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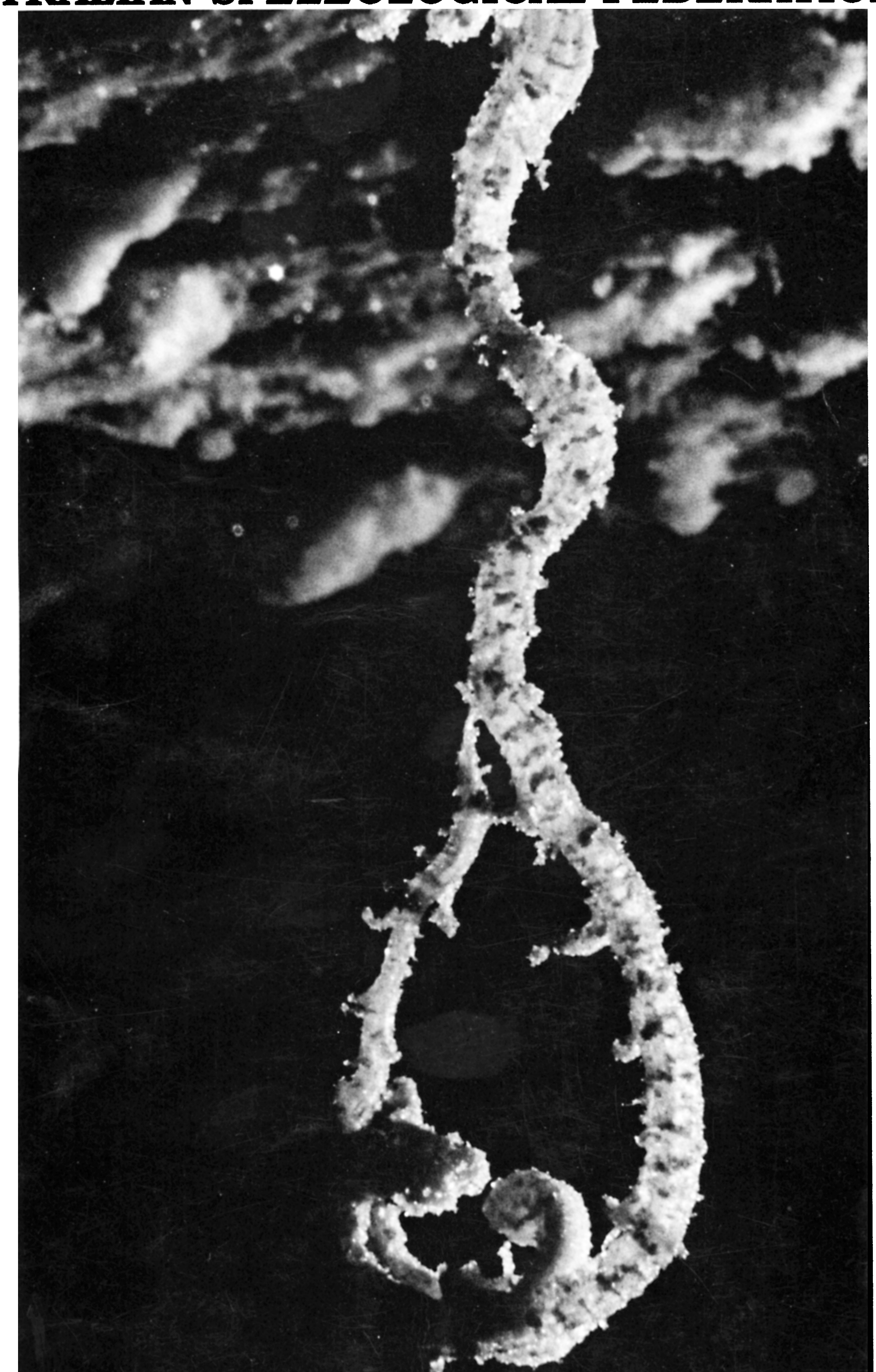
Helictite

JOURNAL OF AUSTRALASIAN CAVE RESEARCH

PROCEEDINGS - 16TH BIENNIAL CONFERENCE AUSTRALIAN SPELEOLOGICAL FEDERATION INC.



Halite, Nullarbor (1st Prize, Speleothems)
Photograph by Ken Boland

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Helictite was founded by Edward A. Lane and Aola M. Richards in 1962.

This Journal was (and is) intended to be wide ranging in scope from the scientific study of caves and their contents, to the history of caves and cave areas and the technical aspects of cave study and exploration. The territory covered is Australasia in the truest sense – Australia, New Zealand, the near Pacific Islands, New Guinea and surrounding areas, Indonesia and Borneo.

In 1974 the Speleological Research Council Limited agreed to support the Journal with financial assistance and in 1976 took over full responsibility for its production.

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- a review of Speleological Investigations in the Nullarbor ,Plain.

THE EXPLORATION AND SPELEOGEOGRAPHY OF MAMMOTH CAVE, JENOLAN.
J.R. Dunkley 1972. - a detailed history and description.

CAVES THROUGH THE AGES. G. Hangay, J.M. James & M. Dorrell 1974.
- a colouring book for children.

PAPUA NEW GUINEA SPELEOLOGICAL EXPEDITION NSRE 1973. J.M. James 1974.
- the report of the 1973 Niugini Speleological Research Expedition to the Muller Range.

A BIBLIOGRAPHY OF THE JENOLAN CAVES. PART ONE: SPELEOLOGICAL LITERATURE.
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THE CAVES OF JENOLAN, 2: THE NORTHERN LIMESTONE. B.R. Welch (ed) 1976.

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Expectations of Classification and Management of Victoria's Caves - N.J. White

Vicarious Caving through the Literature - S. White

Cave Exploration in New Zealand - Susan Cade

(These papers are not subject to the normal Helictite refereeing process.)

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Affiliation Codes

BCA	Baptist Caving Association
CCC	Chillagoe Caving Club
CCOG	Campbelltown Caving & Outdoor Group
Endeavour	Caving & Recreational Club
HCG	Highland Caving Group
ISS	Illawarra Speleological Society
KSS	Kempsey Speleological Society
MSS	Metropolitan Speleological Society
MUCG	Macquarie University Caving Group
NC	Northern Caverneers
NSS	National Speleological Society (USA)
NSWITSS	NSW Institute of Technology SS
OSS	Orange Speleological Society
RANCA	RAN Caving Association
SRGWA	Speleological Research Group of W.A.
SSS	Sydney Speleological Society
SUSS	Sydney University Speleological Society
UNSWSS	University of NSW Speleological Society
UQSS	University of Queensland Speleo. Soc.
VSA	Victorian Speleological Association
WASG	Western Australia Speleological Group.

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SPORT AND SCOUT CAVING - THE PRESENT DILEMMA

Evalt Crabb

Abstract

This paper traces the evolution of organised caving as a post World War 2 phenomenon, and the changes in practice and attitude that have occurred. These practices are contrasted against stated behavioural codes.

Parallel to this, the development of caving as a scouting activity is discussed, with reference to the general principles and practice of Scouting.

The author has been working toward evolving policies and practices within scouting which are consistent with the needs of conservation and the underlying philosophies of scouting. Implementation of these new attitudes in one Area is fully detailed, with some comment on the success and acceptability of the programme. This training programme is contrasted against the foreshadowed NSW Branch Policy on Rock-Related Activities.

The sequential discussion highlights some weaknesses within clubs and ASF, particularly in our methods of communication. There are no firm proposals, but possible directions for future discussion are indicated.

It is the intention of this paper to give an historical perspective to some of the present perceived conflicts; in reality, the only conflict is between our oft-expressed aim of conservation of caves (i.e. safeguard the karst heritage of Australia), and our visible activity - use of caves for recreational activity. Both the intensity of expression of our concern, and lessening of self-constraint on recreational activity have greatly magnified with time; we are fast approaching a 'crossroads' scenario where our credibility is at great risk.

Caving in Australia as a semi-organised recreation is a post World War 2 phenomenon. From first settlement to the pre-war period, cave discoveries and exploration were usually tied to another activity, such as prospecting for mineral resources, development of tourist caves (due to transport limitations, these were often developed for a local market), accidental finds; in the later years of this period some bushwalkers visited caves as part of their excursions. Conservation as an ethic was seldom considered, and then only in the context of preserving some speleothems to maintain viability in tourist caves.

The immediate post-war period heralded a great change - motor cycles and cars became more freely available, freeing bushwalkers from the constraints of rail transport. By the early 1950's, a few walkers were becoming cavers, fascinated by the unique environment and motivated in part by a need for 'wilderness' or rather, 'wildness' experience. There were no tutors, available literature was extremely primitive by today's standards, leading to an intense quest for knowledge using perception, observation and deduction. Cavers were so enthused that many others were encouraged to share the experience. Groups merged to become clubs, and by 1956 clubs had corresponded, leading to the formation of ASF as a means of communicating nationally.

Most of the caves explored and re-explored during this period had been subject to earlier vandalism and damage; among the new cavers driven by their curiosity, a protective sense developed, wanting to limit cave damage to that sustained much earlier.

Recognising that only people damaged caves, a basic theme was developed - the difference between "them" and "us". "They" vandalised caves; "we" did not, in fact "we" protected them, and many cave owners or managers were persuaded of the correctness of this theme. The only criteria for being regarded as a responsible caver was membership of an acceptable club. Early attitudes to conservation were shaped around the policy that only recognised caving clubs should have the right of access to caves, and further, this was an inalienable right rather than a privilege.

Rapid industrial and commercial growth in the late 1950's and early 1960's created a massive pressure on limestone resources - building construction and steelmaking had a priority high above the need for caves about which little was known. A reaction from the caving fraternity was to claim "scientific value" and "preservation for future generation". The conservation movement was born, using hastily gathered information to support objections to any proposed changes to the status quo of limestone deposits.

People looking for a cause joined with cavers concerned for their freedom of access to caves, strengthening the club structure that existed. New clubs emerged, absorbing the messages of the new conservaion culture; interest in caves was diluted by reaction to the perceived risk to rights of access.

The increased affluence of the boom period, the expansion of tertiary education facilities with their sports promotion and improvements in access roads led to a wider acceptance and demand for caving as a recreational activity. The earlier motivation of curiosity about caves gave way to giving caving a go because it was different - awareness of landscape and its components gave way to passing through landscape quickly to get to a unique site. This evolutionary phase was well developed by the early 1970's, when other factors came into play.

Scientific study had been a component of cave usage from the earliest days of the Colony - fossil bones were noted at Wellington, NSW in 1830. Subsequently, research work centred around geological studies for possible mineral exploitation, and individual workers from universities and museums.

With the development of caving clubs, "scientific study" became an all-embracing catch-cry to justify access to caves, to oppose quarrying operations, and even for clubs to claim exclusivity to sites. If we examine this "scientific study" closely, we would find that it usually amounts to little more than interested ovservation; interpretation is usually incomplete and hypotheses are seldom tested. Publication is random and usually irretrieveable.

Although these comments seem harsh, no criticism is intended to the practice of observation of cave phenomena by members of caving clubs; such behaviour is to be praised.

Comparison can be drawn to the actuality of recognised cave research. Although the various workers may be members of caving clubs, they are seldom "active members". Their field work is usually with a few non-club companions; their behaviour usually causes minimum impact on the cave environment.

Conservation campaigning continued well into the 1970's, sometimes successfully, sometimes not. Arguments presented were emotionally charged; the scientific reasoning could be questionable. It took the non-caving fraternity to bring conservation and environment awareness to its present advanced state in such aspects as plant community integrity, genetic diversity, habitat, etc. Caving, per se, has been left behind in this gathering and dissemination of environmental knowledge.

The most dramatic change in caving practice and attitudes started during the late 1960's, and is still evolving. This was the swing away from using ladders for vertical descents and ascents, initially to abseiling into caves, then the later development of single rope ascending techniques. It is undeniable that these newer techniques are far safer and more convenient when used appropriately. Gruelling 14 hour trips into deep caves could be accomplished in 4 or 5 hours, minimising risk of exhaustion or hypothermia; a far greater vertical range could be covered in expedition caving with the same weight of equipment; the dimensional limit of endurance is greatly extended.

Through the availability of reliable lightweight rope and a range of equipment, abseiling as a sport was developed and promoted through the 1970's, up to the present day. The thrill of abseiling could be enjoyed anywhere, from the use of cliffs to buildings, bridges and inevitably caves. The intrusion of abseilers into caving clubs, and cavers almost universally adopting abseiling has completely changed the character of caving activity. Caves are no longer observed and cared for - they are merely used as a site for thrill activity and as such suffer massive human impact.

It is possible to draw an analogy between many cavers and novice photographers - most novice photographers buy the most technologically advanced camera that they can afford, spend endless hours crooning over the features of their toy and waste endless film taking meaningless snapshots. The camera is never seen simply as a tool toward graphic communication with other people. Similarly, nowadays cavers are equipment minded but do not know very much about caves.

Scout caving echoes the evolution that has occurred in mainstream caving, and that is particularly sad because of the traditional basis of Scouting's programmes.

Until the mid 1970's, scout caving did not constitute a major pressure on caves. Certainly, Venturers (formerly known as Senior Scouts) did go caving, and all degrees of responsibility to caves, the environment and other people were displayed. Participation level was low due to the limitations of distance/travel cost, the low level of cave awareness, and the limited capacity of voluntary leaders.

The growing affluence of young people and the development of abseiling enabled many more Venturers to undertake activities with a higher risk than simple hiking and camping. Within the community, there were fewer people with enhanced outdoor skills prepared to volunteer for scouting leadership, and this tended to lower standards. The relatively brief training given to scouting leaders can never be a good substitute for life experience in outdoor skills.

As the accident rate grew, the automatic response was to introduce more qualifying and behavioural rules. Thus NSW Branch policies were promulgated for abseiling, caving and rock-climbing. These policies were drawn up within the Scout Association with virtually no outside consultation, and seemed to be based on the premise that caving was dangerous because abseiling was an integral part of the activity. It was, because scouting made it so.

With some notable exceptions, scout caving progressed along the previously mentioned lines - using caves as an activity site, using an internally assessed leadership qualifying with outside reference point.

Inevitably, by 1985 the quality of scout caving had declined to a stage where NSW Branch called a halt until new policies could be prepared. Over this period, the accident rate was quite high; to be fair, many accidents (not notified) occurred on phantom trips. Again, to be fair, many good leaders gave Venturers a positive and worthwhile caving experience.

During 1985, I was able to run a caving trip for Venturers, and this subsequently developed into a scenario where I was able to contribute to development of scout caving in an Area. The basic programming tenets of scouting were used as background; learning by doing, in small groups, with an outdoor orientation; developing one's skills to be able to help others, improving perception and observation, looking after natural resources. This was codified into policy form, the proposed Area policy having as its aims:

1. To encourage caving activity with an emphasis on observation, understanding and recording of cave-related phenomena, in diverse caving areas.

2. Using deliberately selected caves, provide primary training in physical aspects such as body use, total darkness, foul air, fatigue, climbing skills, helping each other and environment awareness. It is expected that this primary training would occur in the field, in small groups.

3. Develop leadership skills in leaders in such aspects as recognition of the leader's role, sense of responsibility and a continuum of cave education.

4. To ensure the safety of Venturers, for whom caving is only one of a broad range of activities, develop a cave/leader classification system, limiting exposure to extremely hazardous caves or techniques more appropriate to specialist speleologists. To this end, any climbing technique without secondary safeguards should not be used.

5. For conservation reasons, to limit practice and enjoyment of abseiling and use of mechanical descending and ascending devices to non-cave sites.

For sake of brevity the enabling procedures are not detailed here; also, point 5 has since been diluted by user demand.

I abandoned the previous concepts of pre-caving lectures in halls, on the basis that young people are not in scouting to go to school. I chose instead to simply visit Venturer units and explain what the camping conditions would be, what basic equipment is required, etc.

These concepts were tested on trips with Venturer units - party size was kept to a maximum of five, and descriptions of the origin of caves, hydrology, structure of the caves, biology and sedimentology were the subject of yarning on the way to caves and slowly moving through caves. Safety precautions were taught by example, such as finding your way using whatever secondary source of light was available.

This was the approach for beginners; where Venturers had previous and showed impatience with the concept, they were persuaded to act as party leaders of a small group, assuming responsibility for instruction and safety. This action thrust a sense of responsibility onto young people who had previously been blind followers in higher risk situations. Naturally, these exercises were carried out in a sequence of known caves with identifiable and avoidable hazard spots.

The results were far better than expected - the young people responded by wanting to know more and more, and were learning to work as a close team. A checklist of cave observation was produced and distributed on trips, greatly extending the range of phenomena to be observed. As an example - postulating on the source of different sediments led to a greater understanding of cave processes. Noticeable improvements occurred in increased self esteem, and person-to-person communication.

The next step was to develop a similar, more advanced programme for leaders. This was more difficult; the activity motivation for many adults had been to try and be a leader of "indian file" scenarios. Patience was required to convert that attitude to one where the leader's role was as resource - the explainer, the first-aider, the encourager - allowing the young people to develop themselves among their peers.

Meanwhile, NSW Branch will shortly promulgate a new policy for Rock-Related Activities, drafted with little or no outside consultation, and with little opportunity for submission or discussion. These draft policies appear to offer no change of philosophy, being merely a re-arrangement of older material, modified communication lines and the deletion of "ASF" as a prefix to a few caves. Further communication is occurring.

This experience of the last year has highlighted many perceived weaknesses in our own structures and behaviour.

How often, on club trips, do parties of whatever size simply "trog a cave" and/or go on to "do" another cave, etc.? We read this constantly in club newsletters - seldom do we read of action following aims and objectives stated in the many constitutions. Yet we resent the tag "hypocrite". Prospective members in many clubs are expected to do so many hours caving to become a member. The quantity is defined, but what about the quality? And who would be the judge?

The structure, role and recognition of clubs is untouchably sacred. Yet every advance that is made philosophically, scientifically or in communication has been developed and promoted by individuals - the club is irrelevant. An ingrown, tightly bound club structure serves to inhibit development, and evolves ultimately to the level of the lowest common denominator. We may have such clubs.

We encourage groups to become Associates of ASF so that they may be positively influenced. By what? By the codes that have been developed, published once many years ago but now not easily retrievable? We should, but apparently can't decide to, ensure that any material of any value remains easily available. Nor can we find simple authoritive explanations of the origin and evolution of caves, a simple outline of many features such as sediments, fossils, bone material, biology, meteorology and many others. We pretend to promote an interest in cave observation or science, but haven't ensured that resource material is at hand.

We need to think out what we are doing, and at what cost. We may need to re-define our aims. Most of all, we must first recognise our complacency.

In conclusion, I pose the rhetorical question - Why did we work so hard to save Colong from the bulldozers - was it so that we could slowly kick the cave to death ourselves?

THE CLEANUP OF WEEBUBBIE CAVE

Norman Poulter

Abstract

For many years Weebubbie Cave had been used as a water resource.

This utilisation ceased somewhere around 1984.

Although the active pump and piping were removed, the debris of previous exploiters remained. The description is given of the methods employed to remove the debris based on experience gained from an earlier cleanup in the Yallingup tourist cave.

Weebubbie Cave 6N-2 is a large collapse doline located on the Hampton Tableland of the vast Nullabor Plain some 14 km north of Eucla near the Western Australian border. The region is arid with an average rainfall of 125mm per year, although it has been known to fall (all) in one day. With summer temperatures sometimes reaching 50 degree C, water is essential for survival. The predominating vegetation of saltbush and bluebush is well suited as stock feed.

HISTORY

Although now an acknowledged Aboriginal Site, Weebubbie was not sighted by European Australians until Clayer and Juncken, employees of the South Australia Telegraph Department, chanced upon it early in 1900 and lodged an application in June of that year for an 80,000 acre(32,375 hectares) grazing lease which included the cave. In their telegram of application they mentioned the discovery as a:

"large subterranean lake 200 or 300 feet below the surface near Eucla".

A deposit of five Pounds accompanied the application.

With a rare display of governmental speed and foresight, the Surveyor General, on 2 August 1900 placed a temporary reserve of 5000 acres around the cave while at the same time granting Clayer and Juncken a lease of 40,000 acres that bordered the reserve.

Citing a South Australian graziers opinion that the cave's saline water was suitable for stock, Clayer and Juncken stated that their find would be of immense value for potential grazing in the region and with all the ornamental language of the period therefore asked (as compensation for the 'loss' of the cave) for a reward, the amount respectfully left to the Surveyor General's discretion.

Inter-departmental correspondence indicated that the Government favoured a reward for the discoverers and suggested to them that they nominate a suitable sum subject to a favourable report by a government appointed inspector as to the quality of the water.

Much gasping and eye rolling must have resulted when Clayer and Juncken duly applied for a reward of 500 Pounds, approximately $26,300 by today's value.

Not surprisingly, the well oiled wheels of government suddenly froze and despite much telegraphic prodding from Clayer and Juncken as to when a government inspector was going to visit the area to sample the water, no one was forthcoming. Not to be daunted by the government's un-explained apathy, Clayer and Juncken persisted, but to no avail, until circumstances placed a seemingly suitable government employee in the area.

From March 1901 John Muir (Inspector of Engineering Surveys PWD) led an expedition to examine the country between Kalgoorlie and Eucla in relation to either constructing a future transcontinental railroad direct to Eucla (from Kalgoorlie thence to Tarcoola SA) or sending a 50 mile (80km) spur line south from the railroad to Eucla. The main reason behind such a plan would have been to carry supplies for the railroad construction utilising the already existing Eucla jetty.

The mind boggles as to what would have happened to the region (and the caves) if such a railroad came to fruition. Imagine though, going caving at Weebubbie by air-conditioned train.

Muir was persuaded by Clayer and Juncken to inspect the water and forward his opinion to his superiors. Muir duly inspected the cave, concluding the lake to be a:

> "small underground reservoir" due to the
> "impervious character of the surrounding strata."

Much to the disgust of Clayer and Juncken, Muir's October 1901 report, accompanied by three interior photographs of the cave, claimed the estimated three million gallons of highly mineralized water not suitable for stock.

No doubt a much relieved Surveyor General telegraphed the luckless pair that on the strength of Muir's report - there would be no reward.

Despite protests from Clayer and Juncken that Muir's observations were no more than casual and that he was not qualified to pass judgement on such an important issue, the government remained deaf and shortly afterward Clayer and Juncken faded from the scene.

But the needs and attitudes of government are manifold and change with time. On 23 December 1927, a proposal was made that the temporary reserve be given permanent status and leased (for watering stock) in an effort to raise money from the resource.

Subsequently, on 4 January 1928, Water Reserve #19713 (2560 acres) was leased to JD and O. D. Jones for grazing purposes under section 41a of the Land Act 1898. The fee was 10 shillings per year subject that the general public have free access to the water.

The lease to Jones was cancelled on 24 December 1930 due to non-payment of one Pound five shillings lease fees. The cave was re-leased to M. O'Sullivan of Kalgoorlie shortly afterwards. The period of this lease is not known.

