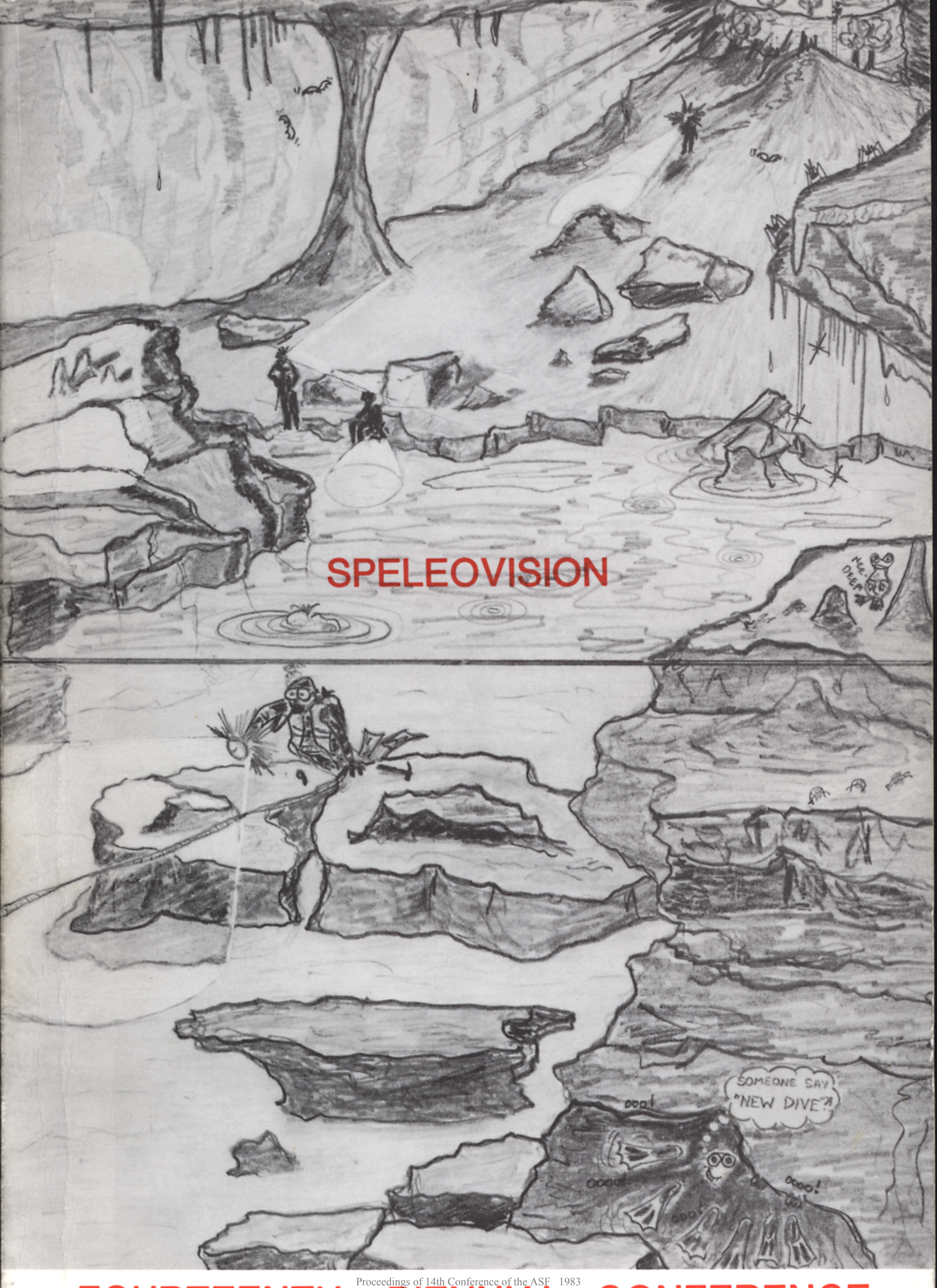

SPELEOVISION

FOURTEENTH BIENNIAL CONFERENCE

FOURTEENTH AUSTRALIAN SPELEOLOGICAL

BIENNIAL CONFERENCE

SPELEOVISION

PROCEEDINGS

Editor

Graham Pilkington

1984

AUSTRALIAN SPELEOLOGICAL FEDERATION

Proceedings of the Fourteenth Biennial Conference

hosted by

Cave Exploration Group (South Australia) Incorporated

c/- South Australian Museum
North Terrace, Adelaide
South Australia 5000

3rd to 7th JANUARY 1983

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FORWARD

The Australian Speleological Federation was formed in 1956 in Adelaide at what proved to be its first Biennial Conference. Since then it has developed into a powerful cohesive force holding Australian speleology together. Through its auspices, cavers have been able to expand their horizons beyond the backyard cave to perceive the complex creation, evolution and final demise of karst regions in different climates and within different geological terrains. But how does 'speleology' help you the caver? Well, besides being able to better appreciate a cave in all its details, to see things you did not realize were there, and help you create minimal damage for maximum enjoyment; speleological knowledge is essential for safe cave exploration, and a boon for finding those as yet untrogged caves and passages.

The ASF is a collection of clubs having similar objectives. It sets common ethics, disseminates new information, and speaks on behalf of Australian cavers AND caves. But most importantly it creates a forum for people and private and government bodies throughout Australia to exchange views and ideas so that what few caves we do have can survive the pressures of people.

Australian Speleological Federation

14th Biennial Conference
3-7 January 1983
Flinders University -- Adelaide

The fourteenth conference proposes to have two aims as basis of discussion. These will be

1 <u>Visual aspects of cave recording.</u>

i) This theme will cover all aspects of cave recording. Topics will include photography, both in 2D and 3D and their application in mapping, scientific and navigational activities in caves.

ii) Trends in cave mapping with the advent of computer plotting, alternative methods of depicting caves and holograms.

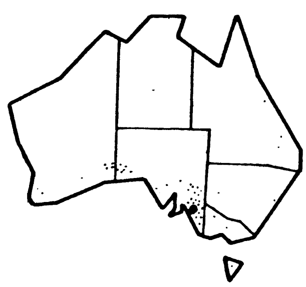
iii) Use of information retrieval systems eg. microfiche, aperture cards and word processors.

2 <u>Forcasting the future of Australian Speleology.</u>

i) How advances in technology affect speleology

ii) Cave access and management in the next decade. How past trends may affect the future.

iii) Population pressures on our natural cave resource.



Forkarst of caver density ~ Australia January 1983

SPELEOVISION

Convenor	Graham Pilkington
Secretary	Kevin Mott
Audio Recording	John Ellis
Bar	Athol Jackson
Bookshop	Bernie Maegraith
Photographic Competition	Meredith Reardon
Registration	John McCormack
Speleosports	John Ellis

DATES

Preconference Field Trips	26th Dec 1982 - 2nd Jan 1983
Sessions	3rd Jan 1983 - 7th Jan 1983
Postconference Field Trips	7th Jan 1983 - 23rd Jan 1983

SESSIONS VENUE

Flinders University
North 3 Lecture Theatre
Sturt Road, BEDFORD PARK, S. AUST. 5042

VENUE for

Accommodation

ASF Committee Meeting

Bookshop

Cavemans Dinner

Caving Equipment Shop

Meals

Flinders University Hall
Sturt Road, BEDFORD PARK, S. AUST. 5042

SPELEOSPORTS VENUE

Flinders University Grounds
Sturt Road, BEDFORD PARK, S. AUST. 5042

THANKS & ACKNOWLEDGEMENTS

A task such as producing these proceedings is a slow, tedious one. I thank all the CEGSA Members who contributed for their help but especially John Ellis for the audio-taping and Jan Peterson for the typing and artwork.

The main editing and tape translation help came from Bill Parker, George Parker, Bernie Magraith, Stan and Kathy Flavel, Peter Horne, Shane LePlastier and Max Meth. Also thanks to Kevin Mott for drafting up some diagrams and maps to accompany the tape transcripts.

I would also like to thank Genna Pilkington for putting up with the constant invasion of her home by hordes of CEGSA Members and then having to supply refreshments.

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* Proceedings are available

AFFILIATION CODES

ASF	Australian Speleological Federation
BA & CS	Bungonia Abseiling and Caving School
CCC	Chillagoe Caving Club
CDAA	Cave Diving Association of Australia
CEGSA	Cave Exploration Group (South Australia) Inc.
CQSS	Central Queensland Speleological Society
CSS	Canberra Speleological Society
HCG	Highland Caving Group
HSC	Hills Speleology Club
ISS	Illawarra Speleological Society
KSS	Kempsey Speleological Society
MSS	Metropolitan Speleological Society
MUCG	Macquarie University Caving Group
NPWS (NSW)	National Parks and Wildlife Service - New South Wales
NSWITSS	New South Wales Institute of Technology Speleology Society
OSS	Orange Speleological Society
RANCA	Royal Australian Navy Caving Association
SGS	Southern Caving Society
SRGWA	Speleological Research Group Western Australia
SUSS	Sydney University Speleological Society
TCC	Tasmanian Caverneering Club
TWS	Tasmanian Wilderness Society
UQSS	University of Queensland Speleological Society
VSA	Victorian Speleological Association
WASG	Western Australia Speleological Group

Registrations from S.A.	23
from interstate:	64
total:	87
accompanying:	44
	131

SPELEOVISION REGISTRATIONS

NAME				AFFILIATION	STATE
Ron	ALLUM	paper		CDAA,CEGSA	SA
Robyn	ALLUM		na	CDAA,CEGSA	SA
Dale	ARNOTT		na	CEGSA	SA
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Andrew	BRUIN			NSWITSS	NSW
Martin	CAIRNS			CEGSA	WA
Peter	CEAPA			MSS	NSW
Peter	CLARKE			CEGSA	NSW
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Harvey	COHEN			VSA	VIC
Adrian	DAVEY			UQSS	NSW
John	DUNKLEY	paper		CSS	ACT
Peter	DYKES		na	HCG	NSW
David	ELLIS			CEGSA	SA
John	ELLIS			CEGSA	SA
Brendan	FERRARI			VSA	VIC
Stan	FLAVEL			CEGSA	SA
Rudy	FRANK		na	VSA	VIC
Graeme	GALLOWAY			SUSS	NSW
Janeen	GRIMES			UQSS	QLD
Ken	GRIMES			UQSS	QLD
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Stephen	HARRIS	paper		SCS	TAS
Lloyd	HITCHINS			RANCA	NSW
Derek	HOBBS			MUCG	NSW
Peter	HORNE	paper		CDAA,CEGSA	SA
Bruce	HOWLETT			OSS	NSW
Phil	HUTCHESON			VSA	VIC
Sue	HUTCHESON			VSA	VIC
Athol	JACKSON	paper		CEGSA	SA
Phil	JACKSON			SCS	TAS
Kevin	KIERNAN	papers	na	TWS	TAS
Ken	LANCE			WASG	WA
Ian	LEWIS			CEGSA,CDAA	SA
Roman	LICHACZ			NSWITSS	NSW
John	McCORMACK			CEGSA	SA
Guy	McKANNA	paper		SUSS	NSW
Kate	MACKAY			VSA	VIC
Phil	MACKEY			VSA	VIC
Bernie	MAEGRAITH			CEGSA	SA
Ian	MANN			SUSS	NSW
Brenda	MATTHEWS			WASG	WA
Richard	MATTHEWS			WASG	WA
Margot	MATTHEWS			VSA	VIC
Peter	MATTHEWS			VSA	VIC

SPELEOVISION REGISTRATIONS

NAME				AFFILIATION	STATE
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Denis	MURNANE		na	VSA	VIC
Bill	NICHOLSON			TCC	TAS
Gordon	NINNES			CEGSA	SA
Kerry	NINNES			CEGSA	SA
Terry	O'LEARY			NSWITSS	NSW
George	PARKER		na	CEGSA	SA
Chris	PARR			UQSS,CQSS	QLD
Jan	PARR			UQSS,CQSS	QLD
Peter	PASSMORE			RANCA	NSW
Bronwyn	PIERCE			VSA	VIC
Miles	PIERCE			VSA	VIC
Graham	PILKINGTON	paper		CEGSA	SA
Tom	PORRITT			VSA,CCC	VIC
Norman	POULTER	papers		SRGWA	WA
Ronald	POULTON			ISS	NSW
David	RAMAGE			NSWITSS	NSW
Meredith	REARDON			CEGSA	SA
Terry	REARDON			CEGSA	SA
Bill	RICHARDS			VSA	VIC
Peter	ROBERTSON		na	VSA	VIC
Michael	ROCHLER			CEGSA	ACT
Peter	ROGERS	paper		CDAA,CEGSA	SA
Henry	SHANNON	paper		UQSS	TAS
Rosie	SHANNON			UQSS	TAS
Dave	SMITH			VSA	VIC
Andy	SPATE	papers		CSS,NPWS (NSW)	NSW
Bruce	STEWART			SUSS	NSW
John	TAYLOR			KSS	NSW
Phillip	TOOMER			SUSS	NSW
Darrell	WARDEN			HSC	NSW
John	WEBB	paper		VSA	VIC
Rauleigh	WEBB	papers		WASG	WA
Nicholas	WHITE			VSA	VIC
Susan	WHITE			VSA	VIC
Tom	WHITEHOUSE			VSA	VIC
Andrew	WIGHT		na	CEGSA	SA
Bridget	WILKINSON			CEGSA	SA
Kerry	WILLIAMSON			UQSS	QLD
Richard	WILLSON			ISS,BA & CS	NSW

* na = non-attending

OPENING ADDRESS

by
Dr. Sue Barker

Doctor Sue Barker is currently the manager of the programs branch of the National Parks and Wildlife Service, South Australia.

Her work involves the preparation of management plans for the State's national parks.

A botanist by training, she graduated from the London University and did her post-graduate study at the University of Adelaide.

She has an interest in the arid zones and was involved in the debate about whether national parks should be burned regularly.

Her study of the fire history of snow gums in the Kosiosko National Park in 1973-74 concluded that many of the older trees would not have reached their current size if they had been burned regularly, say every 10 years.

For five years she lectured in the Geography Department of the University of Adelaide on bio-geography or the geography of plants and animals.

For a period she was the National Parks and Wildlife Service's acting State Director after joining the Service about eight years ago.

OPENING ADDRESS - DR. SUE BARKER

Ladies and Gentlemen,

It is with great pleasure that I am standing here today, having accepted the invitation of the Cave Exploration Group of South Australia on behalf of the Speleological Federation to open your 14th bi-ennial conference. In my opening remarks I want to explain in fairly general terms the role of National Parks and Wildlife Service, with particular reference to caves - which are your special interest.

The National Parks and Wildlife Service has a great deal of contact with speleologists and the Speleological Federation. This happens for a number of reasons. Many of the caves in Australia are not accessible to the general public because they are on private land and have been either filled in or fenced off. Many of the caves which are accessible come under the management auspices of National Parks and Wildlife Services, not just in this State, but throughout the country.

The National Parks and Wildlife Services, do not always have the expertise and the knowledge to enable them to carry out the proper management of caves which are vested under their control, and consequently we have to rely on the services of people like yourselves and the Speleological Federation to help us carry out scientific investigations and management endeavours.

Conservation agencies have caves which are open for public inspection and again we have a responsibility to explain them to the general public, who may have a very poor general knowledge of caves. We have to explain to them what the important features of these caves are, and again we rely on speleologists to provide us with the sort of information we should be giving to the general public about their particular scientific value.

In South Australia, the areas of contact that we have with speleologists are quite evident. We have caves which are accessible to caving enthusiasts, particularly those which are not open to the general public. We also have caves which are of scientific importance and are currently the subject of scientific investigations, and of course we have the tourist caves which are open for general public inspection at all times of the year. Generally speaking, in South Australia caves come under the classification of conservation parks, in other words they are areas which are set aside for the conservation of some particular feature. About 90% of our conservation parks were specifically set aside to protect the biological features within them. But there are a number of National and Conservation Parks which have other specialist features of geology or archeology and which also have caves.

For example, those of you who are South Australians would know the Kelly Hill Caves, Tantanoola Caves, Naracoorte Caves and Nullarbor National Park which also has caves in it. In addition, there are underwater caves at Piccaninnie Ponds Conservation Park and also at Ewens Ponds where the caves are not under N.P.W.S. control. In any park, the National Parks and Wildlife Service has an obligation to manage it in accordance with a series of objectives which are specified in the National Parks and Wildlife Act. In relation to caves these objectives are: the preservation of historic sites, objects and structures of historic and/or scientific interest within reserves; the preservation of features of geographical, natural or scenic interest; and the encouragement of public use and enjoyment of reserves and the education in, and proper understanding and recognition of, their purpose and significance.

In order to achieve these objectives the National Parks and Wildlife Service should take some fairly positive action to protect the outstanding natural features of any park and to retain representative samples of Australian flora and fauna. Such action generally includes protecting naturally sensitive environment from overuse and controlling the impact of recreational developments, of which we have several in any parks system whether in this State or any other. We also need to control or eliminate non-native species, and that refers particularly to some of our big conservation parks, where we have feral goats, wild dogs, wild cats, weeds and pigs and that sort of thing. We also have to protect native flora and fauna and natural features from illegal activities, such as people who collect, whether it be rocks, sea-shells or birds' eggs or birds, for their own purposes without a permit. We also have to rehabilitate degraded areas, where such areas occur, to prevent erosion, and we also have to effectively manage fire, and as you know at this time of the year we are particularly sensitive about fire.

In caves, the preservation of geological formations and the unique biology of the caves is most important. For example, some caves have most important populations of bats, birds and insects which we are obliged under our Act to maintain. In some caves, particularly those on the Nullarbor, we are responsible for protecting the archeological evidence which they contain in forms of paintings or relics of other activity or occupation by the Aborigines. Some caves have ancient animal remains in them.

In general terms these parks, particularly those which are of natural vegetation, are tending to become relatively undisturbed island within the cultural landscape. In other words they are surrounded by developed agricultural land in lots of cases, and some of them not far from here, are surrounded by suburbs. Consequently the pressure of use by human populations is increasing and our responsibility in trying to maintain these areas in their integrity is also becoming more difficult simply because more areas, which we may wish to add to the parks' system are coming under clearance from agricultural development. Management of any natural resource is both expensive and time consuming and consequently government always has a tremendous responsibility in this regard. Management activities thus need to be ordered and systematic and based on a clear set of priorities and this is as particularly important to cave parks as in any other parks.

These sort of priorities, and priority for the sort of development which might take place in a park, are elucidated in a document known as a management plan.

A plan of management is a set of guidelines which identifies how a park is to be managed. It is the basic working document of the park manager and also advises the public on how the park service intends to manage a particular park in the long-term. Management planning, therefore, does several things. It identifies the purpose of the park; the philosophy for which the park was set aside, and it identifies the natural value of the park and its natural outstanding features, vegetation, communities, geological formations, etc. It identifies the boundary of the park, which in a lot of cases is uncertain, particularly in remote areas. It determines the management strategy to be followed to meet the basic management objectives and it determines what works need to be carried out to attain these basic management objectives. Out of all this the ranger who is in charge of a particular park has a scheme of operation within which he works in trying to manage the park.

It is our intention to have a plan of management produced for every park in the State. We have in the order of 196 parks at the present time. Preparing a management plan for each of these is a fairly time consuming business. We have had a lot of support in the last three or four years in pushing our planning programme ahead and indeed some of you would already be aware that we have used the skills of the Speleological Federation membership in helping us to prepare draft management plans for both Tantanoola and Naracoorte Caves Conservation Parks in the South-East. We have been able to use your expertise to determine the precise underground locality of some of the caves, their size and their scientific, geological and aesthetic importance. This has been of tremendous value to us. In 1983 we hope we are going to be able to start management plans for Piccaninnie Ponds Conservation Park which is an underwater cave system and also for the Ewens Ponds Conservation Park system which is not far from Piccaninnie Ponds. The Ewens Ponds cave diving area is the responsibility of the Department of Lands, but we have an area of land alongside the lakes which we manage and which a lot of cave divers use for camping. Consequently, a management plan for that park will include both the Department of Lands and ourselves and again we may be seeking some expertise from your membership to help us with that. In preparing a management plan there are a number of steps in the process. The first one is the collection of resource data about what the area is like, what special features it possesses, how many people go there, what people like to see when they get there, how long they spend and what sort of further facilities they would like to see. We get this from people like yourselves and also by direct approaches to particular bodies of people who we know are interested. We put an advertisement in the paper to say that we are preparing a management plan, please write in with your ideas. Sometimes we do not get much response. That is no criticism of people who put in ideas, I think it is very difficult to generate ideas in a vacuum. People find it a lot easier to think of things when they have a document in front of them to comment on. Once we have that background information we then put up a series of proposals in a draft plan which is then exposed to public comment for a month or two months. Those draft plans are free of charge to anyone who wants to comment on a particular plan. Once the public comments have been received, those comments and the draft plan are forwarded to the Reserves Advisory Committee which is a small body that the Minister has to advise him. It consists of five people.

The Committee goes through the plan and the public comments, and indicates whether as a result of the public comments the plan should be amended. The plan and the Reserves Advisory Committee report then go to the Minister who decides whether to adopt the document as the plan of management. It can then be published in its final form and is available for sale. These final plans we do charge for.

The South Australian National Parks and Wildlife Service manages parks for the preservation of those values which are special, while allowing for public access. This is especially true for the management of caves which have unique features and unique usage by visitors. In South Australia some new techniques are being employed, especially in the light of access to minimise the potential damage which could be brought upon caves which are now open to the public, and I think a number of you would be quite conscious of the sort of damage which has been brought about in the past in cave usage by the public.

The very bad and the very good in preservation can be seen next to each other at Blanche Cave and Victoria Fossil Cave in the Naracoorte Caves Conservation Park. For example, the decorative formations in Blanche Cave were extensively damaged by ignorance and vandalism during the first 50 years after its discovery, as there was no form of restriction or control over public access to it. In 1885 the South Australian Government Forest Board appointed a ranger who was instructed to beautify the cave and its surrounds before the turn of the century. The cave is still used today for the demonstration of the historic uses of caves with graffiti from candle carbon, tables and chairs from the times when the area was used for balls and parties, with the remains of ornamental trees, ferns and creeper beautifications and the older style coloured lights. More modern ideas on cave display are demonstrated in the Victoria Fossil Cave, where, with the assistance of speleologists, the public has been allowed to see the scientific value of the work which is carried out by scientists in that cave. Fossil beds which are now considered to be amongst the best in the world were discovered there in 1969.

Bones found include some from giant extinct marsupials to tiny marsupial rats. With an Australian National Estate Grant and the help of the South Australian Museum, the proper interpretation and the significance of the scientific discoveries can be made. The construction of the glass-sided laboratory is such that work on the fossil remains can carry on at the same time as public viewing.

In spite of this, obviously problems in managment still occur. 60,000 people visited the tourist caves at Naracoorte during the last financial year, while 1,500 people like yourselves who are interested in exploring wild caves actually went through the wild caves at Naracoorte last year. The main proportion of people arrived during the summer holidays. 15,000 out of the 60,000 for example, last year visited in January. This places a tremendous strain on the physical resources for viewing, and in addition, on the financial and people resources that the State has to actually take people around the caves and explain to them what they are all about.

The theme of your conference is the future of speleology. As far as I am concerned I believe there will always continue to be a close liaison between the National Parks and Wildlife Services and speleologists, because no service is going to be able to have sufficient speleological expertise on its staff to help it to produce the right sort of management decisions.
Consequently, I hope that the Australian Speleological Federation will continue to make available to the South Australian National Parks and Wildlife Service the best advice and advances in the scientific study of caves and also in management ideas. It is our hope that the proper and improving management can ensure an instructive and enjoyable experience for all future cave explorers be they hardy adventurers or the general public. It is with great pleasure therefore that I declare the 14th bi-ennial conference of the Australian Speleological Federation open.
Thank you.

REPLY TO OPENING ADDRESS

by
Ken Lance
A.S.F. President

I don't think there would be many of us here who wouldn't share the experiences and concerns Dr. Barker has expressed here.

We are all aware, that caves are an extremely limited resource in Australia generally, and of the importance of developing appropriate management strategies so that we can retain these resources the destruction of which would be of considerable loss to all concerned.

It is pleasing to note that many of our objectives and those of the South Australian National Parks and Wildlife Service and our own Federation are shared in reference to the protection of our karst heritage. Not only for caves of scientific importance but right across the whole spectrum of uses that were mentioned, from the ordinary caver to the people who visit tourist caves for recreation. We are both happy to work together to share management programs that will enhance the enjoyment of all of those people whilst at the same time retaining representatives of the areas of scientific importance.

It is important to note that Dr. Barker's personal expertise in bio-geography is directively relevant, particularly pertaining to botany to the extent that if we don't look after the surface areas of caves then we will lose the interiors of the caves. We can't just focus on the interiors and forget about the whole surface vegetation pattern and the landscape and various other external effects on the cave, apart from the effects which we or other users may have on the interior, or whatever else may happen to the caves.

I believe that we should take an overall and general view of things including the surface management. I think, Dr. Barker, knowing the previous co-operation that our Federation and member societies have been able to enjoy with the South Australian National Parks and Wildlife Service, I hope that we can continue to work together in this way.

Thank you very much for opening our conference.

SPELEOVISION PAPERS

CAVES AS A RESPONSIBILITY

by
Elery Hamilton-Smith
V.S.A. and C.E.G.S.A.

Convenor A.S.F. Commissioin on Cave Tourism and Management

Caves are now widely recognised as an important element within the National and World Heritage. More importantly, they are one of the least replaceable of all elements.

It is argued that the responsibility of governments for the protection and management of caves must extend beyond the boundaries of parks and reserves. Care must be taken not to trivialise this responsibility by shoddy, inept or in-appropriate tourism or park management.

Others, including landowners, cavers and other visitors, can best be regarded as having a responsibility which arises out of their degree of knowledge. Those with knowledge should stop moralising about the less informed and should act themselves, or seek government action when necessary, even where this may mean refraining from visiting specific caves.

Text taken from audio record of the Conference.

Nearly 30 years ago several of us sat one night around a flagon of claret here in Adelaide and discussed a problem. Our problem was that we had walked over most walkable parts of the State, we had savoured the whole of the coastline and we were running out of really interesting things to do in our spare time. We decided on two possibilities. One was to go skin diving and the other was to go caving. Then someone found out the price of skin diving equipment and we very quickly agreed that caving was what we wanted to do.

We set off with no knowledge of safe caving techniques, in a couple of vehicles - one of which stopped every few miles and you had to take the cover-plate off the side valves and bang them with a hammer to get them moving again. The other was a peculiar monstrosity called a Bradford Station Sedan that basically consisted of a 1,000 C.C. motorbike with a large tea-chest mounted on it. We did find that it would hold up to 16 cavers. The only trouble was that when you got over 40 kilometres an hour with such a load the front wheels lifted off the road.

Today I am here talking about caves and responsibility. Now, either I've lost my sense of fun and been around too long or I've learnt something in the meantime. I'm not sure which. I don't think we started caving in a very responsible way, but it was the best we knew at the time. I leave it to you to judge whether I've lost my sense of fun or whether I've actually learnt something useful. What I want to do is talk mainly about the question of who should be responsible for caves.

There has been a lot of discussion and a lot of literature about why caves are an important environmental and social responsibility for our society. I'll spend a few minutes on that first to clear some ground.

It is commonly agreed now that caves are a very important part of our heritage. There are already a number of caves and cave areas on the world heritage list, not just on the Australian list. For instance, the Mammoth Cave National Park and the Nahanni National Park are both on the world heritage list. Now, one of the points I want to make about why we should be concerned about caves and feel a sense of responsibility for them, is that our answer to that question is beginning to change. In the past our answer has always been in human-centred terms or what a philosopher would call instrumental terms. Thus, we have argued for the preservation and care of caves because of their value to human beings, not because they might be valuable in themselves but because they are valuable to us as people. And those sort of arguments have been applied to all wild places. Godfrey-Smith says that you can classify the arguments into four, and I like his terms. He says there is the 'cathedral' argument which argues that wild places are places of beauty and spiritual renewal; the 'laboratory' argument which says they are important to us because of their research value; the 'silo' argument which says they are important to us because of the extent to which they conserve the genetic stock; and the 'gymnasium' argument which says they are valuable because of the extent to which they provide us with opportunities for healthy recreation.

Now all of these are essentially instrumental in character, and are all about the value of wild places, including caves, to human beings. I believe there is now evidence that we are gradually beginning to move towards a non-anthropocentric view which says that wild places are important in themselves. I do not think this realisation has yet hit many of our political leaders nor many of our businessmen. I think it has, however, impacted on the thinking of a very large proportion of the general population. If you look at the research evidence, summarised in the 1981 National Estate Report of our own Federal Government, (pp.12-17) I think you can sense something of that shift towards a non-anthropocentric view. If you talk to people around the community, you can sense something of it. Certainly it has been around in the environmental literature for some time. It is now clear that such an idea is no longer seen as highly eccentric as it was 30 years ago and is becoming much more broadly accepted.

One of the pioneers of that viewpoint, Aldo Leopold, in his essay, "The Land Ethic", argued that accepting the intrinsic value of wild places was both an evolutionary possibility and an ecological necessity. As an analogy he pointed out that Odysseus on his return from his wanderings saw himself as being utterly free to hang a number of his slave girls because they had misbehaved during his absence. And at the time no-one would have questioned that. Human life was not valuable in itself. It was only valuable as a tool for the master to use. Today we would abhor that viewpoint and say that human life, any human life, is valuable in itself. Leopold argues that we will ultimately extend that thinking to include the land. So the point I am making here is that we can see now the beginnings of a shift towards the way in which we justify the conservation of wild places, or the proper husbanding of other natural resources. We are beginning to see our environment and natural resources as intrinsically valuable in themselves and not just for our purposes.

Now against that background, let me turn to the question of who might be responsible for caves. Here I do get into perhaps what could be called an exercise in moral philosophy of trying to sort out a rather complex set of ideas. One of the interesting things is that I find very little in the literature which argues why Governments or anyone else should be responsible. There is a lot of comment which says "of course governments should be responsible because they have got the power". Or "of course governments should be responsible because they have got the money". Now they are not arguments about what the government should do, they are only arguments about what it can do. It is very dangerous to assume that any argument for what can be done is an argument for what should be done. That is the argument the Hydroelectric Commission uses in Tasmania.

They would argue that the Franklin River can be dammed, therefore, it should be dammed. Power and money are certainly not real arguments about who should have responsibility. They are only statements about who can bear the weight of responsibility. Now I want to suggest that if we think about what we mean by the word 'responsibility', we do in fact answer the question of who has the central focus of responsibility. Responsibility cannot be defined just as duty. Duty is the obligation to do what should be done and while you talk just in terms of duty, well obviously it is everybody's duty to look after the environment. And we all know that what is everybody's duty becomes nobody's. So that is not a very adequate definition of responsibility. It is in fact a tautology and it cannot be operational. We somehow have to get a better definition of responsibility. The philosopher called Charles Frankel has, I think, put this in the best and most useful sense.

He says a decision is responsible when the person or the group that makes it has to answer for it to those who are directly or indirectly affected by it (p.203). In other words a decision, Frankel says, can only be a responsible one when you have to answer for it. Now he is at some pains to point out that he doesn't guarantee whether the decision is good or bad, or right or wrong. His definition only helps us get to grips with the notion of responsibility. And it leads us to the position that in our kind of society, responsibility for a broad social concern has to rest with the elected government. That is what we elect a government for. The electoral system is a means, admittedly a very blunt instrument, to ensure the kind of accountability Frankel is concerned with. Let me explore some aspects of that.

To use a modern term, when we talk of responsibility we talk of accountability. Now we know the electoral system is a pretty blunt instrument for all sorts of purposes, not just securing accountability. As one of my favourite bits of grafitti says, 'It doesn't matter who you vote for, you get a politician anyway'. Namely you get a government that tends to think and operate to the next election. So there are some real blunt instrument problems here. They become a larger problem if the voters are not interested enough or cynical enough and so have short political memories which fail to call governments to account for their actions. We have a long tradition of apathy in this country which has not called our governments to account.

However, in the long run it seems to work. Now let me look briefly at the Franklin River issue which might illustrate a couple of the points I've made so far. I think it is fairly clear that in its discussions the Federal cabinet has thought of responsibility purely in duty terms, not very much in accountability terms, and certainly not in legal terms. And they have said, 'Well its our duty to be nice to the State and not to interfere'. They have, in fact, defined the Franklin issue as not their responsibility.

However, if you think for a moment about Frankel's notion, the Federal Government cannot do that, because in fact, the Federal Government is responsible. They have made, what on his terms, is a responsible decision, even though it may very well be a wrong one. But it is a responsible one and hopefully they will be accountable and answerable for it at the next election, providing people's memories are long enough. If not, it will certainly be called to account by later history. Now I am not suggesting that a Liberal Government is automatically anti-conservationist and Labour automatically conservationist, I think that is utter nonsense, and the record of both parties is not good. But I would certainly go so far, in respect to the present government to paraphrase another bit of grafitti, and say that anyone who cares about the environment and votes for the present Federal Government is like a chicken voting for Colonel Sanders.

Let me talk about another broad-scale shift and that relates to government accountability and responsibility. I believe we are seeing a shift where we are not only calling the elected government to account but increasingly calling the executive branch of government, the public service, to account. Along with that, we are gradually developing mechanisms which are making the public service more accountable. Examples include the administrative accountability procedures being established, the freedom of information legislation that is developing here and there around the world, the development of ombudsmen and administrative review tribunals. All of these are ways in which people are passing responsibility more and more to the executive branch rather than merely the legislature. Of course, this has gone hand in hand, perhaps regrettably, with denial of ministerial responsibility by various of our ministers. In practice, this means that we will see the agencies of government, including the public service departments, come to be held much more directly to account. We should recognise this shift which does effect the strategy of people who are outside the government and who want to bring about greater accountability.

Next issue. There are problems about the way in which governmental responsibility becomes bureaucratised and split up into components. At the moment, no matter how hard any National Park Service tries to carry out its responsibility on the lands for which it is legally held accountable (namely the parks themselves), it can have very little impact outside of those lands. There are all sorts of problems arising because of these boundaries within which land is parcelled. We have all seen the example in NSW of the environmental integrity of the Wee Jasper Caves being utterly destroyed because no-one took any responsibility for it or made any decision about it (and that includes speleologists as well as land managers). This arose very much because of bureaucratisation and the fact that the Wee Jasper Caves were in a gap where no-one was taking any responsibility. It is one of the more dramatic examples that we have in this country of that sort of thing happening.

There are also some much harder problems to overcome with bureaucratisation of actual land management. Bureaucracies develop their own criteria for decision making, about staffing, and the actions of staff, and these may not be in terms of the integrity of land which is being managed. It is much more likely, being slightly cynical, to be in terms of the integrity of the paper work, which may not have any relationship to the land. It is not the public servants' fault; it is the fault of the systems of accountability we have developed, which place very high premium on the paperwork that can go across the minister's desk or be tabled in the House. If the paper-work is in order people seem to be moderately satisfied. And I am not suggesting our land managers are necessarily being careless or stupid in this, but their job is defined by someone else. I am not at any point in this criticising the people who are struggling in a government authority to do the best they can, but looking at the broad-scale system.

The bureaucratisation of management certainly leads to the phenomenon we all know well and could best be described as the game of musical rangers. No ranger stays long enough anywhere to really get to know his park as well as he should. It's inevitable within the present system. But if you look at our parks, and look at the people who have made significant contributions to the development of those parks, it is very hard to see many of them in very recent years. The real development and real vision has often been a way behind us. And it has been people like Lynch and Reddan and Wiburd, men who stayed for many, many years on a park and who came to know every millimetre of that park every hour of the day and every season of the year. I think we need some time to look at whether public service systems of land management can be changed in a way which will effectively lead to really stable staffing of parks and all the benefits which come from that. Certainly this has been looked at in one of the management plans prepared by the Federation, where the decision made by the responsible authorities was to, as far as possible, aim for long run stability rather than for management of a cave park being part of a general musical rangers game. However, even that raises problems because I do not think this problem is limited to cave parks at all; I think it is true of many parks, and probably most.

Finally, governments tend to trivialise environmental management and that is partly a historical burden that we bear from the 19th century. Parks were originally conceived as monuments and as centreing around monumental features. So the notion was to find particular features and to show them to the public so that people would go oh! and ah!. Appreciation of the environment was seen not in terms of a holistic eco-system but rather singling out of particular features, isolating them from their ecological context. The traditional practice in show caves and cave parks has been to do just that. So we are still struggling against that idea. Not, of course, because the park managers might not understand the problem (although sometimes they do not) but more because there is a lot of the public who do not understand the problem and who demand the old monumentalism. Again, I'm looking at society and the way in which we, as a total society, look at the responsibility we place in the hands of our government.

Now let me briefly say a bit about those who one also hears of as having some responsibility for cave conservation - the land owners and the cavers.

I only want to look at these two very briefly. Landowners firstly: often landowners do not own the caves. The title may be of limited depth so that the landowner only owns the land above the cave and perhaps the entrance to it, but not the cave itself. In this situation the cave is the property of the Crown, although there is some divided legal opinion as to what that really means. I am not going to explore that one at the moment. However, even if the landowner has a centre-of-earth title, a title that runs all the way to the centre of the earth, as we do have in the Buchan area in Victoria, where it is clear that the landowner has actual title to the cave itself, then I think there is still an issue. We have constraining legislation, both planning legislation and pollution control legislation, which constrains the right of the private landowner. I believe we need constraining legislation to retstrain the right of the private landowner to destroy features of environmental value. An example of where we more adequately do have that legislation in this country is in regard to Aboriginal relics. Some of you may be aware of the legislation which does constrain the landowner's right to destroy Aboriginal relics on his property. I believe that principle should be extended. I would even suggest to you that we will ultimately rethink our concept of private ownership of land, as some European countries are beginning to, or have done so for years. We might then see that private ownership is the equivalent of human slavery. I talked earlier about Aldo Leopold's analogy of Odysseus murdering his slave girls because they had misbehaved, because at that time there was no value placed on human life. Today, we do not believe people can own people. If you extend that to the land ethic, you should be asking some very serious questions about the right of any one individual to see himself as owning a bit of land. But, of course, in this country with its tradition of squatting, that's a very sacred cow. I am only giving it a tentative kick, but someone needs to give that cow very hard kicks, because the concept is outmoded and it is environmentally unsound. The present day legislation of Sweden or Yugoslavia, to quote two countries that are politically miles apart from each other, suggests to us that perhaps we should be looking at issues of land tenure in a new way and we should be saying there is a responsibility upon landowners to care for that over which they have temporary guardianship. That is really what it is, but at the moment, we do not really recognise that.

Cavers: Cavers do have a knowledge, as Dr. Sue Barker has pointed out, of a particular sector of the environment. I think that knowledge confers upon us at least a duty. I do not think it can be a responsibility in Frankelian terms. I do not think we can be held to account for it, perhaps unfortunately. But I do think we have a duty to act upon the knowledge we have. We have a duty to be amongst those who try particularly hard to call governments to account for the decisions they make. We cannot, as I and others were doing 30 years ago, just load ourselves up and go off to have a glorious weekend grovelling in a cave without thinking about the implications. Through our grovelling we learn a great deal about that bit of the environment. We do develop a love and a care for it and I believe that confers upon us, at the very least, a duty to try to see that our caves are well conserved. It may mean that we find ourselves excluded from some caves because of that. I think there are far more important issues than whether or not we can have a good time in a particular cave. I think those far more important issues are to do with the intrinsic value of the cave environment and its importance to future generations-that we guard that intrinsic value. To be very specific about this, in the last few days I've tried to assess the size of the bat population in Bat Cave at Naracoorte Caves as part of the work we are doing towards the draft management plan for the park there. That population of bats is as healthy numerically as it has been in any time of my 30 years acquaintance with it. The population is still in very good shape. That is not true of any other bent-wing bat population in South Eastern Australia. Now I think a very important element in the health of the Naracoorte population is the fact that the park service has closed that cave to visitors, including cavers. Cavers have accepted that and respected it and I think it shows the responsibility, both of the cavers most concerned and the Parks Service that such action was taken and that the population of bats at least is still in good shape. I do not think it says much for our concern about or duty to the environment or that of the management authorities concerned that the equivalent bat populations in Victoria and NSW have been decimated. Someone hopefully one day will start to call at least governments, and perhaps us, more to account for it.

I have really enjoyed discussing these issues that I have raised with you. To me it is an exploration in trying to sort through why it is that we commonly assume governments are responsible. It is useful for me to think about that and try to clarify my own ideas on it and I only hope it helps you to a clearer idea of how you see your responsibility for caves, and your role in cave conservation, viz-a-viz the role of your elected government and how you put the two together.

Thank you very much.

Australian Heritage Commission (1982), The National Estate in 1981, Canberra : Australian Government Publishing Service.

Frankel, Charles (1955), The Case for Modern Man, New York : Harper & Row.

Godfrey-Smith, W. (1980), The value of wilderness; a philosophical approach, pp. 56-71 in Robertson, Helman & Davey (eds.), Wilderness Management in Australia, Canberra : Canberra College of Advanced Education.

Leopold, Aldo, The Land Ethic : many printings, but most readily available in the 1970 Ballantine Books paperback edition of A Sand Country Almanac, pp.237-263.

WILDERNESS KARST IN TASMANIAN RESOURCE POLITICS

by

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Until the early 1970s karst resources were largely unrecognised in decisions regarding land-use in Tasmania. Over the past decade growing concern for the protection of the wilderness landscape of the island's south-west has stimulated the growth both of community based environmental interest groups and of protective agencies within the administrative machinery of government. Both have attracted individuals with expertise in karst and a personal committment to its proper management. Largely through their awareness and individual efforts, caves and karst have been promoted as little-known but worthwhile components of the wilderness.

The positive results of this have included a stimulus to our knowledge of karst, an increase in public awareness of karst and a strengthening of the case for the prevention of the wilderness area. On the negative side, there may be some potentially dysfunctional consequences attached to the politicising of karst, including the loss of any "first strike" advantage which might otherwise have been available to karst advocates dealing with areas where it is a primary rather than subsidiary resource; and also the developmnent in some sectors of the community of an "anti-cave" ethos which might otherwise not yet have arisen.

INTRODUCTION

The object of this paper is to trace the nature of and changes in the management status over the past decade of one small component of the Tasmanian environment : karst. In particular, I wish to persue the question of how the management of limestone areas and the conservation of caves has become intertwined with, and impinged upon by broader questions of land use priorities and Tasmanian politics; to examine also the tactics adopted by various parties, and to consider some of the implications for the karst areas. To do this I will need to traverse considerable ground which may not at first glance appear to be related to caves per se, but I hope to demonstrate that cave conservation problems can be neither understood nor resolved without taking account of the wider environment.

This paper represents a form of case study, but one which emanates not from an entirely dispassionate observer but from a participant in the processes described. It must therefore suffer both the shortcomings and strengths inherent in that perspective - hopefully by stating areas of my personal involvement attention will be drawn to specific areas for scrutiny in this regard. To introduce the paper I wish firstly to review by example the pattern of land-use decision-making in Tasmania and then the status of karst at the time the congress of this Federation last met in Tasmania in 1970, before reviewing structural changes, public issues and advocacy which have impinged upon the situation since that time.

PATTERN OF LAND-USE DECISION-MAKING IN TASMANIA

The most effective method for describing the social and political milieu and the relevant processes operating within it in Tasmania is to review briefly the first major conservation issue in the state, which reached its crescendo in the early 1970s. In 1955 submissions from bushwalkers and private pilots led to the creation of a 2400ha scenic reserve known as the Lake Pedder National Park. In 1962 geologists and engineers began to examine the general area with an eye to the development of its hydro-electric potential. Disquiet among the small group who knew Lake Pedder led to the formation later that year of the South West Committee (SWC), a federation of interested organisations which requested the Tasmanian government to protect the entire South-West as a fauna reserve.

In 1964 the state government established instead an interdepartmental committee (IDC) which included representatives from various government agencies, and on 21 December 1966 the IDC was briefed to consider future development of the South-West. The SWC was refused membership and so produced its own plan for a major national park. On 21 June 1965 Premier Eric Reece quietly acknowledged that there was to be "some modification to the Lake Pedder National Park" (Mercury 21 June 1965). On 13 April 1966 a South West Fauna District of 646 000ha was gazetted, but within two months its future seemed questionable when a case for special financial aid for a hydro-electric project on the Middle Gordon River was submitted by the state to the federal government. On 29 March 1967 continuing disquiet as to the still unspecified threat to Lake Pedder resulted in formation of the more activist Save Lake Pedder National Park Committee (SLPNPC). In 1967 the IDC predictably supported proposed power development, but also recommended an extended national park. Yet it was not until 25 May 1965 that the proposal of the Hydro-Electric Commission (HEC) was finally tabled in parliament (McKenry 1972). It provoked an immediate public response. Reece's "some modification" meant total inundation and obliteration. Millions of dollars had already been spent. Conservationists were shadow boxing with something bordering on a 'fait accompli'.

To this point we can recognise the foundations of a number of important elements in the decision processes which persist today. Firstly there is an unwillingness to upset planning procedures and risk any challenge to professional values by disclosing information in a threatening social environment. More than a decade elapsed between initial investigations and the first public release of information. Secondly, there is a resentment by the old institutions and power elites of the state when subjected to any questioning: at one stage Premier Reece accused the SWC, a public body, of "meddling in public affairs". Put more bluntly, a classic strategem of obfuscation, distortion, misinformation, secrecy and half truth was developed which set a pattern for future public resource decisions affecting the Tasmanian wilderness. A further problem lay in the fact that little was known of the area in question, for while resistance to flooding Lake Pedder was immediate, the Gordon gorge area and to a degree also the remarkable Serpentine River were surrendered without resistance, and it was to be some years before it was realised by cavers that karst had also been destroyed. (Kiernan 1981a) Secrecy gained the HEC a critical delay to the mobilisation of contrary public opinion, by which time the scheme had gained considerable momentum.

A record petition of 10,000 signatures was presented to the state House of Assembly (lower house) during the ensuing debate, to which the Legislative Council (upper house) responded by establishing, on 14 June 1967, a select committee of enquiry. Neither the HEC nor the state government saw fit to await its findings, for by the end of June legislation had been introduced to the lower house to authorise the project and give the HEC total control over the entire South-West Fauna District. Here lies the foundations of the more recent control of parts of the Gordon-Franklin area by the HEC. Premier Reece was so justifiably confidant that the Bill would pass without amendment that he skipped the last day of the debate to secure special bridging finance of $47 million from the Loan Council in Canberra, even though the proposal had not been passed by the state legislature. On 22 August 1967 the select committee reported in favour of the dams, but urged also than an extended national park be proclaimed. The first finding was endorsed enthusiastically but the latter was never fully complied with. Among other recommendations was that all future proposals be scrutinised by parliamentary select committee, but this too was ignored some years later when the Pieman River project was approved, and a shell-shocked conservation movement put up negligible resistance to the loss of a major riverine wilderness: there too karst areas unknown to cavers were to be destroyed. Lake Pedder fell from the headlines until the early 1970s, although ongoing biological research revealed Pedder to be a unique ecosystem with numerous endemic species which faced probable extinction (Bayley, Swain, Tyler and Lake 1972). The Reece Labor Government lost office in 1969.

A more radical public group, the Lake Pedder Action Committee (LPAC) emerged in 1971, and it was as secretary of that group that my own involvement increased. By the following year the Serpentine dam was already completed and the flood-waters were within a few kilometres of Lake Pedder. A move in the upper house failed to produce a referendum. In addition to their public campaign, several LPAC members infiltrated the very small Centre Pary (= Country Party) whose sole parliamentary representative was the deputy premier, Kevin Lyons who opened the Hobart Conference of this federation in 1970, and was a brother of one of the principal protagonists involved in the split which provided Tasmania with a new cave group in the late 1960s. Several LPAC members were elected to the state council of the party, and ripples resulted from questions about Lake Pedder being raised by Lyons in the state parliament. In February 1972 Lyons resigned from the Liberal-Centre coalition government and thereby forced a state election, at which conservation candidates stood as a body called the United Tasmania Group (UTG) and nearly gained seats despite a press advertising campaign against them by the HEC.

Several other elements in the process should now be apparent. Firstly, although unprecedented public disquiet was evident, the rejection of any HEC proposal still seemed unthinkable. Secondly there was a readiness to be very selective in regard to the findings of a parliamentary enquiry. Thirdly conservationists were becoming more vocal and very politically involved.

A scientific element crept into public awareness. The International Biological Programme of UNESCO and the IUCN called for a halt to the flood. On 13 July 1972 there was an unsuccessful attempt to reopen the upper house enquiry, stimulated by a petition from life scientists from around Australia. Scientific values were ignored by the Tasmanian government, just as they were to be ignored a decade later when the archaeological caves of the Franklin River were capturing scientific headlines world wide. When legal opinion suggested the flooding of the national park was illegal the Attorney General resigned because cabinet refused to allow him to grant his fiat to a citizen action by LPAC members against the government's Commission. This incurred the wrath of the bar association and the church amid claims that the action contravened the Magna Carta. Retrospective legislation passed the parliament and the Attorney General resumed his post. The government had got away with it and a precedent had been established. Similiar retrospective legislation was enacted in 1981 to validate flooding of part of the Cradle Mt - Lake St. Clair National Park by the Pieman Scheme. Meanwhile conservationists had turned their Pedder lobbying towards Canberra. On 2 December 1972 the ALP was elected to national government. It was a very different ALP to the state branch which had resumed government in Tasmania earlier in the same year, and on 23 February 1973 it honoured a pre-election promise to establish a committee of enquiry in a bid to halt the flooding. The Tasmanian government and HEC refused to give evidence. In an interim report released in June 1973 the enquiry recommended a moratorium on the flooding, with any costs to be borne by the national government. In September two Pedder protestors disappeared under highly suspicious circumstances while flying to Canberra by light aircraft to lobby for support for this proposal. The federal government accepted the argument that Pedder was a national responsibility and offered a blank cheque to Tasmania to cover costs in developing an alternative scheme. The offer was refused and Lake Pedder drowned.

Recurrent problems highlighted during the Pedder and subsequent debates have included the inappropriate structure of government machinery, whereby functionally narrow agencies persue narrowly defined objectives; the existance of outdated legislation founded upon very narrow values; and the complications posed by existing long term development rights. The Hydro Electric Commission, for instance is "an autonomous, semi-governmental authority responsible almost entirely for the conduct of its own affairs. The Minister administering the Hydro Electric Commission Act is answereable to parliament for the activities of the Commission but the Commission is not directed by or responsible to the Minister as is a government department". (Tasmania 1967 : 327). The Commission is therefore able to act as a defacto government with respect to power supply and attempt to present the parliament with a 'fait accompli'. A further problem, but one of diminishing significance has been the resistance to upstart youth and changed values. This was exemplified in in 1973 by the premiers public attack upon me for daring to question him when I was not even old enough to vote - at the time I was 20 years old, and while the 18 year old franchise had not yet been proclaimed it had been accepted by government. The Whitlam government was perceived in Tasmania merely as impetuous youth in parliamentary clothing. Despite all of this Pedder was recognised as a national possession, but federal initiatives to safeguard it were defeated, in the final analysis, by bureaucratic insensitivity, even arrogance; by the intransigence of insular government; and by the pride of old men. Facts were of diminishing significance to the final outcome, for while Lake Pedder was tossed upon stormy seas of materialism it foundered upon the rock of pride. Clearly the HEC had extraordinary power : Premier Reece was known to consult it not merely on matters of energy supply but on the direction of general government policy. And in the wake of failure at Lake Pedder the conservation movement would have to fight harder for the Gordon-Franklin than it may have had to in the wake of success at Pedder and a decade of Tasmania adjusting to the greater legitimacy of conservation as an institution. Pedder had opened a Pandora's box of nested sub-issue.

POST-PEDDER STRUCTURAL CHANGES

The monosyllabic planning which fuelled the Lake Pedder debate also exposed grave weaknesses in Tasmania's legislative arrangements for environmental protection. The Scenery Preservation Act lay agape in toothless glory. But when the Liberal-Centre coalition gained office in 1969 it brought with it a policy for a National Parks and Wildlife Service. Mr. Ron Brown, a member of the SWC and one time Legislative Councillor for the Huon, was instrumental in having this policy, initially proposed by Ms Anita Damgard and Mr. Don Field, accepted by the Liberal Party. I suggest that the birth of the Service at that time is directly attributable to the far sighted, individual efforts of those people. The later passage of an Environmental Protection Act and the establishment of a Department of the Environment was a direct result of the UTG entry into the 1972 state election. With the probability of conservationists polling strongly the ALP plagiarized some of the UTG policies and on regaining office found itself stuck with it. There is more than one way to skin a cat! The Department remains toothless however, preoccupied with popping-it-in-a litter-bin while the South-West drowns, our forests are carted away to Japan to be converted into junk packaging and Hobart's Derwent River carries toxic levels of heavy metals such as mercury, zinc and cadmium which in some cases are at world record levels, exceeding even those of Japan's infamous Minimata Bay. But while the Apple Isle vanished with the fruit industry and the holiday isle was becoming the isle of galvanised oysters the establishment of these new agencies provided niches to be filled by conservationists of professional rather than activist orientation. And outside Tasmania, Pedder contributed a great deal to stimulating efforts to increase federal environmental powers, including establishment of the Committee of Enquiry into the National Estate.

THE STATUS OF KARST IN 1970

1970 provides a useful benchmark against which to measure progress in karst protection over subsequent years, for not only does it predate the main bourgeoning of environmental awareness in

Australia, with its offspring concepts of public participation in planning, but in karst terms it also represents the rediscovery (or perhaps discovery) of Tasmania by mainland speleologists. Exploration was still centred upon 3 or 4 principal areas and there was little known of the South-West karsts, apart from Brian Collin's tentative steps towards Mt. Anne. Discoveries in Exit Cave had made it the deepest and longest known cave in the southern hemisphere (Goede 1968), and then the depth record was broken again in Tassy Pot shortly before the 1970 ASF Congress in Tasmania (Kiernan 1971a). This attracted many mainland enthusiasts to the state and set the stage for further dramatic discoveries and depth records in the following days and months (Kiernan 1971b,1972)

But although organised speleology in Tasmania was well into its third decade there had been no new reserves proclaimed to protect any of the many discoveries which had been made over that time. From a review of existing cave reserves which I published in 1974 many of the problems of 1970, some of them unknown to us, become evident : in addition to the fact that there were simply too few reserves none of those existing had been delineated on the basis of ecological or hydrological criteria; only sites with potential economic value as tourist venues had been reserved; many reserves were enshrined only in folklore; some protected only the entrance and not the body of the cave; reserve declarations lay scattered among myriad pieces of legislation or potentially temporary department whim; and the potential existed for boundaries to be altered, interference permitted or entire reserves extinguished without public knowledge (Kiernan 1974). Some karst was inadvertantly but fortuitiously protected in national parks, although in the case of the Florentine Valley most of the karst had been revoked from the Mt. Field National Park to permit logging. But when most of the major caves were excluded from a mineral exploration licence at Mole Creek it had been openly admitted to be a bid to avert another Lake Pedder type row. The South-West? We simply didn't know if there were any caves in it, but the potential certainly seemed to be there (Harris 1967, Harris & Kiernan 1971, Kiernan 1974).

(See Figure 1).

THE PRECIPITOUS BLUFF CONFLICT : A MAJOR THREAT TO WILDERNESS KARST

The first major threat to wilderness karst arose only 12 months after the 1970 ASF conference. In 1938 a geologist had reported caves in the limestone flanks of Precipitous Bluff above New River Lagoon, and in the 1960s a number of these had been explored by a Tasmanian Caverneering Club party who flew to the lagoon by tiger moth sea plane. (Goede et al 1973). In December 1971 Mineral Holdings (Australia) Pty. Ltd. applied for an exploration licence over $32km^2$ but the application was declared invalid. A second application for $40km^2$ lodged a month later was met by several objections from wilderness conservationists. In December 1972 a mining warden, Mr. J. Temple-Smith, rejected the licence application because the value of the area in its "pristine and primeval condition far outweighs the nebulous benefits which could be expected from mining activity". This incensed the pro-development lobby. An appeal was lodged by Mineral Holdings amid mounting public outcry. (Wessing 1978). There were reports that the Tasmanian government intended a bet each way and that it would declare the area a national park, but allow mining under the management plan. The stage seemed set for a major conflict.

Speleologists bought into this issue in 1972 when I led a national expedition to the Precipitous Bluff caves to gather information and publicity supportive of the conservation case. Participants came from several Australian states and from New Zealand. Two lengthy outflow caves and some pot-holes were explored, and other entrances were recorded (Kiernan 1975a; Middleton and Montgomery 1973; Pavey, Fisher and Radcliffe 1973). The project gained considerable media attention and the discovery of a number of new invertebrate species in the cave came at a time when the loss of unique species at Lake Pedder was still in the public mind. The expedition provided photographic material to the Australian EXPO display at Spokane, Washington. Although the local municipal news-paper condemned the cavers activities, the explorations perhaps helped a little to put a human face on an area little known by the public but for reports of esoteric court-room battles.

An application by Mineral Holdings to the Master of the Supreme Court in chambers for a declaration against the mining warden's decision was unsuccessful. But following a Supreme Court hearing Mr. Justice Nettlefold found, on 8 June 1973, that the objectors were not competant to object because they lacked any proprietary estate or interest, and so reversed the warden's decision. Subsequently through the good offices of federal conservation minister Dr. Moss Cass, Urban and Regional Affairs Minister, Tom Uren and Attorney General, Lionel Murphy the federal government undertook to finance an appeal by conservationists. This led to a major clash between Tasmanian Premier Reece and Prime

Minister Gough Whitlam. Whitlam singled out Precipitous Bluff as a major feature of Australia's threatened heritage in a statement announcing the Committee of Enquiry into the National Estate. But in subsequent ruling the full bench of the Supreme Court dismissed the conservationists appeal. This finding was subsequently reaffirmed by appeals to the High Court and to the full bench of the High Court. Conservationists still have no legal standing under the Tasmanian Mines Act.

Notwithstanding this, the public furore was such that in 1976 the Tasmanian government announced that Precipitous Bluff was to be included in the South-West National Park, and mining disallowed under the management plan. But this was to involve a trade-off whereby part of the Hartz Mts. National Park was to be revoked to compensate a paper pulp company for unused concession area foregone. The company has since closed down for at least two years. The swap ultimately occurred, despite conservationist resistance. This issue dovetailed into the whole question of wilderness park planning in Tasmania.

PLANNING PARKLANDS : CAVERS IN THE COGS

(i) THE OFFICIALS:

I have already mentioned that the advent of new government agencies charged with environmental protection provided niches for conservationists of professional orientation. Although relations between the activists and professionals were rather low key for a long time, and in some cases even hostile, the emergence of dedicated conservationists in the agencies, including some karst enthusiasts had been significant. In addition existing departments such as Lands and Forestry saw the public relations value of getting in on the environmental act. Environmentally concerned officers could at least have an impact. The Lands Department developed a network of recreational reserves, and the Forestry Commission developed small reserves at such areas as the Julius River caves, and also Lake Chisholm, a beautiful karstic lake.

While there had long been concern at the prospect of dams in the Gordon-Franklin area, an important contribution came from a one-time member of the Tasmanian Caverneering Club, David Steane, who as an official in the new management branch of the Lands Department asked in a departmental report in the mid 1970s whether Tasmania should perhaps retain a wild river, and focussed his comments upon the Franklin in particular. In addition to laying the foundation for the concept of a Wild River National Park and shifting the focus away from the Lower Gordon to a degree and onto the Franklin in particular, it was encouraging for conservationists to be aware of such a sentiment in a department where it was not expected. After the inevitable leak I enthusiastically embraced Steane's argument and as chairman of the South-West Tasmania Action Committee at that time, and later as founding director of the Tasmanian Wilderness Society, I was able to strongly promote this concept in conservation circles. Those who followed me at the helm of TWS, firstly Dr. Norm Sanders and later Dr. Bob Brown, have continued to do so.

Several karst enthusiasts have become involved in the National Parks and Wildlife Service where they have been in a position to work for karst protection and have provided receptive ears for proposals from outside government. One of them had been attracted to Tasmania through the Precipitous Bluff expedition and was a former member of the Colong Caves and Bungonia Committees; Greg Middleton of the Sydney Speleological Society. Within a few months of returning from Precipitous Bluff he had obtained a position in the National Parks and Wildlife Service where he was responsible for investigating potential new reserves, and he has since risen to the position of Chief Resources Officer. Others later to join the Resources Division have included one-time Southern Caving Society president Stephen Harris, and, for a time, former vice president of this Federation Andrew Skinner. These people were able to take a personal interest in the fate of karst areas, and a number of reserve proposals have been perused at various times. In subsequent years the service has been successful in establishing reserves to protect Exit Cave and Kubla Khan Cave. Some of the problem reserves have been rationalised, with control being assumed of reserves at Trowutta and Junee Cave. Various karsts have been adventitiously protected within larger reserves, such as the extended parklands in the South-West. Despite this considerable work remains, particularly in the more classical areas such as Mole Creek.

