ACKMA Inc.
Australasian Cave and Karst Management Association Inc.

Journal of the Australasian Cave & Karst Management Association

No. 129, December 2022

ISSN 2652-3957 (online)- Published Quarterly

The ACKMA Journal

Official Publication of the Australasian Cave and Karst Management Association Incorporated.

Published quarterly in March, June, September and December.

EDITOR: Kirsty Dixon

ACKMA Inc is cross-affiliated or otherwise associated with:
American Cave Conservation Association,
Australasian Bat Society,
Australian Speleological Federation,
Bat Conservation International,
Cave Diving Association of Australia,
Guiding Organisations Australia,
International Show Caves Association,
Jenolan Caves Historical & Preservation Society,
Korean Cave Research Institute
Malaysian Karst Society,
New Zealand Speleological Society,
Savannah Guides Ltd,
USA National Caves Association,
USA National Speleological Society Cave Conservation and Management Section,
WCPA Working Group on Cave and Karst Protection

LIFE MEMBERS of ACKMA Inc
Steve Bourne*, John Brush*,
Michael Chalker*, Peter Chandler*, Brian Clark*,
Grant Gartrell*, Kent Henderson*, Greg Martin*,
Tim Moore*, Dave Smith*, Andy Spate*,
Dianne Vavryn*, Rauleigh Webb*, Kevan Wilde*,
David Williams*.
Deceased: Alan Costigan*, Elery Hamilton-Smith*,
Ernst Holland*, Chester Shaw*, Roy Skinner*,
Clyde Stiff*,
*(*Previously elected as Fellows)*

FELLOWS of ACKMA Inc
John Ash, Peter Bell, John Brush, Dale Calnin,
Deborah Carden, Arthur Clarke, Ian Houshold,
Julia James, Neil Kell, Kevin Kiernan, Lana Little,
Robyn McBeath, Cathie Plowman,
Dennis Rebbechi, Barry Richard,
John Watson, Nicholas White,
Anne Wood, David Gillieson, Andy Baker.

ACKMA PRESIDENTS
Ernst Holland 1987-91, Andy Spate 1991-95,
Michael Chalker 1995-97, Greg Martin 1997-99,
Brian Clark 1999-2001, Peter Dimond 2001-02,
Peter Chandler 2002 -03, Robyn McBeath 2003-05,
Steve Bourne 2005-11, Peter Chandler 2011-13,
Dan Cove 2013-16, Dale Calnin 2016-2018,
Andy Spate 2018-2020, Ian Eddison 2020-

FRONT COVER: Gypsum chandeliers up to six meters long. Photo: Robbie Shone. Note the figure in the background

BACK COVER: Delicate formations grading from calcite popcorn at their base into aragonite needles at the tips. Photo: Max Wisshak

Both cover photos are from the book 'Lechuguilla Cave: Discoveries in a Hidden Splendor', reviewed on pages 22-24. Used with author's permission

ACKMA Inc OFFICE BEARERS 2022-2023

President – Ian Eddison
Email: president@ackma.org

Australian Vice President – Scott Melton
Email: aus.vice.president@ackma.org

New Zealand Vice President – Neil Collinson
Email: nz.vice.president@ackma.org

Executive Officer – Cathie Plowman
Email: executive.officer@ackma.org

Treasurer – Regina Roach
Email: treasurer@ackma.org

Membership Officer – Rauleigh Webb
Email: membership.officer@ackma.org

Secretary – Steve Bourne
Email: secretary@ackma.org

Publications Officer – Kirsty Dixon
Email: publications@ackma.org

International Relations Officer – Andy Spate
Email: international.relations@ackma.org

Webmaster – Rauleigh Webb
Email: webmaster@ackma.org

Committee Member 1 – Shannon Corkill
Email: CommitteeMember1@ackma.org

Committee Member 2 – Dave Gillieson
Email: CommitteeMember2@ackma.org

Committee Member 3 – Liz Reed
Email: CommitteeMember3@ackma.org

To send an email to all committee members:
Email: committee@ackma.org

Conference Convenor
Email: conferenceconvenor@ackma.org

Ann Augusteyn Award
Email: AnnAugusteynAward@ackma.org

IN THIS ISSUE

We recognise the traditional people of the lands of all our members and editorial contributors.

ACKMA acknowledges the Traditional Owners of the land on which we meet and work, and all Traditional Owners of country throughout Australia. We recognise Aboriginal and Torres Strait Islander peoples' continuing connection to land, place, waters, and community. We pay our respects to their cultures, country, and elders past present and emerging.

ACKMA recognises the unique role of Māori as Tangata Whenua and embraces Te Tiriti o Waitangi recognising Māori as tino rangatiratanga of Aotearoa/New Zealand while embracing the three guiding principles of the Treaty – Partnership, Participation, and Protection. We will endeavour to implement bicultural policies and practices that incorporate and value Māori cultural concepts, values, and practices.

Editorial

Kirsty Dixon

Greetings fellow ACKMAites,

I hope this finds you hale and hearty and ready to enjoy whatever festivities you celebrate at this time of year!

Welcome to a bumper end-of-year edition of the ACKMA Journal – many thanks to all those contributors who made this such an impressive issue!

I was intending to make the focus of this journal on New Zealand, to whet our appetites for the upcoming conference, but due to a variety of issues this has not eventuated. However fortuitously I did receive several very interesting articles with a Nullarbor focus, and due to the contentious issues of development there at present, this is probably very timely.

We also have the announcement of the 2023 Cave Animal of the Year – which will fit in very well with our conference location.

The good news story with an NZ focus is the purchase of the land at Takaka with the entrance to the Greenlink Cave System. This is very near our 2023 conference location, and we are hoping to be able to organise a visit. ACKMA was able to contribute to this purchase, so you can claim credit for this one!

There are a couple of new cave books that are reviewed, and both look stunning. Garry Smith has also found time to contribute a fabulous travel article on the highest altitude show cave in France.

Andy Spate has provided a summary of the LED workshop given by Liz Reed, and you can view the workshop on the ACKMA website.

Congratulations to Professor Andy Baker who has just received a prestigious award from the Royal Society of NSW for his karst research, and to all those who have assisted him in these endeavours!

On behalf of the Committee, I want to send our best wishes for a speedy recovery to all those who are unwell or caring for them, especially Neil Collinson and Geoff Deer – our thoughts are with you.

This issue marks the unveiling of the Takaka 2023 logo – and it is a ripper! Many thanks to the student of the Takaka High School for their vision and enthusiasm.

Reminders to submit nominations for the Ann Augusteyn Award for excellence and outstanding contribution of an individual to cave and karst guiding and interpretation. I am sure many of you know people that could qualify for this, and it is important that we recognise these efforts!

Finally, there is copy of the 2023 Conference registration form at the back of the journal, as well as the information on accommodation options – so get busy and get booking!

Wishing all an enjoyable and safe festive season, and I look forward to receiving all your wonderful journal contributions next year!!!

Kind regards,

Kirsty

ACKMA Presidents Report

Ian Eddison

Dear ACKMA members,

As the 2022 calendar year comes to a close, I can report to you that your committee have been very active. We met online in October and November. Several other meetings have been attended by members of the committee to remain aware of and contribute to major developments as outlined in this report.

There are new COVID variants evolving and rising in our societies. We all still need to be careful and minimise risk.

Our cave tourism sites have been busy with school excursions and are recruiting and training staff for the next holiday period.

The International Year of Caves and Karst is now ending. This was extended to a two-year event 2021 – 2022 with many international events being unable to occur because of the pandemic. The theme: explore, understand, and protect, has been reflective of what we do in all our natural and developed cave and karst areas. I trust you all participated in or observed online through the International Year of Caves and Karst website the various projects globally as well as added interpretation of this through your own communications and events.

The ACKMA Website and email server is in a better position after a long and challenging resurrection by Webmaster Rauleigh Webb. Thank you Rauleigh.

The engineering projects at cave sites continue as a response to previous bushfires, floods and landslips continue across Australia and New Zealand.

Wombeyan Caves projects are underway. Abercrombie Caves are dealing with a new landslip on their entrance road. Jenolan Caves are struggling with road access but do hope to open for Christmas holidays. Buchan Caves continue with their redevelopment projects.

There are Green Energy Issues at Arrowsmith WA and Nullarbor WA – ASF liaison continues. ACKMA is supportive of the green energy developments, but we need to remain vigilant and constructively help prevent issues conflicting around caves and karst with these developments.

The Western Australia Government last year announced in July 2021 a proposed major green hydrogen project on WA's remote south-eastern coast at Eucla. Some of your committee have attended various meetings online and continue to work towards the protection of the caves and karst under threat due to the size and scale of the project. The consortium behind the project, dubbed the Western Green Energy Hub, is made up of InterContinental Energy, CWP Global and Mirning Green Energy Limited. Rather than impacting the environment under the guise of the development of 'Green Energy', ACKMA and the ASF feel there is much to be said about the national and world heritage values of the region and it requires protection.

It gives me great pleasure to announce ACKMA has contributed to the 'Greenlink' land purchase at Takaka NZ. See a report later in the Journal. This is a NZSS project to secure an important catchment in this area of New Zealand. A $10,000 NZ commitment by ACKMA has been made. You will hear more on this from our New Zealand members, and it is part of our base region in our conference in 2023.

Kirsty had hoped that this journal issue would be devoted to New Zealand as we gear up for our May 2023 ACKMA conference at Nelson and Takaka. However, not much information reached our Editor. You are urged to plan to attend this wonderful site in the South Island of New Zealand. We do plan to have an online component however there are significant band width issues and online components may be a great challenge. You do need to see the area if you can make it. From our past experience, Anita and I recommend this area to you and encourage you to consider a New Zealand holiday around the conference.

I wish you and your families a lovely Christmas and New Year.

Ian Eddison

President

I pay my respects to the traditional custodians of the land where I live, work and engage in.

The Nullarbor – definitely not boring!

Andy Spate and Susan White

Reprinted, with permission from the Geological Society of Australia, *The Australian Geologist* 205, 36-37.

The Nullarbor Plain – the largest contiguous limestone outcrop in the world – is widely regarded as somewhere without interest to be driven across or by rail on the 'Trans' as quickly as possible by Australian travellers.

Au contraire, it is a fascinating place with so many geologic, geomorphic, and other scientific and cultural values.

Our discussion is restricted to the geology, but it would be remiss of us not to mention the First Nation's people art sites in caves and their manipulation of their environments with their engineering of water-filled rock-holes. There are also highly significant paleontological deposits with remains of megafauna and more recently extinct fauna such as the 'Tasmanian Tiger' and a significant cave-adapted invertebrate fauna. It is also the site for the majority of Australian meteorite discoveries.

The values outlined here demonstrate than the Nullarbor needs to be better known to Australians – not as an area to be crossed but as an asset.

World Heritage values and more

Image: Chowilla Landslip collapse doline, photo K. Dixon

In 1992 the Commonwealth Department of The Arts, Sport, The Environment and Territories commissioned a report from the University of Canberra to investigate the World Heritage values of the Nullarbor.

The report found that the Nullarbor met all four of the Natural Heritage criteria for World Heritage listing. Cultural heritage values may also meet World Heritage standards. Since the 1992 report there has been much ongoing research and documentation of the karst, sub-fossil and subterranean ecology values.

The Victorian Speleological Society (VSA) supported by other speleologists, has documented over 3,000 karst features across much of the 230,000 square kilometres of the Plain utilising ultralight aircraft. Over 7000 features are now documented. Such recent discoveries by speleologists have generated a complete rethink of cave development on the Nullarbor.

The Nullarbor Plain is one of the largest karst areas in the world. About 190,000 km² is underlain by limestone, making it Australia's largest karst region and one of the world's great karst areas. As such the Nullarbor should be better recognised in Australia for its significant landscape.

Platforms and cliffs

The Nullarbor is a west-side up/east-side down tilted carbonate platform of flat lying Eocene-Miocene cool-water carbonate calcarenites of the Eucla Group with three formations: Eocene Wilson Bluff Limestone, Late Oligocene- Early Miocene Abrakurrie Limestone and Middle Miocene Nullarbor Limestone. The tilting occurred in the Late-Miocene- Early Pliocene, resulting in the spectacular continuous cliff-lines of the Great Southern Scarp – the Baxter and Bunda cliffs and the Hampton Escarpment. A later uplift created the Roe and Israelite Coastal Plains that are covered with a thin Pliocene-Pleistocene carbonate sand.

Image: Wilson Bluff Limestone at the base of Bunda Cliffs, overlain by Nullarbor Limestone with modern calcrete on top, photo K. Dixon

The Nullarbor is not flat! It has a low rolling relief with an amplitude of between three to less than10 metres and a wavelength of several hundred metres. On at least one place on the Eyre Highway, we cross a prior stream valley relating to Australia's wetter past as we drifted north. Perhaps the most dramatic feature of the Nullarbor are the spectacular cliff lines displaying the elements of the Nullarbor's limestones. We have the Baxter Cliffs to the east and the Bunda Cliffs to the west – probably the longest unbroken cliff-line in the world with heights of up to 150 metres above the Southern Ocean. Between the sea cliffs we have the dramatic Hampton Escarpment overlooking the Quaternary Roe Plain – a result of sea level change.

Caves and blowholes

There are several deep caves often reaching to the water-table, and hundreds of shallow caves, blow holes and rock holes. The often water-filled deep caves are long and have collapse doline entrances are mainly within the Wilson Bluff Limestone and were probably imitated during the Oligocene. The two types of shallow caves; widespread vertical tubes or blowholes (<10m deep) with small passages, and fewer horizontal caves often containing dark coloured calcite speleothems.

The blowholes "breathe" spectacularly in response to changes in atmospheric pressure. A band of them is located along the Late Miocene shoreline across the Nullarbor and probably formed as flank margin caves in the zone of enhanced dissolution at the seaward margin of the freshwater lens along the limestone coastline. The entrances occurred from denudation due to the Late Miocene-Early Pliocene uplift.

Image: Nullarbor blowhole "breathing out", photo K. Dixon

Evidence of climate change

Evidence of uplift and sea level change is to be found in several places in the Eucla Basin and on the Nullarbor such as the Ooldea sand dunes and in the cutting of the Rae and Israelite Plains. There is also evidence of climate change as Australia drifted northwards after separation from Antarctica perhaps best demonstrated by the plethora of paleochannels to the north of the Nullarbor.

Additional evidence of climate change can be seen in the caves. Old black calcite speleothems, deposited in wetter times, are now being destroyed by halite wedging with an intervening period of gypsum deposition.