During 1964 there was a minor panic when, on reference to Army 1:250 000 survey maps, it was discovered that the cave was no longer in the centre of the reserve that had been thrown around it. In fact - it was quite a respectable distance outside the boundary.

The pantomine that must have resulted from that revelation would have done justice no doubt to a latter-day 'Yes Minister' script before the error was rectified later in the year.

Before we leave this historical gem of comedy and for those who may be interested in precision surveys, below is the official 1967 description of the cave reserve boundaries:

> "All that portion of land (being about 2560 acres) with (Weebobby) cave as its centre bounded by lines starting from a point situated about 987 chains and 53 links west from north east corner of pastoral lease 393/512 (Moopina) and extending south about 160 chains; thence west about 159 chains and 98 links thence north about 160 chains and thence east to starting point".

In July 1976 the reserve was metricated to approximately 1035.9952 hectares. Up until 1964 the cave had been periodically referred to as Weebobby. The name Weebubbie did not appear in official corespondence until 15 February 1967 when F.E.B. Gurney sought permission to use the cave to water stock on his nearby Moopina Station property. Formal approval of the name Weebubbie was granted on 8 April 1968 following representation from David Lowry, then of the W.A. Geological Survey.

On 3 July 1967 the PWD Under Secretary for Lands advised the Lands and Survey Department that they had no objection to Gurney leasing the Weebubbie reserve provided that the public still had free access to the cave.

However, there is no record that Gurney took up the lease, suggesting that he utilisied the water for the Eucla Roadhouse illegally. In April 1985 the Gurney lease at Moopina Station (valid to the year 2015 at $283.99/year) was cancelled due to non-compliance of conditions and the Gurneys left the region.

THE CLEANUP

Weebubbie Cave was in use supplying water to the nearby Eucla Roadhouse (legally or otherwise) until 1983-4 when the current owners sank a bore within the confines of the Eucla complex obtaining better quality water, thus enabling, with the aid of a $30,000 reverse osmosis process to advertrise fresh water - ordinary soap lathers in the 20c per minute showers. Presumably, at much the same time, the managers removed the pipe casing from the roof of the cave, casting that had long marred many a picture of Weebubbie's main lake.

The surface debris, in the form of water tanks, pump house, timbers and other miscellaneous junk still remain. Most, if not all of the rubbish actually in the cave is reputed to have been used and later dumped there by the Main Roads Board when they sealed the Eyre Highway during the 1960's.

It had long been known that both lakes of Weebubbie Cave contained debris of past water pumping and tourist operations and it was this rubbish that SRGWA was concerned about when it became obvious during the SGR Nullarbor Expedition of Sept. 1986 that the cave was no longer used as a water resource. It was then speculated that a multi-society Christmas cleanup trip was possible.

Such a plan was put to the Dept. of Conservation & Environment Cave Working Group in mid-October along with the view that the status of the cave be changed so that it could be re-vested from the Lands Department to the Department of Conservation and Land Management (CALM). The cleanup proposal was endorsed and invitations for assistance sent out. The response, although not overwhelming, was sufficient to allow the project to proceed.

Material assistance was solicited from various government bodies and the management of the Eucla Roadhouse. The Western Australian Water Authority built and supplied a transportable tripod/sheer legs complete with guy ropes and a 3:1 block and tackle as well as some grappling hooks. The Eucla Roadhouse provided an additional hacksaw and pulley while the Eucla Police loaned a well worn length of rope.

The cave cleaners whose names appear elsewhere assembled at Weebubbie on 28 December 1985 spending most of that day setting up the sheer legs and lowering gear into the cave - the most important of which was the diving gear and Norm Poulter's 5m canoe.. Preliminary dives later in the day revealed that there was much more debris beyond snorkel depth than first thought.

To make the canoe a stable platform from which to raise heavy objects from under water, the canoe had wooden spars lashed to it forming an outrigger frame. Two vehicle inner tubes were inflated and lashed to the outer framework thus acting as pontoons.

The first priority with the underwater debris was to recover the unsightly lengths of pipe. Great difficulty was experienced in raising the 60mm diameter steel pipes that were in some cases in excess of 20m long, extremely heavy and bent into crazy, pretzel-like shapes. It is suspected that a government department (or subcontractors) must be responsible for this dumping as no one in their right mind should willingly consume such vast quantities of time and energy bending the pipes and then dumping them in the lake - far from shore, rather than the obvious and much simpler task of dismantling the pipes and carrying them out of the cave. Such are the minds of men.

The amount of effort required to raise the long, bent lengths of pipes was incredible. Two to three people worked in the canoe with ropes attached to a pipe, part of which was then raised the 10m to the surface and cut into manageable lengths that were hauled ashore with much difficulty. To help raise the pipes to the canoe for cutting, the ropes were wrapped around canoe paddles for greater leverage. The strain exerted on these ropes was so great that they compressed the timber paddles leaving deep and permanent grooves. The amount of pipe removed, mainly because of the long lengths, would not have been possible without the aid of the modified canoe. Two shorter lengths of pipe remain to be recovered. This can be done with the aid of air bags.

One curious thing that amazed everyone was that although the pipes had been submerged in the lake of 20 years or more, they were in remarkably good condition with little rust, while adjacent 60 litre oil drums disintegrated on touch . In fact, where lengths of pipe had been joined using screwed sleeves, these joints, in most cases could be un-screwed with little difficulty. It did appear however, that most of the zinc coating had been dissolved from the outside of the pipes. Most pipes had air trapped inside.

The most distasteful part of the cleanup was the removal of timber debris from the lake. The timber was extremely heavy and covered with slime. Most of the recovered timber was removed from the cave in polyester agricultural bags. The area where the timber was brought ashore, broken up and bagged was badly stained as a result of this activity but as it is where most people congregate for swimming and diving operations, the area should be eventually cleaned. This proved to be so, as the area was much cleaner when the author had the opportunity to re-visit the cave four months later.

A quantity of timber remains underwater for later removal. Unfortunately, it appears to be all below snorkel depth.

During the course of the cleanup it was estimated that about 80% of the rubbish was removed from the cave. Time and depleted energy reserves did not permit completion of the project. That must be left for other like-minded people. Go to it....

ACKNOWLEDGEMENTS

As with many major undertaking, assistance, both active and passive is required lest the project fail to materialize. The Weebubbie Cleanup was no exception and due to the tremendous physical effort involved all participants have more than earned the right to have their names associated with this paper. No less a right goes to those who lent equipment. My grateful thanks to one and all for a tremendous job well done.

Participants - passive

Jim McKenzie - SRGWA	Datsun truck
WA Water Authority	Custom tripod and lifting equipment
University of W.A. - Botany - Physics	Diving compressor (not used), wet suit Plumbers vice
Eucla Roadhouse	Hacksaw and pulley
Eucla Police	Additional rope

Participants - active

WAIT Outside Club	Alan	Noonan - diver	
Action Outdoors Association	Beverly	Foden	
	Julian	Yates	
	Steve	Allen	
Mofflyn Child & Family Care Services	Cecil	Holmes	
	Ivan	Managhetti	
SRGWA	Marjorie	Sargeant	
	Duncan	Sargeant	(at camp)
	Nicholas	Christodoulou	
	Robert	Poulter	(at camp)
	Norman	Poulter	

LITERATURE SOURCES

Lands & Surveys Department	Roads & Reserves, Weebubbie Cave file #5431/00 Roads & Reserves, file #741/63
Battye Library	Proceedings of Parliament, 1st session 4th Parliament 1901-02/3
	Report on Preliminary Examination of Country between Kalgoorlie and Eucla. John Muir

AN APPEAL

As mentioned above, about 20% of the rubbish remains in the cave and is listed below. It would be appreciated if other cavers and divers took it upon themselves to remove some or all of this rubbish when they visit the cave.

Dry passage ------- at the northern end of the small lake

one diesel motor one metal frame	would need dismantling, may be able to work again. ownership unknown but does not belong to Eucla. don't forget to drain the oil out of the motor.
some 60mm dia. steel pipe other junk	hacksaw and bags needed.

Main lake -------- divers territory

2 moderately short straight lengths of pipe	much easier to handle than bent ones, could be raised with air bags and hauled ashore for cutting if need be.
various sections of timber	ropes best for removal from lake and bags to remove from cave. They can be heavy when first removed and they will be slippery.
miscellaneous PVC pipe & other junk in isolated parts of lake	all the junk is below snorkel depth unfortunately, polyester ropes and bags again for removal from lake and cave.

MOUNT ETNA CAVES
THE FIGHT TO SAVE MOUNT ETNA CAVES FROM LIMESTONE MINING

Josef M.C. Vavryn

Abstract

This treatise is a record of the dates and events, heavily condensed, of the history of Mount Etna since The Caves area was first settled. I hope to show that since the fight to save Mount Etna was first joined, seriously, in 1964 or there about, that the Central Queensland Company and the Queensland Government has had no intention to voluntarily release Mount Etna from limestone mining. Even in the event that conservationists took the Queensland Government to court, the Government had plans prepared to counter such. That was clearly shown when the Government rescinded the Recreation Reserve, R444, on Mount Etna and refused to give a fiat to prosecute the Government. The next event, the passing of a law stating that any mining lease inadvertently granted illegally will now stand and be legal, was aimed at any mining lease granted illegally including Mt. Etna. At this point in time there is very little that is being done to save Mount Etna. I hope that this paper will create new interest and revive the flagging "Fight To Save Mount Etna", with input from ASF member societies and individuals. If the treatise does not have the desired effect of renewing interest in the fight, and if Central Queensland Cement Pty. Ltd. starts mining the main cavernous northern face of Mount Etna, the next ASF conference, or possibly the following, will have a "Letter of Requiem" read to them. If the Australian public can save the "Gordon-below-Franklin" area and the "Lindeman Island National Park", surely something can be done for Mount Etna.

HISTORY

1882: John Olsen found the first caves in the Rockhampton area in 1882; they are the present day Olsen's Tourist Caves.

1884: He started guiding tours for the public through his caves, Olsen's Tourist Caves, in 1884.

1886: Although no record exists at this time, the discovery of Johannsens Caves by John Olsen occurred around the year 1886. (Theodore Olsen, deceased, personal comment 1967). Theo Olsen, son of John Olsen, did not call the caves on Limestone Ridge "Johannsens Caves", but called them "Mount Etna Caves". This name also appeared on Lands Department maps.

1892: A report regarding the feasibility of mining guano from Olsens and Johannsens Caves was prepared by the assistant Government geologist, Mr. William H. Rands (Rand 1892). Mr. Peter McLean, Undersecretary Department of Agriculture, collected guano samples for analysis in 1892. Guano had therefore been removed from Olsens and Johannsens Caves by 1892 (Rands 1892).

1919: The Lands Department granted P.H. Ebbott a special lease of thirteen years duration for guano mining on 9 December 1919.

1920: On 21 February 1920 Reserves R444 and R272 were gazetted in the State Government Gazette, reference page 724, as Recreation Reserves. Mount Etna was covered by R444 and Limestone Ridge by R272. At that time a Recreation Reserve was the highest form of protection given to Crown Land. It could be mined providing no damage was done to the surface area.

1925: On 11 November 1925 Mining Lease 200, which covered Mount Etna, was applied for by G.J. Twine, J.W. Heatherington and J.J. McAuley. This appears to be the first limestone mining lease granted on Mount Etna. On 21 November 1925 an application was made by J.H. Hart for a further four leases for limestone mining on Mount Etna and Limestone Ridge: ML201, ML202, ML203 and ML204.

1926: In February 1926 Mr. F.W. Whitehouse reported on the "Limestone and Guano Deposits of Mount Etna". He stated that "The prettiest caves seen from their display of stalagmites and stalactites were those of Mount Etna". In the same year Mount Etna Fertilizers Pty. Ltd. set up a fertilizer processing and packaging plant on Portion 118.

1935: Mr. B. Pilkington, on 11 April 1935, applied for ML236, an area of 10 acres on Limestone Ridge.

1939: Three years later in 1939, Mr. Pilkington applied for a further lease of 51 acres on Limestone Ridge, ML243.

1948: Mr. Pilkington set up a research laboratory in 1948 and employed a chemist to prove the quality and extent of the limestone deposits on Limestone Ridge for cement manufacture.

1951: Two large international cement companies were attracted to the area in 1951 and sent representatives to inspect Mr. Pilkington's leases. This event moved the local cement company, previously contacted by Pilkington, to re-examine the area.

1954: E.M. Pilkington applied for ML281, an area of twenty acres on Mount Etna, on 1 Junme 1954.

1958: On 1 July 1958 Mr. B. Pilkington applied for ML307 on Mount Etna, an area of 4 acres.

1959: On 30 July 1959 Hartley Investments Pty. ltd. was formed and on 21 October of that year the name was changed to Central Queensland Cement Pty. Ltd. (Central Queensland Cement Pty. Ltd.).

1960: W.R. Thompson applied for ML340, an area of 36 acres and 34 perches on Mount Etna in 1960.

1962: On 1 April 1962 Central Queensland Cement Pty. Ltd. bought ML340 from Thompson. The other three leases on Mount Etna and Pilkington's two leases on Limestone Ridge were bought between this year and 1965.

1963: In 1963 Mount Morgan Ltd. acquired ML306 on the northern end of Limestone Ridge and began to quarry limestone at the entrance to Johannsens Cave.

1965: On 25 March 1965 Central Queensland Cement Pty. Ltd. negotiated a major contract with Noyes Pty. Ltd. for the erection of quarry equipment and installation was to commence in 1965.

1966: The Central Queensland Cement Pty.Ltd. quarry on Mount Etna was begun in 1966 and a crushing plant, storage bins, workshop and mine office were erected.

THE FIGHT

1962: The first trip by the University of Queensland Speleological Society (University of Queensland Speleological Society) to Mount Etna was in 1962. The large colony of Little-Bent Winged Bats (*Miniopterus australis*) in Bat Cleft was discovered late in 1962.

1964: In August 1964 Mr. John McKean of the CSIRO Division of Wildlife Research visited the area and wrote to ASF expressing his strong concern that the Johannsens Caves, which house a large colony of Ghost Bats (*Macroderma gigas*) were being quarried. In reply to enquiries the mining company stated that "they didn't know which were Johannsens Caves". In December 1964 a report was prepared by E. Hamilton-Smith for discussion at the Perth ASF Conference 1964 - 1965. University of Queensland Speleological Society members prepared data for this report. The report was sent to the ministers of the departments involved and the National Parks Association. Following these representations operations at Johannsens ceased.

1965: University of Queensland Speleological Society published a letter in the Brisbane "Courier Mail" concerning the proposed quarrying of Mount Etna in 1965. In reply the manager of Central Queensland Cement Pty. Ltd., Mr. Woodcroft, denied claims that quarrying would destroy caves.

1967: Easter Sunday 1967 Resurrection Cave was first entered by the University of Queensland Speleological Society. This cave is situated under the first and second benches of the eastern quarry on Mount Etna. On 28 August 1967 the late Mr. L.J. Jones, general manager of Queensland Cement and Lime (parent company of Central Queensland Cement Pty. Ltd.), stated that the company had an agreement with the Mines Department to limit quarrying to areas outside of 1 chain from exposed caves, ie. caves with natural entrances. In October Mr. P.C. Caffyn of University of Queensland Speleological Society had a meeting with the man replacing Mr. Jones. Mr. Walker said that he had put the matter in the hands of Mr. Woodcroft, general manager of Central Queensland Cement Pty. Ltd. On 27 October Mr. Woodcroft stated that his intention was to mine the whole mountain. In December Mr. Tichner, manager of the mine, said that the northern edge of the quarry, as it stood, would form the boundary of the quarry.

1969: The agreement between Central Queensland Cement Pty. Ltd. and the Mines Department not to work within 1 chain of a known cave entrance was breached in 1969. The distance between Winding Staircase Cave and Number 4 Bench was 57 ft. In July a report was prepared for R272 on Limestone Ridge to be declared a National Park.A 31-page submission was passed on to Mr.Sullivan, Minister for Lands. Attempts to gain interviews with company directors were unsuccessful. In August workings were found within 76 ft of Main Cave's lower entrance anad blasting had occurred within 141 feet thereof.

1970 - 1971: Central Queensland Cement Pty. Ltd. started mining on the western toe of the northern flank of Mout Etna.

1974: In April 1974 the National Party candidate for Capricornia Mr. Connor said that "... the Premier, Mr. Bjelke-Peterson, has given me an assurance that mining of Mount Etna would cease in the near future". In May 1974, National Party candidate Mr. Connor said, "... the Minister of Mines has assured me that a new national park will be dedicated on not only Mount Etna, but also on the main cave system on Limestone Ridge". Organised tours to view the emergence flight of the Little-Bent Winged Bats from Bat Cleft commenced in December 1974. Estimated numbers of visitors per season: 400 average - signatures are available in the visitors book. On 24 November 1974 another politician jumped on the bandwagon. Deputy Premier Gordon Chalk said that he was "sympathetic to the gazettal of a national park on Mount Etna". On 25 November 1974 a letter to the Labor Party candidate for Port Curtis from the Minister for Mines, Mr. R. Camm, vindicated claims made that there were alternative economic deposits of limestone available other than Mount Etna. A company was surveying mining prospects in the Bracewell - East End area of Mount Larcom. The company had applied for four leases and Mr.Camm, Minister for Mines, said that the lease area aggregated 5,612 acres for the mining of limestone and clay.

1975: On 7 January Minister for Mines, Mr. Camm, said, "...at no time have I,as Minister, ever indicated that Mount Etna would be preserved as a National Park".

23.1.75: The State Government cabinet gave approval for the continued mining of Mount Etna and gave their endorsement to the decision to make Limestone Ridge into a National Park.

24.1.75: The decision by the Queensland Government to continue mining Mount Etna came one day ahead of a report by the State Ombudsman. He agreed that there was an anomaly in the Government's decision on a course of action while he was still investigating complaints of such a course of action.

1.2.75: Electrical Trades Union members asked the Queensland Trades and Labour Council Conservation Committee to authorize bans on the supply of electricity to the crushing plant of Central Queensland Cement Pty. Ltd. if mining commenced on the main northern face. Also in that year the Queensland Conservation Council obtained a Queen's Council's opinion that the leases on Mount Etna may have been invalidly granted. To take the Queensland Government to court the Attorney General's Department must grant a fiat, ie. permission to proceed. No such fiat was granted.

1976: In 1976 the Department of Mapping and Survey changed the names of the caves on Limestone Ridge from "Mount Etna Caves" to "Johannsens Caves". Also in that year the book "Mount Etna And The Caves" was launched.

1977: In 1977 the Queensland Government rescinded the Recreation Reserve (R444) on Mount Etna. The Attorney General's Deprtment refused to grant a fiat to prosecute the Government.

1978: In 1978 the Ghost Bat (Macroderma gigas) was listed as an endangered species in the Mammal Red Book.

1980: Central Queensland Cement Pty. Ltd. broke into Elephant Hole cave in the western quarry.

1981: Mount Etna Caves were placed on the National Heritage List on 25 August 1981.

1982: In June 1982 mining opened an entrance to "Crystal Palace Cave",a cave in the western quarry. Its main chamber's dimensions were - 30m x 10m x 10m high approx. This cave had the most helictites ever seen on the Australian mainland. Literally millions were destroyed when the company blasted the cave in July. It is now a flat plain. In November 1982 the company erected a 2m high barrier in the bottom of Bat Cleft Cave. This barrier obstructed approximately 50% of the passage to the nursery area. Had this barrier been allowed to remain it would have resulted in the catastrophic destruction of a large number of that season's juveniles.

1984 - 1985: Mid 1984 the company started lowering and widening the road from the crushing plant to the western quarry. It was completed in early 1986. There is now a 20m cliff face at the bottom of the Bat Cleft Track.

1986: Estimated supply of limestone in the western quarry is approximately 3 years at the present usage.

1986 onward: Considering the supply of limestone in the western quarry and the widening and lowering of the road, and in view of the monies and manpower spent on same, the conclusion can only be that the company will start mining the main face in the near future, at the most in two to three years.

CONCLUSIONS

In view of the little success conservationists have had in the past on saving Mount Etna by legal means, and in view of the previous points raised for 1986 onward, the only hope I can see for saving Mount Etna is a large concerted effort by conservationists, such as the Tasmanian "Gordon-Below-Franklin Dam" issue or the "Lindeman Island National Park" issue. The local clubs, both the Central Queensland Speleological Society and the University of Queensland Speleological Society, are too small in numbers, also the Mount Etna issue has been dragging on too long and has become stale to be able to do much good by themselves. I BEG OF YOU TO GIVE US YOUR PHYSICAL SUPPORT to regenerate the issue and save Mount Etna.

In my opinion, and I stress my opinion only, what is needed is:-

1. Either a change in the Queensland Government, or

2. About 200 persons or more to stage a "Cave Sit-in" on Mount Etna for 12 months or longer and therefore force a relocation, or

3. Sufficient money to buy out or relocate the quarry.

As at the time of writing points 1 and 3 do not seem possible, it does not seem to leave any other option but a "Cave Sit-in". If anyone can think of any other method of saving Mount Etna that has not been tried in the past, please let me know. THANK YOU.

ACKNOWLEDGEMENTS

Theodore Olsen, deceased, personal comments 1967.

REFERENCES

1882-1969: Mount Etna Caves, University of Queensland Speleological Society 1970.

1970-1976: The Explorer, Newsletter of the Central Queensland Speleological Society.

Address for correspondence: J. Vavryn, Barmoya Road, The Caves Q 4702.

TRAIL MARKING AND AREA DESIGNATION - A STANDARD APPROACH?

Norman Poulter

INTRODUCTION

Reflective signs have been used by several generations of cavers (for various reasons) so what is new about this lot and how can they be used to assist cave consevation. Well, read on.

As cavers become aware of the damage that they and those who come after them can do to the sensitive environment of a cave they try and work out means of minimising or preventing that damage.

This can be attempted in numerous ways such as;

1. permanent closure - not a popular move,

2. restricted access - not very popular either, but acceptable,
   a. number of people allowed in at any one time and,
   b. how often,

3. strict adherance to established, well defined trails,

4. construction of retaining walls, installation of pathways etc.

These innovations have been periodically documented from areas such as Jenolan, Buchan, Leeuwin-Naturaliste Ridge and more recently Tasmania and are usually the result of consideration by a few people in relation to time, materials and people available to carry out particular programs. Somewhere in all that the cave gets considered also.

However, there seems no indication of attempts to standardise the approach of damage prevention or minimisation throughout Australia. It is left mainly to the individuals on site and with what materials are available at that time.

One such approach however, is in the realm of trail marking and area designation - an area that this society has been interested for some time leading to much experimentation. The current format developed by SRGWA is detailed below.

DESCRIPTION

During the Tasmanian ASF Conference of 1984, Bob Woolhouse of the Northern Caverneers outlined a plan to restore damaged areas of Kubla Khan and take steps to minimise future damage by changing the method of exploring the cave by altering some of the existing tracks and introducing one-way trails. In order to achieve this he required numerous reflective markers - markers that were supplied by SRGWA. Bob was impressed by these markers and made mention of them in his article published recently in the Australian Caver.

