



The ACKMA Journal

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FRONT COVER

Before and after images of a graffiti cleaning site at Cotter Cave. The arrows point to the cave tag.

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Editorial

Tim Moore

Triskaidekaphobia, the irrational fear of the number 13, had its genesis (deliberate bad joke, word use) in the total of those present at the Last Supper and its coincident compounding of the 13th day of the month being a Friday, coinciding with the day of the crucifixion, holds no fear for me as I write this, my 13th (and final) editorial for this Journal!

I have enjoyed the just more than three years that I have had the pleasure of curating this publication for distribution to members of ACKMA. That time has seen change for our Journal and, much more dramatically, change in our world - the latter arising from COVID-19 and its dramatic impact not only on the now omnipresent risk to human health, but also the necessity for closure of caves and the, now, gradual and constraining terms of emergence from lockdown of tourist cave activities.

In Australasia, the main locale of our membership, the geography of being two island nations has spared us much of the brutal impact falling elsewhere. It is my hope that Christian Bom, your new editor, who will take over from me for the preparation of the September 2021 edition of the Journal, will be able to bring better tidings from caves and caving in the not-too-distant future.

There have also been changes with this Journal itself - all of them to some extent are electronic. The most basic was the shift to a full electronic journal being distributed and archived solely online.

Whilst I enjoyed the mental stimulation of coming to grips with the Microsoft Publisher software for my first edition (June 2018) and the necessity, subsequently, to engage with resizing electronic images for publication (seeking to reduce file sizes for downloading whilst avoiding, not always completely successfully, causing pixellation and loss of image clarity), with this edition that also changes.

This change arises as a result of contracting with Hansen Print in Naracoorte, the firm which has, over recent years, produced and distributed the print copies of this Journal. As reported to the recent AGM, layout and image insertion will no longer be the province of the editor. The editor's tasks will be confined to checking and correcting the spelling and grammar of contributions; selecting image locations and their captions; and keeping the information on the inside front cover up to date.

COVID-19 has also changed the balance of the material submitted for publication. For the foreseeable future, further opportunities for vicarious exploration of extramural caves (such as those in Vietnam or Madagascar or those elsewhere in the world about which others such as John Brush, Andy Spate, Kent Henderson or Greg Middleton have written (and me to write my own pieces about my cave related wanderings in France) await the opening of borders. Those opportunities, we all hope, will arise again and be reported in future Journal editions.

However, also out of the gloom and darkness can come light. The ACKMA data logger project (about which

Andy Baker, Andy Spate and Dave Gillieson have written over the past few Journals and with the data to which Rauleigh Webb has devoted considerable effort to making electronically usefully accessible) provides a welcome contribution of positivity in these otherwise gloomy times.

The changing of the guard in the editorship of this Journal provides me with an opportunity to thank, generally, all those who have submitted pieces for publication, and I do so.

Although it is invidious to do so, I feel I must offer some special thanks to stalwart and regular contributors (without meaning, by non inclusion in what follows, that I am any less grateful to those who have contributed and who are not specifically named).

First, I express my gratitude to Andy Spate, my friend of now some 30 years. I described, in my first editorial (for the June 2018 edition), my first encounter of him at Yarrangobilly. I wrote:

My first memory of him is at a conference I attended of NPWS managers at Caves House at Yarrangobilly Caves. The (then much younger) Mister Spate had been assigned to uncomplicated aspects of the catering operation, namely the making of a tossed salad to feed some 15 or so people. I stumbled across Andy in the kitchen, shaking a large green garbage bag and looking as though he was infected and doing the St Vitus Dance. When I shyly enquired what he was doing, he informed me that he had concluded the most efficient way to make this high volume tossed salad was to put all the ingredients in the garbage bag; pour a bottle of white vinegar and 1/4 of a bottle of olive oil in; close the neck of the bag firmly shut; and shake the whole arrangement vigorously. I instantly detected a kindred spirit!

Throughout my 13 editions, he has been an anchoring contributor with his regular Andysez pieces and other contributions. He has also provided encouragement and support throughout my tenure.

From an editorial production perspective, I thank Tony Culberg and his wife, Pat, for their proof reading and checking assistance. Whilst Tony and I have had our occasional linguistic and grammatical differences (his objection to the use of the word "whilst" being one of them and here incorporated, teasingly, to infuriate him), I will miss our edition to edition 7.30 am chats and regular email exchanges. I am sure that the friendship that has developed will continue (and I hope to catch up with Tony and Pat when they visit Sydney next December).

ACKMA President Report June 2021

Ian Eddison

Your ACKMA President is personally very pleased with having just become a grandfather for the fourth time. This latest birth is a second grandson who has taken part of my name as his, so I am particularly honoured and pleased. Our daughter and grandson are doing fine. It is a sunny, calm winter's day in Bathurst today, but winter is certainly making its presence felt here and throughout Australasia. Today is 6 June 2021, the International Day of Caves and the Subterranean World. I have wondered what you are doing today. My wife, Anita, who works at Jenolan Caves, and I working at Wellington Caves, will not physically be in or around caves today but we certainly are talking about our love of caves and karst, the places we work and the upcoming meetings of ACKMA. You may be hesitant about the talk of travel. The latest news is about the ongoing challenges to do with COVID-19, shutdowns extended in Melbourne and construction of quarantine centres and planning for the future arrivals from overseas. This demonstrates that not only is the Australian government planning for the next months, but also the coming years ahead with similar challenges. We therefore might expect other crises along similar lines. We simply must adapt to this.

A week ago, Prime Ministers Ardern of New Zealand and Morrison of Australia met, made possible by two-way quarantine-free travel across the Tasman.

<https://www.pm.gov.au/media/joint-statement-prime-ministers-jacinda-ardern-and-scott-morrison>

I would like to think this will encourage you to consider travel carefully. In terms of our organisation, ACKMA has plans to meet at Wellington Caves, New South Wales, this October (registration details in this Journal), and in the Takaka region on the South Island of New Zealand within the next year. May 2022 is most likely. Neil Collinson and Pete Chandler are working on those plans in New Zealand. Shannon Corkill at Waitomo is also liaising on this event.

Our AGM was held on 8 May 2021. Thank you to those of you who joined us on our Zoom for that. Your ACKMA committee met a few weeks later and are tending to various administrative tasks and remain busy on a number of fronts.

Liaison and relationship building with ASF and NZSS - a positive relationship between ACKMA, ASF and NZSS is established and positive communications are ongoing.

There is a combined effort in the creative Celebration of Caves and Karst in Australasia competition. ACKMA, ASF and NZSS will contribute to a \$1,000 grand prize and Ledlenser is providing four \$500 vouchers for each of the divisions of the creative competition. More details are in this issue. Check out the conditions and get creative! Share details with your creative friends.

Atmospheric data-logger project - this project continues to gather momentum, with data coming in and analysis being conducted by Professor Andy Baker enabling a better appreciation for all our members.

Batteries are being installed for the next ongoing leg of data record. This project, funded by ACKMA, assists tourist cave sites to have factual data of temperature and humidity records. Andy Spate, David Gillieson and Andy Baker have all worked on making this a successful program. Additional effort is going into the possibility of formal research opportunities related to this project.

Sixteen Legs - this exciting travelling exhibition through Bookend Trust is currently in Capricorn Caves, Rockhampton, Queensland. When you visit Wellington in New South Wales this October, the exhibition will have been established there. Do consider how you might be able to work your town in with this team and especially for those of you who work in cave tourism.

Cave tourism site restoration - work continues for cave tourism sites following devastating bushfires and flooding. These include Jenolan Caves, Wombeyan Caves, Buchan Caves and Kelly Hill Cave. I trust key people from each of these sites will be able to prepare presentations at Wellington in October as well as updates in the ACKMA journal.

'Best practice' guidelines for show caves - input is invited from those managers who can contribute from recent experience in restoration and repairs following fires and floods, as well as other developments. This project really is an extension and update on past guidelines. Contact Andy Spate and David Gillieson.

The Guides' School and ACKMA meeting - these activities at Wellington Caves, New South Wales, are now scheduled for 20-24 October 2021. The Guides' School, more precisely the Eco Guide Certification, is 20, 21 and 22 October, facilitated by Savanah Guides, and our meeting (including 20 minute presentations) is on 23 and 24 October. Please plan to present and encourage your network of ACKMA friends to do the same. For our many overseas members who may feel restricted this year and, indeed, any of our members unable to physically attend may be able to participate on line. Technological communications' options are being explored and our good friends at Weidmueller have sponsored this event to the tune of \$5,000 in order to help link those members stranded elsewhere. We seek further funding to match this and aim to have a quality on line link showcasing different locations within the Wellington Caves operation.

I wish you all continued health, improved economic situations in your respective work- especially those show cave member sites. Please remember to promote the International Year of Caves and Karst and the themes 'Explore, understand and protect'.

CELEBRATE THE
INTERNATIONAL YEAR OF CAVES & KARST

2021

ACKMA
MEETING

Wellington Caves NSW

20-22 October 2021 - Caves Guide School 'Eco Guide' Certification conducted by Savannah Guides

23-24 October 2021 - Post-Bushfire Workshop, operational adaptation to COVID-19

This event will be different to any other ACKMA event as we adapt to social distancing guidelines. Regardless of the changing restrictions and border closures, you can participate in person or online.

The Wellington Caves Caravan Park has a number of accommodation options. Please visit our website www.wellingtoncaves.com.au for further information.

To book please contact our office on 02 6840 6481 (Monday – Friday) and mention you are attending the ACKMA event.

P: (02) 6840 6481 E: enquiries@wellingtoncaves.com.au



Registration Form

Please return to: enquiries@wellingtoncaves.com.au
 All attendees will be invoiced prior to the event

Business Registration

Name (participant)	
Business name	
ABN	
Business address	
Phone	
Email	

Individual Registration

Name	
Address	
Cave site or organisation	
Phone	
Email	

Eco Guide Training 3 Days 20-22 October 2021 \$540 includes:

Eco Guide Training facilitated by Savannah Guides
 Dinner Tuesday evening 19th October
 Tea breaks and lunches on 3 days
 Transport to Sixteen Legs exhibition and Soldiers Club dinner Wednesday 20th October
 Transport to Hermitage Hill, 3 course dinner, 'Caves' book launch by David Gillieson and hear our keynote speaker Anthony Sharwood author 'From Snow to Ash' Friday 22nd October
 Inclusions are subject to change as required.

Please indicate:

ACKMA Meeting 2 Days 23-24 October \$360 includes:

Transport to Hermitage Hill, 3 course dinner, 'Caves' book launch by David Gillieson and hear our keynote speaker Anthony Sharwood author 'From Snow to Ash' Friday 22nd October
 Tea breaks and lunches on 2 days
 Including farewell sponsored by 'Caves' nibbles and wine tasting by Bell's River Estate Sunday 24th October. Inclusions are subject to change as required.

Please indicate:

All 5 days \$595 Includes all of the above. Inclusions are subject to change as required.

Please indicate:

Online participation sponsored by Weidmuller (\$20 per day) on these days:

Wed 20th	Thu 21st	Fri 22nd	Sat 23rd	Sun 24th

Pre conference caving Tuesday 19th October: Y NPost conference caving Monday 25th October: Y N**Unisex Conference T-Shirt (select size & indicate quantity \$15 each):**

Collect at the meeting. Additional postage fee for online participants

S	M	L	XL	XXL

Cotter Cave (PR1) cleaning and restoration project

John Brush

Canberra Speleological Society, Inc.

Over the last several years, the Canberra Speleological Society Inc (CSS) has been involved in a cave cleaning and restoration project in the Cotter (or Paddys River) karst area in the Australian Capital Territory (ACT). This article provides an update on the work that has been undertaken so far.

Cotter Cave is an interesting and spacious cave in the Bullen Range Nature Reserve, about 30 minutes' drive from central Canberra. Although the cave has little more than a 100 metres of passage, it is easily the longest cave in the ACT. It is a roosting site for eastern the bent-wing bat (*Miniopterus schreibersii*) which is a listed vulnerable species in the ACT and NSW. Two species of cave-dwelling spider (*Stiphidon facetum* and *Epimecinus sp. nov.*) have been recorded in the cave and it is the type locality for the latter (Gray, 1973). In terms of European history, pencilled graffiti throughout the cave records visits by European visitors dating back to the early years of the 20th century. Low key commercial tours were regularly conducted into the cave between the 1930s and 1950s. The varied natural and cultural values of the cave and its surroundings were formally recognised by the ACT Government in March 2011 when the area was placed on the ACT Heritage Register.

Unfortunately, the cave has suffered considerable damage over the years and there have been significant impacts, including breakage and removal of speleothems and graffiti, since the heritage listing in 2011.