(ii) THE ACTIVISTS:

The preparation of plans for extensions to the South-West National Park became a major preoccupation of wilderness conservationists in the mid 1970s, and provided another avenue whereby cave enthusiasts could work towards karst protection. The initial impetus came from these "private enterprise" conservation groups. While the SWC had long proposed extensions to the SWNP, their revised proposal in the early 1970s acceded to development in various areas such as the Middle Gordon and southern forests, and covered none of the country north of the Strathgordon road nor the Lower Gordon and Franklin. Many of the problems in the South-West seemed to me to be due to a piecemeal perspective whereby conservationists fought for indiviaual areas and not the region as a whole. At the 1974 state conference of the UTG I successfully proposed new boundaries of a vastly expanded national park to be adopted as party policy. This was the first formal proposal for a national park to protect the wild rivers, together with such areas as the Prince of Wales and Denison Ranges, and it also aimed to link the SWNP to the Cradle Mt - Lake St. Clair National Park in the north west centre of the island (fig. 2). Karst areas were considered in defining these boundaries although the broader conservation movement undoubtedly had little interest in karst. Key elements of the plan as far as karst was concerned included the protection also of various karsts in the Gordon-Franklin area including Mt. Ronald Cross; protection also of Precipitous Bluff; the Cracroft; the Mt. Anne area; most of the Weld River area; and the adoption of then unprotected Exit Cave as a cornerpost for a boundary extension to protect the Southern Ranges. But the main aim was to turn thinking towards the region rather than the sites, and to reaffirm the importance of those areas ignored by the SWC. The latter factor led to protracted and bitter debate between more conservative and more radical factions within the conservation movement.

The UTG plan stimulated a great deal of discussion. By this time conservation activities were becoming more vocal as logging roads pressed deeper into the South-West and the dams threat loomed. This led to the advent of the South West Tasmania Action Committee, and as chairman of that body I succesfully proposed a slightly larger plan which gave an added protection to the Weld River karst. Meanwhile the Australian Conservation Foundation had also opted for the larger plan, with some further boundary refinements, and most groups generally came to subscribe to the idea of a big park. Even the then very conservative Tasmanian Conservation Trust broadly followed on, with some unfortunate concessions. Again infiltration was a critical factor with the staunch but respectable Jamie Kirkpatrick a member of its South-West policy committee and myself as its chairman.

Up until this time Tasmanian conservation had been characterised by a myriad of small ad hoc committees which had sprung up whenever any threat loomed to a national park or wilderness area. Seldom had these specific groups had more than two or three members, camouflaged by a letterhead (e.g. South-West firing range; Freycinet granite quarries) although some groups were slightly larger (e.g. LPAC). In 1976 I proposed the formation of a Tasmanian Wilderness Society, and in retribution was made its founding Director. One of its earliest activities was a series of field trips designed to increase membership awareness of karst, to areas such as the Weld Valley (logging threat) and to Loongana (dam threat). A series of state government enquiries around this time finally led to a successful recommendation that the ACF boundaries be declared a Conservation Area under the National Parks and Wildlife Act, and that any proposed land-use changes within it be subject to examination by an advisory committee. While this fell far short of being a national park it at least meant that the various protagonists agreed on the broad boundaries for their arguments. However some of the southern karst areas were protected when interim extensions were made to the SWNP in 1976. Many of the more northerly areas were protected in May 1981 when a Wild Rivers National Park was proclaimed by the state Labor government, finally linking the SWNP to the CMLSCNP such that parkland covered 763,400ha, though some areas remained unprotected, including the Denison Range where the Lake Rhona area was burnt out by an escape from an illegal Australian Newsprint Mills regeneration fire in late 1982.

THE GORDON-FRANKLIN DEBATE

The professional and activist wings of the wilderness movement have drawn closest in the current debate over the South-West dams. On paper Tasmanians are the largest consumers of electricity in the world but in fact much of this power goes to a handful of low employment, capital intensive industries owned by outside interests. Some 50% of Tasmania's loan funds are spent on dams and power stations, debts on HEC borrowings amount to $865 million or $2045 per man, woman and child in Tasmania, and the annual interest bill is over $50 million and consumes 43.4% of HEC revenue. To add a further 180 megawatts to the states grid, or about 12% of the projected output of

Victoria's Loy Yang station, the Hydro Electric Commission proposes to spend a minimum of $550 million damming the Gordon River below its confluence with the Franklin, thereby inundating the most extensive of the western Tasmanian karsts - despite strong evidence that energy conservation and alternative methods of generation are viable options, and while the heaviest consumers appear to be winding down.

The limestone outcrops of the Gordon-Franklin are largely unmapped but are undoubtedly extensive (Kiernan 1979). In the early 1960s members of the TCC twice visited the Gordon area and examined several small caves, using boats and foot transport for access. However exploration of this remote region was then overshadowed by dramatic discoveries in more accessible areas such as Mole Creek, Junee Florentine, Ida Bay and Hastings.

In 1971 Stephen Harris and myself pointed out the likely threat to caves posed by proposed HEC Schemes. (Harris and Kiernan 1971). That same year an early rafting party reported caves along the banks of the Franklin. (Morley 1971; Koolhof 1974). Later in 1971 Stephen and Chriss Harris and myself investigated some possible routes to the Franklin limestone. My first attempt to reach the limestone areas from the upstream direction ended tragically on 6 January 1972 when my companion Olegas Truchanas, was drowned in a canoeing accident on the Gordon near the Serpentine junction. In October 1972 I led a further trip from the Crotty area. The party included a number of cave enthusiasts, including Andrew Skinner, at that time a colleague in a small group which formed in a hurried but successful attempt to halt a planned tri-services firing range in the South-West. The party examined several karst areas in the light of leaked information on aspects of the damming scheme, and then as secretary of the LPAC I released a major media statement detailing the HEC's plans and the features threatened, including both known and likely caves. This gained wide media coverage and increased media pressure on the HEC. In 1973 the recently arrived Greg Middleton and I joined with a large contingent of Sydney Speleos on a voyage aboard the tourist vessel Denison Star up the Lower Gordon. The idea crystallised that by documenting caves we might make a contribution to the conservation case.

After the visitors departure Greg Middleton and myself made a bid to reach the limestone in the Nicholls Range from where HEC reports had indicated the presence of caves, but we ran out of time in the scrub of the Hamilton Range. A track to the Gordon Splits has since been cut by bush-walkers, who took some years to cut it along the route we sought to follow. As late as 1974 HEC Commissioner, Sir Alan Knight was still seeking to discredit conservationists with a claim that "there is no Lower Gordon Scheme to condemn". Shades of Pedder! There was abundant evidence to the contrary. During Easter 1974 a small party explored part of the Gordon-Franklin area (Hawkins, Kiernan & Middleton 1974). Later Bob Hawkins and Greg Middleton purchased New Zealand Hamilton jet boats to aid upriver exploration and in January 1975 caves were explored in the Nicholls Range, Gordon-Sprent and Franklin areas (Middleton and Sefton 1975; Kiernan 1975b). More caves were explored the following summer at Nicholls Range. (Middleton 1977, Kiernan 1977). In 1977 Canadian canoes and a motorised punt carried cavers up the Franklin. Fraser Cave was among many caves recorded, some of which were given the names of political decision makers in whose hands the future of the area lay. Reviews of the emerging picture of wilderness karst were provided to conservationists publications (Kiernan 1976b, 1978a, Middleton 1978). The parties also established a pattern of providing film for TV useage, and carrying media crews who prepared nationally distributed documentary material.

It was not until 1976 that the first small rubber rafts took to the Franklin and the river became a popular recreational waterway. More caves were explored in 1978, 1979 and 1980. (Middleton 1980a,b, Kiernan 1978b). Much of the impetus for all this exploration came from Greg Middleton, who published a major review in 1979 (Middleton 1979). The exploration was conducted under the banner of SSS and no local clubs expressed any interest in joining it. In response to public pressure a very inadequate survey of the Franklin caves was undertaken by the HEC (Naqvi 1979) the many shortcomings of which have been detailed elsewhere. (Kiernan 1980, Jones 1981). In January 1981 Greg Middleton guided two archaeologists to the Nicholls Range. They were successful in finding a small surface site, and excavated in one small cave, apparently without success. (Middleton 1982). A couple of weeks later I led a TWS party to the Goodwins Creek karst on the lower Jane River, a tributory of the Franklin, and while returning downstream we visited some of the Franklin caves and first recognised the archaeological significance of one of them: it was none other than that which bore the name of the current Australian Prime Minister, Malcolm Fraser. (Kiernan 1981b).

This focussed attention upon the caves and their archaeology, and the area received massive publicity both nationally and internationally as a consequence of the discovery and subsequent pilot excavation. Members of the Senate Select Committee on SW Tasmania flew to Fraser Cave and it was there that they heard the verbal submissions of two of Australia's leading prehistorians, Prof. John Mulvaney and Dr. Rhys Jones. Further archaeological discoveries were made in February 1981 (Kiernan 1981c) and January-February 1982 (Kiernan 1982, this volume, Harris, this volume). During a visit by Tasmanian parliamentarian Dr. Norm Sanders and myself we found a further surface site exposed long ago by HEC siteworks despite the Commission's claim in their project proposal that no archaeological sites existed in the project area. In parliament Sanders questioned either the integrity or competance of the HEC. A few weeks later he moved a motion of no confidence in the state Labor government.

In 1979 the Hydro Electric Commission had formally presented its project proposal to the state government. During the subsequent state election the Liberal Party, under Geoff Pearsall, a moderate whose maiden speech in the House some years before had focussed upon his recent visit to Exit Cave, followed its usual tradition of wholehearted support to each and every HEC proposal - but it could easily have gone the other way because Pearsall had previously claimed at a public meeting that the HEC proposal "had holes bigh enough to drive a bus through" and the Liberals decision seemed more a hasty and tactically dubious decision to have a policy rather than one about a policy. The Labor Party under Doug Lowe, a moderate who sought to placate lobbyists of the Pedder era by assuring them that "Eric won't always be in charge" refused to allow the Franklin to become an issue. Labor won. A number of documentary films showed the rivers to a wider public, while the HEC plans continued to dominate the news media. The Directorate of Energy recommended that rather than flood the Franklin the government should opt for a smaller dam on the Gordon above the Olga (which would still flood the Nicholls Range karst area), coupled with a 200 MW thermal station. As the cabinet decision drew closer Lows indicated probable support for the Directorate's proposal, but two days later comments from the HEC swung his support to the Gordon-below-Franklin. The Commissions strongest advocate, former NP & WS minister Neil Batt was away overseas when cabinet met a day later and opted for a hydro course. At the next meeting two days later Lowe supported saving the Franklin and a subsequent caucus meeting opted for the smaller scheme. Deputy Premier Michael Barnard was a crucial advocate for the Franklin, together with HEC and Resources Minister Andrew Lohrey, and back benchers Michael Aird and Mary Willey - and as the first Premier prepared to question the HEC Doug Lowe's role was critical. The HEC was furious. Lohrey was subsequently dumped from Cabinet for advocating ministerial control of the HEC. The Liberals moved and lost a motion of no confidence, in the government, inspired by their energy spokesman Robert Mather who as an executive member of the Hobart Walking Club in the earliest Pedder days had engineered the acceptance of Lake Pedder's destruction by Tasmania's biggest out-door organisation. The Gordon-above-Olga bill passed the lower House.

A pro-dams pressure group had developed within the HEC, while another formed under the patronage of former Premiers Reece and Bethune and former HEC Commissioner Sir Alan Knight. It is a measure of prevailing attitudes in Tasmania that this "Dad's Army" was able to exert any influence. A Select Committee of the Legislative Council, chaired by long-time advocate of mines and dams Mr. Harry Braid, supported the HEC and the Council backed itself into the same corner as the Liberal Party. The support of the trade union movement swung behind the Liberal Party, despite an admission to cabinet by HEC Commissioner Russell Ashton that jobs would not be lost if the governments new plan was adopted. The commission became even more nervous of criticism and attempted to silence Prof. John Burton, chairman of the former Lake Pedder Enquiry. After his critical comments made in the professional journal "Engineers Australia", it threatened to sue both Burton and the publishers if there was any repetition. The HEC had previously threatened to sue the Department of the Environment if it released to the public a report containing passages critical of the Commission for impeding environmental studies.

In 1981 the government threw down the gauntlet to the Legislative Council by declaring a Franklin-Lower Gordon Wild Rivers National Park and offering it for World Heritage status. Power-plays were rife within the ALP and the dam proponents reversed the policy of the state party, but this was not binding on the parliamentary branch. As part of a push to unseat Lowe, several ministers openly dissented from saving the Franklin. Lowe was unceremoniously dumped only a week after Geoff Pearsall had been replaced as Liberal leader by a staunch HEC advocate from Melbourne, Robin Gray. Gray trumpetted that mainlanders should stop interferring in Tasmanian affairs and let Tasmania decide. The government was forced to a referendum. As part of the move to oust Lowe the no dams option was excluded from the ballot paper within days of Lowe having promised it, while powerful factions wrestled for control of the ALP. The public was only given a choice between the two dams. Some 47% voted for flooding the Franklin, only 7% for the Olga option, and a massive 46% voted informally, with 33% of the total voters having written "no dams" on their ballot paper. Conservationists interpreted this a majority against flooding the Franklin, dam proponents including the ALP took the converse view. The Legislative Council continued to precipitate a constitutional crisis. Lowe and his former whip Mary Willey resigned from the ALP to sit on the cross-benches with Australian Democrat Norm Sanders, leaving new Premier Harry Holgate at the helm of a minority government. Holgate bought the support of television naturalist Harry Butler, and then prorogued parliament to buy time. When it resumed Sanders moved a successful motion of no confidence, which was supported by Lowe, Willey and the Liberals. At the May 1982 election the Liberal Party came to office, and a bill to flood the Franklin was passed by both houses. Meanwhile at federal level the ALP had adopted a "no dams" policy.

In September 1982 14,125 ha of the Franklin-Lower Gordon Wild Rivers National Park and 14,200 ha of the South West Conservation Area were revoked and vested in the HEC. A further 780 ha of the national parks comprising the bulk of the Franklin River karst, will remain in the park until 1st January 1990, supposedly to allow archaeological studies of the cave deposits to be undertaken.

Resistance was increasing at a national level. A series of "no dams" write-ins on ballot papers during mainland elections culminated in a massive 40% "no dams vote" in late 1982 for the federal seat of Flinders in Victoria. As the possible implications of World Heritage status sunk in the new Liberal government in Tasmania sought to beat up a States Rights issue out of the nomination, firstly by asking the federal Liberal Government to withdraw the nomination, which had been given added credibility by the Fraser Cave discoveries and the representation of many of the world's leading archaeologists, and secondly by attacking the prospect of the national government invoking foreign affairs powers in order to honour Australia's obligations as a signatory to the international World Heritage Convention. The international archaeologists comments were published as a full page advertisement in The Australian newspaper. In federal parliament the Prime Minister revealed that he had received over 6000 letters on the Franklin. From the first decision by cavers to explore the Gordon-Franklin area to gather information supportive of the conservation case, the caves of the region, and particularly the cave to which they had attached the Prime Minister's name, had emerged as arguably the most compelling element in the case against the dams.

In its report of November 1982 the Senate Select Committee concluded that there was no urgent need to commence construction of a new power scheme, and supported alternatives to the Franklin dam. It urged the Australian Government to fulfill its obligations under the UNESCO World Heritage Convention. This decision was based upon economic arguments and tha archaeological importance of the Franklin caves, the Committee repeating Prof. John Mulvaneys viewpoint that destruction of the caves "would be the greatest desecration of archaeological sites in Australia .. that, for the Stone Age of the World, it is the equivalent of destroying the Pyramids" (Australia, 1982:204). The only dissenting voice was that of its chairman, Tasmanian Liberal Senator Brian Archer. A subsequent bill to ensure that Australia honoured its obligations under the World Heritage Convention passed the senate. The issue had set Tasmanian against Tasmanian, Labor against Labor, Liberal against Liberal and now potentially the two houses of federal parliament were also at loggerheads.

While mainland newspapers editorialised against the dams the Tasmania media and Premier Gray tried to promote the idea that Tasmanians had magically become unanimous in support of the flood, and appealed to Tasmania xenophobia by demanding an end to interference by mainlanders. Meanwhile the TWS was organising a physical blockade of the site works, which had commenced in Spring 1982. Talk of rifts in the state Liberal Party were both initiated and suppressed by Gray's dictatorial control of the party he had led to office in its own right for the first time ever. Special police powers legislation was passed to cater for the blockade and one of Grays reputed critics, Attorney General Max Bingham was despatched to Paris, ostensibly in a bid to dissuade the World Heritage Committee from ratifying the nomination, but possibly to get him out of the Premier's hair.

But in early December 1982 federal cabinet decided not to intervene because of protestations that the sacred cow of states rights must not be challenged. Australia it seemed was still not to be one nation. The absence, due to illness of Prime Minister Malcolm Fraser, considered a closest conservationist in the cabinet, was probably a critical factor. Although he had delayed forcing the issue in Cabinet pending Fraser's return, Environment Minister Tom McVeigh was finally forced to proceed, without his strongest potential ally, at the last Cabinet meeting prior to the World Heritage meeting. Cabinet chose not to intervene on the dam, but insisted the heritage nomination would go ahead, and offerred the federal police to assist the Tasmanian government during the blockade. It claimed the cave deposits would be salvaged by a proven process of resin impregnation. Prof. John Mulvaney publicly ridiculed the suggestion and as a protest gesture resigned in disgust from the interim board of the Museum of Australia. The Australian Archaeological Association described the proposal as utter nonsence and the government's statements as deliberately misleading, and condemned the decision not to intervene as cowardly and irresponsible. A meeting between an AAA delegation and Minister McVeigh degenerated into a swearing match. Salvage archaeology was informally declared black by the association. Longstanding rifts between the Tasmanian aboriginal community, the archaeological fraternity and the conservation movement shrank overnight in the face of the mutual enemy of political intransigence. Virtually every major newspaper in Australia condemned the Cabinet decision in editorials, an exception being the Hobart Mercury which rejoiced.

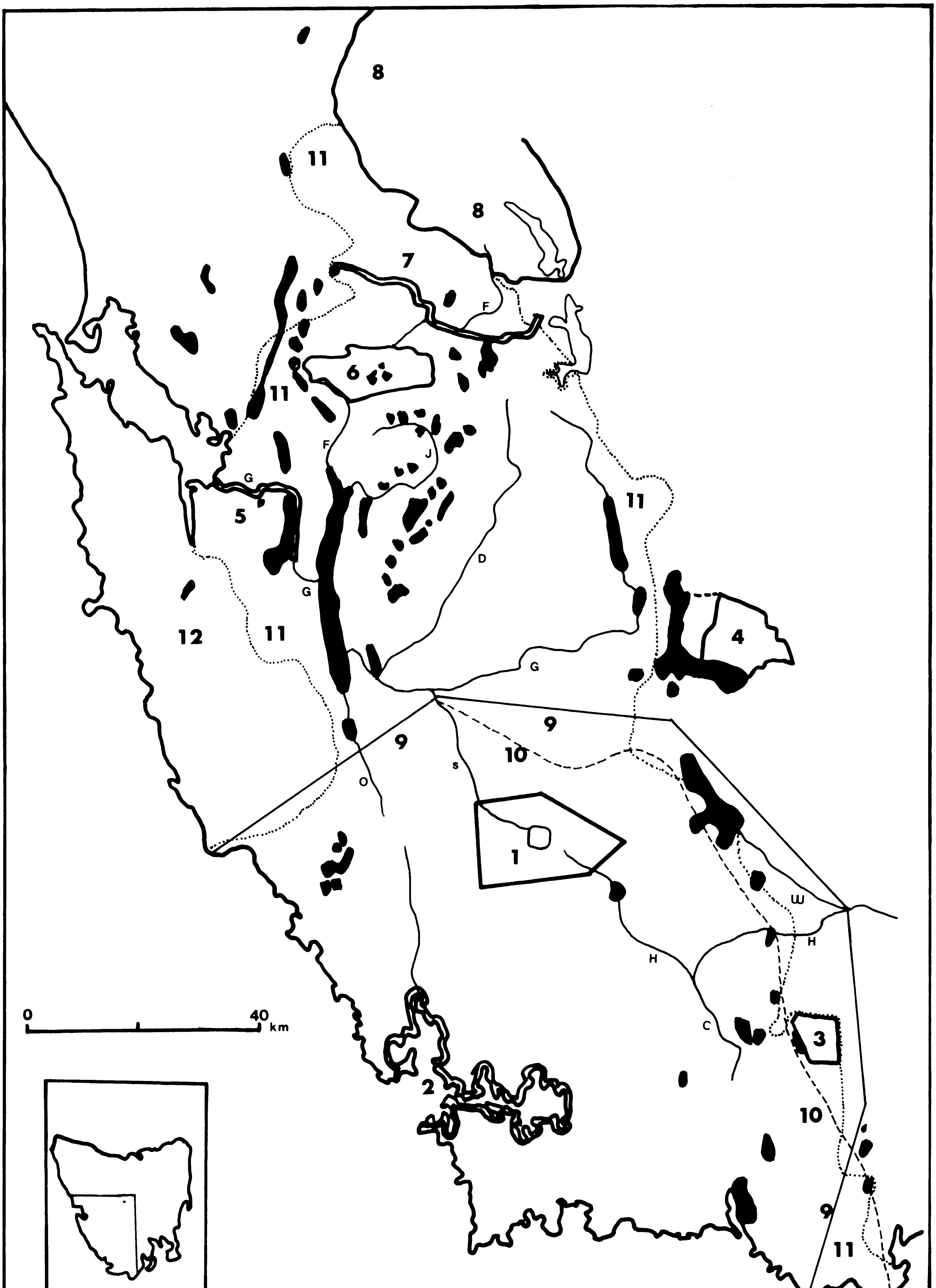
On 13 December 1982 the World Heritage Commission listed South-West Tasmania, recommending that Australia nominate its upgrading to the list of World Heritage in Danger. The blockade commenced the following day and by the time HEC workers commenced their Christmas holidays three days later, some 196 conservationists had been arrested, including a millionaire businessman, grandmothers and younger folk. They were charged with trespass and many were incarcerated in Hobart's Risdon Prison when they refused to accept bail conditions which forbade their return to the Gordon-Franklin. Democrate member of state parliament Dr. Norman Sanders resigned his seat in protest at the arrests, and announced his intention to contest a Senate seat. Around the same time the prestigious American journal Science carried a full page editorial on the Franklin caves issue (Lewin 1982). Although not editorially supporting the conservationists the national Australian newspaper could not ignore the fact that TWS Director Bob Brown was nominated by over 80% of those readers who suggested contenders for that daily's selection as Australian of the year. In early January 1983 Brown was released after nearly three weeks in prison, and within 24 hours had been easily elected by recount to fill Sanders seat in the House of Assembly. As this conference draws to a close, a major article on Fraser Cave (Kiernan et al 1983) is due to appear in the journal Nature, considered by some to be the world's most prestigious scientific publication. The federal government seems unlikely to accede to pressure to reverse its decision not to intervene and the conservation movement is planning a major campaign in marginal seats against the Liberal Party in this years national election. The issue is far from over.

SUMMARY AND CONCLUSIONS

Clearly, although conservation has been a dominant theme in Tasmanian politics for many years, karst issues have, until very recently, been only a minor component of it. But since the prospect of drowning Lake Pedder raised the spectre of karst areas of unknown significance falling to a similar fate, an element of the speleo fraternity in Tasmania has responded to the threat. The situation in Tasmania is peculiar insofar as the greatest threat to karst in this state is to unknown or little known areas, rather than to known major features. Conservationists have had to defend the unknown, while at the same time trying to find out about it. Perhaps this constitutes a classical form of wilderness conservation. The poor resource inventory which many observers have considered to underlie land-use problems in Tasmania is exemplified by the situation with respect to karst. Because of these problems, karst has become intertwined over a number of years with the principal issues in Tasmanian politics and at the present time the significance of one karst area is utterly fundamental to an issue which has toppled a government; instigated constitutional crisis; personally involved the Prime Minister; promoted debate in the national parliament; seen Australia become the first nation to breach the World Heritage Convention; precipitated a major row over states rights under the Australian constitution; seriously split the two major political parties; far transcended the boundaries of those parties; seen hundreds arrested and imprisoned; and turned Tasmanian against Tasmanian as never before. Whether that is a good or bad thing, the fact remains that it has happened, and that is significant. But advocates for the protection of areas where karst is a primary rather than subsidiary resource no longer have the advantage of promoting something novel and new in a "first strike".

None of this is attributable to the usual advocates of karst, the caving clubs, whose approach to cave protection in Tasmania has always been low key. The clubs have prepared the odd submission

Figure 1: Limestone and dolomite outcrops in south-west Tasmania.



for localised reserves, but it has been the political climate rather than the factual argument which has seen them fail or prosper. Factions exist within the Tasmanian caving fraternity to a degree which found its ultimate expression of idiocy in the deliberate sabotage of one clubs proposal for Exit Cave reserve by an individual member of a rival club. Many of Tasmania's staunchest and most knowledgeable karst advocates are not members of this Federation.

The reason for the intensity of debate in Tasmania over land-use options transcends questions of energy, dams, mines or woodchipping. All these things are merely symptoms. To challenge any is to challenge the whole basis of Tasmanian existance; to challenge the power elites and the basic assumptions handed down like heirlooms from father to son, from parliament to parliament (in a society where both can mean much the same thing). There are dozens of nested sub-issues. One of the reasons for the growth of the Conservation movement in Tasmania is probably the simple fact that it represents the nearest approach to a political opposition, in a state where the principle debate between the major parties tends to revolve around who can do the same thing best rather than whether it should be done at all.

That karst has become embroiled in all this is the result of some of the individuals concerned about re-routing the direction of Tasmanian development having also been karst enthusiasts, concerned to ensure that karst gained a measure of protection amid the turmoil. While some contribution towards two small cave reserves is the sum total attributable to the local caving clubs by the most generous observer, probably two or three dozen entire karst areas have been given national park status due to the efforts of others. This degree of success, if that is what it is, is not the result of restrained submission of proposals by concerned citizens to a bureaucratic enuch, but results from the fact that concerned individuals have actively sought out positions of influence, and then worked from those positions with the protection of karst as one of their priorities. The efforts of Greg Middleton, who would be regarded by xenophobic Tasmanians as an interferring mainlander, exemplifies this process. While on the subject of xenophobia, the efforts of the Sydney Speleological Society also deserve to be singled out for praise. The vociferous response of the Tasmanian Nomenclature Board to SSS for having had the temerity to name some Tasmanian caves says much of the peculiarities of the Tasmanian ethos. I might add that the application of politicians names to the Franklin Caves followed a previous case in N.S.W. - curiously, while the Goolwa Conference of this Federation considered this to be an appropriate tactic for gaining publicity in 1968 it chose to regard it as an inappropriate action when taken in Tasmania for more subtle reasons in 1977. Even as a descendant of two political exiles to Tasmania I could still develop a trace of xenophobia after five generations of isolation and breeding in the ecocide isle. The latest word on this particular subsaga is that alternative names proposed by the Nomenclature Board were resolutely rejected, and the Board has now aceded to those names given to the Franklin caves by the Tasmanian Aboriginal Centre. Fraser has become Kutikina, meaning spirit. It remains to be seen whether the state and national government will succeed in their bid to destroy the spirit of the Tasmanian aborigines as effectively as they destroyed the society of those original Tasmanians whose home they have over-run.

BIBLIOGRAPHY

Australia 1982. Report of the Senate Select Committee on South West Tasmania. AGPS.

Bayly, I.A.E., Lake, P.S., Swain, R. & Tyler, P.A., (1972) Lake Pedder. Its importance to biological science. pp. 41-49 in Pedder Papers. A.C.F.

Goede, A. 1968. Underground stream capture at Ida Bay, Tasmania, and the relevance of cold climatic conditions. Austr. Geogr. Studs. 7, 41-48.

Goede, A., Kiernan, K., Skinner, A. & Woolhouse, R. 1973. Caves of Tasmania. xerox.

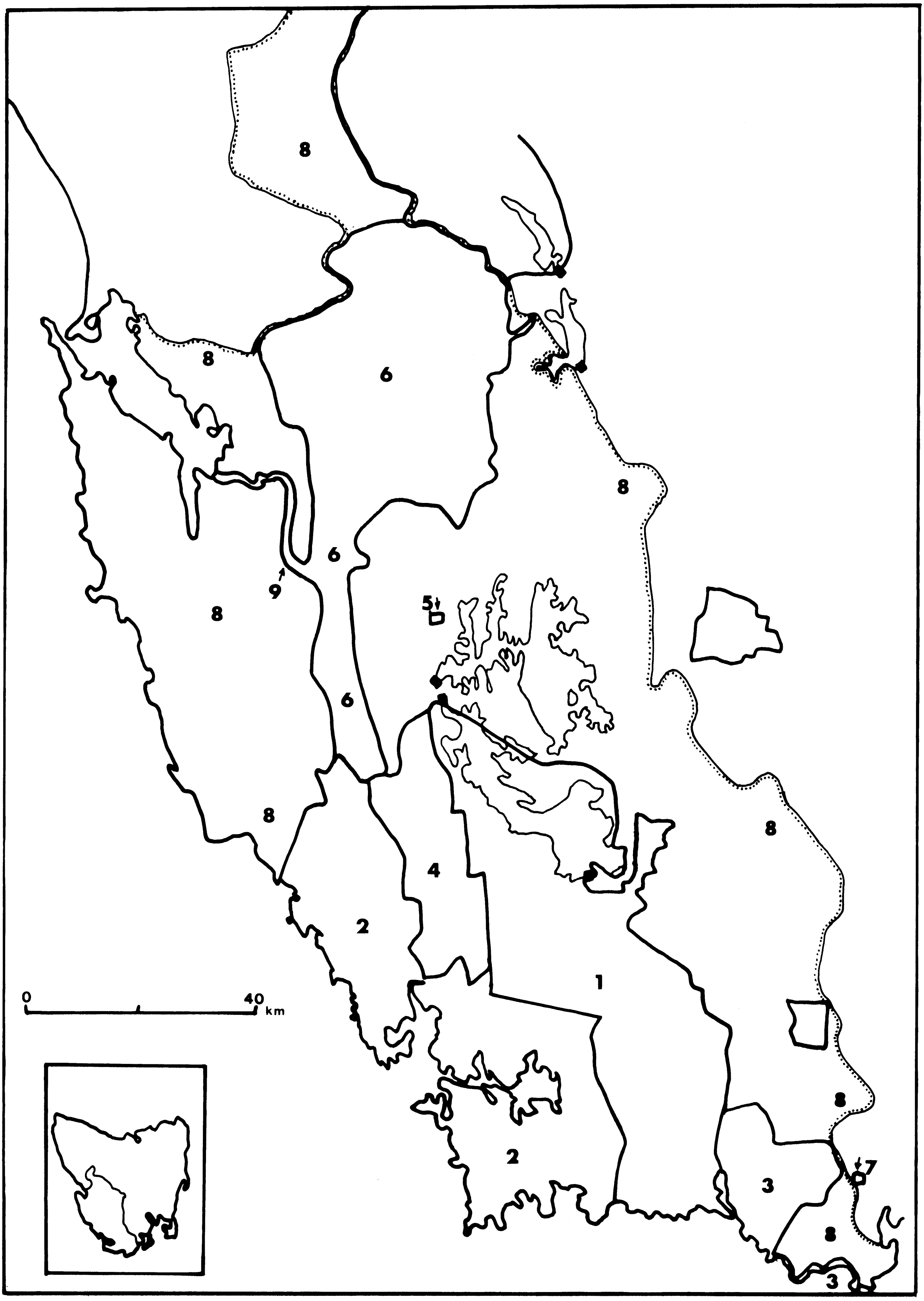
Harris, S. 1967. The South West. South Cav. 1(2), 7-8. this vol.

Harris, S. & Kiernan, K. 1971. Cave conservation and Tasmania. South Cav. 3(2), 13-25.

Hawkins, R., Kiernan, K & Middleton, G. 1974. Reconnaissance trip to limestone areas on the Gordon and Franklin rivers in south west Tasmania. J. Syd. Speleo. Soc. 18(7), 177-195.

Jones, R. 1981. Submission to the Senate Select Committee on S.W. Tasmania. Hansard 19 March, 1982, reprinted in Australian Archaeology 14, 96-106.

Figure 2: National Parks and Conservation Areas, 1981 with existing hydro-electric dams.



Kiernan, K. 1971. The Descent of Tassy Pot. Aust. Speleol. Fed. Nl. 6, (March 1971).

1971 b. Khazad-Dûm expedition. South. Cav. 3(1), 6-9.

1972. An Historic Descent. South Cav. 3(3), 6-8. Reprinted pp. 34-36 in D.S. Gilleson (ed.) Australian Speleology 1973. A.S.F.

1974. Conservation and the Gordon River. Aust. Speleol. Fed. Nl. 64, 3-7.

1974. A critical examination of Tasmania's cave reserves. South. Cav. 6(2), 3-25.

1975a. The case for Precipitous Bluff. South. Cav. 7(2) 2-29.

1975b. Gordon River expedition 1974-75. South. Cav. 6(3) 2-6.

1976. Caves of the wild western rivers. J. Tas. Wild. Soc. 4, 14-17.

1977a. Eulogy for the Franklin. South. Cav. 8(4) 2-6.

1977b. The Lower Gordon River State Reserve. Tae. Cons. Trust. Nl. 69, 3-7.

1978a. Caving pp. 156-159 in H. Gee and J. Fenton (eds.) The South West Book A.C.F. Melb.

1978b. Notes from a Franklin River diary. South. Cav. 10(1), 9-13.

1979. Limestone and dolomite in and adjacent to the King and Lower Gordon basins, south-west Tasmania: an inventory and nomenclature. J. Syd. Speleol. Soc. 23(8), 189-204.

1980. The HEC and its Western Rivers cave study. South. Cav. 12(2), 24-33.

1981a. Of dams and dolomite : the Scotts Peak area, south western Tasmania. J. Syd. Speleol. Soc. 25(9), 165-175.

1981 b. Days in a wilderness. South. Cav. 12(4), 72-78.

Kiernan, K. 1981c. Landform Evolution and Anthropogenic Geomorphology in the Lower Franklin River Valley, South Western Tasmania. Unpub. rep. to NP&WS (T), 84 pp.

1982. The exciting, lonely, damp, dirty world of caves. Saturday Evening Mercury 22 May '82, 24 and 49.
this vol.

Kiernan, K. Jones, R & Ranson, D. 1983. New evidence from Fraser Cave for glacial age man in south west Tasmania. Nature 301, 28-32.

Koolhof, F., 1974. Rafting down the Franklin. The Tasmanian Tramp 21, 97-107.

Lewin, R. 1982. Tasmanian ice age sites threatened by dam. Science 218, 988.

McKenry, K. 1972. A History and critical analysis of the Lake Pedder controversy. Pedder Papers A.C.F.

Middleton, G. 1977. Sydney Speleological Society Gordon-Franklin Expedition 1976. J. Syd. Speleol. Soc. 23(3), 51-91.

1978. Caves of the Lower Franklin River, in H. Gee (ed.) The Franklin : Tasmania's Last Wild River, TWS.

1979. Wilderness Caves of the Gordon-Franklin River Systems. Envir. Stud. Cent., Univ. of Tasm.

1980a. Franklin River (Rubber Ducky) Expedition 1975. J. Syd. Speleol. Soc. 24(3), 53-75.

1980b. Franklin Cave (F1) visited and surveyed. J. Syd. Speleol. Soc. 24(8), 177-182.

1982. Lower Gordon River archaeological expedition 1981. J. Syd. Speleol. Soc. 26(1), 3-14.

Middleton, G. & Montgomery, N. 1973. Southern Caving Society Precipitous Bluff Expedition 1973. J. Syd. Speleol. Soc. 17(7), 185-212.

Middleton, G. & Sefton, A. 1975. Sydney Speleological Society Gordon-Franklin Expedition 1974-75. J. Syd. Speleol. Soc. 19(11), 271-291.

Morley, J. 1971. Limestone at Franklin River. South. Cav. 3(1), 10.

Naqvi, I.H., 1979. Cave survey. HEC Geol. Rep. 64-91-9.

Tasmania 1967. Tasmanian Year Book 1967.

Davey, A., Fisher, C. & Radcliffe, P. 1973. An expedition to Precipitous Bluff. Spar 24, 9-33, UNSWSS.

Wessing, P. 1978. The Precipitous Bluff Case, pp. 263-265 in H. Gee & J. Fenton (eds.) The South West Book. ACF.

FIGURE CAPTIONS

Figure 1: Limestone and dolomite outcrops in south-west Tasmania. Parks and reserves proclaimed prior to 1970 and two extension proposals of the mid 1970s are superimposed.

Rivers: C = Cracroft; D = Denison; F = Franklin; G = Gordon; H = Huon; O = Olga; S = Serpentine; W = Weld

Parks and Reserves: 1 Lake Pedder NP; 2 Port Davey Scenic Reserve; 3 Hartz Mtns NP; 4 Mt. Field NP; 5 Lower Gordon River Scenic Reserve; 6 Frenchmans Cap NP; 7 Lyell Highway Scenic Reserve; 8 Cradle Mtn-Lake St. Clair NP; 9 South West Fauna District; 10 South West Committee NP proposal; 11 United Tasmania Group NP proposal; 12 UTG extension area.

Figure 2: National Parks and Conservation Areas, 1981 with existing hydro-electric dams.

1 "South West National Park" (Lake Pedder NP, 1968); 2 Port Davey Extension (1976); 3 Precipitous Bluff and Southern Ranges Extension (1976); 4 Davey River Extension (1981); 5 Truchanas Huon Pine Reserve (1970); 6 Franklin-Lower Gordon Wild Rivers National Park (1981); 7 Exit Cave State Reserve (1979); 8 South-West Conservation Area (1980); 9 Proposed Gordon-below-Franklin damsite.

DROVERS CAVE, WESTERN AUSTRALIA

Cave Destruction through Management

by

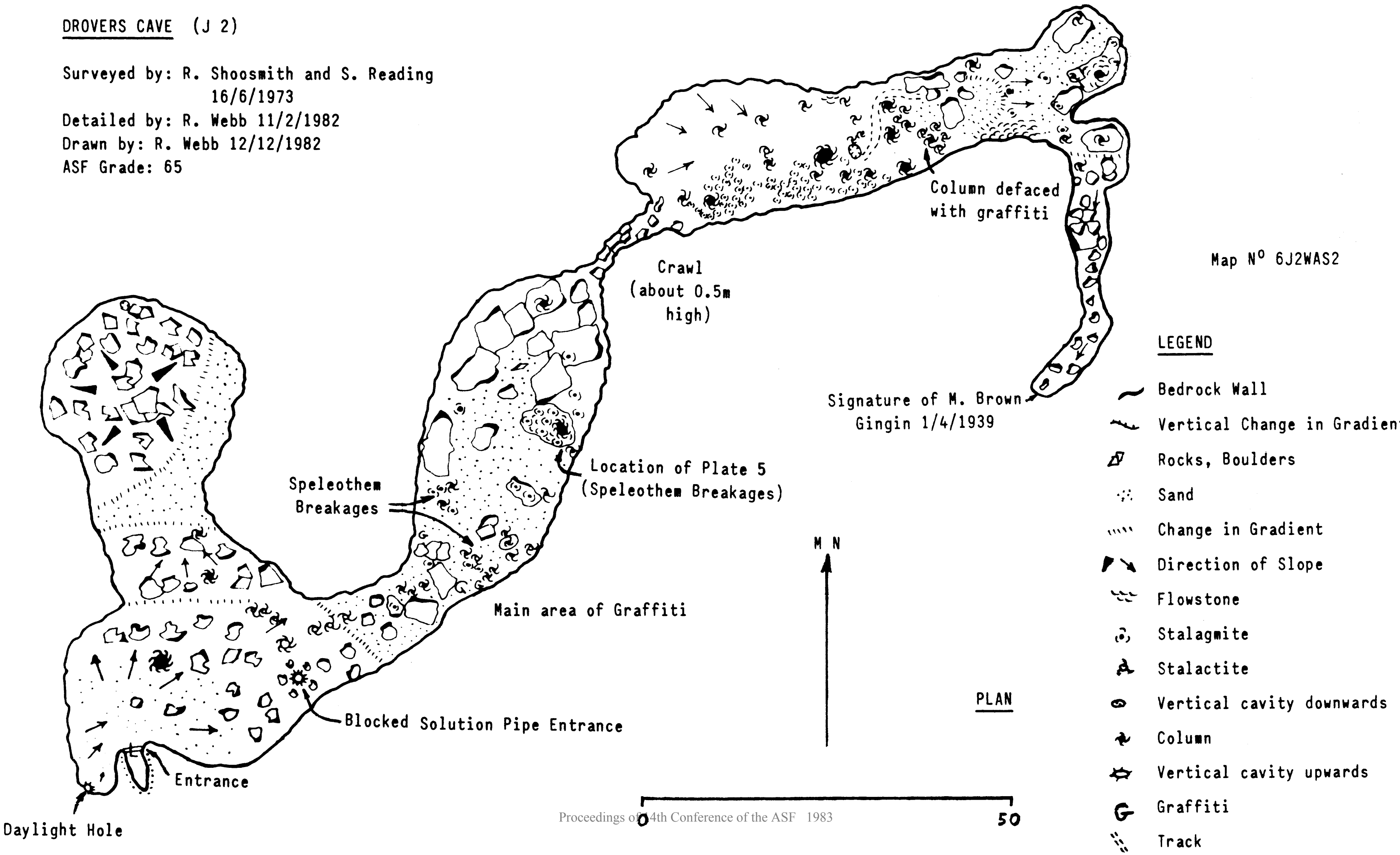
Rauleigh Webb

W.A.S.G.

Many factors lead to the gross vandalism of Drovers Cave. Several management strategies are proposed which may avoid or reduce vandalism from these causes.

The managerial decisions which probably contributed to the vandalism of Drovers Cave are discussed with respect to other caves which may be befalling a similar fate.

Figure 1.



DROVERS CAVE (J 2)
Surveyed by: R. Shoosmith and S. Reading 16/6/1973
Detailed by: R. Webb 11/2/1982
Drawn by: R. Webb 12/12/1982
ASF Grade: 65
Map Nº 6J2WAS2
Column defaced with graffiti
Crawl (about 0.5m high)
Signature of M. Brown Gingin 1/4/1939
Speleothem Breakages
Location of Plate 5 (Speleothem Breakages)
Main area of Graffiti
Blocked Solution Pipe Entrance
Entrance
Daylight Hole
M N
PLAN
0
50
LEGEND
Bedrock Wall
Vertical Change in Gradient
Rocks, Boulders
Sand
Change in Gradient
Direction of Slope
Flowstone
Stalagmite
Stalactite
Vertical cavity downwards
Column
Vertical cavity upwards
Graffiti
Track

INTRODUCTION

Drovers Cave (J2) is situated in the Drovers Cave National Park about 5km east of Jurien Bay in Western Australia. The cave has suffered extensively at the hands of vandals over a long period and the current management policies offer little hope of this vandalism being curtailed.

I wish to examine here a short history of the cave with respect to the cave's management and then propose a management strategy that would have and hopefully will reduce vandalism in the cave.

A BRIEF HISTORY

The cave was well known to early explorers and stockmen. Its proximity to the Canning Stock Route meant that it was visited by drovers and hence the name.

Several old signatures on one of the cave walls may be genuine. For example, Plate 1 shows the signature of one J.W. Hacket with the date 1886. The authenticity of the signature may be checked by consulting old records of that period. The majority of visits by stockmen appear to have been in the 1930 - 1940 period if the dates associated with the graffiti in the cave are to be believed.

The ability of early explorers is clearly indicated by the signature of one M. Brown - Gingin 1/4/1939 at the end of the presently known cave (see Figure 1). Trips were made to the cave by members of the Western Australian Speleological Group (W.A.S.G.) in the early 1960's. Bain (1960) gives a good description of the cave including an extension that does not appear on the map of the cave shown in Figure 1. He also mentions the existance of a small bat colony in the cave. Another report by Cook (1962) describes the cave as having "two entrances - a shaft in the roof of the first cavern and a walk-in entrance". He also mentions the sighting of a bat colony in the cave.

The cave was surveyed by Bob Shoosmith and Stan Reading in June, 1973. Their plan view of the cave was re-detailed by the author in December, 1982 and this plan appears in Figure 1.

The National Parks Authority (N.P.A.) file on Drovers Cave records the following major events in the caves recent history.

The cave was broken into again in January, 1971. This was reported by the then Ranger in charge of Nambung National Park, Alf Passfield. It was probably locked in 1969 although this has not been ascertained with certainty. An area of 2680 ha is reserved around Drovers Cave and the area was vested in the N.P.A. as a Class C reserve in May, 1972. The name Drovers Cave National Park was proposed in February, 1973 and gazetted in March, 1973 despite objections by the W.A.S.G.

The Conservation through Reserves Committee report of 1975 states "Drovers Cave has potential for development as a tourist site, due largely to spectacular stalactite formations." They recommended that the reserve status should be altered from C Class to A Class. This recommendation was adopted and in January 1978 the reserve was changed to A Class.

In 1976 mineral claims were sought in the National Park. The then Minister for Conservation and Environment, Mr. P.V. Jones, stated "at this stage on all the evidence available to the Department (Conservation and Environment), and to myself, it would not be our intention to support any objection." The Director of the N.P.A. objected to the mining claim in Drovers Cave National Park and in the Wardens court in March, 1976 his appeal was upheld.

Later that year the ranger R. Harris stated in a letter to head office that he had "a major problem with vandals in the area, particularly with Drovers Cave itself."

Attempts by the Cave Working Group in W.A. to change the name of the Drovers Cave National Park to Drovers National Park are thwarted by the Surveyor General who says "the idea does not have merit".

In September, 1982 the N.P.A. objected to exploration permits to search for coal beneath Drovers Cave National Park. Finally, in December 1982 the N.P.A. approved the conducting of educational tours in Drovers Cave by a local resident of Jurien Bay. A series of conditions are placed upon these tours.

VANDALISM

The vandalism in the cave falls into two categories : graffiti on walls and speleothems; and speleothem breakage. The graffiti has accumulated over a long time. The oldest dated signature known in the cave is that of "Hacket, 1886" shown in Plate 1. Other signatures are dates 1896. Several early 1900's signatures occur but then there appears to be a break until the late 1930's when a spate of signatures appears. Also several of the "drawings" in the cave appear to be from this period as indicated by the "drover" pictured in Plate 2.

A vast majority of the graffiti is undated and hence when it occurred cannot be determined. However some of the recent signatures are dated 1970 and 1971, an example is shown in Plate 3. These signatures occurred after the gate was placed on the cave. Some of the worst graffiti, shown in Plate 4, is the use of red paint to write names on the cave wall. This gross act is known to have occurred between 1965 and 1973 - no more accurate timing can be placed on the act due to the relatively low visitation rate of speleologists to the cave.

The map of the cave, Figure 1, indicates the major areas of graffiti and also speleothem breakage. Speleothem breakage and removal is prevalent in the main chamber prior to the crawl. Plate 5 shows a particularly bad area of speleothem breakage. Within two metres of the person in the photograph, over 50 major speleothem were found to have been broken. The floor of the cave is relatively free of broken formation and hence one assumes that the majority of breakages occurred for the collection of a variety of speleothems. As indicated by Figure 1 the majority of the speleothem breakage occurs before the low crawl. This obstacle has deterred the main would-be vandals and as a result the speleothem displays past the crawl contain few breakages. One column has been badly defaced by graffiti but this is the only major damage in this area.

Drovers Cave is by far the most highly decorated cave in this area. In fact speleothem development is almost totally absent from other caves of the region with the exception of a small area of recently discovered development in Old River Cave (J7). Hence the preservation of the speleothems that are still intact in Drovers Cave is of high priority.

PAST AND PRESENT MANAGEMENT

In 1969 the cave was gated by the N.P.A., which was in itself a major act of vandalism. It not only defaced the cave entrances by almost completely blocking the solution pipe entrance but also made the walk-in entrance unrecognisable. This left the entrance area and surrounds covered in cement and devoid of foliage. Also the gate placed on the cave only had a hand hole in it. As a result the bat population in the cave either died or escaped via this hole - never to return! The ecosystem built up around the bat population was also devastated.

As indicated in the caves history the area was made a National Park and named Drovers Cave National Park. This attracted attention to the area in general and the cave in particular. Signs were erected on the main road telling passers-by that this area was Drovers Cave National Park. Hence Drovers Cave must be in there somewhere! So quite a number ventured in down the main 4WD track into the park. The first feature, 5 metres off this track, that you notice is a barren area with exposed caprock and cement!

Consequently the number of times the lock has been cut, blown or shot off cannot be estimated but it is well into double figures. Although the N.P.A. have Drovers Cave National Park under their control the active management that it receives is almost negligible. The ranger in charge of the park is stationed at Nambung National Park 50 km to the south and he visits the cave and/or the park infrequently.

For example the cave had no lock on the gate for at least four months of 1982. When it was finally replaced it was "removed" within two weeks. I wish to categorically state that I do not believe that this lack of active management is a result of policy decisions within the N.P.A. but rather the result of a lack of funding for the N.P.A. which severely restricts its ability to deploy rangers within the National Parks under its control. Consequently many National Parks in W.A. remain unmanaged or severly undermanaged and unless the government changes its policy with respect to the financing of the N.P.A. this situation is only likely to worsen as more areas of the state are declared National Parks. However, the managing authority has made some crucial "mistakes" in its management of Drovers Cave to date. These have been:

1. Locking the cave without thought to the bat population.
2. Destruction of the natural entrances and hence causing unknown alterations to the cave meteorology.
3. Naming the National Park - Drovers Cave National Park and hence attracting undue attention to a cave without active management or the likelihood of getting it.
4. Poor gate design to protect the lock and hence reduce the number of break-ins.
5. Destruction of the vegetation surrounding the entrances.
6. Placement of the major access track to the park within 5 metres of the cave entrance.
7. Placement of signs on the major access road indicating this is Drovers Cave National Park.

The effects of these managerial "mistakes" are fairly clear within the cave today in the form of vandalism and graffiti. Fortunately several of these "mistakes" are not irreversible but for the cave to have a secure future they must be corrected.

FUTURE MANAGEMENT

At this point I should remind readers of the Conservation through Reserves Committee quote that "Drovers Cave has potential for development as a tourist site, due largely to spectacular stalactite formations". In a paper outlining the future tourist caves of the South West of W.A. (Webb, 1982) no mention is made of Drovers Cave. The reason is that the vandalism of the speleothems in the cave has completely removed the possibility of the cave ever being developed for tourism. The future user group for the cave is initially likely to remain speleologists but if the proposed plan outlined below is carried out then the future may hold a more diverse outlook.

Several of the "mistakes" noted above can be rectified by the adoption of a plan which I call the "Big Re". This plan is in two parts - the immediate future and then the long term aims. This plan effectively reverses several of the "mistakes" made by the N.P.A., and then allows for the management of the cave as a wild cave.

THE "BIG RE"

Short Term

1. Redesign the gate to protect the lock.
2. Revegetate the area surrounding the cave entrances.
3. Relocate the access track away from the cave entrance.
4. Replace the Drovers Cave National Park signs with signs saying National Park.

Long Term

5. Restore the cave by the Removal or coverage of as much graffiti as possible.
6. Rename the National Park to Reduce public pressure on the cave.
7. Recommence negotiations with the appropriate authorities to Remove the cave name from maps available to the general public.
8. Re-evaluate the need to gate the cave and if appropriate -

   REMOVE THE GATE!

This eight point plan has far reaching implications, not only for Drovers Cave but also for other caves in a similar situation. I will consider the long term aspects in some detail as the short term points are self explanatory.

RESTORATION IN THE CAVE

Cave restoration is not an easy process and one that requires considerable thought and patience in its implementation. The speleothems in the cave have been irrepairably damaged and no restorative efforts will improve their condition. However a great deal of the graffiti in the cave can be removed or covered.

Plate 1 - The oldest signature found in Drovers Cave.

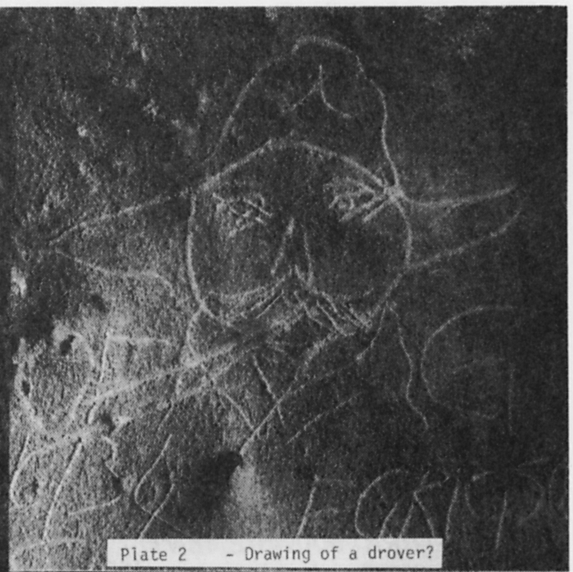


Plate 2 - Drawing of a drover?

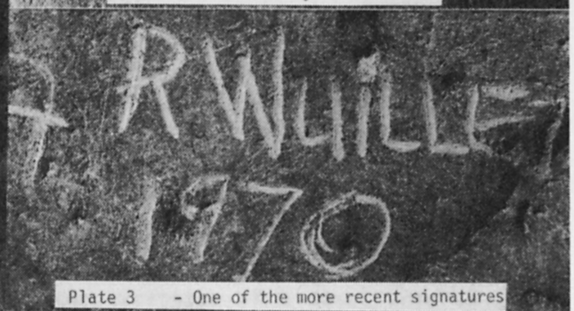


Plate 3 - One of the more recent signatures

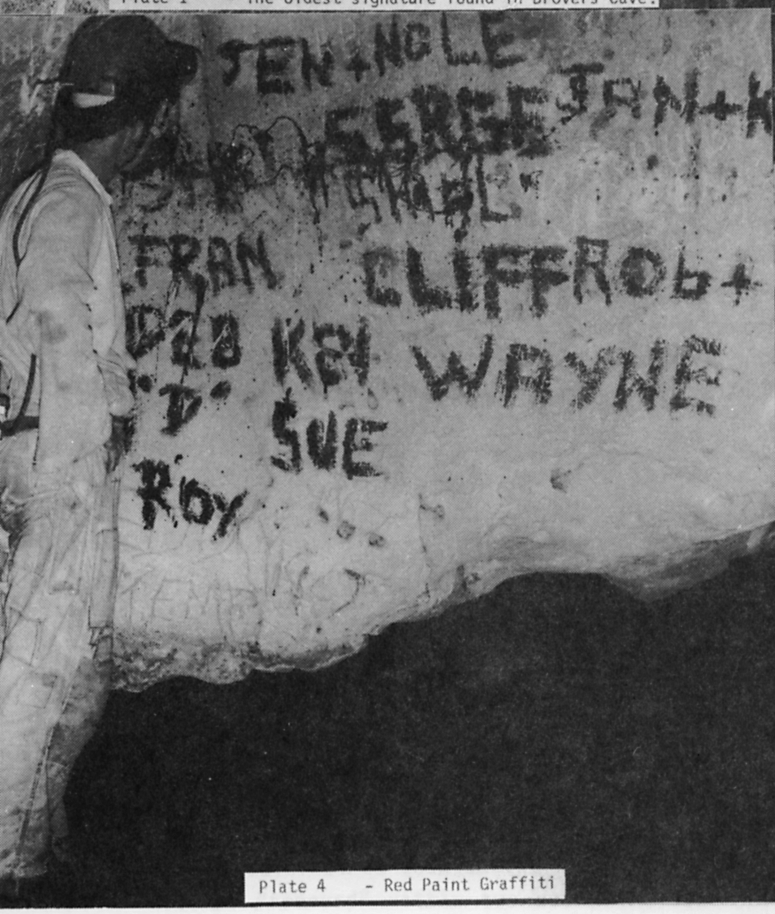


Plate 4 - Red Paint Graffiti

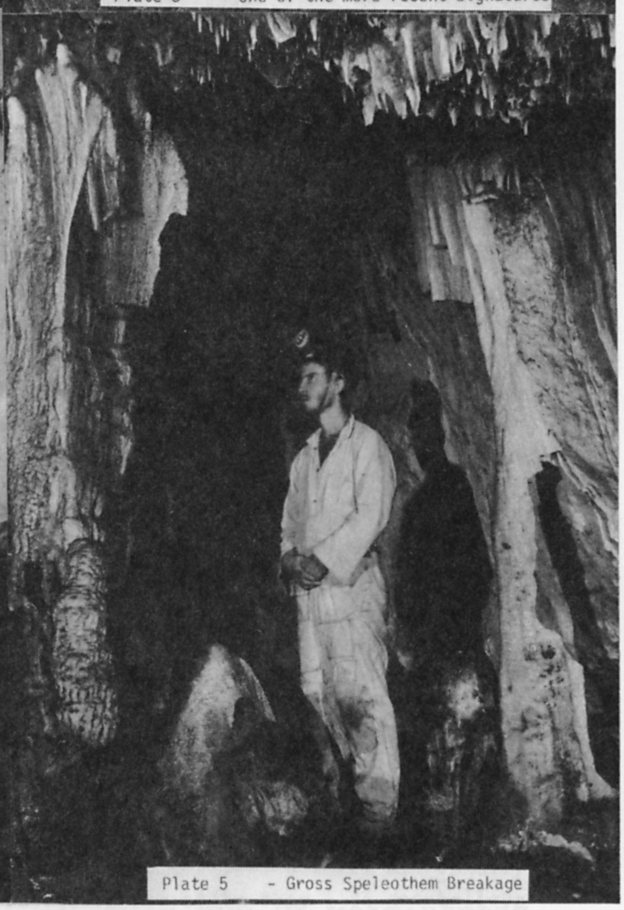


Plate 5 - Gross Speleothem Breakage

The graffiti that is on the surface of the walls such as pencil or charcoal can be removed with a wire brush without further significant defacing of the cave walls. Graffiti that is carved into the walls can also be removed depending on the depth of the engravings. Some of these engravings are too deep to remove as they would result in unsightly "holes" in the cave walls.

The red paint that has been used in the cave (see Plate 4) can not be removed as it has been absorbed into the limestone during its application and hence any attempt to remove it would result in severe defacing of the cave wall. The alternative is to cover the red paint with a water based white-cream paint that matches as closely as possible the "colour" of the cave wall. This you may claim is a further act of vandalism but consider that we are trying to achieve, by any restorative work in the cave, the reduction of the possibility of further gross acts of vandalism. The disguising of the worst acts of vandalism in the cave can only assist in reducing the probability of such an act occurring again by removing the "....but the cave is already stuffed so what will some more matter...." syndrome.

RENAME THE NATIONAL PARK

This is a difficult action as the Cave Working Group (W.A.) found when it recommended to the Surveyor General that the name of Drovers Cave National Park should be changed to reduce the pressure on the cave. This recommendation was quashed by the Surveyor General who considered that the proposal "did not have merit". Such a rejection is disconcerting considering the combined expertise of the members of the Cave Working Group with respect to cave management. However if public pressure is to be removed from Drovers Cave then government authorities must be convinced that the naming of a National Park or Conservation Reserve after <u>any</u> highly susceptible natural feature may be aiding in the destruction of the very thing they are trying to preserve! This is particularly pertinent if the National Park or Conservation Reserve is vested with a managing authority who, for whatever reason, are unable to actively manage the site in question.

This may well be the case with proposed National Parks in the Nullarbor region of W.A. The N.P.A. has <u>no</u> possibility, under their present funding arrangements, of establishing a ranger in this area and so the declaration of National Parks in this region will only draw undue attention to sensitive caves with little or no management. Hence the action of naming a National Park after a particular cave is one which must be given <u>exceptional consideration</u> before it is undertaken.

The job of convincing government authorities is unlikely to be a sinecure but one which must be tackled immediately.

REMOVAL OF CAVE NAMES FROM PUBLIC MAPS

The placement of a cave's name and a symbol indicating its location on a map available to the general public may play a significant role in the visitation rate to that cave. Any reduction in the visitation rate to caves of a fragile nature can only reduce the probability of cave vandalism. A complete outline of the intricacies of this problem are given by Webb (1983) for the W.A. situation and so will not be discussed at length here. However it must be said that the removal of a cave's name from a public map will definitely assist the conservation of that cave. This is certainly the case with Drovers Cave due to its proximity to major access roads. As with the previous point convincing the appropriate authorities, that removing the cave names from public maps will greatly assist in the conservation of the cave resource, will be an onerous task but one that is vital for cave conservation in future years.

RE-EVALUATE THE NEED TO GATE THE CAVE

This step should be taken <u>only</u> after the other seven proposals have been accomplished. At present the <u>only</u> managerial tool that is being used to protect Drovers Cave is the "locked" gate. This is proving to be a costly and time consuming method as the lock is continually being removed.

After the implementation of the first seven points of the plan then the need to maintain the gate on the cave should be reassessed. With the proposed passive management plan in effect the need to gate the cave may no longer be a necessary managerial tool. Given responsibility the general public may be able to visit the cave as a wild cave. Hamilton-Smith (1977) expresses the opinion that - "If we treat people as hooligans, it merely increases the likelihood that they will behave as hooligans. If we treat people as responsible individuals it increases the likelihood that they will behave responsibily."

If this philosophy is accepted then the removal of the gate may be the best long term strategy. However this must be assessed once the remainder of the management plan is in effect.

OTHER CAVES

Given that a great deal of the proposed management plan for Drovers Cave is a general strategy then the possibility of extending the ideas expressed within the plan to assist other caves in the same or a similar situation is highly feasible. As a general factor affecting all caves whose names appear on a public map, it is desirable that, on an Australian wide basis these names are removed. This policy must be conveyed to the National Mapping authority as well as the various State authorities.

In general I would ask all speleologists to consider my general points seriously and if they consider that these or other factors are adversely affecting caves within their State that they strongly convey their ideas to the appropriate managing authority or government department.

CONCLUSION

I must finish by saying that I'm not one for excluding people from National Parks, on the contrary. However I hope that I have illustrated here that unless special management considerations are given to caves they can certainly suffer due to poor management practices.