These markers were 25mm diameter discs witha 4mm hole in the centre and were produced from damaged road signs, hence the term RRS, Recycled Road Signs.

The signs were 'acquired' from various parts of the country as the opportunity arose and Australia's bad drivers permitted.

As the idea of a standardised trail marking and area designation system formuated, it became evident that this unreliable method of acquisition was no longer tenable. To this end SRGWA approached the Main Roads Dept. of Western Australia for a supply of recyclable signs. The Department was very helpful and allowed us a trailer load of signs, signs that once had a purchase price of $55 each.

Working on a theoretical output of 950 discs per sign we estimate that we have enough signs to yield 1,000,000 discs in the primary colours of white, yellow and red. However, due to damaged sections, black lettering etc., it is further estimated we can only realise only half that number - still enough to supply Australian caving clubs for many years to come - for a small fee thank you very much.

These discs can be utilised in various ways;

1. using the central hole they can be afixed to walls, rocks posts etc. with nails or screws (Figure 1)

2. rested or glued on or to small ledges,

3. glued to plastic price tags with Silastic (Figure 2) and stuck in cracks, earth floors etc., they can become trail markers and carry information. They then have the ability to be used as permanent survey markers - a useful navigation aid in long or complex passage-ways.

However, by virtue that various colours are available, the way is now open to establish area designation as well.

AREA DESIGNATION- what is it?

Reflective road signs come in five basic colours and SRGWA proposes that the first three be utilised in the following manner;

WHITE the most prevalent colour - to be used as route/survey markers.

YELLOW caution/hazard areas.

RED no go areas.

GREEN green sign generally occur on freeways but for some strange reason do not often get damaged, possibly because they are so large (too easy to hit?) This colour could denote unlimited access?

BLUE blue signs are usually found in country areas and therefore stay there when damaged. The new suburban route number signs have not yet been in place long enough to be attacked by motorists or vandals in sufficient numbers to start appearing on the MRD scrap heap. This colour could be used as a direction change (junction) or other instruction i.e. end of trail survey marker.

DISCUSSION

WHITE general route/survey marker

This will be the most numerous disc produced which is just as well as it it will most likely be the most widely used. This disc has already been used with success in Kubla Khan (Tas.), the Nullarbor and Leeuwin-Naturaliste Ridge. They stand out in stark contrast to their surroundings and according to Bob Woolhouse appear as crystal faces in photographs. When mounted on plastic price tags (or equivalent) with the ability to carry information, their versatility is greatly expanded.

YELLOW caution/hazard area

Why yellow? We have been conditioned to recognise amber as caution so yellow, being similar could denote the same condition. To make the colour more useful, a number 'key' system could be instituted to designate why the discs were put in place.

such a 'key' could be:

1. unstable area
2. delicate decoration requiring special precautions
3. cave fauna ahead
4. area only to be entered seasonally

A sub-key function could also be utilised ie

1a unstable area, ceiling

RED no go area

Again we have been conditioned to stop at red and again the colour could be used with a standardised number 'key' such as;

1. passage already explored - no chance of extension
2. scientific area
3. high mortality rate caused to fauna if disturbed
4. no through way unless carrying special dirt-free clothing

A sub-key function could be used with this colour as well.

CONCLUSION

This society feels that these discs are more aesthetic than other types of track markers and would be quicker to put in place than custom built signs or marker. Due to standardisation they would be more likely heeded by the general caver.

If a suitable 'key' was formulated then such a key could be published in society magazines and the Australian Cavers on a regular basis ie once a year. This key would need to be 'standard' throughout Australia.

Early in 1987, SRGWA intends to go into the production of these discs following construction of a more efficient punch and die set than is currently available. To offset tooling and other associated costs, it is intended to charge 2 cents per disc plus postage. Larger or custom sizes will be available subject to negotiation.

It is hoped that there will be widespread acceptance of these reflective discs, our major wild caves have suffered from over-use - especially where poorly designed trails exist.

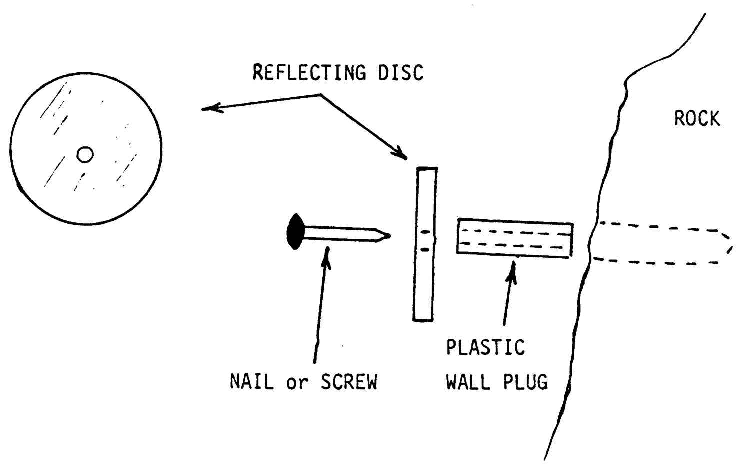


Figure 1
not to scale

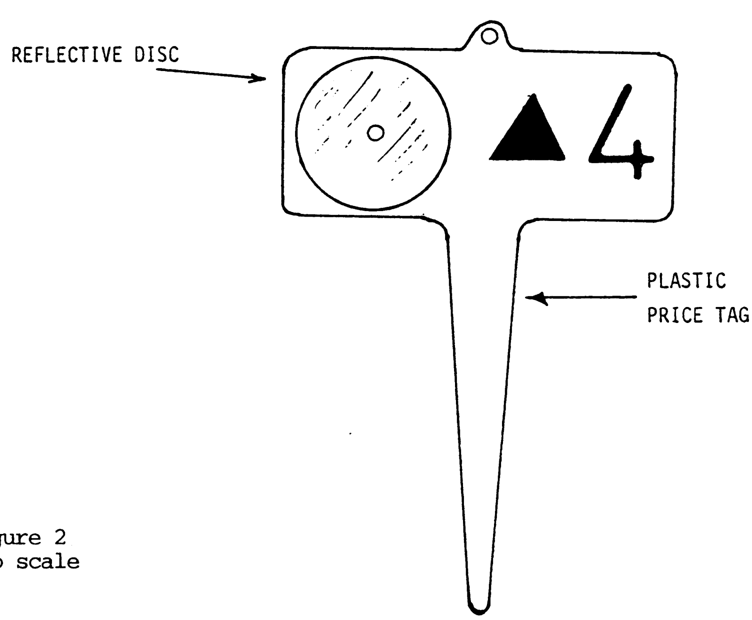


Figure 2
not to scale

THE RESTORATION OF THE JEWEL CASKET, YALLINGUP CAVE, W.A.

Norman Poulter

Abstract

During the September school holidays 1985, vandals extensively damaged the Jewel Casket, one of the centre-pieces of the Yallingup tourist cave. Some of the broken pieces were stolen. This paper describes the restoration of the remaining pieces.

INTRODUCTION

Yallingup Cave is a well decorated cave situated in the Cape Naturaliste region of the Leeuwin-Naturaliste Ridge, the northern end of the most popular caving and tourist areas of the state.

Now surrounded by National Park, the cave was discovered by Edward Dawson in 1899 while searching for stray horses. The cave was opened for public inspection in 1900 with Mr. Dawson as guide, a position he held for about thirty years. Two troglobitic creatures are known to exist in the lowest reaches of the cave, an isopod and a centipede.

The lower tourist section, known as the Main Chamber, has a high humidity, enhanced CO_2 content and abundant decoration, a fair proportion of which is still active. Two pieces of decoration in this chamber, which help set the cave apart from other topurist caves are a cross-banded shawl (its most famous feature) and the Jewel Casket, a small remnant pool where stalactites, amongst other decoration, became encrusted with crystal decoration, the focus of this paper.

The cave is currently vested in the Busselton Tourist Bureau Inc.

DESCRIPTION

The Jewel Casket is a remnant pool, entrapped by a flowstone covered wall, small columns and stalactites. Most of the decoration is damp, caused either by continued seepage or condensation from the cavern atmosphere. To enable this enclave to be illuminated and viewed by the public, a number of stalactites and columns was removed - thus creating a 'hole' in the wall. This hole is large enough to permit human entry, albeit for small humans.

No barrricades or other protection were installed around the feature which is surprising. given the extensive wire netting attention that other, less attractive decoration received at various times in other parts of the cave.

It could be argued that the Jewel Casket received adequate protection while guided tours were conducted through the cave. Guided tours ceased in the early 1970's, to be replaced by self-guided tours. With the inception of self-guided tours it became traditional for a guide to give a short introductory speech at the beginning of the Main Chamber's trail and then sit at a convenient site some 15m away from the Jewel Casket to await the next tourist/s. During the early 1980's, when asked, SRGWA recommended that a clear plastic screen be placed over the viewing hole. This advice was not acted upon.

DAMAGE

Sometime during the school holidays of September 1985 somebody reached into the Jewel Casket in an attempt to steal one or more pieces. In the process of that act, all free-hanging, calcite-encrusted stalactites were broken, with one major crystal cluster being stolen. Several smaller pieces disappeared, either being stolen or falling into small apertures to the side of the feature, but nevertheless un-recoverable.

Due to the characteristic noise that must have resulted from such action it is fair to assume that several people were involved with the breakage and that the guide must have been distracted by another group of tourists. The damage was not detected until much later.

The broken pieces were left where they fell until a SRGWA trip into the cave one month later. It was then proposed to the Bureau that a repair, using 8-hour Araldite epoxy, be attempted on the largest piece. This proposal was accepted.

FIRST ATTEMPT

The necessary items were purchased from a nearby town and the piece glued to the stump of the stalactite. A stiffening rod was positioned behind te decoration, the free-flowing Araldite kept in place by adhesive tape dams. In an attempt to keep the decoration dry and the cave's humidity at bay while the Araldite was setting, a gas burner was placed to one side of the decoration and left to burn overnight. To keep the decoration in position, a plank was placed beneath it and upward pressure applied with a vehicle jack (Figure 1).

On inspection the following day the repair appeared successful and the support was removed. Unfortunately the bond failed six days later resulting in the decoration breaking into three pieces, which were later recovered and taken to Perth for restoration. Moisture attack is suspected as the principal cause of the bond failure.

PROTECTION

In consultation with Busselton Tourist Bureau it was decided to install a clear plastic screen over the Jewel Casket viewing hole and to effect repairs to the decoration during 1986.

Subsequently a sheet of 12mm acrylic (Perspex) sheet was custom fitted and affixed to the viewing hole using plastic wall plugs, chrome plated brass screws and stainless steel brackets. a 75mm camera port was cut in the centre of the screen to allow unimpeded viewing and enable easy handling of the screen.

Independently the Busselton Tourist Bureau erected a 'temporary' pipe and weldmesh fence, joining with two existing fences on either side of the feature. Although a further and now unnecessary barrier, the fence is unlikely to be removed.

REPAIR

The broken pieces were taken to Perth to enable them to dry out and be pieced back together. Some crystals had broken off the clusters and a mini-jigsaw puzzle ensued working out where they belonged. The small pieces presented no difficulty on Aralditing back into place, the tell-tale trace of epoxy being hidden among the shiny crystal surfaces.

Larger pieces did present problems. Although larger surface areas presented a prospect of stronger bonds, it was decided to to further enhance these prospects by drilling random angled 3 - 4.5mm holes into the calcite where possible as well as inserting a notched 3mm stainless steel rod along the decoration's centreline. The notches form a 'key' for the Araldite (Figure 2).

These repairs occupied several months. The method to be employed gluing the large restored stalactite back into place was to have a vertical stainless steel pin in the centre of the sections with thin stainless steel cross-pins passing through it and then glued into place with epoxy. The stainless steel pins would then support the the estimated 3kg weight and not the epoxy joint (Figure 3).

TECHNOLOGY

At this stage, advances in technology came to our assistance. The use of gas burners to defeat the effect of moisture on the Araldite was considered too cumbersome and ineffective. Hot air blowers were an obvious alternative. Domestic hair dryers were considered incapable of delivering the temperature required for long periods of time and industrial blowers, although capable of the required time/temperature duration were judged too cumbersome.

Just at the right moment Bosch released the PHG 520 hot air gun, a lightweight 2 speed gun capable of delivering 520°C and 320°C temperature at 240 and 420 litres per minute respectively. The guns, although light, were rugged and compact. By mounting a board on a small camera tripod the gun could be rested on the board, aimed in the right direction and switched on.

In order that the decoration did not become too hot, a HPM series 797 timer was used in the power circuit. This domestic electro-mechanical device allowed the hot air gun to be operated automatically for 15 minute increments.

From conversations with technicians at the University of Western Australia it was theorised that sodium silicate could provide an alternative to Araldite epoxy. This water soluble chemical reacts with calcite and certainly forms a very strong bond - on dry decoration. It was found that this reaction can take several days unless heat is applied, and reimmersion in water dissolves the medium. More testing will need to be performed to prove this method.

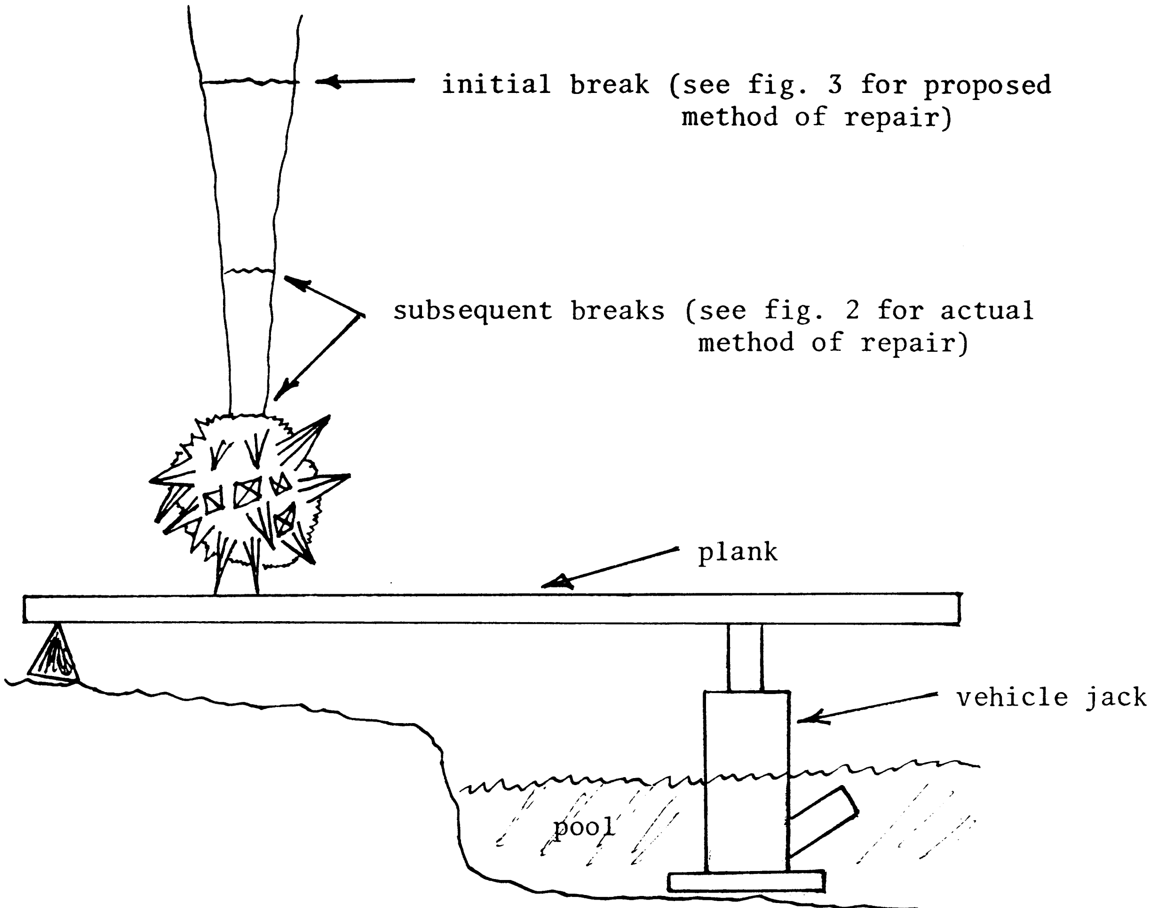
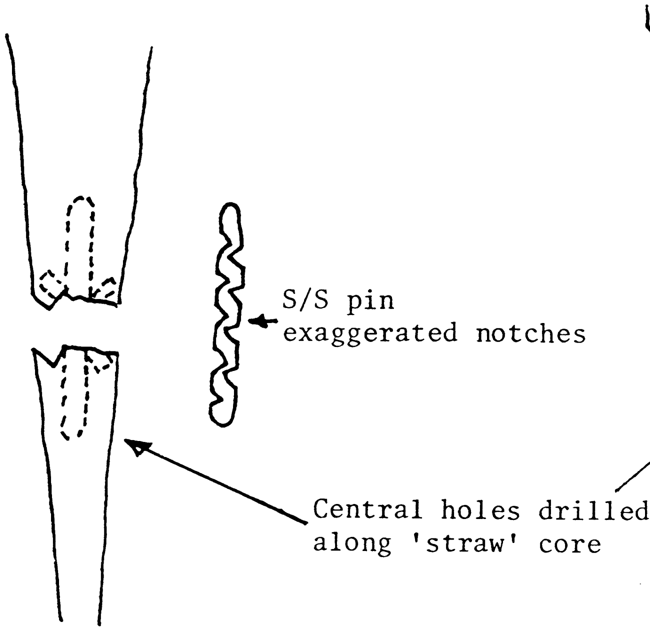


Figure 1.



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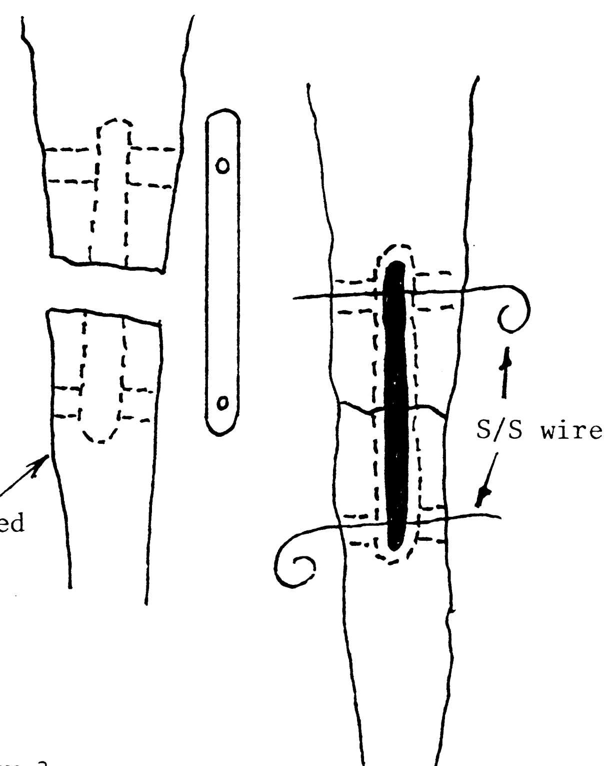

Figure 3.

SECOND ATTEMPT

The smaller crystal cluster was the first to be glued back into place during the second restoration attempt. This cluster was actually two clusters from adjacent stalactites that had joined together. However, during the initial breakage, a section of one stalactite had disappeared and so, rather than rejoin the cluster to its original position and create a strain point on the joint, it was decided in consultation with the attendant guide that centralizing the cluster around one stalactite would not adversely affect the aesthetic appearance of the decoration.

After thoroughly drying the two sections with the hot air gun, the cluster was held in place while the 5 minute Araldite epoxy 'went off'. A section of 3mm acrylic rod was placed underneath the cluster to support the joint. The hot air gun was placed in position and left to run overnight. As epoxy glues take several days to attain full strength, the support rod was left in position for a month, when it was judged that the joint was sound enough to have the support removed.

The reinstallation of the larger stalactite presented problems when the epoxy prematurely 'went off' before the lower portion with the pin installed could be correctly positioned. This necessitated a change in plans as to how it was to be rejoined to the upper section of the stalactite.

The pin was removed, with difficulty, and after the offending epoxy had been removed from the joint, a fresh mix was applied and the joint sucessfully made. A 6mm acrylic rod was placed in position under the cluster and a stiffening rod glued over and behind the joint, held in position with paste Araldite (i.e. Araldite mixed with talc). Holes and wide joints were filled and blended to match the texture of the decoration using paste Araldite. Again the hot air gun was left to run ovrnight by way of the timer.

A decision will be made during 1987 as to whether or not the supporting rod can be safely removed. At this stage it is felt that the rod will become a permanent but unobtrusive part of the decoration. An engraved sign was placed nearby explaining how the damage occurred and the SRGWA was responsible for its restoration.

CONCLUSIONS

This paper has attempted to describe the methods used to restore the broken stalactite clusters of the Yallingup Cave Jewel Casket. The salient points were that:

1. The decoration was close to the floor of the cavity thus allowing easy floor support.
2. Being moist, the decoration precluded the use of water-soluble adhesives.
3. Due to the close proximity of other decoration and restricted access to all sides (of the decoration), mechanical jointing methods could not be employed.
4. The use of internal stainless steel support pins and of random 'key' holes was judged essential for strong bonding.
5. Hot air guns make life easier when working in humid caves or with active decoration, the power being supplied from mains as with commercial caves or generators in the case of wild caves.
6. Sodium silicate appears a viable alternative to Araldite when dealing with dry decoration in low humidity caves.

ACKNOWLEDGEMENTS

The Speleological Research Group Western Australia would like to thank George Husca of the Electron Microscope Centre, U.W.A. for advice and assistance in regard to the use of sodium silicate, and the Busselton Tourist Board for funding and lunches while restoration was taking place. The EM Centre kindly allowed the use of its hot air gun and the Physics Dept., U.W.A. provided materials and equipment for the manufacture of the sign.

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THE AUSTRALIAN SPELEOLOGICAL EXPEDITIONS TO THAILAND 1985-1986

John Dunkley & Kevin Kiernan

Abstract

Two expeditions of 6 and 10 persons plus local logistical support visited Thailand in May 1985 and April-May 1986. A total of 12km of new cave was discovered and over 20km of surveying carried out. The two longest caves on the mainland of South-East Asia, Tham Nam Mae Lena and Tham Nam Lang each reached 8.4km. These two caves aggregate 14km of superb stream passage, exploration of which required rubber boats and lilos. Further geological and geomorphological work was undertaken and some significant archaeological sites requiring further investigation were located.

During the period 1983-86 six expeditions visited the previously unreported karst and caves of the Nam Khong basin in north-west Thailand. Two of these were moderately large endeavours: in 1985 six cavers spent 9 days in the field, in 1986 10 members were 18 days in the north-west and a further 10 in central and south Thailand.