CSS first became interested in the Cotter karst area in the 1950s and has mapped and documented a total of seven caves in the area. Since 2005, CSS has been working with the ACT Parks and Conservation Service (ACT Parks) to address management issues in the area, especially with the main cave.

The saga of CSS's efforts to improve protection of Cotter Cave were covered in an earlier issue of the Journal (Brush, 2019a) which noted that, after promising preliminary consultations, ACT Parks ignored our advice

and constructed a monstrous new entrance barrier and gate in early 2007. Unfortunately, the massive structure was not 'bat-friendly' and was easily breached by vandals, thereby exposing the cave to potential damage and the general public to hazards. CSS called for the structure to be replaced or at least modified as an interim measure. Over the next decade, several modifications were made but these were of limited success in overcoming the original design flaws.

As the integrity of the entrance barrier was often compromised by vandalism, all manner of rubbish accumulated in the cave and graffiti attacks were common. In some areas, four or five layers of paint could be seen (Figure 1). CSS made many trips to the cave to remove rubbish. It also conducted graffiti cleaning trials in 2016 and 2017 and developed a suite of techniques for removing paint from a range of cave surfaces (Brush, 2019b). However, CSS decided a major cleaning effort would be futile unless a more secure entrance structure was installed.

In 2018, the need for action became more urgent. As noted in the earlier article (Brush, 2019a):

'The entrance barrier was breached on several occasions and in April, the gate was completely removed (Figure 2) and thrown into the cave. Vandalism within the cave also became more serious with portable power tools being used to cut off stalagmites and slabs of flowstone (Figure 3). Additionally, new spray-painted graffiti appeared throughout the cave. CSS ramped up its representations and also lobbied politicians. Once again there were sympathetic responses but there was not much action apart from temporary repairs to the entrance structure.'

Unfortunately the following paragraph, critical to the narrative, inadvertently disappeared during the production process:



Figure 1. In parts of the cave, there were four or five layers of painted graffiti.



Figure 2 In 2017 and 2018 the entrance barrier was regularly damaged and at one stage, the gate was completely cut off and thrown into the cave.



Figure 3 Portable power tools have seriously damaged speleothems throughout the cave.

The real breakthrough came in November 2018 when Marjorie Coggan, as CSS Secretary, informed the ACT Heritage Council of the recent damage to the heritage-listed site and provided supporting photographic evidence. The response was dramatic. Funds became available, meetings took place, CSS was asked for advice on bat-friendly gates, proposed designs were discussed, ACT Parks obtained quotes and, by the end of the year, it had engaged a contractor.'

The article continued:

The contractor commenced on-site work on 21 January 2019. ACT Parks decided to keep the framework of the existing structure so that the round bars would be simply cut off and replaced with larger square-section tube, which included features to increase resistance to damage. The round bars were replaced on a panel-by-panel basis so that the cave was not left unprotected overnight. Staff of ACT Parks closely supervised the work and were equipped to deal with any stray sparks resulting from the cutting and welding work.'

Construction of the new entrance barrier was completed in March 2019 and incorporated several modifications to the original design to increase its resistance to vandalism. In the months following its completion, the new gate successfully resisted several attempts at unauthorised access and, on each occasion, ACT Parks promptly repaired the damage.

With a secure entrance barrier in place, CSS decided it was time to commence a major cleaning and restoration effort in the cave. In May 2019, there were two joint trips during which CSS members instructed ACT Parks' staff on cave-friendly cleaning methods. During the remainder of the year, ACT Parks undertook two further trips and CSS did likewise.

On the graffiti-cleaning trips, we have used the full range of paint removal techniques trialled in 2016 and 2017. The key objective has been to preserve historic, pencilled signatures, while removing painted graffiti using the lightest touch possible. In a few cases, a gentle spray of water was sufficient to remove paint from dusty surfaces. More commonly, it was necessary to wet scrub with nylon bristle brushes (Figures 4), ranging in size from toothbrushes to floor scrubbers, or to use drill-powered rotary brushes with abrasive particles embedded in thick plastic bristles (Figure 5). As a last resort, we have used wire brushes for stubborn graffiti on bare rock surfaces and on speleothems that are intermittently active, so that any scratch marks will in time become covered by new layers of calcite. Drop sheets and absorbent mats

(such as old bath towels) are used to capture runoff water, paint fragments and loose bristles (Figure 6). Any stray fragments or bristles are swept up on subsequent trips.

The degree of success in removing painted graffiti without significant impacts on the cave depends on a range of factors, including the colour, thickness and type of paint, and on the nature of the cave surface that was painted. One example of the cleaning efforts is shown in Figure 7 and a second is on the front cover of this edition.

As the range of scrubbing and brushing techniques is not a treatment for chiselled or carved graffiti, and cannot be used for painted graffiti on delicate surfaces, CSS agonised over whether to simply leave these areas alone or attempt to mask them. After on site discussions with ACT Parks, CSS was given the go ahead to conduct graffiti masking trials. But what to use? It had to be something that was a completely reversible means of covering the graffiti but was also benign, effective and relatively cheap. After much deliberation, we decided to trial a blend of ground limestone, purchased from a garden shop, with potters clay. These are mixed with clean water to form a slurry that can be dabbed on with a small brush (Figure 11). The clay acts as a binder and, when mixed in different proportions, it can be colour matched to a range of cave surfaces. To complicate matters, the slurry changes colour as it dries and, in the cave, this can take a week or more. Our solution, to remove the guesswork from colour matching, was to make up a series of laminated colour cards with samples of the different blends.

Following successful small-scale trials on a range of surfaces in November 2019, CSS undertook more extensive masking work (Figure 12) in January 2020 and in March 2021. While masking appears to be a useful technique in some situations, removal by scrubbing remains the preferred method for dealing with painted graffiti in the cave. To date, scrubbing has been used at an estimated 85%-90% of the sites we have worked on. The issue of how to deal with scratched or carved graffiti on flowstone and other speleothems remains unresolved. The masking trials included a small area of graffiti incised on dry, brown flowstone and the results are reasonably acceptable. However, we are not planning to attempt masking on speleothems that are either clean or intermittently active.

The cleaning and restoration efforts have now removed or masked an estimated 60%-70% of the graffiti that was present when CSS initiated the project. Most of the 'easy' sites have now been tackled. This means sites that



Figure 4 Wet scrubbing graffiti and capturing the loosened paint fragments.



Figure 5 Removing stubborn paint with a mildly abrasive brush attached to a drill.



Figure 6 Drop sheets and towels are used to capture runoff water and paint fragments.

are within comfortable reach and where the paint can be removed - or masked - without too much difficulty. What remains is paint that is either stubbornly attached or will need ladders and climbing gear to safely reach.

CSS is averaging about two cleaning trips a year to Cotter Cave. This appears to be about the maximum level that can be sustained in our small group, without completely killing off enthusiasm. At that rate it is likely take another couple of years to deal with the remaining graffiti. And then what?

There is spray painted graffiti on the walls of Powder Store Cave (PR-2), one of the small caves in the area. Much of the graffiti is on flowstone and cave coral (Figure 13) and CSS has yet to seriously discuss what, if anything, can or should be done in the cave.

If any ACKMA members are passing through Canberra and would like to visit the cave, please get in touch and we will guide you on a detailed inspection trip after thrusting a scrubbing brush into your hand.



Figure 7 Going, going and still not quite gone. A long term project at the base of the entrance pitch. The green colouration is algae.



Figure 11 Covering graffiti by dabbing on a slurry of ground limestone and potters clay.



Figure 12 Working on a large area of graffiti that was sprayed onto a delicate and flaky surface.



Figure 13 Colourful and difficult to remove. A graffiti site in Powder Store Cave. CSS is yet to discuss what can or should be done here.

References:

- Brush, John (2019a), Recent developments at Cotter Cave, ACT, ACKMA Journal 115:24-27.
- Brush, John (2019b), Cave Restoration work at Cotter Cave, ACT, ACKMA Journal 117:25-27
- Gray, M.R. (1973) Survey of the spider fauna of Australian caves, Helictite 11(3):47-75

Ann Augusteyn Award

Cathie Plowman

Decima McTernan, from Naracoorte Caves and Tantanoola Cave, was announced as the recipient of the inaugural Ann Augusteyn Award at the recent ACKMA Annual General Meeting (held online on 8 May 2021).

Decima has a long record of commitment and service to these caves over the past 27 years, in a variety of roles that have included Acting Manager and her current position of Senior Guide. The nomination for Decima noted her excellent tours, her mentoring and training of other guides, and her input into new developments at Naracoorte Caves, including the interpretive panels.

The nomination of Decima for the award was accompanied by outstanding references from community members who have long and significant associations with the Naracoorte Caves.

Sincere congratulations to Decima, and thanks for your many years of service to show cave interpretation efforts.

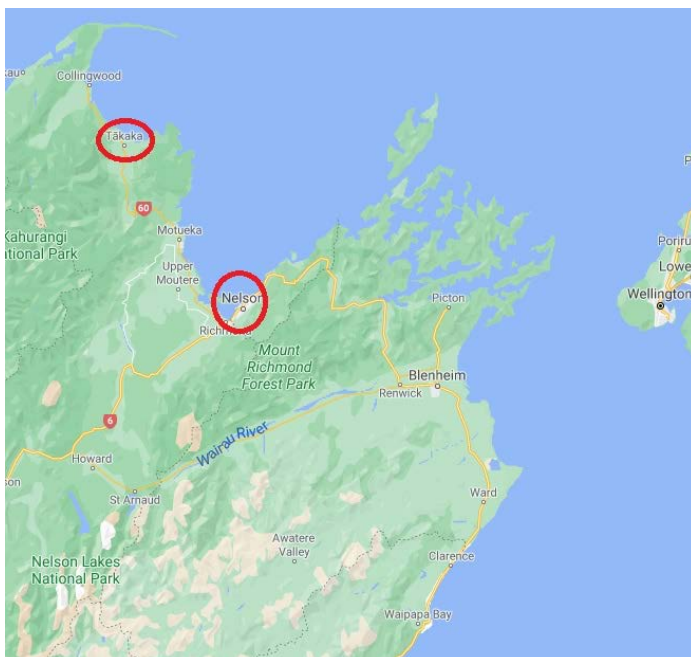
ACKMA determined in 2019 to honour our late member and colleague, Ann Augusteyn, with this award to promote and reward excellence in show cave interpretation and presentation. The Award Committee is Emeritus Professor Betty Weiler, interpretation trainer and consultant, John Pastorelli, and Cathie Plowman (committee chair).

The award will be open biennially and nominations will next be invited in January 2023.



Photo of Barbara Lobban and Decima McTernan with the Ann Augusteyn Award

NEW ZEALAND - 2022



Save the dates!!

ACKMA gathering on the South Island of New Zealand from 1 to 7 May 2022

-o000o-

For information on geology of the Takaka locality, see pages 359 - 372 of [New Zealand Geology: an illustrated guide. - GeoTrips](#)

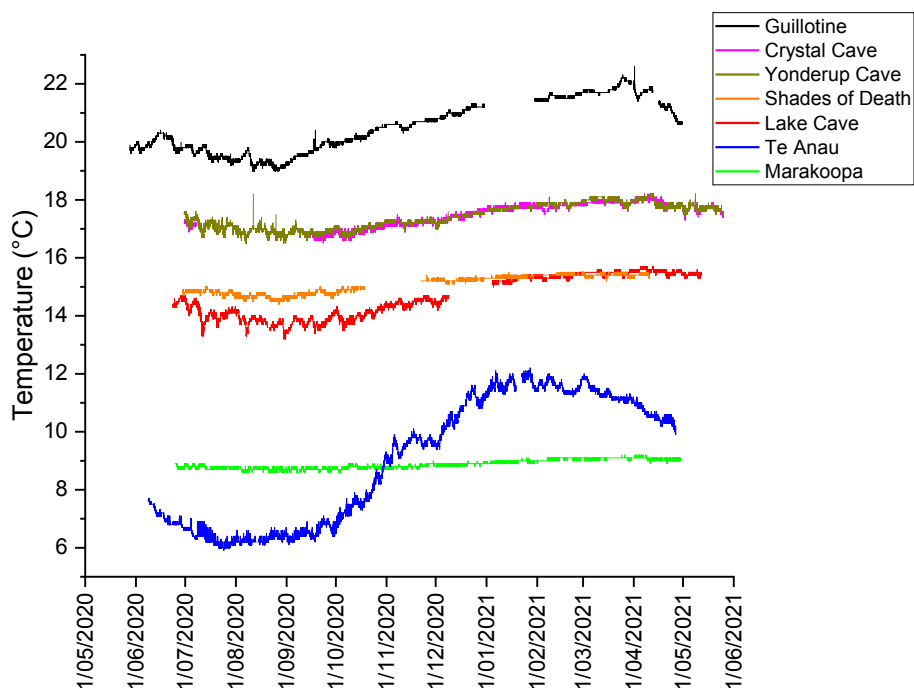
Is the temperature of your cave constant?