Hence if a manager's presence is not felt within a park then, I believe, that the general public will not respect the cave environment for what it truly is - a sometimes fragile, always non-renewable resource.

ACKNOWLEDGEMENTS

The assistance in the field of Chris Goodsell and Rinaldo Cassol is greatly acknowledged, as well as the assistance of Wayne Taylor of the National Parks Authority. I would also like to thank Bob Shoosmith for consenting to the reproduction of his survey of Drovers Cave. I must also thank the National Parks Authority for providing information regarding Drovers Cave.

REFERENCES

Bain, T. (1960) 'Jurien Bay Caves', The Western Caver 12(6) 193-195

Cook, D.L. (1962) 'Jurien Bay Caves', The Western Caver 2(2) 14-15

Hamilton-Smith, E. (1977) 'Is vandalism really necessary', in Cave Management in Australia II, G.J. Middleton (ed.) A.S.F. Hobart, Tasmania.

Webb, R, (1982) 'Wild Cave Management in the South West of Western Australia - Our Future Tourist Caves', in Cave Management in Australia IV. J.R. Watson (Ed.) N.P.A. and A.S.F., Yallingup, Western Australia.

Webb, R. (1983) 'The Removal of Cave Names from Public Maps - A Sound Management Practice', to be presented to the Fifth Australian Conference on Cave Tourism and Management, Buchan, Victoria.

KUBLA KHAN CAVE - MOLE CREEK

An Attainable Goal for Visitor Proofing and Restoration Work

by

Henry Shannon

U.Q.S.S.

The main damage in Kubla Khan Cave is in the tracking of mud over originally clean flowstone in the upper levels. The source of the mud is mainly in some short sections of mud floored cave linking longer sections with continuous travertine floor. It is proposed to construct an elevated track over the natural mud areas, to be made of a non-corrosive steel mesh which is obtainable locally. Once the mud source is isolated, volunteers with scrubbing brushes can work on the damaged areas with reason to hope for a permanent improvement in the cave as the reward for the effort involved.

The inadequacy of gating and access restriction as an approach to protecting the cave is discussed in terms of the cave's past history, and some criticism is made of the philosophy behind this approach.

Kubla Khan Cave at Mole Creek, Tasmania, possesses a reputation as the ultimate decorated cave in Australia, and because of this reputation it gets a special type of visitor pressure. People who want to visit the cave want it badly, and will not be deterred by legal and physical obstacles to their entry so long as its reputation as something extra special lasts. Obstacles such as locked gates have been tried for the upper entrance on several occasions, but the locks have never lasted for long. The popular myth in Tasmanian caverneering circles is that a lock on Kubla Khan has a life expectancy of three weeks.

Both the entrances require vertical caving techniques so those visiting the cave are technically competent if lacking in care in the matter of tracking mud over flowstones. The nature of the damage occurring is what one expects from the rougher edges of Australian caving - virtually no deliberate breakage, the odd broken travertine formation in vulnerable spots, but lots of mud on originally virgin flowstone.

The common approach of official cave controlling authorities in Australia has been to restrict access to decorated caves by a permit system, and it is possible that some such arrangement may be imposed now that there is a Kubla Khan Cave State Reserve. However this approach is not likely to keep out a fringe visitor determined on the caving experience of a lifetime, arriving on the spot and faced with what is probably his once only chance to do the trip. Furthermore, the cave is in easy reach of a public road and is remote from the two tourist caves, where the staff which would be responsible for policing the area are based. The cave areas where permit access restrictions have been technically successful have had access routes that are easily supervised, and a visitor population captive through interest in repeated visits to the area.

In any case, there are ethically dubious aspects to the access restriction approach; it is always in danger of edging into hostility to the cave using public and may be less a means of rationally utilizing the cave, and more a substitute for a real conservation policy. Access restrictions tend to restrict access to organized conforming bodies plus outright pirates, and exclude a middle ground of bona fide but less formal potential visitors less good at paperwork. Particularly if a notice provision is included, it becomes possible to leave people seething with a sense of injustice on being unexpectedly excluded. Harm may come to the cave because the access bottleneck produces larger parties, which always seem to do worse than two trips of half the size.

The administering authorities can develop a resentment of cavers simply because they become a source of extra work. And at the end, does a party with a permit really smear much less mud around the cave than a party without one?

Fortunately for cavers the matter is not in our hands, except for some temptation to play sycophant. It is proper for us to think rather in terms of doing some work on our own account, inside the cave, than can effectively armour the cave against unintentional visitor damage. Track marking and guidance signs are a start, but I contend that the real situation in Kubla is like the situation on the Overland track, where people have gone around the edges of boggy spots so that the bogs are now 10 metres wide, and restoration work has begun by placing boardwalks across the bogs. We should look on the rest of the caving public as potential friends who would do the right thing if gently coaxed along, but must address ourselves to the central problem - that of mud tracking and to bear in mind that the cave must cope with the kind of visitor who is not up to our ideal standard of care. It can be assumed that they won't deliberately break anything, but it will not occur to them that they should always be judging where they put hands and feet.

So a form of fully defined track is needed. From time to time the comment comes up at A.S.F. Conferences that tourist caves are the best conserved caves in Australia, with the counter argument that tourist development itself is the greatest damage, and often tourist tracks are a defacement equivalent in area to wall to wall grafitti. But a track once in does protect the remainder of the cave.

I think a compromise is possible. A track which maintains far more wilderness character than a tourist track allows for, but which is just as effective in protecting off track areas.

To find what is needed and what is possible it is necessary to look over the usual route through the cave looking at the problems rather than the pretties and specifically how the mud got where it shouldn't be.

Trips starting from the lower entrance normally head for the Pleasure Dome, with its enormous area of clean orange flowstone. Very few visitors do not observe the boots off and clean gear rule (now stated in a sign). But muddy footprints appear from time to time. But as the flowstone is subject to seasonal flushing, supplemented by a few volunteers known to bring a scrubbing brush and fill up a bash hat with water from the River Alph, the area is holding out quite well. The main problem is the changing area itself which could benefit from a grating to bridge the mud to the river.

Less often, the lower entrance is used for the start of a through trip. This involves scaling a wall which is usually done by a skilled climber who takes up a ladder for use by the rest of the party. The passages through to the Great Khan are muddy and cavers arriving are muddier than those who came in the top way.

As a suggestion then, through trips should be run from the top entrance and should miss out on the Pleasure Dome unless clean gear can be contrived.

Trips from the Top Hole entrance must pass the squeeze where the various attempts at locking have taken place. The strong, erratic draught is very noticeable. It would be possible to put a sealed door at this point if it is deemed desirable to restrict moisture loss from the cave (most discoverers note that caves appear to dry out after they become frequently visited, thus a correction is needed if the apparent original state is to be maintained. On the other hand if moisture and permanently wet flowstone area is increased there is a greater problem with bonded mud on flowstone).

From the squeeze the cave goes down by three pitches which require vertical caving gear. The natural belays are fairly reasonable except on the last pitch, where wall bolts could be used to establish a route where less of the formation would be trodden on. It is all floored with reasonable dry flowstone. From the foot of the pitch another drop goes down to a cavern with four pools, which could be used as a people cleaning area before going on into the rest of the cave. The normal route is a climb over damp to dry travertine and this type of going is typical of most of the cave from here on. The caving is technically quite difficult. Until I saw the cave myself I did not understand why the locals do it with boots on. There is a great deal of mud tracking, but it is amazing to find that only two smallish sections of mud floor between here and the Great Khan area, plus the branch leading to the Dulcimer via the dug tunnel, are the sources of practically all the mud. Mud from the Great Khan area itself is responsible for messing up the flowstone fed from the Jade Pool overflow. This is the worst affected area in the cave. The tragedy of Kubla is that for lack of a mud free route over a bare 50m or so of passage, the whole of the flowstone floored area is now muddied up. Still, even the Jade Pool flowstone might be restored with resort to a grinder, as the continuously active nature of the flowstone which is responsible for the mud bonding problem also means it can rebuild itself. The rest of the flowstones merely require scrubbing brush, water and lots of work, as practically all of it is the non-bonding type.

Just at the end of the section of near-continuous flowstone floor there is another set of pools which could be used to clean up people, boots etc.

The idea I developed during my visit was that if a clean route could be bridged across the mud floored sections, linking up via the flowstones to washing pools at either end, it would then be practicable to clean up the flowstone route with a reasonable prospect of its staying clean. It is only the feeling that it was futile that has deterred cavers from this kind of work. Doubtless perfect restoration won't occur but it should be possible to remove the mud that is loose and being shifted ever further on people's boots.

Some forms of protection which have been used before, e.g. sheet plastic (Silverfrost Cavern, Jenolan) or rubber mats (Buralong Cave, Jenolan) can't generally be used in Kubla Khan because the ground is rough and/or sloping and/or slippery, although plastic sheet might work in the Dulcimer tunnel (At present the Dulcimer tunnel should be off limits). Anything not firmly attached is unsafe and ineffective.

In thinking of tracks for speleologists in caves like Kubla Khan I keep coming back to the ideal of a slightly raised steel mesh type track which ideally should have a floating and sculptural quality about it. In this I am influenced by Elery Hamilton-Smith's lyrical description of the tourist track in Jeita Cave in the Lebanon. This is a curving concrete structure of considerable beauty in its own right, elevated above the cave floor and constraining the tourists by the drop at the edge. An ideal material would be stainless steel, perhaps with a hammock of poly type bagging underneath to catch dirt. Something rotproof and corrosion resistant is essential. The attachment of the path to the ground has to be firm enough to make it safe, but ideally should provide little disturbance of the ground. This is one advantage of the elevated type of track since the support trestles touch the ground at only a few points, and if ideas change in the future the apparatus can be removed leaving little damage behind it. However, I do not think it possible to make a path over rough ground safe without some holes drilled into rocks with bolts placed and guys tensioned up with for example rigging screws, in the way a mast is held up by the shrouds on a small sailboat. In soft ground, driver rods and base plates would be substituted.

I used to dismiss the idea of stainless steel mesh as a pipe dream because stainless steel was expensive, but it happens that a form of stainless steel mesh in 1.5 x 0.4m units is available as scrap from the Port Latta pelletizing plant of Savage River Mines at $1.00 a length. It is less than ideal in that the surface is slippery and may need artificial roughening, and its strength is limited so it might have to be used with closer spacing of trestles or used in double layer arrays. But there are enough local welding experts around to cope with this work.

The present concept for the cave restoration and protection work is to go in scrubbing down the cave and construct the bridges across each mud section as each one is reached, meanwhile marking out a clear route in much more detail than it has at the moment. If the mesh track proves a great success it may be extended further than just over the muddy bits. But it is that critical 50 metres that matters most, and if it transforms the situation to the point where a hundred visits to the cave do less damage than one does now, I will be content.

The proposal has been well received by all local caverneers I have spoken to about it, and by the guides at King Solomon's Cave. I have not broached the subject to Tasmanian Government authorities owing to a certain feeling that the government is not to be trusted on any such subject. It is obvious to me that all Australian cavers have a right to be consulted on what is after all a cave of national importance. It is, therefore, essential to test the feeling of the whole country on the matter, which is best done at the national forum provided by the conference. A consensus is needed, and I am not prepared to risk giving offence by proceeding without that consensus.

THOUGHTS FROM A CAVE MANAGER

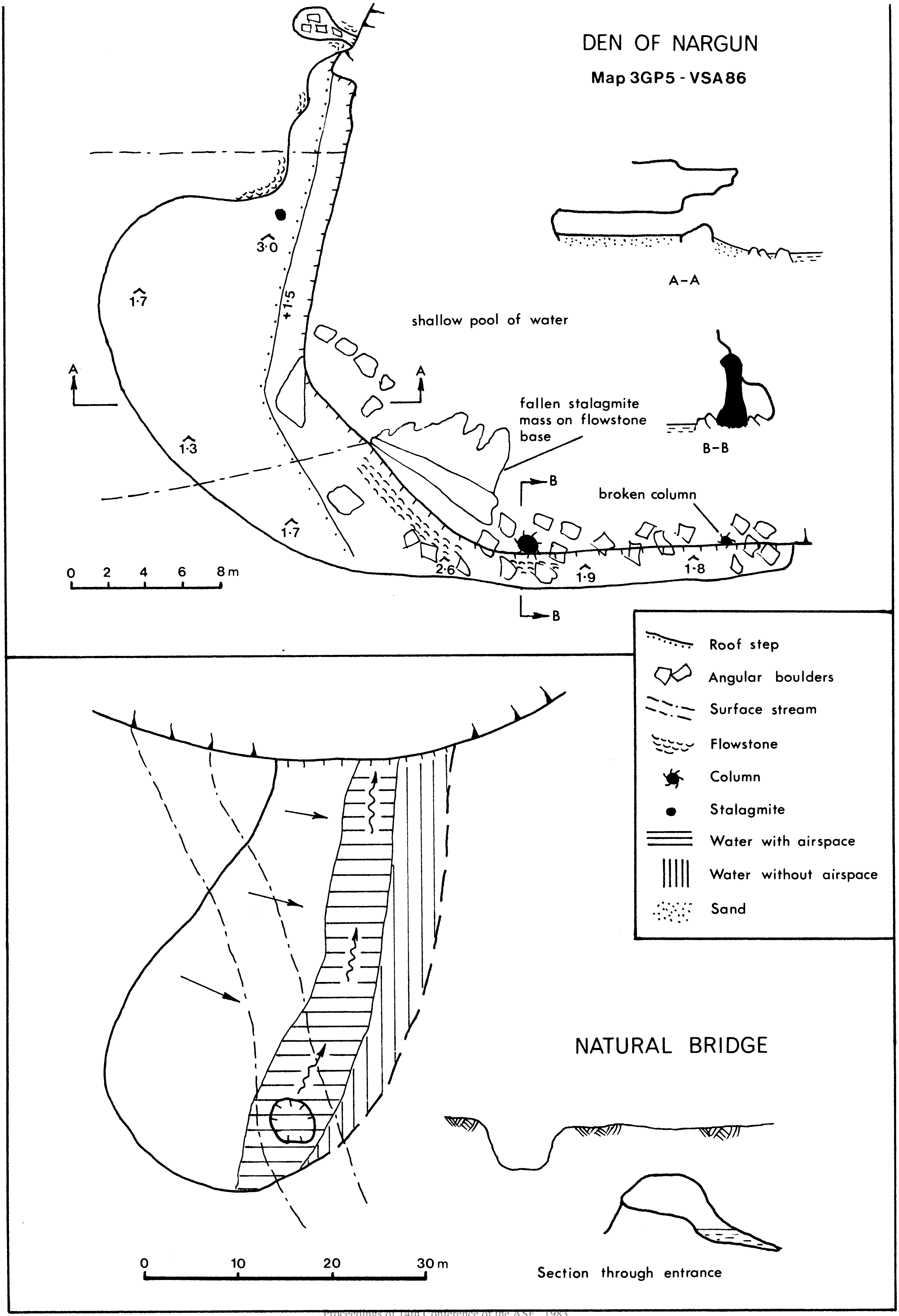
by

Andy Spate

N.W.P.S. (N.S.W.)

This presentation was about the difficulties of being a cave/park manager with the task of creating management plans that satisfy all the requirements of recreation, conservation and science. The task is next to impossible because each propounder considers their major requirement as the dominant theme to be satisfied. Cavers want to cave. Scientists want to observe the cave without interference. Conservationists want caves left alone. The major problem is lack of communication between these groups and that of the body charged with the responsibility of managing the resource. And to prove the point, no paper was submitted for the proceedings. This was prepared at A.S.F. Grade 1.

Graham Pilkington.


DEN OF NARGUN
Map 3GP5 - VSA86
3·0
1·7
+1·5
1·3
1·7
2·6
1·9
1·8
A
A
B
B
shallow pool of water
fallen stalagmite mass on flowstone base
broken column
A–A
B–B
0 2 4 6 8 m
Roof step
Angular boulders
Surface stream
Flowstone
Column
Stalagmite
Water with airspace
Water without airspace
Sand
NATURAL BRIDGE
0 10 20 30 m
Section through entrance

CAVES BEHIND WATERFALLS

Two Examples from Eastern Australia

by

John Webb

Department of Geology, University of Melbourne

Caves behind waterfalls often figure as hiding places in novels, particularly children's books, but are almost never mentioned in the speleological literature.

In eastern Australia there are at least two significant caves that have formed behind waterfalls. The first, Den of Nargun, in East Gippsland, Victoria is a large overhang 10m deep, 25m wide and up to 3m high at the entrance; there is no real dark zone. The roof is a flat-lying bed of resistant sandstone, and the cave has formed by erosion of the underlying crumbly red mudstone.

The second cave, Natural Bridge, is located in southeast Queensland, and consists of a single chamber 46m long, 26m wide and 6m high, with a waterfall cascading through a hole in the roof. It has formed by erosion of a soft, brecciated basalt flow under a harder, more resistant flow. The history of this cave has been complex, involving initial erosion of a small cave behind a waterfall, abandonment of this when the stream migrated, reactivation when the stream broke through the roof, and partial infill by a mudflow, now being eroded. The exceptional size of this cave is the result of two periods of waterfall erosion.

Text taken from audio record of the Conference.

Caves behind waterfalls - you often find mention of them in books and novels, particularly children's novels. In a survey I did of children's novels for this paper, I discovered numerous references to caves behind waterfalls as hiding places - places where dragons, elves and fairies hang out, but in the speleological literature they're almost never mentioned. In fact, you can go through all the common speleological texts and you won't find any mention of caves behind waterfalls.

Why is this? The main reason is that they are mostly just overhangs and it's very rare for you to get a particular condition of formation. In Eastern Australia, during my intensive survey of waterfalls, I've discovered two caves behind waterfalls.

The first is The Den of Nargun. It's in East Gippsland, in a postage-sized national park called Bulga (?) National Park, which was basically declared to protect the cave. The cave is on a tributory of Mitchell River called Dead Cock Creek which for some reason they changed to the more acceptable Woolshed Creek. The National Park is notable apart from the cave, by the fact that the creeks are all deeply incised and you get a remnant rain forest for the contained species that occur - I think it's the southern-most limit for species like the Lilly-Pilly and some ferns.

The cave was first recorded by Howitt in 1876. He did a lot of travelling around Victoria recording bits of geology and he did a traverse along the Mitchell River in 1875 with two Aboriginals. One was called Bungal Bottle (?) which means Old Man Bottle for reasons I'm sure you can imagine, and the other was called Turmile (?) which meant One Who Swaggers. As well as being the first written record of the cave, it also recorded the first vandalism, and it's worthwhile noting the reason for the name of the cave.

Howitt writes..."While I made a quick sketch and examined the rocks, the two blackfellows looked around the cave with many wondering exclamations of 'cookee' at the stalagmites, two of which they carried off as wonderful objects to show their friends. I was amused listening to them conversing in the mouth of the cavern.

Master Turmile the dandy, thought it would be a splendid place to run off with one of the young aboriginal damsels. House ready provided, plenty of wallabies and native bears and a country unknown to the other blackfellows.

Bungal Bottle for his part was impressed vividly by the belief that this indeed was the haunt of the mysterious creature, the Nargun.

The Nargun according to their belief is a mysterious creature, a cave dweller which haunts various places in the bush. So far as I could learn, the blacks believe that the Nargun haunts especially the Mitchell River Valley which we have just followed from Tabberabbera Valley. What the appearance of the Nargun is they can't describe, except that it's like a rock and is said to be all stone except the breast, arms and hands. They said it inhabits caverns into which it drags unwary passers-by, and if you throw a spear or fire a bullet at it, the spear or bullet will turn back and wound you."

So this cave is supposed to be haunted by the Nargun, the Den of Nargun - I've been there several times and haven't been assaulted yet, so I assume it must have left. Pity, really!

The cave is formed in horizontal beds of sandstone and conglomerates, typical river deposits (Upper Devonian/Lower Carboniferous), mainly sandstone but a little bit of shale, all rather red in colour. They're almost horizontal with an average dip of 5^{o}.

You can tell the age because here and there they've got plants and fish. The cave is nothing more than a large overhang and most of the floor is sand. The overhang extends for a considerable distance either side of the bed of the creek. One of the distinguishing features is a large stalagmitic mass, which originally was standing upright, but in 1974 it was undermined in a big flood and fell over. There are still a couple of upright columns along the side. The roof of the cave is a very resistant bed of sandstone. The cave was formed in a bed of very crumbly red mudstone, and it has been eroded away behind the waterfall.

When Howitt was there in 1875 there were a lot of stalagmites but there aren't any left now. The cave's been heavily visited since then and they've all been removed.

At this point it's worth saying that the occurrence of this large stalagmite mass prompted people initially to think that the cave may have been in limestone, but it seems that the calcite you can see has just been derived from the carbonate solution in the outlying sandstone.

At present the creek actually flows overhead. The fallen stalagmitic mass had quite a large face. One thing that is interesting about the mass is what was formerly the inside of the mass (which was facing into the cave) is quite clean and fresh and looks like it's still active, and what was formerly the outside, now facing down in the water is very dirty, decayed and eroded away obviously not depositing any more.

Looking at the beginnings of the cave, it's obviously formed behind the waterfall. At present the only time the cave fills with enough water to get behind the waterfall is in peak flood periods which occur every 16 years or so, so if erosion is taking place at the moment it's occurring very occasionally and if you look at the sand floor at the back of the cave there's no apparent debris visible, so it may be that active erosion is not taking place at present. Before I go on to say why it has formed where it is, it's worthwhile saying a few words about waterfalls in general.

First of all, behind waterfalls, there are two types of erosion taking place. First, there are plunge pools at the base of the falls. Very turbulent, back-cutting purely by the turbulence in the plunge pool. For example in Niagara Falls, which are retreating at a rate of 1m a year, the main factor which is causing it to retreat is the back-cutting behind the plunge pools. In waterfalls like this the gorge is the same width as the stream and waterfall.

The second form of erosion on waterfalls is the spray, which trickles down the face behind the fall and just gradually erodes the rock away. Waterfalls that are dominantly formed by this tend to get ampitheatre-type cliffs forming with the actual stream much narrower than the gorge it occupies. The reason for this is that as the water comes over, you get spray on either side as well as behind the fall itself.

Some people have defined two different types of waterfalls. The first one is the most easily understood. It is called a cap rock fall, and is due to a very resistant band of rock on the surface. The rock underneath is more easily eroded so it's being continually undercut and re-treating backwards forming a waterfall.

The other one is called a discordant fall, which reflects the different rates of erosion in different parts of the stream. A good example of this is this: if there is a main stream flowing down, and if the rate of erosion is greater than that of its tributories, eventually the tributories will be perched on the side and will have a waterfall between them and the main stream. The sort of instances where this happens is if the main stream flows all year round with the tributories only flowing during the wet weather, the main stream will be eroding all year while the tributories erode only during wet weather and may get left behind.

The other typical case you always see in geomorphological text books is Glaciation. If the main valley is glaciated and the side valleys aren't, then the side valleys will be perched above and join the main valley with a waterfall.

How do waterfalls start and how do they finish? Most of them start because there is a re-juvenation of a stream. The stream will form a graded profile, then if for some reason the base level at the bottom drops for example by tectonic factors such as faulting, raising of the land mass or lowering of the sea level, you get a nick point which is usually the site of a waterfall. Commonly, these will migrate upstream and finally disappear, so they're only temporary features and are soon removed by erosion.

Now, going back to the Den of Nargun, the main feature there is the cap-rock. It is the cap-rock which is causing the waterfall to stay there. The reason the waterfall has formed where it is seems to be related to the rejuvenation of that particular stream. When you look at the streams around the area, there's the Mitchell River, Dead Cock Creek and the Den of Nargun - the headwaters of Rose Vale Creek are very close to Dead Cock Creek and it has been proposed that the Mitchell River migrating westwards has captured two streams, because the level of the Mitchell River is lower. The headwaters of these streams have caused active downcutting and led to the formation of waterfalls and hence the Den of Nargun. The Den of Nargun has become much larger than any other waterfall overhang in the area probably because it is related to the strength of the roof and the ease of erosion of the underlying mudstone. So it is an interesting little cave but nothing very unusual.

The second example, Natural Bridge, is much more difficult to work out. It is in South east Queensland in the Numinbah Valley on a tributory of the Nerang River. Once again it's a very small national park of about 200 ha. It has got the highest visitation of any national park in Queensland with over 300,000 visitors a year, and has quite a pretty rain forest. One of the consequences of the over-visitation is the fact that there are no leeches on the paths. Everywhere else in rain forests in south east Queensland you get covered in leeches, but because the track there is only two kilometres long, every time a leech latches onto someone it doesn't get off them until they're in the car on the way home. For this reason all the leeches have inadvertently been removed from the park and rangers were even thinking of searching people as they left just to get them back!

Natural Bridge was known to early aborigines in contrast to the Den of Nargun but none are recorded as having entered it. There's certainly no evidence inside. The first written account of it is in 1891 by some ceder getters (?). This cave is formed in basalt of Mount Warning (?) Shield Volcano. There are thin beds of sediments and easily-weathered basalt in amongst the more resistant beds. The basalts there are all Late Oligocene/Early Miocene in age, which is about 20-23 million years ago.

The cave is basically just a single large chamber with a big hole in the roof. A stream flowing overhead plunges through the hole, forming a big pool and then flows out the mouth of the cave. There are a lot of large boulders and rockpiles. The back of the cave is all mud with a slight bench developed and there's a bit of plant debris brought in by floods. At normal water levels the pool doesn't extend to the back of the cave. In exceptional flood times when the stream is flowing so strongly that the water flows over the hole in the roof and into a dry valley, the water flows right up to the back of the cave. However, this event is rare. The dry valley goes to the cliff which forms the cave entrance. So you've got a cliff line going round with a dry valley on one side, and a cave entrance on the other. The bench is obviously caused by erosion by the stream at moderately high flood levels.

The cave is quite large - about 47m long, 26m wide and up to 6m high. It's quite significant and certainly in a very scenic spot. I became intrigued whilst snorkelling around in the pool when I discovered the wall in the pool was undercut, so I went back with a Scuba-diving friend and we dived it. It's undercut about 5m and gradually narrows off, floored with rubble. Quite a complex and interesting cave.

How did it form? The Geological Survey people had one idea: they proposed that the cave was formed by undercutting of the softer bed of conglomerate, underneath a resistant basalt horizon. Initially the cave had formed by downcutting of a pothole in the stream bed, had broken through into the cave and caused further downcutting behind it, accounting for the large size of the cave. This seemed pretty reasonable until I went out there, when I found a couple of things which I found very confusing and difficult to reconcile about this viewpoint. Firstly, where the stream flows out there's no cave formed behind it. So it seems difficult to understand how it formed by erosion by this waterfall. It isn't as insurmountable as it may seem. The other thing is what they thought to be a soft bed of conglomerate turned out to be a brecciated basalt flow...a much softer flow more easily eroded than the other overlying one but certainly another basalt flow. The roof of the cave has circular structures of lime and chalcedony (?) and there are several in the roof housing bats at different times. The most likely explanation is that they're steam holes. The underlying soft basalt flow had water lying on it when the overlying flow went over the top and vapourisation of the water caused these occasional steam holes. It seems likely that the stream breakthrough that occurred and another one that is forming are related to those steam holes.

When I initially realised that the waterfall is a long way from where it must have been to form the cave, I thought it probably wasn't formed behind the waterfall and must have been a lava tube. When I discovered it was undercut along the edges I felt that this would prove my point, so I thought I must go and dive it - I'll break into this huge lava tube and make my name in speleology! So, I dived it and discovered that it doesn't go anywhere, it was just an undercut. This caused me to re-think and it seems most likely that it was indeed formed behind a waterfall. I had to eat my words and apologise to the geologists who I'd insulted. What seems to have happened is that the stream was originally in a spot where it could easily have eroded a cave behind it. It then migrated laterally and cut the gorge thus abandoning the cave. The cave would have been abandoned off to one side and was presumably fairly small. It hasn't eroded a cave where it is now because the soft-lava bed of the cave has eroded with a very irregular upper surface prior to the second flow. The upper surface plunges steeply down on each side of the cave. The undercut marks the boundary of the upper flow and the lower more easily eroded one. So where the cave is formed is almost solely governed by where this easily-eroded flow is present and accounts for the fact that there is no cave behind where the waterfall is now.

As the stream migrated away from the cave entrance, the groove it cut broke through into the cave and once it broke through you'd get a whole new cycle of erosion, and erosion of a much larger cave. So there've been two cycles of waterfall erosion and this accounts for the large size of the cave in comparison to most waterfall caves. It is interesting that the sediment is entirely unsorted, unstratified mud with no bedding or variation in it. It seems to have been deposited as a single event presumably a mud flow or something like that coming off one of the steep hillsides upstream. This must have been a more extensive deposit but has since been eroded.

Just nearby is a much smaller cave with basalt capping overhead and easily-eroded basalt underneath and a waterfall over the edge with good spray coming back. What is really distinctive here is that water is leaking through the creek and coming out underneath the basalt and that is undoubtedly what is causing most of the erosion rather than the spray behind the waterfall itself. It is probably a combination of piping and joint enlargement and similar effects. In this cave, which is quite small, you can see 6m back and 7m down, being just an overhang. The stream capture at the back has probably caused most of the erosion. It's possible that if all the stream was diverted down there, quite a large cave would form. This method of erosion doesn't appear to have been active at Natural Bridge because there is no evidence of any stream inflow at the back of the cave and there is no evidence of any water being lost in the creek, and nobody's been able to find any, despite intensive searching.

Since I have been looking for waterfall caves I haven't really found any large ones. One of the reasons for giving this paper was to see if anyone knew of any others around which formed by various processes behind waterfalls because I think they are interestng and are often informative about the geological and climatic history of the area.

DISCUSSION

Dave, you were talking about steam holes versus pot holes in the stream bed as causing the stream capture. Did you end up deducting whether it was steam holes working from below or pot holes from above?

I think it's pot holes eroding from above into a weakness caused by steam holes. In some places what's left of a steam hole is leaking water from a pool above and that pool in periods of high flood is a pot hole with stones being churned around in it.

This is about a large cave behind a waterfall. The cave was formed in dune limestone in South West of Western Australia, in the Margret River area. The situation is that a large stream flowed to the coast and managed to maintain a course through the sand dunes as they migrated from the west, driven by wind, except for one section (maybe a larger section at some stage), where these dunes actually came across the course of the creek. At that stage, the stream actually sank beneath the dunes. As this sand became limestone you would have had a cave formed which would have had a sort of meander in it. The other point here is that underlying the dune limestone is an impermeable basement, a granite gneiss, granulites and similar rocks. The basement is irregular so that a tributory stream comes out of the limestone 10m higher than the main stream. A complicating factor is you get surface flood overflow channels. The stream rising has deposited a large amount of tufa over the region. The waterfall here is a tufa waterfall, which probably is prograding in the normal processes out into the main stream while being eroded by the main stream. A lovely thing about this is that if you walk to the right spot you see an amazing sight. The tributory waterfall is falling down and the main stream is flowing straight into it.

On cave management aspects, I'm told everything's been stuffed up - it smells and it's rotten, and there's a large number of introduced pests. The place is having a dry winter this time and a wet summer. I think a lot of the tufa has just dried off and it has lost some of its value.

There is another cave near Hill Top, N.S.W. It's quite a large cave, about 80-100m long. Upstream of this cave the gradient of the stream is less than below. There is a gorge down below the cave. The cave itself is in horizontally-bedded sandstone and it has a graded bed that continues just above the cave and that is where a waterfall is now. There is a waterfall at the moment just inside the cave. I suppose the waterfall must once have been about 10-15m high. The cave was formed underneath in a relatively soluble bed of sandstone.

In any consideration of caves behind waterfalls some are no more than conventional rock shelters but more enlarged, because a cave will flood and sweep away the debris. The main process is simply what you get on the disintegration of susceptible rock.

The reason is because it's wet all the time due to the presence of the waterfall.

RED SANDS OF THE NULLABOR

A Preliminary Note

by

Andy Spate
C.S.S.

Dave Gillieson
Australian National University

Joe Jennings
Australian National University

A predominantly rounded, red aeolian quartz sand has been found in two caves and one doline on the Nullarbor. No acceptable source for the sand can be inferred from present knowledge.

INTRODUCTION

In the course of the 1982 Davey expedition to the Nullarbor, red, apparently aeolian sands were noted in several caves in the Diprose area. A small sample of the sands were obtained from N99 where two piles of sand occurred below "blowhole" type entrances (a "Thylacine" type cave, Lowry, 1970). Similarly deposited sand was observed in Diprose Number 3 Cave (N98); in both caves the gravity piles have been dissected by fluvial action. In Diprose Number 1 Cave (N97) the sands appear to be trapped in the shallow collapse doline a few metres below the surface of the Plain.

ANALYSIS

A limited particle size analysis was carried out on the small sample; the sand is well sorted with a strong mode in the fine sand range, there is some coarse skewness (Figure 1).

Optical microscope examination showed that the sediment is dominantly made up of subrounded to rounded quartz grains, with a high sphericity and frosting of the grain surfaces. The reddish colour of the deposit derives from iron oxide coating of the grains. There is a small component of heavy minerals, many of which are also well rounded. A calcareous component of secondary importance decreases from the very coarse sand class to the fine sand class. At the coarse end these calcareous grains are angular to subangular clasts but at the fine end of their range they are more rounded and spheroidal. There are some biogenic fragments - molluscan shell and chitin- - which are probably derived from cave biota. From this examination it was concluded that the deposit consists of aeolian sand but there is probably a clastic fraction from weathering of the local rock, possibly from the cave roof.

An aeolian origin for the coarse sand is supported by scanning electron microscope examination of the acid insoluble fraction of the medium and fine sand classes. The very low surface relief ($<3\mu$) of the grains is attributable to prolonged abrasion during aeolian transport and is much less than that observed on continental dune sands from the Simpson Desert (Plate 1). Low parallel ridges, especially prevalent on grain edges, are interpreted as remnants of upturned silica plates. Such upturned plates are the result of collisions between saltating quartz grains during wind transport; a plate density - wind velocity relationship has been determined (Krinsley & Wellendorf, 1980).

In addition the Scanning Electron Microscope study revealed secondary accretion of silica over the quartz grain surfaces as silica pellicles and globules. Similar silica plastering is known from old dune sands elsewhere, including the Simpson Desert, and is considered to be due to pedogenic (in situ) processes in the cave (Plate 2).

The conclusion from this evidence is that it is essentially an aeolian sand, dominantly of quartz but with a calcareous component and that the sand has a complex origin with two major sub-populations as follows:

1. Well rubefied, rounded aeolian quartz grains from a dune source, with evidence of several cycles of pedogenic alteration and reworking.
2. Angular to subangular calcareous grains derived from local rock, possibly as roof fall.

DISCUSSION

Aeolian sand accumulation is absent from most of the Nullarbor Plain including the neighbourhood of these cases. It appears that these caves (and maybe others) have trapped sand saltating across the Plain. Two questions immediately suggest themselves : firstly what is the source and secondly, when did this movement occur and/or is transport occurring today? Turning first to modern wind movement, records are available for a number of sites across the Nullarbor but only Forrest has instrumented windrun; the remainder have 0900 and 1500 observations of direction and strength. The Diprose Caves lie within a triangle whose apices are the three stations of Eucla, Cook and Ceduna. The particle size analysis, although in whole phi classes (Figurel), suggests that the graphic mean of 2.13 phi (225 microns) is probably representative further suggesting an impact threshold velocity of 4 m s^{-1} at 1 cm height equilavent to 16 km hr^{-1} at 1 metre height (Mabbutt, 1977 : 219). The Bureau of Meteorology wind records are in classes of 10 km hr^{-1} so percent occurrences of direction for winds above 11 km hr^{-1} will be considered.

At Cook, the data for 1500 hours are most relevant as the effects of surface moisture will be minimal (Table 1).

TABLE 1. COOK. Percentage wind occurrence above 11 km hr^{-1} at 1500 hours.

	E	SE	S	SW	W	NW	N	NE
January		23	17					
April		9	9					
July					20	14	12	
October		9	12	9		8		

There is a strong south-south easterly component in January which accounts for 40% of occurrences. This component declines to 18% in April, and a shift to a west-north west component occurs by July. This component accounts for 34% of occurrences above 11 km hr^{-1}. In October there is less dominance of a single direction, but a southerly component accounts for 30% of occurrences. The resultant wind at Cook is therefore likely to be from the south, with an easterly component.

Ceduna shows a clear dominance of southerly and southwesterly winds in January, April and October, (Table 2).

TABLE 2. CEDUNA. Percentage wind occurrences above 11 km hr^{-1} at 1500 hours.

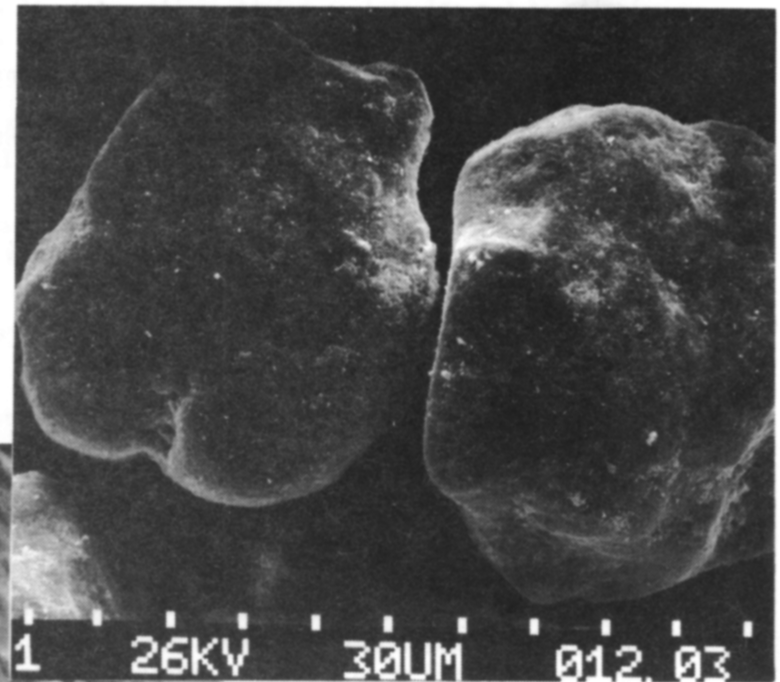
	E	SE	S	SW	W	NW	N	NE
January			60	20				
April			35	25				
July				18	17	11		
October			37	29				

These directions make up 80, 60 and 66 percent of occurrences in these months. In July winds from the west and southwest dominate with 17 and 18 percent of occurrences. The resultant wind at Ceduna is likely to be from the southwest.

The 1500 hours data for Eucla indicates dominance of southeasterly winds in January, April and October. Westerly winds appear more frequent in July. Although all these data are limited, the inferred resultant sand-moving wind in the Diprose area would likely be southerly with an easterly component. However there are southwesterly, westerly and northwesterly winds of sufficient strength to move grains of the size in question. Bowler (1975) has argued that in the Late Pleistocene there was a more northerly component to the wind regime thus allowing transport from more western and northern directions.

Turning to the question of source, dunes are to be found in all directions and distance from the Diprose Caves area but chiefly to the north (Queen Victoria Desert), east (Ooldea to Lake Ifould), southeast (Head of the Bight) and westerly (Roe Plains - Hampton Range areas). Only the dunes to the north and northeast are predominantly quartz; those to the north are conspicuously reddened whilst the eastern dunes are less so. However the trends of the dune systems suggest resultant winds in different directions from those required to bring sand to the caves. They also lack the calcareous sand component necessary to match the cave sand.

Coastal dunes from the Head of the Bight (20 km, SW) and the Roe Plains - Hampton Range area (250 km, W) are predominantly calcareous with a relatively small quartz component. Because of the lower specific gravity calcareous sand will travel at least as far as quartz in given wind conditions. On the other hand, the softer calcite sand will suffer more from attrition than quartz. However, it seems unlikely that during travel over 20 km differential attrition will reverse so dramatically the proportions of calcareous to quartz sand. One would also expect the calcareous component in the cave sand to show even more pronounced rounding and sphericity than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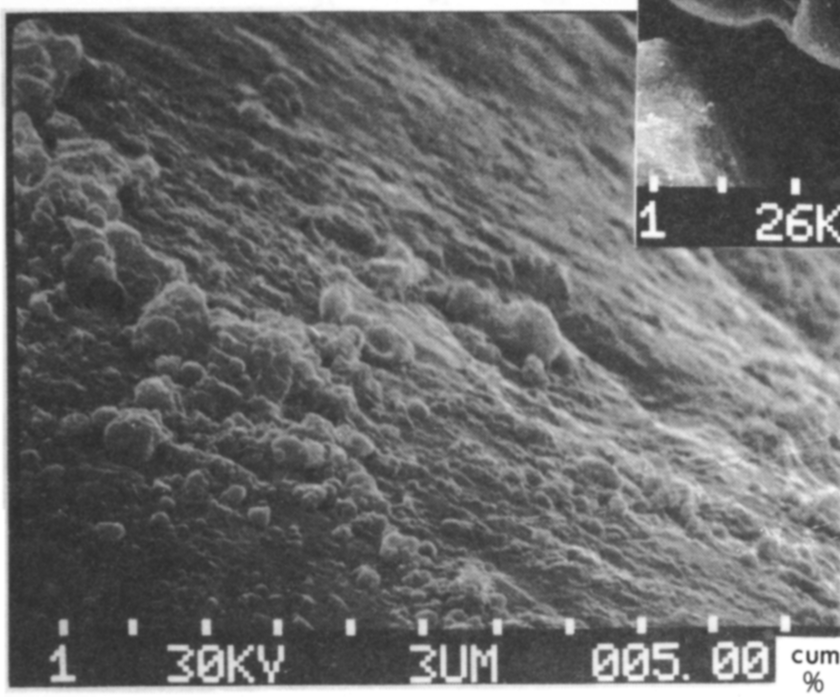
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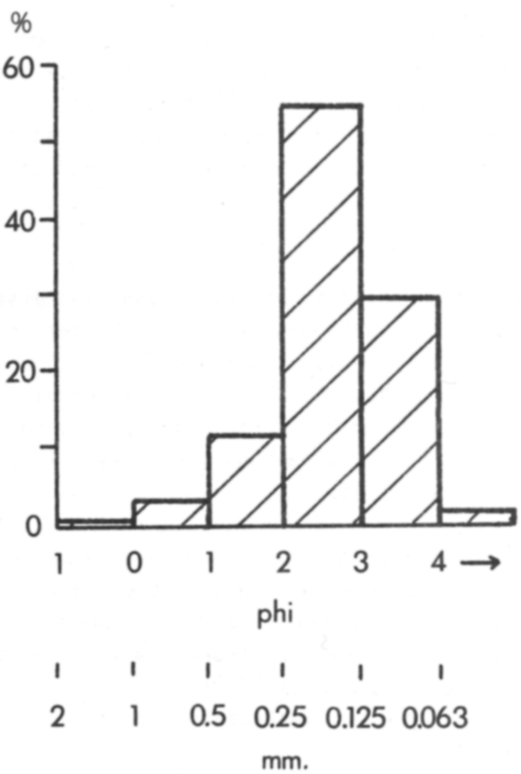
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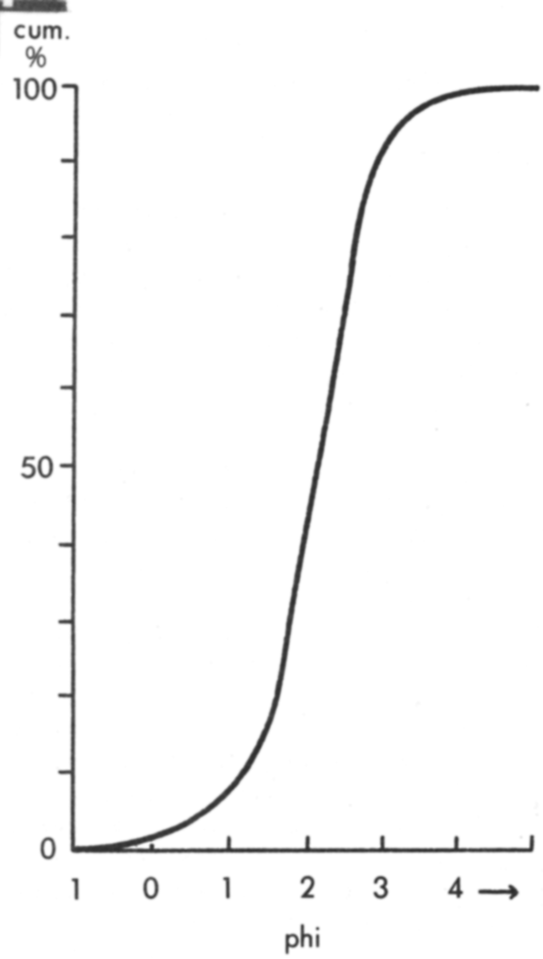

cum. %
100
50
0
1 0 1 2 3 4 →
phi

the quartz grains; this is not the case. Thus these dunes seem an unlikely source for reasons of both lithology and wind pattern.

However, another explanation for the mineralogy of the cave sand, given a coastal origin, is possible - prolonged weathering prior to transport to the present location. Lowry (1970) describes ancient dune remnants along the top of the Hampton Range between Eucla and Madura, and also on the Roe Plains at their eastern end. The latter are certainly younger than the cliff-top occurrencees, which are insecurely proposed as Middle to Early Pleistocene age. The remnants are lithologically sandy clay and kankar (calcrete). Those near Madura are described as partly consisting of fine quartz sand. Such deposits could provide ready-made materials matching the cave deposits when the silt and clay frctions are separated by suspension as atmospheric dust.

A further possible source of sand is as a result of deflation of residual soils left after solution of considerable thicknesses of limestone. Lowry (1970) reports an acid insoluble fraction of up to 4.5% in surface limestones; this fraction is, of course, not necessarily quartz. However, two arguments against an hypothesis that the cave sand derives from the deflation of the former residual soil of the Nullarbor Plain appear to be powerful. Firstly any shallow caves which had openings to the surface at the time of deflation would likely be filled with wind transported materials. The sand deposits in question, though dissected, do not look like the remnants of complete or nearly complete chamber fills. Secondly with such a widespread source material, it is reasonable to expect many or indeed most caves near the surface would have received fills if these had in fact been the origin of the presently known occurrences.

A corollary of these arguments is that the Nullarbor caves we know must have opened to the surface subsequent to the deflation period.

CONCLUSION

None of the sources discussed is wholly satisfactory as a provider of the sands under discussion on presently available evidence, either because they are disposed laterally or downwind in relation to the present and former sand-shifting regimes as inferred from the dune patterns, or because they are too distant upwind in these terms or because transformation in mineralogical character between source and deposition is required.

Old leached dunes between the Merdayerrah Sandpatch and the head of the Bight would constitute a more likely source of origin but none are known to have been mapped as yet. One of us has seen what are possibly old dune remnants between the cliffs south of Wigunda Cave and the younger dunes emanating from the head of the Bight, but this needs verification. It must also be remembered that the Bunda Cliffs are under active erosion and significant loss of land has occurred since the formation of the degraded Pleistocene cliffline plainly visible behind the Roe Plains and buried at the Head of the Bight and behind the Merdayerrah Sandpatch. That old cliffline is pinched out by coastal erosion at the western and eastern ends of the Bunda Cliffs (Jennings, 1967). Old cliff-top dunes of a leached nature and suitably positioned upwind of the caves concerned may have been lost in this way.

More evidence is needed. In the field, caves need searching to see if there are similar cave deposits elsewhere, in particular the last, most speculative hypothesis needs testing by a search to the southwest and west-south-west of the presently known sites of cave dune sand. The known and newly found deposits need examining more closely, particularly as regards sedimentary structures, which may relate to the mode of emplacement within the cave(s). In the laboratory there is need for more thorough analysis of the cave sands and, for comparion of sands from the various possible sources discussed here.

REFERENCES

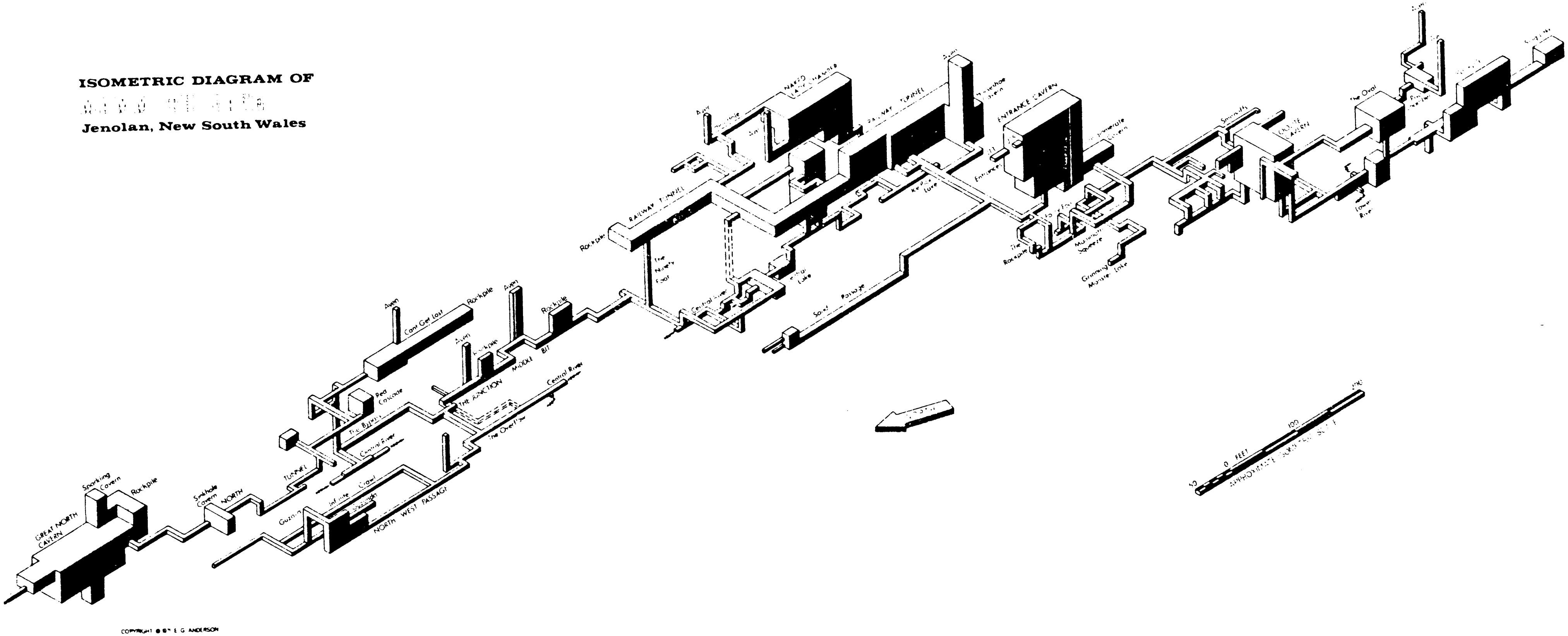
Bowler, J.M., 1975. Deglacial events in southern Australia : their age, nature and paleoclimatic significance in southeastern Australia, in **R.P. Suggate and M.M. Creswell** (eds), **Quaternary Studies, Royal Society of New Zealand,** pp 75-82.

Jennings, J.N., 1967 Cliff-top dunes, **Aust. Geogr. Stud., 5**:40-49.

Krinsley, D.H. and W. Wellendorf, 1980. Wind velocities determined from the surface textures of sand grains, **Nature, 283**:372-3.

Lowry, D.C., 1970. Geology of the Western Australian part of the Eucla Basin, **Geological Surv. Western Australia, Bull. 122.**

Mabbutt, J.A., 1977. Desert Landforms, ANU Press, Canberra.



Block Diagram and Map opposite

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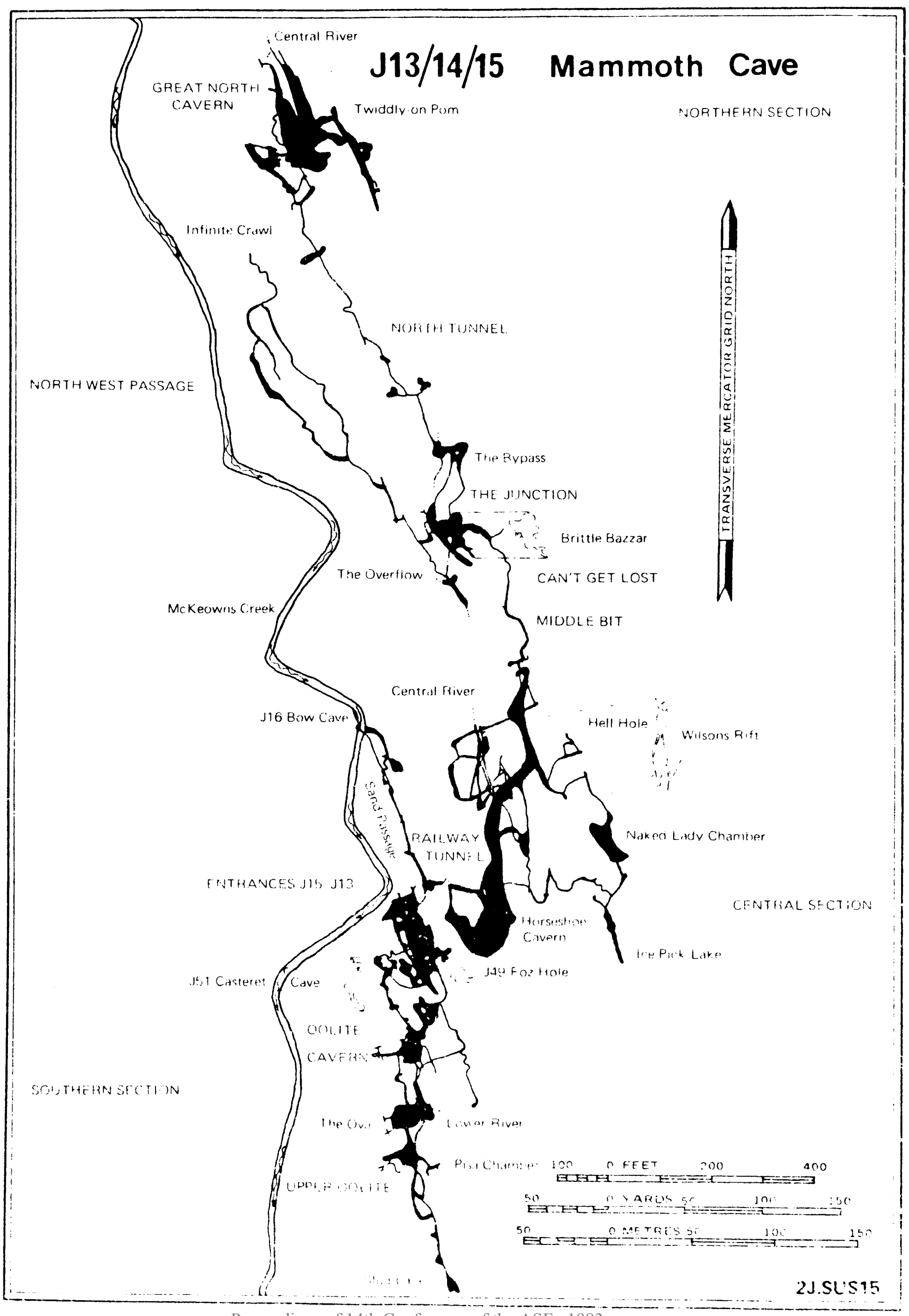
SPELEOGEOGRAPHY OF MAMMOTH CAVE

by
Guy McKanna
S.U.S.S.

A brief history of the documentation of Mammoth Cave, Jenolan, is used to highlight the value of graphical techniques in depicting a cave and in extracting the most value out of survey data.



Speleogeography is the history of speleology; in this case that of Mammoth Cave, Jenolan Caves Tourist Resort, New South Wales. This paper focuses on the speleological documentation and the future of cave documentation through Mammoth Cave's history. Geomorphologically it is the longest wild cave at Jenolan about 1.5 km long. It was discovered 100 years ago - 1982 being the cave's centenary. The cave besides being interesting for itself, has a long speleological history, thus providing a good case history of speleological documentation.

The discoverer in 1882, Jeremiah Wilson, apparently only described the cave verbally, which was fortunately written down by contemporary journalists, thus providing second-hand documentation. Thankfully today's societies trip reports give a much more accurate account of the development of a cave's documentation and history. This second-hand documentation was inaccurate and exaggerated, and is mainly of historical and nostalgic value in that it gives an account of where the early explorers went. The same applies to signatures of these explorers found within the cave, which do have a secondary role as tourist features.

Interestingly it appears that the cave was forgotten till relocated in 1949 by the newly founded Sydney University Speleological Society. For the next ten years it was a matter of re-exploration by means of old maps and the passing on of passage locations and so on rather than by actual documentation for navigation and further exploration or research.

In 1960 it appears information was collated due to the impetus of symposiums and conferences. An underground camp in 1961, to enable further exploration, also allowed surveying and documentation of all known parts of the cave.

Psycho-historically it should be noted that this surveying was pushed along and emphasised by a few people such as Edward Anderson, who is a professional surveyor, and also John Dunkely and others.

In 1962 surveying was undertaken to correct previous maps. It is at this stage that it becomes apparent that there is a continual strive for accuracy and perfection. This paper deals with this development.

In 1967, the Sydney Speleological Society did some Radio Direction Finding work in the cave, allowing it to be placed on the national grid. When this is related to the documentation of an entire system this becomes important. The first isometric cave map produced in Australia was of Mammoth Cave in 1971, this was mainly due to the nature of the cave and the quality of surveying and people involved. Interestingly this form of mapping has not really taken on, probably due to the lack of detail that it shows. This paper supports the usefulness of this form of mapping. The only extra work involved is in the drawing up of the end product, as the "normal" survey plans drawn by all cavers only need inclinometer readings to proceed to the isometric drawing stage, and these are taken whilst surveying.

It must be noted here, that in many cases this extra type of mapping is not necessary, as a cave system may only have developed on one plane. Isometric mapping is best suited to caves which combine both horizontal and vertical development, as is the case with Mammoth Cave. Once an isometric map has been produced it is only a matter of comparing passage shapes, dimensions and features of development and so on, to see what parts of the cave are related. This is what is happening in Sydney University Speleological Society's cave documentation programmes.

This direction in documentation can be seen to have evolved from the natural progression in surveying. Increasing accuracy is fairly readily obtainable and moving towards recording the whole cave. A three-dimensional map when combined with detailed two-dimensional plans and sections enables the hypotheses of how the caves' parts are related, how they formed and also directing further exploration and research. However this is not the only use for this sort of mapping, because when combined with Radio Direction Finding work and surface maps, a whole picture of the cave can be built up in relation to the surface and the rest of the cave system around it. Within the last few years a silhouette map of the major caves of Jenolan, and their relation to the surface and each other, has been compiled. This gives an indication of where to continue exploration and some indication of karst development. But it is not until isometric or other three-dimensional representations (such as "cut-out" sections) of caves are applied that this form of cave documentation comes "into its own", as is the case with Mammoth Cave and the whole of Jenolan, where this technique is now being applied. It has not only provided a complete pictorial record of the cave and its elation to the surface, but also to other caves, and has allowed relocation of smaller caves above Mammoth Cave itself. Ultimately a report on the hydrological and geological development will be forthcoming.

Computer graphic applications bring this form of mapping from the next to the present generation, all that is needed is someone with enough interest and knowledge to streamline this form of karst representation, as similar advances were made in the past. In this case it seems to be worthwhile in that it enables a total representation of a cave, its systems and its surrounding environment and ultimately a hypothesis of how the cave evolved. Which is what cave documentation should ultimately be striving for - a biography of a cave.

DISCUSSION

Isometric diagrams have the disadvantage that they show no interior detail. If using computer graphics or a wax mould or physical model (which could be the next step in cave description), it is possible to obtain the interior detail.

We still need 2D plans and sections because when using isometric diagrams we see the cave as a solid and the rock as a void. This always leads to hidden areas of the cave.

We need to improve the process of getting wall and interior detail into isometric maps.

There is a cave (Corra Lynn) in South Australia that no matter which way you draw an isometric diagram of it, many of the cave passages are hidden from view. The cave is a tight network on four major horizontal planes. That requires a horizontal or vertical exaggeration. It is possible to use slices or slabs as a model.

Isometric diagrams are ideal for vertical corkscrew caves. Should be good for Tasmanian caves.

As an alternative to isometrics it is possible to use stacked cross-section or horizontal contours.

SUMMARISED SPELEOGEOGRAPHY OF MAMMOTH CAVE

Discovery of Mammoth Cave	1882	
Signatures and date in cave	1884	
Written description of certain parts of the cave	1889	Cave made known to others
Bushwalkers sketch map	1943	A rough guide to part of the cave
First proper surveys	1953	Scientific recording of the cave has begun
Available knowledge collated and summarised	1960	This provides a guide not only to the cave but also what needs to be done (led to the underground camp expedition)
Higher grade traverse	1962	
Higher grade traverse	1964	
R D F Work	1967	Allows cave to be related to surface and National Grid
Completion of maps for known cave	1970	
	1971	printing of book and Isometric map, nomenclature now standardised
Underwater exploration of sumps	1979	
Silhouettes of Mammoth and nearby cave	1982	Gives some idea of cave relationships
Isometric, Stereoscopic	1984	Isometric projection of the cave and its relation to the surface and other caves
	198?	Computer graphics. This would be a complete documentation and an aid to research, theorising and public representation of the cave.

THE BRAIN PREFERS THREE DIMENSIONS

by
Graham Pilkington
C.E.G.S.A.

