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Helictite

Journal of Australasian Speleological Research

Microkarren, Gregory Karst, NT

K.G. Grimes

Helictite

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Helictite was established in 1962 by Edward A. Lane and Aola M. Richards, who were the foundation editors. It is intended to be wide ranging in scope from the scientific study of caves and their contents, to the history of caves and cave areas and the technical aspects of cave study and exploration. The territory covered is Australasia – Australia, New Zealand, the near Pacific Islands, Papua New Guinea and surrounding areas, Indonesia and Borneo.

In 1974 the Speleological Research Council agreed to support the Journal with financial assistance and in 1976 took over full responsibility for its production. From 1974 to 1997 the Journal was edited by Julia James assisted by other members of the Speleological Research Council Ltd. In 1998 Susan White and Ken Grimes took over as editors with Glenn Baddeley as Business Manager. Stefan Eberhard joined the editorial team in 2003.

In 2000 ownership was transferred to the Australian Speleological Federation, Inc. (ASF) and is administered by the Helictite Commission of the ASF.

The aim of the Helictite Commission of the Australian Speleological Federation is to publish the results of scientific studies in all fields of speleology in Helictite – Journal of Australasian Speleological Research and other publications.

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Cover: Pattern of strongly developed meandering microkarren on the crest of a dolomite cobble in the Gregory Karst, NT. Photo by K.G. Grimes.

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Editorial

Susan White & Ken Grimes

Helictite Volume 40 (1) contains an eclectic mix of speleological articles, which is indicative of the wide range of speleological work in Australia. This issue includes articles in the areas of Aboriginal heritage, (Ian D. Clark, *The abode of malevolent spirits and creatures - Caves in Victorian Aboriginal social organization*); pseudokarst caves and history (Garry K. Smith, *Tectonic and Talus Caves at Pilchers Mountain, New South Wales*); surface karst (Ken G. Grimes, *Microkarren in Australia – a request for information*); and speleobiology (Arthur Clarke's MSc extended abstract, *Cavernicole diversity and ecology in Tasmania,*).

This diversity of interests was also reflected at two conferences held in Australia this year: the 26th Biennial Conference of the Australian Speleological Federation Inc, held at Mt Gambier in January 2007 and the 17th Australasian Cave Management Association conference at Buchan in May 2007. As editors we can only hope that some of this interesting material is produced in more extensive forms for *Helictite*.

The regular service of a listing of papers published in recent karst journals from around the world continues and we have supplied the contents of *Helictite* issues to the other journals.

Helictite web page

The *Helictite* web site has now been moved to the main ASF site. The new URL is:

http://www.caves.org.au/helictite/

The web site is maintained by our Business Manager, Glenn Baddeley. It provides subscription information, contact details, information for contributors, and contents and abstracts for all issues of *Helictite*.

The abode of malevolent spirits and creatures - Caves in Victorian Aboriginal social organization

Ian D. Clark

School of Business, University of Ballarat, PO Box 663, Ballarat Vic 3353, Australia
Email: i.clark@ballarat.edu.au

Abstract

A study of Aboriginal associations with Victorian caves finds that there is a rich cultural heritage associated with caves. This association has been found to be rich and varied in which caves and sink holes featured prominently in the lives of Aboriginal people – they were often the abodes of malevolent creatures and spirits and some were associated with important ancestral heroes, traditional harming practices, and some were important in the after death movement of souls to their resting places. Aboriginal names for caves, where known, are discussed.

Keywords: rock shelters, caves, dark zones, Aboriginal heritage, mythology, Victoria, Australia.

Introduction

This paper documents Aboriginal associations with caves in Victoria through considering their place in stories and mythology and also through examining place names of caves. Rock shelters, commonly called caves, are a rich repository of Aboriginal cultural heritage. However, this study will attempt to follow the narrower usage of 'cave' employed by most cavers, that is, they must have a dark zone, but it needs to be acknowledged that not all the caves identified here have dark zones. Some dozen or so caves have been identified as having documented Aboriginal association (see Figure 1).

Discussion

The earliest records of Aboriginal associations with caves are found in the 1843 journal of George Augustus Robinson, Chief Protector, Port Phillip Aboriginal Protectorate, and the 1846 publication of William Hull. On 10 November 1843, Robinson visited the Widderin Caves [3H-1][1] near Mt Widderin[2] (Weerteering, in Robinson's orthography) in the Western District. The day before he met about a dozen Aboriginal people, including Piccaninny Bob, a brother of King William at A.M. Allan's station near Mt Emu (see Billis and Kenyon 1974: 13). From these people he learned the names of the caves, and noted that 'the natives have a tradition that Kanung made the caves at Anderson's'. The identity of 'Kanung' is not known. Henry Anderson was at 'Borriyallock', 50,750 acres on Mt Emu Creek, near Skipton, 1839-50. Robinson (Journal 10/11/1843 in Clark, 2000a) entered the following account of his visit to the Widderin Caves south of Skipton:

> *... visited the caves. Mr Anderson's brother went with me. The entrance is a half mile from Weerteering west. The entrance is in a large hole, 60 by 50. Very large tree mallee, 10 to 12 feet high, the largest indigenous tree mallee I have ever seen. The bats during in last month were seen in thousands; there were only three at this time. There are large mounds of dark kind of excrescence [sic] rising in five [columns] 10 or 12 high which is said to be bats' dung. It contained shiny particles. These heaps swarmed with moths, probably what the bats feed upon or the particular […] composed of pieces of moths. I got […]. We had two candles which dimly lit the cave. The cave contained two large chambers (see plan), vaults* [see Figure 2].

Figure 2 is a reproduction of Robinson's 1843 sketch of the interior dimensions of the Widderin cave. It is believed to be the earliest sketch of its kind in Victoria. Duncan, Baker, and Montgomery (1999) have noted that the Mt Widderin Caves were once an immense maternity site for the Southern Bent-Wing Bat (*Miniopterus schreibersii*), but they disappeared from the site in the late 1860s. Charles Barrett (1944: 32) explains how access to the lava caves is through one of the 'sinks' formed by the collapse of the basalt. 'Caves near to the entrance in past times were inhabited by hosts of bats, and layers of guano were deposited on the rock floors'. A detailed description of the cave and its mineralogy may be found in Vince and Hall (1993).

Andrew Porteous has recorded the Aboriginal name of the Mt Widderin Cave as 'Larnook' (Smyth 1878 Vol. 2: 179). This word is 'larng.uk', uk being the possessive suffix, translated 'his/her', and larng meaning 'home', 'camp', 'nest', 'habitation', 'resort or resting place', 'camping place'. Larng is found in numerous western Victorian place names, such as Langi Gheran, Langi Kal Kal, Langi Logan, Langi Willi, Larnebarramul, Laanecoorie, and Larngibunja (see Clark, 2003: 9).

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[1] Where possible, the cave identification codes [e.g. 3H-1] of the Australian Speleological Association (Mathews, 1985) have been given to avoid the problems that result from multiple names being used for the one cave, or the same name for several caves. The numbers refer to tags which have been placed on the actual cave entrances.

[2] Mt Widderin has also been known as Anderson's Hill, after Henry Anderson who held the pastoral run in the 1840s

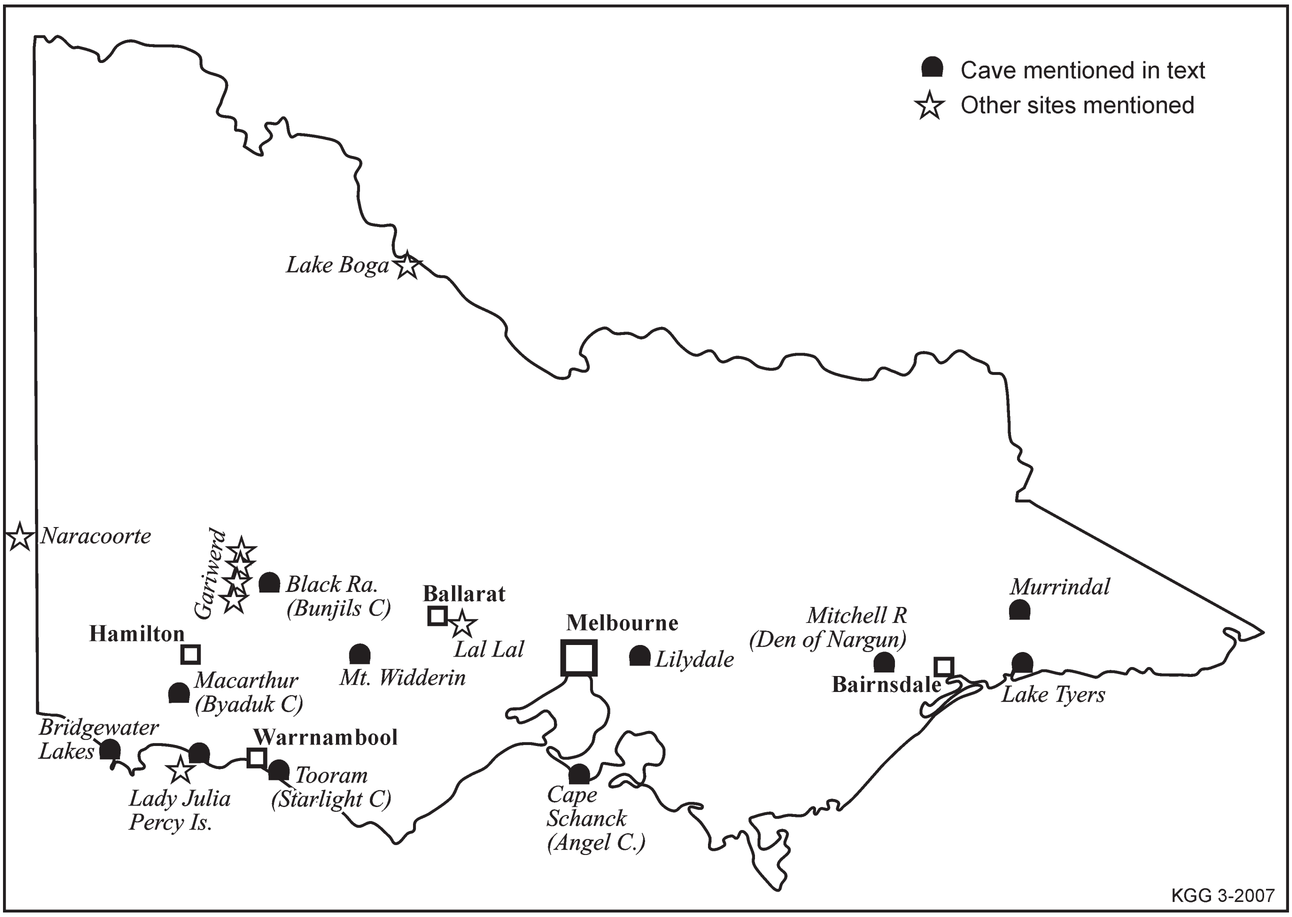

Figure 1: Study area – showing caves and other sites discussed in the text.

William Hull (1846: 28) noted that although some remarkable caverns had been discovered in the Port Phillip District, Angel Cave [3GP-8], near Cape Schanck on the Mornington Peninsula, was the only one that he knew of which had any 'native' tradition attached to it. 'This cavern, facing the sea, they say was once the residence of Pungil, the God of the natives, who they believe came out of the sea – formed it, and much delighted in it. There are no paintings or marks, but apparently a wide altar and decayed steps in the recess'. Massola (1969: 158-9) notes that Angel's Cave (his spelling) is a cool stalactite cave on the seashore east of Cape Schanck near the mouth of the Murwurrarong Creek. He explains that it takes its 'name from the fact that from a certain position in the semi-darkness of the cave, a group of stalactites has a vague resemblance to an angel shape' (Massola, 1969: 158-9). He adds that Aboriginal people claimed that 'Bunjil was one day taking a walk upon the sea, when a great storm arose. The "Great Man" walked up to the then flat shore, commanded it to rise into a cliff, and ordered a cave to form there. He then sheltered in it until the storm had passed'.