Exploration and surveying has been the main theme of the expeditions. About 100 caves have been explored, and a total of nearly 26km of caves surveyed. A scientific research programme commenced in 1986, covering geology, geomorphology and archaeology and we expect this to continue in future years. One paper has been published, three more are in press or preparation, and we have completed a 62-page report on the expeditions.

The main accomplishments in north-west Thailand have been:

1. Discovery and exploration of two major river cave systems totalling nearly 17km of passage, of which about 14km are actual stream passages. These are the two longest caves known on the mainland of south-east Asia.

2. Exploration and survey of a further 8km in caves up to 1.4km long. Included is a cave which at 276m is the deepest known in mainland south-east Asia.

3. Recording of over 30 archaeological cave sites in the Nam Land - Nam Phong basin, and publication of preliminary observations. Coffins and timbers have been recorded in all but 5 of these sites, while artefacts of stone, ceramics, bones and metal are also found.

4. A reconsideration of cave genesis and development. While regional strike alignment is common, the influence of plunging folds may be an important factor in cave development. The two longest caves both have trans-structural drainage, and it seems possible that these caves are formed by erosion along favorable bedding planes following the strike of the limestone around the noses of plunging folds. In common with observations elsewhere, the largest caves are found where potentially aggressive water is able to concentrate on non-carbonate rocks before entering the limestone. Even so, we know of caves of the order of 1km in length whose catchment is entirely in limestone. In these cases, streams maintain a brief course on relatively impermeable hillwash sediments before entering caves.

In the south of Thailand a characteristic tower karst prevails. Surveying and exploration was carried out in the more accessible caves near Phangnga, some of it from a rented power boat. Preliminary notes on this karst have been published and a continuing research programme is envisaged. On future trips we hope to pursue the questions of former sea levels, tectonic uplift and the chronology of relief evolution. This is a superb area for those wishing to combine cave exploration with a little scientific snorkelling.

This report supplements the paper published in Helictite 23 (1), 1985. A comprehensive, well-illustrated account of the area may be found in the expedition report:

Dunkley, J.R. & Brush, J.B.: Caves of north-west Thailand. Speleological Research Council Ltd., Sydney, 1986, 62pp.

1987 S.U.S.S. EXPEDITION TO MT. ANNE

Derek Hobbs and Patrick Larkin

Abstract

Sydney University Speleological Society (S.U.S.S.) is running a three week, 15 person expedition to the Mt. Anne area in Tasmania. The expedition began on January 4th, 1987.

AIMS OF THE EXPEDITION

The Mt. Anne area contains one of Australia's deepest caves, Anne-A-Kananda, which has been descended to -373 metres. The relief of the Dolomite in the Mt. Anne area is about 700 metres, probably the greatest local relief of Karstic rock attained anywhere in Australia (Kiernan, 1979). These two factors, with the more than adequate rainfall, indicate a potential for deep caves, by Australian standards.

The expedition aims to explore the area, looking for caves with good depth potential. The caves discovered will be surveyed and mapped. The expedition intends producing a publication on the area in the near future. The following information is being compiled:

- cave descriptions and maps
- suggested rigging details
- entomology - Graeme Smith from Bayer
- water chemistry - Julia James from Sydney University
- geology - Martin Scott from Sydney University
- botany - Joy Everett from The Royal Botanic Gardens

The area has excellent potential for an Australian depth record.

FUNDING AND BUDGET

The expedition has a budget approaching $20,000. Funding for the expedition was obtained from the following sources:

- expedition fees are anticipated to be $200 - $250 for the 3 weeks
- generous sponsorship from Dick Smith of $5,000
- Australian Geographic will pay $1,000 for an article on the expedition for publication
- the University of Sydney Union sponsored the food for the expedition to the extent of $2,000
- Wildsports, formerly Caving Equipment, provided 200 metres of rope and 2 caving packs
- Aquasea Products provided waterproof flashes, housing, arms, and contacts for the expediton
- Australian Airlines provided airfares at a 50% discount

ORGANISATION AND TECHNICAL ASPECTS

The bulk of the food, caving gear, first aid supplies, plus the generator and carbide were packed into tea chests in Sydney. The 27 tea chests were shipped by sea to Hobart and stored in Rick Tunney's garage. The gear was then transported by road to the Scotts Peak Road.

A small party walked up to Mt. Anne and selected a campsite and prepared a helicopter landing site. The following day, a chartered helicopter was used to transport all the gear and some of the people up to the campsite. The campsite is about a 20 minute walk from the Anne-A-Kananda doline towards Mt. Anne. The helicopter will be used to transport the gear out when the expedition is finished.

A large First Aid kit was assembled for the expediton. As you probably have heard, a member of the expediton dislocated his shoulder while exploring the surface of the ridge. A Westpac rescue helicopter was in the area and they insisted on rescuing the injured person. He was transported to hospital in Hobart, where his shoulder was manipulated back into place. This person has now recovered and will be returning to Mt. Anne on Sunday, January 11. However, he will be restricted to surface work and map and information collation.

There was some interpersonal conflict in Hobart before the expedition left for Mt. Anne. However, this has now been solved and once on the mountain everyone's enthusiasm increased dramatically.

The caves will be surveyed using topofils, Suunto compasses and clinometers, and fibreglass tape. Data will initially be processed on the mountain, using a portable computer. The final surveys and maps will be produced using computers in Sydney.

PROGRESS TO DATE

About 70 large dolines have been noted on stereographic aerial photographs. Several more dolines have been located by surface exploration.

On January 8th, several members of the expedition made a report on the progress of the expedition. The report was sent to an amateur radio operator in Hobart. The radio operator recorded the report and sent the tape to Sydney by overnight courier. The recording was used in the presentation of this paper at the 16th Biennial Conference of A.S.F. Inc.

Highlights of the report were:
- it had snowed continuously overnight to the depth of 5 cm
- a cave had been explored to a depth of 150 metres
- several new tracks had been cut

CONCLUSION

The Mt. Anne dolomite is in a remote alpine region adjacent to the South West Wilderness. The area has not been thoroughly studied and has excellent potential for some really great caving. On behalf of the members of the expedition, I would like to thank our sponsors for their generous support. They are:
- Dick Smith
- Australian Geographic
- The University of Sydney Union
- Aquasea Products Pty. Ltd.
- Wildsports
- Australian Airlines

There has been excellent support from the Tasmanian Caverneering Club. They have 5 members present on the expedition. These people are: Rolan Eberhard, Nick Hume, Stephan Eberhard, Rick Tunney and Janine McKinnon. S.U.S.S. members present on the expedition are: Pat Larkin, Keir Vaughan-Taylor, Phil Cole, Ross Bannerman, Martin Scott, Leonie Waterman, Danielle Gemenis, Rolf Adams, Anne Gray, Graeme Smith, Guy McKanna, and Derek Hobbs. Other people present were Nick Hawkes from England and Paul Boustead (UNSWSS).

REFERENCE

Kiernan, K., 1979, Caving; in "The South West Book - A Tasmanian Wilderness" Australian Conservation Foundation, p. 157-9

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IN CAVE OXIDATION OF ORGANIC CARBON AND THE OCCURENCE OF RAINWATER INFLOW CAVE SYSTEMS IN THE SEASONALLY ARID LOWLAND TROPICS.

Kerry A. Williamson

Abstract

Recent studies have shown that in cave oxidation of organic carbon can play a significient role in cave initiation and development. The production and flux of organic carbon in different seasonally arid tropical karsts and in perpetually humid tropical karst is described, with particular consideration of the role of large particle size organic carbon. The model developed is used to explain the extent of rainwater inflow cave development and the apparent scarcity of such forms in the perpetually humid tropics plus arrested development in the seasonally arid sub-tropics.

INTRODUCTION

Woods (1986) has invoked a model of in cave generation of carbon dioxide by the oxidation of transported organic carbon to explain corrosional enlargement of joints from the bottom up. He described organic carbon sources as being of three types; particulate organic carbon (POC), dissolved organic carbon (DOC), and organic carbon sorbed on mobilised inorganic material (eg. clay particles (SOC). In the tropics greater temperatures would result in greater microbial activity resulting in greater carbon dioxide preduction which in turn would result in a greater rate of corrosion, provided water was not limiting.

Woods' theory very adequately explains cave initiation in both tropical and temperate karsts. Further cavern enlargement and further influx of organic carbon (see James, 1981) is consequent upon fluvial or runnel invasion of the enlarged vadose fissures and phreatic tubes. This invasion is the result of headward growth of, and competitive piracy by, the most efficient anastomosing tube, forming a pressure tube from the spring which drains the vadose fissures and progressively captures surface streams (Ewers 1978). How can such models be applied to the pinnacled, seasonally arid, tropical karsts of northern Australia which in some ways seem to have remained at a very early stage of fluvial capture?

Shannon (1970) in describing the genesis of caves in the Mount Etna/Limestone Ridge karst, recognised rainwater inflow caves as a distinct cave type (autogenic, grike runnel runoff derived, solution pits and crevices); which he contrasted with river (or fluvial) caves. Shannon stated:

"The cave water generally deposits lime except where it is soaking through organic fill; the acid sponge effect is the main agent of solution. The cave floor is attacked. The acid is supplied by decaying vegetable matter in place."

Shannon considered that tree roots were probably the main source of acid (presumably carbonic acid directly by the root's metabolism or indirectly by decay). Particulate organic carbon POC, mainly tree roots, is probably of greater importance. Shannon divided the caves of Mount Etna/Limestone Ridge into three types: rainwater inflow caves, ramifying csves, and master caves. I would prefer to consider these as zones of the underground karst hydrological system, as some caves show combinations of two or three of these zones in the same area. The rainwater inflow cave, ramifying cave and master cave are equivalent to the vadose zone, the nothephreatic/epiphreatic zone and the shallow active phreatic zone, respectively.

SEASONALLY ARID TROPICAL KARST (MOUNT ETNA/LIMESTONE RIDGE, CHILLAGOE)

On limestones of low primary permeability in the seasonally arid tropics, large outcrops are intensively and extensively pinnacled, with joints enlarged into grikes between the pinnacles. The grikes often open out below into cave systems producing flask or bottle like cross sections eg, Figure 1, Mt. Etna.

The surface of limestone outcrops at Mt. Etna/Limestone Ridge and Chillagoe is covered with karstified bare rock interspersed with patches of clay soil and associated vine scrub. Soil is either residual or derived from interbedded volcanics, stratigraphically and topographically overlying mudstones and/or pediment derived, possibly multiply reworked cave fills exposed to the surface by karst denudation. The main form of particulate organic carbon is tree leaves. The pinnacled and griked karst pavement provides a fire refuge for vine scrub communities in a seasonally arid climate

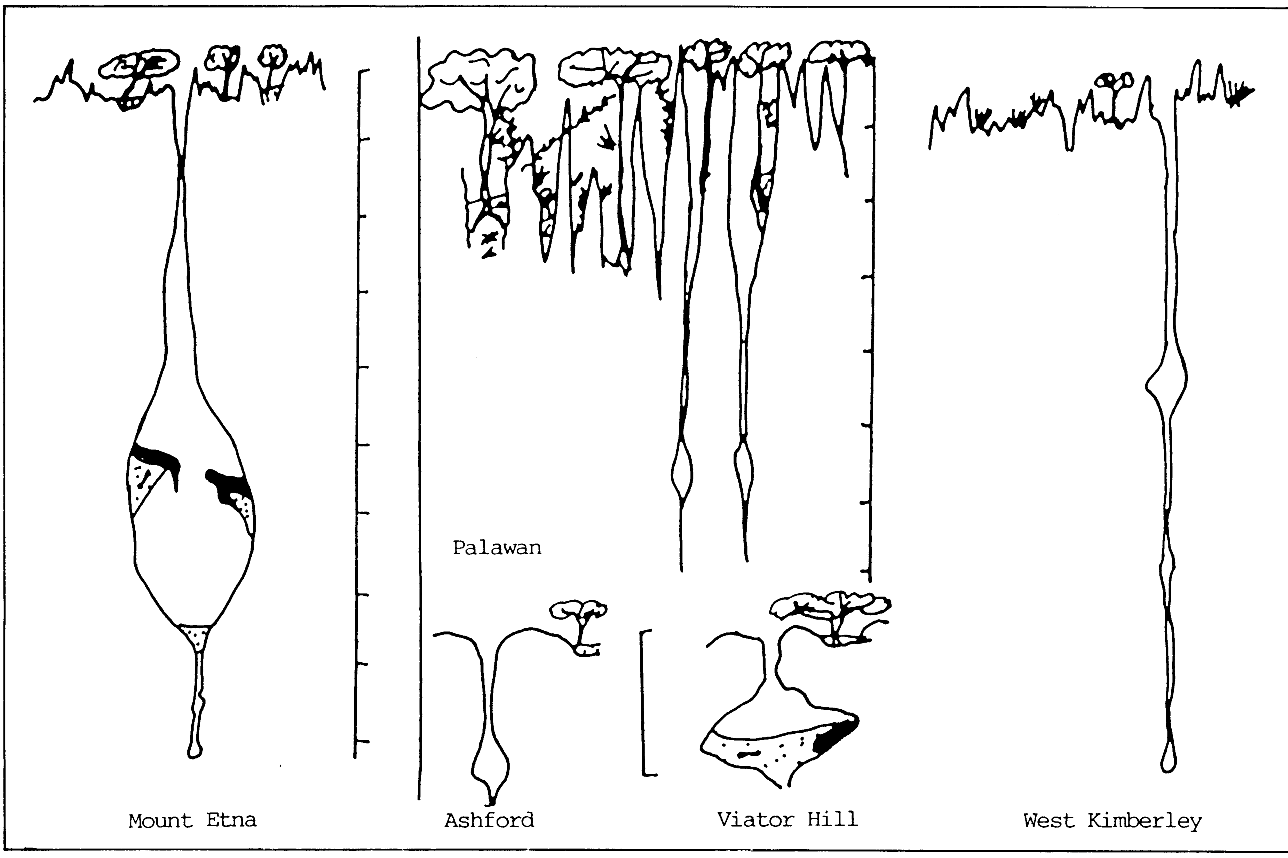

Figure 1 RAINWATER INFLOW CAVE SYSTEMS
SCHEMATIC TRANVERSE SECTIONS

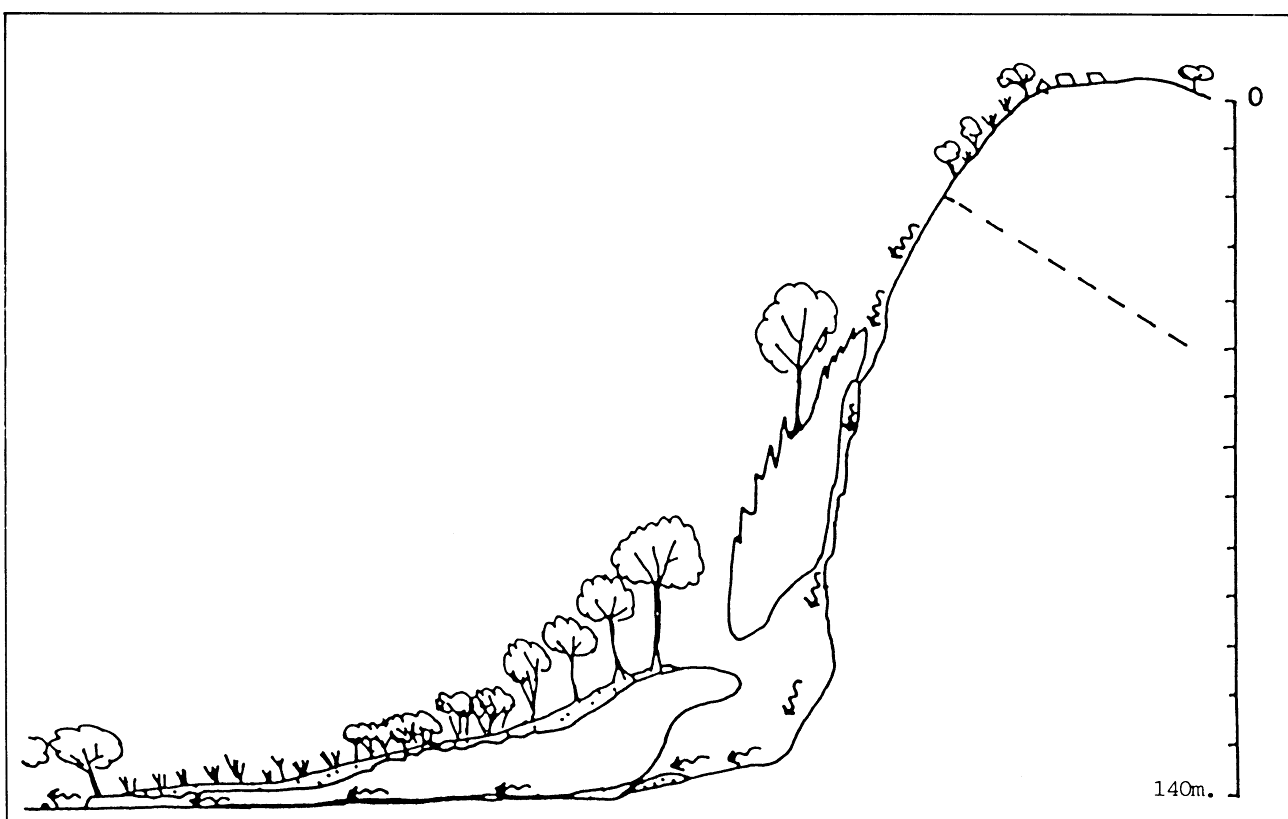

Figure 2. MOUNT ETNA RAINWATER INFLOW CAVE SYSTEM
SCHEMATIC LONG SECTION

(Webb and Tracey 1970). Many of the tree species in this community are dry season deciduous, depositing a covering of dead leaves on the limestone surface during the dry season.

The surface karst consists of joint or fault orientated grikes separated by pinnacle ridges with rillenkarren down their sides. Any leaves falling on such a surface will be washed down toward the grike floor where their decomposition will assist joint enlargement in depth and width. Joints enlarged to 10-20 cm are found at the base of larger grikes. Smaller particulate organic material formed from the decomposition and invertebrate digestion of these leaves will travel by sheet and then gratify assisted capillary flow to base level where it will assist the enlargement upward of the joint in the vadose zone as postulated by Woods (1985). Solution pans are less common surface karst forms; they may form at the base of a grike, and then coalesce to form a stepped runnel. Grikes developed on down slope orientated joints will form long runnels (rundkarren). Runnels 0.5-1 m across occur on Mount Etna above Huntsman Cave and stepped forms occur on Limestone Ridge above the Johannessens Quarry. Any leaves washed or dropped into such runnels will be washed down the runnel to where the underlying joint is sufficiently enlarged to take the entire flow.

This sinking runnel water will invade the upwardly enlarged joint and enlarge it further usually into a circular shaft or a vadose canyon with a waterfall at its head. This water fall or cascade to vase level or an intermediate structure ledge, where its organic sediment load will be dropped with the sudden drop in energy, producing a sediment filled sump. Such a sump, 30 m below a runnel fed sink in Helms Deep Cave, Mount Etna, looks a poor site for carbonate dissolution as the surface is covered by caloareous land snail shells and phosphetic bones. At 10 cm depth the sediment is dark, high in organic carbon and low in snail shells and bones - presumably due to acid dissolution.

The small size of the active phreatic conduits draining the final earth sump, means that the sudden influx of storm waters from a number of runnel fed sinks is drained away slowly, and ponds at base level. This increased residence time (see Wilson 1975) of the ponded water, plus the added aggressiveness due to the concentration of POC at base level by sediment load dropping, and coupled with the fast rate of decay in the warm moist sumps, results in the corrosion of large nothephreatic chambers - often showing spongework and roof pendants over a considerable depth.

With lowering of base level, the zone of maximum corrosion or cave enlargement will move downward, enlarging and obliterating small bore active phreatic donduits, and phreatic rifts. Short remmants of active phreatic conduits may be left between nothephreatic chambers eg. the Test Tube passage in Main Cave, Mount Etna. At the same time, especially where runnels run along downslope oriented joints, slope retreat will result in sinks and runnels occurring further back into the mountain and in runnels further down the mountain intersecting nothephreatic chambers through karst windows further down the neck of the flask. Hence the tight upper level inflow entrances and larger lower level karst window entrances on Mount Etna. Vadose forms will be superimposed upon the sides of nothephreatic chambers - the corkscrew meander channels found in the sides of outer Johannessens Cave, Limestone Ridge; or else the lower level karst window inflow will be in the center of a chamber and will plunge free to the nothephreatic epiphreas with no vadose interaction.

The water chemistry of the spring north of Mount Etna suggests that the water has travelled some distance in small, completely water filled, passages and is in carbon dioxide equilibrium at a level typical of soil or organic sump fine sediment (Dunkerley, 1981). The flow rate is a few tens of litres per minute; the water is warm and very hard (650ppm dissolved carbonate) and the theoretical pCO_2 at 8.3 per cent. This, according to Dunkerley is consistent with "movement of water through an environment enriched in carbon dioxide by organic processes and probably as suggested by the warmth of the water at relatively shallow depth". To reach the exsurgence front the inflow points on the slopes of Mount Etna, the karst water must flow 1-1.5 km. under a gently sloping pediment hence the shallow depth. At the exsurgence end of the active phreas, the conduits are continually water filled and must be too small for human entry to be active phreatic at such a low flow rate. At the other end of the active phreatic zone, where it drains the nothephreatic chambers, pressure tubes up to a metre in diameter are round. Lowering of base level may result in phreatic canyons or rifts, or these forms may be produced by clay deposition causing floor filling and protection, coupled with roof corrosion (eg. Mikes Delirium in Johannesens Cave, Limestone Ridge). Such pressure tubes may connect downstream to further nothephreatic chambers, where further ponding occurs. Successively smaller poressure tubes corresponding to successively lower flow rates will connect each downstream ponding area. In Mela Grotto, Limestone Ridge, a perennial underground stream flows through such a system and has deposited banks of organic mud and silt (A. Robson, pers. comm.). Further into the active phreatic zone sorbed organic carbon may play a greater role in increased aggressiveness.

In the middle section of Limestone Ridge a near horizontal andesite dyke (Shannon 1970) presented a impermeable barrier resulting in extensive ponding above base level which led to the formation of large flat floored and roofed, nothephreatic chambers until chemical weathering and clay mobilisation breached the barrier and a new series of runnels and sinks occurred in the floor of the underground chamber, sinking to the new base level below. The upper levels of caves in this region have large, flat, nothephreatic chambers developed along the dyke while the lower levels have the typical flask shaped cross section nothephreatic chambers developed along vertical joints or faults.

Underground karst processes at Chillagoe are essentially similar to those at Mount Etna Limestone Ridge (Ford 1978, Wilson 1975, Marker 1977, Jennings 1982). These two areas represent the fullest development in Australia of rainwater runnel inflow caves below a pinnacle/grike surface, with pediment exsurgences below the towers.

Chillagoe	803 mm.
Mount Etna/Limestone Ridge	852 mm.
Old Napier Downs (West Kimberley)	691 mm.
Mulu	6,000 mm.
Texas (South-east Queensland)	644 mm.