'The ACKMA Cave Climate Team'

The temperature of a tourist cave is often something that is displayed at the cave or interpreted as part of a tour. Now that we have almost a year of cave temperature data from the ACKMA Cave Climate Project, here is some information that might help you think again about cave temperature.

Is cave air temperature constant?

The answer is "rarely". However, cave temperature is less variable than the temperature outside the cave. Almost all caves have some temperature variability through the year. Here are some examples from some of the participating caves (you can see all the data at <http://www.ackma.org/CaveClimate/index.asp>).



What sort of annual temperature variation do we see at the participating caves?

At Capricorn Caves, the relatively open 'Cathedral' varies by 11.8 °C between highest and lowest cave temperatures. The variability is so great we have not shown it on the graph, but we do show the more enclosed 'Guillotine' location which varies by 3.2 °C (black line in the graph). Most of the participating caves have a temperature variability of a few degrees Celsius or less. For example, Marakoopa Cave (light green line on the graph) varies by just 0.6 °C over a year.

	COLDEST CAVE TEMPERATURE		WARMEST CAVE TEMPERATURE		ANNUAL TEMPERATURE RANGE
Capricorn, QLD					
Cathedral	5 July	13.4 °C	7 December	25.2 °C	11.8 °C
Guillotine	25 August	19.0 °C	25 March	22.2 °C	3.2 °C
Te Anau, NZ	24 July	5.9 °C	27 January	12.2 °C	6.3 °C
YANCHEP, WA					
Yonderup Cave	31 August	16.5 °C	11 April	18.2 °C	1.7 °C
Crystal Cave	23 September	16.5 °C	9 April	18.2 °C	1.7 °C
Marakoopa, Tas.	30 August	8.6 °C	2 April	9.2 °C	0.6 °C
Lake Cave, WA	31 August	13.2 °C	7 April	15.7 °C	2.5 °C
Shades of Death, Vic.	27 August	14.4 °C	21 March	15.5 °C	1.1 °C

As you can see, there is no relationship between how variable the cave temperature is and the external climate and whether it is hot or cold. It is all about the cave morphology and the amount of ventilation that is possible. Caves with large entrances, or multiple entrances, are more likely to allow air exchange between the cave and the outside. The greater the amount of exchange between the outside air and the cave, the more variable the cave temperature.

For example, Lake Cave (images below) has a steeply descending passage and a relatively small entrance (shown on the right) which is situated at the base of a very large doline (shown on the left). This morphology limits the extent of ventilation possible here.

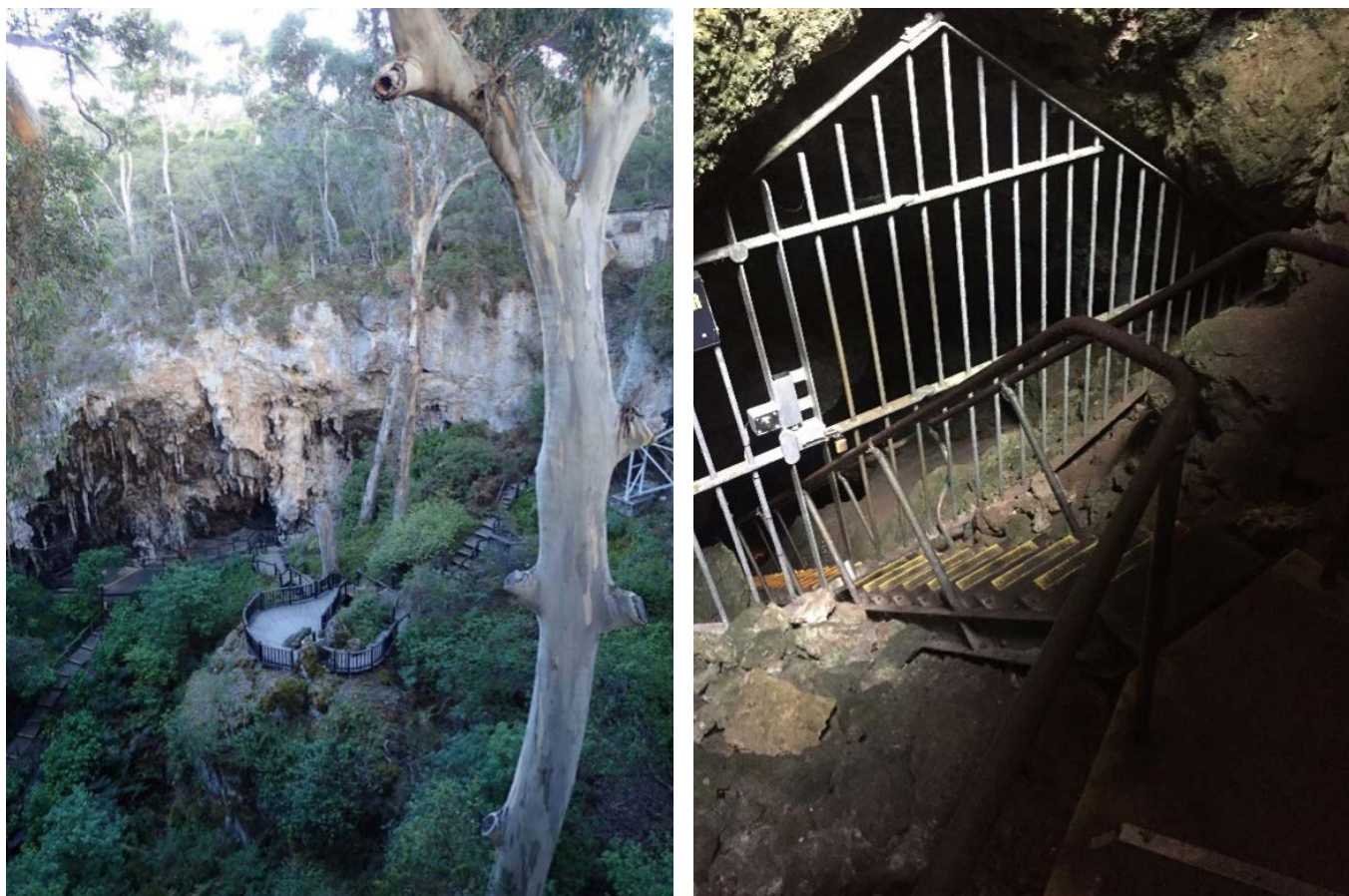


Figure: Lake Cave, WA, with the cave entrance, shown right, at the base of the doline shown on the left. (Photo credits: Mark Delane, David Gillieson)

At what time of year is my cave likely to have the warmest air temperature?

You can see from the table that most caves are warmest in late summer to autumn. In summer, the cave air is cooler and denser than outside air, which means it is trapped within the cave. This cave air is slowly warmed through the summer by the conduction of heat through the rock from the surface. This conduction is a slow process, which is why the warmest temperatures in the cave are after the warmest months on the surface. Most caves will only start to cool after the night time temperatures become colder than the cave air temperature. The warmer cave air then becomes buoyant and can escape the cave, being replaced by cooler, denser outside air. The cooling of the cave air temperatures has thus begun.

‘Summer time’ in your cave is likely to be in autumn – check <http://www.ackma.org/CaveClimate/index.asp> to find out for a particular cave)

And the coldest?

For most caves this is late winter to spring. The processes are the same as for summer, just happening in the reverse order. Ventilation in winter draws in cooler external air and that cools the cave. Conduction of cooler surface temperatures through the rock takes time to reach the cave. That can further cool the cave air temperature. As soon as outside temperatures start to warm, ventilation becomes less possible and the air in the cave becomes trapped there. Eventually it will start to warm again due to conduction of heat through the rock from the surface.

‘Winter time’ temperatures in your cave are likely to be in spring.

You say most caves. What are the exceptions?

No two caves are identical, and this is certainly true for cave climate.

One exception is at Capricorn Caves, where the ‘Cathedral’ temperatures change at the same time as outside temperatures. That is because this part of the cave is so open to the outside air through large entrances on both sides of the limestone tower as well as other, smaller openings. Its climate changes rapidly.

And you can see Te Anau has its coldest and warmest months only slightly after the surface coldest and warmest months. With entrances at different altitudes, and a cave stream as an additional source of heat energy to cool or warm the cave, Te Anau's climate is unique to the participating caves in the study.

Anything else?

The cave temperature variability observed in Australia and New Zealand is not unique and is likely to occur elsewhere. But bear in mind that the closer to you get to the equator, the surface temperature is less variable. And if the surface temperature doesn't vary across the year, the cave temperature won't vary either. So what we observe will be typical for caves in mid to high latitudes, but not for low latitudes.

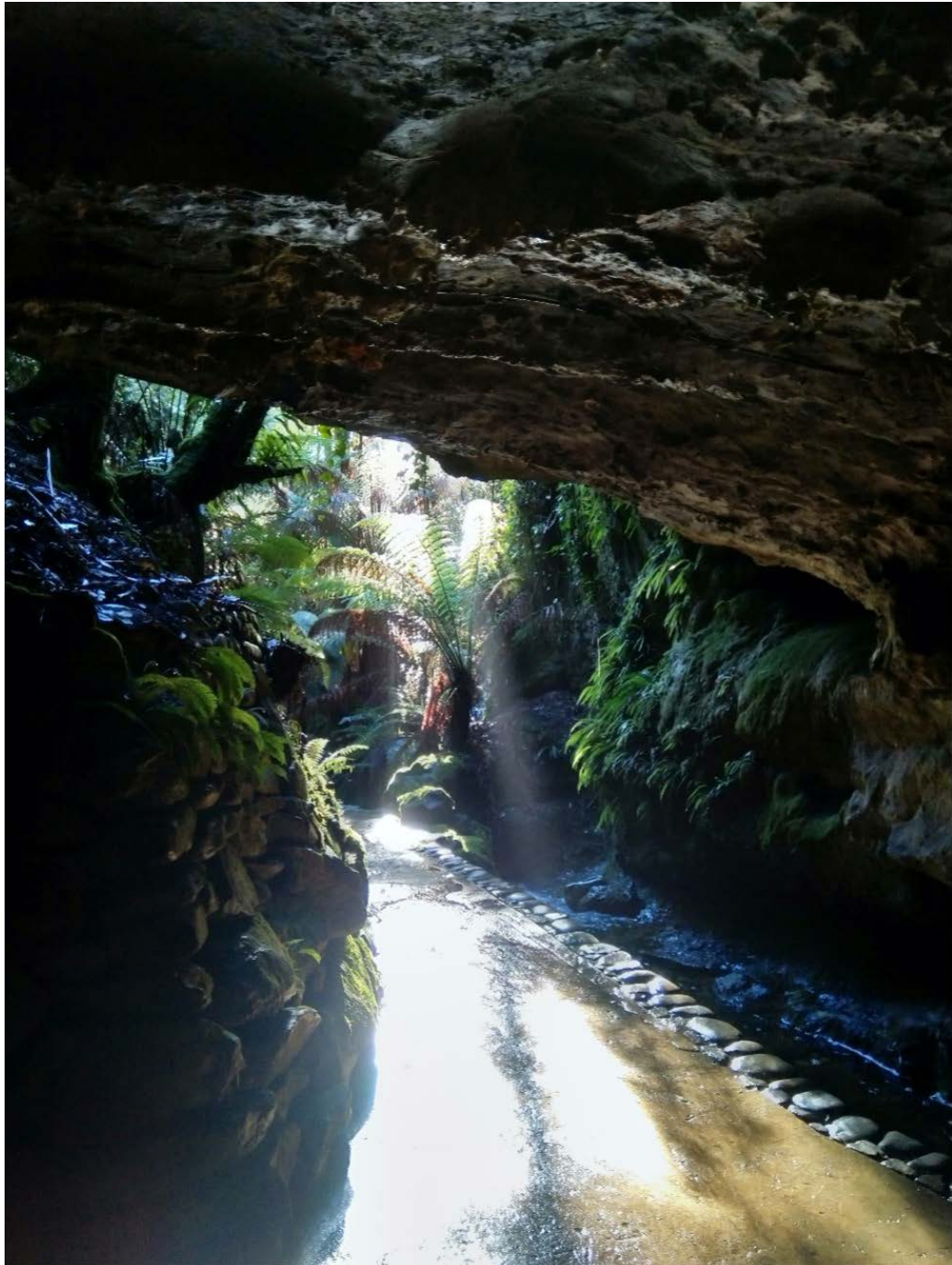


Image: Marakoopa Cave entrance. Photo credit: Renee Larcher

Vale Ernie

Ernst (Ernie) Albert Holland died on Sunday 20 June surrounded by family. Many of our more recent members will not have knowledge of this man. Ernie was a 'larger-than-life' persona (despite his small stature). A long-term guide, and then the Senior Guide, at Jenolan. His enthusiasm and knowledge of caves (and minerals) was both extensive and invigorating.