A resumé of methods than can be used to depict three dimensional cave data on two dimensional media. Emphasis is placed on those techniques not requiring special aids, those that are suitable for use by active cavers and those that are good for public display.

The holographic method of display is put forward as a technique that should be considered for cave records keeping not just a novel method of display.

Cavers have something in common with people. Both are sight orientated and see their world as a visual three dimensional space. However, unlike ash-tray collectors, we have this code of ethics that prevents us from carrying home what we find in our temporary places of abode. Besides, most of us would prefer to take home all of the cave and so far that has proved impractical. We make do with visual triggers to jog our memory; data to create 'mental' caves for others; and that good old loophole - "I'm taking this home for science".

Because our brain prefers 3D images, cavers often resort to the use of symbolic art, sometimes known as cave maps. We tend to forget that plans and sections with all their lines, dots and crosses are arbitrary representations of three dimensional entities. This is why everyone draws their own interpretation of the same cave. You can always tell who the creator of a map was by the style in which it was done, even though we all use the same set of symbols. It takes training and use to be able to readily re-create a cave from maps.

Similar practice is needed to read contour maps. It's just that these are thrust at us from a wider variety of people, and hence we are more used to translating contours into 3D objects. Why are contours used? Because it is easy to draw them, they can be done in black and white which is good for copying cheaply, but very importantly because everyone is expected to have trained themselves to read contours: the authors do not have to train their readers. Of course I should remind you that many contour maps are used as a method of converting overpowering spatially-related-data lists into quickly perceivable visual images. Everyday, TV thrusts barometric charts at us with their highs and lows instead of say heavy and light - a typical double conversion to enable our brains to use our excellent visual processing systems. Maybe we should use the same techniques for caves and present contours of say passage height or floor elevation as well as trying to produce a pseudo-picture.

An interesting possibility is to get the brain to convert visual images into body sensations. For instance, a cave map showing temperature as blue for cold and red for hot with all the in-betweens can, with training, be converted into real temperature feelings. Cave maps were initially just wall outlines which then progressed to imitating photographs with sketches of internal features. Our present symbols are usually pictographs. The brain can easily convert these pseudo pictures into 3D images by calling upon the reader's caving experience. A non-caver finds the task much more difficult if not impossible without having seen cave photographs.

Cave maps, diagrams etcetera are used to create a picture of caves that cannot physically be viewed from a vantage point. These methods have been devised to circumvent mere physical limitations. Possibly isometric views - of which the block diagram is a primitive form - are best, because (unlike plans) they give the perspective which the brain expects for 3D objects even if what is solid is shown as void and vice versa.

The next step up the ladder of realism is the cutaway views which keep the solids solid. These are a specialized version of the sketch.

But even if we use photographs or movies, we are relying on the brain to use pictorial cues to convert 2D to 3D. Many of these cues are unavailable, contrived or misleading when dealing with cave pictures. Some of these cues that I am talking about are; shadows to determine up, concave/convex and near/far properties (the sun is up but not necessarily the flash gun!); shadows from reflected or side light to enable the brain to determine relative distances and which is front/rear; and expected sizes - any "usual" object such as a person has a "known" height from which the brain will scale off the rest of what it sees.

If, like me, you feel I should give my brain a rest, then the use of stereo-pairs is in order. There are two major display categories of stereo-pairs - the non-overlapping and interwoven types. The former are the common twin pictures each looked at by a different eye - a good way to examine things at different scales without losing all 3D.

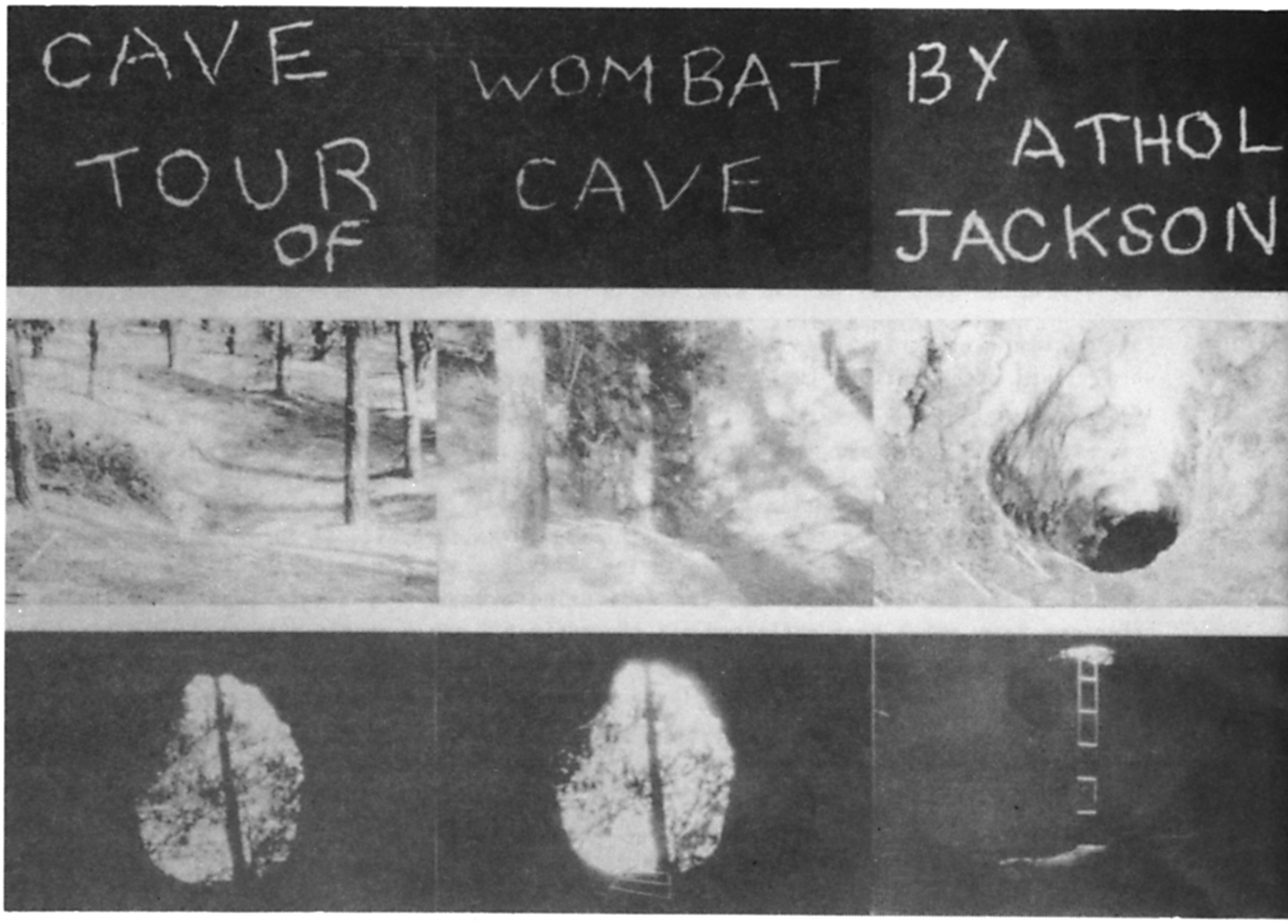
The second method of display relies on each eye picking out only the view appropriate to it when both pictures are actually visible. Many are familiar with the coloured glasses or polarized lenses techniques but another method uses a prismatic screen that makes a different picture dominate each eye with the brain rejecting the interfering strips by insisting on having a sensible 3D image.

I've talked enough about trying to fool the brain into reconstructing 3D from 2D. What exactly is 3D as the eye sees it? Why does a picture as taken by a camera (a man-made eye) not look like the real thing? The answer is that light reaching our eyes has both intensity, as recorded on film, and phase. We lose all phase information.

This is where holograms come into the picture. They record both features of the light and so when viewed are identical (well almost!) to the real thing as you would see it if you'd been there.

They have another advantage too - if you move position, so do the apparent positions of the objects on show. True parallax is there. Why aren't cavers using holography? What is wrong with the cave environment that precludes the use of holography? It turns out that what is wrong is that no caver is doing it. A cave is the perfect place for holography. The criterium needed because of the way that holograms are made using a laser - a single beam split into a direct reference beam and a beam reflected off the subject - are a stable atmosphere for minutes (this mainly means a homogeneous temperature), no stray light and no vibration of the laser system, subjects nor photographic emulsion. These features normally describe a cave. The usual subjects that we wish to encapsulate are highly reflective crystals which give a good light return for the images. However, care must be taken to avoid overexposure at the critical angles of reflection. The method of strip exposure of holograms enables a continuous time or distance picture to be taken including the creation of spherical photographs. A real record of what can be seen in a cave is extractable. Decoration can be recorded in full 3D form for prosperity. In fact, broken pieces can be "repaired" by placing a hologram at the spot!

A whole cave could be recorded by holograms enabling a cave to be set up anywhere, especially around our armchair cavers. Holograms will enable a cave poor country like Australia to double its cave count overnight.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ATHOL
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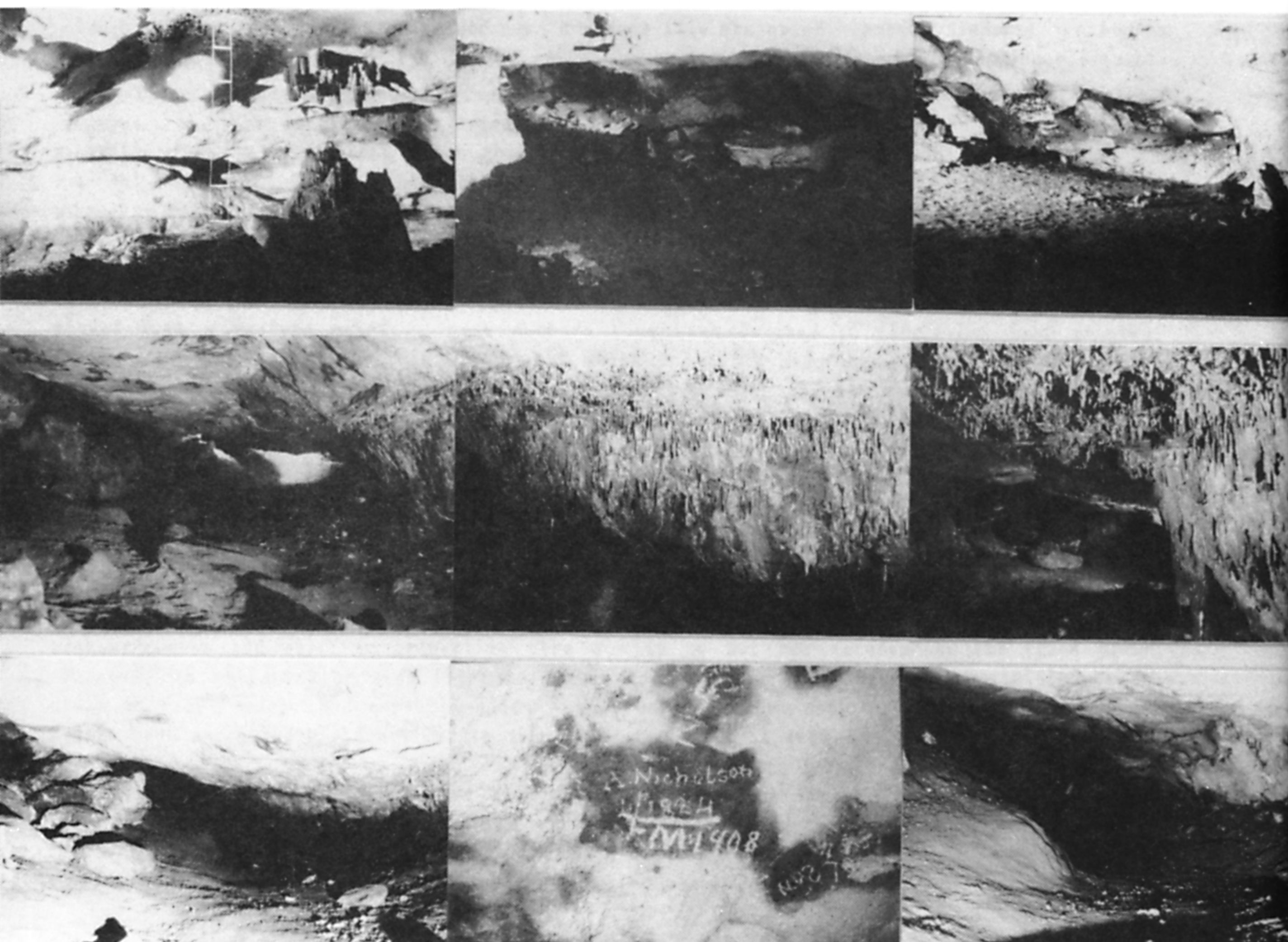

A. Nicholson

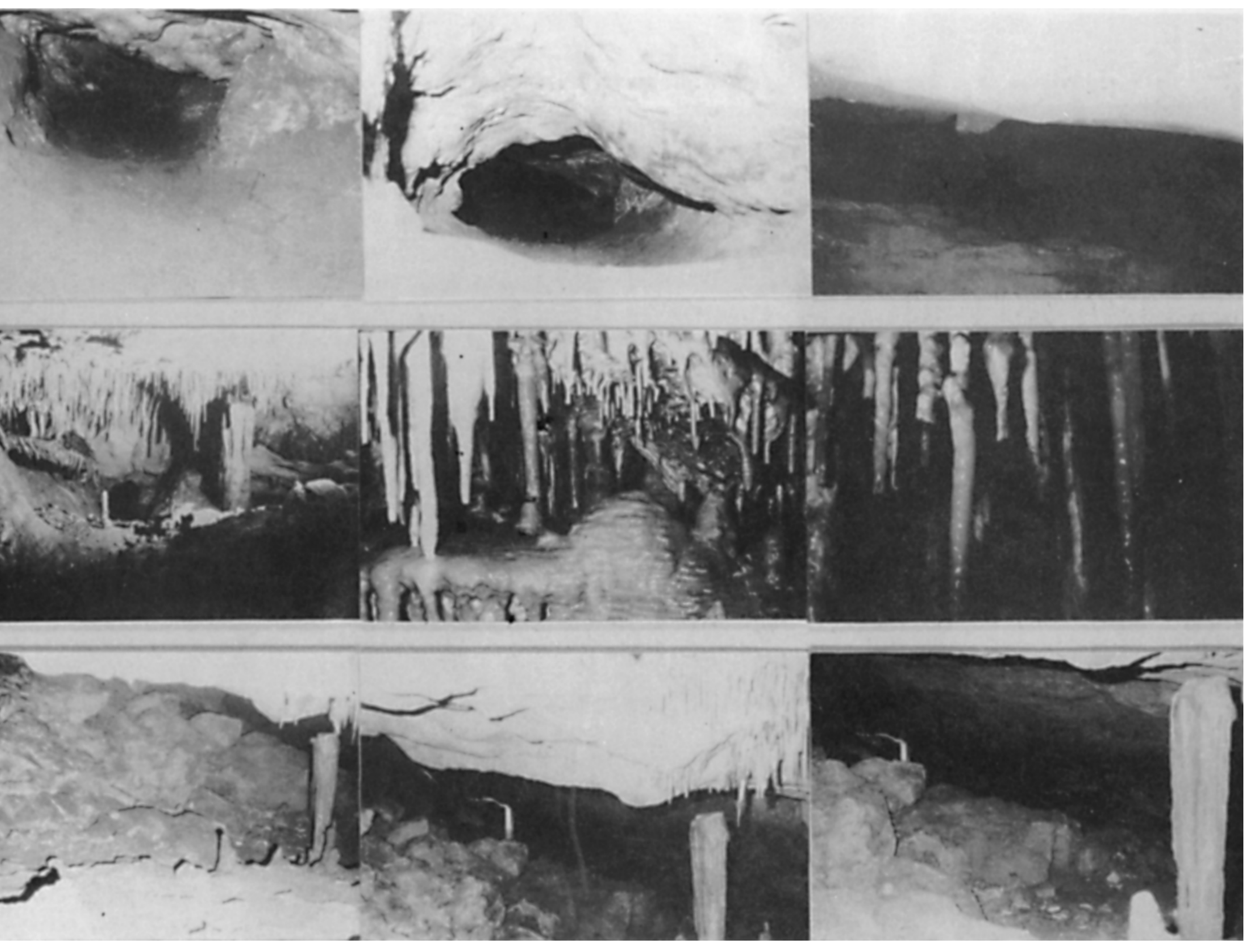
PHOTOGRAPHIC CAVE TOUR

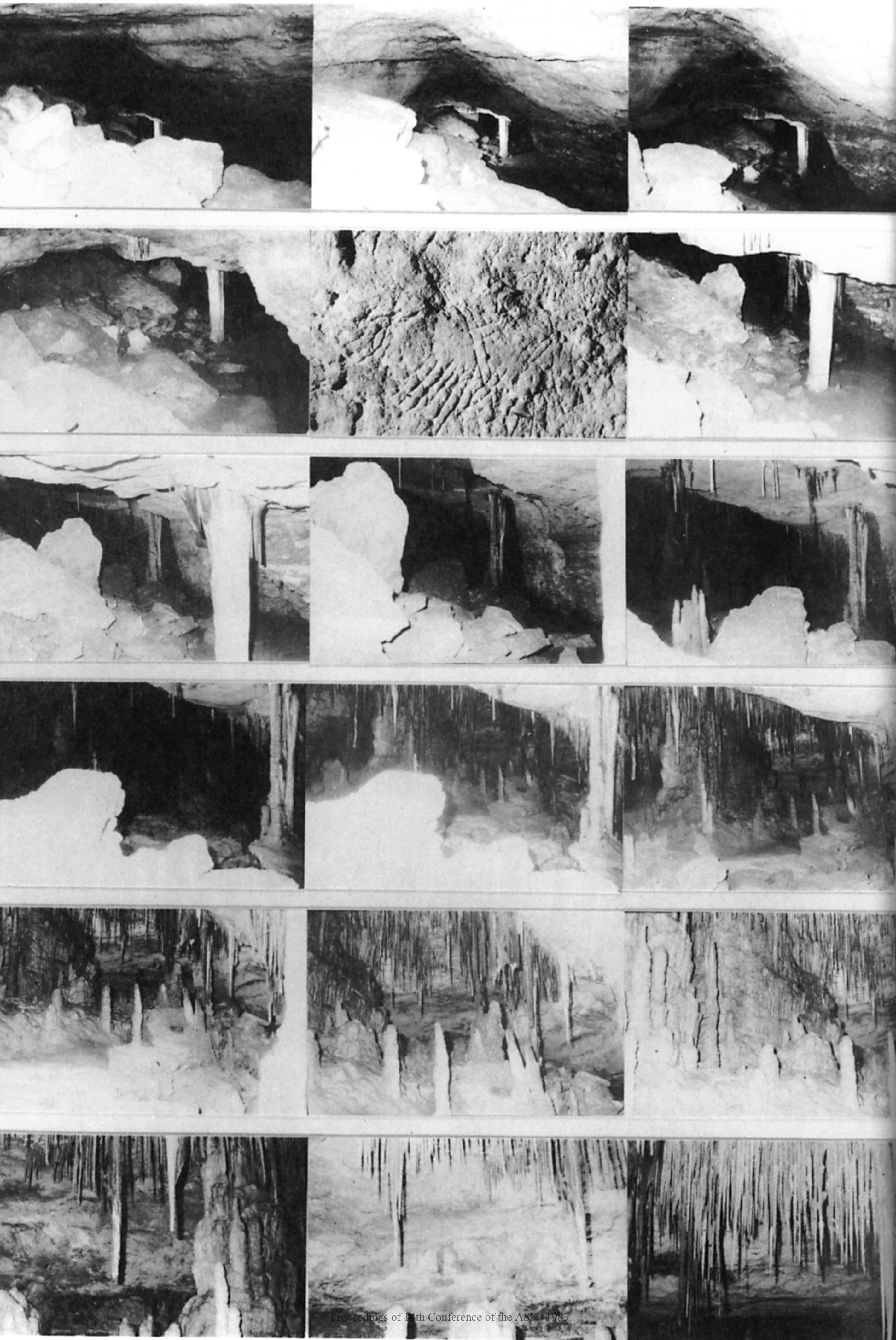
by

Athol Jackson

C.E.G.S.A.

The required techniques to depict a cave to give the impression of moving through it are shown to be effective using two slide projectors with cross-fading and super-imposition. The problems encountered were mainly due to the time needed to complete the project, but careful attention to detail enabled remedies to be applied.





With the theme of this conference aimed at the visual aspects of speleology, I decided to experiment with depicting a complete cave with audio-visual techniques. The aim was to present the cave by sequence slides rather than movie film but attempt to attain the same result - the feeling of motion through the cave. It became obvious very early in the planning of the project that fading and dissolving methods would be needed to give this impression so the slides would need to be taken with these techniques in mind. Ideally, all photos in cross-fade projections should be in the same orientation either horizontal or vertical but with the nature of the caves available being horizontal and speleothems being vertical this presented a problem. Fortunately the cave chosen, Wombat Cave (U58), had most of its decoration at the end of the cave so I decided to attempt to make only one transition from horizontal to vertical and as smoothly as possible.

The slides were taken on four separate trips over a period of six months. After each session the slides were examined and a plan for the following trip was made to fill in gaps to make a smoother progression through the cave. Slides were taken into the cave and examined in situ to make sure that correct positioning of the camera was attained. It was decided that the lighting for all underground photography would be electronic flash as the logistics of providing flood lighting with its associated cables, generator and manpower was not possible for more than one session and it was not possible to do it all in one session because fill-in slides would be needed and a mixture of slides with different lighting would spoil the end result. Up to four flash units were used with the slaves attached, sometimes electronic and sometimes human. One problem with using flash is that until the film is processed it is not known how good the illumination is over the whole slide. With a bit of imagination and a lot of luck most of the results turned out reasonable.

During the project many unforseen and unpredictable problems arose. As the time period was over six months the cave water content changed and when attempting retakes and fill-in photos the amount of water on decoration had decreased which reduced the lustre of the subject. On another occasion when doing fill-in shots it was discovered upon examining previous slides that the cave had been changed. Rocks on the floor of the cave were no longer where they should be so a search had to be made to find and replace them before taking the photo. This reinforced the decision to take previous slides into the cave and examine the fine detail of the area of interest. As the cave entrance is a natural animal trap it is customary to look down the entrance hole before entering. On one trip it was discovered that a brown snake was waiting for us at the bottom of the ladder. The snake was duly rescued and brought to the surface but was found to be dead on arrival. Apparently a rock had fallen onto it from a great height even though the traditional "BELOW" call had been made. It was not wearing protective equipment. When we entered the cave on another trip we were greeted by the smell of a badly decomposed possum. Even though the remains were disposed of the smell had permeated throughout the cave and was not a very pleasant atmosphere to work in. A side effect of this was that there were hundreds of blowflies throughout the cave. Apart from the annoyance of having them follow us, when we were illuminating decoration for focussing and framing the blowflies would land on the decorations. This meant that we had to go over the area and remove the blowflies before taking the photograph. There were also the usual equipment problems of fogging lenses, moving tripods and moisture on flash contacts.

I decided against utilizing people in the scenes as it would be very difficult to have the same people on every trip to act as models although it would have been useful at times to indicate scale or to highlight some particular part of the scene. I also considered using different lenses for different scenes but decided to maintain a constant field of view approximately the normal eye field with a 50mm lens.

As mentioned earlier the projection of the slides was to be performed using cross-fading techniques so two identical projectors were purchased. A manual dual fader control was built and the projectors modified so that the lamp brightness could be controlled. A special frame was constructed to allow the two projectors to be mounted one above the other on a standard projector stand. The final selected transparencies were mounted in Agfa glass mounts to maintain accurate focus and also in an attempt to maintain good registration as some slides were superimposed to indicate a progression of lighting. This was not totally successful as the registration of the slide mount in the projector is not accurate.

A manual fader was preferred over an automatic one so that the superimpositions could be attained and also so that varying times and depth of fade could be carried out. Unfortunately lack of time did not allow the audio part of the project to be completed for the conference but it is hoped that this will be rectified in the near future.

I feel that the experiment was a success and many uses for this type of display can be visualized. In education it can be used to demonstrate to students what a cave is really like. It can be used to show scientific processes such as bone collection and progression through a bone dig. In promotional activities a tourist cave can be depicted to entice the public to see it in real life. In training activities many techniques and processes may be shown in fine detail. All these can be done at a much cheaper cost than using movie film or they can be transferred to movie film or video for ease of display again at a much cheaper cost than doing originals in these media.

I was fortunate in having the same team providing the hands and feet placing and operating the flash units and carrying equipment through the cave. This meant that much less communication was required to achieve the desired result and also discussions amongst the team resulted in better pictures. I would like to thank the Ellis family for the enormous amount of effort and encouragement they provided throughout the project. I would also like to thank the Subterranean Foundation for providing the film and processing to enable this project to come to fruition.

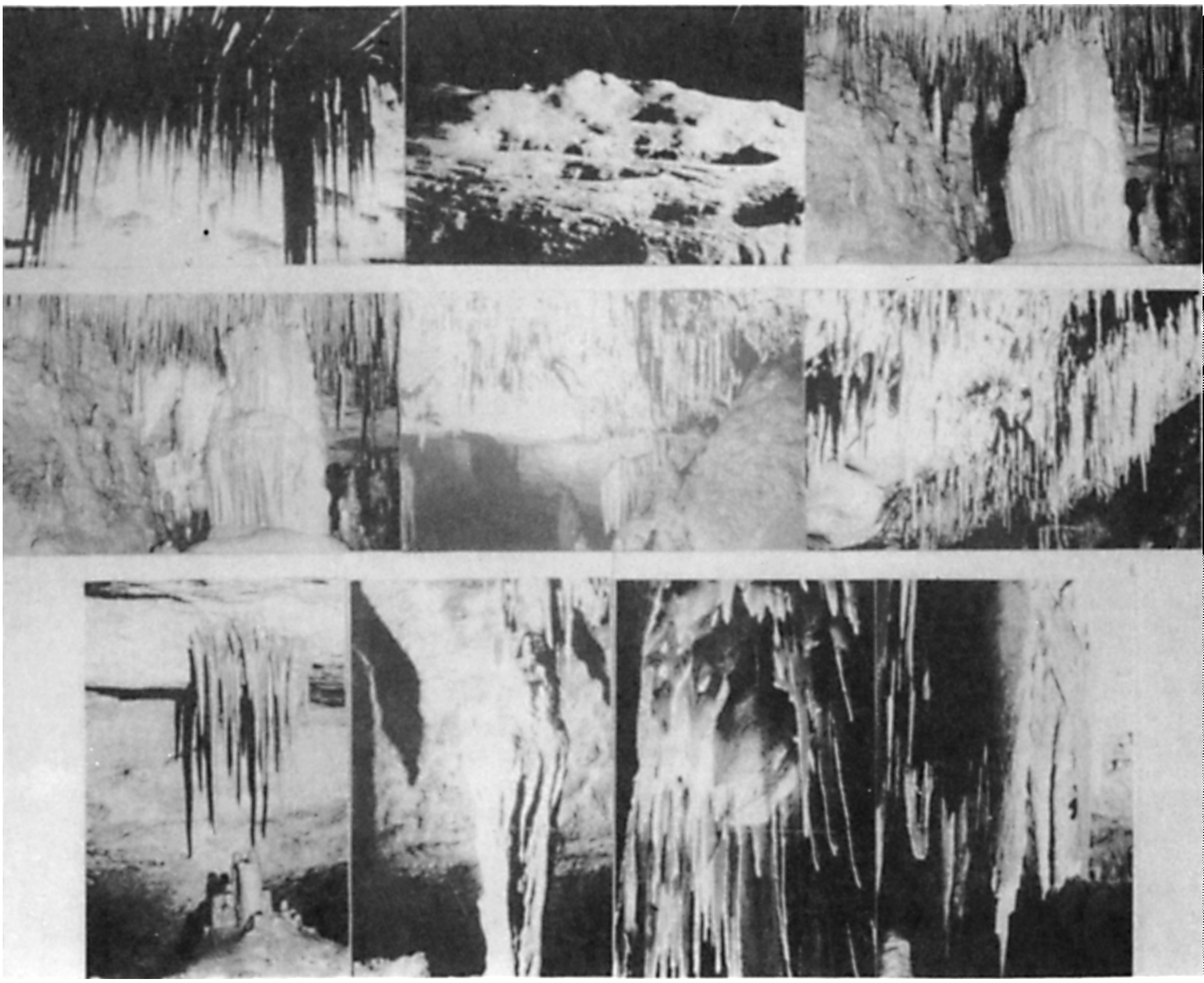


PHOTO TAGGING

The Process and its Application

by

John Bonwick

S.S.S.

The process involves photographing cave entrances. Appropriate information is recorded on the negative by the use of a placard. It is designed to supplement and in some cases supplant the tagging system.

INTRODUCTION

The first time caves were tagged for speleological purposes in N.S.W. was at Yarrangobilly, during Easter 1957 (Lane and Nurse 1961, Ellis and Middleton 1970 and Bonwick 1979a). The numbers Y1 and Y2 were chiselled into rock adjacent to the entrances of East and West Eagles Nest Caves. At the time some people felt that any permanent marking of a cave entrance was an act of gross vandalism.

Later, the now familiar aluminium tag was developed (Halbert 1968) and metal tagging has now spread to most of the frequented cave areas. Societies that once regarded it as the act of Phillistines, now demand it as the right of every red blooded caver to tag a cave whenever he or she feels like it. The latest development in cave identification, developed by S.S.S. over the last three years, is photo-tagging.

Tagging put an end to much confusion and duplication in speleological work. Now, when someone enters a cave with a map bearing the corresponding number, they can be reasonably certain that they are in the cave which was surveyed, despite what the map might suggest. However, experience over the years has shown us that various problems can still arise. Those which come to mind are as follows:-

PROBLEMS WITH TAGGING

1. The tag may be "lost" - it may fall out because it was badly installed, it maybe deliberately removed, the rock to which it was attached may fall away, vegetation could cover it or it may simply not be seen because it is not where the casual cave tagger expects it to be. So, the one entrance may end up with two numbers.

2. What do we do about arches, or entrances which are 30 or more metres across, or caves that have a multitude of entrances through a large rock pile? Finding the normal sized tag would be a needle-in-the-haystack job. And a tag big enough to be seen in such a place would attract cries of vandalism, as well as vandals.

3. Some people believe that sea caves should be tagged. However, in this case the forces of nature are much more severe, and public access more frequent, so that any tags would be very temporary, and in many cases we would be faced with the same problem as in (2) above.

4. Dolines in which there are no entrances are still significant and may need to be referred to in speleological notes. But where would the tag be put? Worse still, some dolines have no exposed rock for attaching the tag to.

5. Experience has taught us the desirability of having the tagging in each area handled by one society and, ideally, by one person. This means that tagging may not proceed as fast as some people think it should, but it does minimise the change of mixups. However, it is inevitable that over a period of time the tagging job will change hands and the risk of mixups during the change over is quite high. For example, a question still hangs over Y11 at Yarrangobilly (Middleton 1974, Wellings 1974 and Pavey 1974). Does it still exist or was it buried by the new road? The original tagger for this area has been overseas for about twenty years and he is the only person who could clear the matter up. The problem stems from the fact that the descriptions, and even maps of the same cave, can vary considerably and therefore may not be adequate proof of identity.

   An accurate surface survey helps a lot, but even here identification at a later date still depends on the original accuracy being repeated.

6. A certain area in N.S.W. is an important tourist area containing many caves. S.S.S. has prepared a book on the area. But, for reasons unknown to us, we have been told that we cannot tag caves in the area, and some tags have actually been removed from caves already numbered. Many people have been working in this area in hydrology, geomorphology et cetera. How are they to refer to the places at which measurements or observations have been made? How could someone in 10 or 20 years time check or compare their figures? If tagging resumes several years hence, the probability that some caves will end up with a different number to that which they had before is very high.

7. Some people feel that certain areas that are accessible to the Public at large and not under any supervision should not be tagged. They reason that tagging makes it easy for vandals to pick out the best decorated caves.

It is suggested that these problems can be removed or at least mitigated by the following technique

THE PHOTO-TAGGING PROCESS

A brief description of the equipment required is given below:-

1. A placard with provision for mounting numerals corresponding to existing cave number systems, e.g. B124.
2. A set of numerals and letters large and clear enough to be read on a photographic print taken some 30 to 40m away.
3. A camera.
4. Ancillary equipment : a) Pointing stick
   b) Magnetic compass
   c) Survey tape
   d) Notebook and pen.

The process simply involves taking photographs of the cave entrance with its number on the placard held nearby.

TENTATIVE GUIDELINES

Two photographs should be taken of each entrance. One should be taken close enough to show the entrance and its immediate surroundings in detail. The person holding the placard should also use a pointing stick to show the position of the tag if any. The second should be taken far enough away to show its position in relation to the surrounding countryside.

The cave number placard should be held at the entrance and facing the camera in each case.

The placard should also have provision for recording the date.

The position from which each photograph is taken should be recorded by noting the distance and bearing of the entrance.

The initials of the society responsible for production of the photograph should appear on the placard.

A notebook which stays with the photo-tagging equipment would be used to record the following data:

1. The distance and bearing of the entrance from the camera in both close and distant photographs
2. Focal length of camera used and owner's name.
3. Condition of tag if any.
4. The time of day (within 15 minutes)
5. Names of those present.
6. Anything unusual about the entrance.

When making up a set of photographs for a particular area the prints should all be the same size- 90 x 130mm seems to be quite adequate.

ADVANTAGES OF PHOTO-TAGGING

The process deals fairly effectively with the problems of tagging.

1. A suspected "Lost Tag" entrance can be checked out in the field by reference to a set of photo-tag prints. Using the distance and bearing figures with each print, it should be possible to achieve positive identification in most cases by standing on the spot from which which the photograph was taken. Knowledge of the surrounding entrances should limit the possibilities to 2 or 3 at the most. Of course another photograph could be taken for a more

exact check and filed with the original print. In extreme cases this should be taken under the same lighting conditions, sunny or overcast, same time of day and year. However, it seems very unlikely that entrances will be sufficiently similar to make this last step necessary. An examination of the pointing stick in the close-up print should pinpoint the position of the "Lost Tag" or the hole where it was originally placed.

2. Large entrances nearly always show a high proportion of distinctive rock areas and are therefore ideal for photographic identification over a long period of time. There would be no need to fit large tags as the tag position is readily pinpointed in the photo-tag print.

3. The problem of fitting a permanent marker to the harsh environment of a sea cave is completely removed. The very nature of the coastal strip makes describing the position of a sea cave much easier than caves elsewhere. Therefore only one photograph of the entrance should be adequate.

4. Earth filled dolines can be photographed with the number placard in a suitable position. It should be noted somewhere (ideally in the photograph), that neither entrance nor tag exists.

5. In some areas just finding an entrance, any entrance, even when armed with a description and a map can be a frustrating experience. Providing some extra care and equipment is used when photo-tagging a difficult area, the resultant prints could be far more useful than any map or description for pinpointing and identifying a particular entrance.

6. Provided photo-tagging has been done correctly, the absence of a tag does not reduce the certainty of identification. All it does is make it inconvenient and more expensive in that anyone visiting an unfamiliar area would need a set of prints if he wished to identify and refer to any of the caves.

OTHER ADVANTAGES

Anyone wishing to get an idea of the topography and vegetation of an area they have not yet visited, could quickly acquire this by looking through the photo-tag prints.

The dated prints could serve as a baseline from which any significant changes in vegetation or landform could be noted.

In the U.S.A., for conservation purposes, entrance photographs have been used as an indication of the speleo "traffic" (Larson 1978). I am not aware of any entension of this to photo-tagging.

GENERAL COMMENTS

BLACK AND WHITE OR COLOUR?

Not so long ago the cost of colour prints would have ruled them out altogether. Now the price gap has narrowed they can be considered and they do make a very attractive record. Permanence is of course not as good as black and white, but it may be good enough for the purpose. Advice from one of the larger film manufacturers is that colour transparency film stored in normal circumstances will still be good after fifty years. Some colour change would be evident, but image sharpness would not be affected and may remain good for two or three times this period. Colour print film is not as good and any move towards colour should be looked at carefully.

Nevertheless, black and white is quite adequate for the main purpose and the photo-tagging programs begun by S.S.S. are continuing in this medium, although some colour (both prints and slides) has been used.

DIFFICULT ENTRANCES

There are at least two types of cave entrances difficult to photograph. On the side of a gorge and on a hillside of dense low scrub.

In most cases the close shot can be managed. The distant shot is the problem. We need to be on an opposite hillside perhaps 0.5km away and of course even if the entrance is visable the placard would not be legible. The low scrub areas are just the sort of places where caves and those searching for them do get "lost", so it is worthwhile taking some trouble to overcome the problem. A suggested solution is as follows:

Use two groups of people in radio contact with each other. At the cave entrance a "Target", say a 2m high triangle, could be erected on a lightweight pole so that it could be seen by the camera party on the other side of the valley. A photograph would then be taken showing the position of the target in relation to whatever landmarks are available. In the foreground of the photograph would appear the cave number on the normal size placard held at a convenient distance from the camera.

The easiest way to locate such an entrance at a later date is to have a good scrub navigator in the party. Failing this, the photo-tagging situation could be repeated. The searching party might need to make several trial erections of the target whilst someone on the opposite hill checks their progress with the photo-tag print.

This 'target technique" has yet to be tried out.

FURTHER EQUIPMENT DETAILS

The cave photo-tagging placard should have two white triangles. Using these in conjunction with the known print enlargement size and the focal length of the camera used, the distance measurement (how far away the camera was from the placard) can be calculated without having to use a tape measure in the field.

The numerals on the placard are 180mm high and on a 90 x 130mm print can be read fairly easily with the aid of a magnifying glass, in prints taken at distances of up to 100m away. The size of the numerals on our placard seem to be the optimum size - a larger placard would hide the entrance details. The existing placard measures 840mm x 430mm.

PRINT PRESENTATION

Early thoughts were that it would be nice to have an album with one page devoted to each cave - two photo-tag prints and the remaining space taken up by as much information about the cave as would fit in. However, in areas containing 200-300 entrances this format would result in an expensive and bulky album.

The arrangement the Sydney Speleological Society is using at present is a four pocket transparent print protector. With two prints back to back in each pocket, one page will do four caves. This not only keeps the cost down but should enable most cave areas to be contained in one album. The bearing and distance figures have been written along the margin of each of the prints.

Ideally there should be two complete sets of photo-tags - one for library reference and one for use in the field. The need for this will of course depend on the usage. Some thought needs to be given to the safe storage of the negatives.

HISTORY

The first experimental photo-tagging took place at Yarrangobilly, on the Easter weekend, April, 1977. A cardboard placard was held in front of Y40 and photo-tagged with a polaroid camera. This quickly revealed that black figures on a white background was most unsuitable. A hasty reversal was made using felt tip pens and several other entrances were photographed to get an idea of legibility at various distances.

Photo-tagging has continued since then, on trips run for other purposes, and has, therefore, not been reported on in detail (Bonwick 1979b, Bonwick 1979c and Bonwick 1979d). The total number of entrances recorded so far is 281.

This is made up of: Bungonia 64; Yarrangobilly 136; Wombeyan 46 and Jenolan 35.

CONCLUSION

Cave identification has often been a problem, especially in remote areas. It is suggested that photo-tagging of entrances is akin to finger printing of people and should be used to protect the tagging system against error and decay.

This article does not cover all aspects of the photo-tagging scheme, but it should be sufficient to provoke discussion. If other Societies see some value in the process S.S.S. would be happy to discuss it in greater detail. If it becomes a going thing throughout Australia, then it would, of course, be necessary for those interested to get together and formulate some ground rules.

REFERENCES

BONWICK, J., 1979a Easter at Yarrangobilly, 1957. J. Syd. Speleol. Soc. 23 (6) : 156-157.

BONWICK, J., 1979b Photo-Tagging at Yagby. J. Syd. Speleol. Soc. 23 (6) : 157.

BONWICK, J., 1979c Photo-Tagging at Wombeyan. J. Syd. Speleol. Soc. 23 (7) : 175-176.

BONWICK, J., 1979d More Photo-Tagging at Yagby. J. Syd. Speleol. Soc. 23 (7) : 176-177.

ELLIS, R., and MIDDLETON, G., 1970.
A Cave Numbering System for N.S.W. Some observations and proposals. J. Syd. Speleol. Soc., 14 (6) : 141-146.

HALBERT, E., 1968 Wombeyan; Appendix - Technical details on numbering. Stop Press, 12 (12) : 190.

LANE, E.A. and NURSE, B.S., 1961
Cave numbering. Communications, 5 (8) : 45.

LARSON, C.V., 1978 Photography as a cave management tool. IN : Zuber, R. and others (eds). Proceedings of the National Cave Management Symposium, Big Sky, Montana, October 3-7, 1977. Albuquerque, Adobe. Pp. 96-103.

MIDDLETON, G. 1974 A note on Y11, Jounama Cave, Yarrangobilly. J. Syd. Speleol. Soc., 18 (7) : 199-202.

PAVEY, A., 1974 Pavey's Nobel Prize or Why eleven anyway? J. Syd. Speleol. Soc., 18 (80 : 231-232.

WELLINGS, P., 1974 Another opinion on Y11, and some further information. J. Syd. Speleol. Soc., 18 (7) : 202-205.

DISCUSSION

Photo-tagging was tried in Western Australia 7 years previously and we got pictures of nice bush, and very little else. Cave entrances are covered in very thick scrub.

Basically you're saying the method is area dependant and not universally applicable.

I have however got good photographs of vegetation which can be located after finding the cave after a fire or some change has occurred. It is extremely useful for getting background ecological information around caves.

You need to put your tag on the cave as well as photograph it.

We've been doing something similar in South Australia and the Nullarbor for quite a while. Using a stick 1 metre or 2 metres long and recording the information as listed in this paper on the back of the photograph later. Especially on the Nullarbor, people going out there don't always know the number of the feature immediately.

Those numbers are actually made up of the traditional 3 series, 1 to 9 plus the letter. On the placard itself you build the numbers up in the field.

Sometimes you find a new feature. One problem out on the Nullarbor is especially large dolines.

CEGSA has been photographing from one end and having the metre stick at the other end. Some of those dolines are so large you need a very large sighting board, bigger than S.S.S. used to be able to read them.

This problem can be circumvented by having the placard close up as suggested in the paper.

Just a couple of points on the historical use in the location of Bushrangers cave at Jenolan on an internal feature defined in the cave. This is something that may solve Western Australia's problem. It might be better to take a photograph inside the cave of something specific to the cave of an identifiable feature.

I'd like to make a comment on John's reference to 50 year life for colour film. There is considerable difference between substantial and no substantial reversal films exemplified by Koda-chrome and Ecta-chrome. When Kodak were quoting 30 years for Koda-chrome they were only quoting 5 or 6 years for Ecta-chrome, the difference is now slightly less viz. 50 years for Koda-chrome and I think still at 10 to 15 years for Ecta-chrome. The Kodak lifetimes given are for storage, and does not include projection for 3 hours during that time for people to look at them. 50 years is possible with Koda-chrome but don't rely on getting more than 10 years with the Ecta-chrome - it may be up to 20 years out. There is a difference.

At this point S.S.S. are looking at prints and are currently happy with black and white.

I can see the utility to a scientist which wants to monitor the vegetation, but I really don't see photo-tagging as representing the interest of most people because you can't have that many sets of things. It doesn't have the immediacy and so fourth to satisfactorily do the job of tagging.

I specifically asked John and Mark about that aspect and they said they accepted that if a club expressed an interest in an area (which would have a high probability of having aluminium tags) the club would be supplied with the correct folio which contained a set of photo-tagging prints for $50 and whatever costs happen to be for that number of black and white prints for whatever the size was. That was the intention. It was not meant for a speleo handbook or Bungonia Book.

CEGSA has found it much more useful for record keeping. When people find something "new" and they can show you a photograph there is something to compare and make some sort of reasonable judgement as to whether the feature has already been numbered.

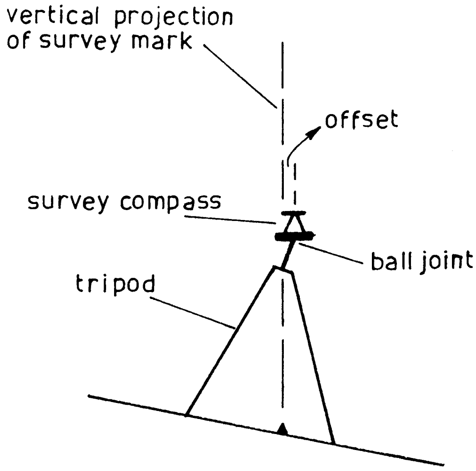
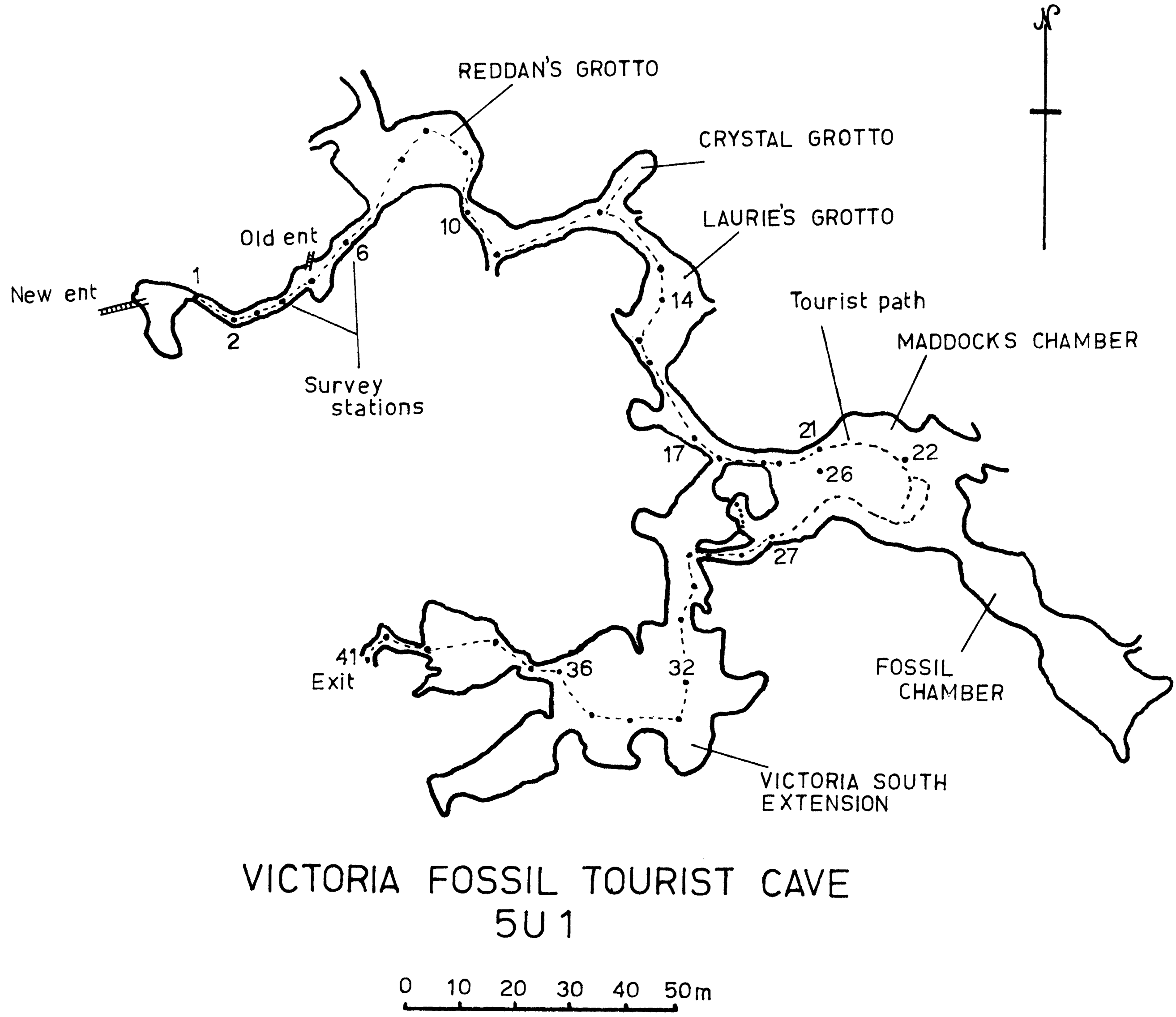


FIG. 3



VICTORIA FOSSIL TOURIST CAVE
5U 1

FIG. 2

SURVEYING IN VICTORIA FOSSIL CAVE

by

Kevin Mott

C.E.G.S.A.

Surveying in tourist caves poses particular problems with the effects of hand rails and electric lighting.

A survey was undertaken using a Tracon S25 surveying compass in the Victoria Fossil show cave. The problems of the survey and comparison of results between a magnetic survey and theodolite survey are made.

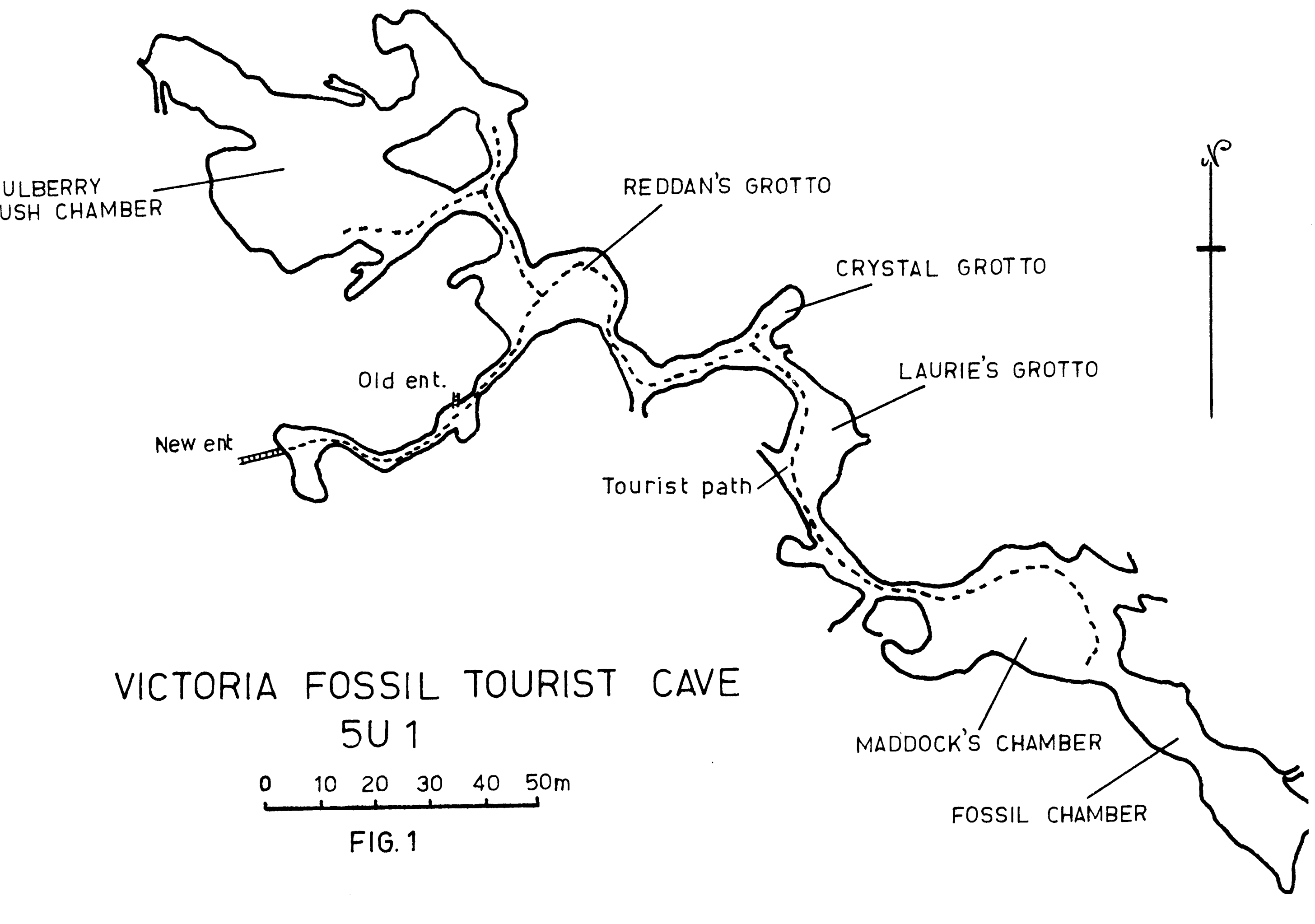


FIG. 1

This paper looks at the history of surveying in Victoria Fossil Cave, the problems we are having with surveying the cave and the results of the surveys.

Victoria Fossil Cave was discovered by William Reddan in 1893 and opened for tourism in 1897. It was known as Victoria Cave (after Queen Victoria) at that time. Probably it is South Australia's major tourist cave.

Although the cave has been known for quite a long time it was only in 1956 that the first map of the cave was produced. Those surveys usually were done with a compass; either a forestry compass or hand compass and a tape, and appeared quite satisfactory.

The extent of the original tourist cave was quite small; reaching only to Laurie's Grotto (Fig. 1). The entrance was a dug shaft with a near vertical ladder. To avoid the problem of old ladies falling down and young lads looking up the dresses of ladies climbing the ladder National Parks decided to excavate a new entrance in 1967. The site of the original entrance was opted for. CEGSA surveyed a route through the crawlway from the natural entrance to the existing tourist entrance. There were no problems with this survey.

With the discovery of the fossil beds by CEGSA in 1969 the tourist route was extended to include the Fossil Chamber in the tour. In 1975 the name was changed to Victoria Fossil Cave to avoid confusion of tourists thinking that there were two separate caves.

In 1979 the tourist route was upgraded and an exit constructed to enable through trips to be conducted to cater for the larger numbers visiting the cave since the discovery of the fossil beds. Using RDF as a control CEGSA surveyed the cave to determine the most practical route suitable for wheelchairs.

As it turned out the eventual pathway was too steep for wheelchairs. The survey based on RDF control did not correlate with the previous surveys. To complete the plans of the proposed new tourist route some adjustment had to be made to the previous surveys.

For the survey of the completed tourist route, which now bypassed the Mulberry Bush Chamber (Fig. 2), it was decided to use the Tracon S25 surveying compass. This instrument, in addition to the compass, has a horizontal circle for reading angles to an accuracy of 5 minutes.

With compass surveys in caves the practise has usually been to use a leap frog method of surveying. The instrument is set up at alternate points with back and forward bearings read to the appropriate intermediate points. Theodolite surveys are set up at each point of the traverse and angles read between the back and forward points.

Using the Tracon it was decided to do both methods concurrently using the compass and the horizontal circle. The theodolite type survey would provide the accuracy and a base to compare the compass survey with. Each survey station was marked by placing a masonry nail in a hole drilled in the concrete pathway. A hole had to be drilled because the rough concrete aggregate mix shattered if the nail was just hammered in. The nail head was left just protruding above the surface of the pathway. Although the tourists could not trip over them they did cover them with the mud they brought in on their shoes. Any future surveys in the tourist section of the cave can tie into the present traverse by relocating these nails.

The survey method appeared quite simple at first but a few problems occurred. Due to the amount of data to be recorded at each point (forward and back angles and bearings, dip, distance and instrument height) if one component was omitted the whole procedure at that point had to be repeated.

Originally the surveys were done at night after the normal daily caving activities. We were eventually given a dispensation to undertake the survey between the tours which were run at approximately hourly intervals. As tour parties approached we would transform into instant stalagmites while the tour party gingerly picked their way past us and the instrument which naturally was placed in the middle of the pathway. Despite their ooh's and ahh's they did not bump the instrument. This feat was usually reserved for me as I recommenced the survey. Parts of the cave turned quite blue at times. Survey parties were always changing so each party needed instruction in the method and reasons before commencing the survey.

The equipment itself posed some particular problems. Parts of the route are quite steep. While some legs of up to 15m could be obtained most were between 3-5m. It was often very difficult to set up the tripod such that the column support of the compass was vertical when attached to the tripod. This is necessary because the adjusting ball joint of the compass is some considerable distance above the plumb-bob attachment on the tripod. If the column support of the compass is not vertical the centre of the compass's telescope is offset from the vertical projection of the survey point (Fig. 3). The Tracon needs to be attached to the tripod with a mechanism similar to that of the tribrach of a theodolite. The plumb-bob should be attached high up on the column support not the tripod.

The survey has not been closed yet as on the last trip I was stricken with hayfever upon exiting the cave and the continual sneezing and watery eyes made reading the instrument difficult. A cold front brought strong winds causing the plumb-bob to oscillate wildly so that the tripod could not be set up accurately.

The magnetic variation (Table 1) changes considerably throughout the cave, that is 19^{0} at the entrance, 11^{0} at the exit, 11^{0} at the power inlet and 32^{0} in Maddock's Chamber where there is no apparent cause of interference. The sense of the difference was not constant throughout the cave. As was expected the difference between the bearings at each point correlated closely with with the horizontal angle.

What needs to be done now is to close the traverse and to analyse the results with respect to what exists in the cave.

SUMMARY OF DISCUSSION FOLLOWING TALK

Ken Lance:

What do you propose to do with the magnetic field varying all over the place like that?

KRM: At this stage I am not sure what to do. Originally I intended to chart the differences and draw up a plan showing correction factors for compass surveys in the Tourist cave.

Henry Shannon:

At each point the compass, if able to be read to $\frac{1}{2}^{0}$, can be used as a theodolite as the error is constant and only the north point has changed. Can adjust survey by using line with least difference between back and forward bearings as a base.

Rauleigh Webb:

Similar problems in Lake Cave, Western Australia. Tested compass and found that if 2m from railing then no problems. Did survey with the cave lights off and staying 2m from rails.

KRM: Cannot do that here as we are constrained to stay on the pathway and keep of the decoration.

TABLE 1

Station / Station	Difference between forward and backward magnetic bearings in degrees	
1	-19.0	Entrance
2	+ 3.3	
3	- 4.1	
4	- 4.8	
5	-17.5	Old Entrance
6	-13.0	
7	+ 4.8	
8	+ 1.8	
9	+10.0	
10	- 6.8	
11	0	
12	0	
13	+ 0.3	
14	-11.0	Power inlet
15	+ 7.0	
16	+ 5.0	
17	- 1.0	
18	- 2.5	
19	+ 2.0	
20	- 5.0	
21	-24.5	Maddock's Chamber
22	+32.5	
25	- 3.5	
26	- 0.5	
27	- 3.2	
28	+ 1.5	
29	+ 2.0	
30	- 5.0	
31	+ 4.5	
32	- 1.0	
33	+ 0.5	
34	+ 2.5	
35	0	
36	0	
37	+ 1.0	
38	- 2.0	
39	+ 1.0	
40	- 1.0	
41	-11.5	Exit

NOTE

Stations 23 and 24 are intermediate points within Maddock's Chamber.

THE NULLARBOR, WHERE IS IT?

by

Norm Poulter

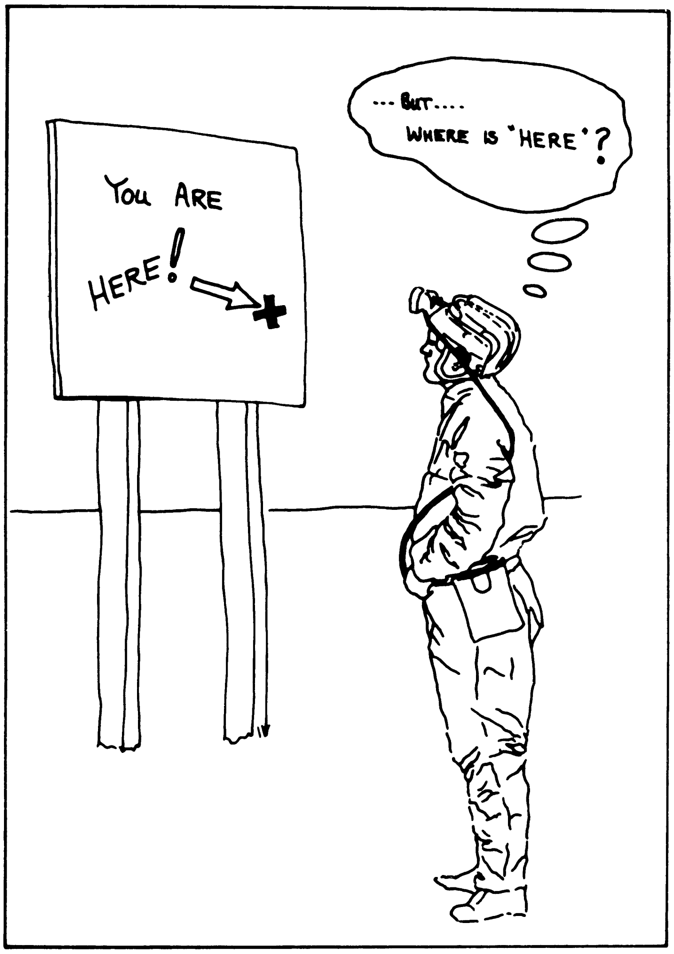
S.R.G.W.A.

Apart from being the world's largest expanse of limestone, the Nullarbor Plain is one of Australia's remote caving areas.

Remote yes, but no longer difficult to reach. With today's "affluent cavers", modern vehicles and sealed highways, the Nullarbor is within easy reach of most capital cities.

The caves of the Nullarbor however, can be difficult to find. Despite advances in mapping and navigation technologies, ground parties still experience difficulty in knowing where they are in relation to caves, maps - and themselves.

This paper outlines a still un-resolved difficulty in plotting the location of Thampanna Cave (N206) and its historical namesake, Thampanna Rockhole.