Andy Spate AM

Member, GSA Tasmania Geotourism Sub Committee
Member, Working Group Six, Australian Geoscience Council's National Geotourism Strategy

Dr Susan White OAM
GSA Victoria
Deputy Chair 2022-23

Chair Heritage Subcommittee

Cave Breezes – Physics for beginners

Grant Gartrell – Part One

One of my driving interests in caves is air flows, even those that may be almost imperceptible emanations coming out of holes barely big enough to put your hand in. For some Nullarbor caves, the airflows from a cave entrance can be strong enough to be heard 100 metres away. In such a cave there is a need to be careful climbing down a rope into the cave so that when you are down and get off the rope, it doesn't blow straight back up and out of the cave, leaving you stranded. They don't get names like Hurricane Hole for nothing.

Not all caves exhibit readily detectable breezes, or airflows. When they do, some cavers find them interesting, but from the comments made, it is apparent that even most cavers do not have a clear understanding of the basic physics behind cave breezes. Quite sophisticated mathematics is needed for the analysis of some of these phenomena, particularly where caves occur in porous, sometimes coralline limestones, yet it is perhaps surprising what can be learned from a barometer, a thermometer, and an anemometer, or failing those, a simple candle flame.

Breezes encountered at a constricted part of the cave may be an indicator of further sections of cave beyond, waiting to be explored. Can it be argued that enlarging such a restriction so that we can get through and continue exploration might degrade the cave? Would such enlargement adversely affect the cave micro-climate? Must it necessarily be a trade-off between what we have and what we might find? The answer lies quite squarely in the physics.

Big Holes and Little Holes

Air is a mixture of molecules, principally nitrogen and oxygen, in the gaseous state. It usually also includes some water vapour with much smaller amounts of carbon dioxide and other compounds such as methane, each with their own partial pressures contributing to the whole. The gaseous state is an energy state in which all gas molecules have sufficient temperature related kinetic energy to rush around unconfined by the relatively weak- intermolecular forces of attraction that bind liquids and solids together. They undergo elastic collisions frequently with other similarly inclined molecules, transferring energy which is collectively perceived as gas pressure as they do so, a three-dimensional free-for-all after the fashion of those linear racks of suspended steel balls on un-cluttered office desks that once kept idle executives amused for hours on end. Airflows are a consequence of mass migrations of such air molecules from regions of higher pressure to regions of lower pressure, which is what happens when you get a flat tyre.

Air flows travel through caves in response to barometric pressure change, which itself is transmitted at the speed of sound (about 340 metres per second at normal atmospheric pressure at sea-level) except in circumstances where the air itself may be passing through the interstices of porous rocks such as some Gambier and Nullarbor limestones. The determinant in this distinction is whether the scale of the spaces in the air-path is comparable with the mean free path of the air molecules (the average distance one air molecule travels before it collides with another air molecule). At sea-level and a nominal pressure of 1 atmosphere, this distance is about one ten thousandth of a millimetre. Where there is a detectable breeze the scale of the opening is already so much greater than this threshold that any moderate enlargement of the passage cross-section, we might wish to make to be able to follow such an air-flow will have minimal impact.

A feature of caves is that because of the relatively poor heat transmission characteristics of the rock in which the cave is situated, the large variations in temperature of outside air between night and day, summer and winter, are largely averaged out to a more constant mean internal temperature within a cave. Thus, we can generalise that Tasmanian caves tend to be cold, South Australian caves tend to be more temperate, and caves in the north of Australia warmer again. This variation does not alter the previous discussion about pressure gradients. Different systems simply reach equilibrium at the appropriate temperature for that location.

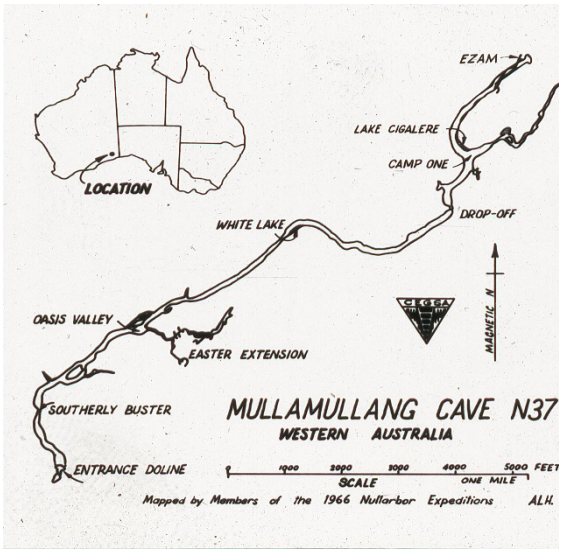


Figure 1 (right): Mullamullang Cave 1966, drawn by A.L. Hill

The classic comparison is demonstrated by large caves such as Mullamullang (Figure 1) on the Nullarbor, where airflows through the Southerly Buster, an easily accessible minor restriction in the main passage, not far from the cave entrance, have been regularly measured reaching in excess of 7.5 metres per second (about 28 km/hr – See Figure 2).

By far the larger volume of air accessed by this cave system lies within the porosity of the rock itself. Barely measurable airflows through the rock surface along the entire length of the cave collectively add up to a large volume of air that is clearly identifiable through significant phase lags to the cave breathing.

Incidentally, measurements show a stable variation of several degrees for the equilibrium temperature along the known approximately four-kilometre lateral extent of Mullamullang Cave, presumably imposed by an underlying geothermal influence.

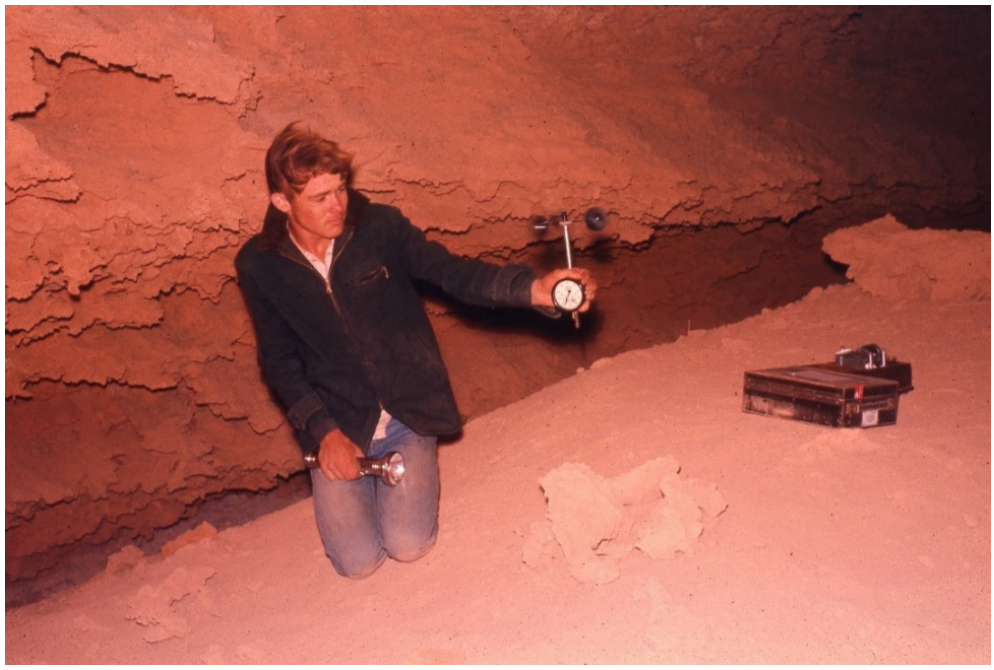


Figure 2: Measuring Southerly Buster airflow

Phase Lags

No, a phase lag is not an old gaol-bird indulging in a mind-altering substance. To explain what is meant by a phase lag a little more clearly, it should be noted that atmospheric pressure at the cave entrance varies both in response to diurnal tidal motions in the atmosphere and to the passage of longer-term weather systems as well. These phenomena drive quasi-periodic cyclic fluctuations of the pressure in the cave itself which may be simply read on a recording barograph or by taking periodic readings of a barometer. The externally imposed pressure variations themselves are the "forcing function" or the driving force for the system. The cave airflows are a measurable response to this forcing function and will also be quasi periodic. In the theoretical case of a cave with completely impermeable walls, only the volume of the cave passage itself can contribute to the airflows, which will thus respond instantaneously to the forcing function and therefore without any measurable lag between the maximum gradients of the pressure variation and the maximum speed of the airflow. In the case that the cave itself provides a conduit which permits a much larger volume of porous rock to "breathe", the result will be that the periodicities of the pressure change themselves take significant time to propagate away from the cave wall and into the rock itself. The airflows within the rock in turn will be driven by those changes as they are experienced and will also take time to propagate back out of the rock into the cave itself. The delays are measurable as time shifts, or phase lags, between the forcing function and the resultant flows, and depend on the system geometry.

Phase Lag Maths

Half a century ago (now Professor) Tom Wigley, joint editor and contributor to both the Cave Exploration Group of South Australia (CEGSA) Occasional Paper No.4, Mullamullang Cave Expeditions 1966, and the joint Sydney University Speleological Society (SUSS) and CEGSA publication, *Caves of the Nullarbor*, included in both those publications observations from the meteorological work in Mullamullang and other Nullarbor caves. At this time he also published in the *Journal of Geophysical Research,72*: 3199-3205 a more mathematical analysis of this work entitled: "Non-steady Flow through a Porous Medium and Cave Breathing" in which experimentally observed phase lags were matched with those from idealised models of caves for which theoretical lags were generated with the use of appropriate mathematical functions. That the outcome of this comparison was so good was a clear demonstration that the modelling was eminently satisfactory for the purpose, which in turn indicated that Tom's understanding and analysis of the mechanism generating the phase lags was accurate.

The Flat Tyre?

We now have enough information to revisit our counter intuitive perception of what happens when we enlarge an entrance, or an internal constriction in a cave. First, let us go back to our more familiar example of getting a flat tyre. When an inflated tyre gets a puncture it will go flat more slowly if the hole is very small, or more quickly if the hole is bigger. But then that is the end of the matter. We are all reasonably familiar with this concept, and probably have it in the back of our mind when considering air passing through a cave entrance.

Perhaps that is how we get the idea that if we make the entrance bigger, the air will rush out of (or into) the cave faster. But that concept is entirely wrong. The air doesn't rush out and stop. The cave doesn't go flat. As has already been made crystal clear by the physics and by observation, the cave wasn't initially inflated to a high pressure like a tyre. Its internal pressure remains to all intents exactly the same as the outside atmospheric pressure. It is that outside pressure which is continually changing, in response to the inevitable progression of weather systems and atmospheric tides.

That the cave keeps on breathing is because the internal pressure of the cave must continually adjust to keep pace with the changes in outside pressure. Because any hole from which we can detect a significant airflow is already so much larger in cross-section than the mean free path of air molecules, then all we would do by, for argument, doubling the cross-section of the hole, would be to make it possible for the same volume of air that previously passed through the hole in a unit time to still pass through the hole in that same amount of time, but at half the speed.

Other Effects

There are other effects that might have a bearing on the movement of air in or out of a cave entrance in some circumstances. Wind blowing across the cave entrance could possibly set up a Helmholtz resonator effect, a periodic low frequency oscillation of the air column within the cave somewhat akin to exciting vibrations in an organ pipe. Helmholtz resonance is more common with regularly shaped cavities such as empty bottles, and quite unlikely in the vast majority of irregularly shaped caves, which is probably why organ pipes are not shaped like caves.

A cave with multiple entrances at different altitudes could tend to have cool and therefore more dense cave air breathing out of a lower entrance and being replaced with air entering through a higher entrance during the warm part of the day, with the circulation reversing once the outside temperature falls below the internal cave temperature, late in the day or at night.

While such scenarios add complexity, the same basic principles still apply, and again where it might be appropriate for other reasons to consider enlarging a constriction in a cave, it may well be the case that as far as airflow is concerned the constriction is only a pseudo-constriction and its removal inconsequential in terms of cave atmospherics.

Water Vapour

Water can enter a cave in several ways. It might be in the form of an active stream, or perhaps as groundwater percolating. It could enter the cave as the humidity component of a flow of atmospheric air. Irrespective of by how many of these individual pathways it enters the cave, and the processes to which it may be contributing in the cave environment, all the forms of water available will contribute to the total partial pressure of the water component of the resultant cave atmosphere in accordance with pre-determined limitations. At any particular time, the activity of drip water might depend on rainfall events several months or even years prior, whereas some cave streams might flood almost instantaneously. Similar, sometimes seasonal, variability may apply to cave breathing. Fortunately, it is not necessary to consider in detail every combination of these variables in order to arrive at basic guidelines in regard to the effects of moderate enlargement of entrances.

In terms of the influence of changes or modifications to constrictions in air flow on the water vapour content we have already established that changes to pressure gradients consequential to reducing the impact of restrictions are generally minimal. Any reduction to the degree of such restrictions would tend to minimally reduce the ability, if any, of the restriction to alter the water content of the air passing through.

The particular physical property of water for which we need to give special consideration is that the water vapour carrying capacity of air reduces as the temperature of the air itself reduces. As outside air cools overnight, it is not uncommon in some regions for dew to start settling particularly on bushes and grass once the temperature falls below a certain value. That particular temperature is known as the dew point, and is the temperature at which the air becomes saturated and can hold no more moisture. When the air cools further below this point, some water vapour must condense out, depositing a layer of dew on cold surfaces. Often leaves which are themselves cooled by evaporative transpiration are colder than the ground itself, which tends to retain some residual warmth from earlier in the day. Water vapour thus cooling into dew will release a significant amount of energy, known as latent heat of vaporisation, when doing so. This mechanism is quite important in the vegetable garden, providing a temporary buffer against frost.

In a cave it is usually on a very much smaller scale and may not be perceptible at all. It is also a negative feedback mechanism, which reducing the impact of a constriction in the cave would minimally diminish. Generally if the water vapour in the cave air does not become saturated when it passes through such a constriction, it will remain not saturated if the degree of restriction is reduced, in which case there should be no perceptible effect whatsoever. Evaporation of any drip water entering the cave must raise the atmospheric humidity within the cave, as would the presence of a flowing stream.

In such circumstances the limit to increasing humidity will remain the same. Once saturation pressure is reached for a certain temperature, then no further increase in moisture holding capacity of the atmosphere is possible.

There is at least one chamber in the huge Mulu Clearwater Cave system which provides a connection between a large section of the upper cave and a major lower-level river passage both containing saturated air but at different temperatures. The quite rapid mixing of both sources of air in the linking chamber fills it with a continually replenished pool of supersaturated air from which some water vapour has to condense out, manifesting itself as a dense fog which turns an otherwise straightforward rock-pile chamber into a considerable challenge.