Ernie was the first President of the then ACMA elected at the inaugural meeting at Yarrangobilly in May 1987. A triumvirate appeared in ACMA at that time – Ernie Does, Celery Reckons and Andy Sez!

A fuller obituary will appear in the September Journal.

ANDYSEZ 61 CONTINUED...

A LITTLE MORE ON EARTHQUAKES

Andy Spate

I felt that I had not given you enough information in the last ANDYSEZ on why the people in Jewel Cave didn't feel anything back in 1968 while the kiosk was damaged.

So, I went Googling – as one does - and was surprised to find that some old codger named Andy Spate had written about earthquakes 16 years ago that was to be found in the ACKMA Journal 58 (March 2005, pp 32-37) as ANDYSEZ 51. It was prepared in the same month the original ANDYSEZ 61 - I had forgotten about the article completely!

You can see it at <http://www.ackma.org/membersonly/journal/58/Andysez%2051%20Earthquakes%20And%20Caves%20Andy%20Spate.pdf>

In the same issue, Rolan Eberhard talked about earthquakes at Marakoopa (MC120, Mole Creek – a tourist cave).

On rereading both ANDYSEZs 51 and 61, I was pleased that there were no major inconsistencies or errors (I hope) – the former dealt mainly with earthquakes themselves while 61 was mainly about speleoseismicity.

I want to touch a little more on what one feels, or doesn't feel, in a cave when the ground shakes. In Rolan's 2005 article he says:

On the 22 December 2004 ... We experienced a very obvious rumbling lasting about 5-10 seconds ... None of us noticed a sensation of earth movement. Enquiries later revealed that cave guides who were at the office just outside the cave entrance did not notice a loud noise or anything unusual at the time.

Later Rolan goes on to mention another quake in November 2004 when:

... Dawn was guiding a group through a section of Marakoopa ... The quake manifested itself as a loud roaring noise ...

A curious feature of the November tremor is [was] the lack of noticeable earth movement inside the cave. The event generated sufficient ground movement outside the cave to cause Ross McNeill to be concerned for the safety of the underground party [who did not report shaking and delicate speleothems nearby were not seen to vibrate.

At <https://earthscience.stackexchange.com/questions/5181/is-it-true-that-earthquakes-are-not-felt-in-a-cave>, an unidentified discussant wrote that:

There are three main types of waves produced during an earthquake: P, S, and L waves, which stands for Primary, Secondary, and Love. (There was a mnemonic I read many years ago that went P=pressure, S=Shear, and L=Long.) The P and S waves are body waves. That is, they propagate inside the earth. The P wave is basically a sound wave; as the mnemonic goes, a pressure wave. The S wave is a shear wave and is perpendicular to the direction of fault slip. The L wave, which has the highest amplitude is a surface wave and, as such, propagates along the surface, not inside.

If you were inside a cave when an earthquake occurred nearby, you would not feel the L waves, since they propagate along the surface. Whether or not you would feel the P and S waves would depend mainly on two things: the magnitude of the original earthquake and the type of fault that produced it. If the fault were a thrust fault, the S wave would be up and down, which a standing person probably wouldn't feel unless the earthquake was quite large (>5.5?). However, if the earthquake were along a strike-slip fault, the S waves would be side to side, which a standing person would likely feel.

It seems likely, then, that the damage to the Jewel Cave kiosk was caused by an L wave or an S wave.

Arthur Palmer (2007, page 80) sums the matter up as follows:

Earthquakes seldom have a noticeable effect on caves because the shock-wave intensity decreases sharply with depth below the surface. The local bedrock usually moves almost as a single coherent block that is fairly resistant to damage. People who have experienced earthquakes whilst within caves report low rumbling sounds, oscillation of water surfaces, and occasionally a few loose rocks sliding down slope, but rarely anything more dramatic.

Anyway, that is probably more than enough on earthquakes and caves. Thanks, Rauleigh, for so expeditiously supplying Rolan's article.

Reference:

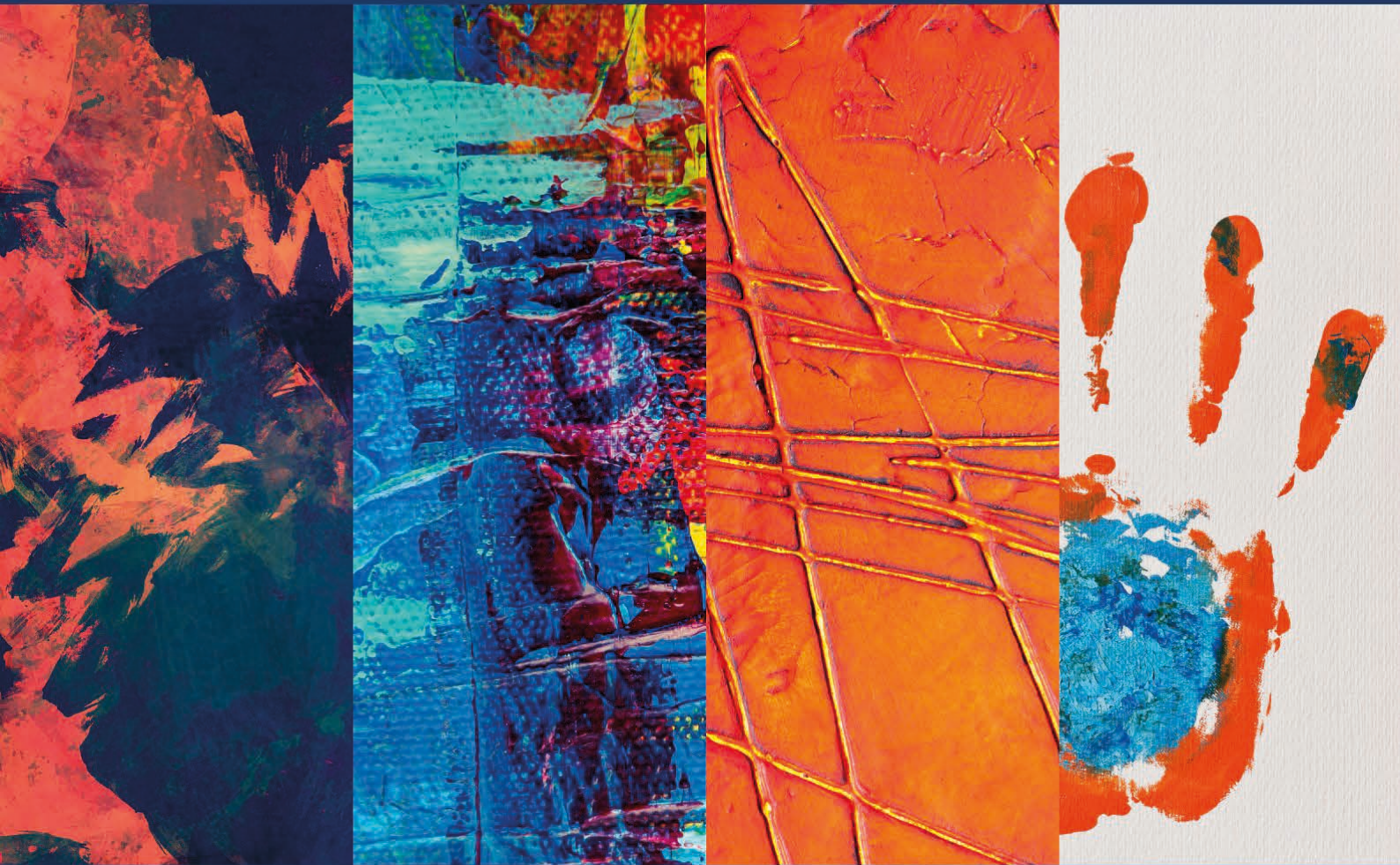
Palmer AN, 2007, Cave Geology, Cave Books, Dayton, USA

CELEBRATE CAVES

THROUGH YOUR CREATIVITY

ACKMA, ASF and NZSS invite

**All creative arts people of Australasia to celebrate the
International Year of Caves & Karst in 2021**



YOUR CHOICE OF MEDIUM - Write a Story, Rhyme, Poem, Song, Sketch, Paint, Sculpt, Photograph or Create a Video.

Four \$500 Ledlenser vouchers and a \$1,000 Grand prize are to be won!

The theme is **Caves and Karst in Australasia**

By submitting your creative piece in an electronic file to asf.caves.competitions@gmail.com you allow ACKMA, ASF & NZSS to showcase your art as part of our celebration of the International Year of Caves and Karst 2021. (See - Conditions of entry)



Australian
Speleological
Federation



Conditions – Creative celebration of the International Year of Caves and Karst – Australasia

All entries are to be emailed to: asf.caves.competitions@gmail.com

Overview

- The theme is Caves and Karst in Australasia
- Open to all ages and levels of skill. (Under 18's must attach a parent consent.)
- All mediums are welcome
- The work is to be produced recently from 2019, 2020 or 2021
- Entry is free
- Closes midday Sunday 21st November with announcements Sunday 12 December 2021.

Creators statement

- Date of work
- Title
- Created by - Collaborations must include their names and role. Entry is by the author (A winning collaborative entry will have the prize awarded to the author/artist)
- Statement - What was it about caves or karst that inspired the work? (500 words max.)
- Medium/treatment/technique

Visual Art and photography – categories Photography; Creative arts

Submissions are to be made as high-resolution, cropped jpegs (no frame, no glass) of at least 1mb10mb max. They need to be easily shared electronically and reproduced in print (no low-res thumbnail images taken from websites, etc.)

Video, audio and recorded performance – categories Stories and poems; Music and song

A maximum running time of 7 minutes.

Video submissions are to be made using a link to YouTube, Vimeo or similar.

They need to be able to be watched/listened to remotely by judges and stakeholders, shared to social media and/or embedded in websites, etc.

Script, lyrics or score for original compositions must also be included with the entry.

Acknowledgements of collaborators, multiple participants and their role are to be made. Clearly state the author which is the person to submit the work.

Writing – categories stories and poems

In the form of poetry, prose, fiction, non-fiction, journalism. – 5000 words max.

Content

The organisers assessment panel reserve the right to refuse an entry based on it possibly being offensive. You are cautioned to avoid culturally sensitive or political issues, nudity, profanity, adult concepts, etc.

Your entry must be your own work or a collaborative work which is clearly acknowledged.

Categories

Photography; Creative Arts; Stories and poems; Music and song

Prizes

Four \$500 vouchers from Ledlenser <https://ledlenser.com.au/> will be issued, one for the best entry in each category. A \$1,000 (Aus.) grand prize will be awarded to the overall best of the categories.

This competition is being conducted jointly by the following organisations

- Australasian Cave and Karst Management Association (ACKMA)
- Australian Speleological Federation (ASF)
- New Zealand Speleological Society (NZSS)

The judging panel will comprise representatives of these organisations. Any correspondence concerning the competition should be addressed, in the first instance, to the email address appearing at the beginning of these Conditions. Any such correspondence will be referred to a representative of the appropriate organisation for direct response.

A condition of entry to this “Celebration of Caves and Karst” is that each entrant authorises the above organisations (ACKMA, ASF, NZSS) non-exclusive use of submitted material for non-commercial purposes online and in print, with attribution and in full. Copyright remains with the artist/author.



Bushrangers at Timor Caves, New South Wales Australia

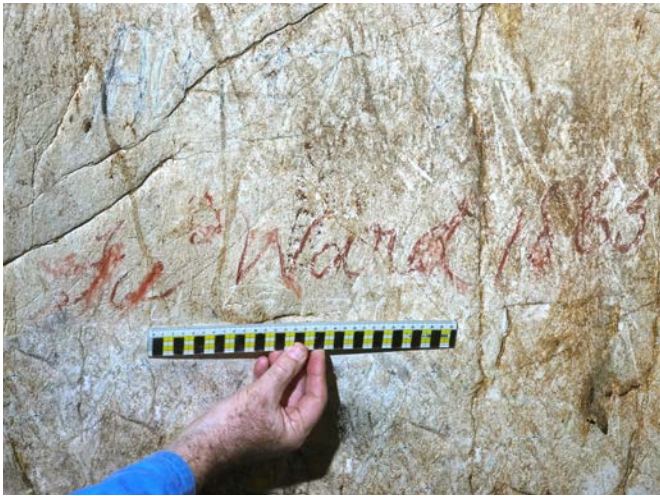
Part 1 – Captain Thunderbolt

By Garry K. Smith

Newcastle and Hunter Valley Speleological Society

There have been numerous instances during the 1800s and early 1900s where bushrangers/outlaws have utilised caves as hideouts to evade capture. Either individually or in a gang, they roamed the inland regions of Australia, robbing citizens or institutions and at times committing murders. Some examples in New South Wales are James McEwan at Jenolan Caves, the Ribbon Gang at Abercrombie Caves and Ben Hall's Cave in Weddin Mountains National Park.