The Nullarbor Plain, at 200,000 km^2 is the world's largest expanse of limestone. Due to the almost featurelwss terrain and often, out-dated maps, navigation to caves is usually difficult. Navigation in fact, away from the major caves and roads, seems to be a hit and miss affair. Unlike city street directories, the maps of the Nullarbor are not revised annually and when revision is carried out, pre-publication surveys appear to be restricted to 'populated' areas and 'main roads'.

The implied question asked by this paper is:

When a person is at a given point (as indicated on a map) are they really there?

This writer became interested in the problems of Nullarbor navigation during the Goede/Jennings Expedition of April/May 1981 when Mott and Pilkington of CEGSA came across a cave in the Thampanna Rockhole area of Mundrabilla Station. According to a sketch map produced by the Western Australian Speleological Group in 1980, the cave was Thampanna Rockhole although the Eucla (1963) survey sheet covering the area showed the Rockhole to be elsewhere. Dr. Glen Hunt (pers. comm. 1982) states that the cave was known to rabbit hunters as early as 1964. Due to the lack of roads/tracks in the vicinity (of the cave) at that time, and despite directions given by the hunters, the Hunt party were unable to find the cave. To further complicate matters, WASG ultimately named the cave, Thampanna Cave N206, due to the acknowledged close proximity of Thampanna Rockhole (approximately 1km east), originally named by the surveyor Turner in 1885, the name most likely derived from aboriginal lore.

The most commonly used maps of the Nullarbor region are 1:253 440 survey sheets published during the early 1960's, which in turn were based on military maps of the 1940's. These maps are only just being replaced by a new metric 1:250 000 series. The 'standard' Eucla map of 1963 has just been replaced by a metric map of similar scale, published in early 1981. Approximately 50% of the new map was compiled from air photographs taken during 1978. In the Mundrabilla region, part of the map appears to be already out of date.

The dominating feature of the Thampanna Rockhole area is a road, running in an east-west direction. The 1963 Eucla sheet plots Thampanna Rockhole a short distance north of this road while the 1981 edition places the Rockhole on the southern edge of the same road. Other rockholes and caves in the same vicinity are also in different positions on the two maps. Why?

The access road to Thampanna rockhole and Cave is the reason given for the position shift of Thampanna Rockhole by the Division of National Mapping, Canberra. They claim that during the seventeen years between the survey for the 1963 map and the supplementary survey for the 1981 map, the access road had 'been moved' (north), hence the apparent position change of Thampanna Rockhole. Reference to the relevant air photographs however, dispute this claim. Careful study of the 1978 air photographs clearly show the existing road overlaying the original road between a gate and Thampanna Rockhole save for the inclusion of some deviations around some low hills. (see Fig. 1). The section of road adjacent to the Rockhole is still exactly where it was prior to the 1961 survey. Somewhere around 1975, the road was extended to the west of Thampanna Rockhole, and thus passed within 100m of the future Thampanna Cave.

The location of Thampanna Cave is now known (Poulter 1982), being proven by aerial observation. In theory, the location of Thampanna Rockhole is also known although finding it on the ground is another matter. The surveyor Turner, during 1885 was surveying the Eucla townsite and plotting rockholes (including Chowilla Landslip) in company with native guides. According to Turner's fieldbook, he established a camp on August 11 at a (corrected) latitude of 31°42'44" and plotted Thampanna Rockhole nearby (most likely) the following day. He estimated the capacity of the Rockhole to be 200 gallons, which implies it to be fairly small and thus hard to find. Turner does not appear to have left any diaries in which other information may have been recorded and the W.A. Lands and Survey have since lost his Original Plans (scale drawings) of the nullarbor region.

When the 1963 Eucla sheet was published, the plotted position of Thampanna Rockhole was approx. 31°35'15". Come 1981 and the Rockhole had been moved to 31°41'38", close to where Turner had originally plotted it almost 100 years before.

Why the interest?

Well, as Billy McMahon once said, "We know where we are going!"

Unfortunately, in order to know where we are going, we first have to know where we are, or for that matter where we have been. In other words, if the federal mapping authorities, despite the advantages of modern cartographic technology, cannot position rockholes (relatively unimportant features by today's standards) on maps correctly, can the caving fraternity be confident that access roads and caves are plotted any better?

DISCUSSION

The use of a known cave to plot a new cave can place the new cave at the wrong location. Turner was not interested in caves and did not plot them on his surveys.

A group from the Western Australian Institute of Technology plan to follow Turner's survey path across the Nullarbor from Mundrabilla (old) homestead to determine the actual location of the Thampanna Rockhole.

REFERENCES

Poulter, N. 1982 'Thampanna Cave N206' ASF Newsletter # 95 pp. 2

Air photographs. Eucla SH52-14 CAE/F 8749, run 6, print #'s 118, 119. 9-2-1978.

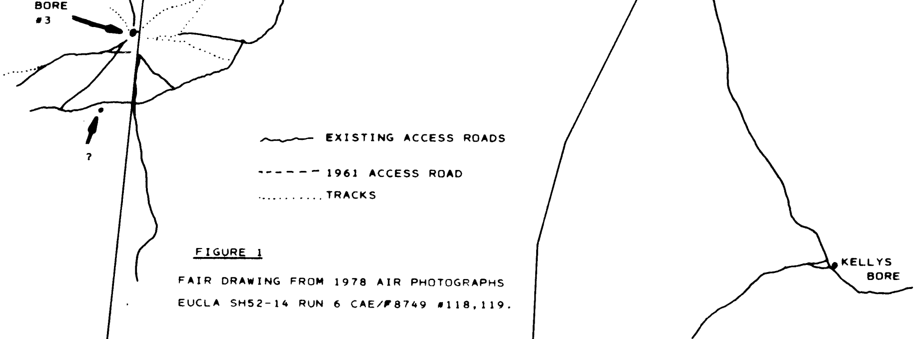


FIGURE 1

FAIR DRAWING FROM 1978 AIR PHOTOGRAPHS
EUCLA SH52-14 RUN 6 CAE/#8749 #118,119.

Well! I must have come in here.

AN AUSTRALIAN CAVE & KARST DATA BASE

by

Terry O'Leary
N.S.W.I.T.S.S.

Randall King
S.U.S.S.

Technology has proceeded to change the way we think and the way computers work. In the past 10 years computers have become more complex yet much easier to use, and of course they have become much cheaper.

Software developments have not kept pace with hardware developments. Software however has become much more user friendly. Now software may form the main cost of any computer project, where once hardware was the major cost.

Recent developments in software are aimed at reducing the cost of this software component of any project.

The scope of this paper is to examine how some of these recent changes in software and hardware would affect a cave and karst data base.

Technology has proceeded to change the way we think and the way computers work. In the past ten years, computers have become more complex, yet much easier to use and they have become much cheaper.

Software developments (which are the programmes which enable the machine to perform useful functions) have not kept pace with hardware developments (which is what we can physically touch). Software however, has become much more 'user friendly'. Now software may form the main cost of any computer project, where once hardware was the major cost.

Recent developments in software are aimed at reducing the cost of this software component of any project by reducing the human component.

The scope of this paper is to examine how some of these recent changes in software and hardware, would effect a cave and karst database.

INFORMATION IS POWER

The brain is adequate for storing certain information and has been used for a long time, but limitations such as intentional and unintentional errors are quite common. No storage device can equal the brain for versatility, but physical storage on knotted ropes, ledgers and magnetic media is more permanent and more easily accessable by other people and if done correctly is usually less error prone.

Electronic computers have helped people to cope and produce the masses of information used in our complex society.

The hardware is now cheap and reliable. It provides storage devices with millisecond access time (often microseconds and even nanoseconds) with enormous storage capacity, megabytes and even gigabytes. (a byte is one character usually represented by eight bits). These devices can be bought at low cost, for example a disk drive with 5 million characters (or about 2,500 A4 typed pages) is available for around $3,000.00. The storage capacity will increase and the cost will reduce in the future.

Storage was once very expensive. Volatile memory (memory which disappears if the power supply ceases) was, ten years ago, about $1,000.00 per one thousand characters. Now, for example, 16 thousand characters can cost about $100.00. This is 160 times improvement in cost performance.

If the car industry could have performed at a similar level, it would cost $2.00 for a Rolls-Royce and 200 would fit on the head of a pin.

The hardware has changed in a remarkable way. The software has improved but not at a rate comparable to the hardware. However, the rate of improvement has increased in the last two to three years in particular.

Until recent times, new and updated information was collected in batches. Then at regular intervals this information was transferred from temporary records to the master storage. The main problem with this approach is that between batches, the information is out of date and at least two copies of records are kept.

Interactive processing is the most common way of doing data entry today. The data is entered directly on to the computer. The master record is now the actual correct data. The computer also has the advantage that it can check the data for errors before storing it. If the data is invalid, the computer then can give the person entering the data a chance to correct it.

The master record group which enables people to have direct access instead of multiple working copies and intermediate forms of the information, is called a database.

A database is a collection of related records on one or more mass storage device(s). All the records and sets are described by a specific scheme.

A record is a collection of data items treated as a unit, such as particular information on one aspect of a cave, such as length, depth, etc...

A set is a defined relationship among the records in a database, for example, all the caves over 50 metres long.

The schema is the structure and logical description of a database. It is this structure which enables the addition of new categories of information without restructuring as would have to happen even with conventional computer files.

The procedure would be to define the new category and its relationship to other databases by adding these new definitions to the schema of the database.

What does all this technological mumbo jumbo have to do with caving and A.S.F.?

A major reason is that a database is the only effective way of handling the mass of data available on Australian caves. With the use of modern computer typesetting for publication, it provides an economical way of producing up-to-date publications with regular updates available.

The database could also be used for scientific research or for a rapid response to conservation issues.

For example, if a database was available, information about certain Tasmanian caves may be more readily available and even a type set quality publication could be rapidly available.

Examples of types of questions would be:

- List 50 deepest and longest caves in Australia, by State.
- List all caves owned by Government, noted as having archeological significance in Western Australia and Northern Territory.
- List all known maps, map controllers and map publication references to caves in the Kimberleys.

These type of questions may help caving in Australia undergo a renaissance, as people can easily see what work has been done and more importantly what still needs to be done.

In conclusion the database project is underway and hopefully soon will produce results, but on its own, it's nothing. What will be important, is how it will be used and how its publications are treated.

They should be questioned and data which is out of date corrected and updates regularly made available. A properly constructed database may cause a new age of activity in caving in Australia.

DISCUSSION

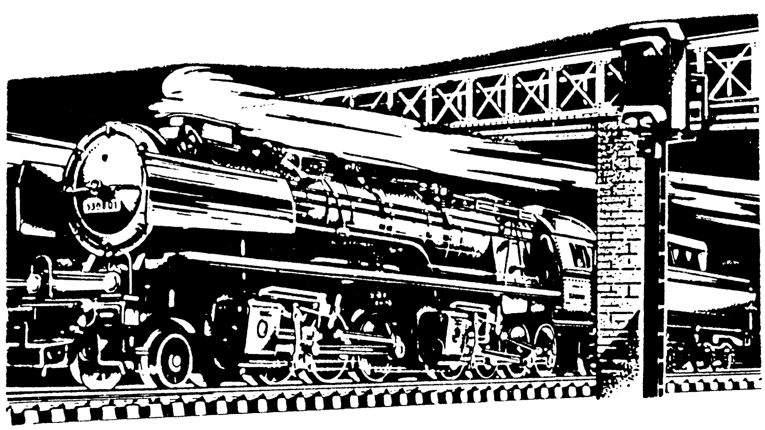
The proposal is to have the database on-line. The data can be safeguarded by cave, State or cave-property by the use of access codes. Individuals with home computers will be able to update and interrogate the database for the cost of a local call in the major cities.

ARMCHAIR SPELEOGICAL ASSOC. AWARD

Its very first award after a long and lazy existance - presented to John Dunkley, viz:

"GRAND ORDER OF THE BATH CHAIR"

for his admirable effort in surveying a cave from his seat on a moving train.



LIGHT EMITTING DIODES

A Use for them in Caves

by
Norm Poulter
S.R.G.W.A.

Light Emitting Diodes (LED's) are bright, virtually indestructable point sources or light with low power consumption.

They have a use as temporary or emergency track markers and have made ideal survey markers.

This paper attempts to demonstrate their usefulness.

A USE FOR THEM IN CAVES

Light Emitting Diodes (LED's) are a bright, virtually indestructable point light source of low power consumption. Originally designed for use in scientific instruments and computers, they have now found uses in all sorts of appliances, from industry to the domestic scene.

The use of LED's in caves was first proposed by Charles Willock of SRGWA in 1976. Following the introduction of brighter and more efficient LED's a few years later, the idea became viable. Originally intended to lay out the angle of view for large scale speleophotographs (fig. 1) as well as marking the camera position, the device also had application for survey and temporary track markers.

Several single LED units assembled in 1979 have been used as survey markers and aiming points for a theodelite survey as well as a solo survey of Frolic Cave in Tasmania during 1981 (Poulter 1981). Aiming a compass, clinometer or theodelite at a low intensity point source of light seems far easier than using caving lights. Utilising a twin 'AA' battery pack, the single LED had an effective light duration in excess of nine days although a disadvantage was that the light could only be seen from one direction making their use as emergency two-way track markers limited.

With the recent introduction of red and green fresnal LED's by Tandy Electronics ($1.29/pair), it became possible to manufacture a colour coded two-directional marker, mounted on a twin 'AA' battery pack without the LED's protruding past the pack bodyline. Once soldered into position with their enabling resistors (fig. 2) the diodes and resistors are embedded in epoxy to protect the connections. Red and green LED's are the best colours to use as these give the easiest colour determination from a distance. Another aid, when using the LED's as markers, is to number them with waterproof felt pens. Weighing 45 grams with batteries and costing about $2.00 for components excluding batteries, the units have an effective light duration of at least 4-5 days depending on the quality of medium priced batteries used. The resistor values shown in the diagram are designed to give optimum illumination with reasonable battery life.

Another type of marker is one that uses the new red flashing LED ($1.59 each, Tandy). Due to the necessary higher operating voltage, the flashing LED (fig. 3) must be used with four 'AA' cells thus giving a weight disadvantage in relation to the constant light LED's. By wiring a standard green LED in series with the flashing LED, the green LED is made to flash in unison. This twin flashing unit has an effective battery life in excess of six days.

CONCLUSION

The LED markers can be used for:

- laying out the parameters of photographic setups,
- marking survey points,
- acting as aiming points for surveys,
- temporary or emergency track markers.

As the LED's produce their own light, a person does not have to shine a light in their general direction in order to find out where to proceed. In a rescue situation, where people may be unfamiliar with caving or a particular cave, this feature could be a distinct advantage.

With a visible range as great, if not greater than reflective markers, LED markers may have a role to play in the continuing, safe study of caves.

REFERENCES

Poulter, N., 1981 **'Rocky Boat Inlet, Tasmania'** ASF Newsletter #94 pp. 7.

DISCUSSION

What effect does the cave environment have on the circuit? Because the circuit is in epoxy resin, the only concern is a short-circuit or corrosion of the batteries. Dampness will limit battery life. Can encapsulate the batteries to prevent corrosion.

There is no on/off switch in the circuit; to stop, disconnect the battery.

Can use slower flashing rate to increase battery life.

LED LAYOUT FOR LARGE SCALE SPELEOPHOTOGRAPHS.

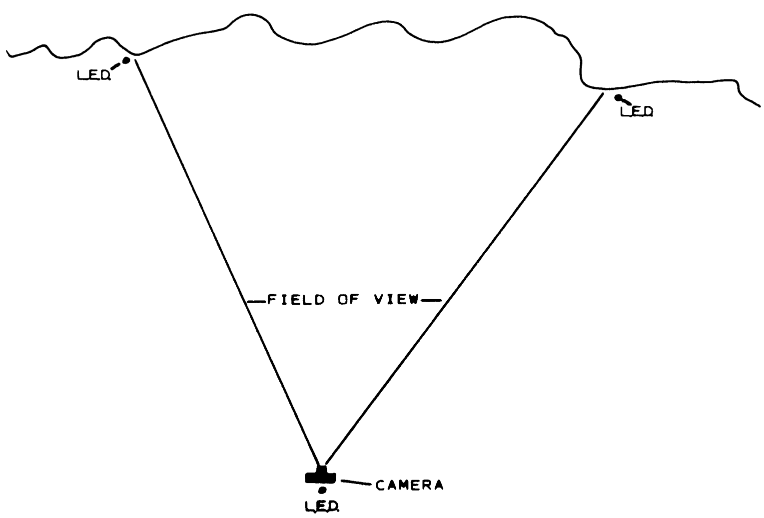


FIGURE 1

NP OULTER
1982

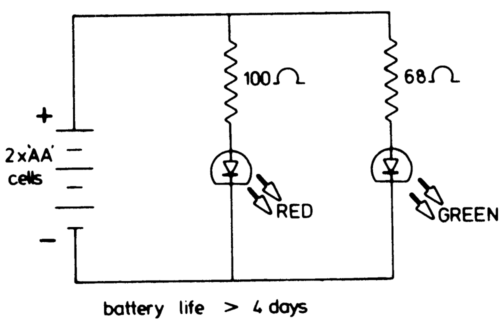


FIGURE 2

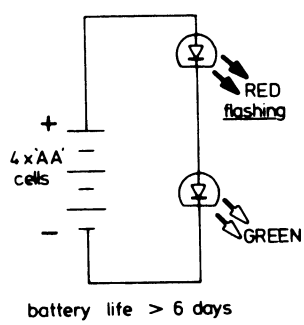


FIGURE 3

LED MARKERS CIRCUIT DIAGRAMS

NP OULTER 1982

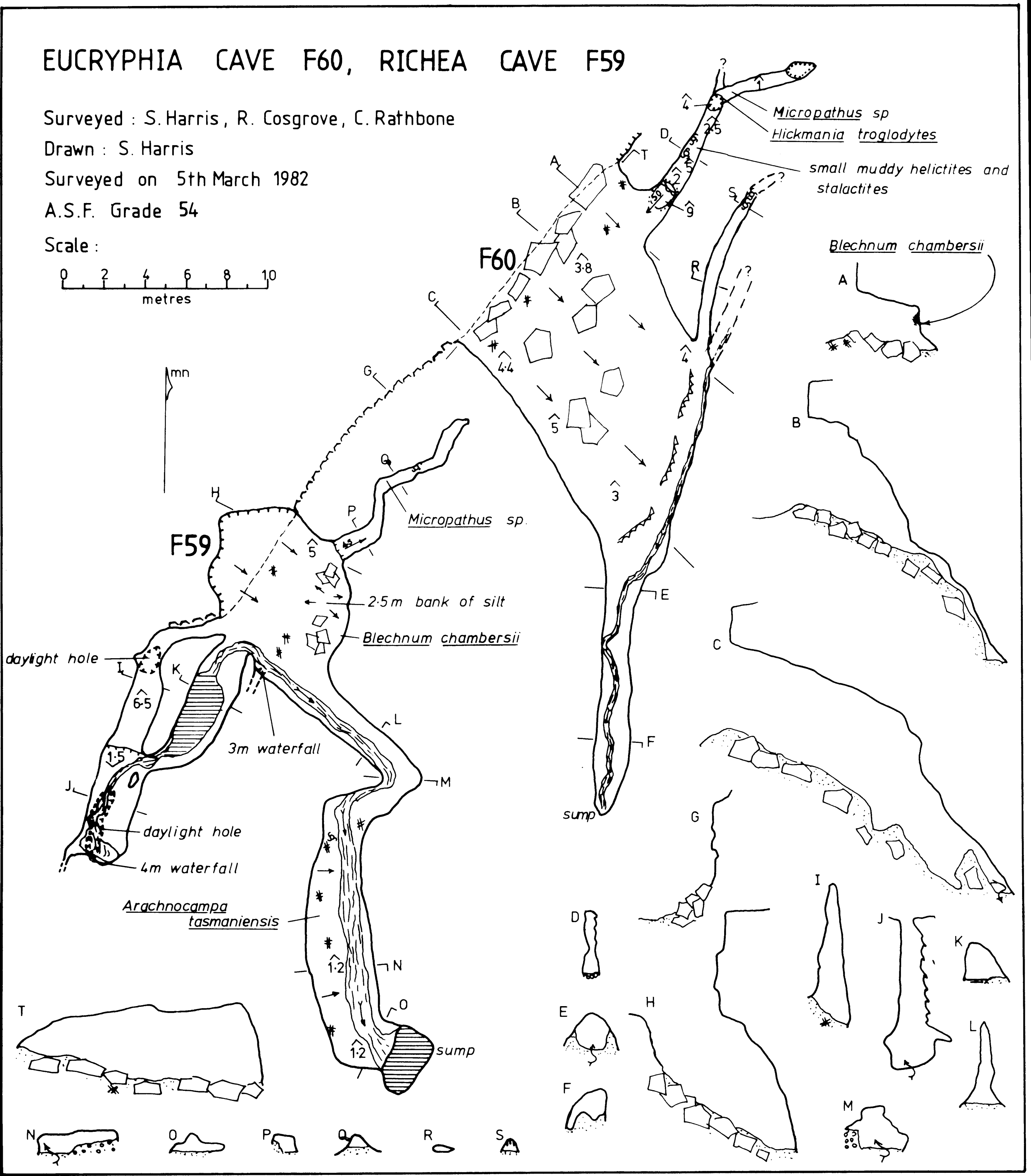


FIGURE I MAP OF RICHEA CAVE F59 AND EUCRYPHIA CAVE F60.

NEW CAVES ON THE FRANKLIN RIVER

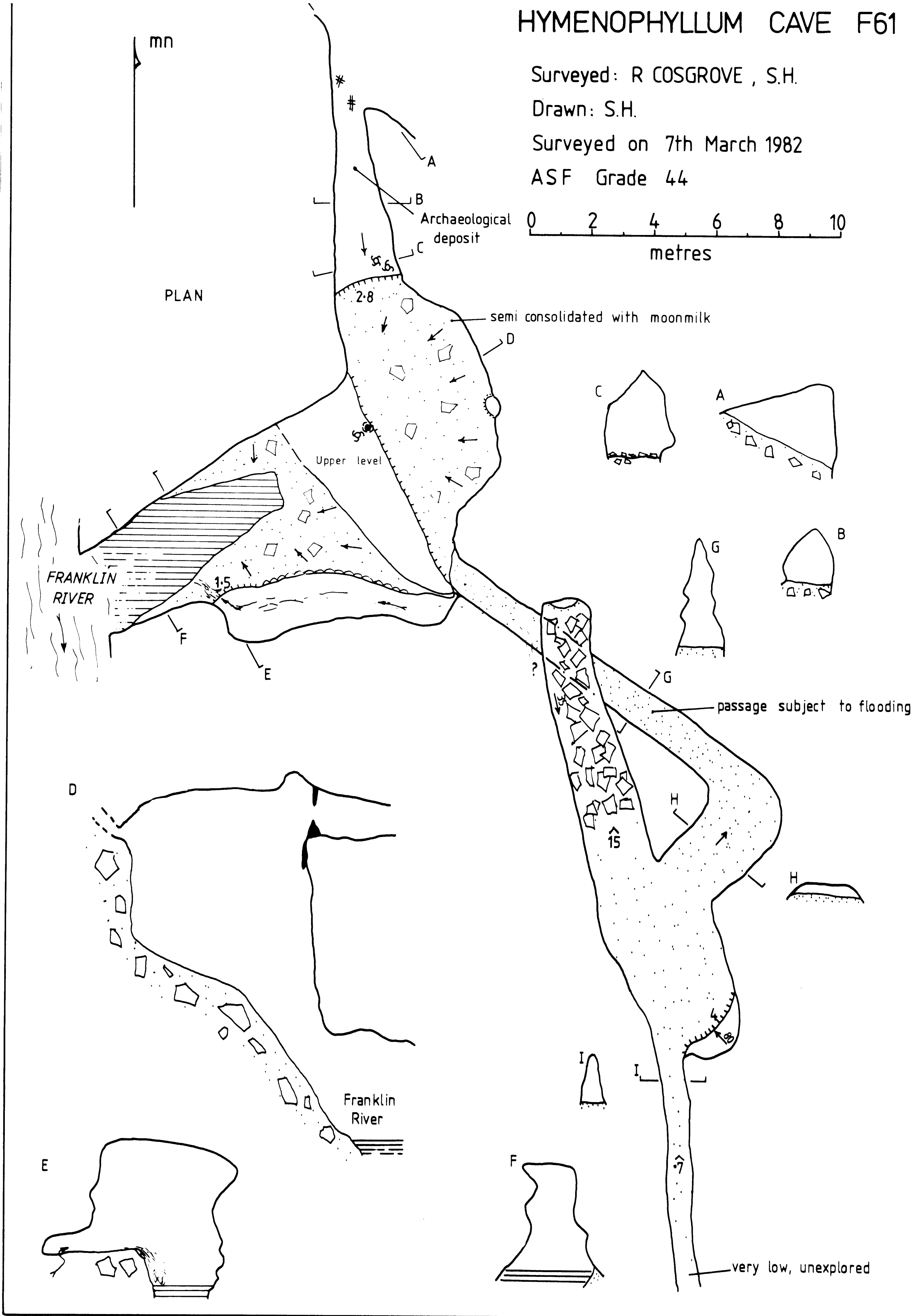
by

Stephen Harris

Tasmanian National Parks & Wildlife Service

Six new caves discovered on the Franklin River (South West Tasmania) during March 1982 have been mapped, these include the longest known cave in the Franklin River area - Biglandulosum Cave with a surveyed length of 366 metres and passages yet to be explored and surveyed. Two caves discovered and explored by the Sydney Speleological Society Expedition in January 1977 have been resurveyed and these contiguous caves have been named Richea Cave (F59) and Eucryphia Cave (F60).

Five of the eight caves contain archaeological relics. All these caves have been named for plants which are typical of the South West Tasmania riverine rainforest.



Proceedings of 14th Conference of the ASF 1983

FIGURE II MAP OF HYMENOPHYLLUM CAVE F61.

INTRODUCTION

Between 22nd February and 16 March 1982 a joint Tasmanian National Parks and Wildlife Service and Australian National University expedition, continued the systematic search for archaeological sites in the densely forested Franklin River valley, south west Tasmania.

Following the discovery of prehistoric sites in suitable cave entrances in 1981 (for example see Kiernan, Jones and Ranson 1983), the continuing search for sites was guided by maps and information compiled by various expeditions of the Sydney Speleological Society and summarised by Middleton (1979). In the course of examining known caves, a number of new caves were discovered. Lack of time precluded proper surveying of all of them and only the six which were surveyed are described here. In addition two known and previously surveyed (see map No: 35 in Middleton, 1979) caves were resurveyed, named and given numbers (F59, F60).

Five of the caves contain archaeological relics, these being Eucryphia Cave (F60), Hymenphyllum Cave (F61), Milligania Cave (F63), Biglandulosum Cave (F66), Aristotelia Cave (F69).

The caves have been named at the suggestion of Dr. Rhys Jones, for plants which are typical of the South West Tasmania riverine rainforest. These names should be regarded as temporary, pending Tasmanian Nomenclature Board approval.

CAVE DESCRIPTIONS

RICHEA CAVE (F59). (Figure 1)

This cave was discovered and surveyed by the Sydney Speleological Society in January 1977, a brief description and a rough sketch map appearing in Middleton (1979). The cave was resurveyed. It is an active stream cave with a sizeable creek entering by a 4m waterfall. Within the cave a tributory creek enters from an unexplored upper level by a 3m waterfall.

The cave is about 62m long with a cliffed entrance doline and 2 daylight holes. The downstream end terminates in a sump. That portion of the passage upstream from the 3m waterfall tributory has smooth limestone floor and walls and no silt or rubble, in contrast to the passage further downstream.

There is no noteworthy speleothem development in this cave.

Glow worms (Arachnocampa tasmaniensis), cave crickets (Micropathus sp) and freshwater shrimp (Anaspidies sp) were observed. A fly of the family Tipulidae (Crane Flies) was observed at the sump.

Richea is the generic name of the pandani palm (Richea pandanifolia) common along the Lower Franklin River, particularly above limestone bluffs near the river.

EUCRYPHIA CAVE (F60). (Figure 1)

This cave was also discovered and surveyed along with F59, by S.S.S. in 1977. In 1982 stone tools were discovered in the entrance chamber which prompted a careful re-survey of the cave.

The cave, 53m long, contains some stalactites and small helictites in its small passages but otherwise exhibits poor speleothem development. At the base of the steep talus and mud-floored slope in the entrance chamber is a trickle of a stream which meets a sump. This presumably flows towards the sump in F59, a connection postulated by Middleton (1979).

Cave crickets (Micropathus sp) and the Tasmanian cave spider (Hickmania troglodytes) were observed in the upper level passage. The fern Blechnum chambersii occurs on a back wall of the entrance chamber in low light conditions.

The Tasmanian endemic leatherwood, Eucryphia lucida is a major component of the rainforest.

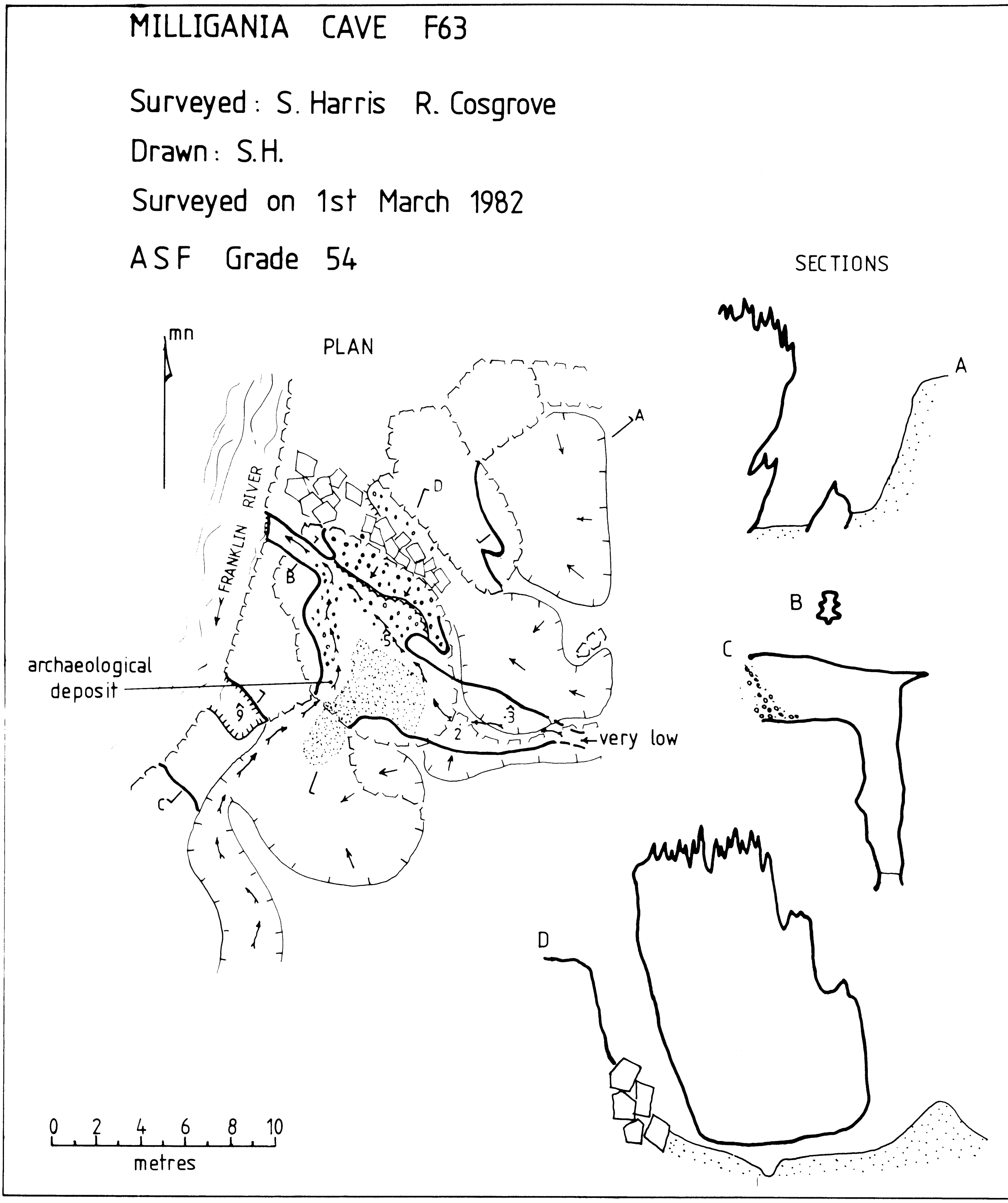


FIGURE III MAP OF MILLIGANIA CAVE F63.

HYMENOPHYLLUM CAVE (F61). (Figure II)

Artefacts were discovered in 1982 in the northern entrance to this cave.

This cave remains to be fully explored but the present surveyed length is 61m and comprises 2 major levels, the upper level conforming to a direction of 340° while a lower level passage is developed in a direction of 307°.

Some attractive stalactites, stalagmites and flowstone occur on an upper level balcony. Speleothem development elsewhere in the cave is minimal. The lower level passage contains much silt and would completely fill with water during any normal flood of the Franklin River.

Hymenophyllum is the generic name of a group of delicate filmy ferns which are ubiquitous in these rainforests.

MILLIGANIA CAVE (F63). (Figure III)

Although it is only 22m long this attractive cave is surrounded by a complex microtopography of cliffs, dolines and bluffs. Stone tools were found on the floor of this cave.

Although there is little speleothem development, the cave and its immediate surroundings are geomorphologically fascinating. For example the passage at cross section B has the classic form of a phreatic tube with scalloping on the smooth walls, while the floor has a neat small vadose trench carrying the present tiny stream. On the bluffs above the cave there is spectacular rillenkarren development often on either side of sharp crests.

Milligania longifolia is the endemic lily known only from the riverside limestone cliffs of the Lower Franklin and Lower Gordon Rivers.

ANOPTERUS CAVE (F65). (Figure IV)

This small cave of 17m length occurs in a low ridge about 200m north east of Bingham Arch. It is dry, floored with angular limestone boulders, and is nowhere subject to total darkness. Some stalactites and stalagmites occur.

Cave crickets (Micropathus sp) and Tasmanian cave spiders (Hickmania troglodytes) are present. There are signs of the cave having been used as an animal lair.

Surrounding this cave, the Tasmanian endemic Anopterus glandulosus is a prominent and attractive tree in the rainforest understorey.

BIGLANDULOSUM CAVE (F66). (Figure V)

This basically horizontal cave is strongly joint controlled with two sets of passage directions more or less at right angles (trending 334° and 64°). With a surveyed length so far of 366m, it is the longest cave known for the area. The cave has 6 known entrances, each of these being in small dolines on the north western side of a large ridge. The extensive archaeological deposit occupies the largest of the entrances. Elevation of this main entrance above the present average summer water level of the Franklin River is 33m$\pm$.

The cave passages seem to be of phreatic origin with domed ceiling pockets and generally smoothly sculptured profiles. Thick banks of alluvial sediments occur in the cave, these apparently once filling the cave, but since this time there has been settling and weak consolidation of the deposits and subsequent subsidence and basal re-excavation of these sediments by very small present streams occupying a poorly developed lower level set of passages.

This cave is richly endowed with speleothems and includes the following formations : gypsum flowers and crusts, straws up to 1.5m long, flowstone, heligmites, helictites, stalagmites and straw columns up to 1m high. Some clay floor deposit has shrunk into polygons and such areas are extensive in part of the cave.

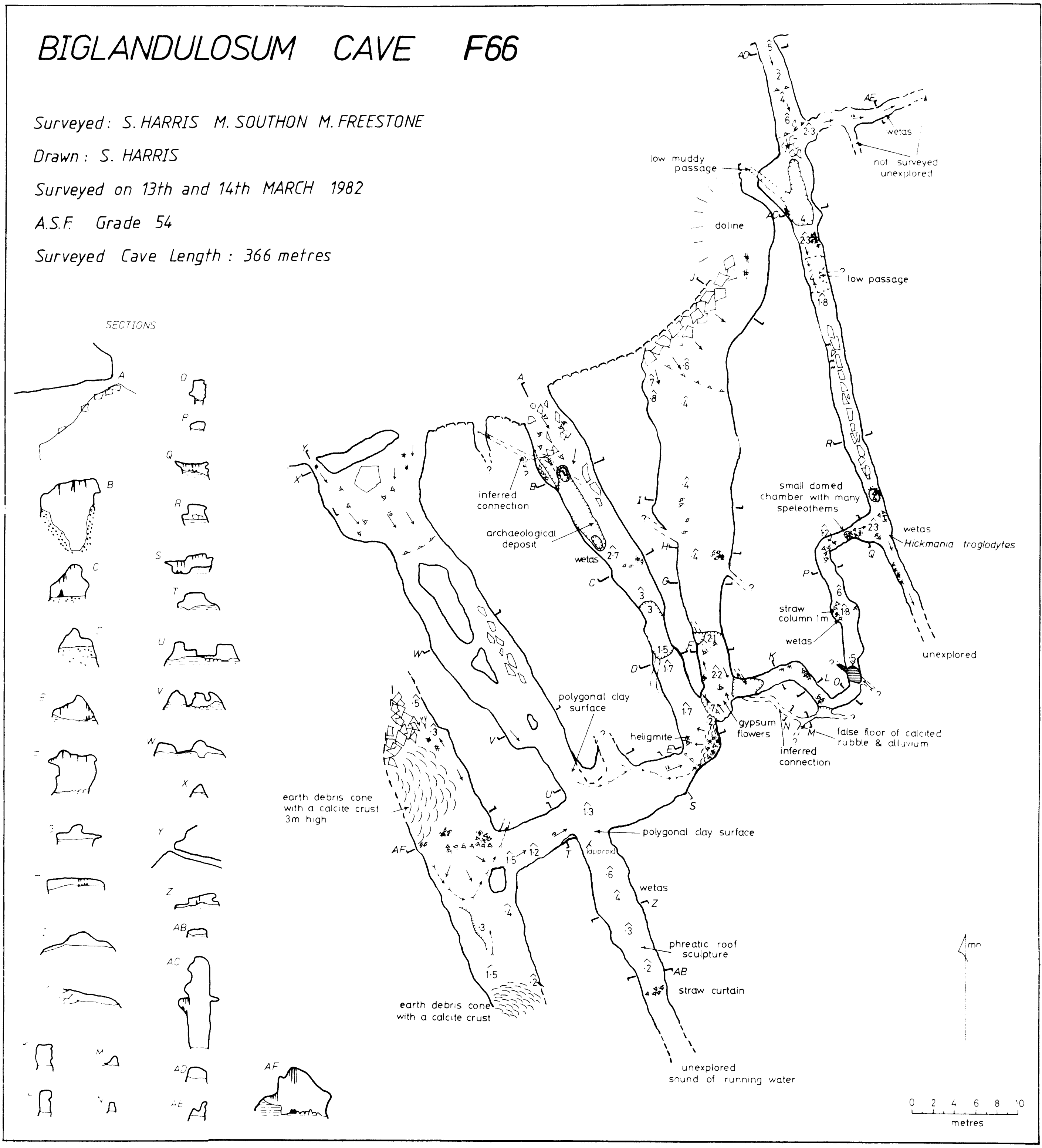


FIGURE V MAP OF BIGLANDULOSUM CAVE F66.

Among the creatures observed in the cave were cave crickets (Micropathus sp) and the Tasmanian cave spider (Hickmania troglodytes). Enough other invertebrates were observed to give the impression that this cave is rich in its diversity of insect fauna.

Anodopetalum biglandulosum ("Horizontal") is a tree which often grows in a confused tangle and is difficult to walk through. It is a common component of the rainforest.

RIPARIUM CAVE (F67) (Figure VI)

The cave is 45m long with a small stream issuing from it. The stream near the cave mouth, is very close to the average level of the Franklin River, into which it trickles through a mound of alluvium and cliff fall debris.

The north western wall of the main passage is comprised of a continuous large bank of alluvium, part of a river terrace deposited by the Franklin River. Most of the surveyed portion of the cave probably originated as an undercut notch formed by the Franklin River prior to deposition of the terrace.

There is no speleothem development within the cave and it is most likely that during periods of prolonged high winter water levels on the Franklin, most of this cave becomes flooded.

Cave crickets (Micropathus sp) occur in the cave.

The cave is adjacent to Shingle Island where a vegetation dominant is the endemic riverine tea tree (Leptospermum riparium).

ARISTOTELIA CAVE (F69) (Figure VII)

Containing a total length of 34m of passages, this small cave is strongly joint controlled along directions trending at 20^{o} and 110^{o}. The entrances to the cave are from overhangs in a cliff several metres above the level of Verandah Cliff Creek. A small archaeological deposit was located at a southern corner of the overhang.

A tiny stream occurs in the cave but has played no significant role in the development of the cave apart from some erosion of infill. The passages of the cave appear to have a phreatic origin probably from an ancient Verandah Cliff Creek, and are floored by more than 1m of stratified clay and gravel deposits.

The cave contains populations of Micropathus sp., and Hickmania troglodytes.

Specimens of the endemic shrub Aristotelia peduncularis occur in the rainforest at the mouth of the cave.

SUMMARY

The work of the 1982 Wild Rivers Archaeological Expedition to South West Tasmania increased both the number of known prehistoric sites and number of known caves. While discussion of the prehistoric sites will be dealt with elsewhere by other authors, one conclusion emerges from the observations of locations of prehistoric sites. Most sites occupy the entrances to caves which are commodious, have a more or less northwesterly aspect and are generally presently dry. However, since these features were used as a search criterion for the archaeological discoveries, the sites found will include this bias. Biglandulosum Cave, discovered by Richard Cosgrove and Melvin Freestone contains a rich archaeological deposit which makes this cave now one of the most important in Australia.

Some aspects of the caves mentioned in this paper are summarised in table 1. Note that most of the cave passages fall into either of two major joint directions at right angles to each other.

Further exploration for archaeological sites will continue this summer, and new caves found will be mapped wherever possible.

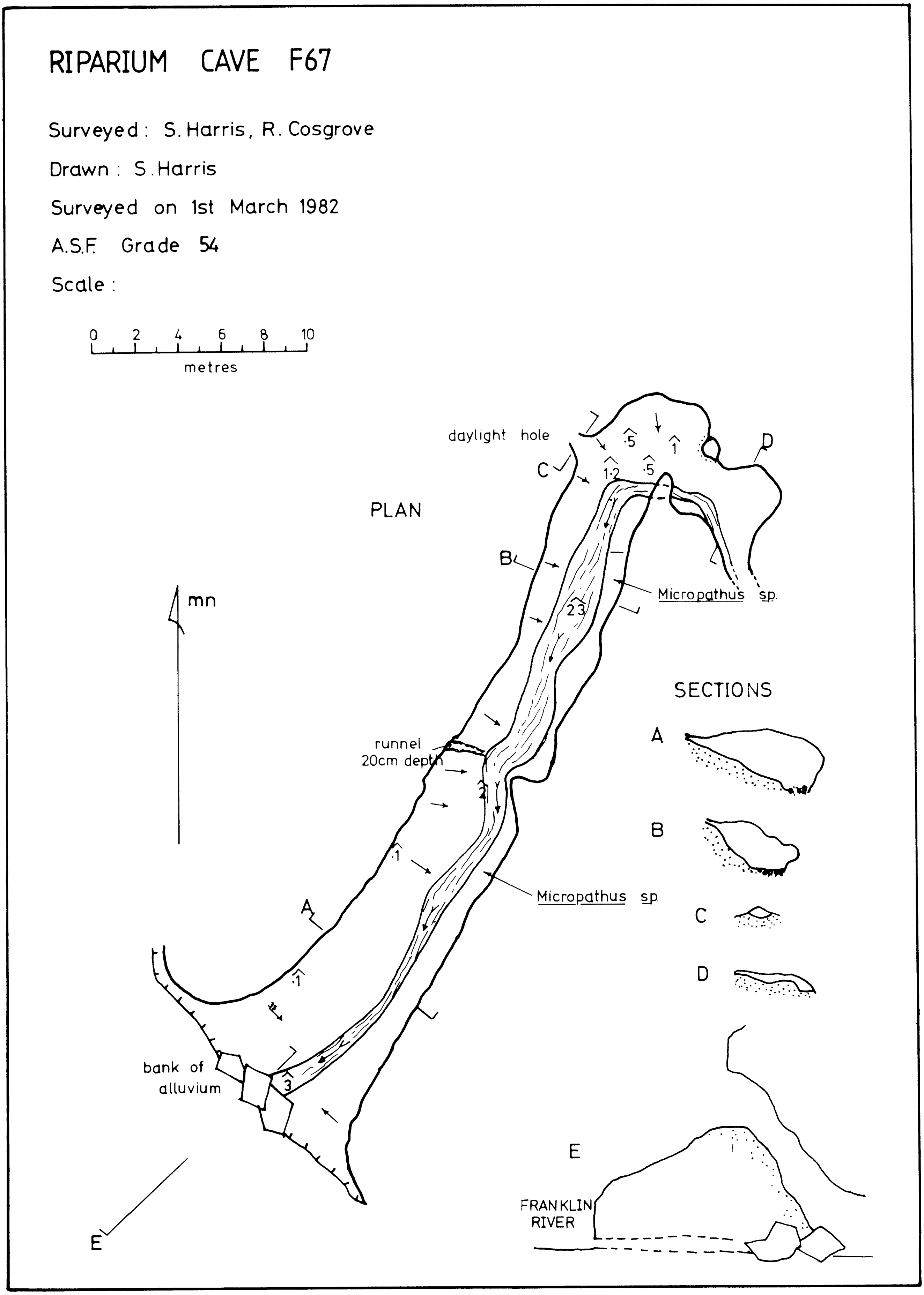


FIGURE VI MAP OF RIPARIUM CAVE F67.

CAVE	No:	Surveyed length (metres)	Major directions of passage development.	Presence of Archaeological deposit	Approximate location of cave
RICHEA	F59	62	26^{o}, 130^{o}, 175^{o}		approx. 1km upstream of F34.
EUCRYPHIA	F60	53	30^{o}, 184^{o}	+	near F59.
HYMENOPHYLLUM	F61	61	307^{o}, 340^{o}	+	short dist. upstream of F34.
MILLIGANIA	F63	22	125^{o}	+	near Flat Id.
ANOPTERUS	F65	17	133^{o}, 212^{o}		near Bingham Arch.
BIGLANDULOSUM	F66	366	64^{o}, 334^{o}	+	east of Big Fall.
RIPARIUM	F67	45	209^{o}		near Flat Id.
ARISTOTELIA	F69	34	20^{o}, 110^{o}	+	Verandah Creek.

TABLE 1.

Tabular Summary of various aspects of the caves listed in this article.

REFERENCES

KIERNAN, K.W., JONES, R.M., RANSON, D. (1983)

New Evidence from Fraser Cave for Glacial Age Man in South-west Tasmania - Nature (6 Jan 1983)

MIDDLETON, G.J. (1979)

Wilderness Caves : A preliminary survey of the caves of the Gordon-Franklin River system, South-west Tasmania, **Occasional Paper II,** Centre for Environm. Studies. University of Tasmania.

ACKNOWLEDGEMENTS

The presentation of information in this paper would not have been possible without the hard work of all members of the team,which comprised Jim Allen, Barry Blain, Richard Cosgrove, Andrew Febey, Melvin Freestone, Rhys Jones, Don Ranson (leader), Chris Rathbone, Mike Southon and Eric Stadler. Thanks to Geoff Tyson for reductions of the maps. Don Ranson offered useful comments during the preparation of this paper. The expedition was organised by the Tasmanian National Parks and Wildlife Service and the Australian National University.

DISCUSSION

Still much limestone not searched for caves, especially areas away from the rivers. The terrain makes travel off the river very difficult. It is easy to walk next to a cave and not know it. The larger caves are not on the rivers.

Marsupials are not as rare in the forest as was once thought, but pollen evidence indicates an alpine environment at the time of cave occupation by the Aborigines.

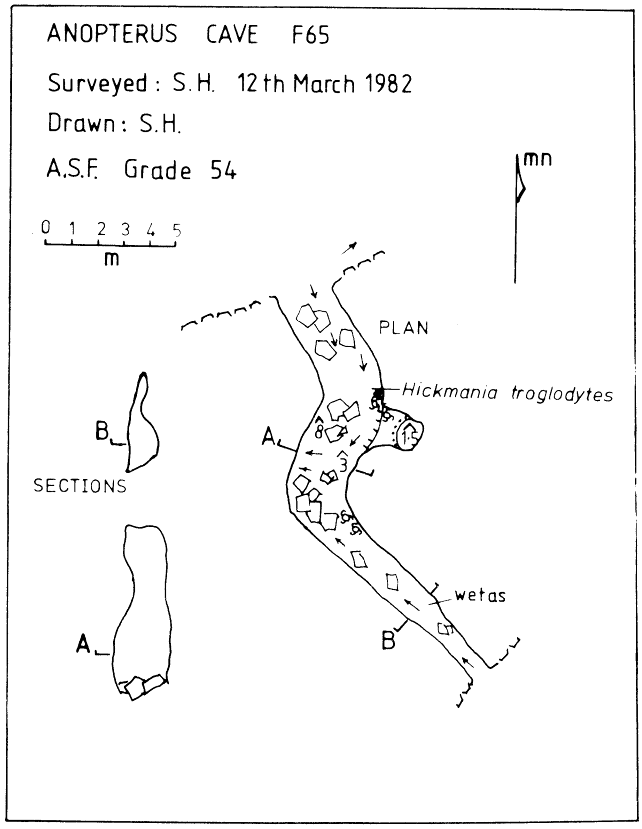


FIGURE IV MAP OF ANOPTERUS CAVE F65.

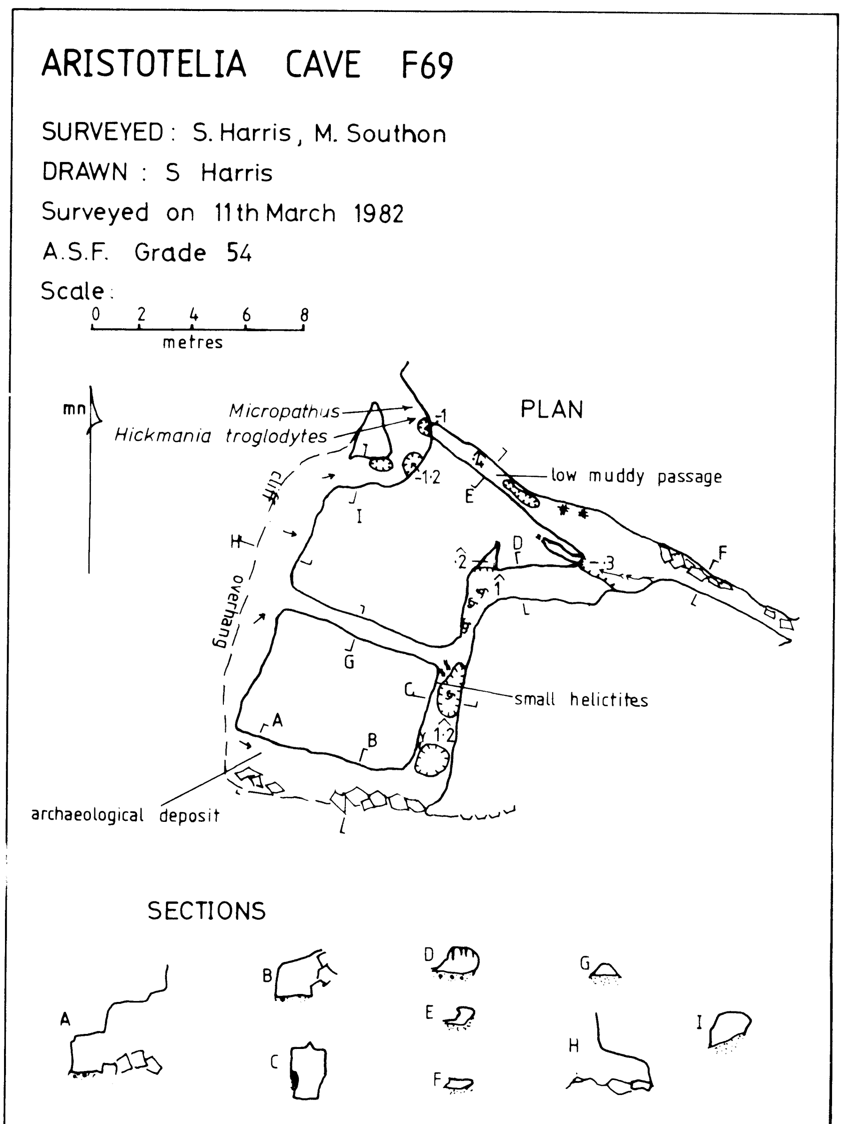


FIGURE VII MAP OF ARISTOTELIA CAVE F69.

PREHISTORIC MAN AND KARST IN SOUTH-WEST TASMANIA

by

Kevin Kiernan

Department of Geography, University of Tasmania

Recent archaeological discoveries in karst areas have disproven previous theories that the inland of south-western Tasmania was not occupied by the original inhabitants of the island. Most of the sites reflect occupation during the cold climatic conditions of the late Pleistocene when the present heavy rainforest vegetation was restricted to specific refugia and a more open landscape permitted easier movement of man and game through the area.

Preliminary excavations in Fraser Cave have vastly advanced knowledge of the Tasmanian stone tool technology, which appears to be derived from the pre-Holocene industries of Greater Australia. The faunal remains indicate specific targetting after a style reminiscent of that of the glacial age hunters of northern Europe. As a number of factors are likely to have attracted prehistoric man to the karst areas, and as a result of the drowning of coastal sites by post-glacial sea-level rise, the inland karsts have assumed a particular importance to the study of the Earth's most southerly ice-age inhabitants. However the karst is largely confined to the valley bottoms which puts it at a specific disadvantage if hydro-electric dams are constructed in the region.

INTRODUCTION

Ethnographic sources contain few references to aboriginies in the rugged, often densely forested landscape of Tasmania's western river basins. This led Jones (1974) to conclude that the area was unoccupied at the time of European settlement. Similarly, Jones (1968) considered that in late glacial times the Tasmanians' occupation was tightly coastal. Both these viewpoints can now be challenged. Fundamental to this re-assessment is the recognition that the environment of western Tasmania has changed markedly during the late Quaternary due to climatic changes. The human habitation of Tasmania is known to have extended back nearly 23,000 years, following work on archaeological deposits in an abandoned sea cave on Hunter Island off Tasmania's north-west corner (Bowdler 1975). The original settlers crossed Bass Strait via a land bridge exposed during the low sea level of the late Last Glacial Maximum. Glaciers developed in the central West Coast Range shortly after 18,800 years ago (Kiernan 1980 a) diminished slightly about 1,000 years later, and had vanished from the highlands by about 10,000 years ago (Macphail and Peterson 1971). The present rainforests of western Tasmania all postdate about 11,500 years B.P. (Macphail 1981). The previous vegetaion of the western valleys is likely to have been considerably more open than that which exists today. A cave site in the Florentine Valley dated at about 20,000 years B.P. reflects these previously more open conditions quite unlike the densely forested environment which greeted the first Europeans less than 200 years ago (Murray, Goede and Bada 1980).

ARCHAEOLOGY IN WESTERN TASMANIA

Scattered surface artefacts dominate among Tasmania's prehistoric sites. Their frequency on the coast indicates dense coastal occupation during postglacial time. Until recently there had been a dearth of archaeological investigation of more inland areas and the viewpoint that aborigines did not occupy the inland had become a self fulfilling prophecy. In 1979 David O'Brien and Kevin Kiernan located burnt and split macropod bones, and stone tools in a limestone cave in the Nelson River Valley just inland of the West Coast Range (Kiernan 1979). This material appeared to be the product of human butchering (P. Murray pers. comm.) and was sealed beneath angular limestone rubble which was interpreted as being the product of mechanical weathering during the late Last Glacial Maximum. On these sedimentological grounds the probable cultural material was interpreted by Kiernan (1980a; in press (2)) as shortly predating the Last Glacial Maximum.

Corbett (1980) subsequently published descriptions of surface sites on the industrially denuded ridges around Queenstown and further finds in this area were recorded by Kiernan (1980a) and Stockton (1982). It has since become known that unpublicized stone tools from this area had been collected decades before and were housed in the vaults of Launceston's Queen Victoria Museum. Corbett (1980) hypothesised that the Queenstown sites immediately postdated the Last Glacial Maximum because the stone tools over-lapped glacial moraines, but Kiernan (1980a) showed that these moraines dated from an earlier glaciation and therefore provided no useful dating framework. However, most of the landscape of western Tasmania is vastly different to the scarred and eroded hills of Queenstown. Where the vegetation is dense and thick peat has accumulated, similar artefact scatters are unlikely to be found on the ground surface. This area provides the least archaeological visibility of any in Australia. However, peat and dense vegetation seldom penetrate far beyond the threshhold of limestone caves in this area. Moreover, caves may serve as a focus of human activity such that archaeological remains are concentrated rather than dissipated across the landscape.

The likelihood that proposed hydro-electric storages in the Gordon-Franklin Rivers area would impinge upon karst areas of unknown significance, stimulated a series of exploratory ventures under the banner of the Sydney Speleological Society from 1974 onwards (Middleton 1979). Earlier visits to the area had been undertaken by the Tasmanian Caveneering Club but interest had waned (Goede, Kiernan, Skinner and Woolhouse 1974), and subsequently by wilderness conservationists concerned for the future of the region (Kiernan 1977). An archaeologist accompanied the 1975 party but no archaeological discoveries were forthcoming (Stockton 1975). By 1979 it was becoming obvious that the carbonate rock outcrop of this area were very extensive indeed (Kiernan 1979b).

During the late 1970's Tasmania's Hydro Electric Commission promoted some scientific research in the region as part of its campaign for the Lower Gordon-Franklin hydro-electric development. When dissatisfaction was expressed that caves and karst had not been examined a Commission geologist was dispatched to the task. The subsequent report (Naqvi 1979) has been strongly criticised as superficial and inadequate (Kiernan 1980b, Southern Caving Society 1979, Jones 1981). While armchair contemplation of bone deposits noted in Fraser Cave since the time of its discovery had raised the question as to whether they might be of archaeological origin (Kiernan 1980b) the H.E.C. survey, which professed to have included Fraser Cave, had concluded that "nothing of archaeological significance has yet been found in any of the caves" (Naqvi 1979).

Two years later the National Parks & Wildlife Service conducted two archaeologists to the Nicholls Range karst area. A fortuitous discovery of several stone flakes was made near the confluence of the Denison and Gordon Rivers where a large tree had collapsed into the water. The discoveries expressed the viewpoint that this site was of glacial age, but sedimentological evidence and radiocarbon dating now indicates a late Holocene date, approximately 300 years old (Ranson and Jones, prep.). The same party excavated a small rockshelter in the same area, apparently without success, but subsequent examination of soil samples from the site has revealed the presence of stone tools (R. Jones, pers. comm.). The site is undated but the sediments suggest a Holocene age (Kiernan 1982a). The following month Kevin Kiernan led a party from the Tasmanian Wilderness Society to several caves along the Franklin River, and recognised the archaeological origin of the Fraser Cave site, which he considered to be of glacial age on sedimentological grounds (Kiernan 1981a). The T.W.S. and N.P. & W.S. combined forces to excavate in Fraser Cave the following month (Kiernan, Jones and Ranson, in press). An additional rockshelter site in the same vicinity was recognised in March 1981 (Kiernan 1981b). Several further rockshelter sites were recorded in the lower Franklin in early 1982 (Harris, this vol.; Kiernan 1982b : Jones, Ranson, Kiernan and Head, in prep.).

KUTIKINA CAVE (Fraser Cave)

The name Kutikina ("spirit") has recently been given to Fraser Cave by the Tasmanian Aboriginal Community. Kutikina Cave is a small outflow stream cave 30m from the bank of the Franklin River and consisting of about 180m of passage. It lies 50m above sea level. The alluvial sediments indicate a progressive reduction in the competence of the cave stream. This is likely to have been due to inwashing of a destabilised slope mantle clogging the cave streamways as the surface vegetation was disrupted by climatic factors or by human firing. The entrance facies were sampled from a pit of less than 1 square metre which reached bedrock at a depth of 2.3m and required 24 excavation units to complete. The lowermost radiocarbon date of 19,770 ± 850 B.P. (A.N.U. 2785) comes from excavation unit 20, which includes abundant bone fragments in fine gravels. A single stone flake and rounded cobble occur at greater depth in an horizon (unit 23) which was incised by the stream channel into which the unit 20 gravels were deposited. The most dense archaeological deposits occur in a limestone rubble zone. This rubble is similar to that in the Nelson River Caves. The uppermost date, only 3-5 cms from the top of the deposits is 14,840 ± 930 (A.N.U. 2781). (Kiernan et al, in press).

ANTIQUITY

The dates from Fraser Cave indicate that humans have been present in southwestern Tasmania for nearly twice as long as they can be demonstrated to have occupied sites at equivalent latitudes in South America (Bird 1969 - reported by Ortiz-Troncoso 1981; Rubin & Berthold 1961). They occupied Fraser Cave for 5,000 years, then abandoned it 5,000 years before the prehistoric artists of Spain adorned the walls of the Altimira Caverns with their paintings. In contrast the total human occupation of New Zealand probably stretches back little more than 1,000 years.