Other sites directly connected with Bundjil include a 'cave' at Bushy Creek, Lal Lal Falls, and the rock-art site known as Bunjil's Shelter in the Black Range near Stawell (Massola, 1957). Parker alluded to the existence of an Aboriginal legend in an article published in the *Port Phillip Gazette* after the March visit (Parker, 1840). Parker wrote, 'The deep and basaltic glen or hollow, forming the fall of Lallal on the Morrabool, near Mr Airey's Station, was the residence of Bonjil or Pundyil while on earth'. Robinson confirmed the connection with Bundjil when he visited the falls on 7 August 1846, and learned from an Aboriginal informant that they were called 'Punjil' (Clark, 2000b:108).

James Bonwick (1863:54), also, discussed Bundjil's residence at Lal Lal Falls:

At Cape Schanck, of Western Port, a cave is pointed out from which Pundyil or Bin-Beal used to take his walks beside the sea. He was accustomed when upon earth to frequent other caves, chasms, or dark places. Deep basaltic glens were favourite homes. We are well acquainted with one of these assumed divine residences situated in a romantic volcanic rent some fifteen miles from Ballaarat, through which the river passes after rolling down the Lal Lal falls. The planet Jupiter shines by the light of his camp fire in the heavens, whither he has now retired.

The name Bungal, a variant of Bundjil, is found locally in the name of the Bungal pastoral run adjoining the Lal Lal station on the east, and also in Bungal Dam. This is also the second waterfall in Victoria, thought to have been named after Bundjil. The other is the Wannon

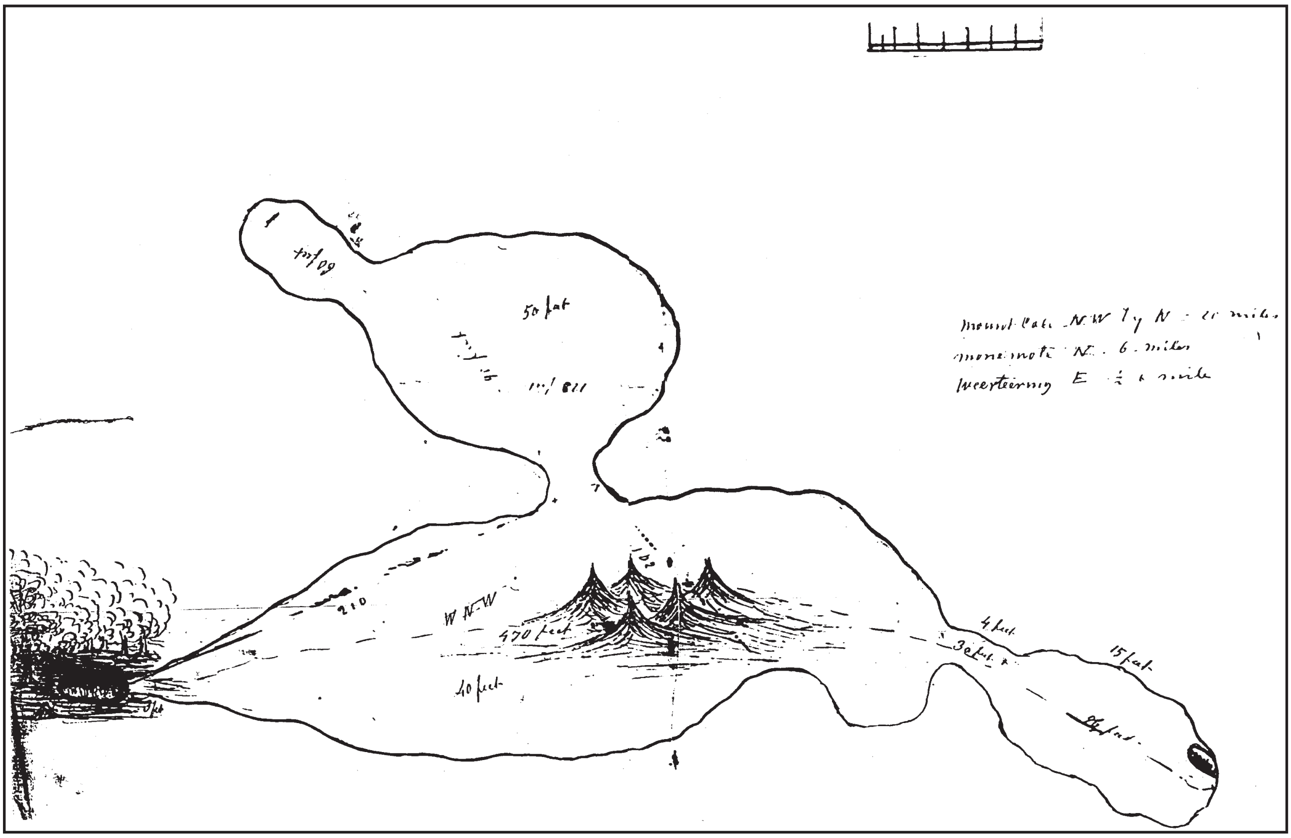

Figure 2: Robinson's 1843 sketch map of the Mt Widderin Cave, with guano mounds.

Falls, known as Bung Bundjil, and the local clan was named 'Bung Bundjil gundidj' (Clark, 1990; Clark and Heydon, 2002).

Anthropologist, Aldo Massola (1968b:59), described the Kulin 'myth' of the 'Lal-Lal Falls on the Moorabool River' thus: 'Bunjil made the falls to relieve the monotony of the landscape. He liked them so much that he decided to make them his earthly home'. This story is unsourced, but Massola (1968b:x) explained in his foreword that the accounts he published 'were collected over a period of ten years, from Aborigines in all parts of Victoria', and he supplemented these with 'the scant published material'. Massola speculated that Bundjil chose to live at the falls because of its idiosyncratic features:

Apart from the fascination of watching the wide creek ending its placid run through the level plain by suddenly tumbling, with a mighty roar, down the 200 feet chasm, there were other reasons, no doubt, why Bunjil was made to live there. One was the fact that the swamp supported a large population of birds and other animals which assured the Aboriginals of plentiful supplies of food. Another was the comfort of the sand dunes on the south-east of the swamp, which make ideal camping places. A third, and no doubt very important reason, was the deposits of white pipe-clay on the east side of the swamp, which are now commercially quarried for paper clay (Massola, 1969:70-71).

Bundjil, the creator-spirit, is also associated with another cave. R.B. Smyth (1878, Vol. 1: 456) recounts the story of Buk-ker-til-lible, the cave or chasm at Cave Hill near Lilydale. The Aborigines believed that Buk-ker-til-lible had no bottom, and when they threw stones into it they could never hear the stones land. They believed that Pund-jel made this deep hole when he was angry with the Yarra Aboriginal people. They had committed deeds that displeased him and he caused a star to fall to the earth, striking and killing a great many people and the star fell deep into the earth, and made this chasm.

Bundjil was also associated with the Bridgewater caves (shelters). Bonwick (1970: 112) explained that the 'natives have some dim shadowings of traditions connected' with the caves. 'Some spirit, Punyil, once resided in one, and was accustomed to descend therefrom and walk the shore. Rude attempts at drawings were said to be found there. I did not observe any, though want of time prevented a close examination of the various caverns'. Presumably this is a reference to the line of shelters [3P-9] in the cliff overlooking the Bridgewater Lakes at Tarragal (Illustrated in an 1851 engraving by Thomas Ham, Figure 3).

Several caverns exist in southwest Victoria, near Port Campbell, where they have been washed out under the cliffs by the force of the Southern Ocean. Phillip Chauncy has provided us with a discussion of one of these caves:

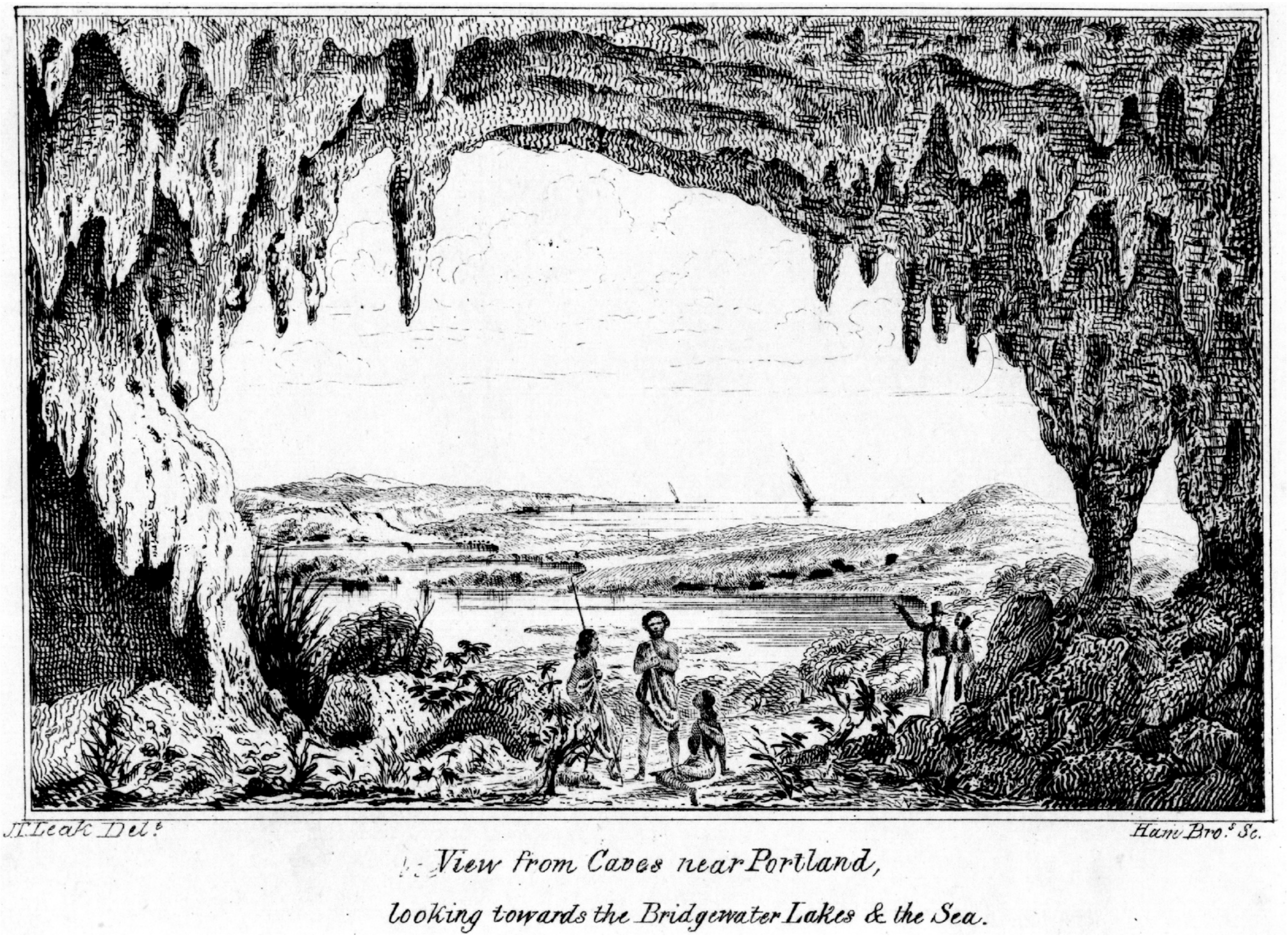

Figure 3: Tarragal Caves overlooking the Bridgewater Lakes and Cape Bridgewater in the distance. From an engraving by Thomas Ham, c. 1851. [nla.pic-an6016280, National Library of Australia].