The discovery of two bushranger signatures in Main Cave (TR1) at Timor, New South Wales could be yet another example if the signatures can be verified as authentic. The signatures in question, "Fred Ward 1865" (alias Captain Thunderbolt), written with reddish-brown chalk or ochre, and "Jimmy Governor 1899", written with black lead pencil, are inscribed on the wall in obscure locations well inside the cave. They are both written in the style of writing characteristic of the time. The signature of Fred Ward at Timor was observed as early as the 1890s by a local resident and again in about 1910 as detailed in the book *Timor Caves* published by the Sydney Speleological Society in 1976 (James et al, 1976). It should be noted that this book quotes Ward's signature date incorrectly as 1856.



Jimmy Governor's signature at Timor was located by Newcastle and Hunter Valley Speleological Society (NHVSS) members in 2007 (Argent, 2007; Smith, 2019 and 2020).

Over the years, there have been a number of comprehensive and well researched books published about the life and crimes committed by each of these notorious outlaws and their gangs, but none specifically mention the outlaws visiting Timor Caves.

So what drove these men to become bushrangers and what did they do during their reign of terror to sear their names into Australia's history? What historic evidence can be found to substantiate the authenticity of each signature? To set the scene let us look at the background of these outlaws and whether they were in the Timor area during the year inscribed alongside their signature. This article is split into two parts: Part 1 dealing with Fred Ward (Captain Thunderbolt), and Part 2 about

Jimmy Governor. Part 2 will appear in the September journal.

Frederick (Fred) Wordsworth Ward, alias 'Captain Thunderbolt' (1835 1870)

Fred was the youngest of Michael (Scottish ex-convict) and Sophia Ward's 11 children. Around the time of Fred's birth, his parents moved from Wilberforce, New South Wales to nearby Windsor (Baxter, 2011, website 1).

Michael "financed his elder children's education at the Church of England school at Wilberforce, and probably paid for Fred to attend the local Windsor school after the family's relocation there" (Baxter, 2011). Fred's elder brothers were stockmen and regularly took Fred droving (which would have kept him away from schooling). Fred's father finally gave up his agricultural pursuits in the mid 1840s, moving his family to West Maitland in the Hunter Valley.

In early 1847, at the age of 11, Fred entered the paid workforce, working for the owners of Aberbaldie Station near Walcha, New South Wales, as a "generally useful hand" to accompany the new owner and his family from Morpeth to their Aberbaldie property. He had been highly recommended as a skilled horseman and knew the 240 mile route well (Baxter, 2011, Chapter 7). Over the next 10 years, Fred worked at many stations in northern New South Wales, including a year at Total, the famed horse-stud near Paterson (Walker, 1957). His outstanding horsemanship skills were soon recognised and became a valuable asset in his work on the property (Brouwer, 2002; Baxter, 2011).

In 1855, he was employed by Augustus Anderson to drive a mob of cattle down the Hunter Valley to market. At Murrurundi, their mob mixed with another and, at Muswellbrook, Anderson sold two illegally acquired bullocks. Anderson and Ward were soon brought to trial by the rightful owner - Anderson being convicted and Ward getting off with a plea of "I know nothing, I was only employed by Anderson to drive the herd down the country" (Baxter, 2011).

In 1856, Fred's nephew, John Garbutt, who was one year older than Fred, became the ringleader of a large horse-and-cattle-stealing operation, and enticed other members of the extended Ward family to join him. Fred, now aged 21, helped drive some four dozen stolen horses from a Lambs Valley property (owned by his brother William) to Windsor where they were sold at auction. Ward and his nephews, John and James Garbutt (both sons of Fred's sister, Sarah), were all convicted - the Garbutts of horse-stealing and Ward of receiving stolen horses knowing them to be stolen (*Maitland Mercury* 13 May 1856, 14 August 1856). They each received a sentence of 10 years with hard labour and were sent to Cockatoo Island penal establishment on 27 August 1856 (Baxter, 2011).

In June 1860, after serving four years, Fred and his nephews were released early on "tickets of leave" for good behaviour (Brouwer, 2002; Baxter, 2011). The three men then moved to Mudgee (their assigned area), where John Garbutt, now aged 26, met and married a 42-year-old wealthy widow, Elizabeth Blackman, who

owned Cooyal Inn and station. Soon after, Fred gained work at Cooyal Station (Baxter, 2011).

In 1861, Fred met Mary Ann (nee Bugg), who was then living with an ex convict, James McNally, and her children at McNally's Cooyal farm, north east of Mudgee. Mary was born to an ex convict British father, James Bugg, and an Aboriginal mother called Charlotte. Mary was educated with five years of colonial schooling in Sydney after her father provided financial backing for her education. She was also taught food gathering, tracking, hunting and bush survival skills by her Aboriginal mother. Mary first married, at the age of 14, to Edmund Baker, 24 years her senior. Their marriage lasted just a year or two and they had one daughter. Mary then had children to two more partners, John Burrows followed by James McNally. Fred was to be the father of her seventh child (Baxter, 2011, website 2).



By the time Mary was pregnant with Fred's child, both John and James Garbutt had breached their ticket-of-leave and were back in gaol at Cockatoo Island serving the remainder of their previous sentence (plus, in John's case, another five years) (Baxter, 2011). So Fred was well aware of the consequences of breaching ticket-of-leave regulations, which included not leaving his allotted district. Despite this, probably at the insistence of Mary Ann, Fred left the Mudgee district to take Mary Ann back to her father's farm at Monkerai near Dungog for the baby's delivery. He returned late for his three monthly muster which resulted in the authorities revoking his ticket of leave on 13 September 1861 (Brouwer, 2002). The problem was compounded because Fred had arrived back in Mudgee on a "stolen" horse, although, at the trial, the owner admitted the horse had simply gone missing from his property and, despite hearing that it had been seen near Cooyal, he had not attempted to retrieve it. Fred was convicted and returned to Cockatoo Island prison to serve the remaining six years of his

original sentence (plus an additional three years' hard labour for being in possession of a stolen horse) (Walker, 1957). Two weeks after Fred's reimprisonment, Mary gave birth to their first child, Marina Emily Ward, at Dungog (Oppenheimer, 1992).

The prison conditions were very harsh and Fred, along with other prisoners, received barely enough (unpalatable) food. Their prison gang work was hard during the day. At night, the small cells' conditions were intolerable. Solitary confinement, in sweltering, humid heat or freezing cold as the seasons dictated, and the stench of open sanitary pans was commonplace as extra punishment for stepping out of line. Fred endured this extra punishment on several occasions.

On 11 September 1863, Fred Ward and a companion, Frederick Britten, slipped away from their Cockatoo Island work gang and remained in hiding for two days before swimming from the north side of the island - most likely to Woolwich. Many accounts claim that Mary Ann assisted in Fred's escape - but she had remained working in Dungog during his imprisonment and escape.

Following the prisoners' escape from Cockatoo Island, the Government posted a £25 reward to anyone providing information leading to the capture of each escapee. The New South Wales Police Gazette (14 October 1863, p 307, "Description of Escaped Prisoners") describes Ward as "a labourer, 27 years of age, 5 feet 8 inches high, pale sallow complexion, light brown curly hair, hazel grey eyes, mole on right wrist and two warts back of middle finger of left hand".

Sometime after making good their escape, Ward and Britten split up. Fred reached Mary Ann at Dungog and spent several weeks living with her at a Chinaman's residence in Paterson. After being disturbed by police, he fled to join up with Britten and they travelled up the Hunter Valley via Singleton - stealing two horses at St Clair station and continuing on to Gostwyck, south-east of Uralla. Here they robbed a shepherd's hut on 24 October 1863 (*The Armidale Express*, 31 October 1863).

Three days later, while they were waiting to ambush the mail near the Big Rock or Split Rock (now Captain Thunderbolt's Rock), they were spotted by troopers. In the ensuing gunfight, Ward was shot in the back of the left knee, an injury that left a critical identifying mark that helped to identify his body after his death. They both fled on foot before remounting their horses tethered further down the valley and escaped (*The Armidale Express* 31 October 1863, Baxter, 2011). Soon after they "bailed up" the Tamworth mail coach but missed a parcel of gold. The pair separated a few weeks later. Ward crowned himself with the nickname "Captain Thunderbolt" during the Rutherford toll-bar robbery on 21 December 1863 (*Maitland Mercury*, 22 December 1863).

He then returned to the Dungog area to see Mary and committed a number of robberies in the area (*Maitland Mercury*, 26 January 1864). Fred had a wide network of support, including his father in law and the extended Bugg family (Ramsland, 2001; Baxter, 2011).

But it wasn't until the *Maitland Mercury*, on 2 January 1864, published an article which formally connected "Captain Thunderbolt" as being Ward who had earlier been part of the gang from Lambs Valley, and who had been convicted of horse and cattle stealing. Thunderbolt was said to have taken refuge in the Tangorin Mountain, east of Singleton (*Maitland Mercury*, 2 January 1864, Baxter 2011).

This was all happening at a time when there was unrest in the remote communities, and far reaching outposts

of white settlement were intent on acquiring more land and pushing the indigenous population off the land. In 1861, the New South Wales Crown Land Acts were introduced by John Robertson, which allowed persons to select between 40 and 320 acres of land belonging to the Crown anywhere in New South Wales. There was much opposition from "rich squatters who believed themselves invaded by small settlers. These settlers often sided with the likes of Ward, creating a network of safe houses across the country" (Brouwer, 2002). Many civilians also felt they were trapped in a colonial caste system which made it extremely difficult to climb the social ladder, and the institutional rule of the well to do was seen to punish severely those without money. For example, being in possession of a cow that had strayed from its owner's paddock was often considered as theft and punishable with a gaol sentence. However, for the well-to-do, money could secure legal representation with the services of a good lawyer or barrister and result in the case being thrown out of court.

Thunderbolt gained a reputation of being the "gentleman bushranger" as he followed an outlaw code of behaviour: robbing the rich not the poor; being courteous to women; not committing acts of unjustified violence; being brave and courageous; and eluding capture by trickery or deception. With the support of many civilians sympathetic to his cause, Thunderbolt became the longest surviving outlaw to evade capture or death (Baxter, 2011).

Historic reports indicate that Fred, Mary and her two youngest children camped on the Culgoa River (near Brenda) from May till around December 1864; however, it is most likely Fred went further afield to steal horses. It was reported that Fred had left the Culgoa district in mid December, supposedly to steal horses from Mr Reynold's station on the Paterson River, then he was expected to return to Mary Ann at Culgoa, having left a favourite racing mare at the camp (*New South Wales Police Gazette*, 1865).

During early 1865, Thunderbolt was joined by three others as they went on a spree of robberies over a vast area from Brewarrina to Moree and over the Queensland border. There are too many robberies to detail in this article. Always one step ahead of pursuers, their frequent robberies became more daring as the weeks rolled by.

On 2 February 1865, Thunderbolt and two others robbed Jeremiah Barr at Bokhara River (north of Brewarrina) and stole cheques and orders valued at £15.

On 16 March 1865, Thunderbolt and three accomplices armed with 15 revolvers and two rifles, held up Mogil station (west of Moree), "threatening the inmates with instant death if they dared to move" (*Maitland Mercury*, 18 April 1865, Baxter, 2011).

On 1 April 1865, the police followed Thunderbolt's gang to Narran Lake and found Thunderbolt's camp inhabited by Mary Ann, two children and stolen goods. Mary was arrested for possessing stolen property, but on the journey back to Bourke she feigned labour and was dropped off at Wilby Wilby station on the Narran River. Thunderbolt's gang then "bailed up" Wilby Wilby station and rescued Mary Ann and her children. They all then headed to the Tamworth district. Fred employed an Aboriginal woman to assist the heavily pregnant Mary Ann during her confinement, hiding out most likely in the Borah Ranges, north-west of Manilla. Records are quite fragmented; however, it is believed Mary gave birth, in mid 1865, to Elizabeth "Eliza" Ann Ward (Baxter, 2011).

Thunderbolt and his gang then headed north-west again and undertook a spate of robberies. On 24 April, one

of the gang was shot and captured while the others escaped (Bendigo Advertiser, 10 May 1865). Thunderbolt permanently parted ways with his last two accomplices in May 1865 and returned to Mary and the children.