For alpine caves we should also consider the effects of yet another change of state for water turning from liquid to ice and releasing further latent heat. The same principles apply, but as the effects tend to be minimally diminished rather than exacerbated, if at all, by enlarging restrictions, that should be adequate consideration for the current discussion.

Since it would appear that the main worry people have about enlarging cave restrictions is that it might be responsible for caves drying out, it is very reassuring to establish that the physics does not back this up. Where there is evidence of caves drying out in recent times, we should not overlook the potential impact of other factors such as climate change or possible lowering of the local water-table consequential to the nearby establishment of extensive plantations of the notoriously thirsty Tasmanian Blue Gum.

The Old Homestead Cave, dry ever since I have known it, and located under the undoubtedly arid Nullarbor, could reasonably be described as an intermittently dry cave. As well as break-down chambers it contains extensive fields of maze-like tunnels and tubes of phreatic origin several metres in diameter, indicating that wetter periods in the past have played a major role in its development. This is a gentle reminder that we should not assume static weather conditions over the life of any cave. The evidence is clear that the reality has often been a succession of drier and wetter periods, ice ages and interglacials.

Some Examples of Nullarbor Cave Air Flows

While it takes only about 13 seconds for any pressure changes to be propagated from one end of Mullamullang to the other, it can take hours for those same changes to be propagated significant distances sideways into the surrounding rock. The same principles apply to cave breathing at Kelly Hill and Naracoorte, as well as caves occurring in any other limestones with significant porosity.

Because the scale of the constriction in Mullamullang at the Southerly Buster is many orders of magnitude greater than the mean free path of air molecules in the vicinity, the restriction to air flow is insignificant, and the pressure gradient through the Southerly Buster at any particular time is barely discernible from the pressure gradient over the entire length of the cave. At a reasonably normal rate of pressure change caused by the passage of weather systems and atmospheric tides, say about half an hectopascal per hour, the rate at which such changes would be transmitted would result in a total variation of the pressure from one end of the cave to the other of the order of 1 part in a million, considerably less than the resolution of many pressure recording devices, and insignificant in terms of environmental processes.

The air must flow faster through that restriction than it would in the larger adjoining chambers of the same cave. The physical characteristics of that airflow will undergo only such minimal change that there is no discernible difference other than airspeed between environmental factors within the constriction itself and the larger chambers on either side of it.

Located about 80 metres towards the entrance of Mullamullang from the Southerly Buster, and occupying most of the passage, is a beautiful sand dune (Figure 3). The two features would appear to be inter-related. If the silt floor of the Southerly Buster were to build up, further reducing the cross-sectional area of the Buster, then the air speed through the Buster would have to increase to compensate. The increase in air speed would enable more sand grains to be picked up and entrained by the air flow, depositing them in the larger cross-section and therefore lower air speed Dune Chamber, and restoring some measure of equilibrium.

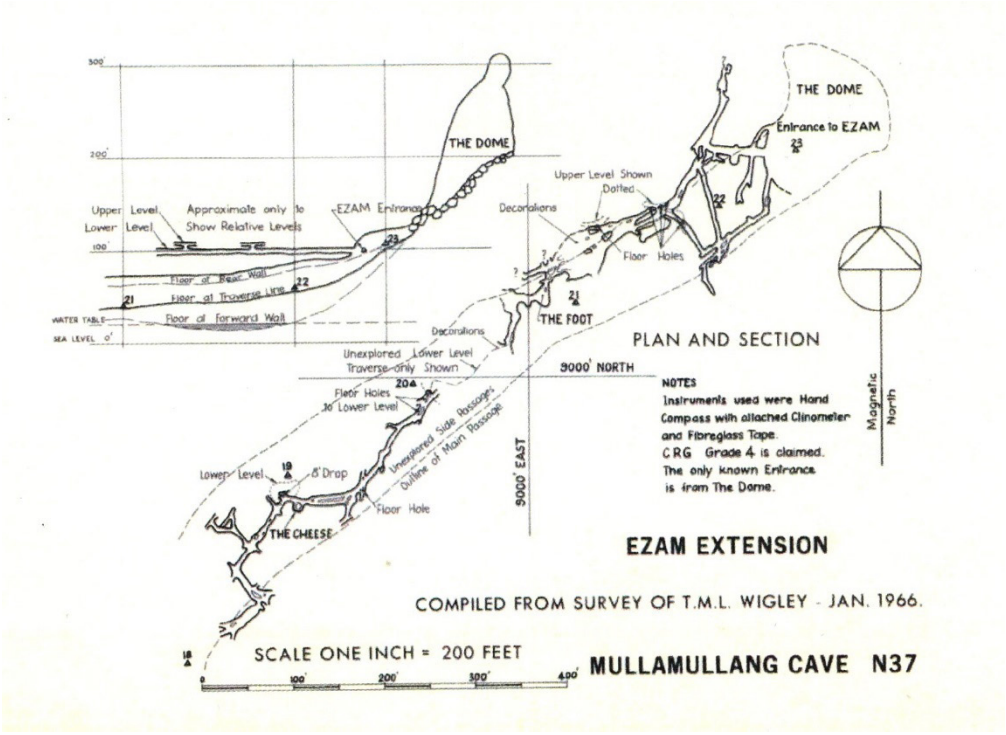
Figure 3: The Dune

A fringe benefit is that lines of footprints in the sand from those passing through the chamber alongside, and even higher up the dune, are imperceptibly but thoroughly obliterated over time.

Breezes coming from most Nullarbor blowholes, while often noteworthy, are rarely indicative of imminent breakthroughs to new cave. Blowholes, in response to pressure variations of only 1 part in 2000 have been measured as pumping out enough air to achieve a total vacuum of the accessible volume in 3 minutes, and then continuing to breathe out at the same rate for a further 12 hours or more. The answer to this conundrum seems to be that the blowholes frequently access a large network of small anastomosing tubes which in turn give access to large volumes of porous limestone. A program of measurement of phase lags associated with a representative range of blowholes might reveal whether such anastomosing tube networks tend to be radially symmetric around individual blowholes, or whether they tend to a directional anisotropy possibly indicating a broader property of the rock itself not necessarily directly related to those individual blowholes.

On the other hand, it is worth considering with a cave such as Mullamullang that should we locate a breeze emanating from a constriction that we haven't previously noticed, for example, a crawl-way, whether through the rock-pile or even off the Ezam (Figure 4), that might enable us to find a way past "The Dome", which is considered to be the current northernmost end of the main run of the cave, then that breeze would certainly be worth following, simply because of the expected structural nature or shape of the cave, even if most of the air in the breeze came from the porous wall of passage beyond the constriction.

Figure 4: Mullamullang Ezam extension 1966, drawn by A.L. Hill



Grant Gartrell – a brief bio in his own words!

Grant Gartrell is an Honorary Life Member both of ACKMA and of the Cave Exploration Group of SA.

He gained a PhD in Physics from the University of Adelaide in 1971. He worked for almost 40 years as a Defence Scientist, and these days still messes around in mud being a commercial blueberry grower.

Mud features in a major way in his life because he also still enjoys messing around in mud attempting to find new caves.

He has now attained the age of 80 years, and therefore thinks that perhaps he should be expected to devote more effort into deciding what he wants to be when he grows up, but fears that he may have left it a little too late.

Editor's Note:
I know exactly how Grant feels – but my philosophy is you are never too old to decide what you want to be when you grow up!

To Dig or Not to Dig? – That is the Question.
A Philosophical and Physical Discussion.

Grant Gartrell – Part 2

Apart from having my own basic desire to explore, to find out more about the true extent of a cave system and why it is there in the first place, I have come to realize that while many of us in the community at large may have at least a casual fascination with caves, few really understand how, let alone why, they are formed, and what caves can reveal about our past. Unless and until we can materially improve both the broader community's perception and appreciation of the significance of caves and karst processes, we risk losing more and more caves as a consequence of ill-informed planning decisions.

The Nullarbor provides us with a classic example of this. To most of us it comes as a great surprise that such a "featureless" landscape actually has "features" hidden beneath it, and there is a general lack of understanding as to why such "features" exist in such a place. Very few except those familiar with the basic principles of karst really appreciate the nexus between the lack of features on the plain surface and the development of elaborate karst features below.

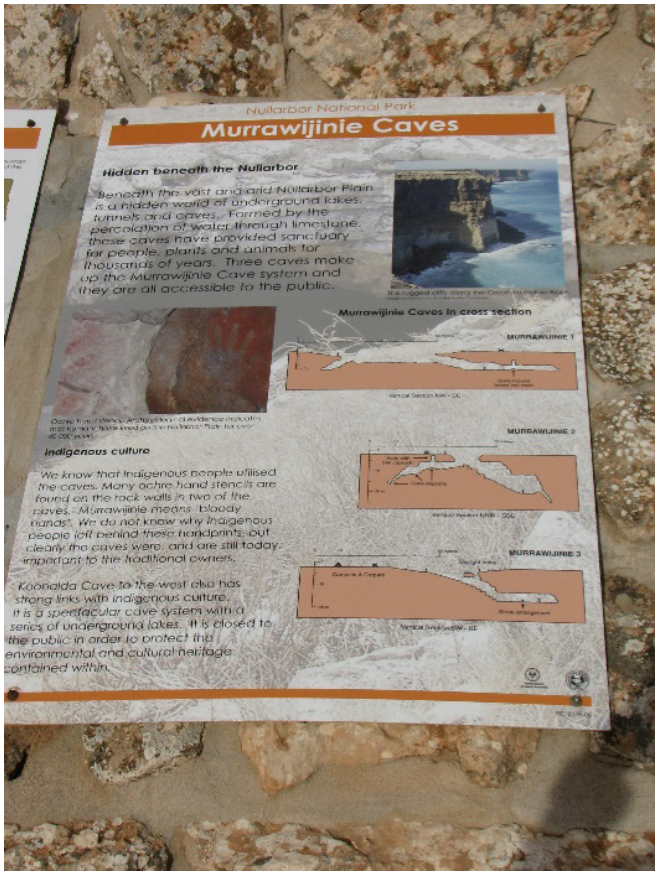


Image above: Murrawijinie Caves, Nullarbor, photo K. Dixon

Image left: Koonalda entrance with Fred Asplin on ladder

And yet the surface is truly far from featureless. Its features might be subtle, but they have a great bearing on what lies below.

Even though undoubtedly a low rainfall zone at present, that clearly has not always been the case, and were it not for the porous nature and solubility of the limestone strata which comprise the basic geology of the area, it would not be a plain at all, but instead have formed a network of ephemeral minor creeks draining into more successful major watercourses, and thence eventually to the sea. The fact that such an erosional drainage network has ***not*** formed over the tens of millions of years since those limestone beds were first laid down in the early to middle Miocene and progressively uplifted, is clear evidence that every square centimetre of that Nullarbor surface is an integral part of an amazing karst system of truly world significance, which should be recognized and respected as such.

A recent proposal to cover an area in which are located some of our most significant known Nullarbor caves with a large array of infrastructure for harvesting wind and solar energy has highlighted the divide between those that understand karst processes and those for whom such an understanding might be inconvenient. I cannot make the point too strongly. I re-emphasise that while the caves and other karst features are formed by dissolution of the limestones under the plain, that process actually starts right at the surface of the plain, and thus the surface of the plain is an integral part of the karst system generating those subterranean features.

Developing extensive infrastructure on the surface of the plain is pretty much on par with commissioning sewage farms or rubbish dumps to be located in the catchment of your city's reservoirs, about as appropriate as adorning the Mona Lisa or even the Sydney Opera House with paid advertising.

Some people who might be truly appalled by concepts with which they are more familiar might take a little longer to fully understand that simply calling a concept a "Green Energy Hub" does not necessarily make it green.

I can understand why some cavers like to keep cave locations a closely guarded secret and access to caves as constricted as possible. Yet this may still be risky, particularly where there is competition for land use. It might be a better strategy to establish the likely true extent and significance of cave systems, and tell the world about it, prior to planning decisions being made that could jeopardise the future of those systems.

I fully understand the desire of some of the more sensitive specimens of the human race, and, rightly or wrongly, I count myself amongst them, to leave only soft footprints upon the earth. Yet I support the need to gate some caves as well as improve access where appropriate to do so, not only for cave rescue situations and for the development of tourist caves, but also for initial exploration and later community assessment for application of appropriate conservation measures.

The most common argument raised against any such alteration by people who are unfamiliar with the not particularly intuitive physical principles pertaining in such situations is that restricting or opening up a cave passage might dry out, or otherwise alter the cave atmosphere. For further discussion of those physical principles, please refer to my companion article on the physics of cave air flows.

The following examples may provide a useful guide for better decision making in the future.

Alteration to Cave Access / Routes – no, yes or maybe?

The "No" Case (no justification for alteration to cave access / routes)

There is a cave in the Flinders Ranges containing an awkward constriction affectionately known by a few remaining old geezers as the eight and a quarter inch squeeze. In my younger days I felt a sense of achievement on a par with the cavers' party trick of climbing through a coat hanger when I successfully negotiated it. Like most people, including palaeontologist Neville Pledge, now retired from the SA Museum, I don't fit through either anymore. Neville even had a cartoon of his rite of passage through it painted on his caving helmet. It just wouldn't be the same if we chipped it out and made it half a metre wide. Why would you? The whole purpose of negotiating that squeeze is that it presents a challenge which would cease to exist if it were enlarged. There are no surprises awaiting us beyond it. We can already go around the easy way to get to the other side. Nobody would ever even think of attempting to rescue an incapacitated caver through it any more than they would contemplate passing a caver on a stretcher through a coat hanger.

Our conversion fifty-six years ago to the metric system may have put the kibosh on it anyway. I haven't even once heard it referred to as the 20.95 cm squeeze.

The "Yes" Case (justification for sensitive alteration to cave access / routes)

If, after a careful survey, we become aware of a breeze coming out of a hole too small to get through, or to get past any other way, some of us have an itch to scratch a few rocks out of the floor, or whatever it takes to check out why that breeze is there. It is sufficient at this stage to simply be aware that the breeze must come from somewhere, and quite possibly somewhere interesting. One of the first questions little children like to ask is "Why?" I must have been quite annoying as a child. I still ask "Why?" Sometimes the answer is simply "Why not?

As part of a team effort (it is good to have other people to do most of the work) I and others have scratched that itch many times over the years and located many caves and cave extensions as a result. Purists are not obliged to visit those sections of cave discovered this way but might be surprised at how little that leaves for them. Seventy-five years after Naracoorte's Victoria cave was first developed as a tourist cave, such a breeze led us to a more than ten-fold increase in the size of the cave as well as the fossil deposits which gave us the new name of Victoria Fossil Cave, the principal reason for South Australia's currently only entry on the UNESCO World Heritage Register. I was skinny back then, half a century ago, but so keen that I happily scraped skin off my chest first accessing the new chamber.