One of these extends under ground nearly a quarter of a mile, and in one place the rain-water has washed a small hole from the surface of the ground down into the cavern. There is a continual draught of air blowing up through this hole, so that if a leaf or any light substance be thrown over it, it is immediately carried up into the air. For ages past the natives were in the habit, whenever they approached this air-hole, to throw a piece of wood into it to propitiate the demon supposed to reside within its profound and mysterious depths. When the late Mr. Superintendent La Trobe examined this part of the coast, in 1842 [sic], some of his men made a rope ladder, and went down over the cliff and explored this cavern. When they came to the part nearly under the hole communicating with the surface, they found an enormous pile of wood, which must have been the accumulation of ages, as the natives had to carry the pieces of wood from the distant forest. The men set fire to the pile, which lit up and displayed a magnificent vaulted chamber, bedecked with long glistening stalactites, and tenanted by vast numbers of bats, whose whirring, whizzing noise was probably that which the natives attributed to some supernatural being (Chauncy in Smyth, 1878, Vol. 2: 268-9).

This cave was visited by C.J. La Trobe in 1845 and 1846, and he recorded a detailed description in 1846 (see Blake, 1975). La Trobe noted that the 'natives' referred to it as 'Lubras' Cave'. This is probably what is now called 'Starlight Cave' [3W-5], south-east of Warrnambool. Edmund Gill (1948) names this 'Guano Cave' (Figure 4), and other names include 'Bat Cave' and 'Lake Gillear Cave' (See Gill, 1948, and Hall, 1993 for more information). La Trobe explained that local Indigenous people knew the caverns well and 'had a superstitious dread of them, stating that the caverns below were inhabited by *headless lubras*' (Blake, 1975: 19).

In northwest Victoria, two of the most important Ancestral Heroes, are the buledji Brambimbula, the two Bram brothers. Accounts of their actions survive from three languages: Wergaia, Djadjawurrung, and Wembawemba (Hercus, 1986). Accounts have them active in a vast expanse of country stretching from Lake Boga in the northeast to Naracoorte Caves in the southwest. A.W. Howitt (1904: 485) noted that the Bram brothers lived in a cavern far to the west. In August 1907, at the Lake Condah Mission, the Reverend John Mathew spoke with Jackson Stewart, a Wembawemba speaker born near Lake Boga. Stewart told Mathew that the 'Brambanngul were two brothers, chief men, who lived in a cave near Naracoorte (Mathew Papers).

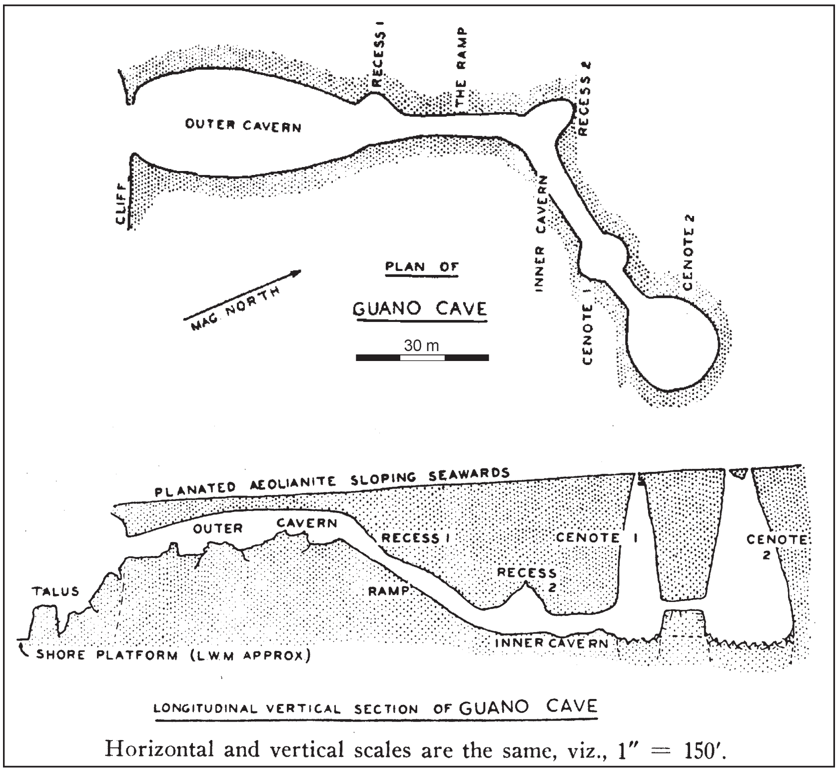

Figure 4: Gill's map of Starlight Cave (from Gill, 1948)

Many of the place names in and around the Gariwerd/ Grampians National Park have mythological references, and many to the actions of the Bram brothers in forming the landscape of the Gariwerd/Grampian ranges (see Clark & Harradine, 1990; Clark & Heydon, 2002). For example, in the story presented by R.H. Mathews (1904), in which the Bram brothers are pursuing Ngindyal, the emu, features in the mountains, such as Rose's Gap, are explained. Many of the Gariwerd placenames recorded actions and events associated with Ancestors and many contained references to Ancestral body parts; for example, Mudjambula which means 'the two of them pick something up'; 'Mud-dadjug' 'blunt or useless arm'; Wudjub guyun 'stabbing spear in the stomach'; Gunigalg 'excrement stick'; Werdug 'his shoulder'; Wudjugidj 'belonging to the man'; and Wulbuwa 'to burn very fiercely'. The importance of the Bram brothers is also seen in the name of the interpretive and cultural centre 'the Brambuk Living Cultural Centre' in Halls Gap, a clear reference to the Ancestral heroes, the buledji Brambimbula, the two Bram brothers. Brambuk translates to 'belonging to Bram'.

Smyth (1878) published an account of the Bram brothers which he had received from the Reverend Hartmann. Presumably, Hartmann obtained them from Wergaia residents at the Ebenezer station.

The Rev. Mr. Hartmann says in a letter to me, in reference to this story, that, according to information given by the blacks, it is known all over the country. It is only part of a long story. The two Brambambulls were rather remarkable men. The blacks' further account of them may be briefly stated thus: — The Brambambulls were invulnerable, and the elder could make himself invisible whenever he pleased. The last thing known about the elder is that he went away in a whirlwind. The younger Brambumbull is said to have vanished too for a while, but to have made his appearance again in another part of the country. He was followed and found by his mother. It is said that he died from the effects of a snakebite; that he was buried; and that he became alive again. After that he could not be found any more. The portion of the story that is sent, Mr. Hartmann says, is written in the way a black would tell it—of course considerably abridged (Smyth 1878: 53-4).

Associations with malevolent creatures and spirits

Caves were often thought to be the abode of malevolent creatures and spirits. For example, J.M. Allan, at Tooram station near the mouth of the Hopkins River, reported to the 1858 Select Committee that the Aboriginal people in his district believed spirits called 'Tambora' inhabited caves (Victoria, 1859: 71). Tambora is the Giraiwurrung word tampoorr, their general word for devil, 'male devil', 'bad male spirit' (Krishna-Pillay 1996: 59). Luise Hercus (1986: 211) learned of the existence of a mythical malevolent creature known as 'Ngaud-ngaud'. Stories of the Ngaud-ngaud are widespread, and range from the upper Murray people of eastern South Australia (Swan Reach) to the Woiwurrung of central Victoria. According to the upper Murray people, the Ngaud-ngaud was a malformed giant, who was ultimately imprisoned by the people in a cave where he starved to death.

In Gippsland, caves are associated with two mythical beings; the Nargun and the Nyol[3]. In 1875, Alfred William Howitt explored the Mitchell River by canoe accompanied by two Ganai men - Turnmile and Bunjil Bottle (Seddon, 1989). Up one creek, known as Deadcock Creek, they came to a cavern now known as "Den of Nargun" [3GP-5]. Howitt noted that his companions expressed delight upon finding this cavern, and planned to return and camp there and collect the tails of the woorayl (lyrebird) among the scrubs of the river, and feast on koalas and wallabies. A little further on, they came to a second cave, fringed by stalactites. The two Ganai men removed some stalactites to show their friends. Bunjil Bottle was convinced that this was the haunt of the mysterious creature, the Nargun, the 'Ngrung a Narguna' (Seddon, 1989: 18). The Nargun, is a mysterious creature, a cave dweller that haunts various parts of the bush. Howitt learned that they especially haunt the Mitchell Valley. Howitt's companions could not describe a Nargun, beyond that it is like a rock (wallung), and is said to be all stone except the breast and arms and hands. It inhabits caverns, into which it drags unsuspecting passers-by. Howitt knew of another cave in the Miocene limestones of Lake Tyers that was said to be inhabited by a Nargun (Seddon, 1989: 18). Massola (1962) searched for this cave and found that its description matched not the presently named "Nargun's Cave" [3NN-1] but another cave, "Cameroon's No.2" [3NN-3].

Smyth (1878, Vol. 1: 456-7) presented the following account of the 'Nrung-a-Narguna'.

A mysterious creature, Nargun – a cave-dweller – inhabits various places in the bush. He haunts especially the valley of the Mitchell in Gippsland. He has many caves; and if any blackfellow incautiously approaches one of these, that blackfellow is dragged into the cave by Nargun, and he is seen no more. If a blackfellow throws a spear at Nargun, the spear returns to the thrower and wounds him. Nargun cannot be killed by any blackfellow. There is a cave at Lake Tyers where Nargun dwells, and it is not safe for any black to go near it. Nargun would surely destroy him. A native woman once fought with Nargun at this cave, but nobody knows how the battle ended. Nargun is like a rock (Wallung), and is all of stone except the breast and the arms and the hands. No one knows exactly what he is like. Nargun is always on the lookout for blackfellows, and many have been dragged into his caves. He is a terror to the natives of Gippsland.

[3] These legends have been the basis for stories written by Patricia Wrightson (1973). In one story she describes a boy's encounter with Nyols who drag him into their cave and want to wrestle with him (among other things).

Massola (1968b: 74-5) has recounted the story of the Nyol at Murrindal.

Once, when the tribe was camped at Murrindal, one of the men went possum hunting. Possums were plentiful on the trees growing amongst the rocks there. While he was hunting, he noticed an opening between two rocks. He put his foot in it and was drawn in. He found himself in one of the many caves in the vicinity. The cave was lit by a strange light, and was inhabited by many very small people who came to him showing signs of friendship. They called him Jambi, which is a general term for friendship, although it means brother-in-law. He tried to get back above the surface, but found that he had to wrestle with the little people. They were very strong, although small, and although he fought many of them, they all overcame him.

Feeling exhausted he lay down to rest. The little people, the Nyols, gave him rugs to sleep on and grubs to eat. The latter were a great delicacy, and he enjoyed them very much. At last, many of the Nyols went away and he was left in the charge of one of them. Everything had been quiet, but now he heard a rustling sound. One of the Nyols came to him saying he would show him the way to the surface of the ground. Before very long he was amongst his own people, but for several days could not tell them what had happened to him. His mind had temporarily gone blank.