Between October and November 1865, four new villains joined Thunderbolt to form his second gang; one which went on to commit a large number of robberies over a wide area of northern New South Wales from Quirindi to the Queensland border. The government was becoming increasingly concerned at the brazen robberies and, on 4 December, posted a £100 reward for Thunderbolt's apprehension and £50 for each of his accomplices (*New South Wales Government Gazette*, 1865).

On 8 December 1865, Thunderbolt's gang robbed Benjamin Cook's Bird in Hand Inn at the hamlet of Quirindi (*Sydney Morning Herald*, 13 December 1865). Throughout December, Thunderbolt and his gang committed robberies or were spotted around Currabubula, Carroll, the Culgoa district, Collarenebri and Moree in the far north of New South Wales (Baxter, 2011).

In late December 1865 or early January 1866, Thunderbolt left the gang and rode the horse he had stolen from a property on the Horton River back to where the three children, Mary Ann and her female assistant were residing near the Borah Ranges. They all then travelled to the Gloucester district, while the rest of the gang continued to commit a few more robberies before being caught (*Maitland Mercury*, 29 March 1866).

On 13 March 1866, the female assistant escaped from Mary Ann and nine days later arrived in Stroud to report she had been with Thunderbolt for 10 months, engaged to assist Mrs Thunderbolt during her confinement. She had wanted to leave after the child's birth but Thunderbolt had kept her tied up at their camp near the headwaters of the Little Manning River (now Upper Manning, in the vicinity of Barrington Tops National Park) (*Maitland Mercury*, 29 March 1866). The female reported that Thunderbolt was quite crippled, with a hurt back after falling off his horse, "also suffering from a bad knee, preventing him from getting about without assistance; that his wife herself had to put him up on horseback; his wife always accompanies him (dressed in men's attire) out to plunder; that she has a large butcher's knife fastened on the end of a stick, rides up alongside the cattle and with this instrument she hamstring the beast, and then kills it. They principally live on beef (very seldom they have flour), wild yams, and wattle gum. The last place they stayed at they remained from June to January, near to a station of a Mr Parnell, and were never molested. The informant made her escape while Thunderbolt's wife was out after beef; she wandered six days through the bush before she came to an inhabited place, and three days from there to Stroud, living on yams and wattle gum during that time. She asserts that there is no one else with Thunderbolt except his wife and three children" (*Maitland Mercury*, 29 March 1866).

On 23 March 1866, a "blacktracker" and three police located Thunderbolt's camp. Thunderbolt escaped capture but was separated from Mary Ann and the three children, who were captured and taken to Mr Hooke's Curricabark station, from where they escaped soon after (*Sydney Morning Herald*, 19 April 1866, Baxter, 2011). When captured, dressed in men's clothing, Mary Ann insisted she was "the Captain's Lady" rather than what the police called her (Brouwer, 2002).

Mary Ann was again arrested on 27 March 1866, at Pigna Barney Creek (about 50 miles east of Murrurundi), on a charge of vagrancy; convicted and sentenced in Stroud

Court to six months' goal. The Government revoked the conviction several weeks later and she was released from prison.

Thunderbolt must have recovered from his back injury by now, as he committed more robberies during 1866, and these escalated in frequency through to late November 1868. During these years, there were two periods of time when Thunderbolt had a new accomplice join him before they parted ways or were captured by the law.

However, Thunderbolt managed to make good his escape after each robbery. The robbery locations covered many areas in the headwaters of the Hunter Valley and would have taken him past the Timor Caves on a number of occasions as he crisscrossed the country to stay ahead of the law. The full chronological list of events is far too lengthy to list here and is not of relevance to this article. However, you may choose to read some of the excellent publications which detail his life and escapades.

On 25 May 1867, reward for the capture of Thunderbolt was raised to £200 (Sydney Morning Herald, 29 May 1867). This was increased to £400 on 24 December 1868 (New South Wales Government Gazette, 1868). From early December 1868, Thunderbolt was on his own - undertaking fewer robberies over a vast region between Uralla and the Queensland border. "On 25 May 1870 he was surprised while testing an inferior horse and was chased and shot by Constable Alexander Binney Walker at Kentucky Creek near Uralla" (Crittenden, 1976).



Fred Ward dead 1870

So what can be ascertained from the history books and reports to verify the authenticity of the "Fred Ward 1865" signature at Timor?

There is no record of Fred gaining a schooling, which is typical of children born to rural workers at the time. Upon being gaoled in 1856, Fred told the registrar he could not read or write, denoted as "R/W: No" in the description book (Maitland Gaol, 1856). However, in 1861, he said that he could read only (Darlinghurst Gaol, 1861). There was no reason for Fred to lie on either occasion. The two can be interchanged, meaning a small degree of reading but not enough to be functionally literate (Carol Baxter - personal correspondence).

If Fred crowned himself with the nickname "Captain Thunderbolt" in 1863 and used that name whenever he committed a robbery, why would he have written "Fred Ward 1865" on the cave wall? If he could not read or write, as he states on the 1856 prison records, then he may still have been able to write his own name as that is one thing children are taught at a young age. So maybe he could just write his name. There is also the possibility that Mary Ann taught Fred to write his name some time after they met in 1861. There is plenty of evidence that Mary Ann was competent in both reading and writing (Brouwer, 2002).

The possibility of locating Fred's signature on some document, such as a marriage certificate, was thoroughly investigated during the research for this article. On several occasions, Mary Ann claimed that she and Fred were married, but there is no evidence to support this (Oppenheimer, 1992; Baxter, 2011, and website 3).

Could Fred have been in the area during 1865? There are sketchy reports that Fred left Culgoa River (near Brenda) in mid December 1864, intent on stealing horses from Mr Reynold's station on the Paterson River in the Hunter Valley. If this is correct, then Fred could well have passed through Nundle, over Crawney Pass and on past the Timor Caves. What we do know is that Mary Ann (now pregnant with Fred's second child) was not with Fred during the period mid December to early January 1865. The documented trail of robberies between late January and early December 1865 indicate that Thunderbolt and his gangs didn't come south of Quirindi, so he is unlikely to have visited Timor in that period. But, on 22 February 1866, probably while taking Mary and the children from Culgoa down to the Gloucester District, Thunderbolt robbed a hut at Berrico near Gloucester.

Sometime in late February or early March 1866, Thunderbolt had a serious back injury that made it difficult for him to get around, let alone ride a horse. So it is unlikely that, in this period, he would have gone into the Timor Caves to write his signature. Bear in mind that it is now well past the end of 1865, which is the signature date. There is, however, the possibility that Fred had lost track of the year.

So, after exploring all available evidence, it is possible that Fred could write his name and may have been at Timor in early January 1865 or late December 1865 to January 1866, but we can't categorically say that the signature in Main Cave is authentic. However, we also can't disprove the authenticity of the signature.

Acknowledgement

Carol Baxter's comments and several research documents e mailed in personal correspondence were extremely helpful in compiling this article. Carol is the author of *Captain Thunderbolt and His Lady: the True Story of Bushrangers Fred Ward & Mary Ann Bugg*. Carol also has an excellent website with a huge amount of factual information relating to Thunderbolt. It can be accessed at <https://www.thunderboltbushranger.com.au/index.html>

A special thank you to Katerina Fulton for proof reading this article.

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19th International Symposium on Volcano-speleology

John Brush reports that the 19th International Symposium on Volcano-speleology in Catania (Sicily) is going ahead between Saturday 28 August and Friday 3 September. The organising committee have advised him that:

It took us longer than we had expected because we had to face problems we have never encountered before and consequently had to make difficult decisions, in accordance with civil and speleological institutions. In Italy the covid19 situation is now under control: the infection is decreasing rapidly because of the vaccine campaign (to this day, 10 million people had both shots, and 20 million more had their first shot out of a population of 59 million people). With the necessary precautions (negative test or green pass) it will soon be possible to return to travel from country to country, not only in Europe but also in the rest of the world.

Last March we considered making an online-only symposium, allowing you to follow it on your PC screen, but the dramatic improving of the situation has made it possible to meet in person in Catania in compliance with the safety conditions for both organizers and participants. This means we had to cut down on some of the activities of the original program and to change some of the locations. We tried to keep the most significant and qualifying commitments such as the geological tour, the car drive to Mt. Etna and the visit of some cavities, but we had to give up the excursion to the Aeolian Islands and the planned speleological Camp on the volcano fields which are too risky for the impossibility of maintaining social distancing.

Whilst only a prospect in our dreams for those of us in "drawbridge up" Australia, perhaps some of our overseas members might be attending and could report for a future Journal?

CENTENARY CAVE

Grant Gartrell

Just over half a century ago I went caving in Mullamullang (6N37) and wore out a brand-new pair of genuine leather army boots in a week, right through the soles. It is at last seeping into my consciousness that I couldn't do that these days. It is coming as a bit of a shock that I look at all the old guys around me and realise that I am one of them. It has been fun, and I am still having fun, but it is high time I ferreted around in the dark recesses of my mind and put some of it down on paper if I want any of my half-finished projects to be any further advanced before I have to hang those boots up altogether, or if I want the corporate memory to live on. How could that possibly happen? Don't let anybody kid you. Age is sneaky.

My father-in-law, Alf Humble, is one hundred and one years old. He was a flying instructor during WW2 and finally gave up flying 20 years ago, but he is actually older than the Royal Australian Air Force (RAAF), which had its own 100th birthday on 31 March this year. I found a new cave on 31 March, and named it "Centenary Cave" in recognition of the RAAF Centenary falling on the same date. I have a fair idea of what the cave should look like, but I have never seen it. I have never been in it, and don't even know precisely where the entrance is. Nevertheless I know a great deal about it, and by the end of this article, if you persevere, perhaps you will as well. If you have a good pair of secateurs and a crowbar, you might yet even be able to participate in the discovery.

I have never been in the Air Force either. But for almost two decades I was attached to the RAAF's Aircraft Research and Development Unit (ARDU) as a civilian Scientific Adviser to a succession of Commanding Officers who were each posted to the Unit for several years. We had test pilots, engineers, armaments experts, photographers, all sorts of specialists and support staff. It was a privilege to be working amongst such an outstanding group of people, and a wonderful experience.

It came back to bite me almost 25 years ago when I found myself in a somewhat adversarial position over the destruction of Sellicks Hill Quarry Cave. As cavers we wanted to save a spectacular cave which had been uncovered within a quarry, but both the quarry company and the Department of Mines really just wanted it to go away, and in an atmosphere of some secrecy, blew it up. Instead of their problem going away, that action unleashed a whirlwind of community outrage that did everything except bring the cave back. During a reasonably emotional TV interview I went to air on Channel 7 describing the actions of the senior management of Southern Quarries as those of a bunch of cowboys, and suddenly found myself in receipt of a threatening letter from the SQ lawyers. Channel 7 received a separate letter for broadcasting the interview. When asked, I confirmed to Channel 7 that the term cowboys was the most accurate I could think of at the time. Pleasingly the station's lawyers were prepared to support my contention at which point Southern Quarries threw in their hand in that particular poker game. But they couldn't resist one more little jab, and accused me of working in "weapons of mass destruction". This phrase was popular at the time and applied by US President George W. Bush and others to those he

called the "axis of evil" during the Iraq War. However, this accusation was levelled against me by Southern Quarries because of my association with the RAAF, and thus became an unwarranted slur against a section of the Australian Armed Services who were constitutionally and honourably engaged in the sovereign defence of our nation. Despite all this I quite liked a couple of the people from Southern Quarries, and believe that at least their initial intentions were sincere and enlightened. We did get on well there for a while. Like divorcees who were once happily married, I still regret that our positive relationship with them got derailed.

Why am I telling you this apart from the fact that at the time it kept me awake for months on end? Principally because of the obvious contrast between those days and the story that follows, about Centenary Cave. We will probably, and hopefully, never see those days again.

REMOTE DETECTION

Remote detection has particular application in geographically challenging circumstances. Back in the early 1960s, long before we could rely on GPS devices, a significant number of major Nullarbor Caves were first discovered at the Australian National University in Canberra, by geomorphologist the late Professor Joe Jennings poring systematically over aerial photographs. Mullamullang Cave was one such cave discovered remotely by Joe, and the primary purpose of the 1963-64 Nullarbor Expedition led by Ted Anderson was to go and check it out. Due to a prior commitment I was unable to participate in that particular adventure, but found myself out there 2 years later as one of the organisers of the 1965-66 follow-up expedition.

Joe was a much loved and revered member of the Australian caving community and an outstanding contributor to our knowledge base. He set a standard for finding caves remotely that might be hard to beat, but is well worth following. It is still used routinely on the Nullarbor, and more recently on Kangaroo Island, and now even has application for Centenary Cave.