We could hardly expect those that followed, including David Attenborough, to do the same, although it might have made interesting colour television. This, and every other related discovery has contributed to the growth of the knowledge database through an amazing group of young and more senior researchers making continuous scientific advances in both the understanding of karst processes and the development of our palaeontological record. It is most comforting to know that my finely honed, but nevertheless basic expertise at scratching away at rocks can lead on to such lofty and inspiring outcomes.

Cave tourism, done well, is an essential element in raising awareness in our communities about the importance of caves, which can all too easily become unfortunate voids in limestone which less speleologically inclined specimens of the human race may consider to have been principally put on earth to be mined, or, as has already been mentioned above, improved by the addition of infrastructure that only engineers could love.

Yes, limestone is a resource, and sometimes difficult decisions may have to be made. But those decisions need to be based on adequate information and expertise.

In the case of the Victoria Fossil Cave, it was particularly good fortune both that the cave occurred within the relative security of a state reserve, and that our initial exploration party included the palaeontological expertise of Rod Wells. At that time the Naracoorte Park was a National Pleasure Resort, operated by the South Australian Tourist Bureau. The park has since been re-dedicated as a National Park, managed by the Department of Environment and Water.

It took a moment to first realise that the corrugated edges on many of the silt encrusted rocks protruding from the surface of an extensive silt deposit were in fact rows of teeth, that what we were looking at were segments of a sea of bone. It quickly became clear to me that Rod had caught an amazingly prescient initial glimpse of the rest of his life and research career stretching ahead of him. While it was obvious to me that the bones were interesting, and special, Rod had studied his field so well that he could tell me not only their names, but what they had for breakfast. I am serious! That's why their teeth have evolved the way they have. A truly amazing detective story that runs rings even around Sherlock Holmes! From the vantage of half a century of hindsight, it is no surprise to me that the now Emeritus Professor Rod Wells AM over his life earned the title of "Father of Palaeontology" at Flinders University.

He was undoubtedly immediately aware of the significance of the find, although more than 95% of the huge original bone deposit even to this day remains undisturbed, buried in deep, stratified, protective cave silt. As work progresses in the safe and enthusiastic hands of the following generations, the find continues to exceed even Rod's expectations and becomes ever more fascinating due both to the quality of the research and the amazing advances in science over the ensuing decades. That detective story just keeps getting better and better! The current carefully planned active research program ensures that this will remain the situation for centuries.

It was also particularly fortunate that on the day of the discovery we had the late Ern Maddock with us. A senior manager with the Tourist Bureau, Ern was looking at a different area of the Victoria Cave at the same time, with a view to improving the movement of visitors, and as soon as we told him of our discovery, he realised that the visitors to the cave would appreciate sharing the detective story as well.

Far too often, the people that get to decide the future of our karst heritage are miners and quarry operators with little or no karst expertise. I remember an incident a long time ago in which a Mines Department officer advocated permanent closure of the Victoria Cave when a rock fell and bent a wheelbarrow while some work was being carried out on a dug entrance tunnel. Being in a park dedicated to caves probably saved the Victoria Cave from being classed as a nice enough little hole that would be better off in a dump truck.

If you consider that I may perhaps be unduly flippant or intemperate with such descriptions, please check out the 18th Report of the Environment Resources and Development Committee of the South Australian Parliament into Sellicks Hill Quarry Cave. It is 130 pages of well-chosen words arising from an enquiry into the destruction of a significant cave system by a quarry operator. The subject matter remains so important to me that I am shocked at how difficult it is to track down a copy of this report after 27 years. Did the then government particularly want it to go away, or is it just that society thrives on forgetting a lot more stuff than it retains? If you would like a copy but cannot find one, you are welcome to send me an email (farm@blueberrypatch.com.au).

Cave rescue expertise is another aspect of caving that cavers understandably wish to avoid, but really appreciate having, just like a good ambulance service. Improved access may be essential in some cave rescue situations. If you ever had any doubts about community interest in cave rescue, just cast your mind back to 2018 and the rescue of the soccer team in Thailand that riveted pretty much the whole world to their TV screens. Think for a moment about those young soccer players themselves, their natural curiosity and sense of adventure. Just about anyone who has ever been in a cave or who has been interested in caves, casually or otherwise, shares a bond with those lads. We breathed a huge sigh of relief, tempered with sadness for the Thai Navy Seal who lost his life, for the soccer team, their families, and for every person involved when the incredible rescue effort succeeded.

But I also breathed a sigh of relief on behalf of caves generally, and cave science. My Sellicks experience leads me to believe that some people in the mining industry may latch on to any negatives, whether actual or simply capable of being misinterpreted that way, to justify to themselves that caves are intrinsically dangerous and that they are carrying out a public service by getting rid of them wherever possible. In my naïve youth I attributed such mindsets only to Southern Quarries and our Mines Department, but there was an outbreak not long ago of something similar at Juukan Gorge in the Pilbara. The broader Australian community expressed disgust at Rio Tinto's collective corporate behaviour over Juukan Gorge and made it clear that the Western Australian State Government had nothing to be proud of, either. Both parties are surely hoping that the destruction of one of the oldest archaeological sites in Australia will be long forgotten a quarter of a century from now. It is hard not to draw close parallels with the Sellicks Hill debacle.

Sellicks Hill and Juukan Gorge Caves, while having totally different origins, are both for me compelling arguments for the "Yes" case. The Juukan Gorge caves were anticlinal rock shelters containing the oldest known continuous record of aboriginal occupation in a remote part of Australia. Essentially wind-eroded surface features, they were a testament that a cave does not have to be large or deep to be a valuable, indeed irreplaceable, site for the preservation of our historical record.

It is hard to believe that either Rio Tinto or the Western Australian Government would have handled the matter as they did if they had any prior appreciation of the storm of adverse publicity their action was about to unleash, but perhaps they did and felt that they could simply tough it out. While many would simply assume this and attribute it to arrogance, I don't want to lay blame on anyone for this quite unnecessary failure, but I cannot help feeling that if the communication processes could have been better prior to the event, then the tragic destruction, for that is undoubtedly what it was, could have been averted. That would have been in Rio Tinto's and the WA Government's interests, as well as those of the broader community. It should not have cost Rio Tinto much to secure the site and it would have been a positive story that enhanced their reputation, instead of the exact opposite.

Similar comments apply equally to Sellicks Hill. We may have thought that we were communicating adequately with both Southern Quarries and the Mines Department, but communication is only illusory if the message that you think you are transmitting doesn't elicit the responses you are expecting. Even though we might think we are speaking the same language, if the words conjure up different historical associations on opposite sides of the table, then the message isn't getting through, and communication is not really happening.

Whether it is possible to make the appropriate translations and get the message through is not at all clear, but what is clear is that the Mines Department people and the quarry operators were in the main just people trying to do their jobs to the best of their ability. We, with our special perspective on the caves in contention, were not communicating adequately, and nor were they. We might have thought otherwise at the time, but it is clear in retrospect that we were not speaking the same language. "Inconvenient isolated cavities" is not an accurate translation of the concept of an extensive and integral karst drainage system, and all the environmental consequences that concept should convey. On top of that we were reluctantly bound by a confidentiality agreement insisted upon by Southern Quarries as a condition for our continued access to the cave. This seriously restricted us from soliciting additional expertise or community opinion in support of saving the cave.

The destroyed section of the Sellicks Hill Quarry Cave was ***not*** just a few accidental cavities in a mineable resource, but a section of an extensive and integral karst drainage system, a significant underground valley which would enjoy better legislative protection and be treated with far more care and concern if it were a more familiar and better understood classic surface erosion valley. Some of this cave must still remain in close to pristine condition outside the current boundary of the quarry. How do we get the message through?

The only way I know to be able to make a case for preservation of such caves is to prove not only that they are there, or could reasonably be expected to be there, but to explain why they are there and why it is important that they are there. We need to be able to shine a spotlight on them and make the community at large aware of them, to open them up sufficiently that the quality of the resource cannot be denied, and can be peer reviewed, and to do so early enough in the planning process that there can be no question of the issuing of mining leases to compromise their future prior to an obligatory and well-informed environmental assessment process. In the case of the Sellicks Hill limestone, for the want of more comprehensive remote detection techniques, cave air flows are possibly the best indicator that we currently have as a guide to the scale of the cave systems generating them.

But before discussing cave values themselves in more detail, we should recognise that in addition to the "Yes" case, and the "No" case, there must also be one in between, the "Maybe" case.

The "Maybe" Case (possible justification for alteration to cave access / routes)

The Jenolan Caves in New South Wales is a wonderful assemblage of largely interlinked tourist caves that have been progressively discovered and developed over a long period of time. Two particular tours, the Orient Cave and the Temple of Baal, were originally accessed by first negotiating several other sections of the system. I am told this involved climbing up and down about 1400 steps, leaving most visitors completely puffed out before they even got there.

To obviate the need for this, a four-hundred foot (130 m) tunnel known as the Binoomea Cut was driven in sideways to provide direct access. Many New South Wales Cavers would know it well. It is an interesting story, but for another day. The tunnel was drilled and blasted without vibrational damage to the delicate decoration to which it was providing access. Presumably the blasts were designed and monitored with this in mind. It was also equipped at each end with well-sealed and insulated doors to ensure the maintenance of the original humidity and temperature regime of the cave atmosphere. It has now been in place and effectively achieving its objective for over 67 years.

Why is it on the "maybe" list? Its construction was not essential for establishing the existence of the section of cave to which it gave ready access. On the other hand, given the tourism status of Jenolan and a reasonable fitness profile for those you would like to be able to visit the cave, then there is a very strong case for it. As well as its purpose, the manner in which the project has been carried out will influence its placement on the sliding scale between the "No" and the "Yes" cases.

To me the Binoomea Cut is an asset for Jenolan to be proud of, and a valuable demonstration that we need not be afraid of creating such structures, provided that we do so carefully and sensitively and make a good job of it.

How Do You Value a Cave?

A number of places around the world have now developed methodologies for placing realistic monetary values on trees. It might take as much as two hundred years, or even longer, to replace some trees. Quite conservative costings in some circumstances arrive at values for a tree of the order of tens of thousands of dollars. This might initially sound overly generous but consider the collective loss in property valuation to a higher-class leafy suburb in just about any capital city if all the more mature trees were removed, especially with the increasing incidence of climate change induced extreme weather events.

While there has certainly been interest in several parts of the world for establishing a valuation methodology for caves, I am not aware of anyone formally adopting such a scheme, but it is high time that we did. Nobody has yet worked out how to replant a cave and have it mature in 200 years. Timescales for cave development should be factored into the valuation and are somewhere between 10,000 and a million times greater than that for a tree.

The concept of value means quite different things to different people. Southern Quarries considered the cave under their quarry to have a negative value. The airspaces created a potential hazard for their heavy machinery, the cavities themselves didn't register on the weighbridge, and drilling cavernous ground tended to flex the drill rods for their diamond drills sideways, jamming them. In that regard, we had something in common with Southern Quarries. Although we wanted the cave, we didn't want it to be under their quarry any more than they did. It was a serious failure of government that the quite obvious signs of karst development were not recognized and properly evaluated when approval was given for the quarry to be established there in the first place. This exposed the quarry workers initially to a significantly higher than expected level of risk which was later substantially mitigated by calling in cavers to evaluate and delineate the cavities.

Developing a methodology for assigning monetary value to caves is not going to be easy, but it is simply not a fair proposition to suggest that just because someone wants to mine a particular area of limestone, the government should therefore artificially set a value of zero for any karst features related to that limestone. There would be no significant difference between that proposition and the idea that our State's Parliament House has a nominal value that should similarly be re-assigned to zero in the event that a mining company wanted to dig it up. Ah, but that is different, do I hear our politicians saying? Not if you bother to think carefully about it! And like the trees, you could build another parliament house much quicker than you can replace a cave.

Surely our society is no longer so naïve that we would consider it to be in our interest that the fox remains in charge of the henhouse. While it might take a good deal of thought, a much fairer proposition would be to assess the limestones in terms of the most current science of karst processes to ascertain the overall cost to society of the destruction of such an actual or potential asset, and balance that against the net returns to the state from the quarry taking into consideration the loss of that asset, the availability of alternate resources, and so forth.

A similar situation relates to the already mentioned proposal to erect an extensive renewable energy farm, with associated infrastructure, across vast expanses of the Nullarbor to the North of Eucla. Considering the lack of any information to the contrary, it would appear that the preliminary calculations for such a scheme are predicated on assigning a zero-dollar value to the land itself. Are we being expected to consider that one of the World's most extensive karst provinces, that some consider should be nominated for World Heritage listing, should be of no value whatsoever and quite expendable? Davey et al, recommended World Heritage status in an Australian federal government funded report in 1992.

It would be quite irresponsible to plan a project such as this without a proper and thorough environmental impact assessment, and it is really difficult to envisage the resources, both financial as well as human, that would be required to complete such an assessment with any rigour before the technology proposed, the wind turbines and solar panels, extensive cable networks, service tracks, security fencing, battery arrays, ammonia plants, perhaps some "fifo" construction and maintenance camps as well as some more permanent accommodation, utility services, rubbish dumps, sewage treatment plants and other ancillary capital structures, becomes obsolete. Even if the Western Australian Government doesn't yet appreciate the resources required to carry out an adequate karst assessment process as distinct from a greenwash, members of the Mirning community who have been linked to the proposal should be all too aware of Juukan Gorge.

On the basis of extrapolating the distribution of known Nullarbor blowholes, which were usually and not surprisingly found close to known tracks, it was carefully estimated that the Nullarbor would have well over 100,000 such features. To that figure can be added a large number of relatively shallow, extensive and generally well-decorated caves, few of which would have accessible adventitious entrances, thought to have developed under the margins of most clay pans along the edges of vast numbers of low limestone ridges.

Image above: Abrakurrie main chamber

Image above: Weebubbie Collapse Doline, K. Dixon

Image left: Mullamullang entrance

And of course, the number and extent of incompletely explored deep caves would be expected to increase significantly as well. Many existing deep caves, also accessed through adventitious entrances, such as Mullamullang, Abrakurrie, and Weebubbie have tantalisingly strong airflows emanating from entrance rock-piles. Such Nullarbor rock-pile airflows are the rule rather than the exception.

It is pleasing to see that the next, normally biennial conference of the Australian Speleological Federation is to take place in Ceduna in 2023 for a special focus on the Nullarbor. There is enough work there for the field trips to run for decades.