Other cultural associations

This study has discovered the Aboriginal names of numerous Victorian caves, in terms of generic words for 'caves' in southwest Victoria, James Dawson (1881: vii) learned that the Djabwurrung word for cave was 'Yeitchmir' meaning 'close the eyes'; the Gurngubanud dialect of Dhauwurdwurrung knew caves as 'Yatmiruk', which also meant 'close the eye', and the Bigwurrung dialect used the word 'Yuluurn'.

A cave featured in the story of the movement of the spirits of deceased people to Deen Maar (Lady Julia Percy Island), an island off the southwest coast of Victoria. On the Victorian coast, opposite this island, a cave named 'Tarn wirring' or 'road of the spirits' formed a passage between the mainland and the island. Grass found at the mouth of the cave was considered proof that a good spirit called 'Puit puit chepetch' had removed the body, of a recently buried person, through the cave to the island and conveyed the spirit to the clouds (Dawson, 1881: 51). Aldo Massola (1968a, 1969) claimed to have identified this coastal cave at The Craigs, east of Yambuk, but no ASF number has been assigned.

John Mathew learned in 1890, of an ingenious use of sink-holes in south-west Victoria. A local surveyor informed him of a custom practiced near Macarthur involving two large sink-holes which Aboriginal people would use in their harming practices: they would drop a morsel of the excrement of an enemy down the sink hole 'who was supposed thereafter to pine and die' (Mathew Papers). These would probably be two of the large collapsed entrances of the lava tubes at the Byaduk Caves, north of Macarthur [3H-11, 12, 13 etc]. In western Victoria, Aboriginal people were very careful in disposing of their excreta, usually burying it with a spatula they called a gunigalk (excrement stick) to ensure that it could not be found by their enemies (Rose, in Bride, 1898: 150).

Conclusion

This brief review of the ethnohistorical literature has examined Aboriginal associations with caves in Victoria. These associations have been found to be rich and varied. Caves and sink holes featured prominently in the lives of Aboriginal people – they were often believed to be the abode of malevolent creatures and spirits and some were associated with important ancestral heroes, and traditional harming practices. Some were important in the after death movement of souls to their resting places

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Tectonic and Talus Caves at Pilchers Mountain, New South Wales

Garry K. Smith
3 Spinnaker Ridge Way, Belmont 2280, NSW, Australia.
gksmith@exemail.com.au

Abstract

There are fourteen known caves within the Pilchers Mountain Environmental Protection Reserve, in New South Wales, Australia. The reserve contains five main chasms which run generally East-West for approximately one kilometre, over a total width of half a kilometre.

The chasms and caves were formed by massive sandstone block separation along sub-parallel joint planes. Movement of the blocks toward the valley floor was aided by the dip of the sandstone layers and presence of underlying shale bands which acted as slip planes when lubricated by groundwater. There are two distinct types of caves at Pilchers Mountain, "tectonic" caves formed by the movement of large blocks of bedrock, and "talus" caves amongst large breakdown rocks and boulders. The chasms provide a micro-climate which supports a pocket of dense, high canopy, subtropical rainforest, and the caves are home to populations of bats and other fauna.

The European history of Pilchers Mountain is detailed in chronological order from the early 1800s to the present day. A Plan of Management is in the process of being formulated by stakeholders and interested parties to ensure the continued preservation of the reserve.

Keywords: Pseudokarst, Tectonic Caves, Talus caves, Fissure caves, History, Management, New South Wales.

INTRODUCTION

Location and Access

The Pilchers Mountain caves and associated chasms are located 54 kilometres north of Newcastle, and approximately six kilometres north of Wallarobba. This small settlement is centred around a railway station and road crossing midway between Paterson and Dungog in the Hunter Valley, NSW (Figure 1). These natural phenomena are protected within a Crown Reserve which was gazetted in 1889. In more recent times the reserve has been changed to an Environmental Protection Reserve (Figure 2). Since there is no formed road to the reserve and it is completely surrounded by private property, the chasms and caves have remained almost undisturbed since their discovery. The reserve is within the elevation range of 240 to 360 metres ASL.

Access is through several private properties and permission is required from the surrounding land owners and Dungog Council before entering the Crown Reserve. For further details on access conditions etc, contact the Newcastle and Hunter Valley Speleological Society Inc. P.O. Box 15, Broadmeadow, N.S.W. 2292, Australia.

Geology

Pilchers Mountain consists of thickly bedded sandstone with lenses of conglomerate, part of the Carboniferous Wallaringa Formation (Allen, 1972). The sediments are generally yellow-brown, grading to reddish at the top of the formation (beneath a bed of Volcanics). They are mostly massive and resistant to weathering and therefore form excellent cliffs. The movement of massive sandstone blocks to form the chasms was aided by the underlying shale bands, which acted as slip planes when lubricated by groundwater (England, 1982).

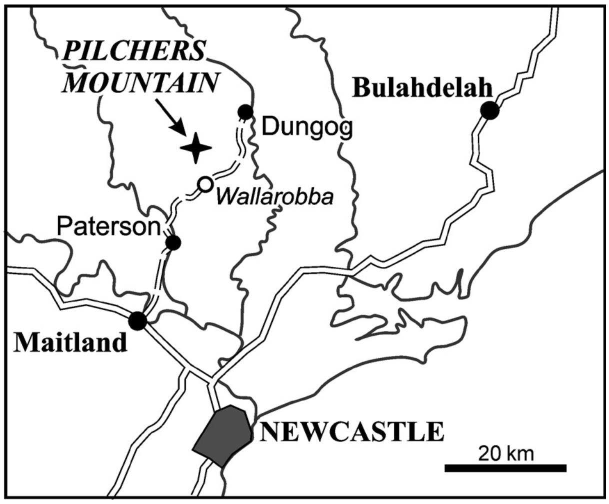


Figure 1: Location of Pilchers Mountain.

Localized dissolution of minor calcite cement in the sediments has resulted in the formation of isolated poor quality calcite speleothems in parts of Bat Cave.

Also of interest is the narrow seam of coal and shale exposed just above floor level in the main chamber of Bat Cave. The coal seam reaches a maximum thickness of around 100mm and tapers down to just a few millimetres in other places.

Hydrology

There are two permanent springs fed by groundwater in the sandstone of the chasm area. The eastern spring drains into Spring Gully Creek and the other spring runs into an unnamed creek toward the western end of the chasms. Both these creeks merge and flow into Wallarobba Creek.

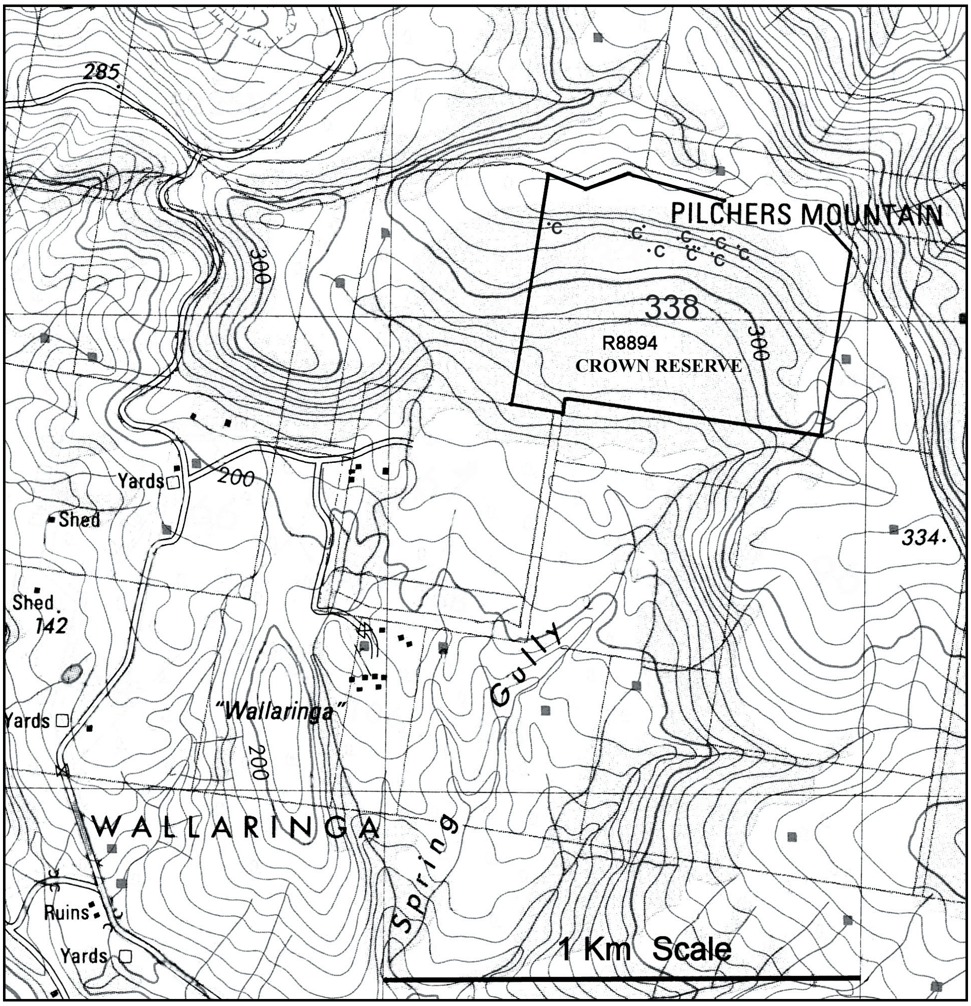


Figure 2:

Topography at Pilchers Mountain Reserve (R8894).

Enlarged from GRESFORD, 1:25000 Topographic Map

CMA 9233-3-S,

c. = caves

THE CAVES, FISSURES and CHASMS

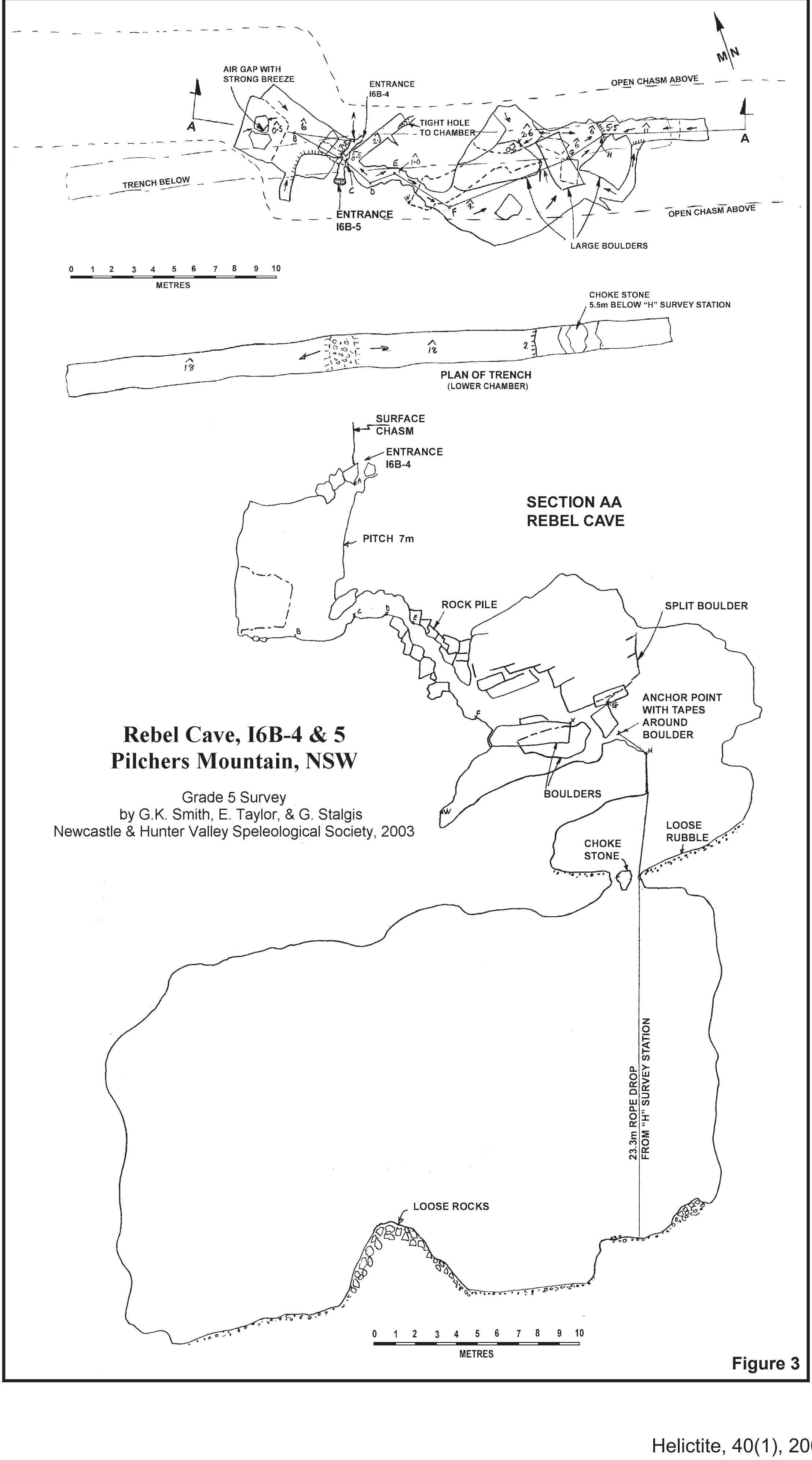
The Pilchers Mountain Crown Reserve was established to protect the caves and unique geomorphology of the surrounding area, comprising several sub-parallel offset chasms that host a picturesque pocket of dense subtropical rainforest. The protected area lies in stark contrast to the surrounding grassy hills cleared of their original dry sclerophyll forest cover for grazing.

