On Wednesday 14 September 2016, the group of 24 met at Old Bar before driving the 6 km to Wallabi Point where an easily accessible rock platform and associated cliff of about 300 m in length exposed Devonian to Early Carboniferous Koorainghat Beds.

In this relatively short exposure, best exposed only on an infrequent very low tide, is a great variety of sedimentary structures and structural features. These features occur in a succession of distal turbidites which have been folded and faulted with large slump structures occurring in a fault zone which has resulted in an approximate 15 degree change of strike in the strata on either side of the fault zone.

Digital handouts of the Wallabi Point and Lower Manning Valley were circulated to club members before the event so that it could be printed out as required.

The Wallabi Point handout included some details of turbidites, debris flows, soft sediment deformation, together with the basics on faults, folds and brittle – ductile shearing. The handout also included many photos taken at the site of the many features mentioned in the text. These features and photos included:

The Bouma units and various combinations of these. Flow rolls, flame structures, boudins, breccia dykes, convolute bedding, normal faults, reverse faults, fault zones, anticlines, synclines, en eschelon tension fractures, and sigmoidal gash veins *(see photos 1 to 6)*.

The Lower Manning Valley handout included an interpretation of the tectonics of the Lower Manning Valley and a simplified geological map showing the major tectonic blocks and the main structural features in the Early Permian rocks. The handout also included brief comments on the sites visited, firstly in the eastern sector of the map and then on sites in the western sector of the map.

At Wallabi Point many of the group were so engrossed with the features exposed in and near the cliff face they failed to see the best exposures of the Bouma turbidite sequences which occur on the northern side of the platform but close to the waters edge. While it took quite a while to find the breccia dyke *(photo 7)* which had been concealed by a large piece of driftwood since the reconnaissance trip, keen eyes not only found it but also found a second example.

After leaving Wallabi Point the group had lunch at Tinonee before viewing some steeply dipping and slightly deformed sediments of the Middle to Late Devonian Yarrimie Formation on the outskirts of Tinonee *(photo 8)*.

The next stop was 'The Bight' Lookout near Wingham. Here to the north-west the faulted block of chert and jaspers of the Silurian to Devonian Myra Beds form the prominent ridge culminating in Johnstones Peak at the northern end. The faulted eastern edge of this block has been intruded with schistose serpentinite. To the south-west, the prominent ridge of the Early Devonian Folly Volcanics with Mount Ganghat at the western end is bounded on the nearside by the Manning Fault which here mark the southern boundary of the Manning Basin *(photo 9)*.

After passing through Wingham a stop along Youngs Road at 'Cedar View', on the western limb of a northerly plunging anticline and now faulted along its hingeline, overlooked, to the west, a northerly plunging syncline, the core of which exposes the soft Early Permian Colraine Mudstone forming the shallow valley occupied by the Cedar Party Creek. On the western limb of this syncline, the Cedar Party Limestone, which underlies the Colraine Mudstone, crops out sporadically and in turn is underlain by the Kimbriki Formation and then the turbidites and diamictites of the Earliest Permian Giro Beds which form the prominent ridge containing Mount Katabundah. To the north-west the Miocene volcanic plugs of Mount Coxcomb and Mount Goonook can be seen below the horizon formed by the Comboyne Basalt and Mount Gibraltar. To the north-east the escarpment formed by the Early Triassic conglomerates of the gently easterly dipping Lorne Basin forms the horizon to the east while the Tertiary basalts of the Comboyne Plateau form the horizon to the west.

Later stops visited exposures of the Early Permian Cedar Party Limestone and the Early Carboniferous Taree Limestone. While quarries in the Taree Limestone have been abandoned and are now overgrown, a large block of this oolitic limestone with the oolites clearly visible *(photo 10)* was examined in a park where it had been placed as an ornament.

On the Thursday 15 September the group met at the Wingham Park to continue into the western sector. The first stop was at a now very weathered outcrop of turbidites of the Earliest Permian Giro Beds. Here 'B' units (parallel banded sandstones) of the Bouma sequence *(photo 11)* are in the order of 40 mm in thickness whereas at the Wallabi Point location 'B' units averaged about 70 mm in thickness. Further along the road another outcrop of Giro Bed turbidites were examined *(photo 12)*. Here the 'B' units were much thinner (bout 120 mm) and the exposure was more deformed as it was located in a narrow strip between two major faults.

The route then descended firstly over the main northern railway where the very weathered Early Permian Colraine Mudstone was exposed next to the railway bridge and in the railway cutting at Charity Creek, and then onto the gravel beds of the course of

the Manning River.

The Manning River gravels *(photo 13)* contained a variety of the more physically resistant rock types from the upstream catchment of the Manning River and its tributaries. The gravel was dominated by strongly indurated pebbles of the Giro Bed diamictites *(photo 14)* and then by cherts and jaspers from the Myra Beds. Basalt pebbles from the Tertiary basalts of the Cells and Mummel Rivers are also present. Serpentinite pebbles from the Mount George area were found on the reconnaissance trip but, in spite of a concerted search, none were found this trip.

Lunch was taken under the shady trees of the Kimbriki Community Hall (previously the Public School) after which the group visited the 'Colraine' property where the type section of the Early Permian Manning Group as described by the late Professor Allan Voisey is exposed. Our thanks are given to Leon and Betty Andrews, the property owners, for their hospitality and co-operation.

A cutting on the track down to the river flats contained a good and one of the rare exposures of the Kimbriki Formation. This outcrop was examined and seen to comprise mainly of light and dark grey banded siltstones overlain by tuffaceous sediments

The Cedar Party Limestone contains pods of clean sparite limestone as seen the previous day but here the Cedar Party Limestone is very muddy and not only crops out poorly but is heavily overgrown and could not be seen. However further along the river embankment recent clearing had exposed more outcrop of the Colraine Mudstone *(photo 15)* which contained abundant marine fossils *(photo 16)*. This was very fortunate as the original riverbank outcrop 70 m further along and described by Voisey had been very thoroughly picked barren by decades of visiting groups.

As time was getting on and many people were heading home afterwards, the remaining two sites of the Folly Volcanics and the Manning Fault zone were not visited.

Report by Winston Pratt.
Photographs by Winston Pratt (5, 6, 9, 11, 14, 16) and Ron Evans (remainder).

2. Sigmoidal en eschelon tension gashes, laminated bedding and boudinage within a bouma sequence.

3. Graded beds of sandstone (Bouma 'A' unit) separated by fine silt and mud (Bouma 'D' unit.

1. Laminated bedding, flame structures, jointing and micro-faulting.

4. Small drag fault. Note how the dark strata on the left has been dragged up, while on the right dragged down.

5. Plunging anticline in foreground. Note the folding in the outcrop behind the anticline.

8. Folded Middle to Late Devonian Yarrimie Formation rocks outcropping near Tinonee.

6. Most of the outcrop is heavily fractures as shown by this series of micro-faults disrupting the strata

9. The prominent ridge of the Early Devonian Folly Volcanics with Mount Ganghat at the western end is bounded on the nearside by the Manning Fault which here mark the southern boundary of the Manning Basin.

7. Small breccia dyke within a sandstone unit.

10. Early Carboniferous Taree Limestone clearly showing small round oolites and crinoid stems.

11. Bouma 'B' sequence (parallel banded sandstone) near Charity Creek.

14. Diamictite, a sedimentary rock consisting of non to poorly sorted sediments suspended in a matrix of mudstone or sandstone.

12. Rocks belonging to the Early Permian Manning Group showing small scale Bouma sequences.

15. Ron at an outcrop of Colraine Mudstone containing marine fossils.

13. Looking for Diamictites amongst the Charity Creek gravels.

16. Echinalosia Sp. fossil (a marine Brachiopod) within Colraine Mudstone.

Coastal Landforms along the Great Ocean Road & Landforms of the Newer Volcanic Providence, SW Victoria Geological Safari 2016

Tuesday 18th October to Thursday 24th November 2016

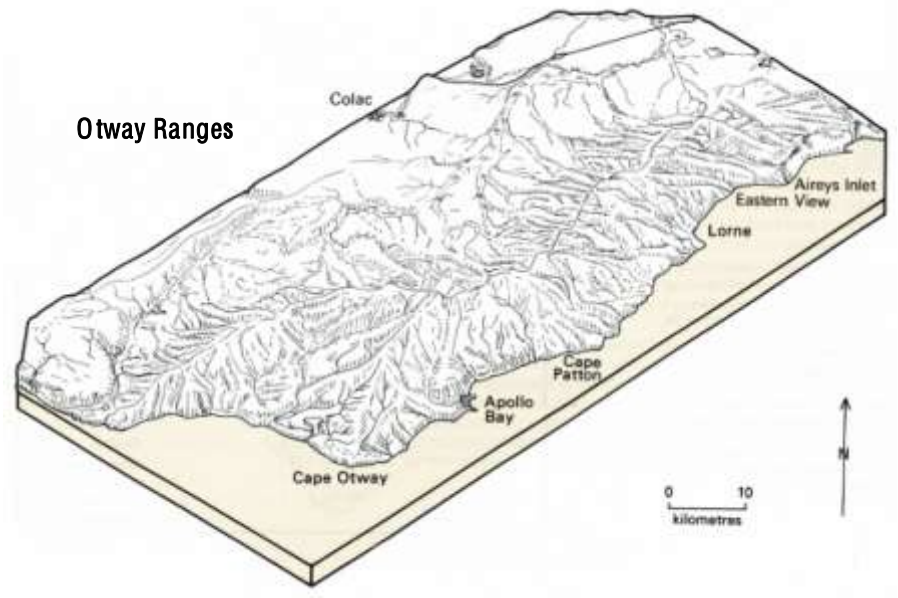
Leaders: *Ron Evans and Sue Rogers.*

Attendance: *Up to 22 members.*

The Otway Ranges.

The Otway Ranges in southwestern Victoria form the eastern margin of the Otway Basin in which non-marine sediments (3,300 m) were deposited during the early Cretaceous (120-90 mya). Deposition took place in a large, intra-continental braided river system flowing from the west. It possibly resembled rivers of SW Queensland today, between the Diamantina River and Coopers Creek (channel country).

Most of the sediments deposited were feldspathic sands and muds with abundant fragments of volcanic rock. These are now greywackes, siltstones and claystones, with occasional coarse gravel beds (conglomerates).



Day 1: Tuesday 18/10

Apollo Bay.