STONE TOOLS

Only a handful of stone tools had previously been recorded from all the Tasmanian Pleistocene sites combined, certainly less than two or three dozen. But from the small excavation in Fraser Cave over 80,000 stone tools and flakes were recovered. Yet this probably represents less than 1% of the total artefact bearing deposit. The assemblage includes steep edged scrapers, domed core scrapers with edges at right angles, and thumbnail scrapers. These are similar to near contemporary mainland industries such as those at Lake Mungo and tend to confirm the view of their common origin. There was little development of this technology in Tasmania following the closure of the landbridge. Most of the tools were produced from siliceous glacial outwash gravels in the bed of the Franklin River, but a noteworthy exception is Darwin Glass, an impactite associated with a meteorite crater in the tributary Andrew River Valley 30km to the northeast. The earliest of these glass tools occurs in excavation unit 14, shortly before the first ochre (unit 15) and just prior to the richest part of the deposit (unit 12). Only one unit later we find some collection of small brachioped and bryozoan fossil fragments, rounded, friable, and presumably gained for non utilitarian purposes.

BONE DEPOSITS

Over 90% of the bones are of the wallaby Macropus rufogriseus indicating a tight targetting strategy totally different to the general foraging of the coastal Tasmanians. This bears comparison with the tight targetting on reindeer of the European ice age hunters. Bone points in Fraser Cave may have been used for sewing skins, but evidence from elsewhere suggests that they ceased to be produced after about 3,500 B.P. (Jones 1971). No megafaunal species have been recognised in the Fraser Cave deposits (Kiernan et al, in press).

MAN AND KARST IN THE SOUTH-WEST

Exploration in the wake of the Fraser Cave discoveries has revealed about 6 further archaeological sites. The most noteworthy of these lies in Biglandulosum Cave, a high level cave with about 300m of known passages (Harris, this vol.; Kiernan 1982b). This cave is second only to Kutikina (Fraser) in the richness of its archaeological deposits of these newer discoveries, the sites which lie in the limestone caves back from the river appear on sedimentological grounds to be of Pleistocene age, but at least one surface site on the river edge appears to be of late Holocene age. With the postglacial rise in sea level having probably drowned most coastal sites of Pleistocene age, the wild river karsts of western Tasmania now seem particularly important to the study of the earliest Tasmanians. During the last ice age the hunters of western Tasmania lived in a more open, windier and drier environment than that which exists today, with mean annual temperatures about 6° C lower than at present. Under such conditions caves are likely to have provided welcome shelter to a people subject to considerable thermal stress. Because the limestone is more susceptible to erosian than the hard metamorphic rocks which dominate the south-west, the karst occurs as elongate lowlands which trend north-south between the more resistant uplands.

The karst belts therefore provide logical access corridors by means of which prehistoric man could have moved large distances following the grain of the landscape. In addition, while cold climatic conditions would generally have favoured a more open vegetation, the high base status of the limestone might be expected to have particularly favoured grasslands, favourable to both humans and their marsupial quarry. Even under Holocene conditions the vegetation of the karst country tends to be slightly more open than that upon the other rock types. A number of factors may therefore have particularly attracted humans to the karst (Kiernan in press b). It is noteworthy too that the Nothofagus rainforest bears stands of eucalypts as possible testimony to fire in those areas revisited by the aborigines in recent millenia.

Today the lifestyle of an almost unknown people remains preserved within the darkness of the Franklin Caves, intact but for a little erosion of the deposits by trickling water as a doubling of rainfall accompanied the post glacial rise in temperature to a mid Holocene maximum about 2°C higher than at present. As the glaciers withdrew the rainforests spread once again from their glacial refugia, and humans withdrew coastwards before the forests, just as other people were being forced back by the rising postglacial seas. A populated landscape became once again an unknown wilderness, but for isolated pockets of humanity in more open areas. Within the last 3,500 years the forests have begun once again to contract. At present we have no evidence of man during the intervening millenia.

Now the government of Tasmania proposes to dam the waters of the natural highways through the region - the Gordon and Franklin Rivers arguing that this would inundate only 1% of the wilderness. But that 1% contains most of the karst, and also the archaeological caves now known. We may yet see the ultimate irony of the state destroying the greatest monument to the first Tasmanians, in pursuit of the same developmental strategy as 150 years ago led to the demise of their descendants.

ACKNOWLEDGEMENTS

I wish to acknowledge with gratitude my co-workers on the Franklin Valley sites, Dr. Rhys Jones and Mr. Don Ranson. I must also pay tribute to Greg Middleton, Steve Harris, Barry Blain, Bob Hawkins, Harry Coleman and others who have contributed to the exploration of the Franklin caves and thereby provided the framework upon which subsequent archaeological exploration could be based. Particular thanks are also extended to Mr. John Head of A.N.U. radiocarbon laboratory. Finally I must gratefully acknowledge various forms of logistical support from the Tasmanian Wilderness Society, National Parks & Wildlife Service (Tasmania), Australian Heritage Commission and Australian National University.

BIBLIOGRAPHY

BOWDLER, S. 1975 Further radiocarbon dates from Cave Bay Cave, Hunter Island, North-West Tasmania **Australian Archaeology 3** : 24-26.

CORBETT, K.D. 1980 A record of aboriginal implement sites in the Queenstown area, Tasmania. **Pap. Proc. Roy. Soc. Tasm. 114** : 35-40.

GOEDE, A.; KIERNAN, K.; SKINNER, A. & WOOLHOUSE, R. 1974 **Caves of Tasmania.** Unpublished MSS; privately circulated (xerox).

HARRIS, S. New Caves from the Franklin River.

JONES, R. 1968 The geographical background to the arrival of man in Australia and Tasmania. **Archaeo. Phys. Anthrop. Oceania. 3** : 186-215.

JONES, R. 1971 **Rocky Cape and the Problem of the Tasmanians** thesis, A.N.U.

JONES, R. 1974 Appendix: Tasmanian Tribes in N.B. Tindale (ed.) **Aboriginal Tribes of Australia** Univ. Calif. Press - A.N.U. Press.

JONES, R. 1982 **Submission to the Senate Select Committee on South-West Tasmania.** Hansard, 19 Mar 82 (reprinted Australian Archaeology 14 : 96-106.)

KIERNAN, K. 1977 Caves of the Wild Western Rivers. **J. Tas. Wild. Soc. 4** : 14-17.

KIERNAN, K. 1979a Nelson River **Southern Caver 10 (2)** : 12-13.

KIERNAN, K. 1979b Limestone and dolomite in and adjacent to the King and Lower Gordon basins, south-west Tasmania: An inventory and nomenclature. **J. Syd. Spel. Soc. 23 (8) : 189-204.**

KIERNAN, K. 1980a **Pleistocene Glaciaton of the Central West Coast Range, Tasmania** thesis, Univ. of Tasm. 249pp.

KIERNAN, K. 1980b **In P. Murrell (ed) Review of HEC "Report on the Gordon River Power Development Stage Two"** N.P. & W.S. (reprinted **Southern Caver 12 (2)** : 24-33).

KIERNAN, K. 1981a Preliminary notes and first thoughts on the deposits contained within a limestone cave on the lower Franklin River Valley, south-western Tasmania (unpub. T.W.S. report 12 Feb 81, 9pp 1 fig 12 refs).

KIERNAN, K. 1981b Landform Evolution and Anthropogenic Geomorphology in the Lower Franklin River Valley, South-western Tasmania. (Unpub. report to N.P. & W.S. 1 Aug 81, 84pp, 9 figs, 5 tables, 109 refs).

KIERNAN, K. 1982a Preliminary comments on sediment samples from NR5 (Unpub. rep. to N.P. & W.S. Nov 82, 11pp, 3 figs, 6 tables, 15 refs).

KIERNAN, K. 1982b The exciting, lonely, damp, dirty world of caves. **Saturday Evening Mercury** : 22 May 82 : 24 & 49.

KIERNAN, K. In press a. A probable Pleistocene occupation site in central western Tasmania. **Australian Archaeology.**

KIERNAN, K. In press b. Prehistoric man in the inland valley karsts of western Tasmania. **Australian Archaeology.**

KIERNAN, K.; JONES, R. & RANSON, D.
(In press - 1983) New evidence from Fraser Cave for glacial age man in south-west **Tasmania Nature 301** : 28-32. 6 Jan 83.

MIDDLETON, G. 1979
Wilderness Caves of the Gordon-Franklin River systems. Environmental studies centre, Univ. Tasm.

MacPHAIL, M.K. 1981
A history of fire in the forest, pp. 15-22 **In** J.B. Kirkpatrick (ed) **Fire and Forest Management in Tasmania.** Papers of a seminar, 2 May 81. Tasm. Conserv. Trust, Hobart 81.

MacPHAIL, M.K. & PETERSON, J.A. 1975
New deglacation dates from Tasmania - **Search 6 (4)** : 127-130.

MURRAY, P.F.; GOEDE, A. & BADA, J.L. 1980
Pleistocene human occupation at Beginners Luck Cave; Florentine Valley, Tasmania **Archaeo. Phys. Anthrop. Oceania 15** : 142-152.

NAQVI, I. 1979 Cave Survey. H.E.C. Geol. Rep. 64-91-9.

ORTIZ-TRONCOSO, O.R. 1981.
Inventory of Radiocarbon dates from Southern Patagonia and Tierra del Fuego - **J. Soc. Americaristes 67** : 185-212.

RUBIN, M. & BERTHOLD, S.M. 1961
U.S. Geological Survey Radiocarbon Dates VI **Radiocarbon 3** : 86-98.

SOUTHERN CAVING SOCIETY 1979
Editorial - Misrepresentation and the Gordon-Franklin Issue, **Southern Caver** 11 (4) : 2.

STOCKTON, J. 1975 Report on field trip to Gordon River (Unpub. N.P. & W.S. report M5/12-75/1724.)

STOCKTON, J.H. 1982
The Prehistoric Geography of Northwest Tasmania thesis, A.N.U.

UNDERWATER CAVE SURVEYING IN AUSTRALIA

by
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C.E.G.S.A. and C.D.A.A.

In the last 30 years in Australia cave diving has flourished. Sinkhole diving in the Mount Gambier area is now safely controlled, and highly advanced cave diving is successfully undertaken in a variety of other areas. During these years many thousands of sinkhole dives have been conducted, hundreds of sumps negotiated, tunnels penetrated and considerable 'dry' cave discovered by divers. However, even now many of the regularly-dived caves have not yet been mapped beyond sketch level, with some no more than vague recollections in the water-logged memory of old time divers. The reason for this is not that cave divers are bone lazy but due to the technical difficulty of conducting underwater surveys.

This discussion outlines the basic techniques and equipment of cave diving and underwater surveying and includes a brief history of Australian cave diving with examples of detailed exploration and mapping that has been undertaken.

Cave diving has been in Australia since 1952, when its unlikely birth occurred in the demanding river systems of the Jenolan Caves. From these pioneering days of homemade equipment and experimentation this rather maligned activity has flourished despite negative publicity and public ignorance.

During these 30 years, the events which most shaped the development of cave diving, were the tragic deaths which occurred during the 1970's in the Mount Gambier sinkholes. These incidents led to the formation in 1973 of the Cave Divers Association of Australia, which has safely controlled diving in these sink holes preventing further fatalities.

Whilst the CDAA has accomplished more than any other cave diving body in the world in the fields of administration, education and qualification testing, it has unfortunately not had the opportunity to undertake organised research into the caves over which it has some jurisdiction. This is in part due to the make up of the membership, most of whom are ocean divers who have been trained and tested in techniques suitable for sinkhole diving. In general these divers could be classified as recreational sinkhole divers with only a passing interest in these unique formations which they consider simply as large clear deep holes.

Consequently it took from 1960 when diving started in the sinkholes until 1980, before any maps were published, even though many holes were dived very frequently. In terms of dry cave exploration this would be unheard of since the usual practice is for the cave to be mapped as it is discovered. In the case of the Mt. Gambier water holes, however, the initial discoverers were usually local, self taught ocean divers with no caving experience. One can appreciate that they were fully occupied with simply surviving the unknown dangers of this new and eerie environment without being concerned with detailed surveys. Even when divers became better equipped and had some prior knowledge of what they were about to enter they seemed content to accept the holes being 'bottomless' football field size chambers without any desire to understand anything further. Eventually curiosity got the better of a small number of divers, and sketches showing basic dimensions, shape and direction of the holes were published in the book 'Cave Diving in Australia' dispelling much of the argument and fictional fantasy surrounding them. It is, however, interesting to note that the personnel involved in the production of these sketches had dry caving backgrounds and had been involved in advanced cave diving in such places as the Nullarbor, Jenolan and Tasmania. All of these locations required very different techniques from sinkhole diving. The generally horizontal penetration diving undertaken lent itself to similtaneous mapping and exploration using standard dry caving survey equipment. Whilst some extensive caves in the Nullarbor were mapped and detailed mapping of stream way passages in the Jenolan caves was successfully undertaken, it was found that the survey techniques used were not entirely suitable for the larger open voids of the Mt. Gambier sinkholes.

Indeed the logistics of undertaking a detailed survey of a water filled sinkhole is so great that only very few serious attempts have been made. From these experiences we have come to recognise the factors which affect the accuracy of the maps. By breaking these factors down under two major classifications - the Diver and the Environment, the magnitude of the overall difficulty of this type of surveying can be appreciated.

THE DIVER

Any person who ventures below the surface of the water for whatever purpose is acted upon by pressure which increases with depth. At 10m depth water pressure is double that of air at the surface and at 20m triple. This basic physical constant when related to human physiology introduces the diver to a number of potentially dangerous afflictions such as Pulmonary Barotrauma (Burst Lungs), Decompression sickness (Bends), Nitrogen Narcosis, and so the lethal list goes on. In a cave diving situation where a direct ascent to the surface, and hence to that vital substance air, cannot be made in an extreme emergency, then the problems become compounded. Whilst the possibilities of becoming stuck or hit by rock falls are what most cavers face occasionally, these events or simply losing ones way underwater has some very severe short term effects - usually death by drowning. Without wishing to sound either morbid or paranoid the simple facts are that diving, especially cave diving has very real potential dangers so great in number and so different from any other activity that only by specialized methods can it be undertaken with relative safety.

Over the last 10 years, systems, equipment and techniques have been developed to make cave diving safer and more enjoyable. The price paid for much of this safety is very limited time underwater. On an average sinkhole dive, the divers would spend not much more than 30 minutes in the water with about half of that time at the maximum depth of 36m (maximum safe depth determined by the CDAA) and the remainder for decompression stops which are required to prevent the bends, and entry and exit. Two dives per day to these depths can be conducted with relative safety, which gives you a total of 30 minutes per day suspended under the ledge in these large chambers. During this 30 minutes the diver must watch his depth and make adjustments to his buoyancy as required, monitor the time, air pressure of his tank and adjust equipment. Most importantly he must watch his buddy, who is watching him, for signs of nitrogen narcosis which has a similar effect to drunkeness and occurs often without any warning. As a consequence of this continuous demand on concentration and manual operation the ability for a diver to undertake even simple tasks such as taking a bearing or noting a distance is severely hampered even in ideal conditions. In extreme conditions such as greater depth, darkness, poor visibility and other environmental factors the task may become so demanding that it could be expected that any data collected would be so dubious as to not warrant the risk.

There are however some positive factors one of which is the divers ability to swim almost effortlessly from floor to ceiling and hover at any point between. This is a considerable advantage over walking around a cave and spending effort and time in clambering about the floor and having to use vertical climbing techniques to check out roof and wall details. Furthermore it can give a diver the opportunity to get a birds eye view provided he has adequate lighting and good conditions. Unfortunately because of the limited time available, the limited vision a mask allows, and the inability to adjust to night vision until nearly the end of the dive it is usually not possible to take full advantage of these benefits. Because of this, divers tend to gain a rather jig-saw memory of underwater features often with considerable difference from diver to diver.

THE ENVIRONMENT

The main environmental factor is water.

Emptied of water these sinkholes would be very large dome roofed chambers with daylight penetrating to almost all areas. Dry cavers would be able to gain access to the tops of the large natural rock piles 30-40m below the doline mouth using vertical techniques and clamber down the slope to the flatter rock strewn areas under the overhangs. At the extremities of the caverns they would be able to explore the small silty tunnels and gaps between boulders for further cave which could connect with other known features via conduits at greater depth below the surface. Certainly an exciting thought, but as yet we haven't a big enough pump to drain the Otway Basin and hence we are left with the problem of water filled caves.

Probably the first difference between our de-watered sinkhole and a typical water-filled hole is that you can't see much below the water surface, in many of the holes algae and aquatic vegetation grow across the surface sometimes in a complete carpet. As a consequence of this surface layer and of the property of water to deflect and absorb light, nearly all of these caverns are in total darkness and powerful underwater lights are necessary. Towards the rear of the chambers only a faint green glow signifies the position of the entrance and the way out. For safety, guidelines are unreeled by the divers so that should they loose sight of the entrance they can retrace their path. Whilst in many cases the water is crystal clear algae and dirt in the water can reduce visibility to less than 1 metre especially in the upper regions whilst silt which has accumulated for thousands of years on the floor and ledges can change visibility from perfect to zero in seconds when disturbed by a passing diver's fins.

Another major problem with the water is its temperature of 11° to 15°C which is sufficiently cold to cause discomfort after 30 minutes even when protected by professional style wet suits. In Tasmania the water temperature can drop to 6°C. At depth, during longer exposures or under certain other conditions the effect can lead to hypothermia which itself is dangerous but can also increase tendencies to other physiolological disorders such as the bends and narcosis. Probably the most common sympton of even mild hypothermia is the loss of manual dexterity and coordination with out which writing, taking bearings and those other simple survey tasks become painfully difficult.

In review then it can be seen that the cave diver has a number of serious disadvantages when compared to his dry caving counterparts. As an outcome any task he wishes to undertake is constrained by time, depth, vision, equipment, physical ability and experience. Unlike the dry caver an oversight in any of these areas could lead to the diver being suddenly at very real risk.

When surveying underwater all of these points have to be considered and coordination and planning thoroughly conducted to ensure maximum efficiency. It must also be remembered that divers cannot talk underwater, communication has to be simple and to the point. Many many dives to undertake a simple task have been wasted because the parties did not understand or were not correctly prepared to do the job.

UNDERWATER SURVEYING

In any cave survey the basic data required is horizontal distance, vertical distance and the direction (bearing), between known points which can then be related to the features of the cave. Accuracy and precision varies with technique and equipment used and since equipment such as theodelites etc., have not been developed for underwater use we are left with only fairly basic tools.

Generally linear measurements are made either using fibreglass tapes or our polyporpylene guideline which is run out from a known point at the surface and marked by placing knots at the features and then measured against a tape at the surface. No correction is made for sag (or infact float) or tension on these lines since the error would be expected to be minimal, however slope corrections can be made knowing the depths of the points measured. The average depth gauge could be expected to generally have an accuracy of + or - 5%, however those used for detailed surveyings are usually check calibrated to 1%. Consequently both horizontal and vertical distance components can be measured quite accurately, given that the diver has had suitable diving conditions.

Fixed lines are often used between selected points and can even be developed into a grid pattern for detailed small area mapping of areas such as bone deposits. It has been found through experience that a well laid system of fixed lines is vital to the success of surveying.

Direction is measured using underwater compasses which cannot be expected to have better accuracy than + or - 5 ^{o}. They are also subject to greater user error and it has been common for several divers to take the same bearing with 30^{o} discrepency between them. Some of these errors can be eliminated by better technique and minor equipment modifications, however, bearing measurement remains subject to the greater error.

The use of underwater datum points which are directly related to a surface point which can be surveyed using more accurate above water techniques and where there are no time restrictions is also a major method of reducing inaccuracy. This can easily be done with points around a sinkhole mouth where shot line can be dropped directly into the water. In enclosed air chambers Radio Direction Finding equipment has been used. As yet we do not have RDF equipment for use underwater as has been experimented with in Britain. This type of equipment could be developed into an under water survey tool allowing surface personnel to trace the path of divers carrying the transmitter in the cave below and could even be used for communication. Until such time as these dreams are realized underwater sinkhole surveying will not be able to extend itself much beyond at best ASF grade 3 level. Nevertheless it must be realised that this is a considerable gain on the nothing we had 5 years ago, and that the end result is a map of sufficient accuracy to meet the major aims of dive planning, orientation and search and recovery. As scientific interest increases in the water-filled environmental systems, we can expect that more detailed maps will be required and more advanced survey systems perfected.

REFERENCES

Lewis, Stace, 1980, 1982. **'Cave Diving in Australia'**

SINKHOLES OF THE LOWER SOUTH EAST OF SOUTH AUSTRALIA

Underwater Environments & Life Forms

by

Peter Horne

C.E.G.S.A. and C.D.A.A.

Until recently, very little research had been undertaken regarding underwater life-forms in the caves, although some of the popular streams and ponds have been thoroughly studied by qualified people in recent years.

Initially spurred more by curiosity than a feeling of obligation to science, the author, assisted by his cave-diving companions, decided to observe and attempt to document the sinkhole environments and creatures so that at least some basic information existed.

A three-monthly study of water temperature profiles in four selected sinkholes brought out some interesting and, for the cave-diving community, potentially useful facts, and discoveries of relatively rare creatures of significant scientific value were made during the first year of research.

The work is now being undertaken in conjunction with members of the scientific community and it is hoped that the findings presented here will be of interest to all conservation-minded cave-divers and researchers involved in speleological studies.

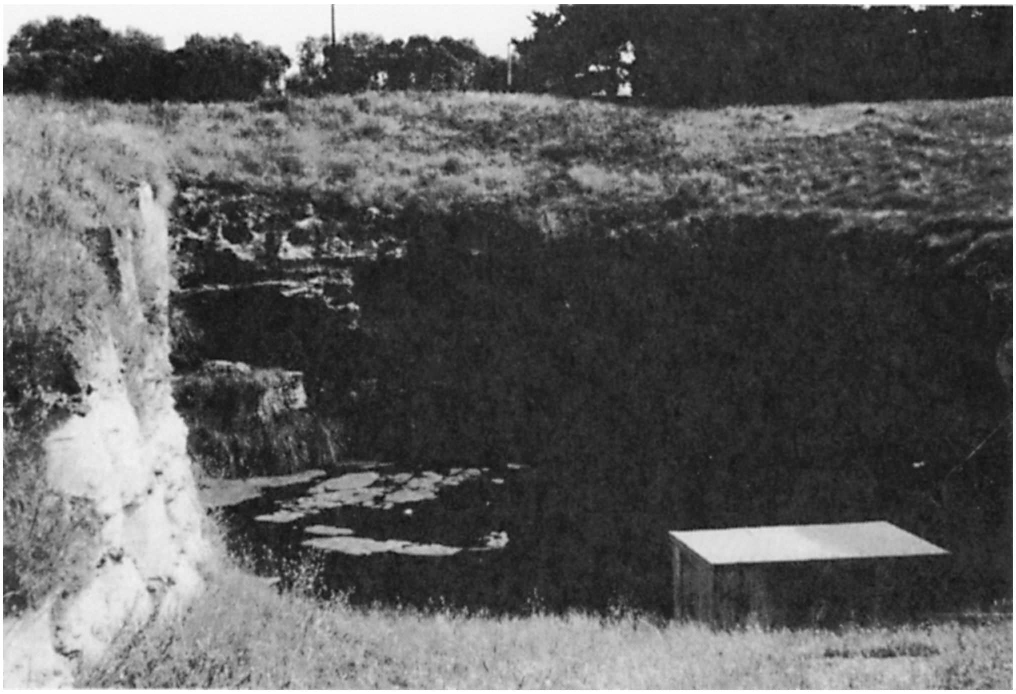
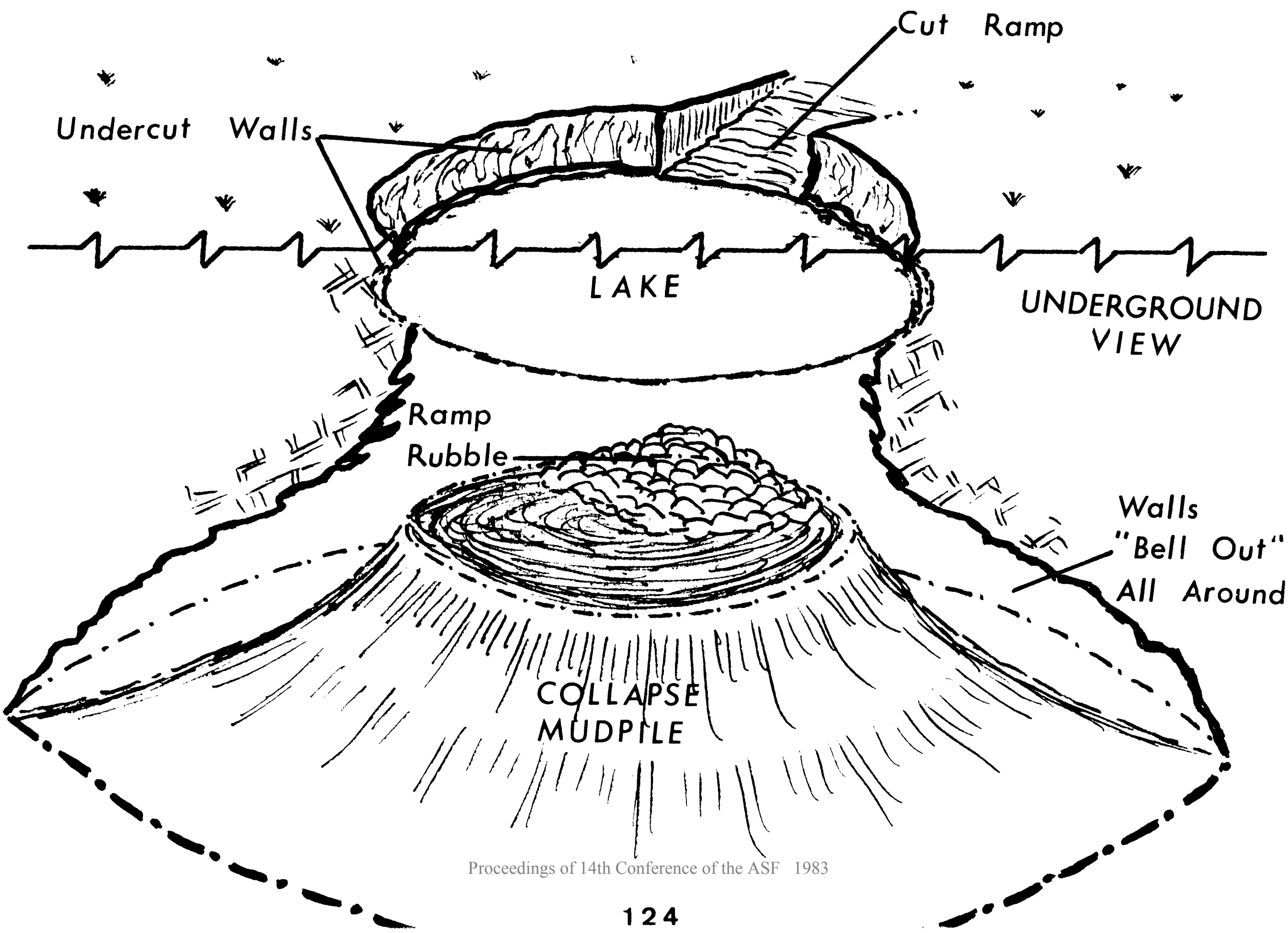


FIGURE 1: "GOULDEN'S WATERHOLE", A SINKHOLE WITH A MAN-MADE RAMP CUT DOWN TO THE WATER TO ASSIST STOCK

photo: Peter Horne

FIGURE 2: 3-D SKETCH OF A "TYPICAL" SINKHOLE



INTRODUCTION

The Lower South East of South Australia has long been known as a major cave-formation area, and was consequently one of the most popular regions visited by people with speleological interests. However, only since the local divers first began to explore their waterfilled caves with Scuba in the early 1960s, has the importance of the underwater sections been realised. The clean, fresh water, filtered through many kilometres of limestone is of a very high quality and an exhilarating experience to explore.

Since those early days, thousands of people have shared their feelings by diving in those caves, and considerable work has been accomplished by several individuals and Universities regarding the identification of the aquatic life which inhabits the coastal springs known as Ewens and Piccaninnie Ponds. This research brought to the public's attention the value in preserving such regions as they contain relatively rare and unique creatures and waterplants, but to our knowledge, no such research has been undertaken in this vein, in the true sinkholes and caves of the Mount Gambier region.

Although most divers are aware of some forms of life in the sinkholes, none had ever bothered to collect specimens for the South Australian Museum for study or identification. Much of the collecting work had been done by a local CEGSA member, Fred Aslin, who is not a diver, and it was mainly as a result of our discussions with Fred that our group decided to try to collect some individual specimens.

Within a few days after our discussions with Fred, in January 1981, our diving party collected some small, centipede-like creatures which were seen swimming about in a small cave known as Fossil Cave, or the Green Waterhole, near Tantanoola. They were taken to the South Australian Museum and the University of Adelaide for study. Their discovery was found to be very significant because the creatures had never been recorded before, and similar species are rare. (See Fig. 8).

Our group was loaded with enthusiastic questions about the life-forms and the sinkholes, but there appeared to be no informed source we could approach to obtain satisfactory answers. It became evident that there were few experts in this field as so little research had been done. The only maps which existed of the sinkholes so popular for cave divers were those drawn up by Peter Stace and Ian Lewis and friends, in the course of their writing of the book "Cave Diving in Australia". Thus, we decided to undertake a layman's project involving the collection of information about the sinkholes of the region.

GENERAL ASPECTS OF THE SINKHOLES

It is important to consider all the features of these caves if we are to better understand the underwater environment, and the range and density of life-forms which can be found there.

Most of the larger waterfilled sinkholes, or "Cenotes", are generally circular in shape and between 20 and 40 metres in diameter, with undercut walls of around 8 to 10m in depth to the water. Many sinkholes, like Goulden's Waterhole (Fig. 1) have ramps which were made into one wall so that stock could reach the water, and often water is pumped for irrigation. Others, such as The Black Hole or Devil's Punchbowl, are almost as natural today as when they were found in the 1840s, requiring a length of rope or cable ladder to reach the ledges above the water. The most extreme example of this kind of sinkhole is Hells Hole which is a 20-odd metre ladder descent directly into 5m deep water. Many smaller caves have a variety of methods of entry.

MAIN UNDERWATER FEATURES

The large cave opening visible at the surface is merely a "window" to the vast caverns which lie under water. Whilst caves meander along randomly orientated joints and cracks, most main tunnels in this region run roughly north-west/south-east and even the big cenotes tend to have their deepest sections and longest penetrations along these directions. Sinkholes generally consist of a large-diameter collapse which fell into a large open cavern. They look something like a champagne glass tipped upside-down, or a bell. (Fig. 2). Lying directly below the entrance is a large rockpile collapse, and although no two sinkholes are exactly the same shape underwater, they generally follow the same basic pattern.

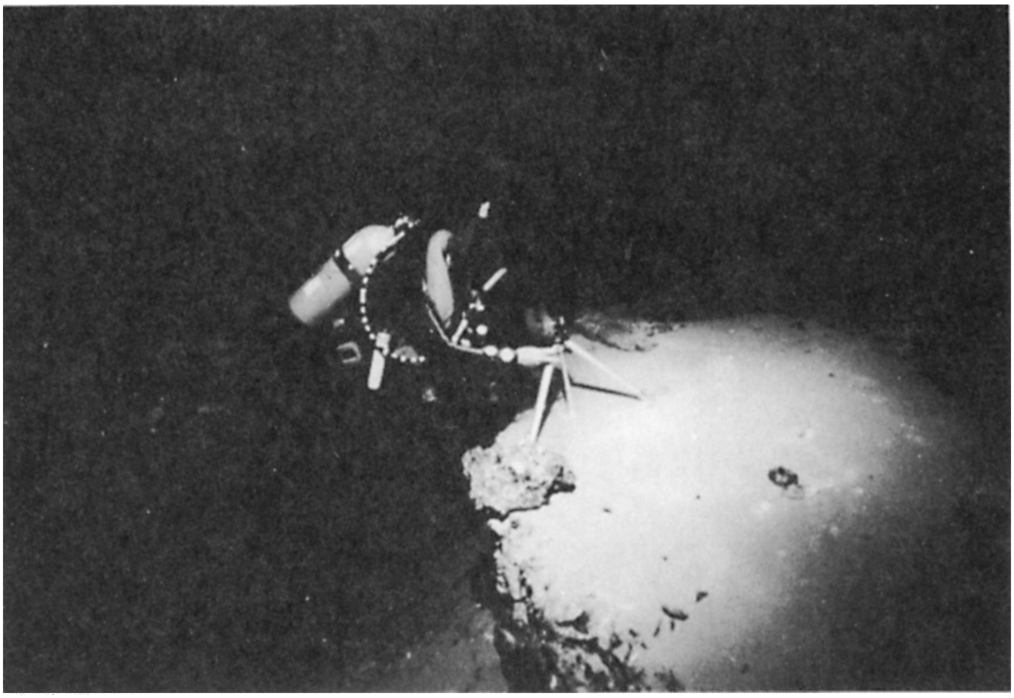
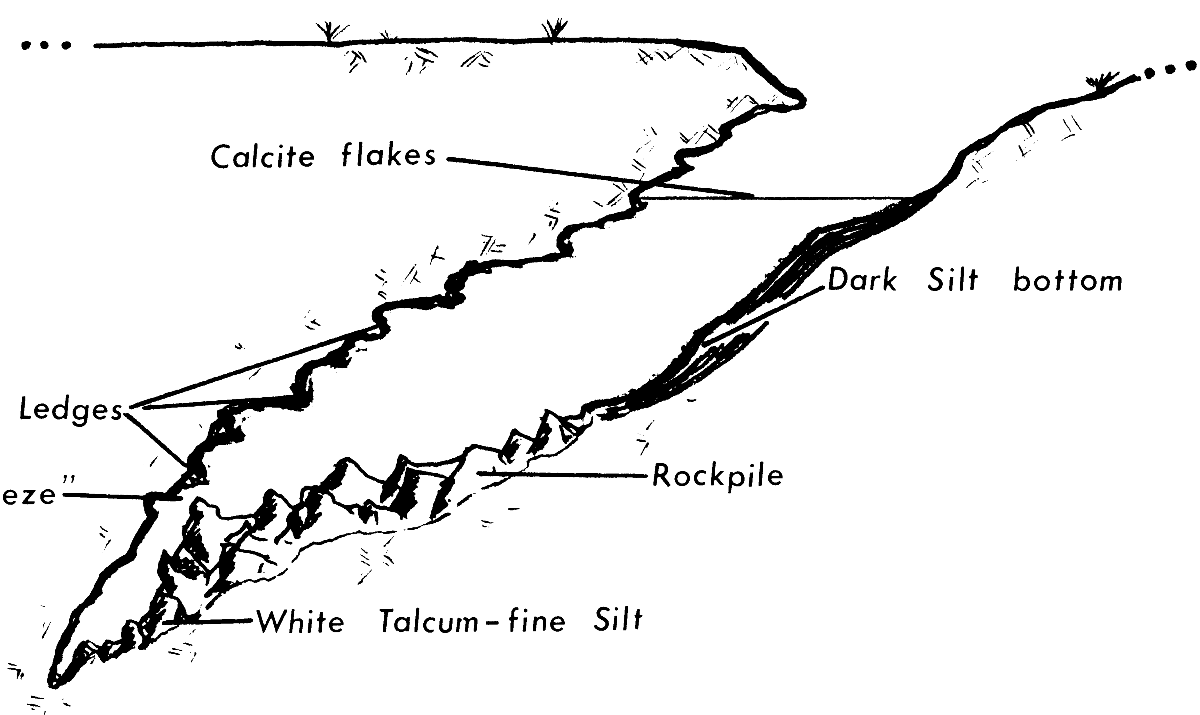


FIGURE 3: A DIVER TAKES PHOTOGRAPHS AT 36m IN THE CLEAR, DARK CAVERN OF L47- "THE BLACK HOLE".

photo: Peter Thompson

FIGURE 4: FEATURES OF A SMALL WATERFILLED CAVE



Most of the larger sinkholes contain water at depth which is indescribably clear (Fig. 3). The huge limestone boulders, some as big as trucks, stand out sharply on the bottom, often covered in a layer of smooth silt which lies like a plain of concrete visible for as far as the shape of the circular sinkhole will allow. This silt is extremely soft but quite thick - a real hazard in confined sections of the caves and a potential killer if guidelines are not used by divers. The silt is one of the reasons for the clarity of the water - the tiny calcite particles attract the washed-in clay particles and then settle to the bottom. The result after many thousands of years is the silt we see today.

Not all sinkholes look the same on the bottom, however. Hells Hole, for example, has a mass of submerged trees lying on the central sandpile, and a discarded car which was deliberately driven over the edge of the hole. Many other sinkholes have car bodies in them as well as rubbish of every description.

The Cave Divers Association of Australia's Category 3 type caves (Fig. 4) are generally more of a true cave than a sinkhole, containing cold, generally clear water which remains about the same temperature throughout the year. Undisturbed caves often have fine flakes of calcite floating on the surface and sheets of this material are deposited over the bottom, along with the silt. This is calcite which has come out of solution.

Whereas the larger sinkholes seem to have relatively smooth walls, the smaller caves often have shelves sticking out from the ceilings, which are covered in thick layers of fine silt. They also have delicate limestone features such as soft walls with etched holes through them and the ceilings themselves are often so soft that large particles and slabs supported by the water sometimes become dislodged by the movement of divers' exhaust bubbles. Unfortunately, the age-old problem of graffiti is now as bad underwater as it is in many of the dry caves, but hopefully people are becoming more conservative as they become educated about what the sinkholes really are.

THE UNDERWATER ENVIRONMENTS

The underwater conditions are evidently very dependent on the time of year and the weather. Although people generally hear that the water in the sinkholes is "crystal clear", this impression is generally false. With only a few exceptions, the clearest water is at the bottom of the caves, where there is also very little, if any, daylight. Water temperature and exposure to sunlight would appear to be major influencing factors in water clarity. During 1981, our group conducted a three-month study of the environment in four popular sinkholes, taking temperature readings and visibility estimates at 3m intervals in depth. It was unfortunate that 1981's winter proved to be one of the wettest on record, and the extreme inflow of water, which raised the levels in some caves by over a metre in a few weeks, probably had a major bearing on both the temperature and visibility. Nevertheless, the observed results were similar to what we had seen before actual measurements were made. Calibrated thermometers were borrowed from the Mt. Gambier office of the Engineering and Water Supply Department of South Australia.

A side-elevation view through Wurwurlooloo or One Tree Sinkhole (Fig. 5) shows in a very summarised form the main results of our preliminary study. In the warm summer months, the upper layer of water was warm, around 21^{o}C, and murky, in the vicinity of 3-5 metres maximum visibility. This effect was evident in all four holes observed, although not the case in caves which were almost always in shadow.

As we went deeper, we encountered a sudden temperature drop, in the vicinity of 3-4^{o} C, where the water appeared to become somewhat clearer, but darker, as the upper, green layer absorbed a lot of sunlight. Descending further, other cold zones, entered across thermoclines, sudden temperature changes were encountered, although none were quite as severe as the first, and the visibility continued to improve. By the time we reached the rim of the mudpile at 34 metres, we could see right around the sinkhole, although it took several minutes for our eyes to become 'night adjusted', as it was about as dark as a full-moon night. Although the dive is cold, the clarity is excellent and any decompression requirements are carried out in comfortably warm surface water, above the thermoclines.

In winter, however, the opposite appears to be the case. The water is cold even on the surface, but it looks more inviting because the murky surface water is absent, giving observers a clear

FIGURE 5: L7 ENVIRONMENT PROFILES

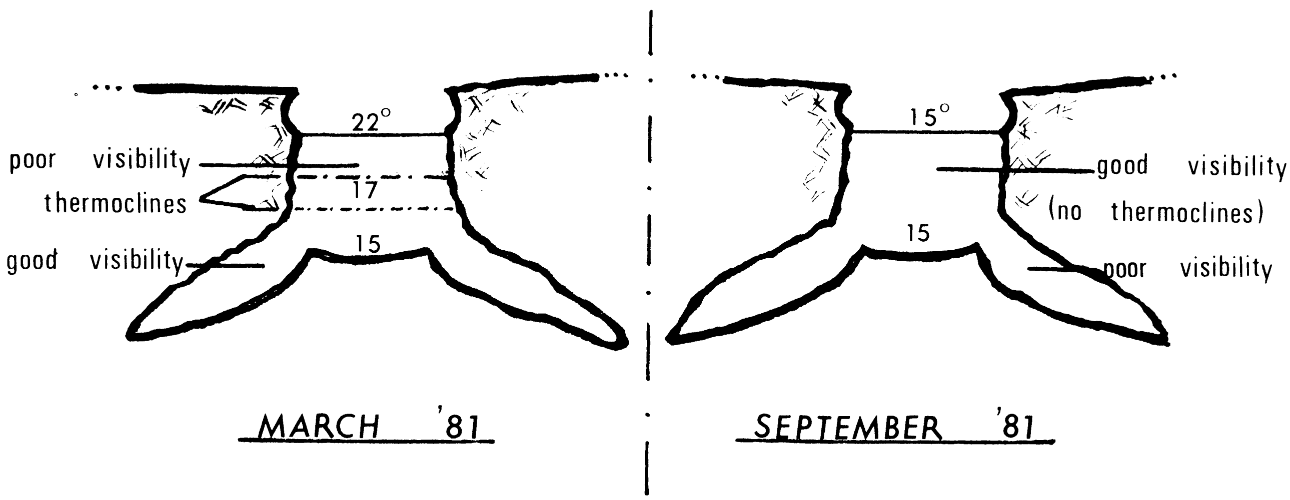
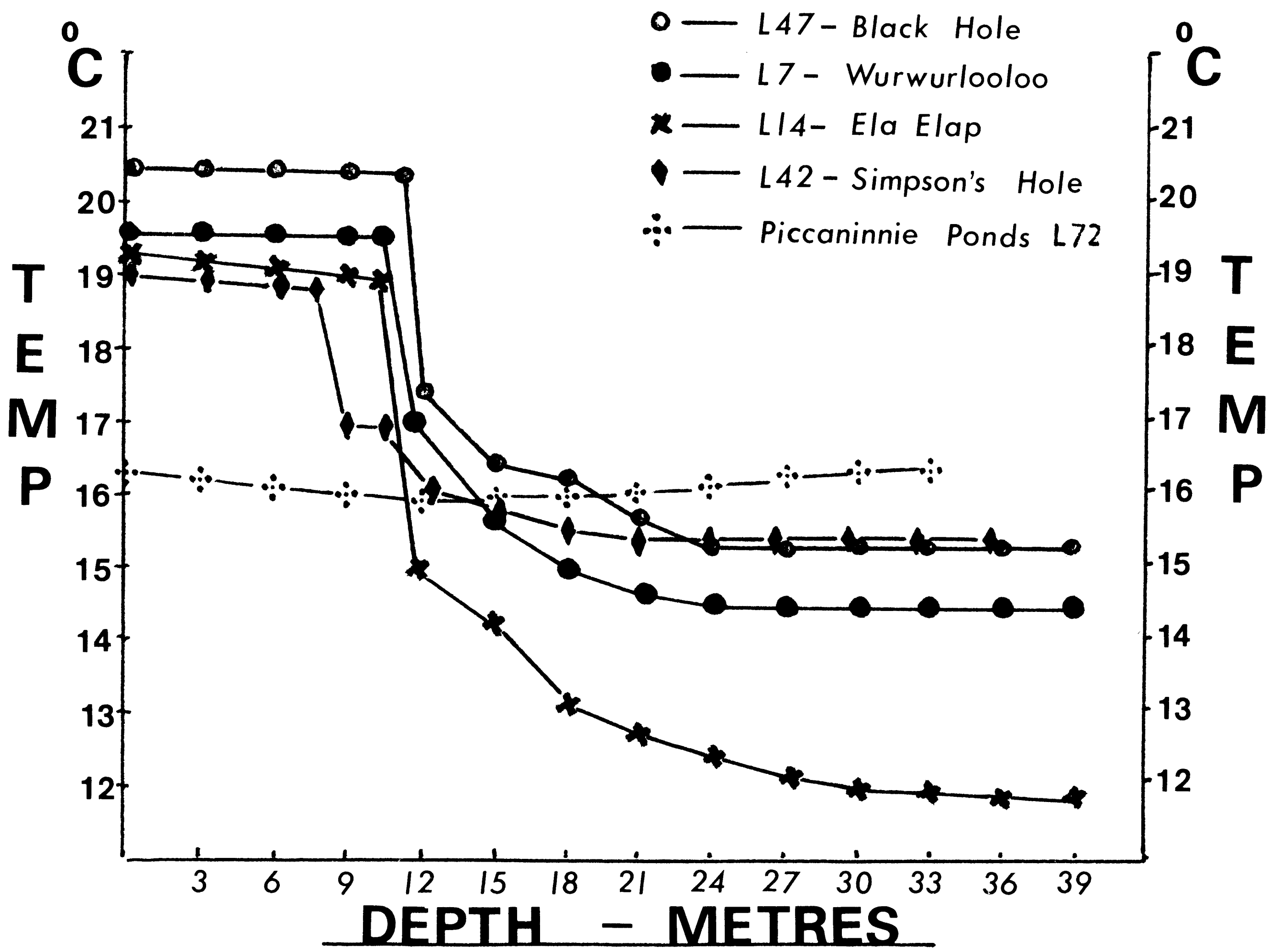


FIGURE 6: TEMPERATURES – MARCH '81



view to considerable depth. However, upon entering the water, and descending, no thermoclines are encountered and the visibility begins to deteriorate, to less than 1m at 38m. Added to this poor visibility are the factors of Nitrogen Narcosis, and cold, which, as those who have been there will truly know, is an experience well worth missing! Also, as there is no warm layer near the surface, decompression is very uncomfortable, and the final emergence into the more than likely typical South East winter storm is quite indescribable!

The results of the study are too detailed to go into here, but as Figure 6 shows, the surface summer readings were generally stable down to the thermocline, where the temperature plunged suddenly. Piccaninnie Ponds was around a constant 16^{o}C being a spring system. Ela Elap was an oddity, continuing to get colder to a recorded 11.2 ^{o} C minimum well after the other holes stabilised at the ground-water temperature of around 15^{o} C. In Jenolan and Tasmanian caves it would be about 5^{o} C colder. I would also like to briefly mention the peculiar effect we observed whilst passing through some thermoclines; the mixing caused between the warm surface water and the colder denser water produced visual effects like oil mixed in water. Nitrate samples were taken. The highest readings were in Allendale Sinkhole, at about 16 parts/million, which is about half of the Australian health limit of 30ppm. More details are available if anyone should require them.

LIFE IN THE SINKHOLES

Now that you've heard of the somewhat unpleasant and unusual conditions to be found in many of the sinkholes, you might understand why there hasn't been much interest shown in their potential for rare forms of life. Perhaps the first sign of life noticed by casual observers is the amount of plant growth around the water's edge. Thick reed beds make entry difficult in some holes, and a casual brush through them with unprotected arms can often elicit a yell of pain from the victim, who will find painful welts developing. Examination of the rushes will show the presence of an innocent-looking green plant which to the educated eye is called a cosmopolitan stinging nettle. I don't think its scientific name of 'Urtica incisa' comes from the fact that it's an Incisa that 'Urts, although one might think that even botanists have a sense of humour!

Often, free-swimming fish are seen flitting about under large floating algal mats, (Fig. 7), and those which have been caught have been either Native Trout or introduced Redfin Perch. The trout have modified their reproductive cycles to that of an enclosed system, instead of returning to the sea along streams and creeks. The Redfin can grow to well over 20cm and have been seen in the deepest levels of the sinkholes, but only about 4 holes have them to our knowledge.

Most sinkholes are inhabited by yabbies, and several species have been found. Wolfgang Zeidler, Curator of Marine Invertebrates at the South Australian Museum, is currently working on them, as well as the rare centipede-like creature mentioned earlier. A relative of the yabbie, the Fresh-water Crayfish, has only been found in two true sinkholes, which lie near the Piccannie Ponds swamp. These holes are also the home of the only known sinkhole-inhabitating eels. As these eels, some well over 1½m in length are thought to reproduce only by returning to the sea, those individuals in the sinkholes are thought to be trapped there, after wandering around from the swamps on rainy nights. They probably feed on the resident trout and shrimps. Occasionally, Tiger Snakes are seen swimming across the surface of the sinkholes, especially in summer, and they are even thought to be able to dive to the bottom and hold their breath for some time. Divers please bear this in mind before touching any striped eels!

Descending once again to the gloomy, twilight world at the bottom of the sinkholes, small snails and pea-mussels can sometimes be found scavenging amongst the fossil shells of their ancient relatives. Tiny red worms are sometimes seen sticking their feeding filters out of the darker sediment, and many species of insect larvae, including the cricket-like may-fly nymph, are seen at various depths. The may-fly larvae are even to be found at 40 metres, but how they calculate decompression is anyone's guess.

Even the deepest and darkest sections of the mighty Black Hole and its nearby sister, Ten Eighty or Simpson's Hole house forms of life unique to these locations. The bright white gleam of tiny rose-like, freshwater sponges seen against the dark limestone boulders are a strange sight in the world of Nitrogen Narcosis and vast chambers (Fig. 8). These sponges living in total darkness

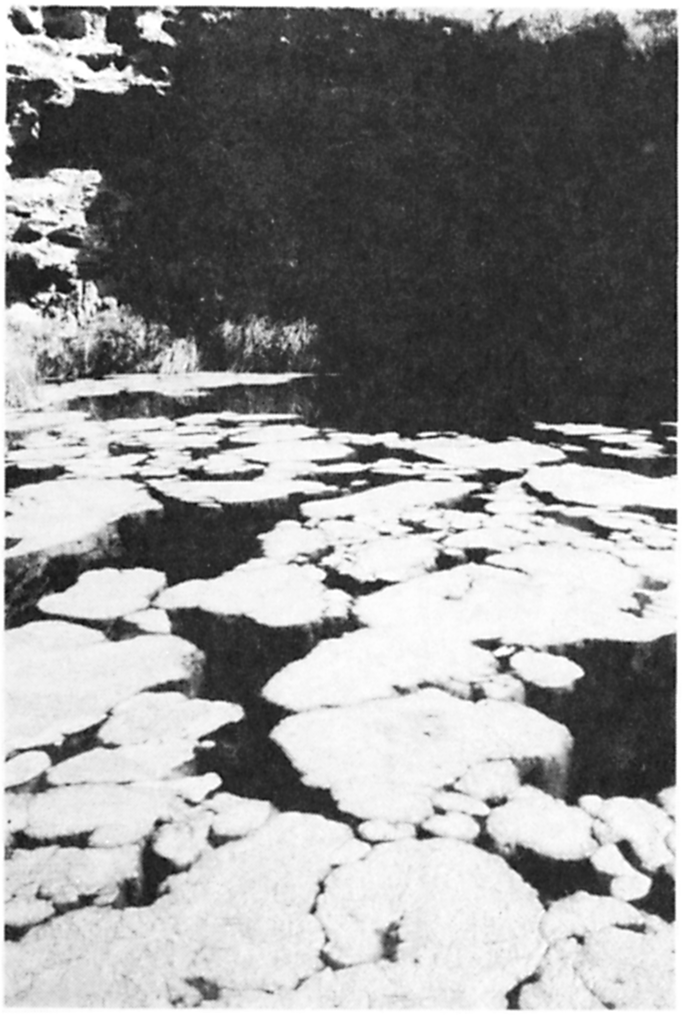


photo: Peter Horne

FIGURE 7: SIGNS OF LIFE IN A SINKHOLE - FLOATING ALGAL MATS

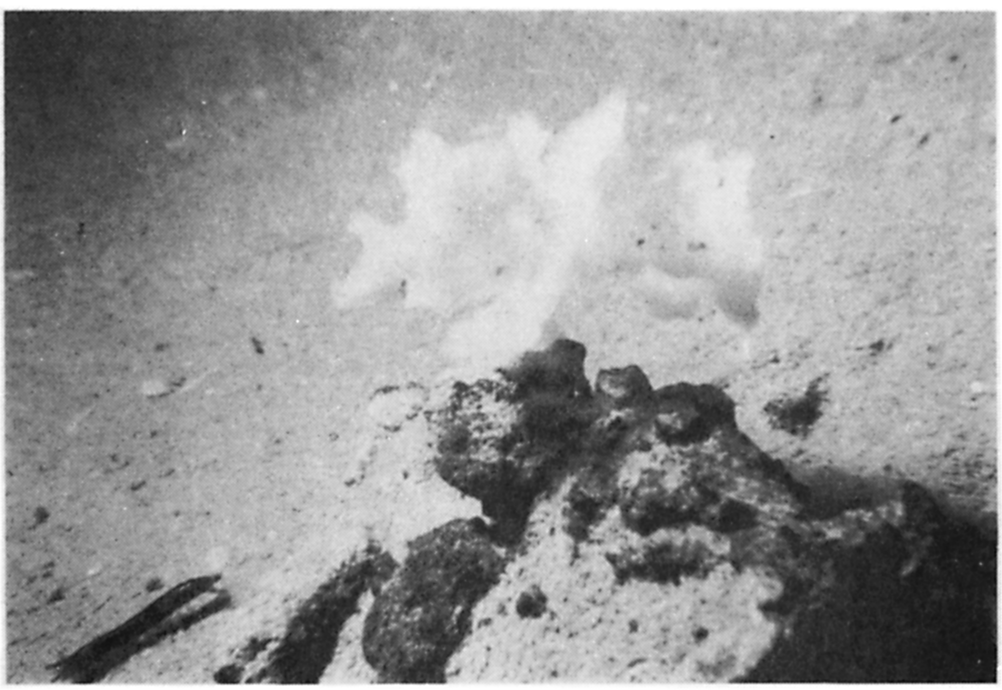


FIGURE 8: TWO RARE CREATURES AT 36m - A SPONGE AND A SYNCARID (BOTTOM LEFT)

photo: Jenny Ploenges

are currently unidentified and will possibly remain that way for some time. Dr. Keith Walker of the University of Adelaide is studying them. Even their means of reproduction has not been ascertained due to their lack of the normal cells. They can evidently reproduce from broken sections, but we doubt that they have evolved to become reliant on the clumsy kicking of cave divers' fins for reproduction! The white colour is replaced by a deep green at different times of the year, and this is thought to be caused by the presence of algae. Tiny snails also live on the sponges at these times.

Rare creatures like centipedes (see Fig. 8) are to be found at these depths as well, but only in a few sinkholes. Known as "Syncarids", these very primitive crustacea were previously thought to be found only as fossil specimens until the 1890s when the first living related species was found in Tasmania. Another species was found in the 1920s in Victoria, but our species, never before described, is as wide as the Victorian species is long; that is, about 5mm wide and over 20mm long. This new species lives permanently in the water, at all depths and is blind unlike all the others. They are evidently the only living common ancestor to the insects and crustacea.

Heading back towards our world of air, laden with samples and specimens, our divers might find flatworms living in the algaes and waterplants which lie on the shallow mudpiles. Beating off 5-centimetre-long leeches whilst decompressing is also very entertaining!

CONCLUSIONS AND ACKNOWLEDGEMENTS

I've tried to present, in a very short time, a resumé of our preliminary research into the sinkholes of the Mount Gambier region. There are probably many other creatures and features awaiting discovery and study if only the right people can become involved. I sincerely hope that this discussion paper has been of some interest and value in promoting the conservation of these unique features. I would like to thank all those people who have been of specific assistance over the past three years. I'd also like to especially thank Dr. Keith Walker, of the Zoology Department at the University of Adelaide for his exceptional interest, and my fellow cave-diving companions, especially Mark Nielsen and Jenny Ploenges, whose photographic skills presented with this paper speak for themselves.

PRESENTATION OF LIMESTONE GROWTHS FROM SINKHOLES

Several stromatolite-like rock growths were presented for comment. They are found on the sinkhole walls below water level and are not thought to be erosional in origin. They have internal structure and always "point" up towards daylight. In external form they look like leaning stalagmites up to 8m tall.

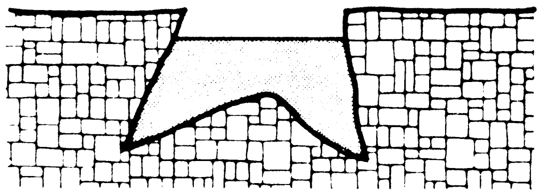
It should be noted that the water is of low salinity - about 300 milliequivalents per litre.

They might be dateable and, therefore, indicate a minimum age for the creation of the daylight openings, old water levels and other information.

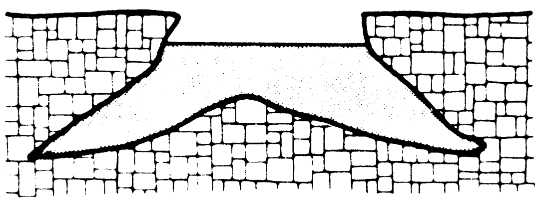
The CDAA "CATEGORY" SYSTEM

All the popular and well-known cave diving sites around the Mount Gambier area have been assessed by the CDAA and divided into 3 Categories, defined as:

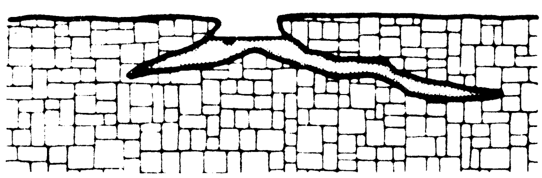
CATEGORY 1 . . . . Open sinkholes with no submerged passages.



CATEGORY 2 . . . . Sinkholes with submerged passages leading off.



CATEGORY 3 . . . . Sinkholes and caves with submerged passages and silting conditions.



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COCKLEBIDDY CAVE

The World's Longest Cave Dive

by
Peter Rogers
C.E.G.S.A. and C.D.A.A.

On Wednesday September 8, 1982 three push divers, part of a trip organised by Hugh Morrison from Perth, extended Cocklebiddy Cave in Western Australia by one kilometre, increasing its total explored length to 4.5 kilometres. The major push dive involved each diver wearing three back-mounted scuba tanks and pushing between them an underwater sled comprised of another 15 tanks. Prior to the push dive an advanced base was established at the Rockpile Chamber, an air chamber approximately one kilometre of waterfilled passageway from the entrance lake. All equipment used on the push dive had to be carted from the surface to the entrance lake, some 90 metres below, assembled, carried by divers to the rockpile, taken apart, carried over the rockpile (a 20 metre high, 60 metre long pile of very loose rocks!) and re-assembled in the lake on the far side of the rock-pile again.

From this point the push divers followed the guideline left by previous expeditions for 2 kilometres, before breaking new ground. Another 550 metres of submerged passage was explored before a lake leading to a new air chamber approximately 500 metres long was discovered. The new air chamber was christened Toad Hall before the divers commenced the return leg of a trip that took a total of 16 hours and in which each diver swam over 7 kilometres and breathed 21kg of compressed air!

To many people the vast arid Nullarbor Plain may seem an unlikely place for a major diving expedition. However, caves are found in the southern regions of this limestone plateau, many with huge passageways and caverns. Several are deep enough to reach the water table some 80 to 90 metres below the semi-desert surface. The first cave diving attempts on the Nullarbor were made in 1972 in Cocklebiddy and Weebubbie caves. Since this time at least eight of the major caves have been dived, and many kilometres of spectacular underwater passageways discovered. As cave diving equipment and techniques improved, divers pushed further and further into the Nullarbor cave sumps. One cave in particular became the focus of attention. Five major trips to Cocklebiddy cave between 1972 and 1979 saw divers discover 3 kilometres of passageway, all but 300 of which was fully submerged. The logistics and expense of this type of dive exploration delayed the next attempt until September 1982, when a West Australian team lead by Hugh Morrison assembled at Cocklebiddy. The team included New Zealand and South Australian divers.

Access to the underground lake in Cocklebiddy is through a large cavern, the floor of which drops 90m vertically over a horizontal distance of little more than 200m. The task of moving equipment down to the lake began on Sunday, fifth of September, and during the next two days more than forty 2500 cubic litre aluminium scuba tanks, a dozen sets of personal diving gear, torches, regulators, food, photographic equipment and even an emergency oxygen cylinder were hauled over the difficult terrain to the lake's edge. 240 volt electricity was run from a surface generator to the lakeside for lighting. 100 m of high pressure copper tubing was connected from a surface compressor down the initial and steepest part of the cave to the lake's edge. Scuba tanks could then be filled without having to be hauled all the way out to the surface. Communication from the surface to the air filling station in the cave was via a two-way intercom system.

On Monday sixth, a "fixed" guideline of 3mm diameter polypropylene cord was run from the entrance lake through to the Rockpile (see map); a 900m dive in which the roof of the passageway reaches a maximum depth of 10m below the water level. With the large numbers of divers due to pass along this first section of the cave, a good reliable guideline was essential. Previously laid guidelines were subsequently removed because they were unreliable. Silt can be stirred up in the first part of the tunnel and visibility reduced from perfect to less than 10m during the week of operations! The guideline also enabled divers to take the shortest route through the large underwater caverns whilst remaining at a relatively constant depth. (In places the passageway is up to 30m wide and 10m deep).

The Rockpile was first discovered in 1976 where the roof of the underwater cave has collapsed, forming a short section of dry passageway. Steep 20m climbs at either end lead down to the waters edge. All sumped off rockpiles are very unstable because of the lack of air movement and weathering. Divers have to be <u>very</u> careful - a minor injury can prevent a return dive. The Rockpile is treated as first base for push dive attempts in Cocklebiddy. All equipment to be used on a push dive must be hauled along the initial 900m dive, disassembled, carted over the Rockpile, and reassembled in the lake on the far side. Tuesday seventh saw the major movement of equipment for the push dive from the entrance lake to the Rockpile. A team of three divers wearing triple 2500 cu.lr. tanks on their backs, and supported by numerous other divers, pushed an underwater sled comprising of fifteen 2500 cu.lr. tanks out to the Rockpile. Here it was taken apart and together with each tank, was carried over the Rockpile, and rebuilt in the lake on the far side. Sets of triple tanks (for the push divers to wear on their backs), the oxygen cylinder, various containers of food and spare parts were also transported over the Rockpile.

