THE COPPERMINE SYSTEM, YARRANGOBILLY, NSW

ANDREW PAVEY* and ALAN WARILD†
University of New South Wales Speleological Society and Yarrangobilly Research Group

Abstract

The Coppermine drainage area is defined as the area contributing to the resurgence at Coppermine Cave; the caves within this area are listed and briefly described. The history of cave exploration is given followed by a brief description of the geology and hydrology of the area and a proposed account of the sequence of cave development. Cave conservation activities and future work are briefly discussed.

Introduction

The Coppermine system is the most northerly of the distinct drainage basins at Yarrangobilly, in the Snowy Mountains of southern New South Wales.

The caves are reported to have been discovered in the 1830's. By the 1890's, if not considerably earlier, several caves in the Coppermine system had been entered. The Coppermine system comprises four major stream sinks and their imputed common resurgence at Coppermine Cave plus other associated caves in the drainage basin. Coppermine Cave has been mentioned in the historical literature and Bath House Cave (as a type example of a streamsink in a blind valley) in the academic literature but the remainder of the caves are known only in the speleological literature.

This paper is an attempt to briefly summarise the known information on the Coppermine system and attempts to define the problems yet to be resolved.

Watershed

We have defined the limits of the coppermine system in terms of its assumed watershed (Fig. 1). The four Coppermine Creeks rise on the high ground of the Fiery Range to the east of the limestone belt and all sink in the limestone within a short distance of the limestone/shale contact.

The southern boundary of the system is the ridge north of Traverse Creek. The closer the ridge approaches the Yarrangobilly River to the west the less certain we can be about the position of the watershed. For this paper we have assumed the watershed intersects the River south of the bluffs around (Y13) Tricketts Cave, although it is unlikely that water falling in this area close to the River actually resurges at (Y12) Coppermine Cave. Following the water tracing experiments of Jennings and others of October 1976 (page this volume) it is unlikely that Traverse Creek feeds Coppermine Cave while it is known that (Y8) Bath House Cave does feed Coppermine Cave (Jennings and Anderson 1966).

Drainage from the dry valley west of Bath House Cave could go to Coppermine Cave, directly to the Yarrangobilly River or to Bubbling Spring.

The boundary of the Coppermine system then follows the eastern bank of the River north to Coppermine Cave itself and follows the eastern bank of Wombat Creek to the vicinity of Y64. On the grounds that Y64, 34, 36, and 37 may well be associated with the development of Coppermine Cave we have taken the boundary north to the nearby hill, thence around the ill-defined "headwaters" of Wombat Creek and up the ridge north of Y45 to the high country again.

The Caves

At least 25 caves are located within the watershed of the Coppermine system. Of these, only (Y8) Bath House Cave, (Y9) Innstable Cave, (Y10) Old Inn Cave and Y45 (which is a streamsink and not