Based on Graham (1970), Grimes (1978), Jennings and Sweeting (1966), Marker (1976), Robinson (1982) and Waltham and Brooks (1980).

TABLE I - AVERAGE YEARLY RAINFALL VARIOUS KARST AREAS.

Chillagoe has a significantly lower rainfall than Mount Etna (Table I) and being further north has higher evaporation. As a result of this, vine scrub is virtually absent from exposed surfaces but occurs in sun sheltered tower feet and karst corridor bases, unlike Mount Etna where vine scrub occurs on the limestone slopes wherever soil patches occur. A Chillagoe the vegetation distribution may have concentrated inflow to the karst corridors and tower cliff bases, on pediment steps and ramps.

At inflow points along enlarged grikes water cascades to partially fill networks of nothephreatic passages showing structural control. This water backs up at earth sumps which contain organic muds and silts. The sumps presumably drain into the phreatic tubes, up to 3 m in diameter, described by Smith (1985)) as often providing connections between caves. A number of writers (Jennings 1982, Wilson 1975, Robinson 1978 and Pearson 1982) have stressed the importance of phreatic solution forms (i.e. roof pendants and spongework) in the caves of Chillagoe and how much of the solution occurs above the level of permanent water (i.e. the nothephreatic epiphreas), during the flooding associated with exceptional wet seasons.

THE WEST KIMBERLEY RANGES - A LESS VEGETATED SEASONALLY ARID KARST

On the northern edge of the Canning Basin or the southern edge of the Kimberley Block lies an extensive range of pinnacled and griked Devonian limestones which have been subject to little if any tilting and still reflect the bedding angles and morphology of a barrier reef (Playford and Lowry 1966). The surface karst is as well developed as that at Chillagoe and giant grikelands occur in places (Jennings and Sweeting 1963). However, sizeable rainwater inflow cave systems of the type found at Mt. Etna/Limestone Ridge have not been found. Sizeable perennial (usually cliff foot) springs do occur, presumably representing integrated flow. The few large cave systems described in the literature are derived from superimposed allogenic drainage - Tunnel Creek and the Cave Spring System (Jennings and Sweeting, 1963); Lowry, 1967) or essentially allogenic drainage from the sediments of a Tertiary erosion surface developed on the limestone, (Jennings and Sweety, 1966).

Bases of enlarged joints in the cliffs of Windjan Gorge are 0.5-2 m in width. Small increases in width occur above present base level (e.g. Pigeon Cave), may be indicating a past less arid time. The vegetation of the West Kimberley limestone is predominantly spinifex (Triodea) with a few shrubs and stunted boabs, and rare vine scrub in very sun-sheltered spots. Jennings and Sweeting (1963) describe the soil and vegetation of the dissected part of the Napier Range as minimal, reducing the biological carbon dioxide so necessary for cave development. The spinifex and scattered shrubs would not produce the readily decomposable leaf mat POC such as is supplied by deciduous vine scrub. Spinifex leaves stay on the plant even in drought; spinifex organic carbon is removed by fire rather than decomposition. Thus less POC is avoidable from the grike fields to fuel base level corrosion and extensive nothephreatic epiphreatic chambers are absent.

Why such a dramatic absence of vine thicket should occur in the West Kimberley is puzzling as Napier Downs has a rainfall only marginally less than Chillagoe (Table I) and lies at similar latitude. The pediment tower interface at the West Kimberley is abrupt with the pediment steps and ramp found at Chillagoe (Jennings 1982). At Chillagoe this area provides a sun shelter and fire shelter. In the West Kimberley karst, fire-adapted savanna grassland comes right up to the tower base. In 1981 a fire came off the tertiary erosion surface and burnt out almost all the spinifex in the Old Napier Downs Polje except for a small area of vine scrub in sheltered location near the fluvial inflows (Williamson

1981). Lamotte (1985) recorded 40 per cent of organic carbon being removed by fire in moist savanna - the percentage in dry savanna would be even greater.

KARSTS OF THE SEASONALLY ARID SUBTROPICAL ZONE

Very small rainwater inflow caves have been reported from areas south of 30'S at Texas, Ashford, Wellington and Timor (Shannon 1970). Large pinnacles and runnels are absent in these areas due to the reduction in both overall precipitation and torrential summer rain, and an increase in more diffuse winter rain. Rillenkarren and grikes are present but soil cover varies between areas reflecting local differences in lithology and stratigraphy. Vegetation includes some vine scrub but tends toward fire resistant sclerophyll woodland (Archer 1978). The larger rainwater inflow cave systems show nothephreatic features e.g. Russenden (Grimes 1978). Grimes reported acid cave earths from Main Cave on Viator Hill. Water is channeled underground by sheet flow down the sides of grikes; and at grike intersections by more concentrated flow (Grimes 1978). No pressure tubes are reported. Cavern dimensions are much smaller reflecting reduced POC input due to lower temperatures and rainfall, plus the removal by fire of surface organic material and also the lack of runnels to mobilise the leaf-size POC. Due to the more even precipitation and lack of runnels seasonal fluctuations of water table within the caves behind back up points are of much smaller amplitude than seen in the Mount Etna nothephreatic epiphreas. At Texas Caves, notch marks on the wall reflect phases of downcutting by Pike Creek (Grimes 1978).

PINNACLED AND GRIKED KARSTS OF THE PERPETUALLY HUMID TROPICS

In the perpetually humid lowland tropical karsts large (30 m) pinnacles and grikes have been reported under lowland rainforest (e.g. Mulu - Osmaston, 1980; Palawan - Longman and Brownlee, 1980, and the Darrai Hills, New Guinea - Williams, 1972). There are no reports of rainwater inflow cave systems of the extent found in the Australian seasonally arid karsts. In the profusely vegetated lowland tropics soil covered polygonal and doline karst forms become more significant even on the tops of towers. With perpetual moisture and high temperature little accumulation of leaves occurs in a lowland tropical forest as leaves decompose quickly after falling. Whitmore (1984) reports highly acid organic soils from the top of karst towers in Malaya. Much less organic matter is washed deep into pits as most decomposition occurs on the limestone surface causing pitting, or in soil and vegetation further up the grike. This produces the greatest development of surface pinnacle and grike karst at the expense of a well developed rainwater/POC fed cavernous nothephreatic/epiphreas. Williams (1972) reported small phreatic mazes developed below crevice karst in New Guinea.

The paucity of reports of rainwater inflow cave systems from the lowland moist tropics may be a byproduct of the greater areal significience of soil cover karst forms in many areas, or simply that the rugged topography of lowland tropical pinnacle/grike karst has caused exploration to concentrate on the more accessible and locatable fluvial systems, especially those formed from large allogenic streams.

Crowther (1982) reported conduits within West Malasian karst towers contributing water to the abandoned fluvial systems below. Waltham and Brook (1980) report side streams entering the large allogenic streams under the towers of Mulu. These must drain either doline or grike/pinnacle karst. Similar side streams enter the main streamway in St. Pauls River Cave, Palawan. In humid tropical lowland alluvial plain tower karst e.g. Mulu, Mt. St. Pauls, underground corrosion by rainwater inflow could be just as great as in the seasonally arid tropics but will pale into insignificience compared to the rate and extent of lateral corrosion by allogenic fluvial processes at past and present tower base level.

CONCLUSIONS

The hydrology of caves occurring below the pinnacled and griked seasonally arid karsts of central and north-eastern Queensland is unique in that inflow water is derived from rapid rainwater runoff from steep bare rock surfaces, with little surface ponding or soil leaching. The water carries its POC load with it to earth sumps where soil-like microbial processes occur below ground, and extensive underground corrosion occurs in the nothephreatic epiphreas. Steeply dropping, often freefall, vadose passage fed by runnel sinks lead to large nothephreatic epiphreatic chambers where the sediment load is dropped and water backs up behind active phreatic conduits which slowly drain the flood waters, maybe by more nothephreatic backup areas, to pediment springs. This hydrologic system is best termed a rainwater inflow cave system to distinguish it from allogenic fluvial systems and from autogenic gully fluvial systems of polygonal doline and honeycomb karst with soil and interstitial flow (Williams 1972). Rainwater inflow cave systems remain at an earlier stage of fluvial capture as the initial seeps and eventual sinks are from runnel/grike floors rather than from stream floors. This results in more, but smaller, inflows per unit area. Surface integration of flow is prevented by pinnacle karren divides, though some degree of underground integration of flow may occur.

Cave systems can be classified in terms of degree of integration of surface flow before inflow, ie. order of stream, as follows:

1. interstitial flow in rocks of high intergranular porosity e.g. Augusta and Roe Plain.

2. rill and sheet flow with the start of runnel flow at joint intersections - rainwater inflow grikes, solution pits and nothephreatic allogenic karst of the seasonally arid subtropics e.g. Viator Hill.

3. runnel flow down grikes to rainwater inflow cave systems e.g. Mt. Etna, Chillagoe.

4. gully flow between hills - polygonal karst forms e.g. Darrai Hills, Waitomo.

5. streamsinks - fluviokarsts, usually allogenic e.g. Camooweal, Yarrangobilly.

Some humid tropical karsts (e.g. Mulu) are a large scale mosaic of types 3, 4 and 5.

In seasonally arid tropical karsts lacking a vine scrub community, particulate organic carbon is limiting and consequently extensive development of rainwater inflow caves does not occur. In the perpetually humid topics no dry season accumulation of leaves occurs and soil processes and carbonate corrosion is concentrated more on the surface leading to limited nothephreatic development in the rainwater inflow cave system. In reviewing tropical karst processes Sweeting (1972) concluded that most corrosion occurs near the surface due to rapid solution and evaporation. Hence caves are generally small except when formed by through-flowing (allogenic) rivers. "Solution is controlled by bacteria and other micro-organisms and tends to take place in swamps, lakes and the bases of cockpits", ie. is predominately lateral. The seasonally arid tropical pinnacled and griked karsts of Queensland differ in that, while fast solution and eveporation occur on the limestone surface and there is microbial activity and lateral corrosion in the soils of the tower base pediments, the microbial activity in the shallow soil patches and leaf mats on the towers is limited by the even higher rates of evaporation in the seasonally arid tropics. This preserves particulate organic carbon and allows it to be transported down to the earth sumps of the cave system's epiphreatic zone, where the enclosed cave environment protects the soil microbial processes from the inhibiting effects of dessication (except in severe drought or in areas of through draft). Thus substantial in-cave microbial assisted corrosion occurs in the epiphreatic zone of seasonally arid lowland tropical rainwater inflow caves, forming large cave systems where surface vegetative production is both sufficient and in a suitable form. In the seasonally arid subtropics the nothephreatic development in rainwater inflow cave systems is restricted for other reasons which relate ultimately to lower temperature and the quantity and type of precipitation.

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WILDERNESS MYTHS AND AUSTRALIAN CAVES

Elery Hamilton-Smith

Abstract

Beyond a preliminary discussion of some of the basic issues in the writing of any history, the paper looks at what might be called the 'Wilderness Myths' of Australian caves. Any wild place generates myths, and Australian caves have their share of these, which constitute the 'folk history' of caving areas (and often that of cave guides). It is argued that these are more-or-less systematic and are not simply the result of error or simple exaggeration in transmitting the story.

Examples include myths about bottomless pits, blind fish, Aboriginal-white conflict, bushrangers and popular heroes of cave discoveries (along with the interesting result that non-heroes are neglected or even completely forgotten).

Wilderness myths present two issues to the would-be historian : what actual events contributed to them and what does their evolution as myths mean ?

INTRODUCTION

Any historian is faced with the problem of validity. The traditional perspective demands that one must check every bit of information with the aim of discovering objective and final truth. There are a number of other ways of looking at history (see Pascoe, 1979 for a review of these) and many contemporary historians would argue that there is no single final truth, but rather various competing, although still valid, perceptions of reality, and further, that even an objectively false view, to the extent to which it is believed, must be taken into account as part of reality, and as often having as much influence on events as if it did have total objective reality (Melbourne Historical Journal Editorial Collective 1984).

So, in opening this discussion, it must be emphasised that the central question is not one of distinguishing truth from fiction, but rather one of trying to understand the range of perceptions held, and something of why and how they arose. In talking of the notion of 'wilderness myths', it can usefully be related to the well-known phenomenon of 'urban legends' (Brunvald, 1986 and earlier works by the same author). We all know some of these - the man who falls naked from his caravan while his wife is driving, the chihuahua and cat incidents, or any one of a multitude of others.

The urban legend is anecdotal, happened 'to a friend of a friend', has some sort of ironic twist and a seductive plausibility. Some may have, somewhere, a factual foundation, but the fact that the same legend appears widely, even internationally, certainly leads us to doubt this - and no one ever really finds that foundation! As indicated below, our wilderness myths may have some foundation, although their relationship to popular belief is extremely tenuous in some cases. The most interesting thing is that many of them can be found, in essentially the same form, in a wide variety of geographic locations, and this in itself suggests some sort of systematic origin, not necessarily based in any local reality.

We all know about bottomless pits (although perhaps less than some years ago, when caves were much more often seen as objects of mystery) although this myth does not warrant any detailed discussion. However, its very ubiquity serves as a useful pointer to its sytematic character.

This paper will deal in more detail with four other commonly occurring examples - blind fish ; the white-aboriginal conflict ; the bushranger's cave ; and the cave hero. Then the issue of commonality between these and their possible origins will be discussed.

BLIND FISH

There are, of course, blind fish found in caves. They occur in Australia at North-west Cape but were only discovered there in the 1940's (Whitley, 1945), and are virtually unknown to the general public (even to many speleologists). The first record of blind fish in caves is probably that of Ambylopsis, first described in 1842 from Mammoth Cave (U.S.A.). However, the Proteus of Yugoslavian Caves has been known for centuries, even though first formally described by Valvasor as recently as 1689 (Vandel, 1965). Although not a true fish, it has been commonly perceived as one, and so, there is a long and relatively well-known history of blind fish living in caves.

There is no hard evidence of blind fish in any of the Eastern Australian caves, although there may well have been examples of etiolated specimens of carp, trout or other common freshwater fish as described from Kubla Khan (Scott, 1960).

To take Jenolan as an example, Cook (1889) reported that carp were actually introduced to the Underground River, and suggested that within three generations, they may become blind. He also reported at some length, quoting Agassiz, the blind fish of Mammoth Cave. However, the letters of early visitors to Jenolan frequently contain references to blind fish in the Underground River. They were probably told of this by the guides - there does not appear to be any which actually claim, in the first person, to have seen a blind fish.

At Buchan, blind fish achieved much greater recognition, being reported from Moon Cave in a brochure published by the Minister for Lands (Anon., 1913, 1925). There are examples from other parts of Australia, but the most recent was probably that from the Nullarbor, widely reported in the popular press during 1969.

WHITES vs. ABORIGINALS

A number of examples of Aboriginal skeletons or mummies have been found in caves. Both these and others, rumoured but not found, give rise to a range of stories. The puzzling thing is the extent to which these relics are seen as evidence of conflict between white and black Australians.

Some of these occurrences are reported accurately by the guides at tourist areas, e.g., Skeleton Cave, Jenolan or Yonderup Cave, Yanchep, as pre-dating white occupation and being simply the result of accident. Yet visitors often ask about or even postulate killings by white settlers as the 'common-sense' explanation, and it is not unusual to be told, very seriously that the skeletons concerned did result from a murder by white settlers.

A more striking case is perhaps the slaughter at Murrindal. The contemporary folk history tells of the total Aboriginal population being rounded up into a bend of the river, shot, and their bodies thrown over the cliffs into the Murrindal River, which ran red with blood for weeks afterwards (reported in Mill, White and Mackey, 1980: 15). The earliest account so far discovered is a manuscript by C.H. Grove, not dated but reporting on the author's personal experiences in 1867. This describes a number of Aboriginal men (between a dozen and sixteen) being apprehended in the course of killing sheep, shot, and their bodies hidden in a cave at the foot of the cliffs (Hamilton-Smith 1986). Time appears to have enlarged the incident considerably !

Then there is the world-famous petrified Aboriginal of Naracoorte Caves. The popular story diverges widely from the contemporary reports, and a few of the variations are summarised in Table I. However, the key difference for present purposes is that although there is absolutely no evidence to support the idea of killing by white settlers, this often appears in recent accounts, either as a certainty (Barrett 1944) or as a suggestion (reported in Lewis 1977). As with the Buchan incident, the story appears to have been embellished over the years, and in this case, many aspects other than the killing by whites seem to have been 'improved'.

THE BUSHRANGERS' CAVES

Right across Australia one seems to find bushranger's caves, even in regions where there is little likelihood that bushrangers would have found any cause for their attentions. So, there are Melville's Caves in North-eastern Victoria ; the bushranger's cave on Hanging Rock at Woodend in Victoria ; Bushranger Cave at Cania Gorge in Queensland ; all the stories of Abercrombie ; Pigeon's Cave at Windjana Gorge in the Kimberleys and, of course, the discovery of Jenolan by the Whalan family in pursuit of the bushranger McKeown.

Many of these appear to be without any factual basis, although there is no question that the Bathurst region was one particularly prone to bushranging exploits and Bates (1982) describes the Abercrombie bushranging stories at some length. Nevertheless, a careful reading of even his narrative suggests that the connection with the caves was probably sporadic at the best and generally a very tenuous one.

Similarly, Havard (1934) has discussed the McKeown myth at some length, and demonstrates that although cattle thieves probably did live in the Jenolan area, there is little real evidence that one of them was named McKeown, or that his hiding at Jenolan led to the discovery of the caves, or even that the Whalan family were in fact the discoverers. As one of the correspondents cited by Havard points out, if there were any truth in the story, then surely McKeown would have been recognised as the discoverer rather than the Whalans. There does not appear to be any further evidence which conclusively establishes the truth of the McKeown story.

THE PETRIFIED ABORIGINAL OF NARACOORTE CAVES

The Contemporary Story

Body was desiccated, weighing only 28 pounds and had a leathery texture. The general description fits with the possibility of a ceremonial burial as known to occur at other sites. The only evidence of any wound was a small nick in the skin of the neck.

The thief was met by the Crown Lands Ranger - a Mr. Lawrence Egan - as he was carrying the body away. Egan then engaged the attention of the police to recover the body, obtaining a magistrate's order from Wehl, then Magistrate at Mt. Gambier.

After the recovery of the body, it was replaced in the cave and protected by iron bars. Some months later, and following a court hearing in Adelaide, the thief returned and again stole the corpse.

(Border Watch, 20 Sept. 1861 ; Adelaide Observer, 30 Nov. 1861; Adelaide Observer, 4 Jan. 1862.)

The Present-day Story often includes :

The body was heavily calcified (and one can only speculate upon the possible relationship of this description to Haggard's novel King Solomon's Mines!) The death was the result of a sheep-stealing episode, ending in shooting of the Aboriginals concerned, one of whom managed to find refuge in the cave and died there.

The thief who stole the body hid it under a hotel bed where it was discovered by a curious maid, who then reported her find to the police.

Following the court case, the body was replaced in the cave and protected by iron bars. However, the thief returned and stole the body again before the cement fixing the bars in place was dry.

Table I: Two accounts of the Petrified Aboriginal story at Naracoorte, South Australia.

THE HEROES OF DISCOVERY

Most cave areas have their stories of a discoverer, recognised above others as a key figure in the history of the caves. One could cite many examples - Olsen of Rockhampton, Atherton of Chillagoe, Whalan, Wilson and Wiburd of Jenolan, Moon of Buchan, Reddan of Naracoorte, or Dawson & Connolly of the South-West.

In many such cases, one can only question the extent to which the 'hero' belief may well conceal a much more complex story from view. Any critical historical analysis must explain, for instance, why the discovery of new caves at Jenolan should have been the monopoly of the caretaker of the day, or that Wiburd's discoveries ceased with the death (while seeking new caves) of his long-time colleague in exploration, Jack Edwards, on 8 Dec. 1908. In the same way, the name of James Mason appears pencilled on the walls of many more caves at Naracoorte than that of William Reddan, caretaker of the caves. Yet Reddan is remembered as discoverer of most of the caves and Mason is virtually unknown.

As an illustration, it is particularly interesting to look at the role of Frank Moon at Buchan. Popular history at present credits Moon with the discovery of most caves at Buchan, associates the Rev. John Flynn ('of the Inland') with him in his explorations and certainly reports that tourism at Buchan commenced with his discovery of the Fairy Cave in 1907. Moon has also been credited in the popular media with a remarkable range of adventurous attempts to extend knowledge of the caves. The Melbourne Argus of 16 Nov. 1951 even ascribed to him an exploit of swimming underwater with matches and candle in his bathing cap - a carbon copy of Casteret's famous entry to the Montespan Cave (Casteret 1933). It is important to note that romantic notions of this kind do not appear to have been claimed by Moon himself, either at the time or in recorded interviews during the 1960's.

In fact, tourism at Buchan was established by at least 1885 and was described in Pickersgill's Railways Tourist Guide of that year. Although Flynn's photographs played an important role in obtaining the support of the state government for exploration and development at Buchan, there is no evidence that his actual cave experience extended beyond a few visits purely for photographic purposes. Moreover, although commonly credited with sharing in the exploration of Fairy Cave, Flynn was no longer resident in the area in 1907. The actual record of discovery is presented in Table II, and indicates that Moon's role in discovery and exploration was remarkably limited. It is not surprising that Henham wrote (in 1909) to the Surveyor-General claiming that Moon was taking the credit for Henham's work.

The person most eclipsed by Moon, however, was Frank Wilson. He was already 66 years of age when he arrived at Buchan as manager in 1907, and finally retired at 80 years, having discovered and explored a number of caves, and being responsible for the whole of the physical development of the caves. He had spent a lifetime in cave management at Jenolan, the South-West of Western Australia and at Buchan, yet receives virtually no reference in present-day popular history. There does not even seem to any extant photograph of him as an identifiable person.

DUKE'S CAVE : Explored by Stirling 1889.

DICKSON'S CAVES : Known for many years, explored by Stirling 1889.

SPRING CREEK CAVE : Known for many years, used as a tourist cave in 1885, surveyed by Stirling 1889.

WILSON CAVE : Known for many years, used as a tourist cave in 1885, surveyed by Stirling 1889.

SLOCOMBE'S CAVE : Known for many years, probably first explored by Slocombe (landowner)

KING'S CAVE : Used as a tourist cave in 1885, probably first explored by King (landowner)

MOON'S CAVE : Supposedly explored by Moon in 1906, but had been known for many years and was entered both by Stirling (1889) and at least 'to a considerable extent' by Kitson in 1900.

KITSON CAVE : Discovered and explored by Moon 1906

FAIRY CAVE : Discovered and explored by Moon 1907

SHADES OF DEATH : Discovered E. Henham (1905?) and entered only to top of pitch by Moon in 1907.

BABY BERGER : Discovered C. Wright, explored by Moon 1907.

MURRINDAL CAVE : Discovered E. Henham 1908, explored by Moon.

LILLY PILLY CAVE : Discovered E. Henham 1908, explored Frank Wilson 1909.

ROYAL CAVE : Apparently discovered by Frank Wilson in 1910 but explored by Wilson, Moon & Brown.