After lunch 10 people booked into Apollo Bay Tourist Park (Evans, Rogers, Colliers, Dunns & Redmaynes). A meeting was held in the camp kitchen at 5:00 pm and all were welcomed. The group were updated on those members not present (Maddens having caravan repairs and Kingdons due to an accident). Medical forms were collected. The procedure to be followed on Safari was outlined: a meeting each evening to review the day's activities and outline next day's program. Lunch and morning tea were to be carried each day. The use of UHF radios was discussed: all present had a radio. Sue and Barry outlined the activities they planned to run on Thursday and Friday.

It was agreed that we leave next morning at 8:30 am for Artillery Rocks and Lorne.

Day 2: Wednesday 19/10

Artillery Rocks, Lorne, Erskine Waterfall and scenic lookouts.

There were some early morning showers, but they seemed to be clearing as we left. By the time we reached Artillery Rocks (500m south of Jamieson River) it was fine and sunny. A set of steps next to a small Artillery Rocks sign took us down onto an early Cretaceous sandstone rock platform where dozens of large concretions were able to be examined safely as it was low tide *(photo 1)*. Bedding planes passed through the concretions indicating that they formed after deposition of sediments. Some individual concretions were perched on sandstone pedestals indicating that they were slightly harder than the sandstone *(photo 2)*. Others merged along their edges forming large convoluted structures *(photo 3)*.

Extensive areas of honeycomb weathering covered the rock platform and many of the concretions. Tessellated pavement was other obvious feature on the rock platform.

We then drove onto Lorne stopping in a small park on the edge of town for morning tea. The Erskine Falls road then took us uphill for 10km to the Erskine Falls carpark. At Erskine Falls, a lookout near the top of the falls gave a good view down the 30m falls.

A 220m walk down a set of well made steps took us to the base of the falls where a better view of the falls was obtained *(photo 4)*. Lush stands of tree ferns lined

1. Rock platform at Artillery Rocks.

2. Exposed concretions showing honeycomb weathering.

3. Merged concretions forming convoluted masses.

Erskine River at the base of the falls. Returning to the cars, we drove back down the road to the Blanket Creek Picnic Area (tables and toilets) for lunch.

It started to sprinkle rain after we had finished lunch, so it was decided that people would find their own way home.

A meeting was scheduled in the camp kitchen at 5:00pm.

4. 30m high Erskine Falls.

Day 3: Thursday 20/10

Beauchamp Falls, Hopetoun Falls, Californian Redwoods Grove and Triplet Falls.

Barry was our leader for the day which turned out be an "easy day" in the Otway Ranges where we only walked 7.42km, climbed 1541 steps and drove a distance of 153km.

The first stop was **Beauchamp Falls** parking area. It was quite cold when we arrived. However after completing the grade three, 2.5km return walk to the falls we were not cold. The walking track took us through a cool, majestic Mountain Ash forest with ancient Myrtle Beeches, large Blackwoods and thickets of large tree ferns to the base of the falls *(photo 5)*. Mosses and liverworts grew abundantly on the trunks of trees and tree ferns. Deppler Creek formed the relatively small falls with a drop of only 25m. On returning to the carpark, the weather was sunny and quite warm providing nice conditions for morning tea.

It was then a short drive to **Hopetoun Falls** *(photo 6)*. The area was similar to that at Beauchamp Falls. A viewing platform 30m from the carpark gave a view down the falls although it was obscured by vegetation. A 30 minute return walk took us the base of the falls where an unobstructed view of the 30m drop was obtained. Beautiful! The Aire River, Victoria's only heritage river which drops 555m over its short 35km course forms these falls.

Our lunch stop was to be **Redwoods Picnic Area** on Binns Road. However, our gallant trip leader drove straight past that spot continuing along the road for several kilometres before all realised 'his' mistake.

Back at the picnic area we walked into a small stand of majestic Californian Redwoods - *Sequoia*

5. 25m high Beauchamp Falls.

8. One of the two main waterfalls forming the upper falls complex.

6. Hopetoun Falls and the Aire River.

9. Remains of a boiler used to produce steam to drive saws in Knott's Number 1 Mill.

7. Stand of Californian Redwoods.

Sempervirens (photo 7) planted in 1938. We were all impressed by the size of the trees and how shady it was under the trees. After lunch in a lovely sunny spot, we drove back up Binns Road, through the village of Beech Forest to our destination **Triplet Falls** *(photo 8)*. A 1.8km circular walking track led to the falls passing through the usual forest of Mountain Ash, Myrtle Beech and groves of ancient tree ferns. A series of elevated viewing platforms provided views of the lower, middle and upper falls. They were certainly the most spectacular falls visited during the day.

Near the end of the walk, the remains of a boiler *(photo 9)* used to generate steam to turn saws at Knotts No. 1 Mill were observed. A replica timber trolley used to take timber from the mill was also present. After reaching the carpark, we made our way back to Apollo Bay, tired but very satisfied by the wonderful day we had experienced made better by the clear sunny weather.

Day 4: Friday 21/10

Cape Otway Lightstation and Mait's Rest Rainforest Walk.

A cold front had arrived during the night bringing wind, rain and cold weather. By the time we left at 8:30, the wind had dropped somewhat but it was still raining. We arrived at the lightstation, paid our entrance fee and started walking (in the rain) around the precinct.

We did not stay together as a group during our wanderings, but made sure we returned to the cafe at 11:00 o'clock for warm scones, jam and cream *(photo 10)* and a cup of nice coffee. Our wanderings resumed after a very good morning tea.

We had a look through the Telegraph Station, walked to the lightstation *(photo 11)* and climbed up the spiral staircase inside the lightstation to view the Fresnel Lens and look out over the wild coastline *(photo 12)*.

Another very interesting display was on Cape Otway dinosaurs collected from Cretaceous rocks outcropping on the rock platform below the lightstation. Three videos explained the significance of the discoveries.

One other venue all found interesting was a round building made from render and tee-tree branches with an enthusiastic aboriginal guide present who explained the significance of the display of artefacts. A small fire burnt in the middle of the building (which had a specially constructed circular roof that let smoke out) kept the interior amazingly warm, although the walls contained many open windows and two open doorways *(photo 13)*.

At 12:30, we met back at the carpark and drove to a small parking area near Point Franklin from which we were able to walk to Point Franklin or nearby Crayfish Bay. Most walked to Point Franklin. However, Ellen and I and the Redmaynes walked down onto the rock platform at Crayfish Bay *(photo 14)* where an unconformable contact between Mesozoic sediments (sandstones) and overlying dune limestones (Bridgewater Formation) was observed *(photo 15)*. Concretions were common on the rock platform and in the cliff.

10. One of several plates of 'yummy' scones.

11. Cape Otway Lighthouse.

12. Cape Otway coastline looking east.

13. 'Round House" containing aboriginal artifacts.

During the walks, the rain stopped and we were able to have lunch outside the cars when we returned from our walks. We left Cape Otway returning to the Great Ocean Road for the drive back to Apollo Bay. On the way out from Cape Otway, we passed an area of dead gum trees that had been killed by an overpopulation of Koalas. On the edge of the dead trees, sheets of galvanized iron had been placed around the trunks of many trees to prevent Koalas from killing them too. In fact, we observed two Koalas near the protected trees. Lots of tourists were stopping to

14. Walking down to Crayfish Bay.

15. Dune limestone (Bridgewater Fm) overlying Mesozoic sandstones. Note the iron-stained joints and concretions.

16. Tree ferns lining the walkway, Mait's Rest Rainforest Walk.

observe the animals.

Twenty kilometres from Apollo Bay, we stopped at Mait's Rest Rainforest Walk to undertake the circular walk that meandered past huge Mountain Ash, Beech Myrtle and tall, ancient tree ferns *(photo 16)*. Very impressive! It was a pity the weather was so cold and damp. Everyone made their own way back to camp after the walk.

Port Campbell National Park and Bay of Islands Coastal Park.

The spectacular cliffs of these parks are made of soft marine limestone.

During the Miocene period (5 to 23 mya) sea levels were much higher than today. The ocean reached as far inland as Hamilton and Ballarat. Formation of the limestone began under the sea with the deposition of marine organisms calcareous skeletons, mainly shellfish and calcium rich algae. Over millions of years these deposits were compressed turning into soft limestone.

Around 5 mya during the last ice age (Pliocene period) sea level dropped exposing the sea floor as a vast plain bridging Victoria to Tasmania.

From 18,000 years ago, sea levels rose partly covering the plain. The shaping and sculpturing of the coast began with acidic rainwater seeping through cracks dissolving the rock, and the relentless battering of the sea undercutting and eroding the cliffs.

Today, the coastline is characterised by vertical cliffs, stacks, small islands, sea caves, narrow gorges, blowholes, natural arches and sinkholes.

Day 5: Saturday 22/10

Apollo Bay to Port Campbell.

We all awoke to a cold, wet windy morning - 8°C. Packing up took place between scuds of cold rain. All safari participants were to make their own way to Port Campbell. Ellen and I left at 10:00 am. While driving through the Otway Ranges, the temperature dropped to 6°C.

After leaving the Otway Ranges and reaching the coastal plain, Ellen and I called into the Twelve Apostles Visitor Centre for a coffee before deciding to continue to Port Campbell to set up our caravan and have lunch.

By the time we finished lunch, the weather had fined up, so we drove back to Gibson's Steps (next to the Twelve Apostles) and walked down a steep set of steps to the beach. This afforded a great view of the vertical cliffs and some stacks. Many tourists were having a great time on the beach taking plenty of 'selfies'.

It was then back to the Twelve Apostles lookouts where we jostled with dozens of foreign tourists. The scenery along the coast is stunning. While there, we met Barry and Elaine and the four of us drove to Loch Ard Gorge where we undertook most of the walks (including Thunder Cave) before being stymied by frequent showers. A most impressive area. By then it was 4:30, so we returned to the caravan park for a 5 o'clock meeting to organise our next day's activity.
(see photos 17 to 25)

17. Beach, cliffs, stacks and tourists below Gibson's Steps. Twelve Apostles lookout in distance.

20. 'The Razorback'. The bumpy top is due to wind-blown spray hardening small areas of rock. The smooth base of the stack is due to wave erosion. The small rock shelf at the base has resulted from undercutting and collapse along vertical joints widened by solution weathering.

18. View from Twelve Apostles lookout of several stacks. There are not 12 stacks present today as erosion has worn some away.