There are five main chasms, and a number of smaller ones running generally East -West for approximately one kilometre, over a total width of half a kilometre. The base and sides of the wider chasms are mostly strewn with massive angular sandstone blocks. The large depressions created a micro-climate which aided growth of the present pocket of subtropical rainforest.

The open chasms reach a depth of 90 metres and typically have vertical walls, with the gaps ranging from a metre or less to over 50 metres (Figures 4 & 5). There are many good examples where opposite sides of the chasms can be identified as matching the shape of separated walls. In places where the chasms are narrow, large blocks wedged between the two walls have created several large caves. (eg. Bat Cave and Rebel Cave). Smaller caves are located in piles of large angular boulders which have fallen into the wider chasms as the sandstone masses moved down-slope (eg. Valentine and Lambton Caves.).

The most northern chasm contains the Rebel Cave and Bat Cave (also known as Wallaringa, Pilchers or Main Cave). Another contains the Lambton, Valentine, Diamond Mine and other caves. In all there are about 14 known caves. The largest chamber is found in Bat Cave (22m long x 2.7m wide x 12m high) which has a survey passage length of 93m. The deepest known cave is Rebel Cave (Figure 3) with a vertical depth of 46m and survey length of 99.5m. It contains a 6m pitch (Figure 6) and another 27.5m free hang. The Bat and Rebel Caves generally follow the line of the northern chasm, while the others are more irregular as they occur in large rockpiles.

There are no reported cases of "foul air" (eg. elevated carbon dioxide concentration) being encountered in Pilchers Mountain caves despite the ingress of organic material around entrances and minimal air flow at the bottom of the deeper caves. The Rebel and Bat Caves stay damp and humid even through the worst droughts. However, the rockpile caves, such as Valentine and Lambton Caves, become dusty during extended periods without rain.



Rebel Cave, I6B-4 & 5
Pilchers Mountain, NSW

Grade 5 Survey
by G.K. Smith, E. Taylor, & G. Stalgis
Newcastle & Hunter Valley Speleological Society, 2003

Figure 3

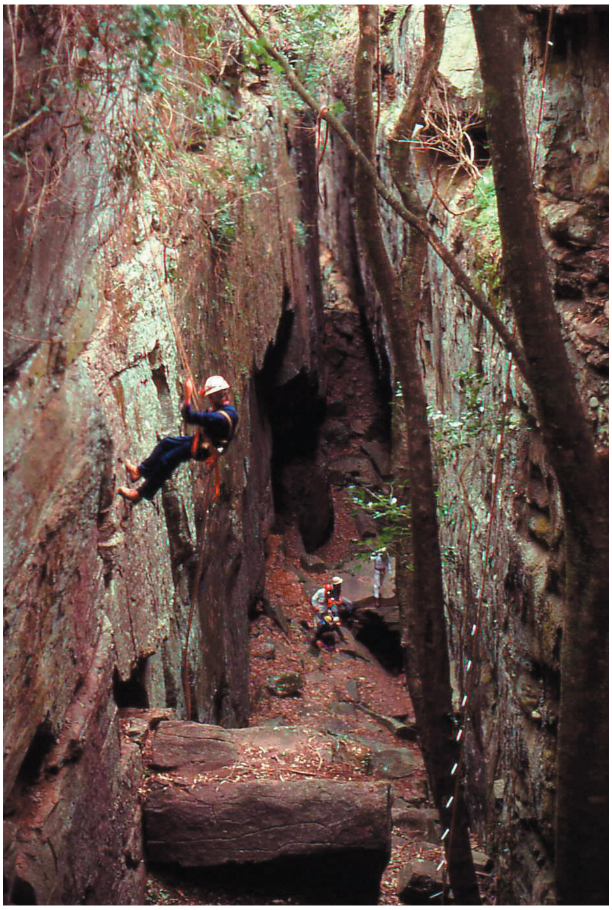


Figure 4: Northern Chasm at Pilchers Mountain

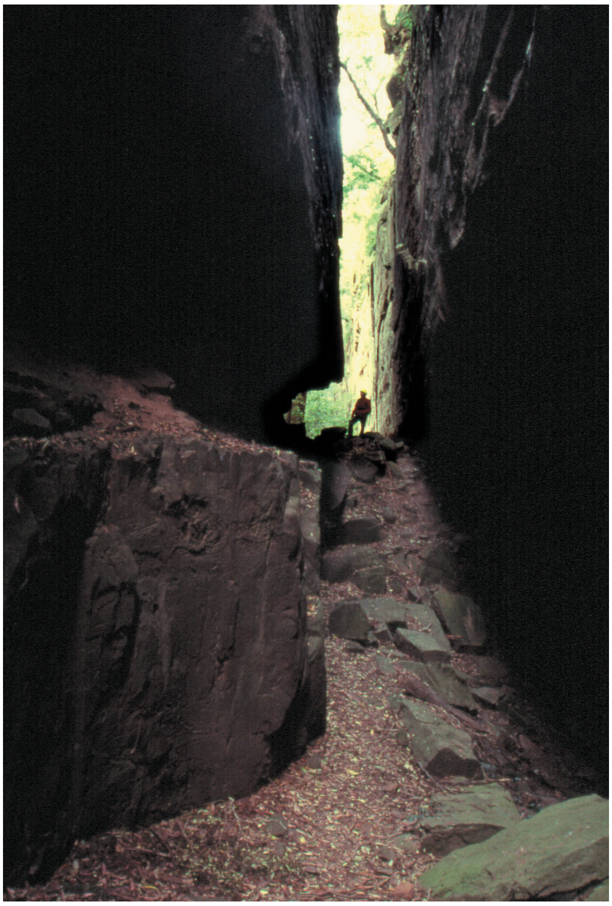


Figure 5: Base of Northern Chasm

Figure 6: Chockstones in upper pitch, Rebel Cave

Figure 7: Surface rubble and vegetation

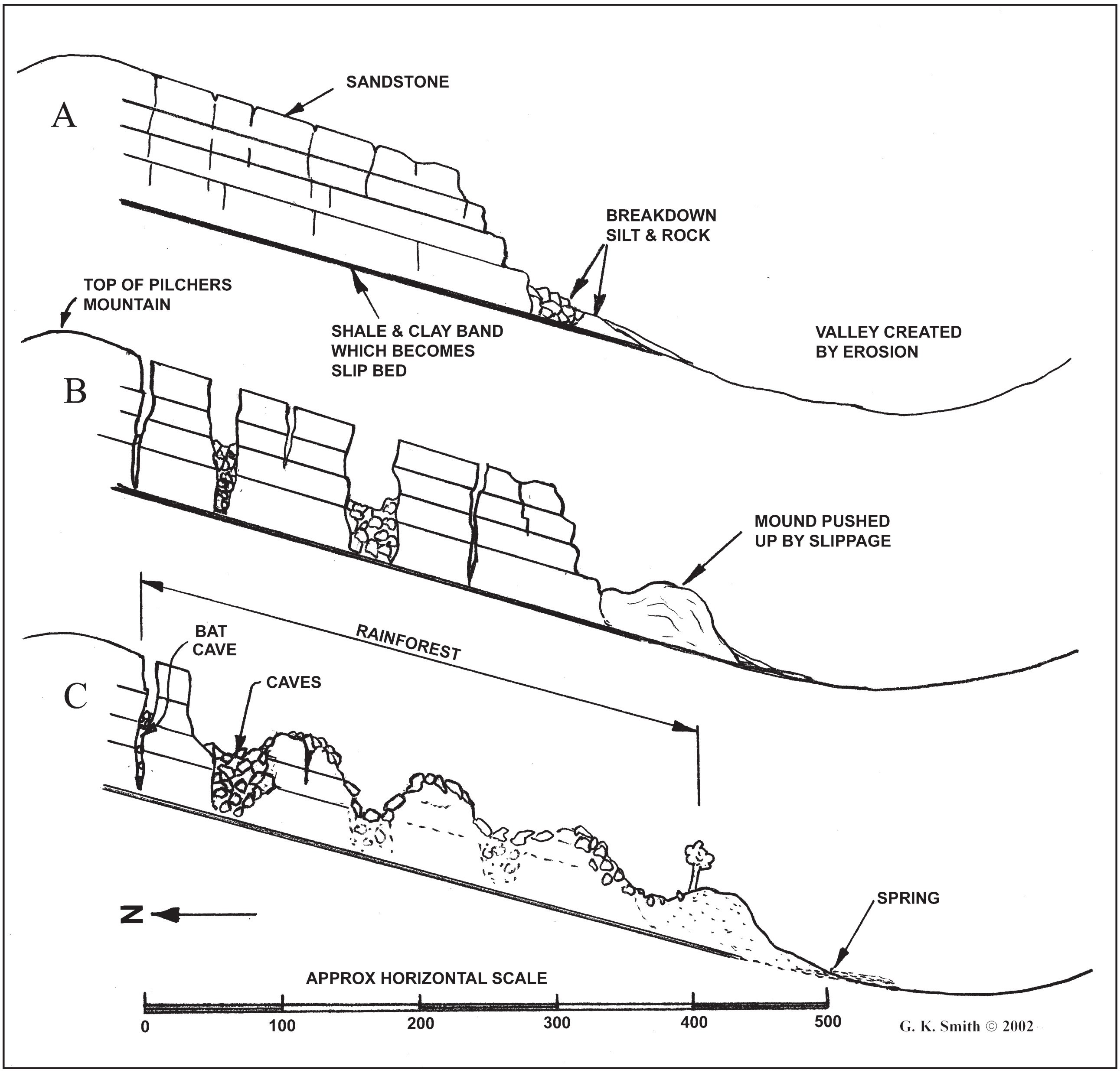


Figure 8: Sequence of movements which formed the chasms and caves at Pilchers Mountain (after England 1982).