I have just re-read the obituary for Joe written by D Walker, accessible from Google. I recommend it highly. Joe died relatively young while skiing in the Snowy Mountains near Eucumbene back in 1984. He was born in 1916 on the 29th of June, and if still currently alive would be 105 years old. While well short of that age myself, I have become old enough to be aware of how fast time flies, and just how much accumulated knowledge will depart with me down the plug-hole when my own time runs out. Few will appreciate just what is valuable about half the irreplaceable junk in my shed, let alone in my brain. Accordingly, I have become increasingly aware of the need to try to transfer not only some of that knowledge, but even more particularly my enthusiasm for its significance, to younger generations of cavers and cave managers, and even, if possible, to the community at large. It is still far too easy for our broader community to make poor decisions based upon a lack of awareness of our karst heritage, and even if I am starting to puff a bit harder and wonder how many heartbeats or Saturday nights I have left, I would really

like to change that situation. And so, obviously, would many cave people around the world, who have taken the opportunity, for that very reason, and others, to get behind the wonderful initiative of the International Year of Caves and Karst.

THE INTERNATIONAL YEAR OF CAVES AND KARST

The default position for caves has for far too long been out of sight and out of mind. The year 2021 is being recognised around the world by the UIS (International Union of Speleology) as the International Year of Caves and Karst (For information see IYCK2021.org). I suggested in a letter to the Premier of South Australia, the Honourable Steven Marshall MP, dated 28 January 2021, that this would be a wonderful opportunity for South Australia to participate in, and celebrate this occasion, by recognizing, and taking the initial steps towards recovery of access to a couple of significant cave systems, one of which formed initially within what is now the Reservoir precinct at Myponga.

My enquiry was forwarded from the Premier's office to the Honourable David Speirs MP, Minister for Environment and Water, to respond on the Premier's behalf, and Minister Speirs' positive response (4 March 2021) has opened the way for discussions with SA Water staff whom I have also found to be interested, positive and supportive. I met with the Myponga Supervisor on the morning of Wednesday April 7, 2021. Since he has been Supervisor for a decade, and the events that I raised with him happened over 60 years ago, it would not have surprised me if he were to be somewhat surprised himself at what I had to say to him. Instead, he surprised me at just how quickly he picked up exactly on what I was saying, and how much his own observations over time had keyed in with mine in a complementary fashion. I am very fortunate indeed that he is the person to whom I have been directed, and feel more encouraged to hope for and even expect a successful outcome to the project as a consequence, even if the way forward is not as obstacle free as I would like it to be.

Although nobody has ever extensively explored a significant cave system at Myponga, please accept for the moment that there is plenty of evidence for its continued existence. One of the principal features of caves such as this that seems to be least understood by the community at large, apparently including some mining engineers, who you would imagine should know better, is that they are generated as integrated drainage systems in the same way that valleys of erosional origin are formed. The difference is that karst caves are principally created by the accumulated impact of solutional processes over similar timescales, although erosional processes may also make an impact.

An important point to understand at the outset is that, just as for valleys, caves must form when the conditions are right. That is to say, when the factors that cause them all align, there is no choice in the matter. They are not optional, any more than the outcome of the force of gravity or other laws of physics is optional.

In my experience, one of the more difficult concepts to grasp in regard to the formation of caves is our appreciation of the impact of the passage of time. We are on earth for such a short time ourselves that we learn to simply accept the current landforms as we find them, to perceive them as static. We know that hills green up in winter and dry off in summer, but we generally don't perceive valleys deepening, nor, until recently, significant climate change, in our lifetime.

The Precambrian Brighton Limestone in which the cave

has formed is some of the oldest limestone on Earth. Limestones are composed of the calcium carbonate based skeletal remains of living creatures, and Precambrian limestones are based on the very earliest of such lifeforms that ever existed. They were laid down on a sea floor approximately 600 million years ago, while Australia was part of the Gondwana supercontinent, and much has happened to that sea floor since then. It was tipped up on edge during a major mountain building period known as the Delamerian Orogeny from 520 to 490 million years ago, and has survived until the present through a long sequence of equally impressive changes such as the relatively recent separation of Australia from Antarctica, naturally accompanied by substantial variations in climate. It is not yet known just when, over this period, the cave first started to form. There is a reasonable expectation that this may have been a very long time ago, and that evidence of some of this ancient geological history may still be preserved within the cave. If so, and there is an opportunity in the future for scientists to have a close look at this cave, some fascinating insights into our geological pre-history may be revealed.

I learned from the Supervisor, who has been doing his own research into the history of the area, that prior to the construction of the reservoir, there was, naturally enough, a creek along the bottom of the broad Lovely Valley. Downstream, the creek is impressive enough as it passes through a series of steep gorges to deserve the title of the Myponga River. In the upper reaches where it passed through the Oldfield's grazing property, it was a good creek with a deep swimming hole. When I told him about Reg Oldfield smoking foxes out of holes on the headland jutting out into the Reservoir just to the east of the dam wall, he asked me how much further to the east of that point the limestone outcropped, and then made the association that the swimming hole was located in close proximity to that point. Quite possibly, drainage through the limestone may have helped to maintain the depth of the swimming hole.

Accepting that the cave does exist, then like any other cave it represents a significant asset for the state, that can, if managed appropriately, be held in perpetuity. It is very much in our interests that any project which might impact upon it includes an adequate environmental impact assessment, not only in the interests of protecting, or at least including in the equation, the true asset value of the cave, but, as was highlighted particularly vividly in this case, in assessing the viability of the engineering project itself.

From bitter experience, I have to point out something that I wish was far more obvious. Being an excellent engineer, or a really competent bull-dozer operator, doesn't automatically qualify a person as an expert on karst values, any more than it would qualify that person to carry out brain surgery. Cave exploration and assessment can often be a slow and careful process, and necessarily of long duration. Our fossil cave discovery back in 1969 at Naracoorte happened after the cave in which it was made had already been open to the public for 75 years. As it is now World Heritage listed, it attracts a range of visitors from all over the world to South Australia, or at least will again be so doing once tourism recovers in the post pandemic era. Incredible discoveries are being made right now under the Nullarbor in caves that have been known for decades. Extremely important evidence of the earth's early history may be lost when newly unearthed caves are not given the benefit of sufficiently expert assessment prior to decisions being made by inadequately qualified people about their intrinsic asset value to the state.

The second aspect of poor decision making, as will become clear below, is that when we don't properly take into account the consequences of karst development, we do so at our peril.

CONSTRUCTION OF THE MYPONGA RESERVOIR

South Australia has had its outstanding successes, as well as episodes which could have been handled better. One of the latter occurred about 60 years ago and was associated with the construction of the Myponga Reservoir. A substantial cave system that would have, and should have, been predicted by more comprehensive and karst aware environmental impact assessment processes, was instead unexpectedly encountered during dam construction. This was first mentioned in a short report I made in the Cave Exploration Group of South Australia's CEGSA News No 178, published in May 2000, which included a report from former CEGSA Member, the late Len Dallow, who was employed at Myponga as a Technical Assistant for the Engineering and Water Supply Department during the construction of the dam.

Construction of the concrete dam wall and spillway for the Myponga Dam commenced late in 1957. As



Myponga Dam Under Construction and in Flood September 1960

would be expected for a project of this expense and magnitude, geological expertise was sought from the SA Department of Mines in regard to the suitability of the limestone and slate bedrock to take the footings for the dam wall. Unfortunately the advice received was far from accurate because the Mines Department geologist(s) involved were clearly not up to speed on karst processes. One could perhaps in mitigation offer the defence that not many people at that time were well versed in karst processes, or karst values, but that would be no excuse today. The advice was that while some minor cracks could be expected in the bedrock, and therefore some minor grouting would need to be undertaken, the location was suitable for construction of the proposed dam. It was therefore a big surprise to find that when the dam wall was almost completed, after the expenditure of £1,100,000 (in today's money, about \$37,000,000), the dam would not hold water. While the Mines Department's assessment of the rock was quite reasonable in general terms, they had failed to take into account the capacity of the pre-Cambrian limestone to develop over millennia significant karst drainage features, and its relationship with the topography of the former Lovely Valley was such that that karst drainage commenced a short distance upstream of the dam wall and ran directly underneath it.

The situation was so serious that even at that late stage, the project was within a gnat's whisker of being abandoned, because while more extensive grouting might be possible success was not guaranteed and the magnitude of the increase in unexpected extra expense possibly somewhat exponential. Eventually the extra work was carried out and the cost of the project increased, to the best of my knowledge, by around 350%. Most of the additional cost was attributed to the injection, under pressure, of a large amount of cement grout into several hundred 2 inch (50 mm) holes drilled up to 200 feet (60 m) deep to seal the network of cavities.

What has not been mentioned, up until now, is that, apart from Len's report of a Mines Department geologist climbing into a chamber of the cave uncovered during excavation of the earthworks for the concrete spillway; breaking off a stalactite; and observing at least a 20 metre deep shaft going down, there was never any serious assessment of the extent or heritage qualities of the cave system, other than an attempt to gauge the extent of the cave by pumping a large quantity of water into it.

Even if undiscovered and at the time unappreciated, the cave system must have been a significant asset for the State of South Australia, just as the Naracoorte caves are today, and therefore an asset the value of which should have been factored into the total cost of the project. To do this should be a basic part of the environmental impact assessment process prior to undertaking the project, and if the Department of Energy and Mining does not have the expertise, then it should be, and perhaps these days would be, obliged to seek it out. One of the basic difficulties in any scientific investigation of this sort is the old conundrum of not knowing what it is that you don't know, which is why it is particularly important to carefully prescribe well ahead of the need arising the expertise that should be engaged to carry out such assessments.

But of course, that is not the end of the matter either. The configuration of the bedrock in the area is such that the Brighton limestone is nominally a hundred or so metres thick, steeply dipping and constrained between beds of far less soluble rock. It is quite clear that the section of cave into which the grout was injected was by any measure a very small part of the full extent of the cave system, which would of necessity extend for pretty much the full length of the Brighton limestone bedding until it has an opportunity for the water draining through it to reach the sea. Further to that, it would appear that the bedding has lain in approximately the present orientation, with the complication of continuing adjustment of various fault lines, since the Delamerian Orogeny, and would have adjusted appropriately to substantial sea level changes over that time. A large quantity of water containing concentrated fluorescein colouring was pumped into the cave when it was first located. While none of this water appeared in the valley downstream of the dam, fishermen reported the sea turning green several kilometres from the coast several days later.

Even though expert cavers were not called in to determine the extent of the intersected cavity, much can be inferred by analysing the grout injection. If we begin by considering a cave with tunnels nominally 2m in width and 3m in height, then 24,000 cubic metres of grout would occupy a total tunnel length of 4km. Even if the cave had four such tunnels in parallel under the dam wall, they would all have to be blocked for 1 km to take all the grout. This is clearly a most unlikely scenario, so we come back quite quickly to considering a larger tunnel, possibly 10m wide and 20m high, which would perhaps fill from floor to ceiling for

80m and then taper down to floor level over a further 80m at quite a low angle of repose. This model seems a far more likely scenario for an extremely substantial grout plug, for reasons which will become clearer later when we consider in more detail the physical properties and logistics of injecting the grout. At the same time it infers that a further 5 to 10km of limestone bedding downstream will still include potentially accessible cave of similar dimensions, perhaps with larger chambers interspersed with constrictions and more rapid drops in floor level as seems to be the situation in most caves in similar circumstances. Such a cave must clearly have existed. Despite the events that have happened to it so far, including blockage of an upstream section by grout, and the associated diversion away from it of what would in the past have been significant underground stream flows, over 95% of it should still be intact.

FURTHER CONSIDERATION OF THE GROUTING OPERATION

Although only a small section of the cave was entered when cavities were broken into during construction of the dam spillway, in totality, even at this stage we know a surprising amount about it.

We know that when 36,000 cubic metres of water was pumped into it over a 12 hour period, the cave showed no indication that acceptance of this water was being limited by the capacity of the cavity. The reports from fishermen of the sea turning green several miles out from Myponga Beach were a clear indication that water must have flowed quite freely for a long distance through the cave, which therefore had to be reasonably accessible over that entire distance.

Although we have not been able to access detailed records of the grouting program, anecdotal accounts when combined with a basic understanding of the properties of cement grout, tell us a great deal more about the dimensions of the main cavities under the dam wall, and consequently, because of the inherent purpose of the cave as a karst drainage system within the limestone bedding, also tell us that such dimensions can be expected to be indicative of the rest of the cave between Lovely Valley and the efflux of the cave now below current sea level.