Compelling arguments for digging.

Some cave digs may be not only desirable, but downright urgent. We lost the Sellicks Hill Quarry Cave not only because we were unable to prove in time when problems first arose that it was there, but because nobody other than cavers were ever able to access the main chambers and be impressed by them.

Simply looking at a preliminary video is not an adequate substitute. Don Goodfellow, the Quarry Manager at the time, under the guidance of caver Mac MacDonald, was prepared to give it a try and managed to negotiate the toughest of the squeezes, which earned him a good deal of respect from the cavers. Eventually he became uncomfortable proceeding any further and so had to be guided back out again before we could have the opportunity to show him the chamber in which we could park a couple of Boeing 737 aircraft if only we could work out how to get them through the squeezes as well.

It is hard to argue that access to such a system should not be made easier by whatever means is available when the alternative through lack of such access is an increased likelihood that the entire cave system might be removed by quarrying. A meaningful environmental impact assessment prior to approval of the quarry could well have altered the course of history. It didn't happen, and once the quarry was established, so was the politics.

Even though the quarry eventually ran into difficulties because the hypothetical cave system turned out to be very large and very real, the quarry operators wanted to be overly generously compensated to cease their operations. Not wishing to discourage miners that might be prepared to invest in the state by giving any unnecessary lip-service to the notion that environmental matters might need consideration for future mining proposals, the government would not either come to the party or even argue for a more realistic compensation figure and thus the fate of the cave was sealed.

We have yet to gain access to what must undoubtedly remain of another significant cave system at Myponga after the government of the day, even further back in time, and again per the Mines Department, made no significant attempt to ascertain the karst development of limestone beds underneath the site of the dam wall for a large reservoir (See Centenary Cave, *ACKMA Journal 123*, June 2021). Reminiscent of advances already noted in the sciences associated with palaeontology, advances in the technology of infrared cameras may have an important role to play in determining the most promising access location through the detection of temperature differences of airflows rising from cracks in the ground.

Where to from here?

It would be in everybody's interests to have more accurate information prior to embarking on such projects, and until we do so as a society, and learn from our mistakes, we are destined to repeat them!

While these events happened 30 and 60 years ago, has there been any meaningful change yet to the attitude of the general community to theoretical caves as compared with those for which you can buy tickets? Even today, as far as we can ascertain, *out of sight* still very much means *out of mind*. For most people I think the explanation is simply a basic lack of comprehension.

I was on a ferry crossing the Murray River many years ago. We were heading for Punyelroo Cave at Swan Reach and started talking to a nice old chap on the ferry. He told us about a cave in the banks of the river he visited a long time ago. "You know," he said, "that cave goes right through and comes out at Waikerie. I went into it so far on one occasion that I almost needed a torch." After that we decided to talk about something else.

The late Elery Hamilton-Smith AM some years ago convened a workshop in Orange, NSW to bring together for discussions members of the caving community and major players in the limestone mining industry such as representatives of Blue Circle Cement and others. It proved to be a worthwhile idea, and both "sides" of the equation should benefit from continuing the conversation when it can be arranged. I attended from South Australia, as did Roger Matthews, at the time Senior Mines Inspector with the South Australian Mines Department. I liked and respected Roger, whom I had met through our mutual interest in Sellicks Hill, and I was pleased to see that the SA Mines Department supported the concept of the workshop sufficiently to approve his attendance. As a side trip to the workshop, some of us visited the Cathedral Cave in Wellington, NSW. The main dry section of Cathedral includes a large flat-floored chamber with a most impressive central stalagmite "mountain". I stood quietly alongside Roger in that chamber as he himself became increasingly quiet and reverent, in response to the atmospherics. After sharing with him an appropriate period of silence, I very quietly told him that while I also was impressed by that chamber in Wellington's Cathedral Cave, we could have fitted the whole thing into Sellicks Hill Quarry Cave, the implication being that we could have shared a similar spiritual experience at Sellicks Hill. Apart from quietly saying something like "Oh my God!" he got even quieter, if that was possible. Such is the complexity of communication that we were clearly sharing a common language, which in this case was silence!

On the other hand, at an enquiry convened jointly some years before by the Mines and Environment Departments, a different Mines Department Officer tried to discredit the cavers' description of the Sellicks Hill Quarry Cave as having cathedral like dimensions by producing a slide showing a cross-section of the main chamber with a cross-section of Adelaide's St Peters Cathedral at the same scale superimposed upon it. His representation showed clearly that the main body of the cathedral fitted well within the dimensions of the chamber, and yet he accused us of misrepresentation because his diagram showed the cathedral spires poking up part way through the roof of the chamber.

Perhaps he would have considered the cave differently if he had actually had the opportunity to stand in it and quietly absorb the atmospherics of it. Perhaps he had dreams of Adelaide being promoted as "The Gravel Capital of Australia". I guess you cannot please them all!

But we do have to try. We have little choice in the matter. Caves clearly need our advocacy. Who else is going to advocate for caves if we don't? Intelligent cave tourism should help tip the scales in favour of conserving caves rather than having them destroyed inadvertently by mining or lack of expertise in karst matters and should surely be an opportunity to increase community awareness of the need for conservation of caves in general, which should in turn help us to avoid repeating the mistakes of the past and improve the outcomes for future quarry operators and dam builders. With a bit more thought, a bit more investigation and more sensitive planning we could have had our quarry and our dam, as well as the caves, while at the same time wasting a lot less money.

Historical Quotes

From *An Introduction to the Geology of New South Wales*, 1922, p39, CA Süssmilch, F.G.S, third edition, revised and enlarged, with 100 illustrations and maps, Angus and Robertson, Sydney.

"In the limestones at Jenolan, Wombeyan, and Yarrangobilly occurs that wonderful series of caverns whose majestic proportions and infinite variety of form have made them world-famous. The caves occur where stream channels cross the limestone belts and have resulted from the action of water charged with carbon-dioxide dissolving away the limestone. River gravels, containing water-worn boulders up to 12 inches or more in diameter, are frequently met with in these caves, even in those high up on the hillsides, giving evidence of the fact that the river at one time flowed through them, as. in fact, it still does through those at the lowest levels. Percolating rainwater has subsequently ornamented the walls of the eaves, with the beautiful stalactitic and stalagmitic formations, whose bewildering beauty is a never-ending source of wonder and delight to visitors."

CA Süssmilch (1875-1946) was "at one time president of the Royal Society of New South Wales, and also was president of the Linnean Society and a trustee of the Australian Museum. He was honorary secretary of the Society for Crippled Children." Short obituary in *The Age*, 10 December 1946.

From *De Rerum Natura (On the Nature of Things)*, Book 1, line 313, Lucretius, ~ 55 BCE

"stillicidi casus lapidem cavat" – A constant drip hollows a stone

De rerum natura is a first-century BC didactic poem by the Roman poet and philosopher Lucretius with the goal of explaining Epicurean philosophy to a Roman audience (Wikipedia).

Editor's Note:
This is possibly the earliest reference to karst related material!

If anyone comes across more gems from the past that they would like to share in future journals, please send them to me for inclusion

Peace and Joy at Christmas
—with the compliments of a slimy maggot.

Announcing our 2023 Australian Cave Animal of the Year.

Who in ACKMA doesn't love glow-worms? These enthralling creatures bring us peace and joy and it is with great delight that we announce the 2023 Australian Cave Animal of the Year is Australia's eight species of glow-worms in the genus Arachnocampa. (There is a ninth species in the genus, *Arachnocampa luminosa* which is endemic to New Zealand.)

Inspired by the long-running German Cave Animal of the Year program (now in its fifteenth year) 2023 will be the fifth year of the Australian Cave Animal of the Year program. We commenced with a ten-year plan with the current promotional products (bookmarks, poster, sticker and mug).

While we've made a start on increasing awareness of cave animals amongst cave visitors, it's time to start thinking about how we can build on these efforts. It would be good to have some more people involved to take our ideas forward. You don't need to commit lots of time, and this would be a great opportunity to learn more about cave animals and contribute to their conservation. Want to be part of the Cave Animal of the Year team? I'd love to hear from you at hello@caveanimaloftheyear.org.au

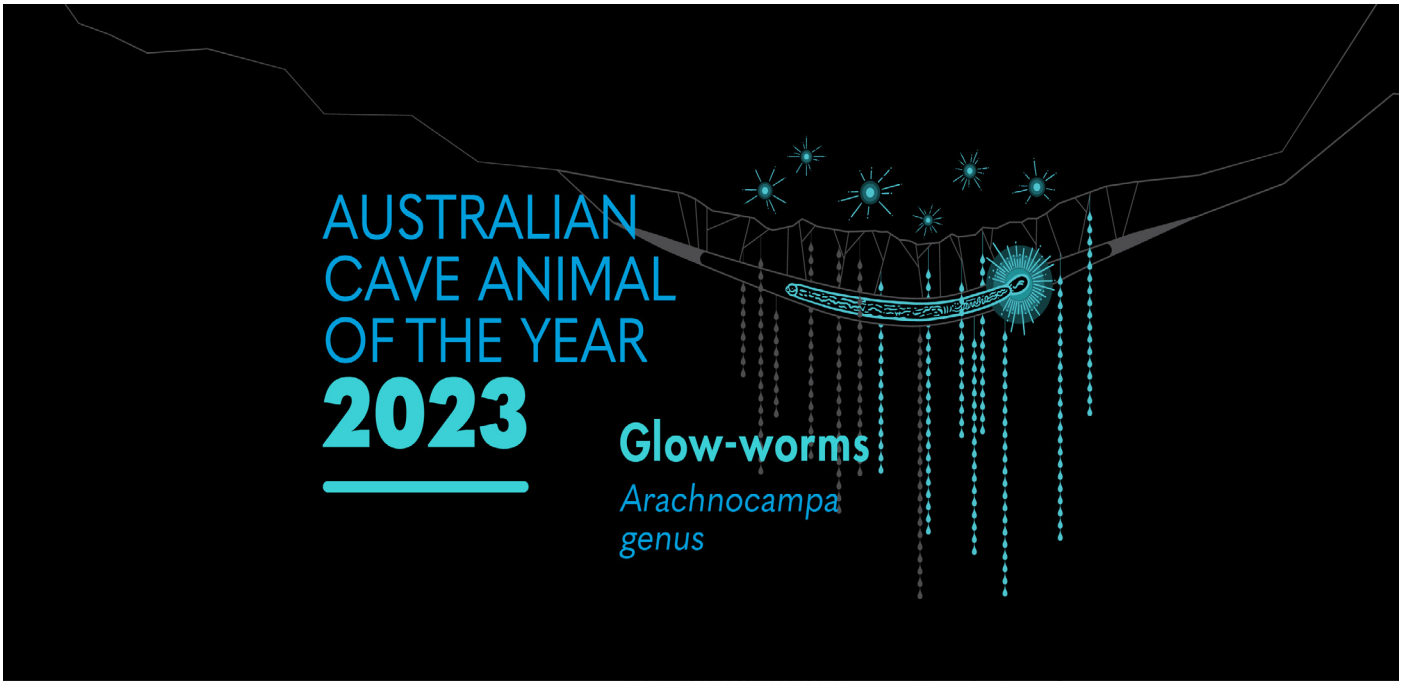
Our 2023 Cave Animal products will be available from December. Thanks to our wonderful production team for their efforts, especially to illustrator Sam Lyne and graphic designer Kelly Eijdenberg/poco people. The intricacies of glow-worm threads and light has provided lots of challenges to everyone involved this year. Thanks to everyone concerned for their excellent efforts.

As usual, the stickers and bookmarks come free of charge, posters are also free of charge and available for display in public areas (sorry, not private offices or houses as the aim of the game is to increase public awareness). Payments to cover the cost of postage is desirable. Mugs are $12.00 plus postage.

Supplies always run out, so don't delay on ordering at hello@caveanimaloftheyear.org.au

Thanks to the Karst Conservation Fund for support of the Cave Animal of The Year program.

For some glow-worm information go to www.caveanimaloftheyear.org.au



The Greenlink Cave System Story

By Michael Brewer

December 2022: – The Nelson Speleology Club, in conjunction with the New Zealand Speleological Society (NZSS) has, for the first time in New Zealand caving history, privately raised over $180,000 to purchase land on top of Tākaka hill to guarantee caving access to the under lying Greenlink Cave System and to preserve the land above.

Money was raised by seeking donations from society members and affiliated groups.

ACKMA gave generously to this cause and this article is in part an acknowledgement of this.

Why Greenlink?

The Greenlink cave system is of national significance. It is New Zealand's second longest cave. It is over 40 km in length and has a vertical range of 400 m. It lies only 90 minutes' drive west from Nelson and is situated within the marble massif that makes up most of Tākaka Hill.

It drains most of the water that falls onto the southern end of Tākaka Hill, with the water resurging at the base of the hill from the Riuwaka Resurgence Cave. Presently there is no humanly traversable connection between the Greenlink cave system and the Riuwaka Resurgence Cave. Overzealous use of fluorescein dye after its discovery proved there was a water connection, by turning the Riuwaka River vibrant green – hence the name "Greenlink".

The potential for connecting these two caves has spurred on exploration over the decades since the cave was discovered in 1974. Such a connection would allow a through trip in a system over 50 km in length with a vertical range of 700 m. Additional caves that have also been dye traced to the Riuwaka Resurgence Cave, if connected, would make a system of over 70 km in length.

The cave system consists mostly of active stream passage with adjacent older, dry, parallel passages that are prone to flooding.

There are multiple large chambers in the lower levels formed by roof collapses. Large upper-level dry passages exist in places, representing remnants of an older system, a lot of which has been eroded away.

There are several highly decorated grottos, multiple complex rockfalls and sumps. Large banks of silt and plant debris throughout the lower levels are felt to be due to the erosion that followed extensive land clearance in the catchment starting in the early 1900s.

Exploration is ongoing. Prior to 2010 the system had a total length of around 8 km. A breakthrough in 2010 led to the bypassing of a rockfall that had stopped explorers since 1983. By 2014 the known cave had expanded massively and totalled 30 km in length. The 40 km mark was reached in 2022. Two permanent campsites have been established. The first one, Camp Levall, is about 4 hours into the cave and the second one, Camp DJ, is another 3 hours further in.

Camping has been made fraught with the knowledge that river levels can rise 30 m following heavy rain. Multiple potential campsites exist on lovely sandy floors close to streams, but it is hard to sleep easily with the thought that water could start lapping your feet if rain were to occur!

Presently exploration is focused on finding a lower entrance to the system, with surveying indicating we are only meters from breaking through to the surface. This would create a superb through trip and enable rapid access to the lower levels of the system, facilitating exploration considerably.