The caves most visited are Bat (Main) Cave, Valentine Cave, Lambton Cave and Crawler Cave. Visitors to Rebel Cave should be very wary of loose rocks as this cave can be very dangerous even to the experienced caver. To protect the bats, visitors should not enter Bat Cave in winter during the hibernation period.

Table 1 has a complete listing of known caves.

Origin of the Caves

The chasms formed as a result of massive sandstone block separation along sub-parallel joint planes, aided by the dip of the sandstone layers towards the floor of the valley, and the presence of underlying shale and coal bands which acted as slip planes when lubricated by groundwater (England, 1982). Figure 8 depicts the possible movement which led to the development of the chasms and caves at Pilchers Mountain. Some speculate that the creation of the chasms occurred gradually over millions of years, however Hunter (1991) suggests that the development process may well have been accelerated by the numerous earthquakes which occurred in the district over hundreds or even thousands of years.

There are two main types of caves represented at Pilchers Mountain. Rebel and Bat Cave would typically fit the cave development type described by Springer (2003) as "Tectonic" caves formed by the movement of large blocks of bedrock atop shales, which allow the overlying blocks to literally slide away. Typically there are solid bedrock walls which have matching shapes on the opposing sides of the chasms. Because there are many variations of cave development due to rock movement, Halliday (2004) uses the generic term "Crevice" caves to cover narrow rectilinear crevices of natural origin. Webb et. al (2003) uses the term "Fissure" Caves when referring

New tag No.	Cave Name	Discovery	Mapped
	Main Chasm (Gorge)	Before 1889	Mapped 5-9-75
I6B15	Bat Cave (Main Cave, Wallaringa Cave and Pilchers Cave)	Before January 1970	Mapped by J. Smith, K. Rugg, G. McHugh & W. Brown, 29-8-75.
I6B16	Cleft Cave	Before January 1976	Mapped by Steven Smith, 2-4-77, Grade 4 map
I6B17	Diamond Mine	Before June 1975	Mapped by Peter Payne, David Carey & Wayne Smith, June-1975, Grade 4 map
I6B4 & 5	Rebel Cave	Around 1970	Sketch map 22-2-86 by D. Armitage et.al. Survey & map by Garry K. Smith, Evelyn Taylor & Glenn Stalgis, 14-6-03
I6B6	Spider Hole	Before January 1976	No Map
I6B7	Arch Cave	Before January 1976	No Map
I6B8	Stalactite Cave	Before January 1976	No Map
I6B9	Cathedral Cave	Before January 1976	No Map
I6B10	Crawler Cave	Before January 1976	No Map
I6B11	Valentine Cave	Discovered by members of Valentine Venturer Scout Unit prior to Jan. 1976	No Map
I6B12	Pioneer Cave	Discovered prior to Jan. 1976 – links up to Valentine Cave I6B11	No Map
I6B13	Lambton Cave	Discovered by Garry K. Smith some time prior to January 1976, and named after Lambton Venturer Scout Unit	Mapped 27-2-93 by Garry K. Smith, Michael Smith, Pat Hyde & Katie Mottram
I6B14	Kotara Cave	Discovered by members of Kotara Venturer Scout Unit in 1992	No Map

Table 1: Known Caves at Pilchers Mountain. Compiled from information by Powell, 1976 and Smith, 1995

to caves created by movement of large sandstone blocks in the Sydney area of NSW Australia.

Around the world, many local terminologies are used to describe this type of caves. Examples are: breakaway caves, cambering caves, closed joint caves, crack caves, crevasse caves, crevasses, earth cracks, earthquake cracks, eruptive fissures, fissure caves, gravity sliding caves, gulls, gull caves, joint caves, mass displacement caves, mass movement caves, open joint caves, rift caves, rifting caves, rock topple caves, sliding fracture caves, slope movement caves, tilting caves, toppling caves, and windy pits (Halliday, 2004a)

The second cave type can be classified as “Talus” or rockpile caves, consisting of the voids amongst large breakdown rocks and boulders which have fallen into depressions (Halliday, 2004b). Examples at Pilchers Mountain are the Valentine, Diamond Mine and Lambton Caves.

HISTORY

The chasm area and rainforest certainly would have been known by the aboriginals of the Worimi tribe (Tindale, 1974), who inhabited the area prior to European occupation. However there is no archaeological evidence to suggest that they entered the caves, and no Aboriginal sites are known within the reserve (Hirst, 2004).

Pilchers Mountain was named after Henry Incledon Pilcher who arrived in NSW during 1830 and was admitted to practice as an attorney and solicitor of the Supreme Court. He was granted a large estate called Wallaringa, near the mountain. Pilcher lived in Maitland where he practiced as a solicitor, while the estate was managed by an overseer who utilised a convict workforce (Hunter, 1991).

Around 1840 a group of notorious bushrangers called the ‘The Jewboy Gang’ terrorised the district, robbing travellers and homesteads of money, guns, ammunition, silverware, jewellery etc. This group of seven escaped convicts carried out robberies in many parts of the Hunter Valley and even up into the New England district. One of the convicts had escaped from the nearby Wallarobba Estate (within 5km of Pilchers Mountain). This estate, owned by Matthew Chapman, was thoroughly robbed as were many others in the area. It was believed by some that the overseer and convicts of the Wallaringa estate collaborated with the outlaws. One of the gangs' hiding places was known to be in the Wallarobba mountains. Hunter (1991) speculates that the Gang may have stowed their ill-gotten wealth in the boulderous caves at Pilchers Mountain. The gang's reign of terror came to an end on the 23rd December 1840 when they were captured at Doughboy Hollow over the range from Murrurrundi. The seven were taken to Sydney, tried, convicted and hanged in March of 1841 (Smith, 1994).

Certainly the chasms of Pilchers Mountain were known by the early 1880's, as a description dated 1886 refers to a fissure varying in depth from 100 to 300 feet (30 to 90 metres). The account also mentions large boulders and lush vegetation similar to a jungle with a tall tree canopy (Hunter, 1991).

During early European settlement and the clearing of land for grazing, it was inevitable that the early pioneers stumbled upon the chasms and rainforest, possibly even discovering the Bat Cave entrance, but no records have yet surfaced to indicate the exact time of its discovery.

The significance of these unique chasms, rainforest and caves was realised soon after their discovery, hence an area covering about 65 acres (26.3 hectares) was gazetted a Crown Reserve number 8894 on 18th April 1889 (Government Gazette, 1889).

The earliest known map to indicate the existence of caves on the reserve is the NSW Crown Land Administrative Map from County DURHAM, Parish of DUNGOG, Edition 4, dated 3rd June 1879.

The Dungog Shire Council (formerly Wallarooba Shire Council) was appointed as Trustee of the reserve on 18th February 1916. However this appeared to be just formalising the situation because under the local government act, the Council had care and control of the reserve since its gazettal in 1889.

In the late 1960's and early 1970's the first caving groups began exploring the area. The cave now called "Bat Cave" was referred to as Wallaringa Cave (WC1) in 'CAVE' the official newsletter of the Newcastle University Speleological Society, May 1970. In this publication the editor (Jordan, 1970) states *"Wallaringa Cave was run through with compass and tape early last year, but nothing further has arisen from this. The Cave is in sandstone, and has been formed by the collapse of a rock mass. It is the only reported cave of its type in Australia, so mapping it will be worthwhile, as would be a full scale study."* The trip report describes five cavers entering (WC1) and exploring the main level but not the lower level. They then moved on to another previously unexplored hole at the top of the chasm (Jordan, 1970). From the description one could assume that they descended the small pitch into the first chamber of Rebel Cave. The name Wallaringa was taken from the name of the property at the junction of Spring Creek and Coxs Creek as shown on the early 1 inch to the mile maps of 1942. However, on more recent maps the Coxs Creek was renamed Wallarobba Creek. The Wallaringa property is approximately one kilometre south-west of the caves. (Figure 2.)

During the late 1960's members of the Scout Association began visiting the area on a regular basis. Beginning in April 1970, several courses per year were conducted to train adult and youth members in all aspects of caving and abseiling with a strong emphasis in conservation and heritage values. Some courses in the early years involved in excess of 50 participants, however in later years this number reduced to around 10 to 15 per course. Regular courses have continued to be run to the present day.

In January 1988, the National Parks and Wildlife Service (NPWS) proposed to acquire Pilchers Mountain as a Nature Reserve. This led to a meeting on the 5th June 1992, where agreement was made between NPWS, Dungog Council and 'Department of Conservation and Land Management' (CaLM) to dedicate the reserve for Environmental Protection and Recreation following land assessment action. NPWS agreed to withdraw from a Nature Reserve acquisition proposal on completion of a Plan of Management for the site (Wiseman, 1994).

In November 1995, the NSW Department of Land and Water Conservation, released for public inspection a 'Draft Assessment of Crown Land at Pilchers Mountain' as a requirement under the Crown Land Act 1989, to seek public comment prior to changes in Reserve classification (George, 1995).

The Reserve 8894 (Lot 338 DP No. 1009839) covering 30.07 hectares, was dedicated as an Environmental Protection Reserve (Reserve No. 1002990) on 15th December 2000, and the earlier classification of Crown Reserve for Public Recreation was revoked. (Government Gazette, 2000). The Dungog Shire Council was appointed to manage the affairs of the reserve trust (Aquilina, 2000).

In a letter to the Dungog Council, the Manager of Resource Access and Compliance for the Department of Land and Water Conservation, said the change in the reserve's status was "in recognition of the significance of the site." (Garboll, 2001).

During 2003 the Dungog Council applied for and received a Government grant to fund the preparation of a "Plan of Management" for the Pilchers Mountain reserve.

In late 2003 the Council formed the Pilchers Reserve Committee to oversee the development of the 'Plan of Management' (PoM) and aid in the implementations of any recommendations which arose from the preparation of the Plan. The Committee composed of adjacent landowners, representatives from the community (bushwalkers, birdwatchers, Scout Australia and caving clubs), Department of Environment and Conservation (National Parks and Wildlife Service) Department of Lands, the local Aboriginal Community and Dungog Council. At the same time the consultants GHD Pty Ltd. were contracted to compile the PoM with input from the advisory committee. The first draft of the PoM was presented to the Pilchers Reserve Committee in August 2004 for comment.

The Draft PoM was then placed on public exhibition in March/April 2005 and submissions on the draft were considered by the Pilchers Reserve Committee at a meeting in April. As a result of the public submissions, a significant number of changes were made to the Draft PoM.

At the time of writing in May 2007, the draft PoM had not been finalised, despite numerous meetings, site visits and many months of ongoing discussion between interested groups and stakeholders. It is believed that a final draft PoM is close to being adopted by the committee and presented to Dungog Council for ratification. The document will then be placed on exhibition for public comment, which may result in minor amendments before it is finally implemented.

Visitor numbers remained fairly constant over the last 30 years to the present day. Organised groups comprise the majority of visitations include members from the Scouts Association, local caving club – Newcastle and Hunter Valley Speleological Society Inc, various bushwalking and bird watching groups.

FLORA

The chasms within the reserve contain dense subtropical rainforest with an upper canopy in many places exceeding 50 metres (Figure 7). There are a number of varieties of tall trees, among them giant Morton Bay Fig*, (Ficus macrophylla*) with buttresses exceeding 6 metres. Some of the finest examples in Australia of the Giant Stinging Tree *(Dendrocnide excelsa)* can be found in this rainforest. There are many good specimens of the Strangler Fig *(Ficus watkinsiana)*, which have taken on the shape of their former host tree, before it died and rotted away from within the grasp of the fig. Other examples of the Strangler Figs' determination to survive are where they have actually grown over and around large boulders the size of small houses.