A certain tardiness on the morning of Wednesday September eighth possibly indicated the apprehension with which many of the party viewed the task ahead. From a group of five potential push divers (Hugh Morrison, Simon Jones, Keith Dekkers, Ron Allum and Peter Rogers), the three who felt fittest and most ready to go on the day were chosen. These were Morrison, Allum and Rogers.

The party comprised the three push divers, four back-up divers (who would assist at the Rockpile and await the push divers return) and nearly everyone else involved in the expedition. They left the surface at 3.15 p.m., to make their way down to the entrance lake. After a leisurely and relaxed dive to the Rockpile, the push divers assembled their equipment on the far side and were ready to leave about 8 p.m.

The dive plan was for the three push divers to swim the sled along another guideline left by previous expeditions until one diver had used a third of the air supply contained in his five tanks on the sled. During this phase, the tripple tanks act as an emergency supply. Divers would then park the sled and continue on, now using air from the triple tanks on their backs. When one diver had used a third of this air, all divers would then turn around and start for home. In the 1979 expedition, Morrison, Jones and Dekkers had pushed 2km from the Rockpile. At this point the tunnel appeared to be deepening and showed no signs of stopping. This increasing depth below surface level meant that decompression problems could arise if a new air chamber was discovered further along the tunnel. Divers might then be forced to decompress before they could surface in the air chamber. This might not be possible on the limited air supplies available at the extreme range of such a dive. It was hoped to add at least 500m to the existing record. Triple 2050 cu. litre steel sets and sled had been used in 1979. This time, aluminium replaced the steel tanks and each was slightly overfilled to hold about 3200 cubic litres of air at about 27 mega-pascals.

So, with the prospect of a six hour dive ahead of them the push dive began. The four people waiting in the gloom at the Rockpile knew that the push divers had an absolute total of nine hours supply of air. Finding an air chamber might not extend this time due to possible decompression problems.

The first 500m were by far the most eventful of the whole dive. Buoyancy control of the sled proved more difficult than anticipated. Sled and divers careered from roof to floor on more than one occasion. Buoyancy was controlled by three scuba diver life vests attached to the front, middle and back of the sled. Each was fed from tanks on the sled. It was necessary to compensate for the estimated 30 kilogram of air that would be consumed during the dive. Also because air filled life vests wee present on the otherwise constant volume sled, depth changes, which varied from 0 to 14m during the dive, caused buoyancy changes and these required constant attention. Other excitement during the first 500m of the dive included a blown high pressure hose on one of Morrison's regulators and an extruded o-ring from the first stage attachment of a scuba feed line on one of Roger's regulators. These problems were subsequently put down to the over-pressurized tanks. A regulator from a tank on the sled was used to replace Morrison's regulator, while the extruded o-ring on one of Roger's regulators was successfully replaced. Both these operations took place underwater! Keith Dekkers and Graham Morrison from the back-up diver team followed the push divers for the first few hundred metres of the dive using twin tanks. When these two turned back the silent immensity of Cocklebiddy slowly enveloped the three push divers.

With buoyancy now under control the divers slowly pushed the sled through the crystal clear waters of Cocklebiddy, following the line laid down by previous expeditions. The history of previous push dives came to light at a point 1 km from the Rockpile. A slate, left by Morrison and Jones in 1977 to mark the limits of their dive was discovered. Here the divers took a 5 minute rest, floating gently on the underside of the roof. Around 1650m from the Rockpile a 500m coil of guide line was found. It was left in 1979 by a South Australian push dive that had failed to break new ground. At the 1800m mark Hugh Morrison indicated that he had used a third of his air from the sled. As arranged, the sled was "parked" against the roof and the divers moved on into the clear waters ahead. 200m after leaving the sled, the guideline which had been a constant companion for 2 km., ended. A new record was being established, and the thrill of breaking new ground was experienced. Morrison tied on a new guideline to the end of the old, and the divers continued. About 100m further a side tunnel off to the left was discovered. This was the first branch in the entire length of Cocklebiddy. A smaller second such branch was discovered at the 2250m mark, and it was with great expectation that the divers realised the form of the main tunnel was changing. From the 2km mark, at 14m roof depth, Cocklebiddy gets steadily shallower, with a more uneven floor and has the two previously mentioned side tunnels. At the 2400m mark an air pocket was discovered, but after some brief underwater signalling it was decided to push on. By this stage the cave was only 3 to 5m deep, and showing every sign of surfacing. 2550m from the Rockpile, with a large air chamber above them, the divers were unable to continue underwater due to a collapsed rockfall. After a 5 minute wait, in deference for decompression sickness, they surfaced into a large chamber with a rockpile leading up out of it. Diving equipment was left at the waters edge and exploration of the new cave started. After an initial steep 15 to 25m climb the rockpile levelled off and the cave continued above the water in much the same fashion as it had underneath. After about 500m, Toad Hall (as it was named) ended in yet another lake, and cocklebiddy headed off once more into the unknown.

The three divers rested for about an hour in Toad Hall before commencing the return journey, anxious not to stay too long for fear of unduly worrying those waiting at the first Rockpile. The outward dive from the Rockpile had taken $3\frac{1}{4}$ hours, and so it was well after midnight by the time the return journey commenced. On arriving back at the sled the divers paused to drink a fruit box apiece, to counter both the drying effects of the compressed air they had been breathing and the effects of decompression before getting underway on the slow return journey. Having mastered the buoyancy problems on the outward journey, the divers returned from Toad Hall to the Rockpile in $2\frac{3}{4}$ hours, a total push dive time of 7 hours. By this time fatigue, both mental and physical, was becoming an appreciable problem. The push divers and backup divers left most of the equipment at the Rockpile for retrieval the next day and headed for the entrance.

The party finally emerged tired but triumphant at 6.30 a.m. the next morning and huddled around campfire in the cold splendour of a Nullarbor dawn. The whole journey had taken over 15 hours, and each push diver had swum 7 kilometres. Despite these incredible statistics, the memory that lingered was one of the magnificent size and splendid stillness of an underwater world that began to fade from reality with the approaching dawn.

DISCUSSION

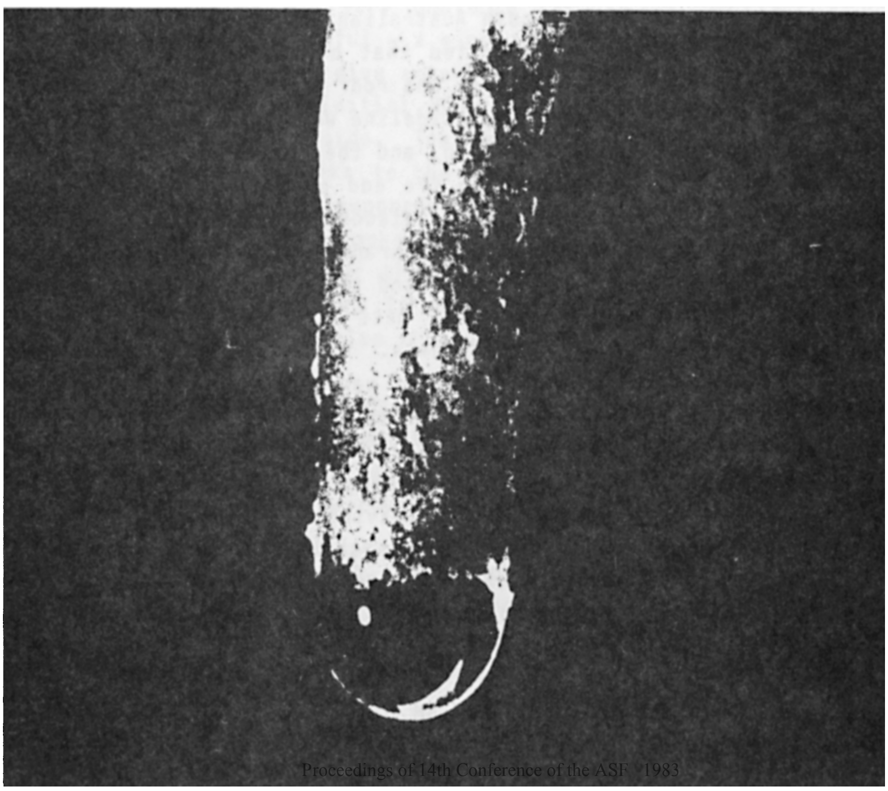
There is a warmer less dense slightly moving upper water layer a few degrees celsius high than the lower. Silt drops out of the top layer within a few weeks of dispersal but stays in the lower for much longer. This creates spectacular effects - it feels like you are swimming over clouds. Much further in the cave away from silt the thermo cline refracts light along it creating a sharp bright band around the walls.

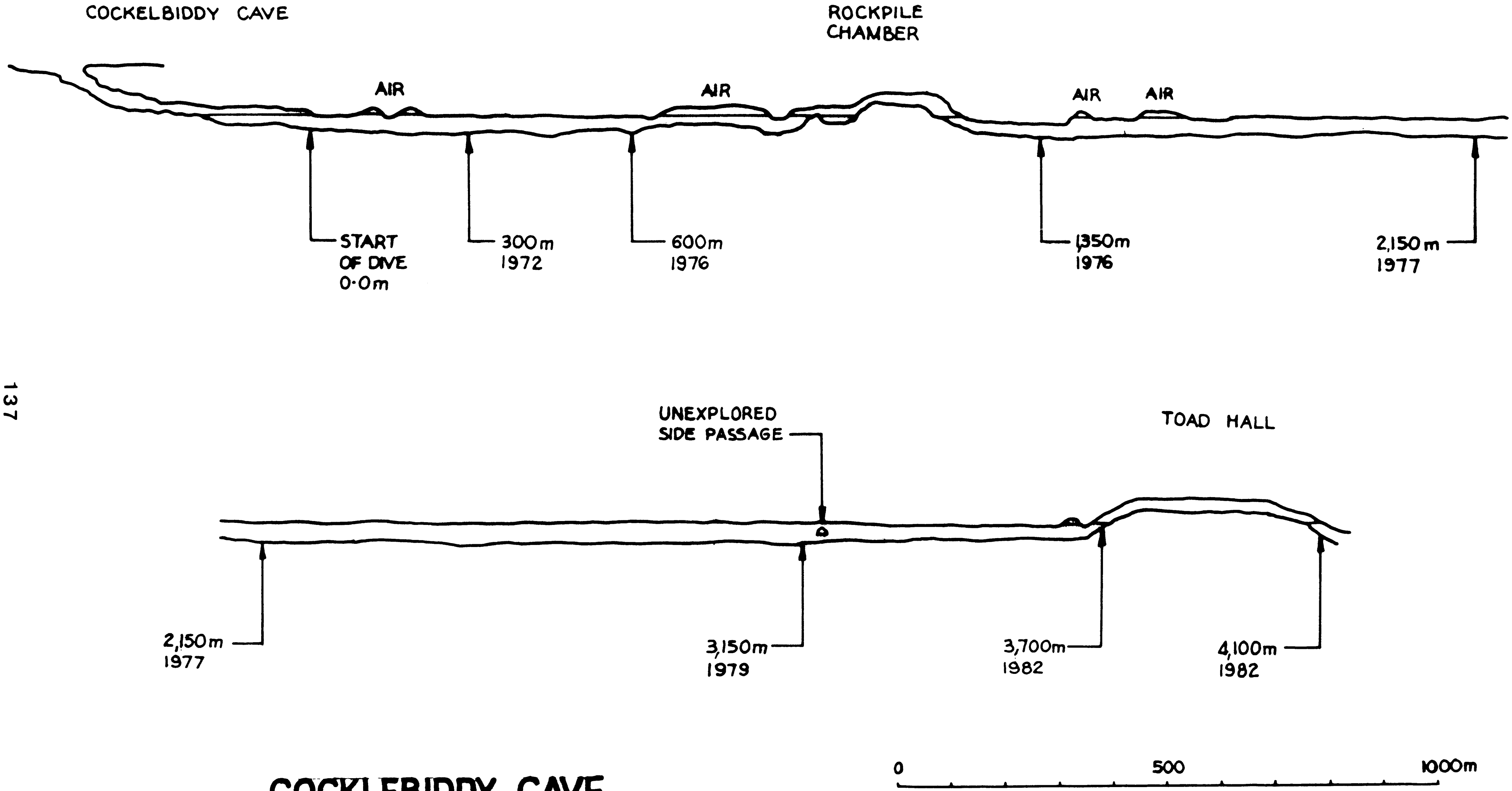
The only effective cure for cold is exercise which means that everyone is both tired and cold at the end of the dive.

THE WORLD'S SHORTEST CAVE DIVE

by

Neil Hallet

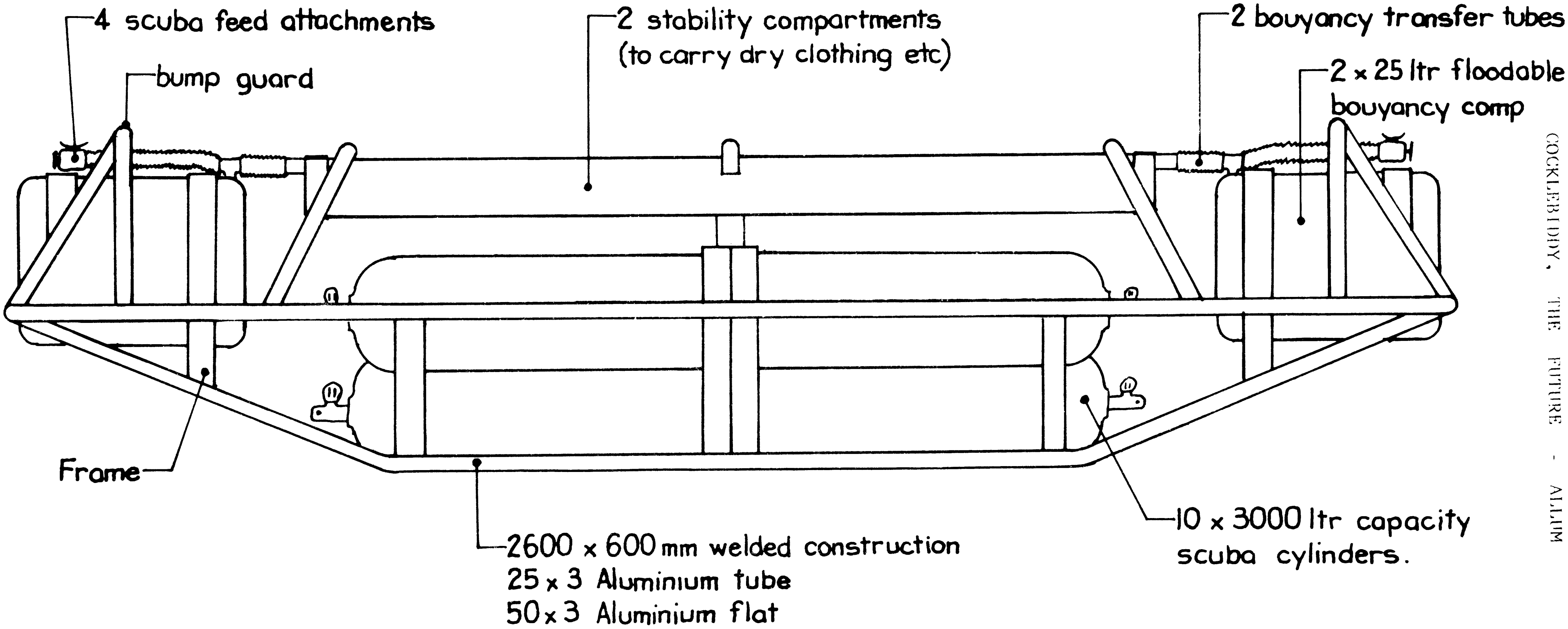




COCKLEBIDDY CAVE

NULLARBOR PLAINS - WESTERN AUSTRALIA

DRAWN BY - ROBYN ALLUM 1982



UNDERWATER SLED - Figure 6

COCKLEBIDDY CAVE

The Proposed 1983 Expedition

by
Ron Allum
C.E.G.S.A. and C.D.A.A.

With no end to this cave system in sight, further plans are being made to continue cave diving exploration in Cocklebiddy. Air-carrying capacity is the major limiting factor in this type of cave diving, and this is directly affected by air consumption rates, which in turn can be influenced by many factors including mental and physical stress. Thus a limit may well be reached where attempting to carry more air by conventional SCUBA techniques will increase air consumption to such an extent that little extra ground will be covered. The future may see rebreathing apparatus using electronic oxygen/inert gas monitoring systems; however cost and availability are currently prohibitive.

The next push dive planned for Cocklebiddy Cave will see an increase in the number of scuba tanks and equipment carried, this will be achieved using 3 one-man underwater sleds rather than one large one. Also, communications equipment is being designed to allow contact between the parties in the rockpile chamber or Toad Hall and the surface. Such a communications system allows for a more flexible exploration plan with the likelihood of an overnight camp at Toad Hall, to combat physical fatigue and allow time for the de-compression of nitrogen from the divers bodies, now a distinct probability.

INTRODUCTION

Beneath the arid Nullarbor Plain 14 kilometres northwest of Cocklebiddy in Western Australia lies Cocklebiddy Cave. A black hole at the base of the northern end of a large collapsed doline marks the entrance to this, Australia's longest cave in a straight line. A short drop then a steep rockpile leads 100 metres below the plain to a large subterranean chamber and lake. Here the cave diving begins.

Over the last ten years, through many cave diving expeditions 4.5km of this incredible cave have been explored. The cave passage has a few slight bends and apart from an occassional rock collapse, has railway tunnel dimensions; 3.5km of the passage is below the water table and totally flooded. The most recent expedition (August 1982) achieved this 4.5km mark and in doing so added further to the longest cave dive penetration in the world (as reported by P. Rogers, 1982 Expedition). The limit this expedition reached was a 400m long rockpile which rises 10m above the water, named Toad Hall. Here the plans for the 1983 Expedition were conceived.

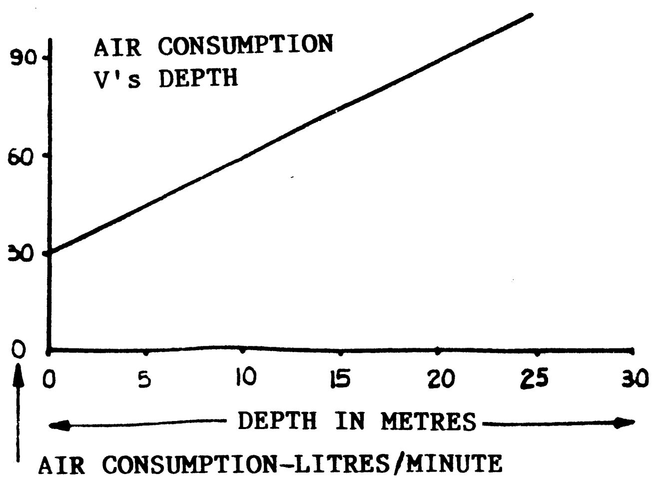
"With one third of our air consumed we surfaced into Toad Hall; the long rockpile was crossed and at its far end another lake; the passage seemed to continue due north. Sitting at the lake, ideas for the next dive evolved" these are now becoming plans for the 1983 Cocklebiddy Cave Expedition.

If it wasn't for Toad Hall the 1982 dive would have involved a single dive over 5km in length and taking approximately six hours, this perhaps being the limit using conventional air SCUBA techniques. In 1983 Toad Hall will be used to give the divers breathing space to recuperate from the physical and mental stress of a continuous dive. The following discussion reveals the requirements of air consumption and decompression, discussion that shows us a three-day underground duration with two nights at Toad Hall is essential for the next push dive.

AIR CONSUMPTION: How not to drown in the Nullarbor

The amount of air contained in a diving cylinder is represented by the volume it would displace if released at sea level (1 ata). A typical aluminium SCUBA cylinder has an internal volume of 11.1 litres and is filled with air to a pressure of 27 MPa. The capacity is approximately 3,000 litres.

An air consumption figure of 30 litres/minute is often quoted for a SCUBA diver at sea level (1 ata) - this increases proportionally to the absolute pressure when at depth i.e. at 10m (2 ata) the consumption is 60 litres/minute. (Figure 1).



However, air consumption is not that simple; it increases with increased work, e.g. pushing sleds (Figure 2) and physical fatigue that results from long duration of sustained work and exposure to cold water. (Figure 3). The actual percentage changes are different for each individual.

Figure 2

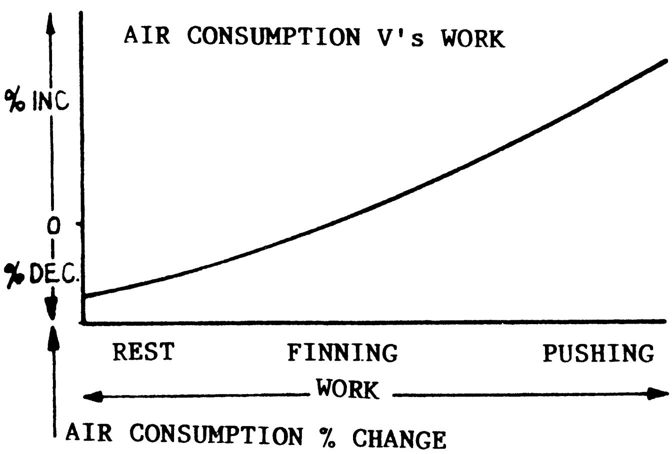
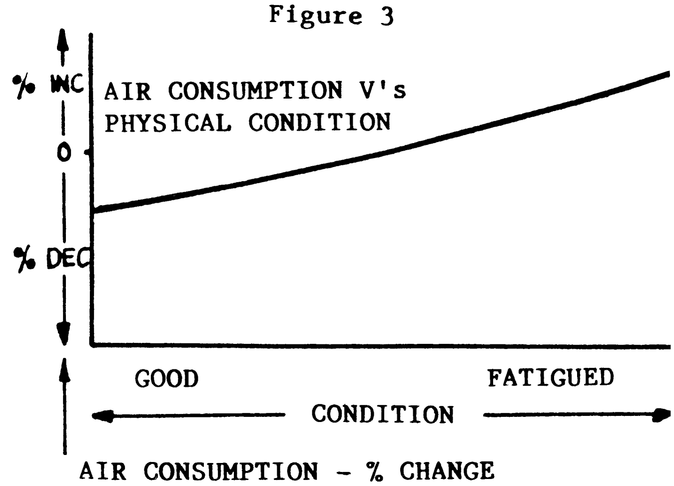
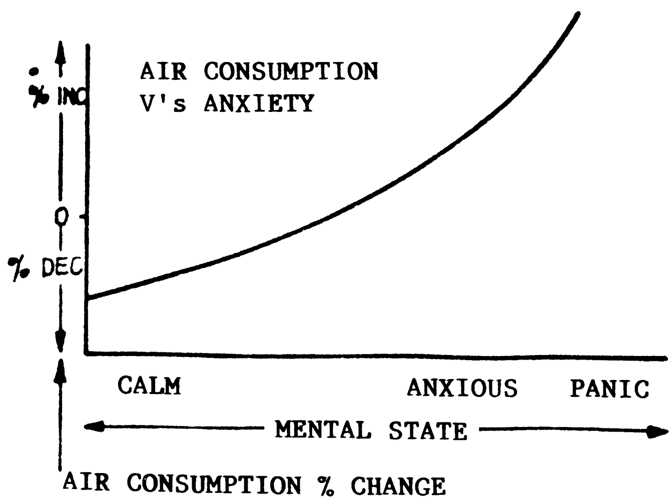


Figure 3



The divers mental state is also a major influence - a calm experienced diver has a lower demand for air than someone ill-equipped and inexperienced. If a situation arose where anxiety increases then air consumption would increase dramatically. (Figure 4).



As a rule for cave diving a "one third" rule applies i.e. 1/3 return and 1/3 reserve. From our experience the following consumption rates apply for Cocklebiddy Cave:

DIVE 1

Entrance lake to Rockpile: Distance 1km; Depth 10m; time underwater 50 minutes.

Air consumed to Rockpile is approximately 2000 litres. However if load is increased, e.g. pushing sleds, then 3000 litres would be consumed.

DIVE 2

Rockpile to Toad Hall: Distance 2.55km; Depth 14m; time underwater 195 minutes.

Air consumed is approximately 8000 litres by each diver. This includes pushing one 15 cylinder sled 1800m, then continuing using triples on back.

To make significant impact the 1983 Expedition plans to have 54,000 litres of air (18 cylinders) for the dive beyond Toad Hall. This will take the three divers approximately 2km, if the cave continues at approximately 10m in depth.

The physical effort that is involved at Toad Hall to set up the push dive is as follows:

Three divers to carry 18 SCUBA cylinders, sled, 3 sets of diving kit, guide line, lights, photographic equipment etc.

The 400m across the unstable rock floor to the north lake - trips totalling several kilometres per person is required to complete the set up.

The diving schedule is detailed later; however before starting the push dive from Toad Hall the divers must have:

1) Completed Dive 1.
2) Completed Dive 2, pushing a sled the 2.55km.
3) Completed the set up of camp and communications.

This will involve 8-10 hours of hard, sustained labour.

Lighting, communications, dry clothing, sleeping kit and warm food will be available for the divers to recuperate. This is essential for the divers to gain maximum mental and physical conditions, to make the best use of the available air on the push dive.

DECOMPRESSION: No Bends at Cocklebiddy

When a diver descends under water the increased partial pressure of nitrogen gas in breathing air will cause some of the nitrogen to diffuse into body tissues. If the time and depth of the dive is sufficient then decompression stops must be made before surfacing to prevent the onset of Decompression Sickness (the Bends). Using the United States Navy air decompression tables the following decompression procedure is necessary for the dive to Toad Hall.

DIVE 1

Entrance to lake to Rockpile Chamber: Distance 1km (700m dive) Depth 10m; Dive time 45 minutes.

No compression stop is necessary; however, some residual nitrogen is retained by the body tissue for several hours after the dive (represented by a letter in the United States Navy tables).

After surfacing from Dive 1 we are in group 'E'. An hour later some of the nitrogen is eliminated; the group is now 'D', as calculated by 'Surface interval' Credit Table.

DIVE 2

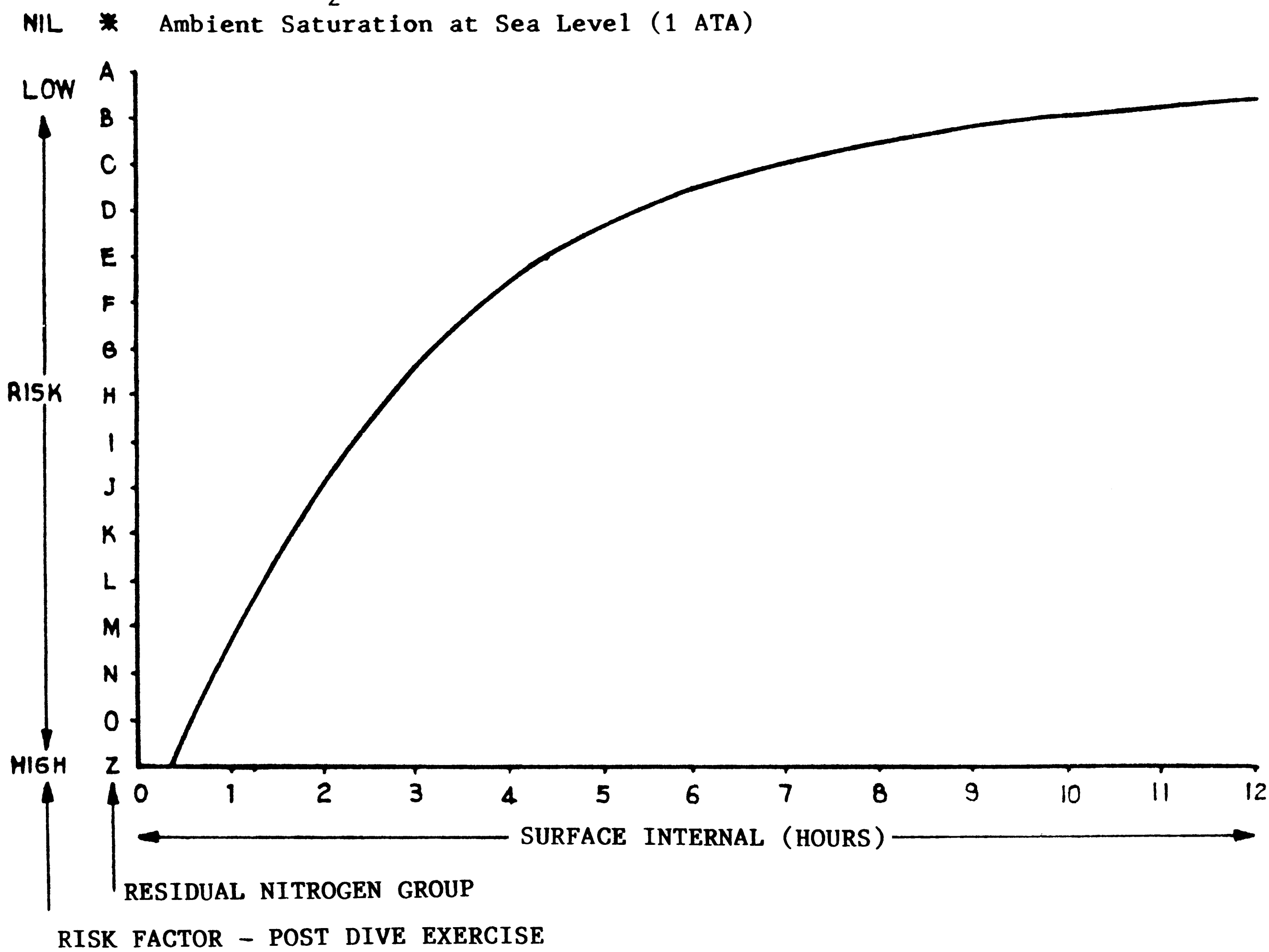
Rockpile Chamber to Toad Hall: Distance 2.55km; Depth 14m; Dive time 180 minutes + residual nitrogen time.

From 'Repetitive Dive Timetable' the time one must add is 29 minutes; the new time to calculate for decompression stops is 180 + 29 = 209 minutes. The decompression stop required before surfacing is 40 minutes at 3m. The new residual nitrogen group at the end of decompression is group 'Z'.

The residual nitrogen group 'Z' is the highest safe saturation point of nitrogen that can remain diffused in the body tissue. We are a walking fizzy drink - if knocked or spilt we would erupt with many nitrogen bubbles forming in our tissues. To avoid decompression sickness we must rest, avoid physical activity or injury for several hours after a dive. Figure 5 represents the de-saturation time to eliminate the nitrogen and to reduce the risk factor of getting 'Bent' as derived from the United States Navy tables.

Figure 5

POST DIVE N_2 DESATURATION CURVE (Group 'Z')



A few hours rest is essential before transportation of equipment over the rockpile to reduce the risk factor. To avoid getting into decompression times on the push dive we will spend a minimum of 12 hours at Toad Hall. It would be a wasted effort to carry our air just for decompression or to have to limit exploration due to excessive decompression requirements.

NEW EQUIPMENT: Sleds under the sand

The most significant change for the 1983 Expedition will be the construction of four sleds from aluminium. It will feature:

1) A cradle-type construction to house 4 sets of triple cylinders.
2) Two floodable bouyancy chambers, each having 25 litres capacity.
3) One-man bouyancy control SCUBA feed and dump valve fittings.
4) Two dry storage chambers for clothing, sleeping bags etc. for the facilities required at Toad Hall.

The new type of sled will speed up loading and unloading of cylinders and equipment as required at the surface lake, the Rockpile Chamber and Toad Hall. (Figure 6).

Under way it is intended to be pushed and controlled by only one person.

It is planned that each diver can consume air from three cylinders on the sled during the 2.55km dive between the Rockpile Chamber and Toad Hall. On this dive the divers will be wearing triples (three cylinders on back) which will be full, as an emergency supply. The sled could be ditched and left if necessary.

Bouyancy control is essential to replace the sleds displacement as air from two cylinders is used. (Approximately 37kg of air is contained in the 12 cylinders). Factors affecting the divers own bouyancy is compensated for by carrying a bouyancy compensator attached to the triple backpack.

PROPOSED DIVE PLAN: Toads of Toad Hall

The dive will consist of five stages as follows:

1) A set up dive to the first Rockpile Chamber.
2) The dive to Toad Hall.
3) The exploration dive.
4) The return dive from Toad Hall.
5) The recovery dive from Toad Hall.

DIVE 1: Support

Support divers using triples (three cylinders on backpack) will push 46 full cylinders and all necessary equipment for the dive and underground camp, on four sleds to the Rockpile Chamber. Three sleds, 45 tanks and the accessory equipment will be carried over the rockpile (one cylinder, one sled left) and re-assembled as three sleds with 12 tanks each and three triples to be used for the next stage. All divers return using the same triples; these now are two-thirds consumed, requiring recharging for the next dive.

DIVE 2: Build up

The three push divers using twins (two cylinders on back) dive to the first rockpile; there, one-third consumed twins are left for Dive 4. The divers cross the Rockpile and check the set up equipment, then wearing the triples, each pushes a sled the 2.55km to Toad Hall. Three cylinders from the sled are allowed for the dive. The triples worn are the divers emergency supply of air. After rest, the camp is set up, the Radio Direction Finding equipment and communications are made ready for use. Eight trips - each over the rockpile - are required to carry one sled, 18 tanks and dive kit to the next lake, and assembled as one sled with 9 cylinders and three triples to be used for Dive 3.

The divers consume warm food with rest or sleep before commencing Dive 3.

DIVE 3: The Push

The divers, wearing triples, will push the sled using one cylinder from the sled for the outward journey; the sled is parked by inflating the bouyancy chambers. The divers continue with triples using one cylinder to continue the outward journey. It is expected that 2km of passage could be travelled underwater before having to return; a guide line will be layed to safeguard our return and to be left to aid future expeditions. With one-third of the air consumed the divers return to the sled, which is used to return to Toad Hall. One-third of the air remains at the end of the dive - this air will be the divers emergency supply on the dive. The divers could be away for 4 hours, possibly longer if air chambers are found. The divers consume warm food and rest or sleep again before Dive 4.

DIVE 4: Wind Down

The 18 cylinders and sled are carried back to the start of Toad Hall. Seven empty and three full cylinders are mounted on each sled; all equipment will be removed from Toad Hall. The divers - all wearing full triples as emergency supply air - push one sled each back to the Rockpile Chamber using three remaining full cylinders on sled. The divers cross the Rockpile and return to base using twins left on Dive 2.

DIVE 5: Recovery

Support divers using triples will recover the 45 cylinders and accessory equipment on the four sleds left on the far side of the Rockpile Chamber.

A number of days will be taken to recover the equipment from the cave.

AIM OF 1983 EXPEDITION: It's only for Science

As well as a push dive the group intends to:

1) Survey Toad Hall.
2) Locate Toad Hall relative to the surface using R.D.F. (Rockpile Chamber has been completed).
3) Set up communications equipment at the surface lake, Rockpile Chamber and Toad Hall.
4) Take powerful flash equipment to photograph the event, including the push dives.
5) Construction of adequate lighting plant.
6) Use measured guide line to assist underwater survey on the push dive.
7) Plan a suitable diet for the camp at Toad Hall and have heating facilities for food if considered necessary.
8) Have a training programme prior to the event, to include support divers.
9) Consider whatever else has not been mentioned.

The length of Cocklebiddy Cave is unknown; the 1983 expedition may gain only a few metres if the passage is blocked by a rock collapse or it plunges in depth. It could surface into dry passage several kilometres in length or just continue as it has for the past 4 km. We are not diving for a world record; whilst the cave continues, efforts will be made to penetrate it. At present we are using compressed air SCUBA equipment; if Cocklebiddy Cave continues, research will evolve new technology for future expeditions, short cuts will not be taken at the expense of safety. The experience of past expeditions has helped develop SCUBA diving as a safe sport; with future expeditions it will become an even safer sport.

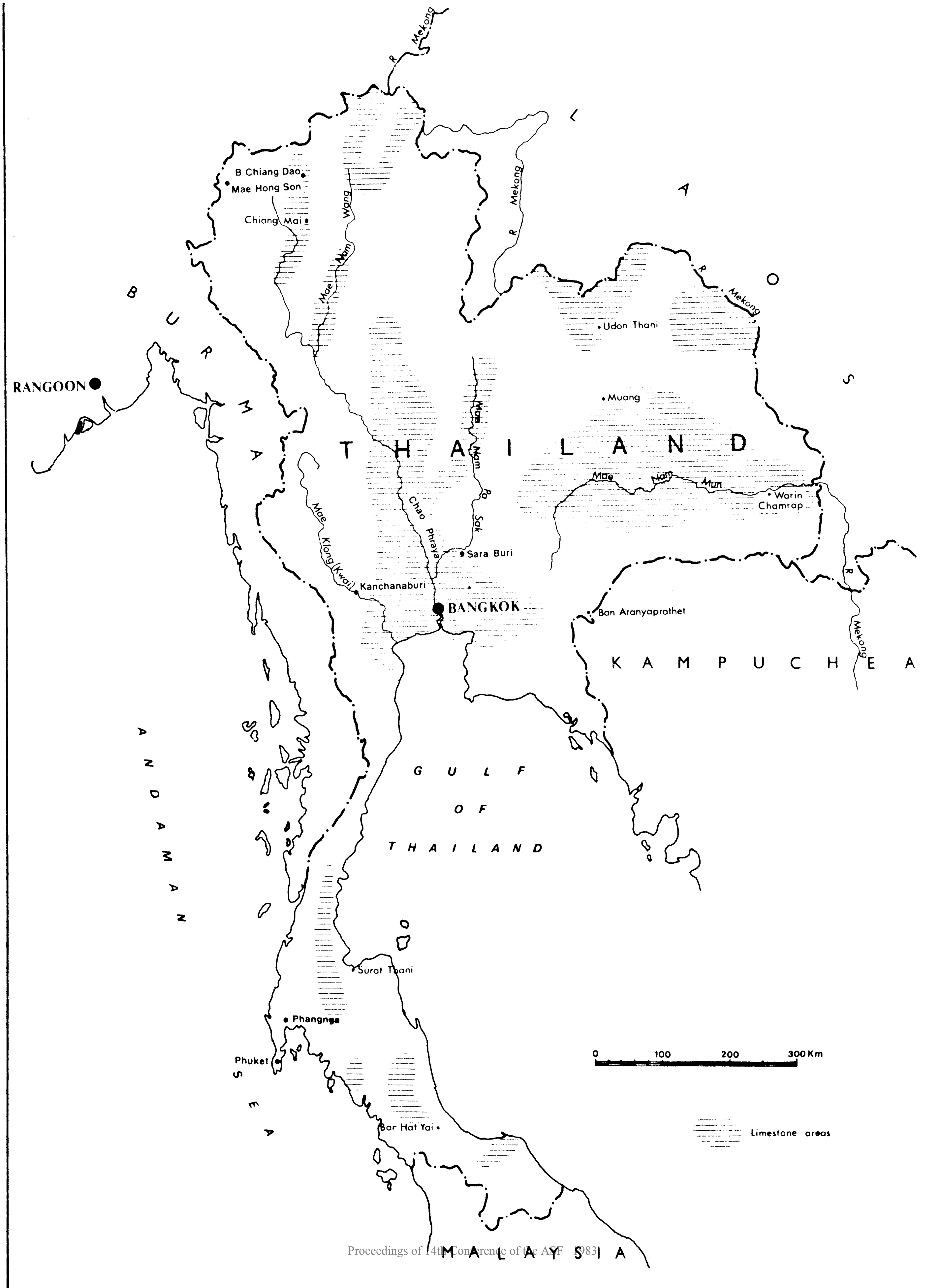
DISCUSSION

The 1982 trip had intended to have powered sleds but the reliability was found to be low and the duration of the batteries was short so that no sled was taken. If used, the divers could traverse more cave in a shorter time using less air when submerged. However, each diver would need to carry enough air to swim back without the sled and carrying the heavy sled and batteries over rockpiles after a dive would negate much of its value. The abandonment of so expensive a piece of equipment would be a financial disaster.

In the future, inert gas apparatus could be used in push dives but this is expensive and will need sponsorship. However, owners of these devices will normally not loan them to persons who have not been trained in their use for years. They might wish to supply the users as well as the gear.

Rebreathing apparatus uses oxygen which becomes toxic below 10m depth. Cocklebiddy requires dive depths of at least 15m in places. Also, if bouyancy control fails, a diver could go much deeper.

At this time we are considering going further on the same air by better bouyancy control, more streamlining and more efficient design of the sled e.g. with clamps.


R Mekong
L A O S
B Chiang Dao
Mae Hong Son
Chiang Mai
Mae Nam Wang
R Mekong
B U R M A
RANGOON
Udon Thani
Muang
T H A I L A N D
Mae Nam Pa Sak
Mae Nam Mun
Warin Chamrap
Chao Phraya
Mae Klong (Kwai)
Sara Buri
Kanchanaburi
BANGKOK
Ban Aranyaprathet
R Mekong
K A M P U C H E A
A N D A M A N S E A
G U L F O F T H A I L A N D
Surat Thani
Phangnga
Phuket
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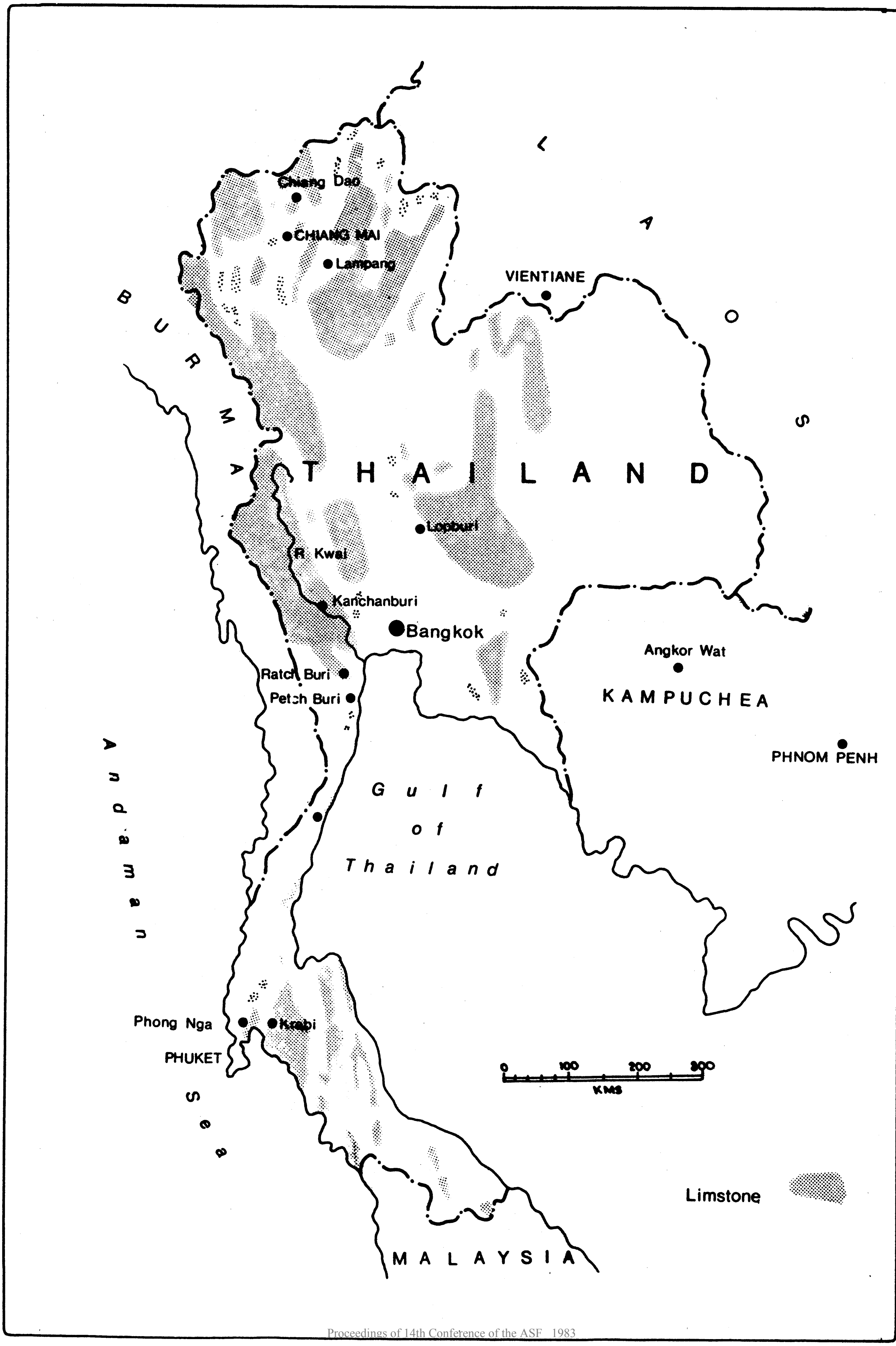
Bar Hat Yai
Limestone areas
M A L A Y S I A


L A O S
Chiang Dao
CHIANG MAI
Lampang
VIENTIANE
B U R M A
T H A I L A N D
Lopburi
R Kwai
Kanchanburi
Bangkok
Angkor Wat
KAMPUCHEA
Ratch Buri
Petch Buri
PHNOM PENH
Gulf of Thailand
Andaman Sea
Phong Nga
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PHUKET
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MALAYSIA
Limstone

KARST & CAVES OF THAILAND

A Reconnaisance Report

by
John R. Dunkley
C.S.S.

Carbonate bedrock occurs over approximately 20% of Thailand. The limestone regions tend to be exposed as long narrow isolated belts following the lineation of mountain chains, trending from NNE/SSE to ENE/SSW. Local relief is commonly 300-400m in the south, to as much as 1,700 at Chiang Dao in the far north.

Karst topography is widely distributed. Tropical karst towers predominate in the south, where aligned belts and ridges extend discontinuously for over 600km. In the far north, altitude modifies climate and there are significant areas of a more temperate doline karst with extensive underground drainage and dolines up to 400m deep.

Caves are widespread and a preliminary field reconnaissance turned up 200. The longest may be Chiang Dao Cave, north of Chiang Mai, a tourist cave said to extend 10 to 14km, opening at the foot of a massive limestone mountain rising a further 1,700m above the entrance. Good scope exists for vertical caves of the order of 500-1000m in this region. Distribution of known caves correlates with settlement patterns and many have been discovered only in the last 20 years or so. Much of Thailand is still very thinly inhabited but access is much easier in recent years. The scope for exploration is enormous.

Thailand covers an area of 514,000 square kilometres, twice as large as Victoria and almost as large as France. Climatic range over its north-south extent of 1,500 km varies from equatorial through monsoonal to altitude-modified warm temperate conditions in the far north.

Carbonate rocks are found over approximately 20% of the total area of the country. Prior to World War 2, only reconnaissance geology was available, but progressive surveys have increased the known area of limestone. Indeed, I was shown caves quite close to major towns, in large limestone outcrops not even included on geological maps. The most common outcrops are of Permo-Carboniferous Ratburi Limestone, a light grey crystalline rock in which recrystallization, at places forming marble, is common, and which is sometimes dolomitized. Less common but occurring widely in the south is the dark to black Ordovician Khung Song Limestone.

The limestone regions tend to be exposed as long, narrow belts following the lineation of mountain chains in an elongated S-shape trending from NNW/SSE to NNE/SSW. Local elevations are typically of the order of 100 to 400 metres, especially in the south and centre, but much greater exposures are reached in the far north, up to a maximum of 1700m at Ban Chiang Dao. In nearly all cases the limestone extends below local base level.

The relatively resistant limestones produce perhaps the most spectuclar features of the Thai landscape, and a preliminary survey suggests at least four broad karst types. I stress that this division is largely descriptive and is based on exhaustive study of available topographic maps, plus several weeks of casual field reconnaissance.

TOWER KARST

Tropical karst towers predominate in the south, in Peninsula Thailand and in isolated outcrops around the margins of the central Chao Phraya valley. Where beds are steeply dipping, the towers are commonly elongated and aligned along the strike, separated by long narrow, enclosed glades. Aligned belts of towers extend discontinuously for over 600km down the Peninsula, entering the sea in spectacular fashion at Phangnga Bay, near Phuket.

CONE KARST

An extensive field of star-shaped and elongated cockpit-type depressions is discernible on some 1:50,000 maps, notably to the east of Sara Buri in central Thailand. It is likely that this type of karst will turn out to be more widely distributed as more detailed maps become available.

PLATEAU KARST

North-west of Kanchanaburi, the River Khawe Noi (Kwai) drains an enormous area of folded limestone with scattered, unremarkable karst features and few known caves. This area is thinly settled, covered with dense monsoon thicket forest (increasingly logged), and has been notable mainly for archaeological excavations and latterly, tourism. As recently as 1960, access to these caves was described as requiring transport by ten elephants, but tourists now employ buses and speedboats and some caves are in National Parks.

DOLINE KARST

This term is used loosely to describe significant areas in the far north where numerous depressions, ranging from small dolines to large poljes (?) pit the surface of limestone plateaux. Altitude ameliorates the sub-tropical climate here, precipitation is very heavy, and other landform assemblages of a humid temperate type include sinking streams, through caves, springs and active and fossil horizontal steam caves.

CAVES AND CAVING POTENTIAL

Although much of the remoter limestone is still difficult of access throughout the country, there is so much that months could be spent in leisurely and civilized exploration, using only public transport and based in acceptable hotels.

A preliminary count has produced 200 caves and rather more features worth speleological attention. The distribution of caves is closely related to settlement patterns, and many were described as having been discovered only in the last 10 to 20 years. This is certainly the case with many of the semi-tourist caves open to the public. A surprising proportion of Thailand was virtually uninhabited until the 1960s and 1970s, and significant areas, especially limestone country, are shown on recent 1:50,000 maps as totally devoid of roads, tracks or villages.

In the tower karst, caves tend to be massive in size if not length, frequently with roof collapses and extensive dry decoration. Cliff foot caves may be found and the towers are commonly pierced by active or fossil stream caves. In Phangnga Bay, tourist boats pass at sea level through several such caves. At late stage there is collapse of the centre of the tower itself, but prior to this some towers, such as the renowned swallow cave of Ko Phi Phi, are little more than empty shells.

The longest known cave is at Chiang Dao in the far north. Year round, over one km is open to tourists and in the dry season guides apparently operate 8-hour trips into the far reaches of the cave, which is said to extend to 10 to 14km directly under Ban Chiang Dao Mountain. In trying to check this in January, 1983, Paul Greenfield and I were stopped by water passages, but confirmed the existence of large higher level passages beyond the tourist section. The mountain is entirely limestone and towers 1700m directly above the cave entrance. More exploration is warranted.

Further north still is a horizontal tourist cave, Tham Tab Tao, which debouches at the foot of a limestone massif. The map shows a suggestive alignment of dolines on the plateau above the probable trend of the cave, extending 5km due west of the entrance. Local information was that exploration is incomplete, the cave having been penetrated for "half a day" beyond the 1km tourist section.

Close to the north-west corner of Thailand and extending across the border from Burma is a massive limestone plateau towering 400 to 700m out of a deeply entrenched gorge. Even the 1:250,000 map shows the plateau pitted with numerous depressions. A 30km long stream, Namlang, drains several hundred square km of limestone, penetrates a large through cave and sinks in a polje-type depression below 400m high cliffs.

To the south of this the limestone plateau is almost uninhabited and, according to local information, largely unknown. 10km to the north east, at the village of Ban Mae Lana, another long stream disappears in a polje (?), rising 8km further west on the Huai Pong Saen Pik. We were unable to get into any of the sinks and did not have time to reach the three or four risings to the west. However we were assured that at least one of these is readily enterable.

CAVE USAGE

As elsewhere, caves in Thailand have proven archaeologically valuable and prehistoric artifacts have been recovered in the River Kwai area and more recently near Mae Hong Son.

A surprising number of caves are open for public inspection, many have generator-powered electric lighting, visitation is quite high and there is a thriving postcard industry. There is a well-developed local tourist trade; one temple cave near Phangnga was recording about 4,000 non-Thai visitors a year because the enterprising abbott had placed it on the Phuket - Phangnga Bay tourist circuit. A count of 27 such tourist caves reveals 3 or 4 developed purely for tourism or recreation, one (Ko Phi Phi) is exploited primarily for swallows nests, and the rest are associated with a Buddhist temple. I was told that the quiet and solitude of caves and rock shelters appeals to many Buddhist monks, but the income from the often self-guided cave inspections is clearly a motivating factor as well. There has been some small infrastructure investment in tourist caves in several places I visited, and plenty of potential.

SUMMARY

With 100,000 square km of limestone in a warm, humid environment, Thailand has tremendous scope for cave exploration and study, and it is surprising to find almost no previous reports. The greatest prospects are in the far north where long horizontal caves are already known and there is vertical potential of the order of 500 to 1000m. Road access is improving rapidly, public transport and accommodations are excellent, the scenery spectacular and the people most hospitable. The stunning karst towers in Phangnga Bay are probably the finest in the world and are grossly underrated as a tourist attraction.

The most productive exploration could probably be done by a group or 4 or 5 working in the far north and north-west, but there is plenty to occupy even one or two cavers with a week or so to spare.

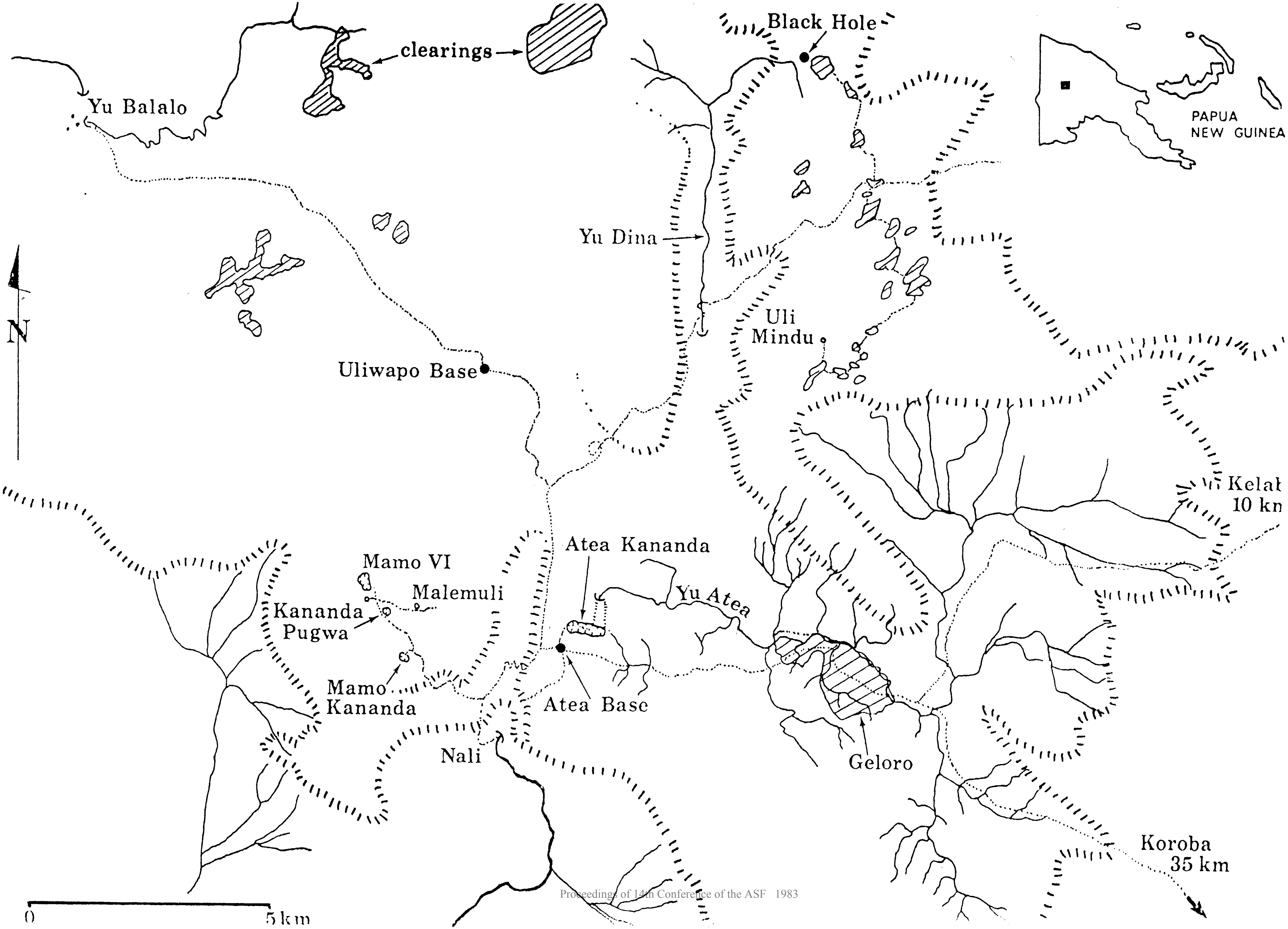
MULLER 82

The Australasian Expedition to the Muller Range, P.N.G.

by
Julia James
Al Warild
Steve Bunton
Tony White
Rauleigh Webb

An examination of the results of two months of intensive cave exploration by the fifty-nine participants of the Muller 82 expedition to the karst of the Muller Range, Papua New Guinea.

Several specific aspects of expedition cave surveying and photography are considered in some detail.


Black Hole
clearings
Yu Balalo
PAPUA
NEW GUINEA
N
Yu Dina
Uli
Mindu
Uliwapo Base
Kelal
10 km
Atea Kananda
Mamo VI
Malemuli
Yu Atea
Kananda
Pugwa
Mamo
Kananda
Atea Base
Nali
Geloro
Koroba
35 km
0
5 km

The Muller Range in the Southern Highlands of Papua New Guinea was the scene of the successful Australasian expedition, ATEA 78 which explored the now famous Atea Kananda system. When ATEA 78 finished many inviting caves were left incompletely explored or untouched because of the onset of the wet season. Muller 82 was a follow-up expedition which went into the field with a most ambiguous cave exploration programme. One aim was to survey 100km of new passage. To do this initially, Muller 82 had 59 members and 12 Duna tribesmen. These were divided into a number of mini expeditions with widely diverse projects.

Thanks to ATEA 78 the Atea Kananda was already the longest cave in the Southern Hemisphere and subsequent studies had shown where concentrated efforts might increase both its length and depth. The Atea Riverway was a prime objective despite its hazardous nature, even in the so-called "dry" season.

The main base camp would be set up at the ATEA by an advance party but if other areas proved more fruitful the capability existed to deploy the entire resources elsewhere, possibly to the 8km Mamo Kananda. It was only discovered in the last weeks of ATEA 78, and was believed to be a gateway to a vast labyrinth lying below the 100 sq.km Mamo Plateau.

Other objectives were to be undertaken from smaller camps or by mobile groups. The Nali Gorge sported two tantalising entrances high in its walls. Could these provide a backdoor to the Atea Kananda? At Uliwapo and high up in the moss forest of Legari there were unfinished shafts; Uli Mindu where rocks drop for six seconds in silence ... and what of the Black Hole: unvisited, glimpsed only from the air? Perched almost two km vertically above any known risings: could either of these be left unchallenged? Far to the west flows the Yu Balalo, a large river first noticed in 1973 and known to disappear underground. What if this was even more ferocious than the Atea? Could it be explored?

LEGARI - from one Black Hole to another

The airphotos of the Legari Region show alpine clearings, obvious streamsinks, and an impressive black hole at altitudes of 2900m to 3200m. The mountain has 2000m of limestone below it both to the east and west.

Five vertical cavers were set down by helicopter with a month's supplies in a clearing right next to the Black Hole. It did not look right. They could see the bottom only 100m down and that was the end. It was not the "Black Hole" in the MULLER 82 pamphlet! Their main objective had been "explored" in ten minutes between helicopter shuttles and they were isolated with no tracks, 25km and perhaps a week's cutting from anywhere. Serious thought was given to climbing back onto the helicopter and escaping elsewhere, but the Black Hole had not been the only objective.

Uli Mindu was 8km from the dropsite, six of these 8km are through the worst jungle imaginable, so thick that you have to cut track to move. In that 8km are ten streamsinks, which are all completely impassable. Much of the rock is so soft you can cut it with a bushknife. Towards Uli Mindu the limestone looked better, but still they doubted whether there would be any caves larger than the overhang they were living in. The "feeling" was wrong and was not improved when they found Uli Head, one of the most horrible caves on earth. It consistently refused to do the decent thing and finish. Instead this cave spun out for 300 terrible metres attaining a depth of 70m. Their only caving experience was completing the exploration of Uli Mindu. A 150m entrance shaft and a descent through boulders took them to a depth of 200m. Then began a three day hike cross-country to rejoin the other members of the expedition. their jungle walk involved dropping into the Yu Dina valley where for a while they wandered through doline karst with many inviting open shafts, but their food and enthusiasm was rationed, so back to Atea base camp and the real caves.