The Purchase

Tākaka Hill has large tracts of private land which has proved to be generally marginal for farming and is more and more the domain for people who enjoy the isolation and challenge of living off grid in a rugged environment. Some cattle and sheep are still being run on well-established farms, but a lot of the land is regenerating bush.

There are also areas of commercial forestry which, when logged have caused run off and significant sediment accumulation in cave entrances and passages.

Unlike a lot of caves in the South Island of New Zealand, which are on conservation land, access to the caves on Tākaka hill is controlled by landowners and the ongoing health of the cave systems depends on what the landowners decide to do with the land above.

By purchasing the land, we will have bought two of the six known entrances to the cave system and guaranteed the protection of the regenerating forest on this land. This area of land has already been identified as having high conservation value. We hope that this will lead to further purchases allowing for greater protection of Greenlink and other vulnerable cave systems in New Zealand.

It is the first step towards ensuring the long-term health of what is a truly remarkable cave system.

Cave Conservation and Access Trust

NZSS has established a trust to purchase and manage land for the purposes of conservation and access to karst and cave environments. More information is available at https://www.cavecat.nz/

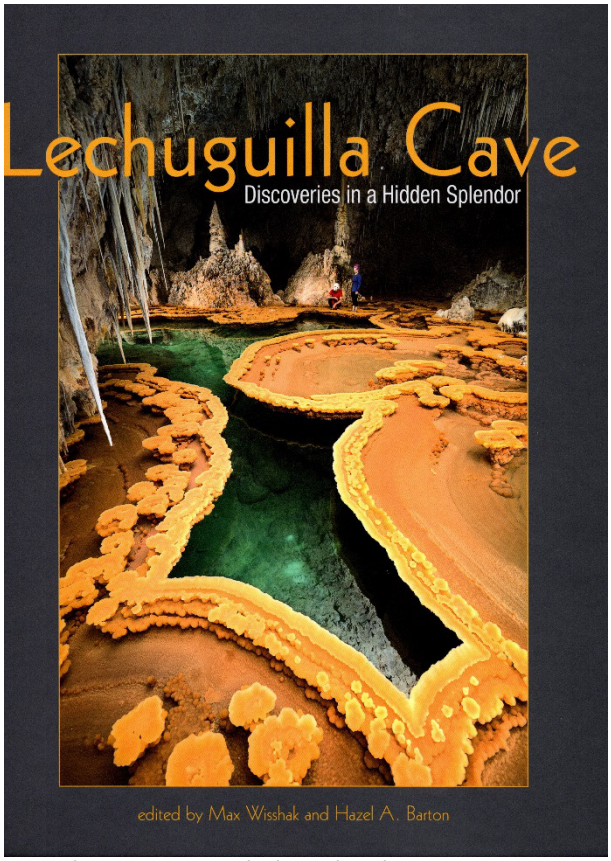
Resources

BOOK REVIEW by Andy Spate

Lechuguilla Cave: Discoveries in a Hidden Splendor

Max Wisshak

This is a remarkable book about a remarkable cave – named after a plant! The book talks about *Agave lechuguilla* (little lettuce) as follows:



"Yet the agaves are far from lettuce like, with thick, succulent leaves that end in vicious spikes capable of puncturing a car tyre. If you are fortunate to be around for the one week during its lifespan when the Lechuguilla plant blooms, you will witness an impressive head of colorful flowers that bathe the desert in a pungent smell." (p15)

Let's start by looking at the publisher's blurb:

"Lechuguilla Cave is one of the most beautiful caves on Earth. Since its discovery in 1986, more than 240 kilometers of cave has been explored – with no end in sight. Owing to its geologic setting and unusual process of formation, the cave contains a remarkable diversity of rare minerals and formations, which have helped change our understanding of how caves form and the microbial life they can contain.

In this book, the most active explorers of the cave show the features that made it famous and reveal new discoveries in terms of beauty, scale, and science. Through their writing and photography, they take the reader on their journey of preparing for, and exploring, this remarkable cave. They describe how to successfully live and work in the underground and highlight the challenges that must be overcome to discover and map new passages. ... Finally, the extraordinary lengths undertaken to conserve Lechuguilla are illustrated, and how such efforts go hand-in-hand with exploration and photography to reveal the intriguing nature of this wonder of the underground."

Sounds pretty good already, doesn't it? I am going to stick my neck out and say Lechuguilla is the most remarkable cave that we know of around our globe. A bit like asking who the most beautiful woman is ... this statement will get me into trouble!

At first glance this is a 'coffee table' book – lots of images but not much else. At a better look one's appreciation of the book changes dramatically. Actually, there is heaps of 'else' – some 13 chapters written by a variety of experts. There are also three well-written forwards and one afterward. These are supplemented by a comprehensive bibliography, a fact page documenting dimensions, surveyor's efforts and much more, and then brief biographies of the 36 contributors. The final page, 'Imprint', details facts about this wonderful book including attributing the photographers to images throughout the book.

The book has 258 wonderful images, a wonderful, 3-D model covering four foldout pages, various forwards etc and the 13 explanatory chapters which vary in length from eight to 42 pages of substantive discussion.

Image: Helictite growing upwards from the tip of a soda straw. Photo Max Wisshak

I am going to list the contents here to give you an idea of the scope of the discussions:

- Hidden Splendor (opening statement by Johnathan B. Jarvis, former Director, National Park Service)
- Fragile Beauty (forward)
- Greatness (forward)
- Beginnings (introduction and editors' preface)
- Discoveries
- Speleogenesis
- Speleothems
- Water
- Hidden Life
- Preparation
- Camp Life
- Exploration
- Mapping Mazes
- Photographing Darkness
- Rescue
- Conservation
- Best of the Best (closing remarks)
- Fact Sheet
- Bibliography
- Contributors

Each of the chapters is preceded by a double page image. Unfortunately, this means that the splendorous images are somewhat distorted by the fold between pages. It is also a pity these double-page images are not identified as to place, etc. These are very minor quibbles given the overall quality and substance of the book.

Some of the tallest snake dancers in the cave, aligned along a fissure in the flowstone floor. Max Wisshak. Photo of a double page spread from the book.

Whatever else this glorious book tells us about the glorious cave one cannot be utterly amazed by the variety of speleothems and the very complex mineralogies in this unusual cave. The images are simply stunning! And the scale of the speleothems is simply astonishing! Six metre gypsum chandeliers, 4.6 metre straws, six metre gypsum hairs, and massive calcite stalagmites and columns up to 24 metres tall! A flowstone cascade over 200 metres in height!

Lechuguilla Cave is formed in five separate limestone units by ascending acidic waters. The profusion of gypsum and sulfur lends support to speleogenesis by sulfuric acid dissolution. The sulfuric acid is believed to be derived from hydrogen sulfide that migrated from nearby oil deposits. Therefore, this cavern formed from the bottom up, in contrast to the normal top-down carbonic acid dissolution mechanism of cave formation that we are used to in Australia and New Zealand.

As well as a book full of stunning images we have accounts of the remarkable climbs and other extreme exploration efforts, the camping arrangements and, most crucially the efforts made to conserve the cave and its features as it is carefully explored.

Lechuguilla is the third longest cave system in the world – surpassed by Mammoth Cave, Kentucky, and the Clearwater system in Sarawak, Malaysia. Let's look at some other statistics associated with this remarkable cave:

Total length – 244,790 m
Maximum vertical range – 484 m
Length of ropes rigged – 8,327 m
Number of survey stations – 40,695
Tallest dome climbed – 163 m

The book is edited by Max Wisshak and Hazel A. Barton.
Max's bio in the book reads as follows:

> *Geoscientist and Publisher based in Germany. Became addicted to Lechuguilla in 2006 and regularly leads expeditions ...*

Hazel's is:

> *Professor of Biology and Geoscience ...specializing in cave microbiology. Expedition leader and cartographer ... in over 30 expeditions ...*

It is published by Max's own publishing label *speleo photo editions* (www.speleo-photo.de) in 2022 and there is a new website entirely dedicated to the book and the cave at www.lechuguilla-cave.info.

The book has:

- 240 pages
- 258 colour photos and seven drawings
- Double-foldout page with 3D model of the cave
- Hardcover 22.5 x 30.5 cm
- 5-color offset print on coated matt premium paper
- Carbon-neutral production
- ISBN 978-3-9821714-2-5

Max Wisshak has also published *New Zealand Karst.* A promo of this book can be seen at https://www.speleo-photo.de/editions.html. There will be a review of this book in the March Journal and a display copy will be available at the conference next May.

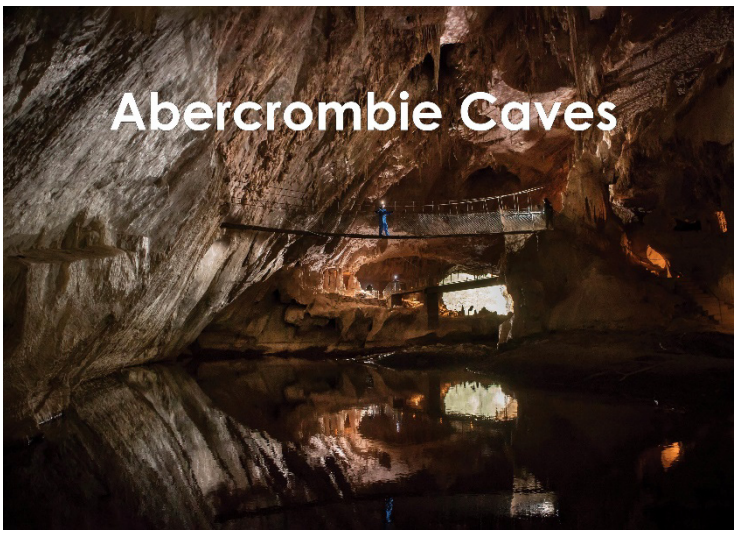
I paid AU$196 for my copy of *Lechuguilla Cave* with about AU$80 being the postage cost! However, it can be ordered direct from Max for EUR59.90 (about AU$93) with and only EUR21 shipping to Australia (AU$33) at the above links. Expensive but beautiful and informative.

Image: Subaqueous pool deposits. Photo Stephen Eginore – used with permission

BOOK REVIEW by Marilyn Scott

Abercrombie Caves, NSW

Garry K Smith



The Metropolitan Speleological Society (MSS) has been researching and documenting the caves at Abercrombie NSW for the past four years and their work has culminated in the soon to be released book "Abercrombie Caves". The caving community book launch will be at the ASF conference in Ceduna in April 2023.

This full colour publication consists of 160 pages of well researched articles covering a range of topics including How Caves are Formed, Karst Management at Abercrombie Karst Conservation Reserve, A Geological History of the Abercrombie Caves Area, Early European Exploration, the Wiraduri Connection to Abercrombie and Bushrangers at Abercrombie.

The publication includes descriptions of all the known caves and eight detailed maps of the major caves. Many of the caves have been accurately resurveyed for this superb publication.

There is a vast amount of new research and documentation in this book as well as references to an extensive list of past research, articles and publications. There is a wide variety of colour photos from many photographers that depict the amazing beauty of the Abercrombie Caves, surrounding karst, flora and fauna.

With contributions from 11 authors and over 190 photographers, graphics and cave maps, this first-class reference book will certainly be the bible of Abercrombie Caves for many years to come.

The book would not be possible without the ASF Karst Conservation Fund grant and the driving force of Beth Little and the MSS support team who took on various tasks during the project. There was also valued input from specialist groups such as the NSW Bird Atlassers, the Goulburn Field Naturalists Society and Wiraduri Elder Aunty Gloria Rogers.

To ensure you don't miss out on this limited edition, take the opportunity to order your copy of this book at http://www.mssadventure.org.au/home/AbercrombieBook, Cost is $45 plus shipping & handling.

For those who are technologically advanced – here is the QR code which can be used to go to the order form.

Is All Well in Subterranean LED-Land?

Andy Spate

The short answer to the above question is – maybe not?

Recently ACKMA conducted an online cave lighting forum with Dr Liz Reed of Flinders University presenting a comprehensive review on 9 October 2022. Unfortunately, the forum was not well attended but the presentations can be seen at http://ackma.org/Forums/cavelighting2022/index.html. Note part 1 is Liz's presentation and part 2 is discussion from the ten attendees.

We recall how excited the cave world was when LEDs came along – cheap 'white' light – cool – energy efficient – long lived – compact sizes – possible lampenflora suppression. All wows!

Now we could see our caves in their natural colors utilizing 'white' LEDs. But the natural color of caves is black! But this is not the only But! White LEDs have a great deal of 'blue' light in their spectrum. Liz looked across the scientific literature and found a number of sources pointing out that blue light can have adverse impacts on invertebrate species and some mammals such as bats. There can be promotion of biofilm growth on fossils, display bones and speleothems generally.

Her work with colleagues at Naracoorte has demonstrated considerable evidence of white LEDs damaging cave biota, fossil bones and speleothems generally.

Liz's research as outlined in the presentations is very comprehensive and far reaching. Her recommendations include:

- Ongoing photo and visual monitoring of biofilms (UV torch very useful – e.g. Eagtac MX3OL3).
- Monitor cave invertebrate populations.
- Test lights in cave – monitor and maintain.
- Limit light duration, tour length, frequency.
- Chemical and physical cleaning – weigh up impact to the natural biome.
- Warm white is better than cool. but they still have some blue.
- Limit light intensity; light placement.
- Apply filters to remove blue peak (LEE filter gels – which are inexpensive).
- Monitor cave environmental conditions know what is 'normal' (baseline).

She points out that lighting solutions are not "one size fits all" in caves.

This short summary of Liz's presentation will be supplemented by a more comprehensive paper to appear in the March Journal. This will also set out proposed guidelines for cave lighting using LEDs.