21. Mutton Bird Island and Loch Ard Gorge. Note the natural arch through Mutton Bird Island.

19. Stacks. Layers of limestone forming the stacks vary in hardness, hence the uneven weathering. Note the small hole weathered through the top of the left stack.

22. Beach and cave at the end of Loch Ard Gorge. This is where two survivors from the wreck of the clipper Loch Ard came ashore in 1876 . They were Eva Carmichael and Tom Pearce, an apprentice.

23. Mutton Bird Island with a sea cave cutting through its base to form a natural bridge. The Loch Ard was wrecked just out to sea from the island.

24. 'Thunder Cave'. Limestone originally formed an arch over the entrance to the cave which collapsed. Large limestone blocks now lie 15m below sea level.

25. 'Broken Head'. Solution weathering by acidified rainwater is eroding the surface (rough) while pounding waves attack the base of the cliff. The raised cave may represent an old sea level.

Day 6: Sunday 23/10

Port Campbell National Park west of Port Campbell and Twelve Apostles Gourmet Trail.

Cold, overcast but NOT raining! We departed at 8:30 driving west stopping first at Town Lookout *(photo 26)* and then Two Mile Bay Lookout. Tall heath and backlight from the sun somewhat obscured the view over Port Campbell village.

Our next stop was The Arch *(photo 27),* a natural structure cause by a sea cave eroding through a narrow spit of limestone.

Then onto London Bridge. Up to 1990, this was a narrow headland undercut by two sea caves that formed natural arches through it. Then in the evening of 15th January 1990, the main arch connecting London Bridge to the mainland cracked and fell into the sea *(photo 28).* Two people were stranded on the headland and had to be rescued by helicopter. Now, the rocky island only has one sea cave cutting through it.

Next stop was The Grotto *(photo 29).* This landform was produced by both terrestrial solution weathering producing a sinkhole next to the cliffs and marine weathering from the sea. Fluted weathering is present in limestone above sea level, the result of solution weathering.

We had originally planned to continue onto Peterborough but changed our mind, opting instead to follow the Twelve Apostles Gourmet Trail. So we turned off the main road just before Peterborough and drove inland to the small village of Timboon where we had morning tea in the Lions Park. Next to the park was Timboon Railway Shed Distillery and Fine Ice Cream. Cakes, slices, meals, coffee, ice creams and of course whisky and were all available. Most of us settled for an ice cream.

Our convoy then proceeded to Timboon Cheesery where Sue organised a tasting of their cheeses. Some were very nice and they benefited from several sales.

Next venue was Newtons Ridge Winery, a small family owned and run business. The owner told us that their winery was the only one in the area, and that they made and bottled their wines on the estate. She then gave us a taste of all their wines starting with a "bubbly", then 6 white and 3 reds. Some of the wines were nice.

We had lunch at a large picnic table outside the winery *(photo 30)* before proceeding to Apostle Whey Cheese where we had a group tasting of 13 cheeses. Most thought that their cheeses were better overall than Timboon Cheesery. Lots of sales resulted. There were some interesting sculptures here *(photo 31).*

Last stop was G.O.R.G.E. Chocolates. We were able to sample 3 chocolates but none of us seemed very impressed. After leaving the venue, we stopped a few hundred metres up the road at a sand dune and checked out the wildflowers before all made their own way back to camp.

26. Port Campbell from Town Lookout. Port Campbell Creek and caravan park in foreground.

29. Natural Arch at The Grotto. Fossils were found in the limestone cliffs.

27. The Arch formed when a sea cave cut through a small headland.

30. Lunch at Newtons Ridge winery.

28. London Bridge. The natural bridge of rock that connected the island to the mainland collapsed on 15th January 1990 isolating two people who were rescued by helicopter.

31. One of several interesting sculptures at Apostle Whey Cheese.

Day 7: Monday 24/10

Port Campbell to Warrnambool.

Barry had driven down an unmarked track near Port Campbell (Sparkles Gully Track) the previous evening and found some spectacular gorges and caves, so at 8:30 we drove out to have a look. It was certainly worth the trip - 2 spectacular gorges with erosion caves at their ends. By walking out to the end of a small peninsular, we were able to look back along the gorges to the caves. One cave was huge. A small waterfall flowed out of one of the cliffs obviously fed by a small solution cave running through the limestone. The view of coastal cliffs and their attendant stacks was spectacular *(photos 32 to 36)*.

Returning to the caravan park, we hitched up and headed for Peterborough and the Bay of Martyrs, part of the 33km Bay of Islands Coastal Park. After a very scenic walk to Halldale Point followed by a 'cuppa', we drove a few kilometres west to the Bay of Islands carpark. Once again, stunning scenery on what was turning out to be a warm, sunny day *(photos 37 and 38)*.

32. First of two gorges. We walked out to the end of the narrow peninsular on the right.

33. View back up the gorge shown in photo 32. Note the rubble to the right of the cave, an indication of active erosion landwards.

34. View of the two caves from the end of the peninsular. Note how large the left cave is.

35. Large cave. The small waterfall can be seen coming out of the black patch towards the back of the cave.

36. Coastal cliffs and stacks as seen from the peninsular.

We then detoured off The Great Ocean Road to a locality called Childers Bay where we found toilets, picnic tables, more stunning scenery and a small beach at Murnanes Bay *(photo 39)*. Steps (85) led down to the beach where we could examine the limestone cliffs. One section of cliff showed a top layer of limestone that was cross-bedded. It was possibly an unconformable contact between Pleistocene limestone and Holocene dune limestone *(photo 40)*. Nearby Childers Cove was also very

37 . View west from Halldale Point of stacks, arches and caves.

40. Cross-bedded Holocene limestone sitting unconformably on Pleistocene limestone.

38. Bay of Islands, one of many wonderful views.

41. Childers Cove.

39. Murnanes Bay. A group of young overseas tourists were enjoying themselves.

scenic *(photo 41)*, although one of the tracks down to the beach was closed due to erosion.

Following our walk and lunch, we made our way to our caravan park in Warrnambool. Warrnambool Holiday Park is a small park with grassy sites and clean amenities, and close to shopping centres.

We welcomed four more members (Harrison, O'Brien, Staines and Smith) to our safari.

Day 8: Tuesday 25/10

Cape Nelson, Cape Bridgewater, Portland.

After carpooling into 4 vehicles, we left for Portland at 8:40, a drive of 105km. First stop was the visitors centre in Portland for information on the area, but there was very little. Cape Nelson had localities called Yellow Rock *(photo 42)*, the Enchanted Forest Cape Nelson Lighthouse *(photo 43)*.

Yellow Rock turned out to be a pillar of yellowish limestone at the base of a set of steps. The area seemed to be mainly used by surfers. There were good views across Bridgewater Bay towards the lighthouse where 2 small anticlines could be seen in the cliffs. We then went to the lighthouse looking for toilets and picnic tables - none, but very windy! We had to backtrack to an unmarked track that led down into the bush where we found a sheltered picnic table for morning tea.

To reach Cape Bridgewater, we drove back to Portland and followed the Cape Bridgewater Road for 18km. When we reached the carpark near the Petrified Forest and Blowholes, it was blowing a gale. Walking tracks led to both localities *(photo 44)*.

The Petrified Forest was a spectacular outcrop of large solution tubes cutting through Holocene Dune

42. Yellow Rock, Bridgewater Bay and wind farm, Cape Nelson.

45. Solution tubes within Holocene Dune Limestone forming the "Petrified Forest".

43. Cape Nelson Lighthouse.

calcarenite (limestone). Some observed were 2-3m tall and up to 600mm wide. They had been formed by groundwater soaking down through the unconsolidated sandy, but calcite rich dune deposits dissolving out calcite and depositing it at the edges of the tubes *(photo 45)*.

Underneath the limestone were flows of black basalt and purple scoria. The top of many of the flows showed polygonal cracking *(photo 46)*. We did not see any blowholes functioning as it was low tide.

Returning to the vehicles, we drove back towards Portland before turning off to the Bridgewater Lakes, a series of lakes formed when hind-dune lagoons were trapped by the Pleistocene limestone ridges behind them. It was a lovely place for lunch - green grass, tables and NO wind *(photo 47)*.

After lunch, we climbed up to a set of limestone caves (Tarragal Caves) that had formed at the lower junction of a Holocene Dune calcarenite sitting on top of Pleistocene limestone *(photo 48)*. Being exposed to the air, the structures in the caves were polluted by dust, moss, and a black coating that could have been smoke or an algae. A great view of the Bridgewater Lakes was obtained from the caves *(photo 49)*. All then made their own way back to Warrnambool, some of us detouring via a coffee shop. Ellen & I checked out Tower Hill, our next days venue.

44. Walking towards the Petrified Forest, Cape Bridgewater.

46. Basalt flow showing polygonal (columnar) jointing.

49. Bridgewater Lakes from Tarragal Caves.

47. Lunch, Broadwater Lakes.

48. Steep path up to Tarragal Caves formed at the base of Holocene dune limestone that sits unconformably on top of Pleistocene limestone.

Tower Hill: a maar volcano with nested scoria cones.

Maar volcanoes form when rising basaltic magma (1200°C) comes into contact with sediments saturated with groundwater close to Earth's surface. The interaction between the hot magma and water is explosive producing steam and fragmented magma. The overlying rocks are shattered and collapse inwards and become pulverized into sand-sized material called ash. A mixture of ash, sporadic larger particles, gas and steam are hurled upwards through a vent to form an eruption cloud.

A maar volcano typically has a wide funnel-shaped crater formed largely through collapse of the crater walls during explosive activity. A very low cone that slopes gently away from the crater rings this.

The cone is built up of layers of ash, larger basalt lumps (bombs) along with material ripped from the crater walls. The crater floor lies below the pre-eruption surface (at least 40m), evidence of collapse. It's approximately 13m above present sea level.

Tower Hill Volcano (with an estimated age of 32,000 years) displays all these features. It has a roughly circular crater with a maximum diameter of 3.2km. The crater rim is relatively low although its height varies from 5m in the SW to 110m in the NE. It is mainly built of ash composed of basalt and fragmented limestone (Port Campbell Limestone that lies below the basalt surface).

Day 9: Wednesday 26/10

Hopkins Falls and Tower Hill Volcano.

The weather had changed overnight giving us a cold, overcast morning with misty showers. However, we departed at 8:30 for Hopkins Falls, a 15 minute trip. After a scenic drive, we turned off at Wangoom and noticed plumes of mist and froth in the distance. They were being produced by the falls which stretched across the entire fall-maker (basalt) thanks to overnight rain.