FEDERAL CAVE : Discovery and exploration by Wilson and Bonwick 1915.

Table II: Summary of the discovery and exploration of major caves at Buchan, Victoria

TOWARDS ANALYSIS AND EXPLANATION

It is probably tempting to ascribe this pattern of myth-making to the desire of tourist guides to tell a good story. However, it is not nearly as simple as this, and in seeking an explanation, it is firstly necessary to look at the overall direction and pattern of the stories. In summary, we find :

Bottomless Pits: These are world-wide, particularly in places where caves are not well-known or widely understood. Obviously, there is no factual basis.

Blind Fish: Common wherever underground rivers or other large water bodies occur in caves. No factual basis in Australia.

White-Black Conflict : Common throughout Australia. The conflict obviously has a factual basis, but rarely is there any evidence to relate it to the caves concerned. The pattern seems to consistently ascribe the origin of skeletons in caves to killing by whites, or in some other way to exaggerate the extent of violence by whites.

Bushrangers Caves: Common throughout Australia. Again there is an extensive factual basis in Australia, but the relationship to specific caves is usually extremely doubtful or tenuous.

Hero Discoverers: Common throughout the world. Usually a reasonably strong factual basis, but the exploits of the hero are exaggerated at the expense of his colleagues.

From this summary, there is a continuum from no factual basis at one extreme, through to a strong factual basis at the other. In each case, the relationship between the myth as expressed in present-day folk history and the story as reported by contemporary observers or records seems to be consistent from one area to another. It would be easy if we could find one simple explanation which would deal with myth-making in total, but it is doubtful whether this will be possible.

However, there is a degree of unity and continuity in these cave myths, based in the 'mystery' and unfamiliarity of caves, which in turn demands demands a way of formulating satisfactory images in our own mind. To describe a cave as bottomless is in effect a tangible recognition of its mystery - and to label something, even as being bottomless, is one way of dispelling the uncertainty that its mystery provokes.

Further, given a degree of mystery, we are also likely to impose some sort of structure upon whatever phenomenon baffles us. If we have expectations of a phenomenon, then we will tend to use those expectations to formulate descriptions. Thus, underground rivers have blind fish because we expect that to be so ; Aboriginals were murdered by whites, and it is reasonable to expect that the bodies would be concealed, e.g., in a cave ; all our schooldays thrillers tell us that caves are used by pirates and bushrangers and in any case, many caves look as if they are natural lookouts or refuges.

So, a first level of explanation rests in the mystery of caves and the way in which we react to that. A second level is the cult of the hero (whether bushranger or explorer) and their relationship to the cave environment.

Interestingly, Manning Clark (1985: 61-63) in an essay on Australian heroes, identifies the bushranger and the explorer as the first two indigenous white Australian heroes. The general Australian sympathy for bushrangers, as pioneers of resistance against political and socio-economic repression, still permeates our culture, and as Clark expresses it:

> The convicts and their descendents had raised to the status of a hero a man who had defied the laws of God and man. This bushranger hero was a colonial Ishmael, a man whose hand was raised against every man because every man's hand was raised against him. He was also a colonial Cain, a man who did not accept that he was subject to either the laws of God or the laws of man.

He continues to argue that the explorers were raised to the status of heroes "... because they had shown that it was possible to subdue the Australian wilderness". Given both the fear of the wilderness and the mystery of caves together, it is relatively easy to see the origin of the hero myth being personified in a cave explorer. Thus, both the bushranger and the explorer exemplify the potential dominance of the individual over social or environmental determinism.

Even the 'conquering' of the Aboriginal people probably reflected something of this ethos, but in later years has become overlain with a realization of our own savagery and a consequent sense of guilt. Perhaps by telling stories of the slaughter, we mentally transfer the guilt back to the perpetrators, yet at the same time, their power over the alien environment is acknowledged, and so we have the ambiguity of guilt and admiration together. All explorers are individual heroes in the public mind, a and the people who support them and make their exploits possible are forgotten - we only need to think of Hilary on Everest as an example. So, our cave exploration over many years comes to be seen as being related to one dominant individual, such as Frank Moon. In the case of Moon, his association with another popular hero, Flynn of the Inland, is exaggerated, thus amplifying his own standing.

At the same time, this personification serves a valuable function both for the individual concerned and for the tourism experience. In so far as there is any validity in the argument that guides want to tell a good story, there is probably an extent to which early managers like Wiburd, Reddan and Moon recognised the way in which the hero cult potentially increased their power over the cave reserve for which they were responsible. At the same time it is easier to translate the idea of exploration to the public when it can be symbolised through an individual personality.

More fundamentally, we are socialised to make the assumption that conspicuous success is due to individual capacity rather than to any organizational or structural explanation. So, we seen Moon or any of his peers as having conquered the environment which they explored through their own strength and determination.

Finally then, we come to the point that varying perceptions each have their own validity and their own impact upon reality. The hero may achieve better management, more resources for management, greater visitor numbers or any one of a number of other benefits which might have been denied to a less heroic manager. Whether his superior standing is objectively true is not the point; the fact that it is widely believed is enough to give it potency. In turn, that potency is re-inforced and reproduced through its continuing repetition by guides and others.

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HISTORY AND SUMMARY OF RESEARCH IN CHILLAGOE BY BROTHER NICHOLAS SULLIVAN TO END 1986.

Grace Matts

HISTORY

Following much urging by the Matts family with reference to the potential for scientific work - particularly biospeleological - in the Chillagoe area, Brother Nicholas Sullivan visited the area in 1978. He was very impressed with the area and its potential.

In 1981, while on his annual Australian pilgrimage, he arranged to again visit Chillagoe with the view of mounting a large expedition in June - July 1982. He visited several caves and assessed the potential for specimen collection as excellent. While thus enthused he met the Qld minister for National Parks, Tourism, Sports and Arts, Mr. Tony Elliott, who pledged his, and his governments support for an expedition in 1982. This meeting was reported as a news item in the Cairns Post.

"Chillagoe Caves World Centre?

THE EXPEDITIONS (to date)

1982

From July 5 to July 19 - This expedition was the largest so far and consisted of eight Americans and five Australians assisted by sundry members of SSS, NSWITS, and CCC, somewhere in the vicinity of 35 adults and three children.

Studies were done in the areas of archaeology- by Drs Charles and Ellen Brush from U.S.A., palaeontology - by their daughter Karen Brush, biology - by Elery Hamilton Smith assisted by the two students from Manhattan College U.S.A., while Simon Bland looked after the surveying of the various caves used as collection sites.

Unfortunately the area was particularly dry, having not had the usual °wet season' and the late timing of the expedition - July was felt to be too late in the year for best collection. However, some 200 specimens were delivered to the Qld Museum for identification. They were not enthusiastically received as Dr. Monteith had just finished a transect of the Atherton area and over 2000 specimens he had collected there to be identified. He thanked us but pointed out that the Atherton transect would have to be done first.

1983

From June 6 to June 16 - due to financial restraints this was a much smaller expedition, consisting of six Americans and sundry members of CCC who assisted greatly, and one from SSS. As it was in June, this was not a convenient time for members of the Sydney clubs to assist.

As the north of Queensland was in the grip of a drought the water tables were even lower than in 1982. This made access to the deeper parts of the caves easier but reduced the availability of specimens to almost zero.

Of significance were the phone calls from both the Premier's office and the Minister for Tourism, T. Elliott. These precipitated a visit to Brisbane by Brother Sullivan to talk to them both. While there, he discussed the future of the Chillagoe area as a research centre and again got their support. He also visited the Museum where he talked with the director and staff members. They were eager to provide assistance on forthcoming expeditions and expressed enthusiasm for the project, having already identified some of the specimens from the 1982 expedition as being new species.

1984

From June 10 to July 6 - This expedition had the benefit of two entomologists from Bishop Museum, Hawaii, together with three Americans, two Australians and the invaluable assistance of sundry CCC members.

This proved to be one of the most exciting expeditions to date. Whether the conditions for collecting had improved or whether the benefit of having two very experienced entomologists with the group were responsible, the results were fantastic. So many specimens were collected it will take years to identify them all. Already, with their experience, the entomologists were able to state that many new taxa were collected.

Prior to this expedition Brother Sullivan had spent most of the week in discussions with the Queensland government and NPWS officials over access problems in the Chillagoe area.

Following the expedition both the entomologists attended the Queensland Museum to discuss their collections and all the problems associated with the immense task of identification and comparison with those specimens from the previous expeditions. A solution was reached when it was decided that unidentified specimens should be sent to qualified taxonomists to study them. Meanwhile Brother Sullivan returned to Sydney to spend the next few days with the staff of the Australian Museum making tentative plans for the future expeditions.

1985

Unfortunately I was not involved in this particular expedition and there seems to be no documentation available at this short notice. It ran during the month of June and was attended by four Americans including the two entomologists. Of course CCC as usual provided their invaluable support.

The main feature of this expedition was the discovery of the immense fauna in the lava tubes of the Mt Garnet area, resulting in the desertion of the caving area in favour of the lava tubes. The entomologists worked tirelessly (and ate as if each meal was to be their last) leaving reluctantly but with assurances that they would return next year.

Further negotiations were held with the Premier and the Minister for NPWS.

1986

From May 24 to June 17 - Only one of the entomologists could attend this time, the other was doing studies in the caves of thailand. Brother Sullivan was assisted by a student from University of Queensland and five Australians together with the usual CCC support team.

Following their experiences in the lava tubes the entomologists had decided that the foul air required additional equipment as a standby. This did not deter him and as soon as he arrived he went straight to work. Collecting was done in the cave area as well.

This expedition had the benefit of the photographic ability of Johann Pfeiffer. This enabled us to have the photos developed, assessed, and available for Brother Sullivan to use prior to his return to U.S.A. Unfortunately the duplication was done in U.S.A. and the quality was nowhere near as good as the originals. Next year we will make sure that the duplication is done in Australia or two photos taken of each subject.

During the expedition discussions were held with various people re the setting up of a research station in Chillagoe to the stage of inspecting available land. At this time I am unaware of the outcomes.

FUNDING

All expeditions have been funded by:

The Explorers Club of New York
Manhattan College, New York
The Manly Foundation
DuPont Australia
Sundry Individuals

OUTCOMES

Following the 1982 expedition Brother Sullivan forwarded to us a summary which gave an overview of the material collected.

Chillagoe Caves Biology - A Summary - 1982

Only samples of each cave population were collected to prevent depopulation of the cave..... The bulk of the collecting was conducted by Elery Hamilton-Smith and a student from Manhattan College, New York.... Several scientific papers will be forthcoming as a result of expedition activity, but until then the following summary will give an overview of material collected.

1. Annelida

Several earth worms were collected in the Ryan Imperial Tower from Marachoo Cave (CH33).

2. Crustacea

a) Amphipoda. At least one, and possibly two troglobitic species were collected in Marachoo Cave (CH33), Giant Causeway Cave (CH78) and Ryan Imperial Cave (CH4). The extreme low water table made collecting of these aquatic shrimp-like organisms difficult. Another species was collected in Tea Tree Cave (CH43-101). Additional collecting will have to be postponed until after a season of rain sufficient to raise the level of water in the pools of the caves concerned.

b. These terrestrial crustaceans (Pill-bugs) are fairly common in the leaf litter and mud of Chillagoe Caves. Most, if not all, are surface forms that have wandered into caves seeking food and/or shelter. Large numbers were seen and collections made in the Spring Tower in the Spring Cave System (CH12-60-89-90). Others were found in Donna Cave (CH2), Marachoo Cave and Ryans Creek Cave (CH123). Non-pigmented forms have been previously reported from Markham Cave (CH10) (Wellings 1969).

3. Arthropoda

As was expected, the great majority of material collected were either insects or arachnids. Many of the caves were bone dry due to the prolonged drought and it was the opinion of those who had visited Chillagoe before, that representatives of all taxa were reduced in number compared to normal conditions.

a) Diptera. Fruit flies (Drosophila) were collected at Royal Arch Tower and Royal Arch Cave (CH9-50). Practically all the other major cave systems contained one or more species of dipterans and collections were made at the Walkunder Tower from Spatial Cavern (CH41); the Queenslander Tower from Queenslander Cave (CH51 entrance); the Spring Tower from Spring Cave (CH12 entrance); the Tea Tree Tower from Tea Tree Cave (CH43 entrance); the Ryan Imperial Tower from Marachoo Cave: and from Wallaroo Tower from Giant Causeway Cave. Mosquitoes (Culicoides sp.) were also collected, plus several specimens of Phlebotomus from Trezkinn Cave (CH14) in the Donna Tower.

b) Hemiptera. A number of Rediviidae (assassin bugs) were found in the Tea Tree, Donna, Queenslander, Spring and Walkunder Towers. It is not improbable that at least one new species is represented in this collection. Smaller numbers of Homopterans, mainly Cixiidaens, were collected in the Donna, Haunted (from Spooked Cave (CH7-8)) and Royal Arch Towers.

c) Hymenoptera. Ants of an undetermined species belonging to the family Formicidae, were found in Tea Tree Cave (from both the CH43 and CH101 entrances). The high heat and humidity of this cave undoubtedly attracts these organisms.

d) Lepidoptera. Several Tineideans were seen in most of the major cave systems. These were occasionally collected fairly deep within the cave but otherwise are almost always found at the entrance - common in the Queenslander, Spring, Donna, Royal Arch, Tea Tree, Ryan Imperial and Wallaroo Towers and in the Tower of London Cave (CH5).

e) Orthoptera. The wetas or crickets (Endacusta) occur in all the major cave systems. Individuals were collected in the Tea Tree Tower (from Tee Tree Cave); the Carpentaria Tower (from Carpentaria Cave (CH77); The Ryan Imperial Tower (from Marachoo Cave); the Wallaroo Tower (from Giants Causeway Cave); the Walkunder Tower (from Octopus Hollow CH40); the Tower of London Tower (from Tower of London Cave); the Haunted Tower (from Spooked Cave); the Queenslander Tower (from the New Southlander CH81 entrance); the Spring Tower (from Spring Cave CH12 entrance and Gecko Cave CH13); the Eclipse Tower (from CH208); the Donna Tower (from Bauhinia Cave CH125); and from the Royal Arch Tower (from Royal Arch Cave). These crickets probably migrate in and out of the cave system, depending on available food supplies.

f) Blattodea. These cockroaches (Fam. Blattellidae) are among the most common inhabitants of the Chillagoe Caves. They also provided one of the most significant discoveries. In 1967, a single specimen of a troglobitic cockroach was recovered from Trezkinn Cave (Wellings 1969). It had greatly reduced eyes, vestigial wings and a near transparent cuticle. Unfortunately, this specimen was misplaced and apparently lost by the institution to which it was sent for identification. Two more specimens of what is assumed to be the same species were collected from Trezkinn Cave during the recent expedition. In addition, three specimens of another, possibly troglobitic species, was collected from the Tea Tree Cave System. The only previously identified species of troglobitic cockroach from Australia is Trogloblattela Nullarborensis, found in the caves of the Nullarbor Plain. Many specimens of the Oriental cockroach (Blatta orientalis) were found in all the major cave systems that were explored.

g) Mecoptera. Six of the long winged scorpion flies were collected from three sites in the Spring Tower.

h) Thysanura. The silverfish are among the most primitive of all insects. Several were recovered from the Queenslander Tower (from the New Southlander entrance CH81). Although these organisms may appear to be adopted to a cavernicolous existence they are in reality surface form.

i) Coleoptera. Several species of beetles were collected in Clam Cave (CH26) in the Walkunder Tower. This cave is a major swiftlet nesting site and has copious quantities of guano on the floor. Both troglobitic and trogloxenic forms were found. However, attempts to collect the only previously known troglobitic Pselaphid from Chillagoe, originally found in Trezkinn Cave, were unsuccessful. One or more species were collected from most of the cave systems.

4. Arachnida

a) Acarina. Guano mites (Ixodiedae) were collected from two caves in the Walkunder Tower (from Clam Cavern and Spatial Cavern); and in Royal Arch Tower (from Royal Arch Cave).

b) Araneida. At least three species of spiders and huntsmen (and possibly five) were collected from all the major cave systems. Most belong to the family Pholocidae and, although widespread in the Chillagoe Caves systems, none demonstrate adaptations to a cavernicolous existence.

c) Pseudoscorponida. The first reported pseudoscorpions from Chillagoe were found in Tea Tree Cave and additional specimens were collected in the Royal Arch Tower (from Royal Arch Cave).

5. Chilopoda

a) Scutigeromorpha. Centipedes, all epigian forms were collected from caves in the Tea Tree Tower (Tea Tree Cave); the Queenslander Tower (New Southlander entrance); and Ryans Creek Tower (Ryans Creek Cave). All belong to the Scutigeridae.

6. Mollusca

a) Gastropoda. Snails were located in three caves in the Royal Imperial Tower (Ryan Imperial Cave, Keefs Cavern CH24 and Marachoo Cave); The Markham Tower (Markham Cave CH10); the Haunted Tower (Spooked Cave); the Queenslander Tower (New Southlander entrance); and the Royal Arch Tower (Royal Arch Cave).

Many species of bats and birds were observed in and near cave entrances, but no collection was made of vertebrates. It is planned to return to Chillagoe in May or June of 1983 to undertake more intensive collecting, if there is sufficient rainfall. In either 1983 or 1984, collections will be made in those areas not previously studied. It must be stressed that it will take several years before a definitive review of the Chillagoe cave fauna can be published.

From the 1986 Expedition report I have taken the highlights as follows:

...Howarth and Irvin collected between 10 and 15 new troglobitic invertebrates in Long Shot and 210 Caves (lava tubes). Among them is a blind thread-legged bug and a new Nocticola related to those at Chillagoe Caves. Two suprising troglophiles (?) were also discovered. The first is a blue Peripatus, probably a new species. Peripatus are rare in collections - this was captured in the deep cave zone. The other suprising discovery is a population of singing crickets in the deep cave zone. Virtually all cave crickets world wide are mute. Only a few singing crickets are known from Indonesia to the Philippines. These are first from Australian caves.

Howarth... had made 27 visits to 18 different caves, collecting both environmental and biological data. Nearly 1000 specimens of invertebrates are now being processed and identified.

...Howarth and Irvin moved camp to Yaramulla Station to study lava tubes in the Undarra Lava Flow. Their main quest was to repeat the faunistic survey along the environmental gradient which they did in 1985. As expected, species distrubution was strongly correlated with environmental conditions. However, COs concentration reached only 4.5% and some troglobites were scarce.

Since the collections have been so large and the work involved so difficult there has been no opportunity to detail the results. Several papers on the work are in process at this time. One of the most prestigious nature magazines have accepted an article for publication in 1987.

Both entomologists, Drs Frank Howarth and Fred Stone, have had their work in Chillagoe recognised by the NSS - receiving Certificates of Merit.

Brother Sullivan is now firm in his belief that it is essential to set up a research station in the Chillagoe area as soon as is possible and is working towards this - having the support of the Queensland Premier and the Minister for NPWS.

At this point I would like, on behalf of Brother Sullivan, to express his appreciation of the assistance give to him by the Chillagoe Caving Club and other caving club members during these expeditions.

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PHOTOGRAPHIC WORKSHOP SUMMARY

Chaired by Bob Kershaw (I.S.S.) with assistance from: I. Binnie (M.U.C.G.); A. Robson (Q.); and N. Poulter (SRGWA).

INTRODUCTION

Photography is an art form that expresses the thoughts and creativity of the author, as well as demonstrating s/his technical skills!

The photographic competition permitted the exhibition of many authors' works whose creativity and technical skills are excellent!

These combined skills of the authors provided an insight into the Cave photographer and his/her photographic equipment at this well attended and thought provoking workshop. Many a Cave Photographer would improve his/her overall photographic skills by joining a local camera club (see your local phone book) or by reading about photographic composition. The workshop did not cover the aspect of composition, which is another topic in itself.

Below is a summary of the topics covered in the workshop.

EQUIPMENT

The equipment used by the major photographers ranged from an Olympus trip camera to the complicated electronic masterpiece of the Nikon FE2.

IT DOESN'T MATTER WHAT EQUIPMENT OR WHAT SIZE LENSES that you use BUT HOW YOU USE THEM!

Numerous lenses were used, ranging from a standard 50mm lens to a 35mm-210mm lens. Accessories included diopters bellows and macro lenses.

Tripods varied from the lightweight SLIK 450 to a heavy 'pod carried in an old car inner tube.

Flash units used included small ones linked with slave units to big'uns with guide numbers of 45m(iso 100). Some units can now be synchronised to the camera's electronics and meter with through-the-lens (TTL) metering systems for macro work. Methods of carrying gear seemed to favour ammunition cases modified by the individual to suit his/her needs.

The advantages are:

- it is waterproof
- takes a lot of punishment
- reasonably compact but is still able to put everything in it you need

Films depended on the individual's choice. Small grain (ISO 64) is better for clarity and macro work but ISO 400 plus is much better for distance shots in caves because of the light capturing ability of the faster films.

The 400 film also increases the depth of field when dealing with macro shots.

Black and white films used are either Illford or Agfa. Ilford FP4 or Agfa 400 uprated to 800.

Slide duplication. To improve the composition of your well earned slides use a method of slide duplication, i.e. either bellows and macro lens or a slide duplicator.

These methods can also be used to make inter-negatives for black and white prints.

Shutter speeds. If your flash is linked to your camera use the sync speed suggested by the camera's manufacturer. But if your flash is not linked then set your camera on B or T and use a cable release with a locking mechanism.

Multiple exposure is also used in the B or T settings, but be careful of your composition and don't move your camera.

Handy Hints

1. Take more film than you will need,and keep it in the 'fridge if you don't use it for next time.
2. Wipe your gear with Mr. Sheen, DO NOT SPRAY IT, so that you protect your gear from moisture and dirt. Wipe your gear after use and it will look like new!
3. Take plenty of spare batteries into the cave with you. Either Nicads or Alkaline.
4. Use a skylight la or lb filter to protect your expensive lens's front element from scratching.

CONCLUSION

Simply, IT'S NOT WHAT YOU'VE GOT BUT HOW YOU USE IT! Two people may have identical gear but one of them will SEE better than the other. Don't just race through a cave but take your time and enjoy the speleothems and other scenery that exists in and around caves.

USE YOUR CREATIVE EYE TO CAPTURE THE SPECTACULAR! Good luck with your cave photography and remember the EDITOR of the AUSTRALIAN CAVER is always looking for photographs for the front cover and inside.

PHOTOGRAPHIC COMPETITION

There were four divisions:- Chambers, Speleothems, Scientific, and Action. Only colour slides were accepted and only two slides per division per person. Judging was by a photographic judge not connected with caving.