In the rainforest there are other tall trees, include the Flame Tree *(Brachychiton acerifolium)*, Red Cedar *(Toona australis)*, and Brown Beech *(Pennantia cunninghamii)*.

The high canopy trees are hosts to huge vines, ferns, orchids and mosses. Among them are Elkhorn *(Platycerium bifurcatum)*, Staghorn *(Platycerium superbum),* Bird's Nest Fern *(Asplenium australasicum)*, Pink rock orchid *(Dendrobium kingianum)*, King orchid *(Dendrobium speciosum),* and Maidenhair Fern *(Adiantum aethiopicum)*. The vine Smooth Tender Grape (*Cayratia clematidea*) reaches its known southern limit here. These are just a few of the 120 plant species which Floyd, (1982) recorded within the reserve.

At the extremities of the rainforest and on parts of the surrounding land now used for grazing, one can see the occasional Grass Trees *(Xanthorrhoea)*, numerous varieties of Eucalyptus as well as Turpentines *(Syncarpia procera)* and Wattles belonging to the *Acacia* genus.

The chasms which host the dense subtropical rainforest are in stark contrast to the surrounding grassy hills outside the reserve which are cleared of their original dry sclerophyll forest.

FAUNA

The caves contain a variety of vertebrate fauna. The Bat Cave is the roosting site for a large colony of Eastern Bent-wing Bats *(Miniopterus schreibersii)*. The colony usually roosts in a small chamber which is generally inaccessible to humans. A small number of Eastern Horseshoe Bats *(Rhinolophus megaphyllus)* can be found in some caves. Personal observations of bat numbers in the Rebel and Bat Caves over the past 37 years has not identified any discernable change in the bat population as a result of visitation by organised groups.

Invertebrate fauna observed in the caves includes crickets, millipedes and various other unidentified invertebrates. There are also unidentified species of geckos and frogs. The two permanent springs which drain from the reserve, have not been investigated for aquatic fauna.

The subtropical rainforest within the chasms supports a diverse range of wildlife including; Spotted-tailed Quoll (*Dasyurus maculatus*), Brush-tailed Phascogale (*Phascogale tapoatafa*), koalas (*Phascolarctos cinereus*), Long-nosed bandicoot (*Perameles nasuta nasuta*), unidentified possums and wallabies.

Fruit eating birds such as Top-knot Pigeon (*Lopholaimus antarticus*), Wonga Pigeon (*Leucosarcia malanoleuca*), White-head and Brown Pigeons have all been recorded in the area. Other birds include the Regent Bower Bird (*Sericulus chrysocephalus*), Southern Boobook Owl (*Ninox novaeseelandiae*), and Wompoo Fruit–dove (*Ptilinopus magnificus*) (Floyd, 1982). Hirst (2004) lists 60 species of birds within the reserve, including the rare Peregrine Falcon (*Falco peregrinus*)

CONCLUSIONS

The Pilchers Mountain caves and chasms are significant geomorphic features in sandstone, not previously documented in speleological literature other than brief trip reports.

The chasms, caves and remnant rainforest within the Reserve are important habitats to a variety of flora and fauna. The Reserve remains an important site for study, training and recreation. Regular visits are undertaken by organised groups such as the Newcastle and Hunter Valley Speleological Society Inc, Scout Association, bushwalking and bird watching groups, all of which aspire to high conservation values within their organisation.

The present visitor numbers (estimated at less than 200 per year) has not resulted in any notable degradation of the flora or fauna within the reserve. Comparisons of early photographs has not shown any significant change in vegetation coverage other than a few pockets of introduced weeds (eg. *Lantana camara*).

Due to the remoteness of the reserve and access only via foot the reserve has remained in a pristine natural state. Without the appointment of a fulltime ranger the continued conservation of the area is reliant on support of surrounding property owners to report any illegal activity to the authorities, as they have in the past. These occasional illegal activities (eg. removal of ferns) have been associated with visitation by individuals not affiliated with any conservation minded organisations.

The formalisation and implementation of a PoM to balance the conservation, cultural heritage, public access, recreation and interests of surrounding landowners is essential to ensure continued preservation of these natural wonders into the future. The continued visitation by organised groups in line with presently established practice appears to provide a good balance between public access and sustainable conservation.

The PoM should also include a program to control introduced weeds and feral animals as well as encouraging ongoing research projects to provide defined baseline data and monitoring of future impacts within the reserve environment. Within the caves, research projects could include bat and invertebrate surveys, photographic documentation, cave exploration and mapping.

ACKNOWLEDGEMENTS

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Microkarren in Australia – a request for information

Ken G. Grimes

RRN 795 Morgiana Rd., Hamilton, Vic 3300, Australia. Regmap1@ozemail.com.au

Abstract

Microkarren are the smallest class of visible karren. They are finely-sculptured solutional forms, typically recognisable within a one centimetre grid. They come in a variety of patterns, of which fields of moderately to strongly sinuous microrills about 1mm wide and several decimetres long are the most conspicuous type. A descriptive terminology is suggested. Their genesis is uncertain, but appears to involve solution by thin films of water (dew, sea-spray or light rain) with surface-tension effects. In Australia their best development seems to be in the tropical monsoon (seasonally dry) and arid areas. However, these cryptic forms are poorly recorded and it is too early to make definite statements about their distribution. This note is a request for people to watch for them and report any sightings.

Introduction

Microkarren are the smallest class of visible karren. They are finely-sculptured solutional forms, typically recognisable within a one cm grid. These facinating little rills, spikes and pits could provide a clue to the behaviour of surface-tension films.

I will summarise the published ideas on their genesis, but make no attempt to add to that debate. Given that these small-scale features are poorly recorded, and probably more extensive than supposed, the first step is to determine their distribution and compare that to lithologies, climates and other environmental factors. The purpose of this paper is to stimulate interest, and provide and illustrate a terminology for field use.

Previous reports

Laudermilk & Woodford (1932) reviewed earlier work, provided detailed descriptions and a classification of microrills and did some experimental work on limestone slabs. More recent descriptions appear in Davies, 1957; Ford & Lundberg, 1987; Ginés, 2004 and Ford &Williams, 2007, p.323-4.

The global distribution of microkarren is varied, but most records are from dry climates – both hot and cold (e.g. Greenland, Davies, 1957). However, Ford & Lundberg (1987) described microrills from Vancouver Island in a rainfall of over 2500mm, but they were restricted to very fine grained limestones, and to bare surfaces in a supra-littoral setting where sea spray would have been a factor. The only published descriptions from Australia are from Chillagoe (Jennings, 1982; Dunkerley, 1983)

Theories of genesis generally involve solution by thin films of water (dew, sea-spray or light rain) with surface-tension effects (Ford & Lundberg, 1987). Some forms, e.g. micro-pits, may be polygenetic and not always associated with other types of microkarren.

Types of Microkarren

Angel Ginés (pers comm, 2005) suggests the following size divisions of karren:

Macrokarren: Large-sized karren – recognisable within a 10 m grid (pinnacles, giant grikes, etc).
Mesokarren: Normal-sized karren – recognisable within a 1m grid (rillenkarren, kamenitza, etc).
Microkarren: Small-sized karren – recognisable within a 1cm grid.
Nanokarren: Minute features – recognisable under magnification within a 1mm grid.

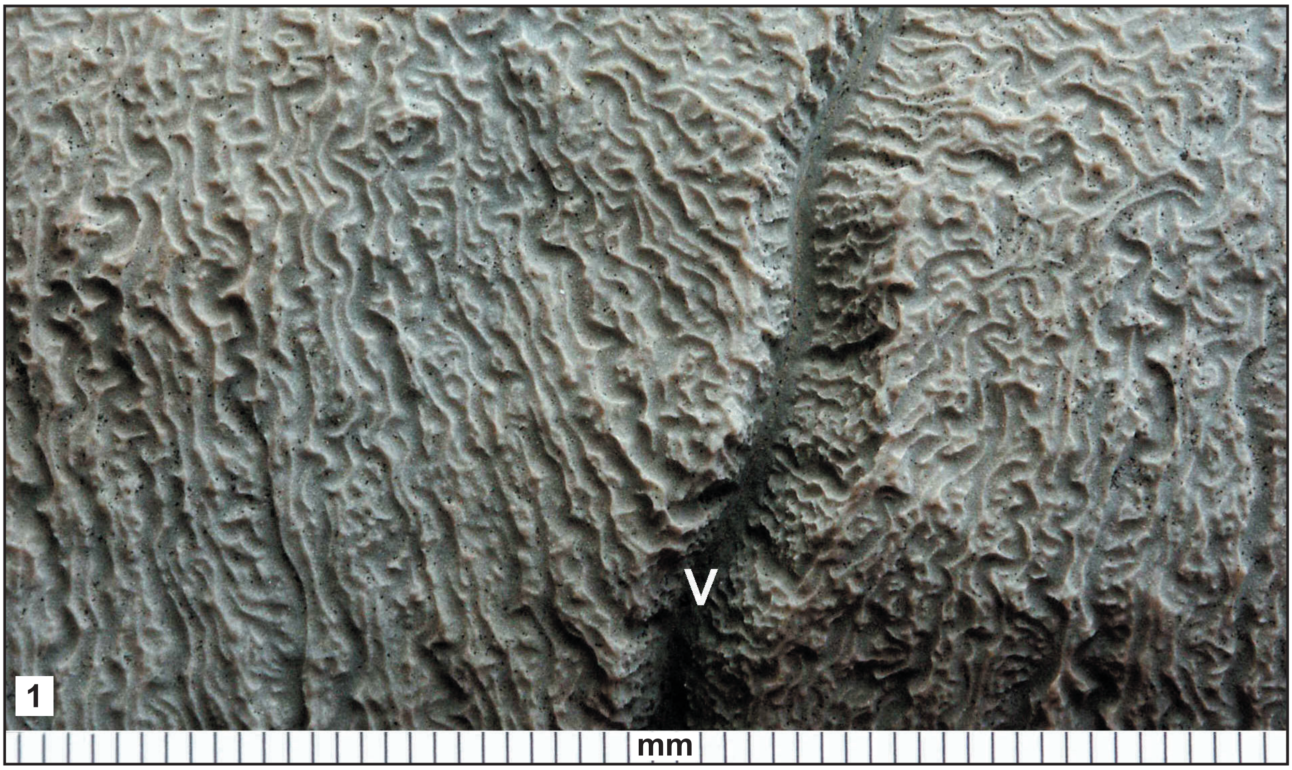
Laudermilk & Woodford (1932) described four types of Rillensteine (another name for the most conspicuous types of microkarren):

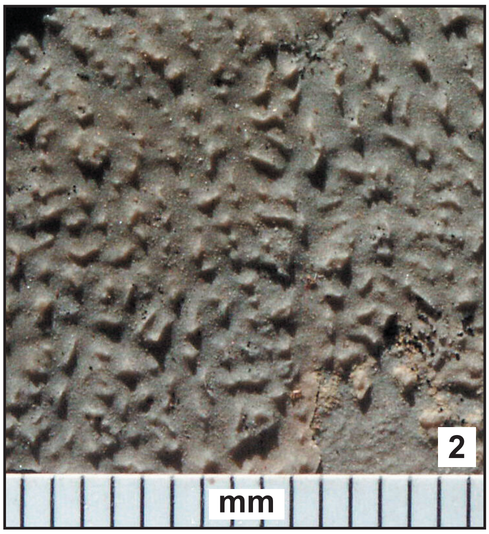
Type 1: low-sinuosity, shallow & mildly dendritic unpolished microrills,
Type 2: higher sinuosity and deeper rills.
Type 3: possibly corresponds to my micro-teeth & micro-networks?
Type 4: broader and shallow rills, smooth and frosted (but with patterns similar to types 1, 2 & 3).