Tower Hill nested maar.
Google Maps.

50. Hopkins Falls. The river flows over a lava flow that fills the valley. Tannins stain the water brown.

The falls are some 90m wide with a drop of 11m *(photo 50)*. The brown tumbling, frothing water made an impressive sight. In late summer, its possible to see elvers (baby eels) climbing the falls.

Our convoy of 6 vehicles then departed for Tower Hill taking some back-roads that brought us out near Von Guerard Lookout situated on the eastern side of the maar rim, its highest point some 110m above its floor. From the lookout, named after the artist who first captured the area on canvas, I gave an explanation of how the Tower Hill maar volcano, its nested scoria cones and crater lakes formed and answered questions *(photo 51)*.

We then drove down into Tower Hill stopping just inside the entrance to examine the banded tuff exposed on the top of the crater *(photos 52 to 54)*. Because this was the site of a past quarry, we were able to walk right up to the exposure, examine and touch it. A most impressive outcrop.

It was then onto the visitors centre for morning tea and a comfort stop. Everyone then 'did their own thing' until 12 o'clock when we assembled for a guided tour. Our guide, John *(photo 55)*, gave an explanation of how Tower Hill formed, its history and answered questions. He then took us for a walk, showing us plants used by aboriginal people and identified the plant species for us. Several koalas were present in the area seemingly unafraid of us *(photo 56)*. The walk then took us out onto the Lava Tongue Boardwalk. John once again identified edible plants (which some of us ate) as well as harmful ones such as native nettles. We walked past a small flow of basalt (the only occurrence of basalt in the maar) and into some bush where we spotted a female koala with a baby. At the end of the walk (which lasted 2 hours) Sue thanked John for such an interesting and informative walk.

I drove around the Tower Hill Maar (finding 2 more quarries exposing tuff) before returning to the caravan park.

51. View southwest from Von Guerard Lookout towards the entrance road to Tower Hill maar.

52. Banded tuff deposits from the entrance road into Tower Hill maar. The vertical exposure is the result of quarrying that took place here.

53. Abandoned quarry site beside entrance road into Tower Hill maar.

54. Differing layers of ash (light) and coarser cinders (dark) are weathering at different rates.

55. Our guide John presenting information on the different species of trees growing in the Tower Hill maar.

56. One of many koalas seen.

Day 10: Thursday 27/10

Free day in Warrnambool.

Ellen & I drove to the mouth of the Hopkins River at Thunder Point, explored the breakwater, had coffee, drove around town, lunched in the Botanic Gardens and explored the Flagstaff Hill Maritime Village *(photo 57)*.

Sue had booked entry to the Maritime Village that included dinner in a nearby restaurant and a sound and laser show called 'Shipwrecked' for us after dinner. So we all met at the Clovelly Restaurant for a two course meal before going into the Maritime Village for the sound and laser show in which you experienced the voyage and subsequent wreck of the clipper Loch Ard near Loch Ard Gorge. There were only 2 survivors from the wreck. It was a very enjoyable evening.

57. Flagstaff Hill Maritime Village, Warrnambool.

Day 11: Friday 28/10

Warrnambool to Mount Gambier.

People made their own way to Mount Gambier with some stopping for coffee or a ride on the historic tram in Portland. What amazed all were the size of the pine plantations passed on the way to Mount Gambier.

It was nice sunny day, so Ellen and I detoured via Port McDonnell. The waterfront was beautiful. Of surprise, was the 'Petrified Forest', a collection of short upright pinnacles thought to have formed when calcite and silica were deposited around the trunks of ancient trees, now rotted away *(photo 58)*. Left standing today are upright hollow casts. Large outcrops of flint were also present along the beach.

Our caravan park, the Central Caravan Park was situated in the centre of town, very convenient but not a lot of room.

After we had all arrived and set up, we held a meeting in the camp kitchen to outline the next lot of activities.

Day 12: Saturday 29/10

Glenelg River Cruise and Princess Margaret Rose Cave visit.

Some of the group decided to walk along the top of the Glenelg River Gorge in the morning before undertaking the river cruise at 1:00 pm. The walkers left at 8:30 for Nelson, drove over the bridge, turned left onto the North Nelson Track driving north through forest until the Glenelg River was reached upstream from the Princess Margaret Rose Cave. We had a very pleasant walk along the Gorge Walk *(photo 59)* for an hour in glorious sunshine before stopping at their cemetery on the way to Nelson to look at wildflowers.

Lunch was eaten near the boat wharf before we boarded the Nelson River Explorer for a river cruise to Princess Margaret Rose Cave.

It took an hour cruising up the Glenelg River to reach the jetty below the cave. Near Nelson, we passed a small island containing a marker to explorer Major Thomas Mitchell. Apparently he placed stores on the island *(photo 60)* in the mistaken belief that aboriginal people couldn't swim. No stores when he returned! On the way we passed many fishing shacks *(photo 61)* and the small village of Donovans. Colourful limestone cliffs were seen as we passed through the gorge section of the trip. The gorge section along the lower reaches of the river stretch for 15km and have cliffs up to 50m high.

58. Flint cast thought to have formed around the trunk of an ancient tree.

59. The Gorge Walk track on the southern side of the Glenelg River.

60. Historic marker indicating the exploration carried out by Major Thomas Mitchell.

61. Fishing/weekender shacks along the river banks.

62. Painting of a large black lizard with red eyes.

63. A large fluted column beside a stalactite and stalagmite that will not meet for thousands of years.

Someone had painted a black lizard in one of the caves *(photo 62)*. What was interesting was the fact that the cruise commenced in Victoria (Nelson), passed into South Australia (Donovans) and then back into Victoria for the cave visit. Our captain presented a very interesting commentary during the trip.

After docking, a 300m uphill walk took us to the National Park Office and cave entrance. A steep set of steps (68) took us down into the cave which is a wet cave and still active. The cave is described as an 'Underground Wonderland' as it is considered the most decorated cave per square metre in Australia. The usual cave structures (stalagmites, stalactites, straws, shawls, columns and helictites) were present in abundance, our guide giving an excellent explanation of their formation *(photo 63)*.

It was then back on board for the return river cruise to Nelson arriving at 4:30. People made their own way back to Mount Gambier.

Mount Schank.

Mount Schank is located 10 minutes drive south of Mount Gambier. It erupted in the Holocene, about 5,000 years ago, about the same time as Mount Gambier. It is a very basic ash cone perhaps a hundred metres high, and the base of the crater does not extend below the water table, so there is no crater lake as with those at Mount Gambier. There are two small subsidiary craters adjacent to the main cone and some lava flows resulting from the eruption. The northern crater is circular, 300m in diameter and 100m deep, the older southern crater is 200m in diameter and partially overlapped by the larger crater.

Protruding 159m above sea level it is very prominent above the limestone plain. The rim offers fantastic views of the surrounding countryside, coast and the nearby geological formations, and from here evidence can be seen of the lava flow and changes in the rock formation caused by heat and steam.

On the southern side of the mountain, a small cone can be seen believed to have been formed by the first of two main eruptive stages.

Day 13: Sunday 30/10

Mount Schank and Port MacDonnell Foreshore.

Around 4:30 in the morning, a cold change with strong winds came through Mount Gambier meaning the morning was cold and windy, but, thank goodness, no rain. So, the hearty amongst us departed for Mount Schank some 14km from Mount Gambier. Upon arrival at the foot of the small volcanic cone that is Mount Schank, new toilets and a shelter greeted us as well as information boards and newly laid limestone blocks on much of the track up to the crater rim. This made the walk up relatively easy. However, when we reached the

64. Scoria layers at the crater rim sloping away from the main crater as the volcanic debris was ejected away from the central vent.

65. Mount Schank volcano and its central crater. Layers of scoria can be seen on the far crater wall.

66. Lava/scoria ridge is the site of the initial fissure eruption.

67. Largest of the subsidiary craters that formed before the last eruption. The crater edge closest to the main cone has been destroyed by the main cone.

68. Little Blue Lake, a water-filled sinkhole used by locals as a swimming pool.

69. Caroline Sinkhole. Now dry, the cavity under the ledge on the left was used as a winter shelter by aboriginal people.

crater rim, the strong wind nearly blew us off. All present walked around part of the crater rim track. Wind made some sections unsafe. Layers of scoria and ash forming the crater walls could be clearly seen *(photos 64 and 65)*, as well as the ridge where the original fissure eruption occurred *(photo 66)*. The two smaller subsidiary craters were clearly visible *(photo 67)*.

Morning tea was held out of most of the wind in the shelter. As it was still fine, we drove to Port MacDonnell to look at their "petrified forest". This was an outcrop on a rock platform of small vertical columns (casts) of calcite and flint that had formed around the trunks of trees *(see photo 58)*. The tree trunks had long rotted away.

As well as these structures, bands of large flint nodules were abundant along the edge of the rock platform. These showed an amazing variety of shapes and most made a sonorous sound when struck.

By then, the wind had increased accompanied by small showers, so our visit to nearby Cape Cumberland was abandoned. We drove back into Port MacDonnell and went into a fish and chip shop (out of the cold wind) for a fish and chip lunch. Very, very good!

People then had a free afternoon. Many of us

visited the nearby library, visitors centre, gallery and museum, all in a new building. The lady in attendance took our photos for inclusion in their local paper and for their Facebook page.

We had Ian and Sue with us, so we went exploring nearby sink holes. Firstly, Little Blue Lake, a water-filled sinkhole used by locals as a swimming hole *(photo 68)*. It had a set of steps down to the water. While we were there, two men donned scuba gear and went for a dive. While at the visitors centre, we were told about two other sinkholes worth visiting, Hells Hole and Caroline Sinkhole. Both were situated within a large pine forest and neither had a sign indicating their location. Sue spotted a picnic table near a patch of bush within a cleared forest area. On investigating, a track took us to Hells Hole, a water-filled Cenote. A steel walkway jutted out over its edge giving us a great view.

We then continued east until we found Penambol Conservation Park. After some trial and error along tracks, we found a parking area with a track leading into the bush (no signs) that took us to Caroline Sinkhole. This also had a steel walkway over its edge. This was a dry sinkhole with long creeping plants hanging down into it *(photo 69)*. Past aboriginal people, the Bunganditj, used the overhanging ledges in the sinkhole as a winter shelter.

Just as we were about to take photos, a squall of small hail and rain hit us, so it was back to the vehicle. I sheltered behind a tree and managed to take some photos after the squall had passed. We then returned to Mount Gambier just as rain started.