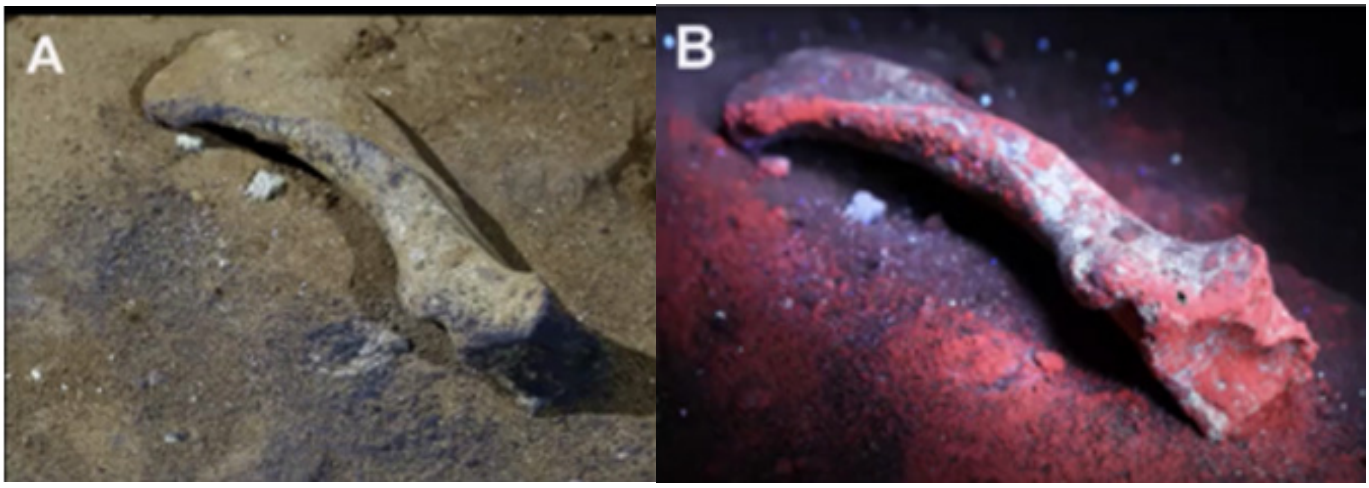


Photo: Liz Reed, Biofilms on bone. A. Cool white LED torch; B. UV torch 365 nm.

ACKMA Conference and AGM, New Zealand 2023

At last – the moment we have all been waiting for over the past several years – an in-person ACKMA conference!!!!!

Takaka, New Zealand, May 21 to 26, 2023

We can now reveal the logo for the upcoming ACKMA Conference!

This is the result of a design competition for students at the local Takaka Hight School. The conference theme is 'Water Underground' and we delighted with the winning entry!

Hopefully you have all booked or are about to book your accommodation option and are thinking about submitting your conference registration!!!

The registration form is available at the end of the journal and is also available on the ACKMA Conference website at http://ackma.org/conf2023/index.html.
You can fill this out, save it and email it to the Conference Convenor at conferenceconvenor@ackma.org
There are also some wonderful photos of the area on the website submitted by ACKMA members which you can view to whet your appetite

Are you thinking about giving a presentation? Have you let the conference organisers know???????

If you would like to present either a paper or a poster and have not corresponded with the conference organisers, please do this **as soon as possible**, as we need to finalise the conference program so we can let you know the exciting details of what is going on in the March Journal!

Nominations for the Ann Augusteyn Award

Open on 16 January 2023

Do you know a cave guide/cave and karst presenter who gives innovative and outstanding tours and presentations? The Ann Augusteyn Award recognises the excellence and outstanding contribution of an individual to cave and karst guiding and interpretation.

At ACKMA meetings and amongst ACKMA members there is often discussion about how we can expand and improve cave interpretation. Recognising the efforts of innovative individuals who give outstanding presentations is one way to help achieve this.

Is there a cave guide/cave and karst presenter who you consider innovative and outstanding? Considering nominating them for the Ann Augusteyn Award.

Full details are at the end of this issue of the journal.

Nominations will close on 13 March 2023. Enquiries to: annaugusteynaward@ackma.org

Congratulations to Andy Baker

Awarded the Clark Medal for distinguished research in Natural Sciences (Geology)

The Clark Medal is named in honour of William Branwhite Clark (1798–1878). An English clergyman and geologist who emigrated to NSW and established the understanding of the state's geology – including the discovery of gold

Professor Andy Baker, of UNSW School of Biological and Behavioural Sciences, has been awarded the Clarke Medal for 2022 from the Royal Society of New South Wales. The nomination was for his karst research in NSW.

He is an international authority in cave science, hydrology and geochemistry, especially as it pertains to our understanding of karst – complex underground systems formed from dissolution of soluble rocks, characterised by sinkholes, caves and stalagmites.

The Clarke Medal is awarded each year for distinguished research in the natural sciences, conducted in Australia and its territories, in the fields of botany, zoology, and geology.

Andy sent the following thanks via email:

"First and foremost, thank you to Pauline Treble for inviting me to join her existing Yarrangobilly research program and team, and the support of Bernadette Zanet (and managers before her) at Yarrangobilly Caves. Sophia Meehan for suggesting that I work in the Macleay, which has led to a fruitful collaboration with the Kempsey Speleological Society. Thank you to Kathryn Crowe and the team there for supporting that research.

Thank you, Sophia, again for her support of fire research on karst in NSW, and David Smith at Wombeyan and all the other NPWS staff that helped make that happen, and all the students, RAs and PhD researchers that did the work.

Thank you to the NCGRT team (Ian Acworth, Martin Andersen, Helen Rutledge, Mark Cuthbert, Gabriel Rau and more) who back in 2011 got behind the 'caves as observatories' program and irrigation experiments at Wellington Caves, and Michelle for supporting the ongoing research there (and managers before her).

Mike Augee, Andy Spate and Andrew Baker were generous with their NSW karst knowledge, thank you!

And now and into the future, thank you to the emerging 'caves as observatories of groundwater recharge' and 'stalagmite records of fire history' teams, including Pauline and her group, Andreas Hartmann and his group, Micha Campbell, Liza McDonough, Christina Song, and Rebecca Chapman. And finally, thank you to my colleagues in the UNSW Analytical Centre who made so many of the geochemistry and isotope analyses that provided the evidence base for all the research, in particular Chris Marjo's team and chief IRMS wrangler Lewis Adler.

Professor Andy Baker. Photo: UNSW.

Links to the Wider World

This section aims to provide links to articles and items related to caves and karst that may lie outside the normal ACKMA sphere of influence but may still be of interest. All links are functional at the time of publishing but may not open if viewing at a later date.

1,000-year-old stalagmites from a cave in India show monsoon isn't so reliable

Gayatri Kathayat, Xi'an Jiaotong University and

Ashish Sinha, California State University, Dominguez Hills

https://www.eastmojo.com/world/2022/09/22/1000-year-old-stalagmites-from-a-cave-in-india-show-monsoon-isnt-so-reliable/

By analyzing the geochemistry of these stalagmites in a new study published Sept. 19, 2022, in the Proceedings of the National Academy of Sciences, we were able to create the most precise chronology yet of the summer Indian monsoon over the past millennium. It documents how the Indian subcontinent frequently experienced long, severe droughts unlike any observed in the last 150 years of reliable monsoon rainfall measurement

Study finds famous Australian caves are up to 500,000 years older than we thought – and it could help explain a megafauna mystery

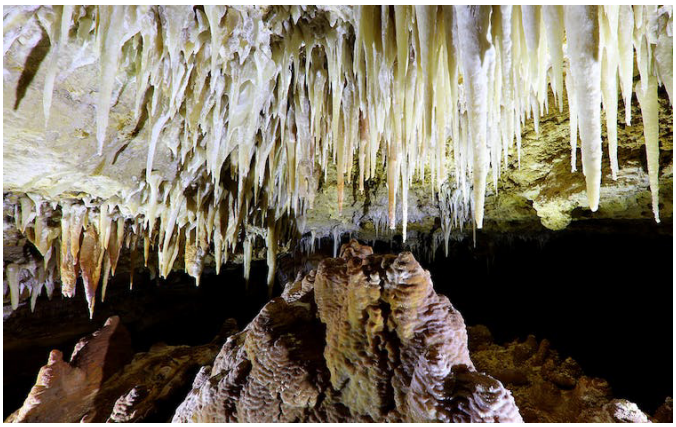
Rieneke Weij, Jon Woodhead, Kale Sniderman, Liz Reed

In The Conversation Sept 27, 2022

https://theconversation.com/study-finds-famous-australian-caves-are-up-to-500-000-years-older-than-we-thought-and-it-could-help-explain-a-megafauna-mystery-190688

South Australia's Naracoorte Caves is one of the world's best fossil sites, containing a record spanning more than half a million years. Among the remains preserved in layers of sand are the bones of many iconic Australian megafauna species that became extinct between 48,000 and 37,000 years ago.

The reasons for the demise of these megafauna species are intensely debated. But the older the fossils we can find, the better we can understand the species' evolution and extinction.



To date, determining the precise age of the caves has been difficult. However our research demonstrates, for the first time, how old Naracoorte's caves really are – and the answer is up to 500,000 years older than previously thought.

Our findings shed new light on the antiquity of this important place. We hope this will aid understanding of how biodiversity responds to a changing climate over time.

Image: Whale Bone Cave, one of the oldest caves at Naracoorte. Photo Steve Bourne

---

UIS Cave Glossary Project

The International Union of Speleology (UIS) has started a project to produce an extendable, multi-lingual glossary of cave and karst terms that is both human-readable and machine-readable.

The project is being run by the Dictionary Sub-commission of the UIS Informatics Commission (UISIC) and aims to create a web- and Linked Data-accessible cave and karst glossary of terms that also provides definitions linked to the terms in the existing Caver's Multi-lingual Dictionary. In the first instance it will start by converting an existing comprehensive and professional glossary into a term-addressable web page, linked to the terms in the Multi-lingual Dictionary. This glossary will also be incorporated into the UIS KarstLink Ontology for *Linked Data*.

Everyone interested is invited to follow or contribute to the project.

Full details of the project can be found on the project's web page and forum:
Web page: https://www.uisic.uis-speleo.org/lexgloss.html
Forum: https://www.uisic.uis-speleo.org/forum/viewforum.php?f=19
Draft Glossary: https://www.uisic.uis-speleo.org/lexgloss1.html
Multi-L Dictionary: https://www.uisic.uis-speleo.org/lexintro.html
KarstLink: https://uisic.uis-speleo.org/exchange/karstlink/index-en.html

Peter Matthews - Project Leader
Mike Lake – Assisting

France HABE PRIZE 2023

The *Karst and Cave Protection Commission* of the *International Union of Speleology* (UIS) is pleased to announce the opening of the PRIX France HABE 2023.

The prize is named in memory and in honor of Dr. France HABE (□10/12/1999) from Slovenia (Yugoslavia), Past President of the Protection Department of the UIS (1973 -1997). The purpose of this prize endowed with €300 is to promote the protection of karst and caves. Their natural heritage is an increasingly rich source of proven information on the history of our planet and of humanity, allowing us to act in a more thoughtful, effective and sustainable way for the future of our environment.

You will find the complete regulations in French, English and Spanish on the UIS website by following this link: http://uis-speleo.org/index.php/karst-and-cave-protection-commission/

Feel free to disseminate widely.
Jean-Pierre Bartholeyns
President

Under the Earth: Caves of Tasmania

Yoav Daniel Bar-Ness for RACT

https://www.ract.com.au/membership/journeys/experiences/under-the-earth-caves-of-tasmania

Tasmania is a significant destination for cave explorers, with some of the deepest and most challenging caves for those who can't resist the call.

These definitely aren't places you'll want to explore alone. They are cold, wet and exceedingly dangerous. They're also delicate and sensitive places that are easily damaged irreparably. Fortunately, here in Tasmania there are caves of all sizes and geologies that are safely accessible for those who are feeling adventurous.

Mole Creek Caves tour (formerly Marakoopa Cave Tour)
Credit: Tourism Australia & Graham Freeman

Hollow Earth: Art, Caves and the Subterranean Imaginary

An exhibition at the Nottingham Contemporary until January 2023

https://www.nottinghamcontemporary.org/whats-on/hollow-earth-art-caves-the-subterranean-imaginary/

A major thematic exhibition which brings together a wide range of responses to the image and idea of the cave. It includes painting, photography, sculpture, sound, installation and video, as well as archives and architectural models, stretching from 1960 to today, alongside works from the 18th and 19th centuries.

Travel

Grotte de Fontrabiouse: highest altitude show cave in France

Garry K. Smith

Member of ACKMA and Newcastle and Hunter Valley Speleological Society (NHVSS)

All images by author

At 1,530m ASL, Grotte de Fontrabiouse (pronounced – Font-ra-boose) is the highest altitude show cave in France. While there are no huge chambers, this cave is jam packed with an amazing quantity of speleothems of all shapes and sizes. Its chance discovery and astounding beauty make it a must see if you are in the south of France.

Location and discovery

Set in the Pyrenees mountains close to the ski fields of Formigueres and Les Angles, this cave system was originally discovered by chance when blue marble was being quarried for material to construct the nearby Matemale Dam. The naturally exposed limestone (marble) surrounding the quarry has almost no signs of fluting nor other solutional weathering as is typical of other karst areas. The narrow discontinuous band of Devonian limestone runs from the Pic du Mèrens in Ariège to Villefranche de Conflent, a distance of approximately 45 km and has a thickness of several hundred metres. Much of the limestone is capped by granite and forest of the Capcir region.

At the time of the quarry operation, speleologists had not been drawn to the area despite there being the raging fountain that gushes from vertical fractures to the north of the limestone, below the elevation of the quarry. The spring, Fontaine Rageuse, (English translation meaning Angry Fountain), has a non-constant seasonal flow and the opening not large enough for cavers to enter. The nearby small village was named after the spring (Henri 2019), however there was no indication of a cave in the area of the quarry.

Blasting at the quarry during 1958 exposed a 20 m deep hole. A constant breeze of cold air gushed from the exposed hole, indicating there was a considerable cave below. A rope was lowered down the shaft and the first to descend was Armand Girona, the head miner of the quarry (Henri 2019). He explored 300 m of cave passage.

Speleologists mounted multiple day expeditions and an uncomfortable underground camp was established. They found extremely well decorated passages, clear pools of water lined with crystals, a flowing underground river (water temperature 5°C), fossil beds, high vaulted galleries and a spacious passage up to 40 m diameter (Henri 2019). In many places the cave walls intersected shale beds and in other places crumbly Silurian schist, being the edge of the limestone. Our tour guide told us that speleologists have now discovered and surveyed around 11 km of passage much of which contains beautiful decorations.

The cave was first opened to the public in 1983 and a new entrance excavated in 1990-91, enabling through tours to traverse the 950 m of well decorated passage.

The Cave Tour

Our tour starts at the reception building (built in 2010), with a short walk up past the abandoned quarry where the first entry to the cave was made. There is now a concrete slab over the original blasted entrance. The track continues up the hill to the right of the quarry. Here the excavated tunnel entrance is concealed by a concrete bunker fitted with a metal airtight door.

When the metal door is first opened we are greeted with a strong blast of chilled air. Inside a steep 70-step metal staircase, lit with strip lighting leads down to the first cave level.