However, I found that classification difficult to apply and there are many other types of microkarren not mentioned by Laudermilk & Woodford (1932). A broader descriptive classification is suggested below for use in field reporting. As we gather information this can be refined and possibly expanded.

Microrills: Narrow grooves, running down gentle slopes. Typically 1 mm wide, and less than 1 mm deep, and a few decimetres long (up to 60cm long in the Gregory Karst). They vary from straight, to sinuous to tightly meandering. There may be some branching, both contributory and distributary depending on whether the slope is spreading or focussing the rills. As the density of branching increases microrills grade to micro-networks (see below). The surfaces can be polished, dull or frosted. The ridges between the rills can be sharp or rounded, and some may be bleached.

There are (at least) two sub-types of rill: The most common type are regular in width, sharp-ridged, with parallel sides, and can be straight, sinuous or meandering (Photos 1 & 4). A less common type, mainly found on the gently domed surfaces of cobbles, is variable in width (fanning out and widening downslope) with either sharp





Photos

1: Sharp, moderately-branching, and sinuous to meandering microrills. Partly superimposed on a larger splitkarren notch (V)

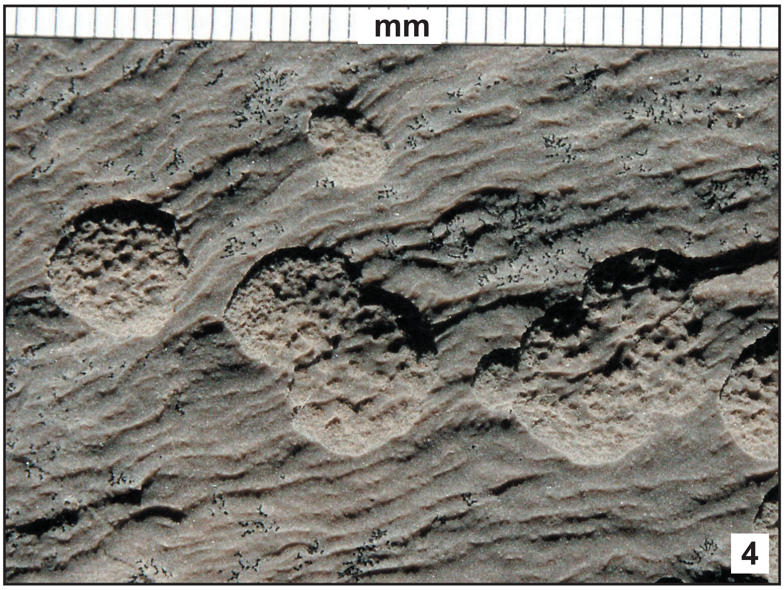
2: Rasp-like micro-teeth

3: Micro-tessellations cutting a field of micro-teeth.

4: Micro-pans superimposed on low-sinuosity microrills

5: A cobble with micro-pits on top (left) grading to variable-width microrills.

All specimens are from the Gregory Karst, NT.



or rounded ridges (Photo 5). These might correspond to Laudermilk & Woodford's type 4. Occasionally, microrills can be superimposed on rillenkarren and may modify their form.

Micro-networks: Are similar to microrills, but more densely branched to form an irregular or elongate network rather than long linear runs (see top corners of Photo 1). Laudermilk & Woodford's type 3 could include this type. With decreasing branching they grade to microrills. With increasing branching they may grade to micro-teeth.

Micro-teeth: In these the network of grooves has become so densely branched that the interfluves have been reduced to isolated sharp, rasp-like, conical or faceted teeth about 1 mm wide and less than 1mm high (Photo 2). At Buchan, some teeth were in rows that seemed to be forming by the breakup of the sharp crest between microrills into chains of elongated "hills", rather than as an extreme case of networks.

Micro-pits: Hemispherical to conical pits occur in a wide range of sizes from 1mm wide and deep up to 20 mm (i.e. to normal "rain-pits"). A broad range of sizes can occur within a single outcrop. Possibly there are several modes of formation for these and only some would be related to other microkarren. On gently-domed surfaces there is a tendency for micro-pits to occur on the crest and grade to microrills on the slopes (Photo 5).

Micro-pans: Shallow pits, 5-10 mm wide, but only 1-2 mm deep. They have flat to slightly concave floors with fine micro-pits or teeth. They are commonly superimposed as scattered clusters on other microkarren (Photo 4) – which suggests that they formed later. A possible, but unconfirmed, origin might be concentrated solution beneath pellets of wallaby dung.

Micro-notches: Irregular V-section notches that follow cracks in the rock (a micro- version of splitkarren). They have a broad range of sizes.

Micro-tessellation: Networks of U-section notches (Photo 3). They commonly disrupt other pre-existing microkarren and appear to be following a cracking or crazing pattern which is superficial, not deep as in joints. Shallow, barely recognisable, versions are also seen.

Micro-decantation rills: These run down the vertical sides of a cobble, becoming smaller as they descend – implying a loss of aggressiveness as they descend from their source at the top.

Etched rock structures: Various structures of fossils, crystals, joints, cracks or bedding may be etched out; negatively or positively and sharply or more rounded. These effects may be unrelated to other microkarren.

"*Solution-morel pebbles*": See Scott (1947). The name refers to their fungoid appearance. A deep pattern of anastomosing ridges, furrows and a few pinnacles. They are somewhat larger than typical microkarren, and microrills may be superimposed on them. They have not yet been reported in Australia.

Distribution in Australia (so far)

There is limited data at present – hence this request for observations. Well-developed microkarren have been recorded at four sites in tropical Australia (black dots on location map): at Chillagoe (Jennings, 1982; Dunkerley, 1983; Grimes, in prep), two separate parts of the Barkly Karst Region (R. Zollinger, pers comm; Grimes, in prep) and the Gregory Karst where they are particularly widespread (Grimes, in prep). In temperate Australia, so far, I have looked only at Buchan and Wee Jasper (open dots on map) where microkarren do occur but are less common and not as strongly developed – it took an hour of searching to find a few poorly-developed teeth and rills at Wee Jasper.

Microkarren seem most common on smooth, gently sloping, outcrops, including those recently exposed from beneath soil. They do not compete well with meso-karren, but have been seen superimposed on shallow rillenkarren.

Data Collection

Please contact the author if you wish to help search for and record these features, or if you see any in your travels. I can supply additional notes, photos and suggestions as to what features need to be noted. I can measure parameters such as sinuosity and branching from digital photos, so most useful would be photos (with a scale) of all types seen and an estimate of their relative abundance, together with notes on the setting, climate and limestone character.

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Thesis abstract

Cavernicole diversity and ecology in Tasmania

Arthur K Clarke, BSc

Extended Abstract
MSc Thesis, University of Tasmania, 2006

The five cave zone regions, ten macro-habitats and 44 micro-habitats for invertebrate species recorded from caves in two adjoining karst areas of southern Tasmania (Hastings and Ida Bay) are described. The information for these two karst areas is a sub-set of the 7,861 cave or karst area invertebrate occurrence records listed in six relationally linked tables together with 309 database queries or tabulations (contained in a Microsoft Access database) that documents collections and observations of 1,292 species from 749 occurrence sites in karst and non-karst cave areas of Tasmania. The cave related data and its content including a comprehensive micro-habitat site analysis and species taxonomy detail in a relational database is unique, making it the only cave fauna database of its kind in the world.

The database provides a historical account dating back to the early 1840s when glow-worms were first reported from caves in Tasmania; these are recorded along with accounts of the first cave spider and cave beetle species described in Australia. Together with anecdotal accounts from some of the early entomologists and naturalists who studied Tasmania's cave fauna, the significant role of modern day cave biologists is commended along with their contributions that have vastly expanded our knowledge base. The history of the study of cave biology is discussed, together with the development of cave fauna related ecological terms and theories or explanations for the colonisation of caves and evolution of troglomorphic characters in aquatic and terrestrial hypogean obligates. Following a brief introduction of geomorphic processes, the term "karst bio-space" is introduced to encompass the total living space for all hypogean species in the saturated or unsaturated karst and karst-like cavities, crevices and voids including caves. The concept of cave ecology is expanded to describe the five cave zone regions, ten macro-habitats and the 44 micro-habitats deployed in the detailed analysis of habitat data for species in the Hastings and Ida Bay karst areas. A comprehensive explanation of the database fields is provided, along with guidelines for operating the database and constructing queries to answer questions related to the diversity and ecology of Tasmanian cave species.

Incorporating the most up to date and current taxonomy for cave species in Tasmania, this thesis provides a detailed overview of the diversity of the most common groups of cave dwelling invertebrates and the first records of new species not previously recorded in the speleological or cave biology literature. The major species groups discussed include glow-worms, cave crickets, land snails, springtails, multipedes (centipedes, millipedes, symphylans, pauropods and onychophorans), aquatic and terrestrial amphipods and isopods, bathynellacean and anaspidacean syncarids, aquatic snails, cave beetles and the arachnids (ticks, mites, pseudoscorpions, harvestmen and spiders).

In addition to factors related to cave morphology and hydrological influences (stream recharge or input etc.), the two predominant factors influencing the distribution of invertebrate species are the intensity of karst bio-space development and the input of organic matter, its re-distribution and dilution as it is transported further into the subterranean domain. In most of the wild caves at Ida Bay, this organic material is naturally derived, but at Hastings where tourist caves have been developed, much of the organic matter has been introduced to the cave. The source of organic input in tourist caves is varied and includes the artificial introduction of exotics in the form of tree trunks, rough sawn timber and other plant matter used in the construction of stairs and fern log pathways, plus the litter "inadvertently" placed in caves by natural processes, carried in by humans or dumped as refuse in the course of the continuing development of caves for tourism.

Aside from organic input, the survival and distribution of cave species is dependent on a range of factors including the presence or absence of surface disturbance and the impacts of human use of caves or other components of the karst bio-space, including groundwater. Within the karst bio-space itself, there are the complexities of inter-relationships of species and predator-prey relationships within the subterranean food chain, together with the presence of cave bacteria and other micro-organisms found deep within the dark zone of caves; the dependence of cave species on these micro-organisms has not been studied here in Tasmania. A proportion of the cave species are obligates, totally dependent on the cave for survival and some of these species are cave adapted (troglobites or stygobites). The number of cave adapted species in Tasmanian caves generally exceeds the numbers found in most areas of mainland Australia and five caves in the study area at Hastings and Ida Bay are rated as being at world standard in the number of obligate species.

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

The following examples illustrate the style:

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

Vandel, A., 1965: *Biospeleology. The Biology of the Cavernicolous Animals.* Pergamon, London. 524 pp.

Wigley, T.M.L. & Wood, I.D., 1967: Meteorology of the Nullarbor Plain Caves. *In:* J.R. Dunkley and T.M.L. Wigley (eds), *Caves of the Nullarbor. A Review of Speleological Investigations in the Nullarbor Plain. Southern Australia*: 32-34. Speleological Research Council, Sydney.

Illustrations

For papers that have a geographical location we will provide a small location map in a standardised style (typically a map of Australia with a dot, rectangle or arrow—see recent issues for examples). Figures and photographs should not duplicate information in tables or other material. Photographs should be relevant to the text, with sharp focus.

Figures and photos should be numbered in a single sequence and specifically referred to in the text. All illustrations should be designed to fit within a full page print area of 170 x 258 mm and ideally should be a column width (80 mm) or double-column width (170 mm). Captions should be typed on a separate sheet (or supplied at the end of the text file).

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