Naracoorte Caves National Park, South Australia's only World Heritage site.

The Naracoorte Caves are part of the 800,000 year old Naracoorte East Range. They are World Heritage listed, and one of the world's most important fossil sites.

The site was officially recognised in 1994 because the fossils in the caves are preserved bones of megafauna that became extinct roughly 60,000 years ago. There are 21 known fossil deposits in the park.

The caves contain clues to help interpret the geological and evolutionary history of Australia.

The bones of Megafauna species such as Thylacoleo carnifex Marsupial Lion, Thylacine, Zygomaturus and sthenurine kangaroos have been found in the fossil deposits.

Paleontologists have excavated and dated many of the fossils in Naracoorte Caves and have reconstructed the skeletons of a number of the megafauna that inhabited the area so many years ago.

The caves have acted as pitfall traps, collecting animals for at least 500,000 years, preserving the most complete fossil record we have for this period of time. Bones collected - layer upon layer, year after year - creating a rich fossil record of the ancient animals that roamed the area.

The fossil record covers several ice ages and the arrival of humans in the area.

Of the 28 known caves in the park, four are open to the public. Other caves are set aside for scientific research or to protect the caves and their contents. Many of the caves contain spectacular stalactites and stalagmites.

Day 14: Monday 31/10

Naracoorte Caves National Park.

Another cold and windy day as we drove north through the green countryside with numerous water-filled hollows in the paddocks. Our convoy arrived at Naracoorte Caves NP at 9:45. A guided tour had been organised for 10:00 am, so we paid our entry fee and waited for our guide, Gavin.

In the foyer of the Wonambi Fossil Centre, Gavin gave us an introductory talk on the history of Naracoorte Caves and how the large accumulations of megafauna skeletons came to be trapped in the caves, as well as listing some of the species discovered. Several life-sized models of extinct animals were on display in the foyer and Gavin described how they were made. We then had a tour of the Fossil Centre which re-creates a scene of the Naracoorte area as it may have appeared 200,000 years ago. Some animals we see today were also present in the display, as well as those that became extinct some 50,000 years ago *(photo 70)*.

It was then off to the Victoria Fossil Cave which contains an enormous deposit of fossils, yet was only discovered in 1969. This was 75 years after the first chambers of the cave were discovered and opened for guided tours. Gavin explained how the remarkable discovery came about. As we slowly made our way through the outer chambers, Gavin described how the various speleothems formed which although not huge in size, were numerous and beautifully formed *(photo 71)*.

We moved ahead and entered the fossil cave, the deposit of fossils beds being in the dark. Two skeletons of extinct megafauna were dramatically displayed in front of the seats *(photo 72)* heightening our expectation of what was to come. After sitting down on seats provided, Gavin dramatically turned on the lights to display the fossil bone beds *(photo 73)*. This deposit has yielded tens of thousands of fossils, yet most of it is untouched. This deposit is one of some 20 major fossil deposits found within Naracoorte's caves with 110 different species of fossils identified. To date, 25 fossils of extinct species have been found, while the remaining 85 species were present at the time of European settlement. Many of these species have become extinct over the last 200 years. Unfortunately, another tour group entered the cave and we had to leave as Gavin had another tour to lead in 20 minutes (he ran over time with us).

It started to drizzle after we left the cave, so we took our lunch up to the cafe to eat and purchased a nice coffee.

70. One of many extinct megafauna displays in Wonambi Fossil Centre.

71. Wonderful display of stalactites in the outer chamber of Victoria Fossil Cave.

72. Skeleton of the Marsupial Lion, *Thylacoleo carnifex* in the viewing area, Victoria Fossil Cave.

73. One of several deposits of bones from extinct Australian megafauna in the Victoria Fossil Cave.

74. Exploring the main chamber in the Wet Cave.

By the end of lunch it had fined up, so we undertook the self-guided Wet Cave walk *(photo 74)* before leaving for Mount Gambier

On the way back, our first stop was at Struan House, a magnificent home built by the Robertson Family from 1873 to 1875. It is now used by the Department of Agriculture SA as a research station. It appears as new because $2 million has just been spent on renovations. Next stop was Bool Lagoon, one of the largest and most diverse freshwater Lagoon systems in southern Australia. This seasonal wetland is home to a wide range of wildlife and provides essential drought refuge for many rare and endangered bird species. There were thousands of frogs croaking amongst the water weeds while we were there, as well as many different bird species.

Then, just north of Penola we called into Father Woods Park which displays a series of sculptures carved from trees celebrating the life of Catholic Father Woods who served the district from 1857 to 1867. Last stop was in Penola where we walked down Petticoat Lane which still retains original cottages and gardens from the 19th Century.

Mount Gambier.

This is a maar complex associated with the Newer Volcanic Province. It contains four lake-filled maars called Blue Lake, Valley Lake, Brownes Lake and Leg of Mutton Lake. Of the original four lakes found within the maars, only two remain. The Leg of Mutton Lake (named for the outline of its shoreline) became permanently dry in the 1990s. Brownes Lake suffered a similar fate during the late 1980s. Both these lakes were quite shallow; their demise is attributed to the lowering of the water table as a result of many years of land drainage to secure farmland.

It is one of Australia's youngest volcanoes, but estimates of the age have ranged from over 28,000 to less than 4,300. The most recent estimate, based on radiocarbon dating of plant fibers in the main crater (Blue Lake) suggests an eruption a little before 6,000 years ago.

Blue Lake which is world famous due to its unique colour change from somber winter steel blue to brilliant turquoise blue between November and March each year is also the source of water for the City of Mount Gambier which flanks the volcanic crater.

Centenary Tower, located on the highest point of Mount Gambier, is 190m above sea level. The strenuous walk is well worthwhile for the 360 degree spectacular views of the Crater Lakes, City and surrounds.

Blue Lake, a water-filled crater lake.

Valley Lake from the Centenary Tower track.

Day 15: Tuesday 1/11

Free Day to explore Mount Gambier.

Most of the group went to the Main Corner complex to watch a movie on the geology of volcanoes found in the Mount Gambier area. It was an excellent production explaining the formation of many of the volcanoes we had, or were to visit.

After the movie we all went our own way. I took a drive through the Mount Burr Range, the area where volcanism first commenced in the area. However, there was not much to see as pine forests covered most of the area. We did visit lake Leake, a maar lake filled with fresh run-off water.

On returning to Mount Gambier, we explored the Blue/Valley lake complex and walked up to Centenary Tower from which wonderful views were obtained *(see photos)*.

Valley Lake, caravan park and Blue Lake crater.

Mount Schank viewed from the Centenary Tower walking track.

Day 16: Wednesday 2/11

Mount Gambier to Hamilton.

Because it was only a short drive to Hamilton, most chose to take a scenic route. First stop was the village of Dartmoor where chain saw artist Kevin Gilders had carved on the butts of 9 Atlantic Cedar trees, sculptures to commemorate servicemen and nurses from Dartmoor and district who served in World War I. This row of sculptures is called the 'Avenue of Honour' *(photo 75)*. Three Cyprus trees at the Village Green have also been carved.

We then drove north to Casterton (passing the villages of Digby and Merino) before driving east through Coleraine to Wannon where we turned off to the Wannon Falls.

The Wannon Falls were created by lava flows that surged upstream to the Wannon River. The falls were impressive due to recent rain. The tannin-stained water cascading over a 30m drop into a plunge pool below actually flows over a hard basalt flow. A large cave undercuts the falls because the lower strata is soft and easily eroded *(photo 76)*.

Our last stop was Nigretta Falls, an impressive wide set of falls made up of several smaller drops and cascades due to the joint patterns in the rock *(photo 77)*. The fall maker here was 410 million year old acid volcanic rock. There was no undercut cave below the falls because there is no softer layer of rock at the base of the falls.

Excellent walking tracks and viewing platforms were present in the area.

It was then into Hamilton to set up camp.

76. Wannon Falls. Softer weathered basalt and soft clayey sediments buried beneath the basalt are more easily eroded so a cave has formed beneath the hard basalt layer at the top of the falls.

77. Nigretta Falls.

75. 'Over the Top!' One of many carvings along the main street in Dartmoor's "Avenue of Honour".

Mount Napier.

This is one of the youngest volcanoes in Australia. It finished erupting about 7,200 years ago.

Mount Napier has a composite lava shield with a superimposed scoria cone. The cone rises 150m above the surrounding plains to an elevation of 440m, making it the highest point on the Western District Plains of Victoria.

Mount Napier erupted in two stages causing the distinctive profile. The eruption began as a shield volcano with fluid lava flowing out of vents relatively quietly and running downhill forming a low dome (or shield) centered on the eruption point.

This quieter stage was replaced by more violent eruption with magma being forcibly ejected in a fountain from the crater lake. Ejected lava formed scoria before it fell back to earth, or sometimes reached the ground as liquid lava, which spattered onto previous spatters. Remnants of the splatter cone can still be seen on the edge of the crater. Scoria formed a steep-sided, but fairly wide, cone on top of the initial lava shield. The cone was breached at some time towards the end of the eruption. The breach in the crater wall can still be seen.

The Byaduk Caves.

Located in Mount Napier State Park, they are the most extensive and accessible set of lava caves in Australia. Being so young (only 8,000 years), they are largely unweathered and in their natural state. They were formed when a spectacular lava fountain several hundred metres high roared up from a lava lake in Mount Napier's crater approximately 8,000 years ago. The lava rose from a depth of over 30km and its temperature was about 1200°C. It flowed in four directions, and the westerly flow down Harman's Valley, extends for approximately 24km. The caves are accessed through collapsed roof sections and display many well-preserved features left by the retreating and cooling lava. The largest tunnels are up to 18m wide, 10m high, and extend to depths of 20m below the surface.

Tumuli.

Near the limits of the Harmans Valley flow at Wallacedale, 13km west of the Byaduk Caves, are a number of unusual clusters known as lava tumuli. The tumuli are circular mounds or hummocks of rock up to 10m high and 20m in diameter, and are considered to be not only unique in Australia, but also most likely rare on a world scale. When the surface of a lava flow quickly crusts over, pressure in the liquid lava beneath can cause the crust to rise. Generally, it forms irregular broad mounds and hollows known as Stony Rises, but occasionally, it creates smaller, steep-sided domes called tumuli.

The best examples are on Old Crusher Road, west of the Port Fairy road.