Chambers

1st	Robert Kershaw	'Bendethra Main'
2nd	Ken Boland	'Abrakurrie'
3rd	Norm Poulter	'Looking towards the Entrance of Weebubbie Cave'
Highly commended	Ken Boland	'Croesus Cave'

Speleothems

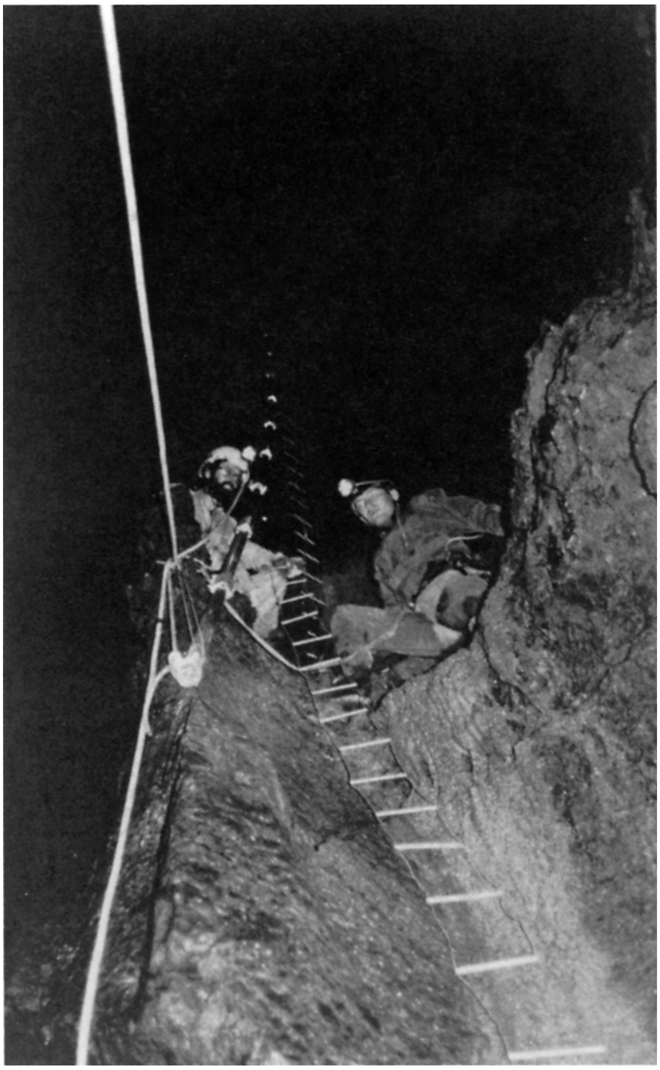
1st	Ken Boland	'Halite'
2nd	Ian Binnie	'Waterfall, Tuglow'
3rd	Rauleigh Webb	'Abstract'
Highly commended	Norm Poulter	'Water Drop' and 'Crystal Cluster'

Scientific

1st	Andrew Robson	'Pseudomorphs of Gypsum'
2nd	Josef Vavryn	'Shark's Tooth Shawl'
3rd	Josef Vavryn	'Oolites in Mud Holes'
Highly commended	Ken Boland	'Asphodite'

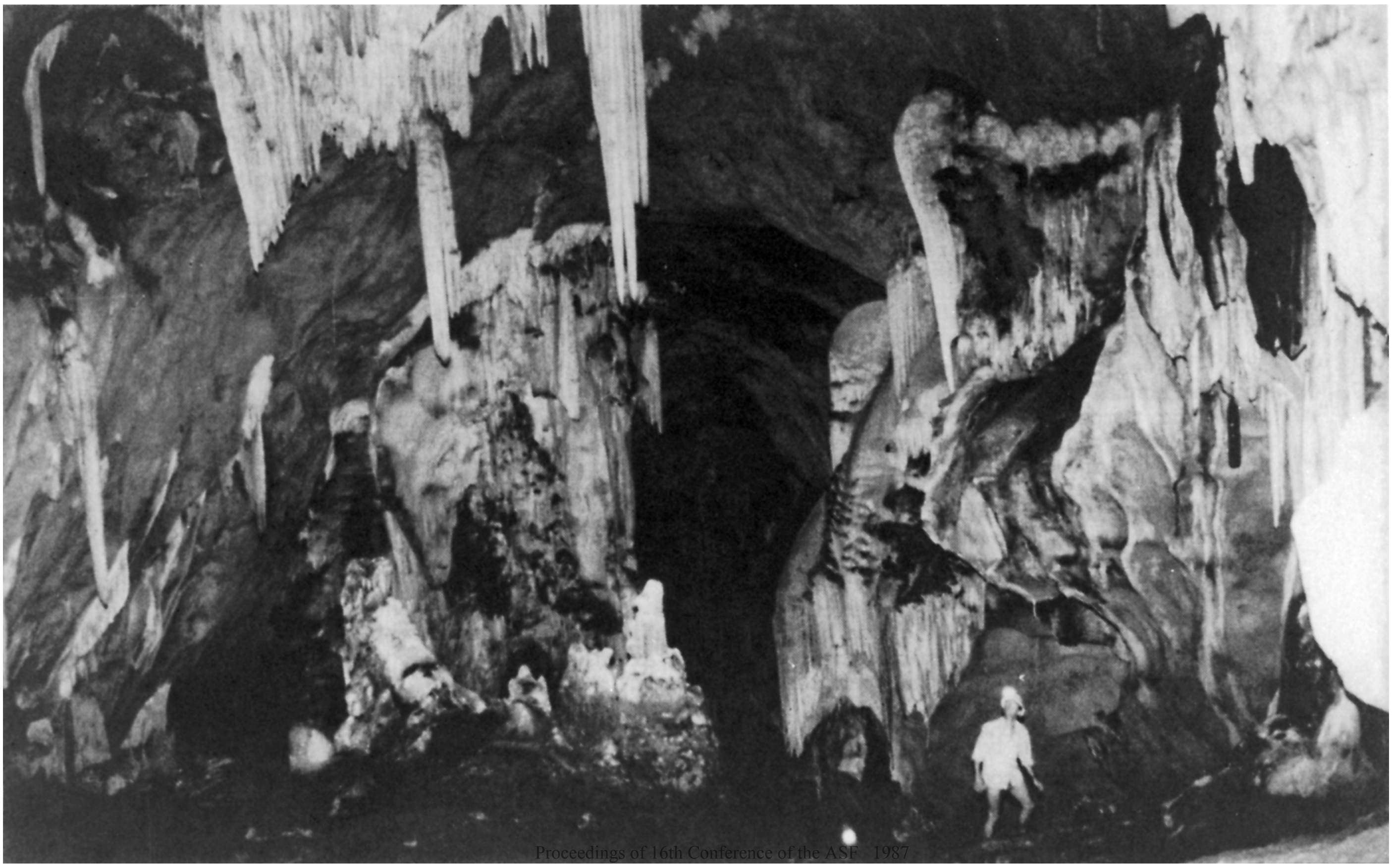
Action

1st	Ian Binnie	'Scaling Shaduf'
2nd	Norm Poulter	'Precarious Photographer'
3rd	Norm Poulter	'Long Narrow Stretch'
Highly commended	Josef Vavryn	'Impossible Squeeze'



1st prize - Action: Scaling Shaduf, Bungonia, by Ian Binnie.

1st prize - Scientific: Pseudomorphs of Gypsum, by Andrew Robson.



1st prize - Chambers: Bendethra Main, by Robert Kershaw.

FIRST RESPONDER CARE FOR CAVE ACCIDENT VICTIMS

R.A.L. Osborne
Read by R. Steenson

Abstract

Although cave accidents are fairly rare events in New South Wales there is need for Police, Ambulance and V.R.A. personnel to be aware of the problems presented by cave rescues and to be able to act should a cave accident occur. The N.S.W. Cave Rescue Group is available to provide advice and training in cave rescue and, in the event of an accident taking place, can be mobilized through the Police Disaster and Rescue Branch. Like most members of the caving community, the Cave Rescue Group is a largely Sydney-based organization and its response time for an authentic call out is likely to be between 3 to 5 (or even more) hours. In the event of a cave accident there will be a delay of at least an hour before initial reporting, (members of the victim's party must leave the cave and summon help, or a party is reported overdue). As caving areas are some distance from major centres the first responders are not likely to reach the accident scene in less than two hours after the accident has taken place. With some N.S.W. cave areas it is reasonable to assume that an accident victim may be 24 hours or more away from first responder care.

It is vital that the first responders to a cave accident are aware of the type of care required by cave accident victims and of the hazards that caves present.

THE HAZARDS OF CAVES

Caves are foreign and dangerous to ill-equipped and/or disabled humans. The major dangers in caves are:- 1. lack of light; 2. thermal conditions; 3. noxious atmospheres; 4. the physical shape of caves; 5. flooding; 6. rock falls; 7. physiological and psycho logical effects.

Since all caves are different, some are wet, some cold, some have foul air, and others deep shafts, there is a great need for first responders to be aware of the conditions found in caves in their area of responsibility.

1. Lack of Light

Caves are totally dark. Complete loss of light is a serious threat to cavers since any attempt to move without light is likely to result in injury. Cavers are advised to carry three independent sources of light and it is common to see less well equipped caving parties completing trips using their, often quite inadequate, back up lighting. Total light failure means that cavers have to stop, and so an overdue party may simply have run out of light. Total or partial light failure will increase the possibility of trauma. First responders themselves need to be very aware of the need for reliable light. Since cave rescues can be protracted affairs, their normal handlights may be quite inadequate for the task.

2. Thermal Conditions

Caves have a fairly stable thermal environment. Cave air temperatures remain close to the annual average air temperature for the area in which the cave is situated and so cave air temperatures are fairly pleasant in most N.S.W. caves. It is, however, the thermal environment that poses the greatest threat to a cave accident victim, particularly an immobilized one.

While involved in strenuous activity cavers may become quite warm, however, on resting they rapidly lose heat due to wet clothes, strong draughts and most importantly through contact with the rock.

For an immobile accident victim heat loss through physical contact with the rock poses a serious threat. Victims trapped in confined spaces will rapidly lose heat to the rock. If measures to conserve their body heat are ineffective they may become hypothermic, a serious condition that can result in death.

3. Noxious Atmospheres

The chemical composition of cave atmospheres is rarely identical with that of the outside air and in many N.S.W. caves it is sufficiently different to pose a threat to the health and safety of cavers. The main atmospheric problem affecting cavers is foul air.

Foul Air

Foul air is enriched in carbon dioxide and/or depleted in oxygen relative to normal air. In most, although not all cases, the enrichment in carbon dioxide is the factor that most affects cavers.

In so-called "normal foul air" oxygen is replaced by carbon dioxide almost volume for volume and its effect on cavers is for carbon dioxide to build up in the blood (hypercarnapia) which will in severe cases result in acidosis and could eventually be fatal. The symptoms and signs of hypercarnapia are:

Increased pulse and respiration
Lips, ears and face becoming red (peripheral vasodilation)
Skin hot to touch
Headache (often first symptom)
Decreased mental ability and coordination resulting in a drunken-like state (carbon dioxide narcosis).

Normal air contains 0.03% carbon dioxide and the threshold limit value for carbon dioxide is 0.5%. Most people can tolerate up to 2% carbon dioxide for extended periods. Experienced foul air cavers can work in up to 4.5% carbon dioxide for short periods but will suffer after effects (nausea often with vomiting) due to acidosis. Normal foul air containing above 6% carbon dioxide is potentially fatal. Some caves in N.S.W. contain foul air with up to 13% carbon dioxide.

A more dangerous, and fortunately more unusual form of foul air is "stink damp". Stink damp contains increased carbon dioxide and very significantly reduced oxygen, with the oxygen being replaced by nitrogen, methane and hydrogen sulfide. An extreme example of stink damp collected from the lowest part of Grill Cave at Bungonia Caves contained 1% carbon dioxide and only 10.8% oxygen. In such an atmosphere the threat of anoxia is immediate. Since the low carbon dioxide concentration won't elicit a physiological response - (increased pulse and respiration rate) - in the victim a rapid loss of consciousness, followed by death could ensue.

Although numerous methods exist for measuring the oxygen and carbon dioxide composition of air, the simplest tests using flame extinction offer the best protection to the non-specialist. A match is extinguished in about 1% carbon dioxide and a candle in about 4% (normal foul air). Only personnel wearing breathing apparatus or experienced foul air cavers should enter an atmosphere that extinguishes candles.

4. The Physical Shape of Caves

Dangers to cavers related to the physical shape of caves fall into three main groups; falls and climbing incidents, entrapments and becoming lost.

Falls and Climbing Incidents

Many caves contain deep shafts and almost all caves have irregular floors making falls the most likely initial cause of injury to cavers. In the United Kingdom in 1982 11 out of 47 underground incidents involved falls, being the most common of 15 classes of cave rescue incidents. Experience in the U.K. has shown that most falls occur on short drops (probably due to less care being taken).

As well as falls the presence of shafts in caves can result in cavers being trapped on ropes and ladders, hanging suspended on safety lines or being unable to ascend a rope they have descended. With the increasing popularity of Single Rope Techniques (S.R.T.) it seems likely that the prevalence of these types of incident will increase.

A person hanging on a rope for any length of time is in danger of suffering from crush syndrome-like effects due to the restriction of circulation in their legs by harnesses. Such incidents should be treated very seriously.

Entrapment

Caves contain many narrow rifts and tight passages resulting in a real, but probably exaggerated, risk of cavers becoming physically jammed and unable to extricate themselves either by their own efforts or those of their companions. A jammed caver faces five main dangers:-

1. Becoming more jammed
2. Loss of body heat to the rock
3. Physical inability to breathe
4. Shock due to the trauma of the situation
5. Suffocation in their own exhaled breath.

There have been cases in the U.K. and the U.S. where victims have not been able to be extricated and death has followed due to hypothermia, asphyxia, and heart attack due to congestion of the blood vessels.

Becoming Lost

It is fairly rare for cavers to be unable to find their own way out of a cave. It is common for even experienced cavers to be "uncertain of their position" for 30 minutes or more. The main danger is that a party may run out of light while trying to find their way. Although some caves are quite complex, most are fairly simple. Major problems in direction finding in caves are that cave passages look quite different when viewed in the opposite direction (it is good practice to look behind regularly when moving through a cave), large blocks of rock or formation may be passed on different sides, and junctions may be missed.

5. Flooding

Cavers being trapped underground by flooding is the second most common cause of cave rescue incidents in the U.K. Although there have been no incidents of this type in New South Wales there are a number of caves where the potential for such incidents exists. Once underground, cavers have no knowledge of surface weather conditions and so flash flooding can easily catch them unawares.

Water levels in caves may be affected by large falls of rain in distant catchment areas adding to the danger of flooding in caves. Cavers trapped by flood waters can only move to the highest point and sit it out. As flood waters will take some time to fall they can be expected to run out of both light and food.

6. Rock Falls

The main danger of rock falls in caves comes from rock piles formed from old rock falls, and rubble filling shafts. These may be moving naturally, or move by being disturbed (in some cases only accidentally kicking a loose rock may cause a pile to move). As with any rubble pile, moving the wrong block can have serious consequences. Specialist advice from geologists and mining engineers may be required should a caving party be trapped by a rock fall.

It is rare for falls to occur from cave roofs as caves, unlike artificial tunnels and mines, have existed long enough to allow the rock mass to adjust to having a cavity formed in it. Most roof falls occur fairly early in the history of a cave.

7. Psychological and Physiological Factors

Caves are dark, cold, and wet, and caving is hard work being both mentally and physically demanding.

Cold, wet, and tired people (particularly if they have been exposed to foul air or have inadequate lighting) will make mistakes and have accidents. Due to the stresses to which they have been subjected injured cavers will rapidly succumb to shock and eventually hypothermia. It is important to remember that a cave accident victim is likely to spend many hours in the cave before any evacuation is attempted and may have been already in the dark for many hours before first responders arrive.

On occasions cavers will reach their psychological limits and "freeze" on ladders and climbs while others may become so physically tired that they cannot continue. Experienced cave party leaders are usually able to deal with these situations without outside assistance. When a member of a poorly experienced party gets into these types of difficulty, problems can arise.

Cavers are encouraged to think in terms of self-rescue in all but the most serious situations. This is one reason for the small number of cave rescue incidents reported. Experienced trip leaders of both caving clubs and youth organizations take their responsibility towards their party members very seriously, and many are quite competent in cave rescue procedures. It is likely that a first responder group may arrive and find the situation fairly well under control. Responsible cavers may call on outside help "just in case" even if they feel they can deal with their situation and should not be discouraged from doing so.

FIRST RESPONDER CARE

The first responders to a cave accident are likely to be the local Police, Ambulance and the nearest P.R.S. or V.R.A. units. The actions they take will be the MOST IMPORTANT in determining the outcome of a cave rescue incident. The management of cave rescue incidents can be divided into six distinct stages:-

1. Surface assessment
2. Reaching the victim
3. Underground assessment
4. Protection
5. Stabilization
6. Evacuation

It is the first four of these activities that will always be the responsibility of the first responders.

1. Surface Assessment

This involves establishing the history and nature of the incident, the location and state of the victim and making an initial decision as to the likelihood of needing outside assistance. It is important to find out what has already been done and to get as much information as possible about the location of the victim, as names used for parts of caves can vary considerably.

In the case of a person being believed to be lost in a cave, or of an overdue party whose position is totally unknown, outside help should be called without delay. This is because searches of caves and cave areas take days to complete and require large numbers of skilled personnel.

2. Reaching the Victim

Once the victim's likely status and position has been established the next aim is to reach the victim with a small assault party (4-6 persons) who can render immediate aid and make an underground assessment. This party should ideally consist of members of the first responder rescue organization, an Ambulance Officer, and at least one person with a good knowledge of the cave.

In popular caving areas it is likely that there will be competent cavers close to the scene who can be used to make up members of this party. If possible use a member of the victim's own party as a guide. Care is required as such a person may be in a disturbed state.

The first party should carry first aid equipment, blankets, extra lighting, food, tackle and hardware as the situation suggests.

It cannot be stressed too strongly how difficult it may be to find the victim's location from interviews with witnesses on the surface. Cave maps (frequently not available) can assist but are of varying quality and reading them is more an art than a science. Good local knowledge of the cave is most important at this stage.

3. Underground Assessment

There are three types of assessment that need to be made on reaching the victim; medical, hazard, and rescue. In cave rescues the principle of not becoming the next victim is most important and the assault party must be aware of the likely hazards to themselves before attempting to assess the status of the victim.

(a) medical assessment

The medical assessment of a cave accident victim differs little from that required by any trauma victim except that particular attention should be paid to checking for signs of shock, loss of body heat, effects of foul air, and to establishing the mental state of the victim.

(b) risk assessment

Before attempts are made to treat the victim it is essential that a good assessment is made of the risks that the victim faces. Most of these have been mentioned before but it is important to stress hypothermia, foul air (or air becoming foul), falling further, flooding, entrapment, and being suspended on a rope. These are hazards which require immediate attention.

(c) rescue assessment

Rescue assessment is deciding what resources and methods will be needed to execute the eventual evacuation of the victim. Can the victim walk with assistance when treated or is stretcher transport necessary? Are tight passages, vertical lifts or difficult traverses involved? Will the cave itself need to be modified by simple "gardening" of loose stones or by more drastic methods? These decisions need to be made early in the piece as they will determine what extra assistance, if any, is required.

4. Protection

The protection stage begins with the initial treatment of the victim and continues throughout the remainder of the rescue. It should be clear to rescue and ambulance personnel what is required to protect the victim, however, caves present some special problems whose management requires special mention.

(a) shock

Unlike road trauma victims, cave accident victims may have to wait many hours before receiving initial treatment. During this time they are likely to be exposed to cold, wet conditions and so the onset of shock is likely. Since first responders may be responsible for the care of the victim for a protracted period proper diagnosis and treatment of shock is essential.

(b) loss of body heat

Cave accident victims, even those who are uninjured, will lose body heat. Once basic first aid is completed retention of the victim's body heat is a priority. The victim must be insulated from contact with the rock, have wet clothes removed and be protected from draughts. With immobile, trapped, or badly exposed victims hypothermia can occur.

Ingenuity may be needed to prevent the victim from cooling. Heating by body contact, air blowers, and low voltage electric blankets may all form a part of the management procedure.

(c) foul air

Rapid removal of a victim from foul air, or if not completely possible to air that is less foul, is the first priority. Rescuers need to be aware of the effects of foul air on themselves. Oxygen therapy is the treatment of choice for those exposed to foul air and can be used to sustain the life of a victim who is trapped in foul air. Persons exposed to foul air for any length of time or at high concentrations will be suffering from acidosis and will vomit on receiving oxygen therapy. Rescuers must expect this and be able to act accordingly.

Oxygen therapy equipment most suited to cave rescue work consists of a "C" cylinder fitted with a dial type regulator and flowmeter (e.g. C.I.G. Regulator 518503 and Flowmeter TM 17). Oxyviva type equipment, although effective, is difficulty to carry in caves.

In extreme situations rescuers can breathe oxygen enriched foul air through a therapy mask. This is a risky procedure and should only be used in an emergency.

It is important to monitor the air near the rescue scene, as in poorly ventilated caves the air could become foul due to the respiration of the rescuers.

The comments made so far apply to so-called "normal" foul air. In the case of "stink damp", removal of the victim to good air is urgent and unless this has been accomplished by the victim's own party the prognosis is grim. One particular problem with carbon dioxide narcosis is that its symptoms may mask those of concussion or other serious illness. Where a victim is found lying on the cave floor under foul air conditions the possibility of concussion should not be ignored and the victim's condition monitored appropriately.

(d) entrapment

The cave accident victim trapped in a tight passage or rift is rapidly losing heat to the surrounding rock, afraid, anxious, uncomfortable, and in danger of suffocation in their own breath. The only solution for a trapped victim is their release.

The longer a victim is trapped the worse their condition will become. The first response will be to maintain the victim's body heat by placing blankets around the victim and if the space is enclosed applying oxygen therapy as a matter of course.

Simply methods of extracting the victim can then be attempted. Pulling on limbs, rope loops or air bags under the feet, in fact, any method that might work should be considered. Remember to check for jamming by ruffles of clothing or equipment attached to the victim's body.

If the victim is unable to be easily removed then a major emergency exists and outside help must be called. In any event every effort should be made to maintain body heat and air supply.

5. Stabilization

This stage of the rescue becomes important if the victim is not able to be quickly evacuated from the cave. It involves the use of medical and paramedical personnel to stabilize the victims condition prior to their movement. In its most developed from it involves in-cave hospitalization where treatment is effected (over an extended period) and the victim leaves the cave under their own power.

6. Evacuation

The evacuation of a stretcher patient from a cave can be a very difficult procedure. Being moved through a cave on a stretcher can be quite frightening.

Evacuations from difficult caves can require many skilled cavers and may take days. In many cases it will not be possible to avoid aggravating the victim's condition in order to evacuate them.

Cave rescue practices are probably a poor indicator of the amount of time required to evacuate a real victim from a cave due to their use of a cooperative victim and the need in a real rescue to modify the cave in order to fit the stretcher through.

Evacuation should only be attempted by the first responder organization when it is either imperative for the victim's survival or when it is clearly going to be a simple procedure. In most cases involving stretcher cases extra assistance will be required.