The grouting program was carried out by drilling a curtain of 2 inch (50 mm) diameter holes 200 feet (60 m) deep close to the base of the dam wall. Each hole had a cross-sectional area of about 20 square centimetres, and a total volume of approximately 0.12 cubic metres. If no cavities had been intersected, that volume would represent the total amount of grout able to be injected into each hole.

However, it was reported by Len Dallow that many holes took as much as 4000 bags of cement, a volume of 120 cubic metres, and in some instances a second hole drilled only 12 inches (30 cm) away, would take a similar amount of grout. It is understood that about 200 such holes were drilled, taking around 800,000 x 40kg bags of cement, making 24,000 cubic metres in total.

One might imagine the grout flowing for large distances, but a basic property of the grout is that once the cement is mixed with water, the mixture has a lifetime of 1 hour or less before a chemical change causes it to set. It is also clear that although it may be pumped into the initial bore-hole under pressure, in the majority of instances where it escapes from that bore-hole into a larger intersected cavity, it spreads out under much reduced pressure from the injection point, forming a cone with a natural angle of repose of about 20 to 25 degrees. Once

that cone rises up to block the drill hole, it may limit the ability to pump further grout down the hole. Most holes stopped taking grout after accepting 4000 bags, but some blocked after a lesser quantity. Given that it would be logistically a very demanding job to mix and pump as much as 4000 bags into a hole over a period of an hour, this could be expected to impose a physical limit on the horizontal migration of the grout. My back of the envelope sums suggest this would require a 5 cubic metre concrete mixing truck to be backed into place, dump out a full load into a pump, and get out of the way to make room for the next truck all within a period of 2 minutes. You can take longer if you don't mind the early loads setting before the last portions of the 4000 bag batch are being pumped. That process would simply tend to result in much steeper angles of repose and therefore more compact grout plugs on average which would further limit the horizontal spread of the grout. This should not be an issue for the overall effectiveness of the grouting program, but would further support the notion that the grout curtain would tend to be confined to the more immediate vicinity of the dam wall, and almost certainly within 100 metres of it.



Myponga Dam Finally Filling September 1962

WHAT REMAINS AND THE IYCK

What we have demonstrated so far is that despite the injection of a considerable quantity of grout into the cave, over 95% of the downstream section of the cave should remain basically in pristine condition, and therefore an important asset for South Australian, and perhaps even global, science and tourism. Access to this cave system in the Myponga area would be consistent with the recent very positive moves towards community access for recreational purposes to the Myponga Reservoir Site and would be a most fitting way in which the South Australian Government, which has been showing a generally very positive approach to environmental matters, could extend this to recognition of the state's valuable karst heritage as a symbolic contribution to the International Year of Caves and Karst, and of course deservedly enjoy the resultant positive publicity which would arise.

ACCESSING THE CAVE – THE THEORY

Apart from Mr Reg Oldfield employing smoke to drive foxes out of a network of cavities, there had been no known investigation of the limestone for caves prior to the dam being built.

As events subsequently transpired, this was a serious oversight, but perhaps we need to reflect that the world was a different place back in those days, and that karst

science was nowhere near as well developed as it is today. People certainly explored caves well before that time, as evidenced by the historical writings of the Rev Julian Tenison-Woods in the mid-1800s. But the Cave Exploration Group of South Australia, with its history of compiling a record of cave data for South Australia in association with the South Australian Museum, first came into existence in 1955, only a couple of years before construction of the Myponga Dam started.

So while we may need to cut our forebears a little slack in this matter, there is no excuse for us not to make the best of the situation in terms of our modern understanding of karst processes, and do our very best to access what remains a significant state asset, the existence of which may never have been confirmed but for this fascinating story.

While we have been greatly assisted by the above analysis to arrive at the firm knowledge that such a significant and substantial cave must exist, we have yet to gain access to it.

Fortunately, there is yet another property of massive limestone which may help us in this regard. The limestone will include a natural network of joint cracks, some of which will be more successful than others at providing pathways for groundwater to access the cave.

While the main channels in the cave started somewhere in Lovely Valley, and are now blocked by the engineering works, other secondary channels will undoubtedly exist that may or may not be immediately accessible to cavers, but which would offer opportunities for exploration/ perhaps enlargement/ following drainage pathways, to gain access to the cave.

Our approach to the Premier was to seek permission in the first instance to enter restricted areas so that we could conduct a thorough investigation of the limestone and valley(s) downstream of the reservoir wall with a view to possibly locating one or more locations downstream for access to the remainder of this cave.

Some of this work may fortunately already have been done for us. Thanks to the amazing capabilities of the publicly available computer program "Google Earth", combined with the historical geological mapping of the Department of Energy & Mining, it is possible to

superimpose an image of the geological strata over an image of the surface features of the land, and use this to identify the best places to look for such possible access points.

The latest aerial imagery used in Google Earth suitable for this purpose at Myponga was photographed on March 23, 2020. The special attribute of this particular time of the year, almost exactly one year before carrying out this investigation, is that it was at the end of a particularly hot and frankly quite dreadful summer, including a number of extreme heat events which made bushfires in the Adelaide Hills and especially on the western end of Kangaroo Island so devastating.

What that same weather did to the landscape west of the Myponga Dam wall was to severely dry off the hillside vegetation leaving greenery confined to areas with any remnant water such as the bottom of valleys. This contrast between green and dry is particularly notable in the photography of the vegetation immediately adjacent the Myponga River in the steep gorge below and downstream from the dam wall, and even on two major bends in the river which are the only downstream places where the river valley itself intersects the limestone.

Progressing a short distance further to the west, the geological map shows the limestone beds breaking away from the river and starting to head in a more south-westerly direction. The limestone crosses a valley containing a tributary to the Myponga River flowing from



Google Earth View of Myponga River and Tributary with Green Vegetation.

south to north which joins the main river a little further to the west.

Even at the end of summer, that tributary valley also has green growth, along the bottom only, for only half a kilometre or so in total. The green growth ceases at the point at which the valley crosses the limestone, strongly suggesting that, particularly at times of low flow, the water flowing down the valley is completely captured by the limestone, and therefore follows a more vertical pathway down into the cave. This looks like a very good place to start investigating access. SA Water's Myponga Supervisor acknowledges that the green vegetation all year round in the bottom of this particular tributary may well be a consequence of leakage running down the hillside from a nest of settling ponds constructed on the top of the hill. These ponds are part of the filtration plant which was installed many years after the initial construction of the reservoir. They were designed and installed to dry out sludge regularly being removed by the filtering process. The sludge, once dried, is then trucked elsewhere, and the process rotated to the next in the series of ponds. There is no particular problem with a percentage of the water leaking from the ponds, as long as the sludge itself remains contained.

We can infer from this observation that without the leakage from the settling ponds the valley floor would be unlikely to be green at the end of summer. There would be no obvious indication of interception by the limestone of water flowing down the valley, and consequently much less chance of locating a suitable spot for accessing the underlying cave system. Thank you settling ponds, and thank you leakage.

It is important to note that this does not imply that the only water ever flowing down the valley is from the settling ponds. Clearly the valley has been shaped by largely erosional forces over most of its life, and even at the point at which it crosses the band of limestone, those erosional forces will still be present. However, additionally within the limestone there will have also been capture of water by joint cracks over an equally long period of time and enlargement of joint cracks by solution. There is therefore a reasonable chance of locating a significant solution feature at the point at which the creek floor vegetation changes back from green to brown, even if we have to dig for a while to get past a choke of rocks generated through erosion.

There is one other inference that we are able to draw from this observation. Below this particular entry point for water into the cave below, the cave itself must be open and accessible to the water entering at this point. If that were not the case, then instead the indicated shaft would not take all that long to fill with water, after which the water would then continue to flow further down the tributary, causing a continuation of the green vegetation down the rest of the valley.

Experience in many other caving areas, including Naracoorte and Sellicks Hill, tells us not only that a shaft is likely to exist at this location, but that the shaft will have been in existence for a considerable period of time, and even if partially blocked near the surface may have been sufficiently enlarged by the action of water to facilitate access. There is a reasonable expectation that we should, perhaps after digging, be able to locate at least a small opening in which it may be possible to detect airflows correlating with atmospheric pressure variation and perhaps even in this particular instance tidal fluctuations in Gulf St Vincent.

My favourite Naracoorte shaft story concerns a shallow blind sink that in my youth I once jokingly jumped vigorously up and down in, trying to create a new cave.

Fortunately nothing happened, but 6 weeks later, when we returned, there was no longer a blind sink, but instead a smooth, circular 20 metre open shaft. We will never know whether one more jump might have accelerated the process, and these days I have more sense than to repeat the experiment. In the interests of history, at the bottom of that shaft was a neat little dated signature written in pencil: "J.M 1908". JM was James Mason, one of the people who worked for William Reddan, the Naracoorte forester who was also caretaker of the caves. 1908 was coincidentally the year in which William Reddan discovered the Alexandra show cave.

Near vertical caves, starting off with holes barely big enough to put a hand in, have been located and investigated at Sellicks Hill over the last half century. Two of these have now been descended to depths of 70 metres, and are expected to go much deeper, following quite substantial airflows. They tend to access larger cavities the deeper they go.

While there may be other shafts to be located at Myponga, successfully accessing the cave through any one of the shafts would enable experienced cavers to conduct systematic exploration of the system and produce a detailed survey as well as a photographic record. All of this would contribute to a better appreciation of the eventual opportunities for science and tourism, as well as possibly identifying other potential access locations for what is expected to be a very extensive and reasonably complex cave system.

ACCESSING THE CAVE – THE PRACTICE

One would expect that on the basis of the information already revealed it would be a simple matter to go to the spot marked "X" on the map and find the entrance waiting for us with a neat little sign saying "This Way, Please".

It hasn't yet worked out that way, for several reasons. The first is that the hills are steep enough to fall off. Local advice is that while they are barely negotiable in the dry weather, when the grass is dry and slippery, then the wet months will be even more difficult. Early trips involving digging equipment, and if successful, later trips involving caving equipment, will require it to be carried in. so we will at the very least have to set up a couple of solid belay points, and use ropes to go up and down the hillside

The second problem is that close inspection shows the green vegetation along the bottom of the valley to be "wall



Blackberries

to wall" blackberry. We expect we will have to lug a brush cutter or two in there. Murphy's Law tells us the stream sink will be in the middle of the densest stand of blackberry.

There have been several brief visits to the area over the past month or so, and I particularly wish to acknowledge the assistance provided by the relatively young and fit Frank Hankinson and Neville Skinner in worrying about my old bones climbing down and up the hill. But I am disappointed that neither has been willing to plunge headlong into the thickest part of the blackberries at this stage. With that sort of attitude, how are we ever going to find the entrance?



Neville and Frank checking out Holes



Searching for a Stream Sink

The third problem is that while the upper reaches of the blackberry gulch start off on SA Water land, below their silt settling ponds, further downstream where the gulch intersects the limestone, it has at that point wandered away from the government land and into the neighbour's place. Luckily, our discussions with him have also been positive.

And of course, there is a fourth problem, which relates back to the first two. Climbing down a shaft that descends directly from a creek-bed is just asking for cloud bursts to appear out of blue skies and initiate the occasional flash flood.

That's enough problems to solve for the present. Should the siren call of this particular projected entrance remain elusive, there are a couple of other encouraging places to look.

SUMMARY

To summarize, what has happened in the past is in the past, and the purpose of this exercise is not to lay blame for what, clearly in hindsight, could have been handled better. Of course, it is nevertheless important that we learn from past shortcomings if we wish to avoid repeating them in the future.

My only regret, even at this early stage, is directed more at myself than anyone else. I wish to some extent that I could have started pushing this "barrow" a long time ago, so that I could have some chance, before I get too old, of seeing some spectacular outcomes for what will inevitably turn into a lengthy project. On the other hand, the time is clearly right in many other ways. Without construction of the reservoir the filtration plant would not have come to pass. Without the filtration plant, the settling ponds would not have come to pass. Without the settling ponds, the valley floor would not have stayed green over summer, and without the implications of the limits to that green indicator, we would not be aware that water sinks where the valley intersects the limestone, even if we have yet to find the exact spot at which it does.

Despite my own concerns about the passage of time, thanks to the forward thinking attitude of the current South Australian Government and its recently adopted policy of opening up the Myponga Reservoir for carefully managed community recreation, the timing could not be better for initiating a project to gain access to a major cave system that was briefly revealed by construction of the dam over 60 years ago.

It would be a wonderful outcome if we could, to the degree possible, restore one of South Australia's significant natural assets and realise its potential as a future tourism drawcard for the Fleurieu Peninsula in particular and South Australia in general. It would be even more positive for South Australia if this activity could be presented to the world as a land-mark gesture of the South Australian Government in recognition of the International Year of Caves and Karst.