78. Red scoria deposit is exposed in the abandoned quarry next to the carpark.

79. Off to the summit of Mount Napier.

80. Track passing through the scoria cone at the summit.

Day 17: Thursday 3/11

Mount Napier, Byaduk Caves and Tumuli.

Originally scheduled for Friday, I led the convoy along the wrong road towards Mount Napier (it was the one I used years ago) meaning we had to backtrack to the road used nowadays. However, we soon arrived at the Mount Napier walking track carpark, the site of a disused scoria quarry. Excellent samples of scoria were available for examination *(photo 78)*.

The group headed up the walking track to the summit through dense forest *(photos 79, 80, 81)* reaching the trig 150m above the surrounding plain in half an hour. Wonderful views in all directions were obtained especially the Grampians and Mount Rouse to the east. About a fifth of the crater edge is covered by remnants of lava spatter *(photo 82)* that formed during the volcanoes last explosive phase of eruption.

We returned to the cars for morning tea before driving to Byaduk Caves, a set of lava caves formed within a lava flow originating from Mount Napier about 8000 years ago. The first cave we visited was Harman's 1 Cave which was accessible *(photo 83)*. A few brave people ventured down into the cave, but little could be seen. Walking further on, we examined the larger Bridge Cave complex *(photo 84)*. These were not accessible. They were called Bridge Caves because a natural bridge that had not collapsed connected two of the caves.

A nearby dry stone wall was examined on the walk back to the cars as we adjourned to the Village Green in Byaduk for lunch.

After lunch, we drove west along Old Crusher Road which paralleled Harman's Valley Lava Flow. A lookout over the lava-filled valley contained three

81. Scoria cone at the summit of Mount Napier.

84. One of the Bridge Caves.

82. Remnants of spatter rim on top of the scoria cone.

85. Several Tumuli and a dry stone wall.

83. Harman's 1 Cave. Beyond the ferns, the cave was blocked.

86. Terry and Ron discussing the processes thought to be involved in Tumuli formation.

excellent plaques explaining features observed and how they formed.

Continuing on, we crested a small rise and spread out below us were many large Tumuli. Parking near a large cluster of Tumuli, we were able to walk through a gate and examine several up close *(photos 85 and 86)*. All were very impressed by the size and number. Quite a lot of time was spent looking at and climbing the Tumuli.

On the way back to Hamilton, we detoured up a dirt road to view more Tumuli. This amounted to nothing as the rough dirt road was blocked when we spotted two Tumuli in a valley below. We (on advice) had taken the wrong road to access them. So we returned to Hamilton for a well deserved coffee.

Mount Rouse.

Mount Rouse is a massive accumulation of scoria and basaltic lava, rising 100m above the surrounding volcanic plain that formed some 350,000 years ago. It is the highest relief in the area and is an important vantage point to view the lavas and adjacent volcanoes of Mount Eccles and Mount Napier.

To the south of the main scoria cone is a deep circular crater with a small lake and a smaller shallow crater rimmed with basalt.

Past lava flows from Mount Rouse followed shallow, gently sloping river courses, extending at least 60km south to the present coast at Port Fairy. A thin basalt lava flow contained in the scoria cone has been dated at approximately 1.8 million years old. This is in conflict with several isotope dates from lava at the Port Fairy end of the flow indicating dates between 300,000 and 450,000 years ago. This is supported by dates of 320,000 and 350,000 years from a flow 20 km south of Mount Rouse.

Day 18: Friday 4/11

Volcanoes Discovery Centre, Penshurst and Mount Rouse.

Hallelujah! A fine sunny morning for our trip to Penshurst. We arrived half an hour before our booked session at the Volcanoes Discovery Centre so spent this time looking at a natural spring which runs through Penshurst Botanic gardens.

The Volcanoes Discovery Centre is an interpretive centre and tourist information centre located in the old bluestone Shire of Mount Rouse offices. It contains information sheets, specimens of rocks and minerals *(photo 87)*, and an audio/visual display of Mount Rouse erupting. It is staffed entirely by volunteers.

At the Discovery Centre we were greeted by Jill and Paul who welcomed us and explained the planned schedule. Time was spent looking through the centre before we went into the education room where we were given an excellent power-point presentation on the structure of the Earth and volcanism. Specimens of volcanic rock were passed around and questions answered. It was a very interesting and educational session *(photo 88)*.

Paul then led a vehicle convoy up Mount Rouse, where, after parking, we walked to the summit. Very windy on top. However, a wonderful view of the green farmland surrounding Mount Rouse greeted us, as did a clear view of the Grampians and Mount Napier *(photo 89)*. Someone spotted a koala up a nearby tree, so geology was ignored and lots of photos were taken.

Stony rises formed from lava flows were clearly visible in some areas around Mount Rouse. Paul described how Mount Rouse formed before taking us down from the summit to our vehicles. We drove down the mountain to an area overlooking a lower crater formed by an earlier eruption. A small lake was present in its bottom and many kangaroos were seen feeding on the grassy crater walls.

Our last stop was in a disused quarry at the base of the volcano *(photo 90)*. This had been extensively mined for scoria in the past. What was unusual about the scoria deposits in the quarry was the fact that a layer of red scoria was separated from black scoria underneath it by a lava flow that thinned to nothing along the quarry face *(photo 91)*.

Walking back up the entrance road, we discovered a series of lava flows, some columnar jointed *(photo 92, 93)*, that contained many interesting features. The flows were overlain and underlain by scoria beds *(photo 94)*. It appeared that the flow extended into the quarry face previously examined where it apparently thinned before disappearing. More than one flow was observed with what appeared to be an erosion surface between flows *(photo 95)*.

Many interesting structures such as bombs in the scoria, ropy lava on the base of the lava flows, blocks of vesicular basalt grading to massive basalt, a small lava tube containing small lava stalactites (lavacicles) formed when molten lava dripped from the ceiling as it

87. Several large volcanic bombs on display. These were collected locally and were formed during the eruption of Mount Rouse.

88. Listening to an excellent Power Point presentation on volcanoes in the Discovery Centre presented by Jill and Paul.

89. Mount Napier, a composite volcanic cone. The more recent steep-sided scoria cone sitting on top of an older shield cone with gently sloping sides can be clearly seen.

90. Exploring the quarry site. Note the folded bedding in the scoria deposit in the distance.

92. Quarry entrance. The columnar jointed lava flow on the left is situated between two scoria deposits.

91. Red and black scoria deposits. The black layer separating them is a thin layer of basalt.

93. Columnar lava flow next to entrance road. The top and bottom of the flow appeared to be more vesicular than its centre.

solidified *(photo 96)* and chilled margins on some basalt flows were observed. Although the red and black scoria deposit was horizontal, the scoria on the opposite side of the quarry was folded *(photo 90)*.

Departing the quarry, we drove back into Penshurst at 1:30 where many of us bought a take-away lunch and coffee from the local store.

On the way back to Hamilton, we called into Lake Linlithgow Lake Reserve, a large freshwater lake fed by both creek flows and underground seepage. The Grampians could be seen in the distance behind the lake *(photo 97)*.

94. Columnar jointed lava flow (basalt) underlain by beds of scoria. Many interesting features such as ropy lava could be seen underneath the basalt flow.

95. Two basalt flows. The top flow is vesicular, while the one underneath is more massive and appears to have an erosion surface on top, indicating a break in time between the flows.

96. Top of a small lava tube. The small round-tipped stalactites (lavacicles) formed when molten lava dripped from the ceiling solidifying as it did so.

97. The Grampians viewed over Lake Linlithgow. The tallest peak is Mount Abrupt is 265m high with an elevation of 815m above sea level.

Mount Eccles Volcano.

Mount Eccles is an inactive volcano in southwestern Victoria, near Macarthur. The Gunditjmara name for the mountain is Budj Bim meaning High Head.

The roughly conical shaped peak rises 178m. The peak is a scoria hill that was thrown up beside a group of three overlapping volcanic craters that now contain Lake Surprise. A line of smaller craters and scoria cones runs to the southeast. Lava flows extend to form a shield volcano and were fed by several lava channels, or "lava canals" as they are known locally.

Initial estimates of the age of the eruption were all "minimum ages" from swamps that formed some time after the eruption and ranged from 6000 to 27,000 years, but the latest evidence suggests that the eruption was at least 30,000 years ago (using dated sediments in the floor of the Lake Surprise crater) and could have been as old as 40,000 for the Tyrendarra lava flow.

Mount Eccles is the source of the Tyrendarra lava flow that extends 50k m to the southwest. The eruptions altered the drainage in the area producing wetlands of the Budj Bim National Heritage Landscape in an area known as Lake Condah where the local Gunditjmara people harvested eels and fish. They used the stones of the lava flow to construct elaborate channels, weirs, fish-traps, windbreaks and stone huts. It is an area of local and national significance as it is considered to be Australia's earliest and largest aquaculture venture and the only place in Australia where Koori people built permanent stone houses. The Bunj Bim National Heritage Landscape was Heritage Listed in 2004.

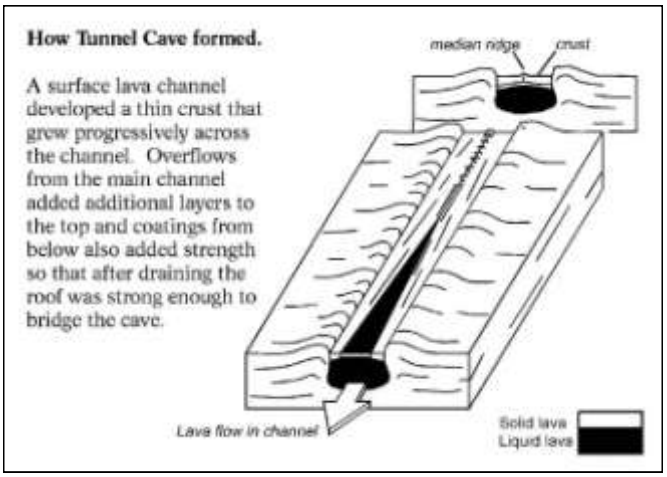
Mount Eccles National Park is Victoria's first co-managed national park. The partnership between Gunditjmara Traditional Owners and Parks Victoria was formalised with the establishment of the Budj Bim Council. The Council forms part of the 2007 Native Title Settlement Agreement between the Gunditjmara and the Victorian Government bringing them together to manage the area's significant landscape.