ATEA KANANDA – a grope in the mud and a fish on the line

The weather conditions on the Muller Plateau during July were ideal for a Riverway push, there was a drought! As soon as the gear arrived at Atea Base Camp the Ship Canal, an 800m swim was rigged with a kilometre of "float rope". The Ducks were found to have some 2m of airspace instead of the 10-20cm familiar to the ATEA 78 cavers. In spite of this the explorers of the regions beyond the Ducks still became nocturnal. If it had not rained during the day they would set out at 9 p.m. in order to get the maximum search time before the possibility of afternoon rain forced a 4 p.m. curfew for the return through the Ducks. The area at the end of the Riverway was given a very systematic going-over but little was found. A last desperate attempt was made by letting a life-lined caver be swept by the full force of the Yu Atea into the Penstock then on a suitable gurgle the strong hauling team would extract him. But he also found nothing. A further 20m of depth was added by a grovel down through the boulders in the floor of Winchester. Thereafter the Riverway became THE tourist trip of the expedition.

The Spanish Inquisition, a connection from New World to the Austral Series was made. At last! There was an alternative to the thixotropic Imperial Mud Standard but it was as easy as its name infers. It was somewhat doubtful if the Spanish Inquisition ever provided faster access to the Silver Hammer Room, another area where depth could possibly be found in the Atea Kananda. There was only one marathon trip to the Austral Series in which the Silver Hammer Room was combed for ways on and down.

The highest part of the Atea Kananda is the Yaragaiya Series and several significant additions were made there. On the first day of the expedition six cavers went into Yaragaiya for a six day camp. After several rather depressing days of crawling into all the leads in the main phreatic maze, systematic exploration back down the Upwapugwa Streamway led into a new higher phreatic level and gave the cave some 39m extra height. When their food supplies were running low the Yaragaiya crew surfaced leaving many leads in this phreatic system. A return was planned, but it was cancelled as enthusiasm for detailed cave exploration diminished with the news reaching Atea from Mamo that cavers were walking through new passage only fifteen minutes from camp rather than after hours of ploughing through Atea mud. The Atea Kananda was left 34.5 km long and 350m deep.

NALI – things that go bump in the night

Out of Yaragaiya and needing a few days in the sun, the underground team rigged a 300m abseil down vertical vegetation to an entrance in the base of the main headwall of the Nali Gorge. The abseil, followed by a scramble down perched vegetation, allowed access to Ngoma Kananda. This cave is an enormous breakdown chamber which makes an excellent campsite if you can tolerate the noise. After dusk when the swiftlets have returned to their roosts by echo location, the fruit bats (flying foxes) begin the night shift, their ghost-like noises occasionally punctuated by the sound of large rocks spontaneously falling out of the roof.

Just along the base of the cliff and around the corner is Pimbiraga Kananda. Behind its railway tunnel entrance is 2.5km of large well decorated passage. Both the Nali caves are believed to be old outflow caves of the Yu Atea but neither has leads in the direction of the Atea Kananda which lies almost directly above. A connection to the Atea Kananda would yield a cave of some 650m deep.

The Nali was again left with entrances still to be explored. The jungle abseil was detackled because the rope was required elsewhere. MULLER 82 had some 4km of rope and there was still a shortage!

ULIWAPO – to bash scrub and bomb shafts

Northeast Mamo was a prime objective of MULLER 82 for it already had Uli Guria (-314m). Left over from 1978 was Uli Eta Riya almost 200m deep and still going. A delightful camp on a stream was created at Uliwapo, a mere 200m from Uli Eta Riya. It would have been closer to the cave but the Duna wanted it where they could fell good firewood straight onto the woodpile. Uli Eta Riya rigged from top to bottom with a continuous length of rope was voted the best vertical cave on the Muller. Only 200m deep, its floodwashed cream limestone shafts were sheer joy and there was NO MUD!

The Uliwapits stayed on in their luxury surface camp unattracted by the delights being revealed in other places. They revisited Kananda Hiewa Hiea, a 1973 discovery and added another 0.5km of passage in cave that they described as impressive - far more so than its 1973 description indicated. The nine year old foot prints of the original explorers were still stamped in the mud indicating that the cave is not inundated by the huge floods which scour most of the caves on the Muller.

YU BALALO - what's happened to the cavalry?

Uliwapo was also the closest point to Yu Balalo. A helicopter reccé was done to assess the viability of the Yu Balalo and the result was a 30m shaft with a river plunging into it. This got the Uliwapits scrambling northward instead of retreating to southeast Mamo with the rest of the expedition.

After several days of track cutting and traversing rough rocky creekbeds, the barefoot Duna, well out of their known territory were to say the least, unhappy. When the Yu Balalo rose some 5m and began lapping at their campsite their limit had been reached. The food was running low; a strike meeting was held and the decision .... return to Atea! The follow-up party with food and caving equipment met them halfway back to Uliwapo, but it was too late, the Duna were not going back to the Balalo. The wrath of the follow-up party was extreme. It would have been worse if they had seen the promise offered by the Yu Balalo Sink and the huge walk-in entrance two dolines away. With more money all the locating and equipping of the Uliwapits could have been done by helicopter for the reccé helicopter landed in the Yu Balalo streambed right next to the sink. Nevertheless the Yu Balalo system remains as a fantastic project for a future Muller expedition.

ATEA OUTFLOW CAVES - bring your own swingboard

Before the Yu Atea sinks into the Atea Kananda it emerges from nine entrances, the Atea Outflow Caves. These caves have great volumes of water in small passages. In late July the drought broke at precisely the same time as an effort was made to explore the remaining Outflow Caves. The Hydrant is the largest of the caves and was explored in 1978. It has a low flow of 1 $m^3 s^{-1}$. The small size and smaller flows from the other entrances is deceptive because behind them lies a maze of distributaries with the waters coming from only two sources. The caves containing these have been named Hydrophobia and Hydrocution. There is a connecting passage between the two, making the system over 2km long.

The exploration of these two caves can be summarised as follows: three daring explorers, surveyors and photographers swallowed their hydrophobia long enough to reach the end rockpile by traversing a streamway 1-2m wide and 3m high with some 0.5 $m^3 s^{-1}$ of water in it. On the way out Hydrophobia snapped at two of them and swallowed a third - found him indigestable and spat him out, saving him from severe hydrocution. Hydrocution at the limit of exploration contains about 1 $m^3 s^{-1}$ water flow in a phreatic tube some $3m^2$ and shows evidence of frequent (daily?) flooding but was not fully explored due to severe hydrophobia.

MAMO - Mamo Kananda, 53km of great caving

In "Caves and Karst of the Muller Range" the report of the 1978 expedition, the bold statement had been made that the next expedition was to be "Mamo 82". In effect it was. The whole crew and all the resources of MULLER 82 could have been deployed on Mamo and still not have found all the cave passage that lies beneath this plateau. If this had been done the enormous cost of the expedition would have been considerably reduced.

At first a camp of 10 cavers was established in Mamo Kananda in a delightfully dry sunny entrance discovered in 1978. Considerable effort had gone into the organisation of the available survey data and the information about the 44 possible leads. Exploration began as the cavers checked off leads from the main dry passage to the deepest point in the cave. They carefully avoided the wet passages which are known to flood to their roof. "What if today is the day the drought breaks?" After two days a new level of passages above Siltstone Blues was discovered containing Roll-a-Go-Go- and Kraftwork. These two main arterial passages were the key to many kilometres of new cave.

Leaptover, a hole between the kitchen table and the food store led to a series of pitches into Siltstone Blues. This gave a route into the cave which only took 15 mins. from the breakfast campfire, from the luxury of pancakes and jam to the frontiers of cave exploration. Two routes into the cave were rigged-down Leaptover which flooded every afternoon sometimes a little, sometimes a lot! 15 minutes through the jungle mud led to the disgustingly muddy MR275 pitch. The preferred route was over Leaptover which avoided the jungle walk and confirms one feature of cave exploration in PNG: that it is frequently faster and always more pleasant to travel underground than on the surface.

One surface exploration priority for the Mamo cavers was to find the "sinking streams". The southeastern fringe of Mamo was considered promising because the dolines are smaller and shallower, several streams appear to collect on siltstone and drain at its edge. Because all the mapping of Mamo has been done by airphoto interpretation there has always been an element of doubt as to whether there would be any surface water courses at all. After 1978 it was felt even more that the sinking streams might just be another cartographers hallucination. To locate the sinking streams was Julia's obsession, little did she know that she had found one in 1978. It was in a doline given the unimaginative name of MR299. This sinking stream was rediscovered by the Mamo cavers and as predicted proved to be the major source of water in Mamo Kananda, leading to a whole set of new entrances. The entrances in turn led to a variety of levels, some old, extremely large and well decorated, others young and exciting vadose streamways.

KANANDA PUGWA - "The Big One"

After the success,the Mamo cavers started to cut track northwest hoping to find a second sinking stream. The very first day brought another success and the second saw them return jubilant after the best days caving of their lives. They had descended a 40m shaft adjacent to the sinking streams and followed a large passage with 50m survey legs all the way, to emerge in the side of a huge chamber (the Departure Lounge) with a massive entrance. This big new cave (Kananda Pugwa) ended in a pitch at the base of an enormous rockpile. The excitement and impulse to explore was contained; the explorers deciding to save this plum for the arrival of the second month team, when a camp would be established in the Departure Lounge. So Kananda Pugwa remained untouched for nearly two weeks during a period of exceptionally dry weather, the irony of which was to be revealed later.

At Mamo Kananda the blistering pace of cave exploration continued. Collapse Scroggin was found and it was the first real indicator that cave passage could extend under the Iquanodon - a huge breakdown chamber. From then on the prospects of depth on Mamo improved.

By the time Kananda Pugwa was occupied Mamo Kananda was 25km long. The pitch at the end of the Departure Lounge was followed through a blowing aperture and down into a dry gypsum covered highway. The air of exploration was invigorating and the explorers raced on, surveying, to a pitch into a sea of darkness. Descending it their highway became an insignificant porthole into Dragons Reach, an even larger collapse chamber. A stream, the size of the sinking stream emerged from a large inlet on one side, flowed around its edge and disappeared over a cliff that conjured up visions of the edge of the world. The survey showed that Dragons Reach was already some 200m below the Mamo datum so Kananda Pugwa was already deeper than Mamo Kananda.

Drawing up surveys on Mamo was never a chore since Sharp Australia donated a Sharp PC1500 portable computer and graphics unit. At the beginning of the expedition the known cave and surface feature on Mamo had been put onto a grid system originating at the Mamo Kananda camping entrance. The computer reduces survey data, to co-ordinate and plot a traverse line that can be overlain on a master plan. Each evening cavers queued to analyse their data in order to direct the following morning's push. Rapid survey plots were a considerable aid to exploration and the portability of the computer proved invaluable when used whilst track cutting to locate cave entrance shafts that had been found from the inside.

THUNDERUSH - trickles, torrents and trappings

Dragons Reach gave up its secrets easily with a dry pitch leading into a small sporting streamway, the Fruit Loop. The main water at the edge of the world was only temporarily avoided. Thunder Rush is beautiful but it clamours with the sounds of danger. "See my smooth cream rock. Look up high at my cleanwashed walls and listen to my stream as it plunges unrelentlessly down through millpools, swims, rapids and pitches", it is but whispering. The party that first explored Thunder Rush got warnings of things to come. The afternoon flood pulse hit. Two cavers in Fruit Loop headed for the roof and another in Thunder Rudh did the same. Two others near the bottom of Thunder Rush made their way out through the minor flood cleaning out the roof sitters as they went.

With 200m of rope down it Kananda Pugwa was already deeper than the Atea Kananda and still going strong. The Mamo Kananda and Kananda Pugwa camps engaged in friendly rivalry as one group extended its cave to 37km and claimed they had the longest cave in the world while the more modest were interested in obtaining the deepest cave in the Southern Hemisphere. Such discussions were made between camps on a single wire telephone system (Mitchie Phones).

As the push for depth continued in Kananda Pugwa a party of nine left for the bottom. The water in Thunder Rush was high so one turned back. A fast party pushed on through to the Doldrums. One was sick so he went out. Another got bored with surveying so he went out. THE RULE was: 'Survey What You Explore'. The party surveying in, observed the curfew and got out. The party surveying back from the end persevered through the afternoon and evening and that day it rained. .... and rained ....

All intercamp rivalry was forgotten. One team of four cavers was trapped in an upstream lead in Kananda Pugwa. They waited out the flood in a comfortable gypsum sand passage. In a slight lull they tackled a raging torrent only to get hit by a second pulse and had to sit it out in far less comfort for another six hours. They emerged on the surface after a 20 hour epic. Even more serious was the plight of the three conscientious surveyors trapped below the potentially lethal Thunderush. They had returned from their marathon surveying trip to find a raging wall of white water at the bottom of the last pitch in Thunderush. The day following the flood it rained consistently and although water levels dropped elsewhere, in Thunder Rush they barely changed. By the next day fears rose of their actually having been washed away by one of the flood pulses or at least being badly exposed. On the third day, an early start was made down the cave to effect the rescue before the afternoon rains. Overnight it had stopped raining long enough for the water to drop and allow Thunderush to become passable once again. The three were found safe and well until they were fed some instant energy food. Golden syrup and water is guaranteed to make even the most healthy caver keel over feeling sick in the stomach. 54 hours was the longest non-camping trip of the expedition and a personal record for Tony White who seems to make a habit of being trapped in flooded caves.

Life returned to normal with renewed enthusiasm to make up for the days lost during the rescue. The only difference was the rigid enforcement of a 2 p.m. return through Thunder Rush and other vadose streamways. This meant the unpleasantness of Alpine starts. At Kananda Pugwa there was a new healthy respect for pushing streamways for depth. For in the Doldrums, where the roof dipped to 2m above the water were fresh tide marks indicating that the water had backed up 10m during the last flood.

As the seriousness of the caving increased, people started to emerge from their underground homes onto the surface. To the north of Kananda Pugwa is doline Mamo VI (volume 25 x $10^6 m^{-3}$ and it is one of the smaller dolines on the Muller). When examined it turned out to be what has become known on the Muller as too big for its own good. A hole to the south of it was full of nothing but rainbows and fresh air but did provide two days of sporting 110m descents to reach the cave entrance in its sides. Despite all this activity, one entrance was left for future explorers.

The maze of jungle covered dolines which make up the Mamo plateau surface has always presented a problem when trying to give the caves a location. But Kananda Pugwa was on a readily identifiable set of geological features and could be placed on the airphotos - its position was such that a more direct route back to Atea Base lay through the MULLER 76 area (MULLER 76 was a small expedition, largely of a reconnaissance nature). In one day of track cutting through light forest full of flowers the 1976 camp was reached. If fates and resources had been somewhat kinder the secrets of Mamo would have been revealed some six years before. In 1976 we had turned back to put our meagre resources into the initial exploration of the Atea Kananda.

Our compensation was however the pit Malemuli found on this route. At first sight it could almost be placed in the too big category. While most cavers use the standard rock drop method to get an estimate of the depth of a shaft, New Guinea rainforests are a bit short on rocks. The Duna have solved this problem by the standard treedrop-chop-chop-chop-1,2,3,4,5,6 CRASH AIEE! 130m below a 30m tree becomes a mass of tooth picks. After a rubble slope. Pitch 2 was a six second drop (rocks this time!). 100m hanging 2m off the clean polished wall and then another 80m by a waterfall to a sump. Malemuli is 420m deep and there is still an entrance in its side waiting to be explored.

FRIDAY THE THIRTEENTH - we're not superstitious

In Kananda Pugwa another set of huge chambers had been encountered and the cave was 528m, the deepest three chambers over a million cubic metres of air space. On Black Friday a party was down trying to break this third blockage when over Mamo Kananda there was a cloud burst just before lunch. Down below cavers were running from place to place trying to avoid the floodwaters which were invading even the driest parts of the cave. A continuous commentary was being heard in the two camps as the Mitchie phones were being used to find out what the hell had happened on the surface and graphic descriptions of what was going on below, complete with the sounds of rushing waterfalls. The party at the bottom of Kananda Pugwa had no such luxury but they also had no flood. They got to the relative safety of Dragons Reach before the flood pulse hit. It came so rapidly and without warning that the dry pitch to Fruit Loop began to resemble the inside of a carwash in just minutes. They breathed a sigh of relief as they saw 0.5 m^3s^{-1} roar off down the narrow Fruit Loop. Most of this water was coming from a passage high in the wall of Dragons Reach.

In Mamo Kananda a passage had been found heading towards Kananda Pugwa. It contained several low, wet sections and also had a good go at consuming the people in it. Everybody was thought to have survived Black Friday until at Kananda when dinner was ready we noticed that one of our biggest eaters was missing. A party of three who in the morning had gone exploring upstream in the Kananda Pugwa sinking stream had not returned. The few who had been there could remember no "safe" areas, but once again luck was with us and the party were safely trapped in a newly discovered dry passage. To be caught in many sections of the Muller Caves as the flash floods come through would be fatal. Even the moderate afternoon rains cause pulses which makes some passages temporarily impassable. Even the cave spiders that live in these flood-prone passages have adapted by developing extra large claws for hanging on.

THE CONNECTION - or how to grow a bigger cave

Unlike the rest of Mamo Kananda "Friday 13th" passage goes downstream to the northwest straight towards Kananda Pugwa. A phone conversation established its co-ordinates. In Dragons Reach was just one passage in the right place and at the right level. Whether it went in the right direction was anyone's guess but it was the passage that the flood came out of on Friday 13th.

The passage was 8m up an overhanging wall and on the first inspection had been declared unclimable. However it was in the right place and at the right level. With a connection at stake (37km + 8km) it was worth another look. A rising traverse looked like the best way of climbing into it. Despite one severe backward step when the leader unzipped 3 pegs back to a bolt (the "peanut gallery" below it was great!), ten hours of climbing saw us up to the passage. A quick run along confirmed that it did really head southeast. At the same time a Friday 13th exploration party had been stopped by a 40m pitch.

Back on the surface the computer confirmed that the two passages were at suitable levels and 200m apart. Mamo Kananda sent a party to descend the 40m pitch and Kananda Pugwa a party to explore the passage from Dragons Reach. As hoped the Kananda Pugwits found a 40m aven 260m along their passage, with Mamo Kanandans at the top trying to throw a rope down. In almost no time Kananda Pugwa had grown by 900% or had Mamo Kananda scored an extra 8km and increased by 22% there are still some unbelievers of the latter.

To the last day Mamo Kananda continued to produce one kilometre of passage a day and each kilometre had leads to spare. As always depth on the Muller proved to be elusive, neither exploration in the hazardous depths or the search for higher entrances was fruitful. The caves had to be detackled - it was found that the saddest story of the expedition is of the party in Kananda Pugwa who in surveying their last kilometre on the last possible caving came upon a 30m pitch into a huge chamber which they assumed to be Dragons Reach because of its vastness. So they pulled up their ropes and returned to camp. Back on the surface again our by now well-worn computer was losing its mind - survey data phoned to Mamo Kananda had placed the end of the survey 150m from Dragons Reach but a quick check of the data confirmed computers never lie - Yes there is another big chamber out there AIEEE waiting!

AN EVALUATION - or where was the sex, drugs and rock and roll

Cave exploration in Papua New Guinea is both exhilirating and frustrating. The rewards are immense but achieving them is difficult. To date the Muller Range contains some 110km of spectacular cave passage, the deepest cave in PNG and the second deepest in the Southern Hemisphere and the 12th longest cave in the world. This list of achievements can be attributed to one or all of three things. The efficiency of the cave exploration, the great potential of the Muller Range as an area for caves or of course luck. Once again we had insufficient resources, there was sufficient manpower but often this lacked direction. Money was short - we spent $16,000.00 on helicopters with another A$10,000.00 we would have achieved more miracles.

It is not only having limited resources that makes Muller caving frustrating. Even before the expedition found its cumbersome way through the hassles of PNG bureaucracy we realised that conditions in this developing country were changing so rapidly that much of our pre-expedition planning and budgetting had been a futile exercise. Devious manipulations of available funds such as substituting a one hour flight for a one day open truck ride enabled us to give Muller 82 a balanced budget of approximately $150,000.00 - astonishing! Many telephone calls to Sydney and some inspired hardwork by the advance party lead by Steve Bunton ensured the first loads of gear and people arrived at a completed Atea Base on time. The expedition continued to run roughly to a very tight schedule - amazing!

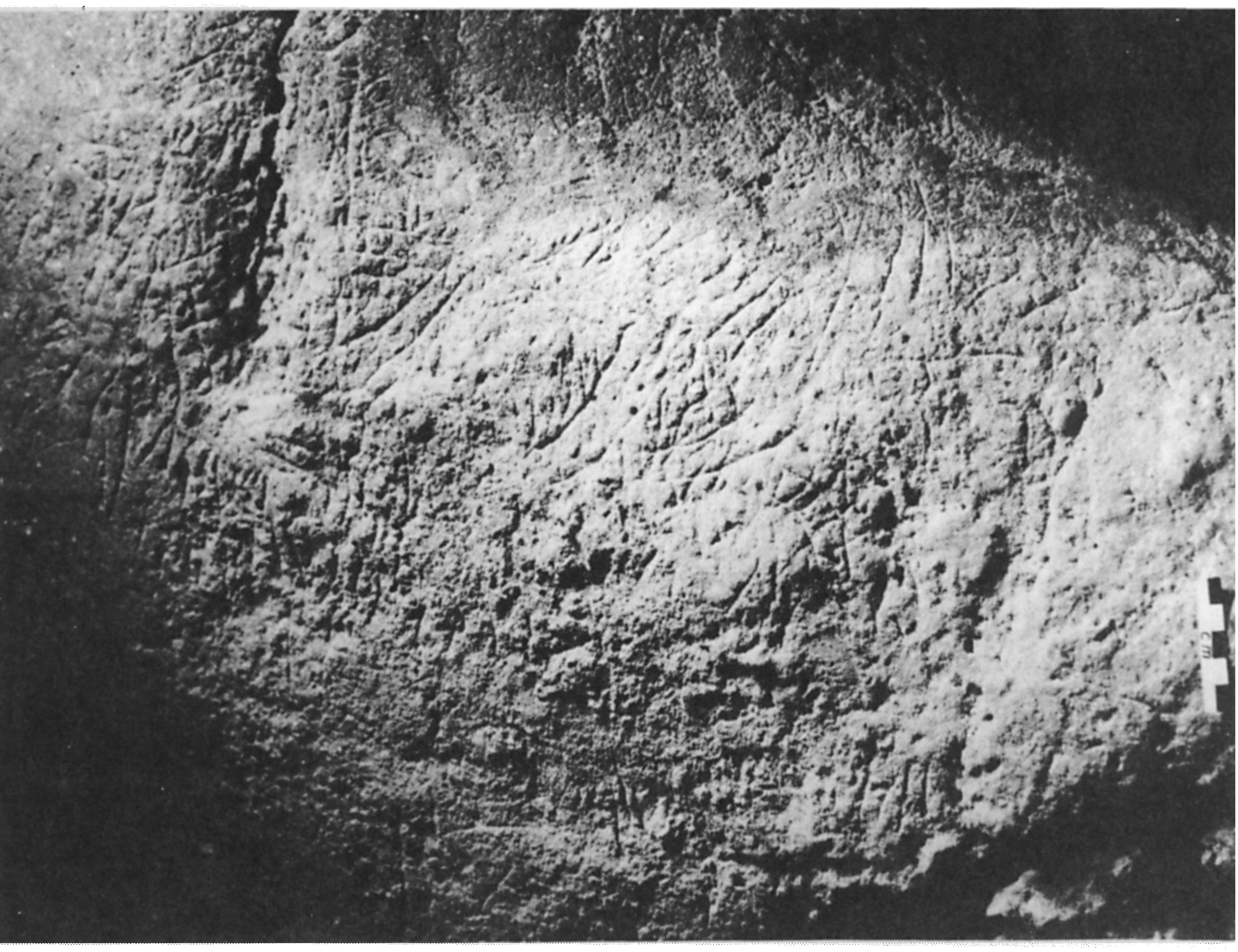
It is the problems of organisation and re-organisation and continuous hassles increased in many ways by the size of the expedition that has led Al Warild to refer to Muller 82 as the last of the big expeditions. But no big expeditions means no sharing of costs. So in the future it will be the Muller for the rich and for those with lots of time and those prepared to take the extra risks involved by caving in the wet season. No-one died in the mighty floods that sweep through the caves - unbelievable! Mamo is one of the great caving areas of the future - it has depth potential and the length of its caves could be a contender for the Kentucky Caves. The rest of the Muller Range is still relatively untouched and the new contour maps show many regions that should produce both long and deep caves.

Oh yes - where was the sex, drugs and rock and roll? Well, they're all in the cave names so to find out about them you will have to read the book.

The cave now has three chambers with over a million cubic metres of airspace.

The helicopter was coming to take them away and the many metres of rope had to be rescued from the caves. The entrance ropes in both Mamo Kananda and Kananda Pugwa were worn out. They were 11mm and reputed to be the most abrasive resistant in the world. Although they were hanging free, the constant abseiling and prusiking, sometimes with muddy gear, had abraded the sheaf to an unsafe condition. But we had prusiked well over a 100km to find our 53km of cave a test for anyone's ropes.

CAVE SCRATCHES



In many caves throughout the South-east of South Australia, one finds assemblages of linear markings on the walls. At various times, they have been considered as being of either Aboriginal or animal origin.

However, examining their distribution within caves makes either of these hypotheses extremely unlikely, even though each may well be a valid explanation of superficially similar markings at other sites.

Any serious suggestion as to their possible origin will be more than welcome - write it on a bit of paper and send it to Elery Hamilton-Smith or Kevin Mott.

Also, in the tradition of the best British humour (Frank Muir et al.) we sought the most improbable explanation for the marks. However, all the suggestions were so likely to have occurred that we reversed our selection and chose the suggestion of Janeen Grimes as the most probable.

CAVE SCRATCHES

Hordes of large hairy cavers, in batches
leave nits on the floor and they hatches.
Although its not nice, to speak about lice,
well, when a cave itches, it scratches.

CHILLAGOE

by

Elery Hamilton-Smith

A description of Chillagoe tower karst and recent scientific studies done in the caves.

Transcribed from an audio recording.

I thought that I should report on this expedition at this convention because there hasn't been much news about it in Australian speleo circles. The expedition was sponsored by the New York Explorers Club and organised by our old friend Brother Nicholas.

Its aim was not exploration, the exploration of Chillagoe has been pretty well done over the years, firstly by members of the Sydney Speleo Society then by various local residents, in particular, Vince Kinnear with his concern for understanding the area and making it available to people; and in more recent years by the Chillagoe Caving Club. So the basic exploration has been done or is being done. The purpose of this expedition was scientific study. The purpose of my presentation today is firstly to tell you a bit about what is going on, and secondly for those of you who are not familiar with it, to give you some introduction to Chillagoe as an area.

Chillagoe is not a particularly big town. It had a smelter in the early days sited near Chillagoe Creek, which is the town water supply. The town and area has a very long history of mining. The layout of the land is that of a basically flat area with a few low rolling hills with tower karst poking out of it. You can tell the limestone by the greyish vegetation. Chillagoe limestone is covered with a deciduous rain forest alternatively explained as a remnant rain forest or as a forest which results from selective dispersal of only certain species. The land between towers is a savannah plain.

The towers have very fluted, very sharp limestone. Most towers rise fairly abruptly out of the plain but some have a bit of debris slope at the base. Solution pans are a common feature on the karst. The towers are typically full of holes - tens of shafts can be seen from the air but traversing the surface of them is hard on the footwear and they are obviously dreadful to fall on.

Each day started with a briefing in the local town hall where each indicated what they wanted to do for the day or intended to do. Any loose bods were allocated to parties and the day got underway. A number of people flew in from North America and around Australia which meant that transport was at a premium and poor Don Matts spent a lot of his time shuffling people to and fro. One of the major elements of the expedition was the continuation of archaeological work in the Walkunder Arch. In this particular excavation, at the top it is some 12,000 years BP and the earliest date so far 18,000 BP, but on a pro-rata basis the present level of excavation will come out at between 25 and 28,000 years BP and there is still Aboriginal material being recovered.

A 14,500 year old woven grass sleeping mat (?) was uncovered during the dig. A second gallery in the Walkunder Bluff was investigated but little archaeological material was located in the soil and it seems that this was a religious site rather than a living site. Extensive paintings are on the walls. Ryan Imperial Bluff to the north has a further series of paintings.

Setting traps for insects in Spring Cave produced some 300 species of invertebrates in the course of the expedition. To make sure that taking specimens of the biota from the caves did not significantly affect the ecology nor the species caught, live traps were used. The animals could be released unharmed and traps had to be checked frequently. Tropical caves are very profuse in cave life although the troglobitic species are few. Only a small number of each species trapped were taken from each cave. Swiftlet guano was searched for insects. At the end of each day, the biological team with which I was involved would get back to sorting, processing and preliminary identification of material. Walter Schoept from New York sorted material then Audrey Stafford from Philadelphia was the registrar in the team.

Tea Tree Cave was studied: an extraordinary hot cave containing fossils of crocodiles and early Australian marsupials. The excavation of material from there was continued with an electric drill to excavate the very tough breccia that is there. The high temperature of Tea Tree Cave was discussed and a generally accepted hypothesis was that the cave had, in part, been created by sulphurous acid from the adjacent orebody rather than the usual carbonic acid mechanism.

Sulphur dioxide can be smelt at the high points of the cave near the orebody and the heat is probably due to the exothermic reaction of the ore with its surroundings. A nearby vertical pothole is also extraordinarily hot, which cannot be explained by the capture of hot air from the surface.

Vince Kinnear, who was honored at this conference with the Edi Smith award, is no longer so actively involved. He single-handedly cleaned out Royal Arch by removing hundreds of wheel-barrow loads of rubbish to convince people that it could be a show cave again, and went over hectares of wall with a wire brush removing grafitti.

The caves typically have a wide entrance and a series of daylight holes along their passages. The light from the holes produce interesting colour effects within the cave. Tiny algae produce photokarst - a calcite deposit that is orientated towards light. These might be related to those found in the cenotes of S.E. South Australia. "Sucker Pods" or "Elephant's Feet" are common in these caves and are not caused by the removal of supporting debris but seem to be due to organic action on the limestone. Oolites are so common that they can cover the cave floor in places.

The Donna Cave is open to the public. It has signatures from the Atherton family from whom the Atherton Tableland was named. They were amongst the earliest pioneers and explorers of the area. False floors are common here as in other caves at Chillagoe.

Cave swiftlets inhabit many of the caves. It will be a very long task getting the biological material collected on this expedition identified and described. Glennis Wellings some years ago obtained one single specimen of a very tiny, completely eyeless and colourless cockroach. Glennis had found one and searched fruitlessly for more. We returned with 6-8 specimens of that species and another five different species with varying degrees of troglobitic adaption. None were more than 2mm long and were found in four caves of the area.

We have been successful in opening up the troglobitic potential of the area and also are starting to elucidate the ecology but it is going to take many more expeditions and a great deal more backroom work before we can get to real results.

PHOTOGRAPHIC COMPETITION

A Photographic Competition was held during the Conference.

The Competition was judged by Noel Speechley and awards presented in the following eleven sections.

MONOCHROME SCENIC PRINT

Rudi Frank — For Warbla Cave, Nullarbor, South Australia

SCENIC COLOUR SLIDE

Chamber Photo Winner — R. Allum — For Jade Pool, Khubla Khan, Tasmania

Entrance Photo Winner — R. Webb — For an untitled slide

Merit Awards for scenic shots were given to: R. Allum, P. Clarke, R. Clarke, J. Jackson, E. Hamilton-Smith, N. Poulter, M. Reardon and T. Reardon.

COLOUR SLIDE OF SCIENTIFIC INTEREST

Won by — N. Poulter — For his portrayal of Brushtail Possum remains from a Nullarbor Cave.

Merit Awards were presented for scientific slides by: E. Hamilton-Smith and R. Webb

COLOUR SLIDE OF SPELEOTHEM

Won by — N. Poulter — For his slide of a water drop on a straw.

Merit Awards were presented to: R. Clarke, E. Hamilton-Smith, N. Poulter, A. Spate, and R. Webb.

ACTION SLIDE SECTION

Won by — R. Allum — For a photo taken on the Nullarbor.

Merit Awards were presented to: R. Allum, P. Jackson and N. Poulter

SERIES OF SLIDES DEPICTING A STORY

This section was won by — R. & P. Clarke — For a series of slides titled "The Impossible Land".

Merit Awards were presented to: P. Rogers — For his presentation of:

a) Caving trip to the end of Mullamullang Cave

and b) Push Dive in Cocklebiddy, September, 1982.

HUMOROUS SECTION

This section was judged by the general caving fraternity enmassed at the Caveman's Dinner.

The semi-sober audience decided on K. Mott's slide of "an impossible reach" to be the most humorous.

MANAGEMENT OF THE RECREATION USE OF NON-TOURIST CAVES IN PARKS

by

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A primary role of park management is the pursuit of a balance between the protection of natural resources and the prevention of wear and tear resulting from recreation use. Caves do not escape this conflict. The South Australian National Parks & Wildlife Service recognises caving as legitimate in parks. Factors necessitating management procedures for the use of non-tourist caves include the "out-of-sight" activity of cavers, the need to ensure reasonable public safety and the limitations on park management resources.

It is necessary to prepare an inventory of cave resources and to classify the caves as tourist, scientific or wild. The latter can be further subdivided into beginners, unrestricted, restricted and limited access.

Management control procedures to be considered include the use of permits and recognised leaders, limitation on group size, equipment standards, prior booking and the recording of cave visits.

A primary role of park management is the pursuit of a balance between the protection of our natural resources and the wear and tear resulting from recreation use. Caves do not escape this conflict; particularly those readily accessible and well known.

Conflicting objectives in park management are embodied in most park legislation. For instance, in South Australia, Section 37 of the National Parks and Wildlife Act states that "The Minister, the Permanent Head and the Director shall have regard to the following objectives in managing reserves:-

.....

(c) the preservation of features of geographical, natural or scenic interest;

.....

(h) the encouragement of public use and enjoyment of reserves and education in, and a proper understanding and recognition of, their purpose and significance;

and

(i) generally the promotion of the public interest."

The South Australian National Parks and Wildlife Service recognises recreational caving as a legitimate activity in parks.

At Naracoorte Cave Conservation Park the availability of public facilities ensures a constant use of the Park's non-tourist caves. This paper considers procedures necessary for the management of this use and is intended as a means of seeking speleological comment on these procedures. Many of the ideas discussed will be applicable to other caves.

Several factors necessitate procedures for the management of the recreation use of the non-tourist caves in the Park. These factors are:

1) Most cave use is not readily witnessed by park management. The results of the use are usually seen after the visitor leaves.
2) It is the responsibility of the National Parks and Wildlife Service to ensure reasonable public safety.
3) Park management resources are not unlimited. The need to set priorities for the use of these resources cannot realistically allow for cave management based solely on surveillance (patrols) and monitoring. The 60,000 visitors who use the Park's three tourist caves each year must receive priority in resource allocation.

About ten non-tourist caves are regularly used for recreation in the Park. Visitors to these caves range from experienced speleologists to research workers to school groups. 1,925 people were recorded as using these caves during 1981; this figure does not include those who entered the caves without advising the Park office.

As indicated earlier, caving is a legitimate use in parks. However, without some control of this use, significant damage will occur, especially in the more accessible caves. The caves at Naracoorte have experienced the impact of cavers since the early 1850's. Complete restriction on the recreation use of the non-tourist caves would ensure their greater protection. However, this would be no answer for the caver, and justifiably so.

Procedures for the management of all caves in the Park can be best applied once the caves are classified on the basis of their values for recreation, conservation and scientific uses. This classification process has been undertaken by the consultancy group (led by E. Hamilton-Smith) which is preparing the preliminary draft management plan for the Park. Aspects of the classification categories, as outlined below, are being considered by the group.

Cave classification must be based on a resource inventory. Information required for each cave includes size, location, ease of access, ease of protection, quality of formations, fossil deposits, fauna habitat and historic use.

Three basic classification categories that can be applied to the caves in the Park are:

1) Tourist Caves. Visitors are normally taken on a guided tour for a fee. Cave developments include pathways, handrails, stairs and lighting.

2) Wild Caves. Not accessible to the unprepared tourist. They have few or no developments and could have some scientific or conservation values. Usually no guided tours and group leaders must be experienced speleologists. Through the hire of suitable equipment (coveralls, hardhat, torch) it would be possible to allow inexperienced visitors to take self-guided tours through "safe" wild caves.

3) Scientific Caves. Provide important habitat for native fauna and/or contain important fossil deposits and formations of scientific and conservation importance. Limited access is provided to bona fide research workers.

Management of access to tourist and scientific caves is straight-forward and entails a rigid control. In determining access, wild caves need to be classified further. They can be placed into at least four categories; further suggestions would be welcome:

1) Beginners. Require a limited amount of equipment. Are relatively straightforward and do not offer any problems with the user becoming lost or injured. Further damage in these caves would be insignificant. For example, Stick and Tomato Caves.

2) Unrestricted. Groups must be led by an experienced leader. The conservation and scientific values of these caves would not be too great to place some responsibility on group leaders to ensure no further significant damage. For example, Cathedral Cave.

3) Restricted. Require to be set on the number of visitors. This could be due to difficult entrances, value of formations (for example, sand-cones), the need to reduce soiling of the cave environment. Groups must be led by an experienced leader. For example, Sandfunnel Cave.

4) Limited Access. Conservation and scientific values require a limit of visitor numbers and for groups to be led by leaders of a very high standard. For example, Fox Cave, Blackberry Cave.

PROCEDURES UNDER CONSIDERATION

1) Permits

All persons wishing to use non-tourist caves must first obtain an annual permit (how long should it be valid for?) Permit could indicate if the person is a competant speleologist (how is this to be verified? Membership of a recognised speleological club does not necessarily denote experience). Is it relevant to require knowledge of a person's caving competancy if he/she is to be part of a small group led by a recognised leader?

Irrespective of the use of the permit to indicate competancy it has two other valuable uses to the cave manager. It is one measure of caving activity and it provides an opportunity to formally ensure that cave users are aware of management requirements; for example, it can list safety requirements and the conditions of cave use.

Non-tourist cave users would be required to present their permits before being allowed access. This would ensure a record of visitor pressure for each cave. It is preferred that permits be obtained via mail as a Ranger will not always be available when a caver arrives at the park to collect a permit. Cave Guides would not be able to issue permits; nevertheless, they would be able to record the use of the caves by permit holders.

This permit system would not replace the present requirement that all persons undertaking research work in a cave, including monitoring and mapping, require a scientific permit.

2) Leaders

The recommendation of leaders by recognised speleological clubs should ensure the selection of competant leaders and would provide a means of direct control over leader quality. Can a speleological club recommend a leader who is a non-member? Is it necessary to require all leaders to be members of speleological clubs? Should the renewal of these positions be annual? They should definitely not be for an unlimited period. Leaders should be chosen on the basis of responsibility as well as caving experience. In fact, in park environments the former is often the more important. Park staff do not have the information to assess the competancy of would-be leaders.

3) Group Size

The caving groups should be limited in size depending on the category of the cave being visited. Generally group size should not exceed six persons, including the leader.

4) Bookings

The group leader should advise the Ranger-in-Charge in writing at least four weeks before an intended visit. He/She should indicate:

(i) the number of people in the group

(ii) anticipated length of visit

(iii) name or location of caves to be visited

At present, the Park can have several groups (possible five) arriving unannounced and all wishing to visit the same caves at the same time. The booking system would prevent disappointment through the prior allocation of caves.

5) Recording Movements

All cave trips should be recorded at the Park office to indicate the location of groups in non-tourist caves. These records would show the visitor pressure being placed on the Park resources and would assist future management decisions.

6) Hours of Activity

Unless prior arrangements are made, recreation caving activities are to take place between 0800 and 1700 hours. Otherwise the opportunity to properly manage cave use is undermined. A ranger is not required to work 24 hours a day, seven days a week.

7) Equipment

Equipment requirements are to be drawn up in conjunction with the speleological clubs. At present Park staff advise recreation cavers of what is required; nevertheless they do not have the experience or expertise to know the exact requirements of each cave. There has been sufficient activity by the speleological clubs for them to present recommendations for each cave in the Park.

ASSISTANCE

Naracoorte Caves Conservation Park must cater for the 60,000 visitors who use the three tourist caves each year. It has not been possible, and is still not possible, for Park staff to give the attention necessary for the wild cave user. The preparation of a policy on wild cave use, in conjunction with the speleological clubs, that incorporates some control by the clubs themselves (for example, appointed leaders) would provide a way of meeting management needs.

Another form of assistance is through voluntary work. Discussions are underway with both the Flinders University Speleological Society and the Cave Exploration Group of South Australia as to how volunteers could be used in the caves. F.U.S.S. has already undertaken a cleaning project in one cave. All volunteer projects require the endorsement of the Ranger-in-Charge and the approval of the Director; the latter approval is sought by the Ranger-in-Charge.

If you have any ideas for assistance please contact the Ranger-in-Charge.

SPELEOVISION SPELEOSPORTS

INTRODUCTION

SPELEOVISION Speleosports emphasised observation, teamwork and safety. Entry was open to teams of A.S.F. members properly equipped for normal caving. Teams could be of any number and composition.

The campus of the Flinders University is laid out on three spurs running down to the Adelaide Plains. Interesting voids exist within the footings of many of the buildings. A steel arch footbridge spans a re-vegetated gully between the Registry area and the (residential) University Hall. The campus contains various bodies of water and of course the vital stormwater drains. With the cooperation of the Registrar and staff we were able to lay out a course using non-destructive adaptations of the architectural features together with several exotic artifacts. The course was triangular, with sides about 0.5km long, and consisted of nine stations. The construction of most of the stations on Tuesday night and Wednesday morning, under the noses of some of the more observant of our fellow Australians, posed an interesting challenge.

THE STATIONS

1. TYRE SQUEEZE

The successful use of old tyres for artificial fish reefs seems to have created a market for otherwise useless objects. We were nevertheless able to assemble enough 165R-14's to build a traditional Ferrari-proof structure under the Library stairs. With suitable team-work, Coke bottles could be passed from one end to the other.

2. DUCKUNDER

The forecast warm weather for Speleosports gave us some problems in ensuring the personal comfort of team members. We decided on evaporative cooling using the reservoir provided in the Library Plaza. The duckunder was in sunlight. The more desperate team members could escape unharmed except for the loss of points.

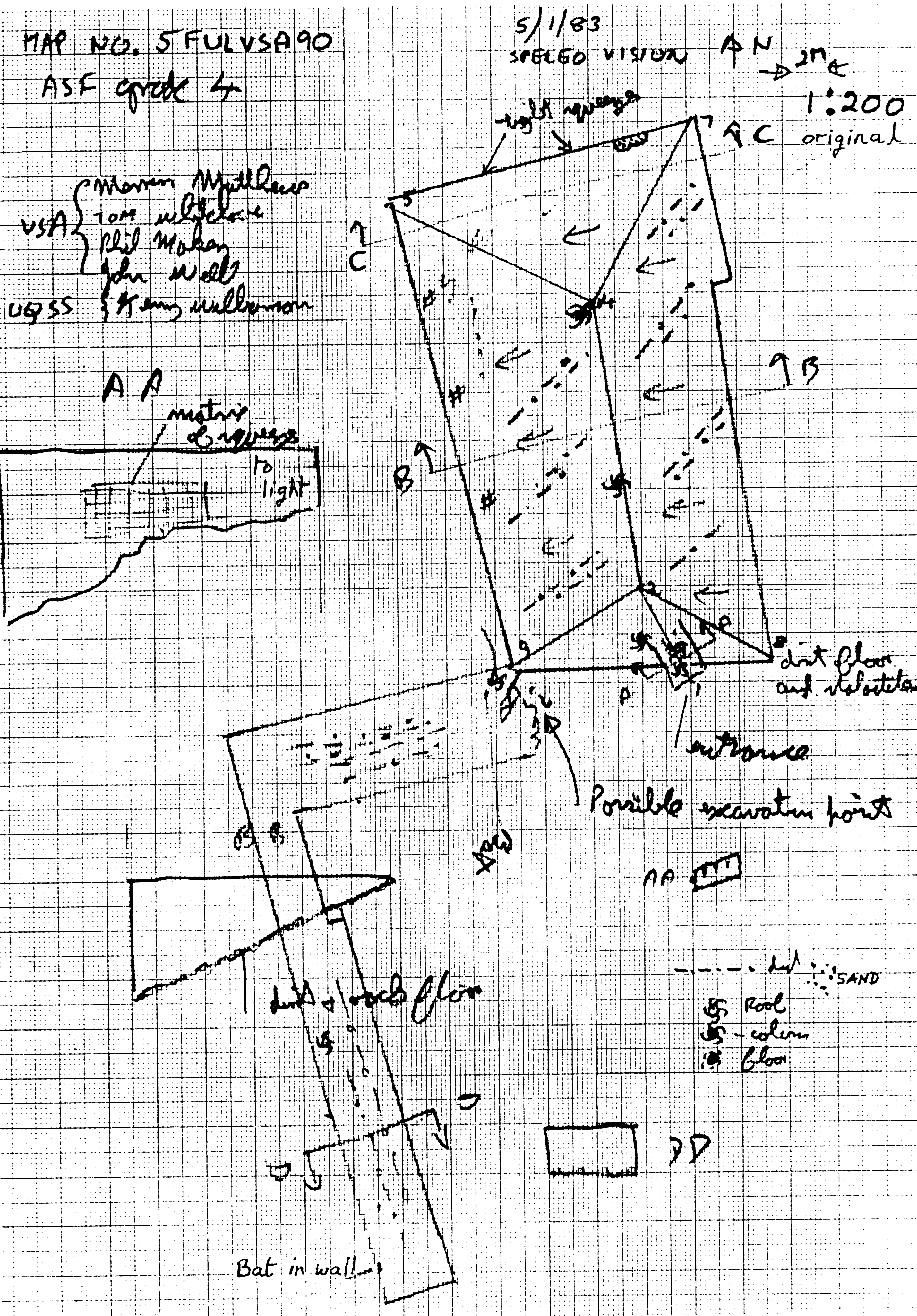
3. CRAWL

Two bicycle racks lashed together formed a triangular tunnel with projections from the floor and the two walls. A piece of white paper on the floor showed wet footprints well. (Don't tread on the flowstone.) Added interest derived from the fact that one of the bicycle racks had seven stands, the other eight. Padding made safe two dangerous brackets without impairing the general awkwardness of the passage. Most teams passed gear, but this was very much a technical challenge for individuals.

4. CAVE SURVEY

Sports Centre Cave, recently re-discovered, contains one chamber developed as a tourist cave. Cavers gain access to a second chamber by lying on the right side before corkscrewing down a rubble slope beneath stalactites. The chamber contains magnificent columns, with interesting vadose elements in an aerial matrix. The maintenance engineer reports no recent surface stream activity. The management plan provides for supervision during the conference season by a surveyor of fearsome rigour, recently retired due to exhaustion of his wombat supply.

At the south-eastern corner of the second chamber, an awkward move gives access to a 40 metre side tunnel. A recent survey (Whitehouse et al., 1983) reports bats in this area, in contrast to the earliest known report (Grimsley et al., 1383), which refers to dragons. Dragons are known to have frequented caves from earliest times. They were in fact warm-blooded animals, as


MAP NO. 5 FULVSA90
ASF grade 4
5/1/83
SPELEO VISION
N
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B
C
light squeeze
dirt floor
entrance
Possible excavation point
AA
D
Bat in wall
SAND

evidenced by their incendiary exhalations. As a result of cooling and shrinkage in the moist atmosphere of the cave, dragons may well have evolved over the intervening period into the little creatures we know today as bats.

5. LADDER/ABSEIL ASCENT/DESCENT

The university footbridge afforded university staff and members of the general public (insured) an opportunity to see safe practice on simple vertical moves. The abseil was 20 metres, the ladder 8 metres. All teams except one chose to abseil down, and that exceptional team ascended by means of the ladder. As a consequence, the organisers were unable to award the special bonus points for the upward abseil.

6. ROCK TRAVERSE

A rockface ten metres long was traversable with one or two difficult moves. Performers varied, but few competitors were bothered by the potential fall of 0.5 metres. This station was the scene of an incident involving an armchair caver, reported below.

7. DIG

The dig consisted of a hollow log one metre in diameter and four metres long, with a somewhat larger chamber at one end. The floor rose to a prick-paved constriction in the middle, then fell away to a short flattener. Earth and rubble containing items of archaelogical significance blocked the constriction and part of the passage. Large tarpaulins excluded light from the chambers.

Initial excavation disclosed a small roof hole immediately above the constriction, from which fell, after the passage of each team, a similar quantity of earth and rubble, containing artifacts reminiscent of those already discovered. Teams earned points for organisation, diligence in searching for artifacts, and volume of rubble removed from the chamber. The dig was most successful. In the words of one team leader -- "You've go to be joking!"

8. EXPLORATION OF UNSURVEYED PHREATIC TUBES

From a rubble-faced wall at the end of the gully, parallel phreatic tubes then lead 40 metres to a chamber two metres square. The tubes exhibit intermittent stream activity, but were dry on the day of exploration. The stream exits the chamber in a single tube. Two metres downstream from the chamber a side tube (0.5 metres diameter) enters high on the wall of the main passage. The side tube can be followed 2.5 metres to a small earth-floored chamber, on the far side of which are two further tubes, only one of which can be entered.

Artifacts of several kinds occur in the small chamber, and each team was requested to search for artifacts of a specified kind. Artifacts of interest to other searchers were to be left undisturbed. Members thus had an opportunity to demonstrate to the management authority a responsible attitude to the rights of others. Most were exemplary.

Various groups have excavated at the site over a considerable period of time, and there has been no coordination of records. The A.S.F. map is probably the only one in existence.

9. FLOWSTONE CLIMB

A rare formation of translucent blue flowstone overlying a softer green laminar deposit. The slope is often subject to spray from an adjacent waterfall, and is difficult to climb in these circumstances. Some teams cooperated well without damage to the formation.

SPELEOSPORTS DAY

1. TEAMS

A.S.F. members fielded seven teams, a total of 25 people. The first team began at 1430 hrs. The last team finished 1830 hrs. The average time to complete the course was two hours. Teams scored points for observation, teamwork, care for the cave environment and safety in carrying out the tasks.

2. COMMUNICATIONS

The relatively large size of the course had certain advantages, among them being the difficulty of collusion in the event of a group fielding more than one team. We were able to obtain five two-way radios which were invaluable in maintaining communications between the stations. One disadvantage of a course of this size is that spectators must necessarily travel around the course in much the same manner as competitors, although this can be useful to the organisers in cases where spectators are in fact undeclared members of teams.

3. AREAS FOR IMPROVEMENT

Tighter control of team starting times, as originally intended, would have prevented delays at the Sports Centre Cave, which was as expected the critical node in the system. This is particularly important where competitors are wet. We had a warm day.

The course time would have been shortened if stewards had issued written instructions to teams at each station. This might have removed the element of surprise which provides much of the fun and enables speleos to demonstrate their ingenuity.

More timely refreshments for competitors at the end of the course, and more transport back to hot showers, were fixable given more manpower.

RESULTS

1. The Carina Armchair Speleological Association

The four members representing this unique body bribed their way around the course in their customary manner, delighting spectators and corrupting the stewards. They began well, losing a large number of points at the first station as a result of improper equipment. Deck chairs are not proper armchairs.

There were however unfortunate lapses from the previous standard exhibited by the members of the Association. The first and most serious lapse occurred when the team actually entered the Sports Centre Tourist Cave, made observations of the second chamber and constructed a map of excellent quality which we have produced in evidence. In consequence, our steward was obliged under the rules to award a considerable number of points. The second reported lapse occurred at the rock traverse, where a team member was observed to walk across the top of the rockface carrying a deck chair. Since his feet actually touched a hold on the traverse, it was again our sad duty to award points.

Rosie Shannon, Henry Shannon, Janine Grimes, Ken Grimes, we thank you for your cheerful support.

2. The Kids

The four lads made good time through the course. They were properly belayed on the ladders, and breezed through the squeezes. In Sports Centre Cave they observed many features missed by others. At the Dig, they out-performed all other teams. They were well organised, fast, and took particular care in recording items of potential archaelogical significance.

Stephen White, Chris Matthews, Darryl Pierce, Craig Wilkinson -- a good effort.

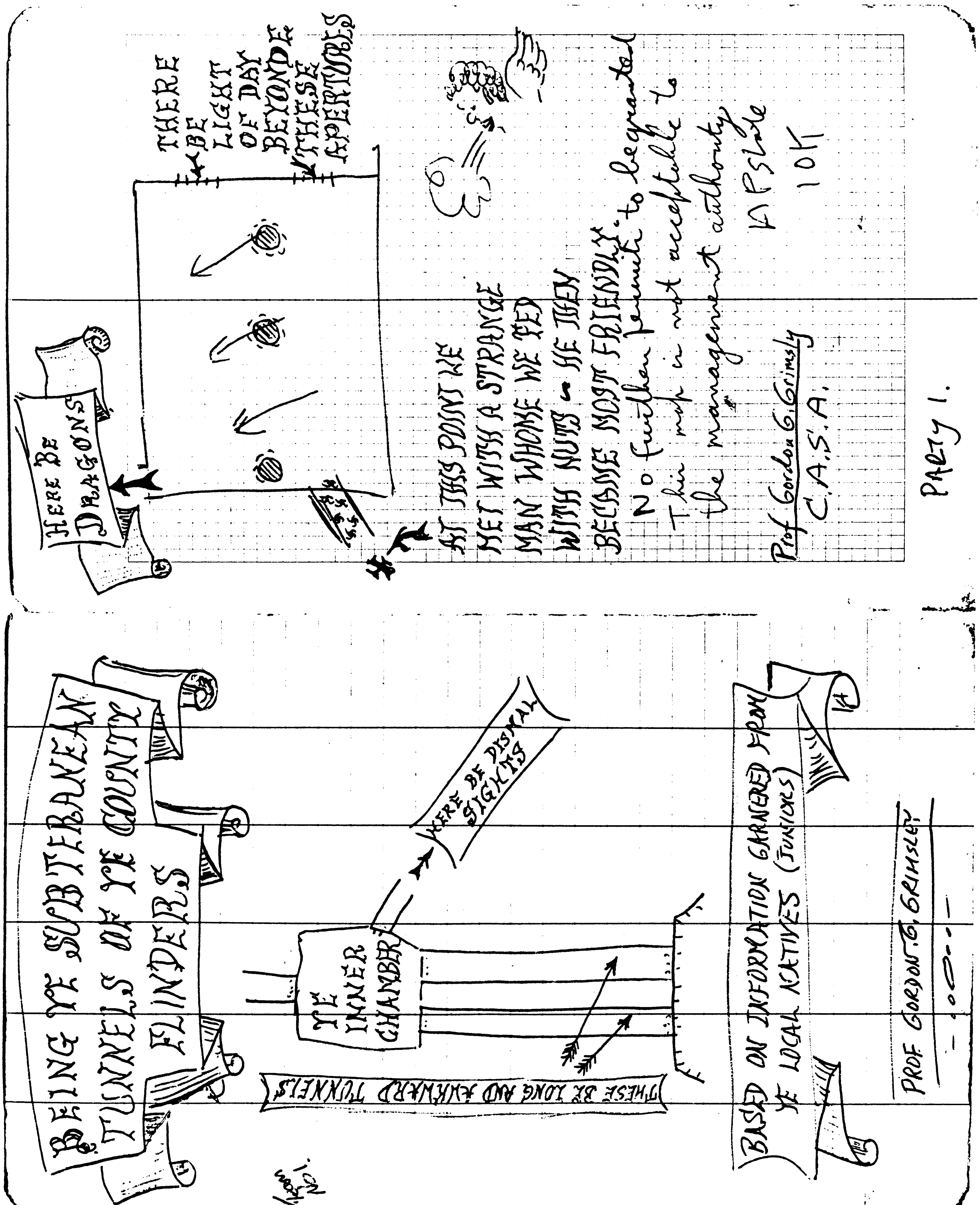
3. Victorian Speleological Association (+ one UNQSS)

The V.S.A. team was notable throughout the whole course for good cooperation between team members, technical competence, safety, and care in passing delicate features. They proved themselves good observers and considerate of other teams on the course. They produced an excellent map of Sports Centre Cave and made an evaluation of tourist potential which will be invaluable in formulation of the management plan.

Tom Whitehouse, John Webb, Phil Mackey, Merran Matthews, Kerry Williamson -- a thoroughly deserved win.

ACKNOWLEDGEMENTS

To nine people who couldn't walk around the course, my thanks.



SPELEOVISION FIELD TRIPS

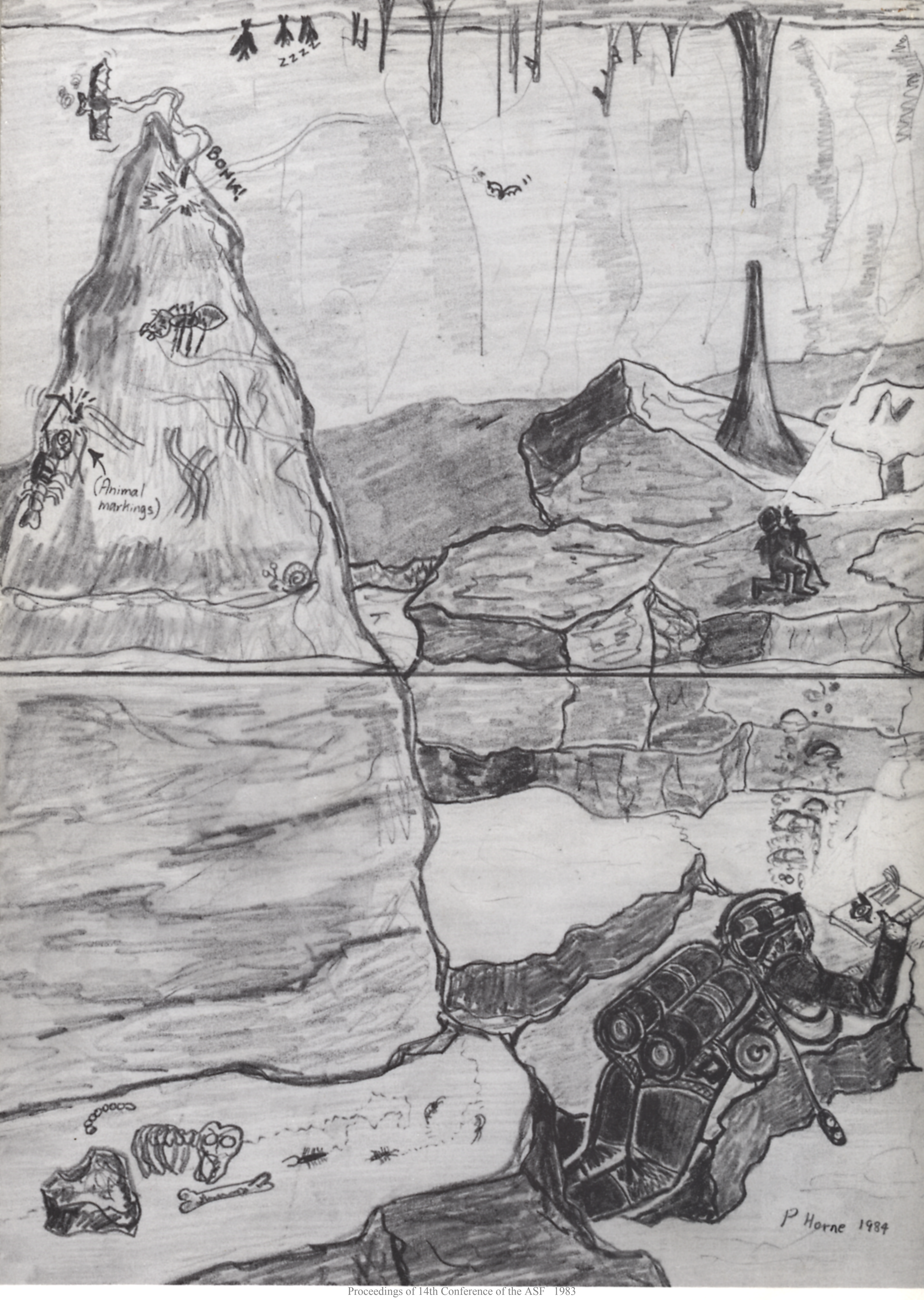
These were organized with established camps for Naracoorte (Upper South East) and the Lower South East but on an excursion basis elsewhere.

Times and places used for joining each trip were listed on distributed sheets. Some trips had camping fees as well as trip fees of 20¢ per person per day (or $1.00 per week). Ladders and belay ropes were supplied and contact with the appropriate trip leader supplied any extra information required. Maps of revelant parts of South Australia were available free from the trip leader to each vehicle on a trip.

SPELEOVISION FIELD NOTES had detailed information on caves and the required equipment and time to visit each cave, camps and facilities, and was part of the registration fee. People attending pre-conference trips collected a copy from the trip leader on joining the trip.

A TOTAL FIRE BAN was in force by local authorities over all the caving areas; cooking had to be done inside huts, tents or vehicles and under no circumstances were naked flame lights allowed to be lit whilst outside a cave.

PRE-CONFERENCE	26th December 1982 - 2nd January 1983		
Southern Flinders Rangers		Meredith Reardon	CEGSA
Kangaroo Island		Lloyd Mill	VSA
Nullarbor			WASG
Yorke Peninsula		John McCormack	CEGSA
DURING CONFERENCE	6th January 1983		
Burnside Mines		Meredith Reardon	CEGSA
POST CONFERENCE	7th January 1983 - 23rd January 1983		
Flinders Ranges		John McCormack	CEGSA
Kangaroo Island		Meredith Reardon	CEGSA
Murray Mallee - Upper South East Lower South East		Kevin Mott	CEGSA
Naracoorte		Athol Jackson	CEGSA
Yorke Peninsula - Eyre Peninsula Nullarbor		Graham Pilkington	CEGSA



AUSTRALIAN SPELEOLOGICAL FEDERATION