SOME POINTS OF PROCEDURE

This paper has been written assuming that the first responder organization to a cave rescue incident will not be the Cave Rescue Group. The procedures outlined do not exactly follow those of the Group who would, as well as following the basic steps outlined above, have use of special equipment and extra personnel.

In a completely Cave Rescue Group manned rescue, a communications team would follow the assault team and lay telephone lines from the surface HQ to the accident scene. At the same time lighting crews would be running 240 volt light along the proposed evacuation route while other groups, under the supervision of the underground coordinator, would be removing hazards and constrictions from the evacuation route and setting up hauling equipment where required.

CONCLUSIONS

Cave accident victims are best assisted by rapid and efficient first responder care. The care given by the victim's own party and the first responder organization will in many cases determine the outcome of an incident.

In order to make their vital contribution to the survival of cave accident victims, first responder must not be afraid of caves or believe that cave rescues are beyond their ability. It is not necessary for rescue groups near cave areas to be proficient in the more specialized and technical aspects of cave rescue as these services are available through the Cave Rescue Group. It is, however, essential that groups likely to be called to a cave accident are proficient in first responder care and are able to reach an accident victim in order to give that care.

To do this rescue groups need to be familiar with the caves in their area and with simple caving techniques.

The Cave Rescue Group's aim is to ensure that an efficient rescue system operates for all members of the caving community throughout New South Wales and is happy to assist any organization whose members may be called to a cave accident with information or training. Regional exercises involving Police, Ambulance, and V.R.A. units are organized where there are caves with significant visitation, or at the request of local rescue groups.

Cave rescues are difficult, but not impossible, and with proper first responder care their outcome can be viewed confidently.

ACKNOWLEDGEMENTS

The ideas presented in this paper have developed over many years as a result of discussions and rescue practices. Initial work was undertaken in the Scout Association with B. Rowe and latterly W. Goddard. Cave atmospheres have been researched in the Department of Geology and Geophysics, University of Sydney, encouraged by the interest of Dr. J.M.James, Department of Inorganic Chemistry, University of Sydney. The stimulus to put the paper together came from the 1983 Cave Rescue Group exercise at Wee Japer Caves. Grace Matts and Ron Dalzell of the Cave Rescue Group read the manuscript and made useful suggestions.

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SEMINAR AND WORKSHOP ON CAVE RESCUE

The Cave Rescue Group of New South Wales
Chairman: Terry O'Leary

The aim of this session was not to be a quick course in cave rescue, but a demonstration of some techniques and equipment with appropriate input from participants. Some results were as follows.

A brief discussion was held about basic caving gear covering various aspects of :-
(a)Footwear - Leather boots with a sherpa type sole or gum boots(dairy boots) were recommended.
(b)Clothing - Adequate for conditions taking care of hypothermia and in the tropics hyperthermia.
(c)Helmet - Recommended an approved type climbing or caving helmet for all vertical work.
(d)Lights - Three independent light sources must be carried.

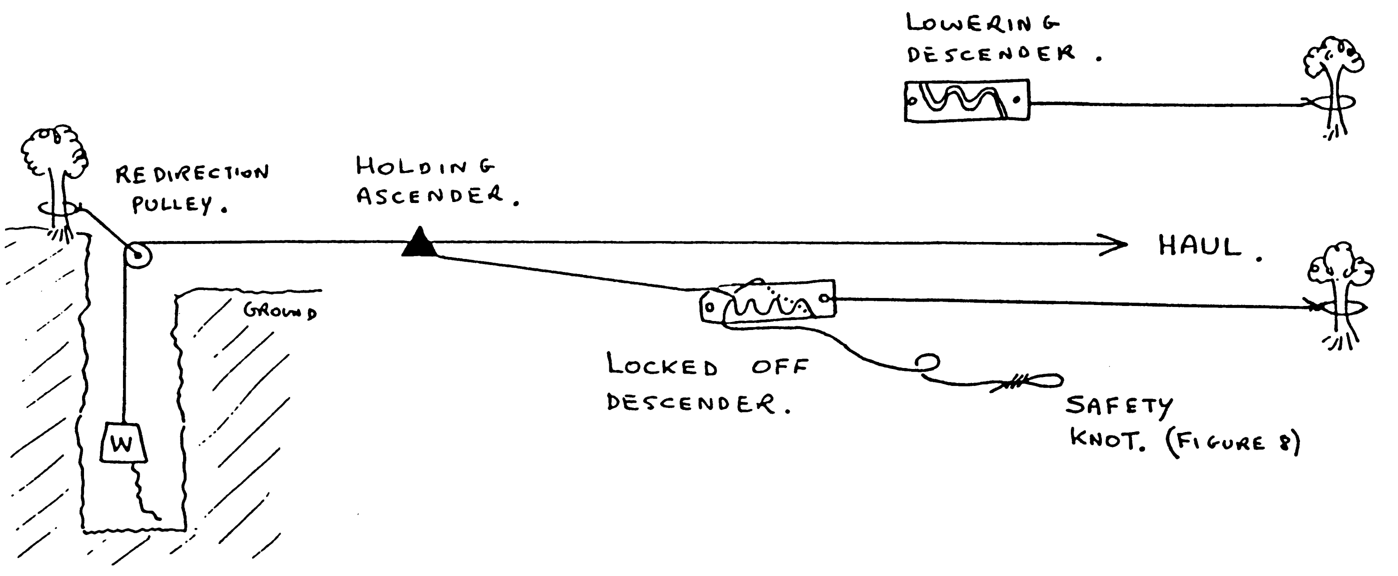
This was followed by a talk about knots and their uses. The dangers of using a bowline in synthetic ropes of sheath and core construction were discussed. The four basic knots for caving were demonstrated :-
(a) Figure-of-eight - An end of rope knot (two way loading).
(b) Alpine Butterfly - A mid rope knot (three way loading).
(c) Double Fishermans - To join two ropes together and tie tape.
(d) Tape Knot - The only other knot to use in tape.

Hauling systems were then discussed aspects covered included:-
(a) Mechanical advantage - one to one and three to one systems were discussed.
(b) Belay line - An independent belay line is essential to all haul systems.
(c) Trailing lines - These enable the patient to be manipulated from below.
(d) Team work - The rigging of pitches in advance of the patient making it easier for the patient to be removed from the cave by advance planning and team work.
(e) Patient care - Includes good first aid paying particular attention to hypothermia and fear in the patient.
(f) Rescuer care - The rescuers themselves must not become victims of unsafe practices, hypothermia or exhaustion.

A demonstration of a three to one (z-pulley) haul system was then conducted on the gym climbing wall.

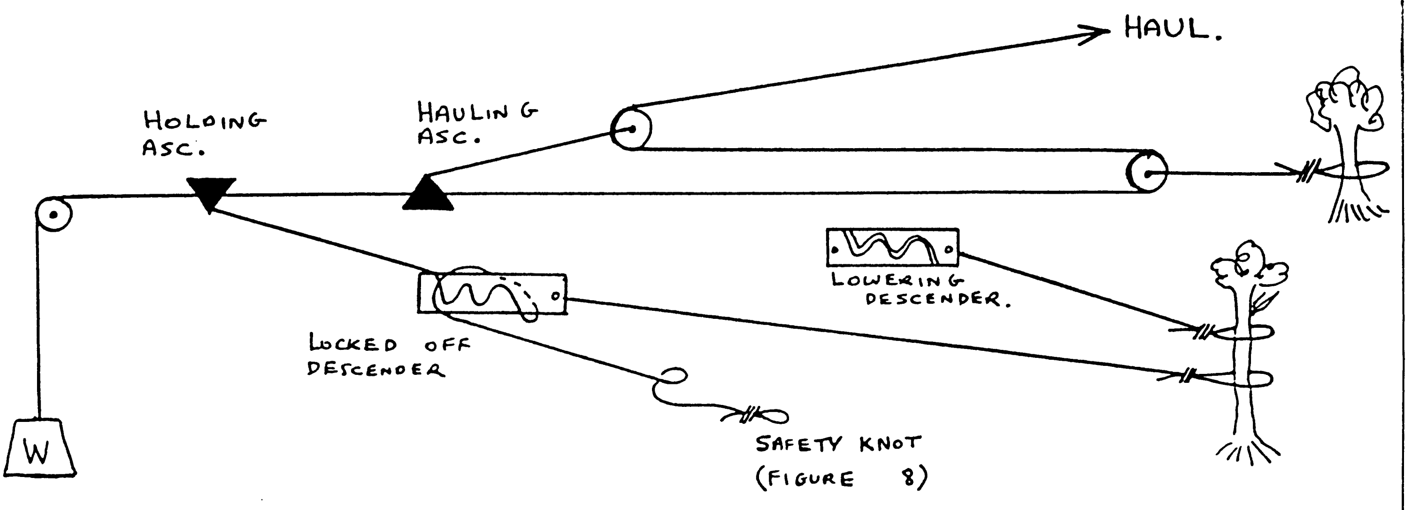
The Cave Rescue Group of New South Wales conducted this seminar. The members who assisted were Terry O'Leary, Ellie McFadyen, David Hamilton, Jeannette Jordt and David Rothery. Also thanks to Brendon Ferrari who volunteered as patient.
The Cave Rescue Group of New South Wales can be contacted at P.O.Box 122, Bankstown, 2200, N.S.W. if further information is required or if you wish to join.

Mechanical Advantage = 1



Notes: You must include a belay line.
Make certain locked-off descender is secure.

Mechanical Advantage = 3 Z-Pulley



Notes: You must include a belay line.
Make certain locked-off descender is secure.

SPELEOSPORTS SPELEOTEC '87

C. Rothery

Pain, agony, side splitting laughter.... it's all yours at Speleosports, and Speleosports Speleotec was no exception.

The course was designed and created by the devious minds of David Rothery, Jeanette Jordt, and David Hamilton. It was a short course involving 7 obstacles to enable many (fools) teams to compete.

1. The first obstacle was a short 10 metre abseil through 3 tyres.

2. Then there was a short run to the Beer Can Crawl. A penalty point was given for each can (formation) knocked over. The passage was on "S" shape about half a metre high. The N.S.A. team with Brendan Ferrari lost 100 points out of a total possible of 100, plus a further penalty for the unsafe practice of taking Brendan Ferrari caving. (Not a formation was left standing!!). The Queensland team had similar difficulties, losing 100 points, but I think they were ensuring that all the "formations" were actually empty.

The next part of this obstacle was a set of monkey bars with a difference. Entrance was head first through 2 tyres at the top, entering into a corkscrew crawl made possible by a series of wooden platforms. The way out was through a watersprayed sump (a series of 2 bath tubs with a cover).

3. Next was a short wet 3 metre climb down using a handline, and then up a 3 metre ladder to...

4. a 4 metre long narrow ledge with a handline (not for those on the tinnies!)

5. Then up and over a 1.5 metre ledge to...

6. a series of tyre crawls _

7. and a race to the fence for the duck-under crawl for the finish.

Teams consisted of 4 people, helmets had to be worn throughout the course and abseiling gear could be left at the bottom of the pitch. There were 14 teams altogether that managed not only to start but to finish as well.

Teams consisted of children (whose size was an obvious advantage in the crawly sections), the most honourable Carina Armchair Covers' who stopped for a spot of tea, played ball and sat out each obstacle, NSA team which degenerated into a water fight at the Monkey Bars when Brendan couldn't fit through the squeese and then those who tried to win the pinacle of caving awards .... the "Golfen Carabiner".

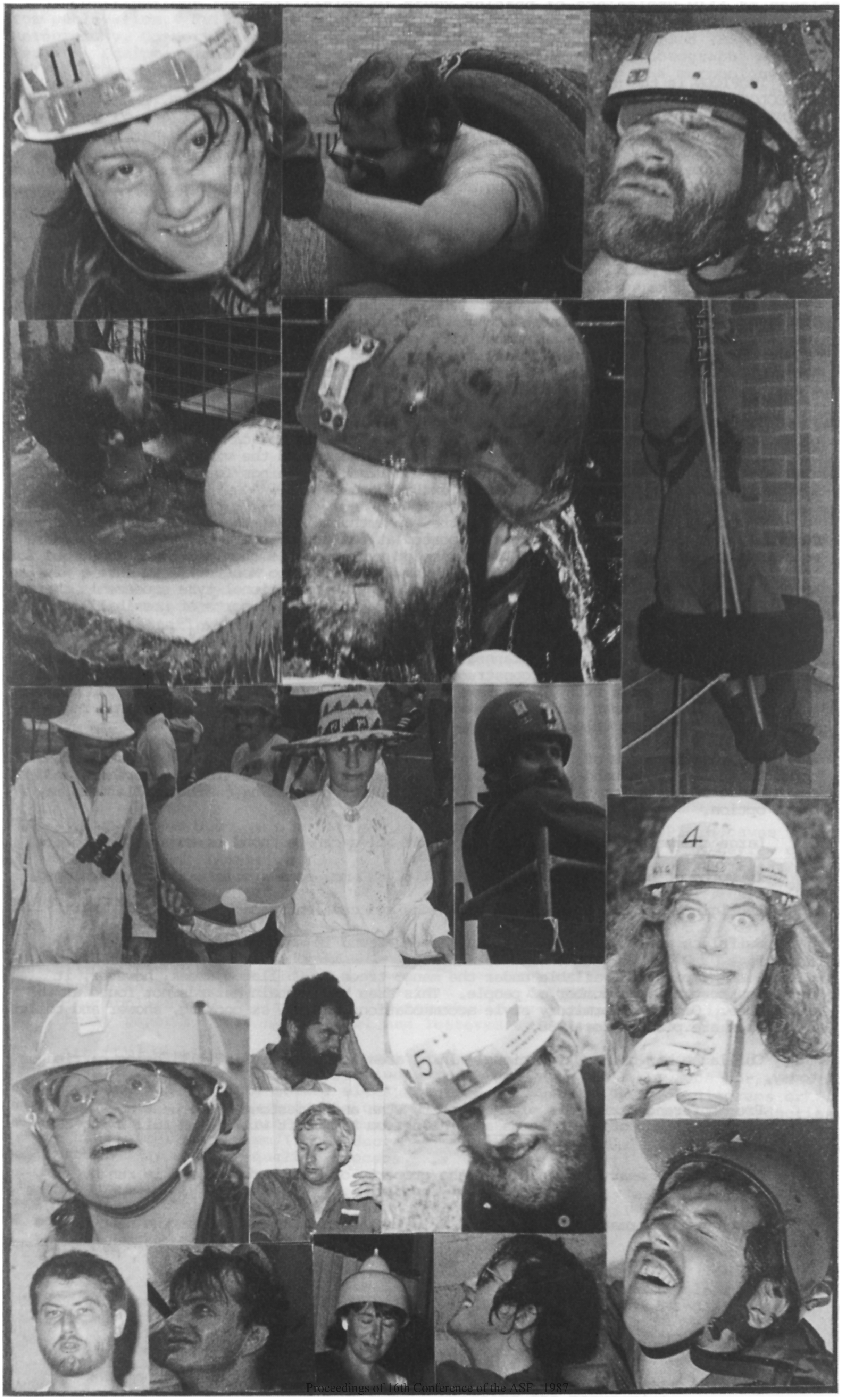
Blood sport was also a feature with the crowds demanding a Speleotec Organizers Team along with a Speleosport Designers Team to enter .... Revenge was sweet.

On the corrected times the prizes were awarded to

1. M.U.C.G. (Macquarie Uni Caving Group) Team, the Golden Carabiner
2. Feral Females and Matthew (token Male)

The prize was to be beer but due to the average age being 9, it was changed to Chocolates.

The organizers would like to thank all those who pitched in to help set up the course and then later to pack up gear. A special "Thanks" to all those who either participated or spectated as it was you who helped make the day the success it was.


11
4
5

TROPICON

TROPICON is the name given to the "SEVENTEENTH BIENNIAL CONFERENCE of THE AUSTRALIAN SPELEOLOGICAL FEDERATION Inc." to be hosted by the CHILLAGOE CAVING CLUB, CENTRAL QUEENSLAND SPELEOLOGICAL SOCIETY and UNIVERSITY OF QUEENSLAND SPELEOLOGICAL SOCIETY. The conference is to be held between 27/12/88 and 30/12/88 at the Queensland Recreational Council's facility at Tinnaroo. This lake was created by the construction of the Tinnaroo Dam in the late 1950's as an irrigation project on the upper Barron river. The conference centre is held on a tentative booking at present as confirmed bookings cannot be made until twelve months before.

This centre has a main accommodation block of four dormitories of twenty beds each. At the rear of this building is a block which can provide accommodation for a limited number of families with children. In the dining and kitchen area there are another forty bunks available, this being the old dormitory section. This is near the recreation room so late night revellers should take a bed in this area. Verbal permission has been obtained from the centre management to have a liquor license for the conference. The cost of accommodation as of August 1986 was $13 per head per day: this includes all regular meals as no food preparation is permitted on the site. Within walking distance of the centre there is a motel, restaurant and a well appointed caravan park. The nearest hotel is about 10 km. away at Kairi.

Conference sessions are to be held in the hall (old picture theatre) or its replacement. The name of the village is Tinnaroo Falls if you can find a map with enough detail. A large area of park land has been set aside around the village and close to the dam wall. The conference centre has canoes and other odd things for aquatic sports available for use by centre guests at no extra charge.

For those interested in Speleo Sports the authorities at the site have provided some carefully designed obstacles, that are located at one arm of the lake, about a 400 metre walk from the conference centre. The suspended tyre obstacle should produce some food for thought. With tyres half buried in the ground (lake Tinnaroo Monster) I am sure a way can be thought of to utilise these to slow people up. The traditional tyre squeeze is there but in a slightly modified form. The next little item has all sorts of possibilities especially with the start of the flying fox in the background.

Post conference trips are planned for Chillagoe which is approximately two hours drive from Tinnaroo Falls. The construction of high bridges has produced a virtual all weather road with about fifty kilometers of dirt road. The township of Chillagoe has two pubs, store, bakery, post office, caravan park and service station. Telecom has recently installed an automatic telephone exchange.

Towards the north of the town is located the remains of the old copper smelter. The tower karst lies in a band south east to north west of Chillagoe with the northern end being about twenty kilometers from the town. Weather permitting a Palmerville trip may be an option.

Large chambers, some containing daylight holes can be found is some of the towers.

In spite of having an average rainfall of 800 mm. some speleothems have developed.

Aboriginal art can be found in overhangs and cave entrances.

Swiftlets and their predators can also be found in some caves.

Bush camping is available under the mango trees on Chillagoe creek, however, it cannot support a large number of people. This area has certain hazards not found at the club house. Camping, dormitory style accommodation, as well as cooking, shower and toilet facilities are planned for 1988.

Chillagoe has been a traditional mining area and activity is still being carried on today.

Pre-conference trips are planned to Mt. Etna and Limestone Ridge near Rockhampton. The emergence flight of Miniopterus australis from Bat Cleft will be in full swing this time of year.

The campsite near Mt. Etna is on the property of Norm Perhouse and is run by C.Q.S.S.

Watch for information about TROPICON in the Australian Caver over the next two years.

INFORMATION FOR CONTRIBUTORS

SCOPE

Contributions from all fields of study related to speleology will be considered for publication. Suitable fields include Earth Sciences, Speleochemistry, Hydrology, Meteorology, Conservation, Biospeleology, History, Major Exploration (Expedition) Reports, Equipment and Techniques, Surveying and Cartography, Photography and Documentation. Comprehensive descriptive accounts of the exploration and morphology of individual caves will be welcomed, but simple trip reports and brief cave descriptions are not adequate. Papers overall should not exceed 20 printed pages in length. Contributors intending to write at greater length or requiring any advice on details of preparation are invited to correspond with the Editors. All manuscripts will be read by referees. Short 'Letters to the Editor', expressing a personal view or giving a preliminary report of interesting findings, are welcomed, and will be given preference for speedy publication.

MANUSCRIPTS

Submitted manuscripts should be in a final form ready for publication. As proofs are not normally sent to authors particular care should be taken to check for typing errors. Manuscripts should be typed, double spaced, on one side of the paper. The title should be uppercase and underlined, and the authors' names should follow. A brief and explicit summary of the notable aspects of the paper, headed Abstract, should precede the main text.

Throughout the main text major headings should be in upper case, centred and not underlined, while subheadings should use lower case, underlined and aligned with the left hand margin. Acknowledgements should be placed at the end of the text before the references, and the authors' addresses for correspondence should follow the references.

Authors with access to an IBM Golfball typewriter may wish to submit their papers in 'camera-ready' form. They should request our leaflet "Helictite Typographic Style". Papers should still be submitted in the above form in the first instance.

REFERENCES

References should be listed alphabetically at the end of the manuscript and cited in the text by the author's name and the year of publication (e.g. "(Grey, 1973)"). Where there is more than one reference to the same author in one year the letters a,b, c, etc. should be added. If there are more than two authors, they should all be named at the first citation and in the reference list, but the first name followed by 'et al.' should be used in subsequent citations. References should be checked particularly carefully for accuracy. Journal titles should be abbreviated following the "World List of Scientific Periodicals", which is available in most large libraries. The following examples illustrate the style:

GRAY, M.R., 1973 Cavernicolous spiders from the Nullarbor Plain and south-west Australia. J. Aust. ent. Soc. 12: 207-221.

VANDEL, A., 1965 Biospeleology. The Biology of the Cavernicolous Animals. Pergamon, London. Pp. xxiv, 524.

WIGLEY, T.M.L. and WOOD, I.D., 1967 Meteorology of the Nullarbor Plain caves. In: J.R. DUNKLEY and T.M.L. WIGLEY (eds), Caves of the Nullarbor. A Review of Speleological Investigations in the Nullarbor Plain. Southern Australia: 32-34. Speleological Research Council, Sydney.

ILLUSTRATIONS

Figures and photographs should be kept to a minimum and generally should not duplicate information in tables or other material. Photographs should be clear black and white prints with sharp focus. Where several photographs are to form one plate they should be mounted together on white card. Any lettering required on photographs should be applied with 'Letraset'. Figures should be drawn in Indian ink on white card, heavy paper or tracing material and lettered using stencils or 'Letraset'.

All illustrations should be drawn to fit a print area of 153 x 260 mm. They may be larger provided that these proportions are maintained, but allowance for reduction must be made when choosing letter sizes and line thickness. Several diagrams or photographs can only be included in one page if they all require the same reduction. Diagrams for inclusion in the text must be drawn to a width of either 153 mm (to appear at the same size) or 210 mm (for reduction); they must be clear and simple as they will be reproduced by a lower-quality process.

Figures and plates should each be numbered consecutively and specifically referred to in the text. The numbers should be marked lightly in pencil on the margin or back of each illustration. Captions should be typed on a separate sheet.

UNITS

The S.I. system (Australian Standard AS 1000) should be used unless citing historical data, in which case the original units should be quoted and appropriately rounded metric equivalents added; e.g. "100 feet (30 m)".

OFFPRINTS

Offprints of papers will be supplied after publication, at the author's expense. The number required should be stated when submitting the manuscript.

Helictite

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PROCEEDINGS OF THE 16th BIENNIAL ASF CONFERENCE

Speleological Research Council Limited