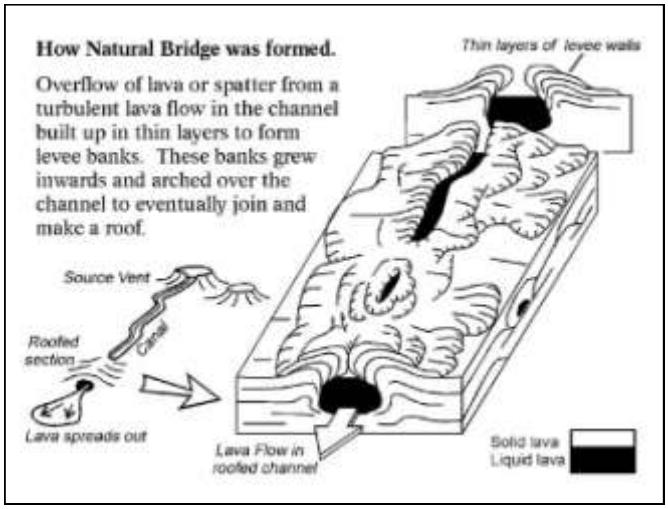
Mount Eccles National Park at Lake Surprise encompasses 61.2km² and includes many interesting geological features such as lava flows, lava blisters, lava caves, scoria cones

and crater lakes. The park has a campground and picnic area near Lake Surprise, a popular swimming hole in summer.

Tunnel Cave *is a lava tube formed towards the end of the eruption of Mount Eccles by the drainage of lava from an underground conduit.*

Natural Bridge *is a small but interesting cave found at the far end of a small lava channel south of Mount Eccles. The main cave can be entered by following the walking track south and then doubling back into the entrance.*





Day 19: Saturday 5/11

Tyrendarra Indigenous Tour and Mount Eccles.

Surprise, surprise! A cold, wet windy morning again. However, we left for Heywood at 8:30 as usual arriving about 9:30. We stopped at the Lions Park for a toilet stop and a walk to stretch the legs.

At 10:00, we entered the Budj Bim Orientation Centre and were greeted by an enormous table made from 2 red gum slabs. After looking at the displays and having a 'cuppa' and fruit (supplied), Eileen Alberts, an aboriginal elder and teacher told us the story of her people, the Gunditjmara. She illustrated her talk with photographs which we passed around and artifacts such as fish nets woven from reeds *(photo 98)*.

We then went to our cars and followed Deb, our trip leader out to Lake Condah, the lake her people had traditionally lived near for centuries *(photos 99, 100)*. She then led us to an area (with toilets and a shelter) where we parked and then walked to a small stream where woven fish traps were placed between walls of rock on Darlot Creek *(photo 101)* to catch short finned eels, her people's traditional main source of protein. In fact, they actually farmed the caught eels.

As part of the tour, lunch was provided. This consisted of cold slices of kangaroo meat, kangaroo meat balls and smoked eel accompanied by fresh salad and bread. It was very tasty.

Driving further on, we stopped at a stone structure built by some of the younger generation to represent eels *(photo 102)*. The gum trees in the area were devoid of most of their leaves *(photo 103)*. This was due to an overpopulation of koalas. Apparently, each koala needs one hectare of trees for sustainability. A number of koalas were spotted in the area.

Our last stop was the stone foundation of a house used by aboriginal people *(photo 104)*. It had been discovered recently.

Deb had offered to accompany us to Mount. Eccles NP which was very kind of her as she took us on a short-cut through aboriginal land to the public road saving us lots of time.

We arrived at Mount Eccles late in the afternoon, so there was only time to walk to the Tunnel Cave, a lava tube at the western end of Lake Surprise. Access was easy as steps took us down into the cave which was quite large *(photos 105, 106)*. All of us had torches, so we were able to have a good look through the cave examining its features. Small lava ribs (drips down the sides of the cave walls) were obvious. Shane provided us with a special treat by playing a tune on his violin.

After returning to the cars, we drove along a track looking for the Natural Bridge. After parking next to a creek crossing, we followed a track along the bottom of the creek looking for the Natural Bridge. The walls of the creek suddenly closed in, became higher and were observed to be made of basalt. In fact, the walls were part of a natural levee composed of basalt that had solidified as lava flowed down the creek *(photo 107)*. The Natural Bridge suddenly appeared before us with a set of steep steps leading down into it *(photos 108, 109)*. Its roof was an inverted 'V'. Most of us went down to the cave at the bottom of the Natural Arch and scrambled out the other side. A well formed track discovered on the other side took us back to the cars.

By this time it was late in the afternoon, so all made their own way back to Hamilton after a very interesting day.

98. Eileen Alberts showing us an eel trap, and explaining how a special reed is used to weave it.

101. Site of fish traps on Darlot Creek. The woven nets were placed in the narrow channels between the piles of rock to trap the eels.

99. Trip leader Deb explaining how aboriginal people used the resources provided by Lake Condah.

102. Stone sculpture that represents eels. It was built by young Gunditjmara people to express their culture and the importance of eels.

100. Lake Condah.

103. Overpopulation of koalas is stripping the trees of leaves. Note Koala on a branch.

104. Recently discovered stone foundations of an aboriginal dwelling.

107. Levees of basalt on the sides of the creek near the entrance to The Natural Bridge.

105. Looking back towards the entrance to Tunnel Cave formed when molten lava drained away from the solid layer of basalt that formed on top of the flow.

108. Steps leading into the cave under The Natural Bridge that formed when basalt levee banks sagged inwards and joined, hence the 'V' shaped roof.

106. Colin exploring the cave. Note the lava ribs of solidified lava that formed as still molten lava dripped down the walls as molten lava drained out of the cave.

109. Cave with its inverted 'V' shaped roof under The Natural Bridge.

Day 20: Sunday 6/11

Free Day.

People were free to do what they liked, although many of us visited Dunkeld at the southern end of the Grampians and had lunch there before looking around.

Mount Noorat.

Mount Noorat is named after local aboriginal elder Ngoora; the Mount was a traditional meeting and bartering place for the Kirrae Wuurong people.

The mountain is a scoria cone with complex eruption point topography, and its central feature is an entire circular crater with a minimum enclosure depth of 85m, which is believed to be the deepest scoria cone enclosed crater in Victoria (and possibly Australia).

The base of this crater (150+m) is lower than the level of the surrounding plain with the highest point being 310m above sea level. A number of mounds and depressions surround the main crater, believed to be other eruption points. Tuff deposits are the lowermost materials exposed in western quarries, indicating an initial maar eruption. Subsequent scoria eruptions have almost completely buried the tuff, which rests on basalt lava flows.

There are fine geological sections exposing scoria draped over tuff beds in the lower western quarries. Mount Noorat is a major locality for xenoliths. There is a public access walking track to the crater.

The Alan Marshall Precinct is located in Noorat, birthplace of popular Australian author Alan Marshall (1902-1984). His best-known work, "I Can Jump Puddles", is said to be a thinly disguised autobiography of his early life and boyhood adventures in Noorat. Never deterred by an early disability, Marshall liked to catch eels in Mount Emu Creek, swim in Lake Keilambete and even reached the summit of Mount Noorat.

Day 21: Monday 7/11

Hamilton to Camperdown.

It was suggested that people, on their way to Camperdown, travelled by way of Noorat. This would enable those so inclined to climb to the summit of Mount Noorat to view the very symmetrical cone-shaped crater, with the bottom below the level of the surrounding plain.

On the way to Noorat, we stopped in Mortlake and had a look into the Mount Shadwell quarry, the source of fine olivine specimens.

Rain was threatening when we reached Noorat, so only a couple of people undertook the walk *(photo 110)* which was well worthwhile as the circular symmetrical crater was spectacular *(photo 111)*.

110. The Alan Marshall Walking Track to Mount Noorat crater and lookout.

111. Circular main crater of Mount Noorat.

Mount Elephant.

Mount Elephant is a steep sided volcanic scoria cone with a breached crater. It was formed maybe 20,000 years ago and is one of the highest volcanoes in Victoria, rising 240m above the surrounding plain.

The area for several kilometres around consists of "stony rises" of more solid basalt of about the same age.

The volcano formed at a single eruption point and has an irregular rim caused by directed fire fountaining. The rim is breached on the north-eastern side giving an opening to a dry shallow summit crater with minimum enclosure of 20m. The breach may be the result of collapse or removal of part of the rim during a small lava flow late in the eruption history of the volcano.

There are few natural exposures on the mountain but several operating and abandoned quarries at the base provide sections into the ejecta. This consists entirely of magmatic material in the form of scoria, blocks and bombs with abundant xenoliths and megacrysts. These occur both in basalt rocks and scoria. Occasional small angular blocks of partially melted granitic bedrock also occur as xenoliths.

Thus, the cone of Mount Elephant consists of scoria, blocks and bombs of solid larva with common inclusions of granite and olivine. (Granite outcrops are common for 50km to the northeast of Mount Elephant). There are occasional lumps

of the limestone layer through which the larva erupted.

Occasionally some rocks were thrown out while spinning rapidly. The outer layer of these is basalt and shaped like a football with a point at each end. The centre is often composed of a dense mass of green crystals of olivine. These volcanic bombs can be from 2 to 20cm in diameter.

Day 22: Tuesday 8/11

Mount Elephant and Allan Woods rock collection, Mortlake.

As usual, our convoy departed at 8:30am, but today was a beautiful clear sunny morning. We drove north to the small village of Derrinallum. The morning light gave us an excellent view of Mount Elephant as we approached Derrinallum *(photo 112)*. After a comfort stop in the Recreation Reserve, we drove about a kilometre west of town to Mount Elephant where we met Chris Lang and his wife Val who unlocked the entrance gate. We drove to the brand new visitors centre officially opened two day's earlier *(photo 113)*. The centre still has to be completed.

Chris filled us in on Mount Elephant and how the visitors centre came to be built. We had morning tea before starting our walk at 10:00 am. Some of us took a new track *(photo 114)* up to the lower rim of the central crater. It was steep and rough with loose rocks. We decided that it would have been better to walk up the road.

Chris kindly drove some of the less able walkers up to the central rim so they didn't miss out on the view of the crater and surrounding countryside *(photo 115)*. The rest of us then walked up a track *(photo 116)* to the trig point on the western edge of the crater rim (I was last there in 2004) *(photo 117)* where a great view of the crater could be seen *(photo 118)*. We then walked anticlockwise around the rim before the track descended to the lower rim meeting the road that led down to the visitors centre. It had taken us 1 hour 40 minutes.