Within ten metres of the door, our guide points out several frogs that have taken up residence in the excavated tunnel. At the bottom of the stairs one is immediately surrounded by calcite speleothems of all description ranging in colour from translucent to pure white through to dark orange and red. Our guide tells us not to touch formations as they can easily be damaged.

Image: Reception Centre at Grotte de Fontrabiouse

Images: speleothems in the Grotte de Fontrabiouse




The tour continues along the passage with our guide pointing out various speleothems and features mentioned on our hand-held audio guide. There are aragonite flowers, dog tooth spar pool crystals, straws up to two metres long and even a butterfly shaped speleothem to name a few. A tastefully lit, crystal clear emerald green two-metre-deep pool next to the track contains stunning pool decorations. Most of the concrete path is reasonably flat with only a couple of spots to duck under low hanging stalactites. Further in we descend another 70-step metal ladder to a lower level that is at the approximate level of the excavated cave exit.

As my partner and I were the only two on the tour at the time, it was easy to take photos although I needed to hurry a little as the tour is normally one hour, however the guide was very patient with my photography and we were only a little over the hour.

We had talking handsets which provided commentary in English, once each station number was punched into the device, however I found most of the cave description talking about speleothems which looked like: a shark, jellyfish, angel's hair, a ghost, organ pipes, flowers, a butterfly etc, etc. This is probably OK for the average tourist, but not very informative if one wants to know more. So after hearing the commentary of just a few stations, my partner took over listening to the audio guide and just told me if there was something of technical interest while I took photos.

Our guide did speak some limited English, however my partner spoke French, so was able to translate some of the technical questions, which I had about the cave. Obviously being in a French show cave, I would not expect the guide to deliver his tour spiel in English nor any other language, so the talking handsets are very helpful for tourists speaking other languages. The audio handsets are available in English, Spanish, Catalan and German.

At one point I was horrified to see our guide play a tune by tapping a number of stalactites with the back of his knuckles. I had visions of one breaking off during the performance, which he obviously was well practiced at and played for every tour.

Most of the track is concreted and well graded, however there are two flights of stairs containing 70 steps each. The steep stairs would certainly be an obstacle to people with impaired mobility.

At one point our guide points up to the original entrance now blocked (by concrete) 20 metres up a shaft where the first opening was made into the cave. It must have been a big thrill for those first exploring this cave to descend into such a wonderful place. However, the force of the quarry blast which first exposed the cave, had obviously caused the breakage of some stalactites in the passage directly below the shaft. This would be expected as a consequence of the blast.

Toward the end of the tour, our guide points out a pit that has ropes dangling down into some lower passages. He said that this is where speleos descend to explore another 10 km of passages not open to the public.

Then a little further on there is a human skeleton mannequin wearing an old helmet and carbide light. Our guide points this out as a caver who did not make it. This would certainly get a good laugh from the average tourist.

The tour finishes at an exit door that opens into the bottom level of the cave's reception centre. A short flight of steps brings us to the ticket sales counter and shop selling a range of souvenirs, rocks (fossils and crystals – thankfully no speleothems), wine, biscuits and a small selection of snacks.

Management issues from an outsider's perspective

There are very minimal barricades to protect speleothems from being touched or damaged by tourists, so one can only hope that the decorations remain in pristine condition into the future. One saving grace may be that most of the delicate decorations are just out of reach of the average tourist. However, there are plenty of speleothems which tourists brush past or duck under, so discolouration or damage will occur in this cave over time. The lack of fences and protective barricades from a photographic and aesthetic point of view is excellent.

The playing of tunes on the stalactites, sets a very bad example for the general public who are told at the start of the tour not to touch the formations (called concretions by the guide). Over time the stalactites which are being thumped to make a tune will become discoloured if they don't break first. This practice of tapping stalactites to play tunes, I thought had been discontinued years ago by the tour guiding fraternity, but it appears not so. I just hope these stalactites don't end up like many others used in the past to play music in other caves around the world.

Our guide explained that as we pass each section of the cave the lighting turns off after three minutes to reduce the likelihood of lampenflora. I could not ascertain quite how this worked as some areas we were in more than three minutes, so there must be motion sensors that I could not see. Whatever the system, it is working as there was not the slightest sign of lampenflora throughout the cave.

The cave temperature was around 6°C which is quite cold for a show cave. I saw no advertisement to tourists to wear warm clothing. We were warned in advance by a previous tourist to take warm clothing which we certainly needed, or my knees would have been knocking together before the end of the hour-long tour.

Photography with or without a flash, is permitted which is great as one can come away with captured memories of the experience. I will say that our guide was very accommodating in allowing me to take photos on the run. It may have been a little different if there was a large group on the tour.

Alternative tours – visitors are also offered cave tours with a step back in time theme, using only the light of carbide (acetylene) lamps. Each adult is supplied with a portable carbide lamp and for safety children under the age of 12 years are supplied with a helmet with a battery-operated headlamp. I can't really comment directly on this tour as I did not experience it, however if I draw on experiences from other similar tours (Smith 2012), I would expect to see a lot less of the cave using this type of lighting. Also, if in a large group, there is the possibility of singed clothing from the naked flame shooting out the front of the lamps. I do have concerns that fumes and soot emitted from these lamps may cause long term issues in the cave.

Site Management

The original marble quarry site and its operation was owned by the Fontrabiouse community and when the cave was discovered they (as owners) took care of its development and managed it up until 2010.

Through an arrangement called, "Delegation of Public Services" the town passed the management over to a private company to run the commercial operation (for an annual rent as well as a fee on entries). Since 2010 the developed part of the cave has been managed by Societe D'Exploitation Touristique De Sites Naturels (SETSN) roughly translates into English as "Company for tourist operation of natural sites". The company (created in 1987) has been in business for 35 years and specializes in the management of historic sites, monuments and similar tourist attractions.

Getting to Fontrabiouse

Pretty well the only way to get to Fontrabiouse is drive yourself. We approached from the east via Perpignan, Prades and Mont-Louis along the N116 highway. This highway is in good condition, most of which has a speed limit above 90 km/h, until reaching Villefranche-de-Conflent. From here the N116 begins climbing steeply up the beautiful valley alongside the Tet River to Fontpedrouse. The road then becomes extremely windy with hairpin bends and gradients up to 10 degrees as it snakes for 10 km up to Mont-Louis and a further three kilometres to La Llagonne. The last 19 km to the cave is along a wide-open valley with very few climbs and relatively straight road. Local drivers can be impatient and will overtake on blind corners if you don't drive fast enough.

Tourist information advertises the cave with driving times of 30 minutes from Font Romeu, 20 minutes from Mont Louis and 10 minutes from Les Angles.

If you have time on route, it is worth investigating the old towns and villages with narrow cobblestone streets and well-preserved building surrounded by fortified stone walls, many dating back to pre-1600s.

Tickets and opening hours

The cave is open daily to visitors from 2nd January to 1st November (the last day of All Saints' holiday) and from 5th to 30th December. Opening hours are between 10.00 – 12.30 and 14.00 – 17.30. Like most shops and businesses in France, the caves reception centre/ticket office/shop is closed between 12.30 – 14.00. When open the caves shop sells coffee, hot chocolate, and soft drinks with a small selection of snack food.

Tours times are: 10.30, 11.30, 14.30, 15.30 and 16.30.

Ticket Cost: Adults €13.50, <18 yo. €12.00, <13 yo. €7.80 and <5 yo Free, Student and Pensioner >65yo. €11.50, **Carbide lamp tours**: Adult: €19.90, Youth (14-17 years old), €17.90, Child (under 14 years old) €15.90. Not suitable for toddlers. Equipment provided: Acetylene lamps and electric head torches for under 12 yo.

Web Site: www.grotte-de-frontrabiouse.com – Tickets can be purchased online

Address Rue des Soulanets, 66210 Fontrabiouse.

Phone +33 (0) 468309555,

Email: fontrabiouse66@gmail.com,

Other high altitude show caves in Europe

The Wendelstein Höhle (pronounced ven-dell-styne hooler), in the far south of Germany at the eastern end of the Bavarian Alps has a natural cave entrance at 1,711 m ASL, making it the highest altitude show cave in Germany (Smith 2013).

Eisriesenwelt (pronounced ice-ree-sen-velt) in the Austrian Alps is reputed to be the largest ice cave in the world. However, in reality this cave is a limestone cave, which contains ice decorations all year round. The main entrance is approximately 1000 metres above the Salzach Valley at an elevation of 1,641 m (Smith 2012).

Acknowledgment – Thankyou to Katerina Fulton for checking this article.

References

Henri S. (2019) FONTRABIOUSE A man: Jean Bernoles - A cave: Fontrabiouse, Bibliography Archives personnel (salvayre@orange.fr.) Contribution of the Departmental Archives Services.

Smith G.K. (2012) Eisriesenwelt Ice Cave, ACKMA Journal 87, 16- 20.

Smith G.K. (2013) Wendelstein Höhle (Cave), Bavaria, Germany, ACKMA Journal 92, 29-31.

ACKMA Inc.
Australasian Cave and Karst Management Association Inc.

Ann Augusteyn Award

The **Ann Augusteyn Award** recognises the excellence and outstanding contribution of an individual to cave and karst guiding and interpretation. Nominations for the award will be open biennially.

Nominations for the Ann Augusteyn Award will open on 16 January 2023 and close on 13 March 2023.

A celebration of Ann Augusteyn

Ann and Ken Augusteyn bought the then Olsens Caves in 1988 and embarked on a journey to further develop and promote the caves which were renamed Capricorn Caves. Ann and Ken, assisted by their family of John, Robert and Helen, worked to modernise the show cave experiences, develop accommodation facilities, provide for greater community connections with the caves and support science research.

After Ken's passing in 2008, Ann continued their vision with a special focus on guide-development and assisting guides to develop engaging cave visitor experiences. Ann was a supporter of ongoing training and development and exposing guides to new and practical ideas to enhance their guiding.

Ann died suddenly in 2018 and ACKMA determined that her efforts to promote vision, excellence and new approaches in cave guiding and presenting should be celebrated and progressed.

ACKMA Inc.
Australasian Cave and Karst Management Association Inc.

Ann Augusteyn Award

Prize

Associate Professor Julia James has donated a shield which rotates from one award winner to the next, with the award winner's name engraved on it.

The award winner will also receive:

- The honour of being recognised by their peers.
- A certificate.
- A year's membership of ACKMA.
- A book prize relevant to caves and karst.

Award criteria

Anyone can nominate an individual for this award. For an individual to be eligible they need to meet the award criteria:

- Be a member of ACKMA or work for an organisation that is a corporate member.
- Show commitment to cave and karst guiding and interpretation.
- Demonstrate leadership in developing new and engaging ways to interpret caves and karst to the community.
- Share with and assist others to further develop the profession of cave and karst guiding and presentation.
- Adapt their cave and karst presentation so that it is relevant to varying audiences.

To make a nomination:

To nominate an individual please provide the following information:

YOUR DETAILS
Your name, full contact details and professional relationship (if any) with the person being nominated.

PERSON BEING NOMINATED
For the person being nominated please include:

- Their **name, workplace and workplace address**.
- A description of their **cave and karst presentation work** (maximum 250 words).
- **Why you believe they deserve this award**. Please refer to award criteria (maximum 250 words).
- **Supporting documentation** such as video, photos and other documentation (maximum of five documents).
- Names and full contact details of **three professional referees**, including each referee's relationship to the nominee and how they know of the nominee's work as a cave guide, interpreter or presenter. Please think broadly here as a referee does not need to be a speleological expert or have been a cave guide to appreciate excellence in cave and karst guiding and presenting. Referees with a variety of backgrounds relevant to cave and karst presentation are encouraged

Keep Your Nomination Secret

Please note that the award committee would like to keep nominations 'a surprise' until the public announcement and encourage people making a nomination to support this.

For enquiries and to submit a nominationplease email: AnnAugusteynAward@ackma.org

Takaka 2023 21-26 May 2023

Theme: Water Underground

Conference booking form

Who are you?			
Name			
Affiliation / background Published in conference handbook			
Postal Address			
Email		Pref. phone no.	

What will you do?			
Paper ( ) Poster ( ) Tick one. Refer to paper guide	Title:		
Where will you sleep? Refer to accommodation guide			
Arrival date	# nights ( )	# extra adults ( )	# extra children ( )
Accomm. Name:		Room Type:	
If shared, who are you sharing with?			

How will you get here?			
Pre: Saturday 20th – Minibus Nelson to Takaka	# seats ( )		
Arriving Sunday pm – bus Nelson to Takaka Included in Registration	# seats ( )		
Departing Saturday am – bus Takaka to Nelson Included in Registration	# seats ( )		

Pre and Post conference options	
Please bring your own Helmet, Light SRT gear, and cold cave personal clothing	
Pre-conference wild caving (own meals and accommodation) Limit 20	# places ( )
27 28 May Post-conference Pakawau (pay as you go) Limit 20	# places ( )

Conference Convenors: Pete Chandler and Neil Collinson
Committee: Libby Chandler, Chris Stevenson, Kieran Chandler
Email: conferenceconvenor@ackma.org
Phone: +64 7 8787621

Conference fees		Your cost
Registration ACKMA Members	NZ$600. Includes lunch and dinner, in-conference transport, venues and many little extras. Includes Sunday pre-conference dinner, Wednesday and final Friday dinner.	
Registration Non-ACKMA Member	NZ$650. Inclusions as above	
Day fee	Please advise which days as costs vary (you will need to add this after consulting with the Conference Convenors)	
	Please advise if you have accompanying family/friends: # people ( )	
Breakfast	Not provided, there are a range of cafes in the Main Street, many accommodations have kitchen facilities	
Total	NZ$	
After 1 April 2023	Add 10% late fee (multiply total x 0.01)	
Credit Card	Add 3% surcharge (multiply total x 0.03)	
Total	NZ$	

How to pay – 3 options		Tick option
A	Australian dollars into an NZ account. 1. Deposit to WPAC NZ2W 03 – 0449 – 0118375 – 000 Please use your surname in the reference codes and also email details to the Conference Convenor	Exchange rate used (… ..)
B	New Zealand dollars into a New Zealand account 2. Deposit to 03 – 0449 – 0118375 – 000 Please use your surname in the reference codes and also email details to the Conference Convenor	
C	Credit cards. Add 3%. Advise, securely, the Conference Convenor of your: card type, account name, expiry date and card number.	

Other details

Please advise the Conference Convenor here if you have any special requirements e.g., dietary, disabilities, invoice required

For presentations, the Takaka High School Assembly Hall has a large screen and IT facilities.
The floor is carpeted, so acoustics are very good

Please also indicate if you have family or others who might like to participate in meals, cave trips or alternatives. We will contact you by email.


© Max Wisshak