All of us had a look inside the visitors centre and signed the visitors book before driving back to the recreation reserve in Derrinallum for lunch *(photo 119)*. I followed the road around Mount Elephant on the way back and was rewarded with a great view of a disused scoria quarry on its southern side. What was evident was that the side of the cone above the quarry was continuing to naturally erode upwards - a fresh scree slope was the evidence for this *(photo 120)*. It had been a great morning.

After lunch, it was a half hour drive to Mortlake where we visited Allan Woods and had a look at his rock and mineral collection. Because of the nearby location of Mount Shadwell and its quarry, Allan's collection concentrated on olivine which is very common in the basalt quarried at Mount Shadwell. He had faceted many of the large pieces of gem quality olivine (peridot) collected over the years into beautiful stones.

On the return journey to our camp, four of us stopped in Noorat at a quarry on the north western edge of town. Its owner had given us permission to enter the quarry. On the eastern edge of the quarry, a rare contact between underlying tuff deposits and later scoria deposits was visible *(photo 121)*. This represented two

113. Visitors Centre and carpark at the base of Mount Elephant. A disused quarry is on the left.

112. Mount Elephant as viewed from the Camperdown to Derrinallum road.

distinct types and phases of eruption.

Very large volcanic bombs were embedded in the deposits of tuff and scoria *(photo 122)*. We were also lucky to find some small volcanic bombs in rubble at the quarry face, as well as broken bombs containing green olivine in their centre.

114. New walking track up Mount Elephant.

117. Ron, at left, at the trig on Mount Elephant in 2016 and right, 2004.

115. Road leading to a lookout at the edge of the small crater.

118. Main crater of Mount Elephant. Note the small lava dome in the centre that is blocking the eruptive vent.

116. Track up to the trig on Mount Elephant. The village of Derrinallum is in the distance.

119. Recreation Reserve in Derrinallum where we had lunch.

120. Scoria quarry on southern side of Mount Elephant. The fresh scree slope on the right indicates that erosion up the side of the cone is ongoing.

121. Black scoria overlaying banded tuff. Volcanic bombs are present in both the scoria and tuff.

122. Volcanic bombs are visible in the scoria, as is a large solution tube (black, RH side).

Red Rock Maar Complex.

The complex is made up of approximately 30 eruption points and is the southern most of a chain of three volcanoes, the others being Warrion Hill and Alvie Hill. It is arguably the youngest eruption point in Victoria at around 8000 years, especially since the age of Mount Napier has been progressively pushed back.

The complex consists of a number of maars and scoria cones. The maars have wide, deep craters surrounded by circular tuff rings; many contain water, as they are deep enough to intersect the water table.

Smaller, shallower craters, which lie within scoria cones, are generally above the water table, so they are often dry.

The scoria cones appear to be younger than the maar eruptions, which in turn are younger than the surrounding stony rise lavas.

Red Rock Lookout is on top of a scoria cone with the inner slope of its crater capped by spatter.

Mount Leura and Mount Sugarloaf.

Mount Leura and Mount Sugarloaf are actually part of a much larger volcanic complex known as the Leura Maar.

The Leura Maar is a shallow oval shaped depression about 2.5km long, 1.7km wide and up to 50m deep which originated from a series of major volcanic explosions, possibly 22,000 years ago. Some of the eruptive material was thrown high into the air, but most surged rapidly across the ground surface as a dense cloud of steam, gas and rock fragments. The Leura Maar may have been formed in just a few months.

Inside the Leura Maar, there are many younger eruption points marked by craters and mounds of scoria. These are said to be nested inside the maar and Leura therefore is a nested maar. These younger volcanic features include Mount Leura, Mount Sugarloaf, the deep crater that separates the two mountains, and several smaller craters and mounds in the southern part of the maar.

Although not as explosive as the activity that produced the maar, the growth of Mount Leura and Mount Sugarloaf would have provided a grand spectacle, similar to the present day activity of volcanoes on the island of Hawaii.

They began as vents on the floor of the maar from which glowing fountains or explosive bursts of lava were ejected. Gases escaping from the lava caused it to break into angular, gravel sized fragments called scoria which fell back to the ground and heaped up around the volcanic vent forming the high, steep cones. The scoria including large blocks and smooth surfaced lava bombs that were hurled into the air and partly cooled before crashing back to the ground to be buried in the scoria.

Mount Sugarloaf is basically a steep conical accumulation of scoria rising as a high point on the same crater rim as Mount Leura. It formed as a result of perhaps several months of lava fountaining from the same point in the crater continuously building an ever-increasing pile of scoria. Scoria volcanoes can achieve height quickly and Mount Leura could have been built in less that 20 years.

Lakes Gnotuk and Bullen Merri.

Lake Bullen Merri and Lake Gnotuk are parts of a volcanic landform known as a maar. A maar is a broad, roughly circular, flat-floored volcanic crater with steep inner walls and a low surrounding rim built of fragments of rock blown out of the crater during explosive eruptions. The word Maar is derived from the German language and is the name given to lakes in volcanic craters of this type in the Eifel district of Germany. In Australia, most maars occur in the southern part of Victoria's Western District and there are more than 30 in the area between Colac and Warrnambool. Lake Purrumbete and Tower Hill are nearby examples of other maars.

The simple, circular shape of Lake Gnotuk shows it to be a single, small maar, while the clover leaf outline of Lake Bullen Merri suggests it is made of three maars which have joined together. After the eruptions ceased, the craters became choked with rock debris and the lakes developed. Some of the water is direct run off from the crater slopes, but most is a result of underground water from the water table leaking into the craters. Without an outlet, evaporation causes the lakes to become saline. Lake Bullen Merri is brackish, but Lake Gnotuk is twice as salty as seawater.

Research into fossils and sediments from the floor of the lakes shows the salinity to have changed considerably over the last 10,000 years. The bottom of both lakes is about the same level (80m above sea level), but Bullen Merri has a steep cone shaped floor and is more than 60m deep while Lake Gnotuk has a flat floor and a depth of less than 20m.

Although Lake Bullen Merri overflowed into Lake Gnotuk in the mid 1800s, the level of both lakes has fallen considerably in the last 100 years due possibly to climatic changes. Former high water level shoreline cliffs can be clearly seen as parallel benches around the north western rim of Bullen Merri.

Day 23: Wednesday 9/11

Red Rock complex, Mount Leura and Lakes Gnotuk and Bullen Merri.

Leaving Lake Purrumbete at 8:30, we drove through impressive stony ridge country before stopping next to a blocky wall of basalt some 15m high *(photo 123)*. This was one edge of the lava disc produced by an early eruption of Mount Porndon, today clearly visible nearby as a steep-sided scoria cone with communication towers on its summit. The lava disc is approximately 3km in diameter. Mount Porndon is a composite cone and many of its lava flows form the impressive stony rises seen in the area, some reaching the edge of Lake Corangamite.

Reaching the A1, we drove towards Colac, turning north towards Red Rock some 11km from town. A small park at the bottom of the lookout road was our first stop (comfort). We then drove up to the Red Rock parking area and walked up to the western lookout. All were amazed by the number of eruption craters visible and the size of Lake Corangamite, the largest permanent saltwater lake (3 times saltier than seawater) in Australia *(photo 124)*. Some counted 12 eruption craters, although there are some 40 within 4km of the lookout. A small spatter rim was situated next to the lookout. Mount Elephant was also clearly visible.

Then a short drive to the eastern lookout where Lake Beeac, Lake Colac and the historic bluestone Coragulac House *(photo 125)*, as well as more eruption craters were visible. Morning tea was eaten was eaten back in the park.

We then drove along Lake Corangamite Road around the NE part of Lake Corangamite through wonderful stony rises until the lake edge was reached. The lake was surprisingly low with the water hundreds of meters away *(photo 126)*. Large flocks of birds could be seen in the distance around mud flats. Continuing on, we came to the hypersaline lake, Lake Cundare. No birds but wonderful reflections as the lake was like a mirror *(photo 127)*. Then into the village of Beeac where we stopped and looked through the windmill park in the centre of town. Lunch was eaten by the lakes edge.

To return to Camperdown, we drove NW to Foxlow before turning southwest and driving between Lakes Corangamite and Gnarpurt. Back in Camperdown, we drove to a lookout northwest of town next to the botanic gardens where we had a wonderful view of the two maar lakes, Gnotuk and Bullen Merri *(photos 128, 129)*. Some of us then drove up Mount Leura *(photos 130, 131, 132)*where we watched a young man fly a drone up above the volcano taking photos.

That evening, we all went into Hotel Hampton for a farewell dinner. It was great meal. To complete the night, we assembled outside the hotel (where it was quiet) an listened to Glenda recite "Geological Safari', a poem she co-wrote in 2004 during the Society Safari to the same area. It was a beautiful way to finish a wonderful Safari.

123. Blocky edge of Mount Porndon's lava disc that is approximately 3km in diameter.

124. View of Red Rock maar complex from Red Rock Lookout. The red outcrop is the remains of a spatter cone.

127. Beautiful reflection on the surface of the hypersaline Lake Cundare.

125. Historic bluestone Coragulac House.

128. Lake Bullen Merri, a clover leaf shaped lake formed within three overlapping maars.

126. Northern end of Lake Corangamite was very shallow. Large flocks of birds could be seen resting on the mud flats. Mount Elephant is in the distance.

129. Lake Gnotuk situated within a single maar crater.

132. Mount Sugarloaf, with its circular walking track, is a scoria cone that formed in the maar after the initial eruption.

130. Mount Leura nested maar. Mount Leura on left and Mount Sugarloaf in the centre.

131. The rim of Mount Leura nested maar is the low ridge next to the black tree-line. Several eruption points can be seen within the maar.

Report by Ron Evans with input from Sue Rogers.
Photographs by Ron and Ellen Evans.

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QR Code.

To quickly log into the Amateur Geological Society of the Hunter Valleys website, scan the code below with your phone or tablet.

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AGSHV website is www.agshv.com

Social Activities 2016

Our hard-working enthusiastic Social Committee excelled throughout the year, as usual!

Once again, Soup and Slides and the Christmas Party were the main activities held again in the home of Ian and Sue Rogers.

Social Committee members preparing food for the Christmas party in Ian and Sue's home.

The craft/sewing days that members participate in continued on a roster basis in various people homes. Some Society inactive members participate in these days where society problems are solved.

The Social Committee and their activities are a valuable part of the Society's annual activities and provide a valuable contact point for people unable to attend many of the field activities.

On behalf of all Society members, thank you Social Committee.

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Ron Evans.