* 45 Arcadia Road, Glebe, NSW 2037

† Bermagui Road, Cobargo, NSW 2547

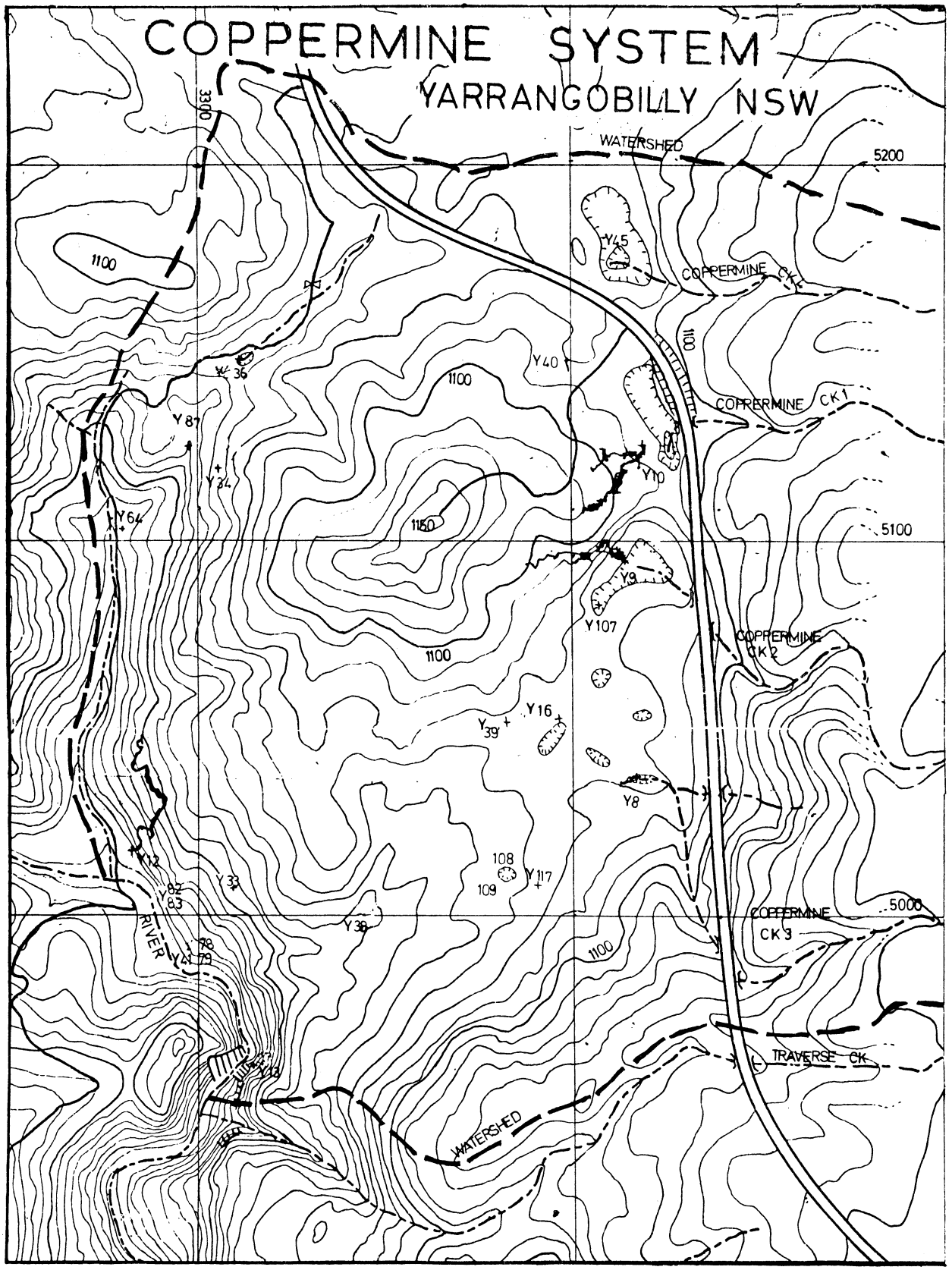

Fig. 1. The Coppermine catchment; Yarrangobilly, NSW (Base map by YRG, 1976, contour interval 10 m, 1 km grid).

a cave) are considered to be important streamsinks. (Y17) Pitch Pot and (Y36) Upper Wombat Creek Cave both lack permanent streams, however, they do show evidence of taking water in flood.

Coppermine Cave is the main resurgence and collects water from Y45 (Pavey 1975b), Bath House Cave, and presumably from Innstable and Old Inn Caves as well. Y64 is a small intermittent spring which probably represents only very localised groundwater flow.

(Y8) *Bath House Cave*
Length approx. 200 m, depth 53 m, first surveyed 1966, resurveyed 1976 by University of New South Wales Speleological Society (UNSWSS), (Warild 1976b).

It is a steeply descending and quite sporting streamway with several waterfalls. There is one 5 m pitch in a waterfall, or a dry bypass which has a 9 m pitch. The lower reaches contain brachiopod fossils, and plenty of mud. This small, tight cave ends as a squeeze into a sump. There are about 70 m of passages above the present streamway.

(Y9) *Innstable Cave*
Length 1005 m, depth 58 m, surveyed by UNSWSS 1976; published in *Spar 62.*

A fairly complex stream cave with a rockfall entrance. The active streamway is quite steep, and ends in a sump after a complex route which includes a bypass, climbs, 7 m pitch and sporting wet squeezes. Much of the length is gained by a long, straight, abandoned stream passage which eventually becomes tight at the cave's lowest point (some 6 m lower than the sump and a considerable distance from it). There are practically no speleothems in the entire cave although a large "erratic" block of old stalactite boss in the passage just before Tea Junction seems to indicate that there was decoration, or still is – but nothing yet has been found).

(Y10) *Old Inn Cave*
Length 1017 m, depth 71 m (47 m from sink to sump). Recent survey by UNSWSS to be published in *Spar,* earlier maps published in *Spar 21* and *42.*

Old Inn Cave is fairly complex. The stream sinks in an intermittent sump, after flowing for 80 m through large boulders and a joint controlled rift. Much of the cave's length is gained in two upper levels which are well endowed with speleothems. The highest level is a long abandoned high canyon with two large chambers, which ends in a massive rockfall of what appears to be basalt boulders. Slightly lower, the second upper level leads via a well decorated chamber (Strawhaven) back to the present streamway. The connection is made via either a loose 18 m pitch or an exceptionally muddy rift. The streamway then becomes very similar to those of Bath House and Innstable Caves until the final sump is reached where the stream sinks into gravel. An overflow passage leads on through a very muddy section and some squeezes to terminate in an almost impenetrable sandy floored squeeze The extra 24 m of depth is gained from the higher Y187 and Y188 entrances to the cave.

(Y12) *Coppermine Cave*
Length more than 450 m, surveyed 1974-76 by UNSWSS (to be published in Spar), best other maps; *Spar 21* and CAVCONACT Guidebook.

Coppermine Cave is a large walkthrough cave containing the resurging Coppermine Creek. Past the sump where the waters resurge there is a well decorated upper level, with some vandalism, and a tight squeeze (now gated) leading on to a rocky, muddy cavern and then to water again. A rift with a howling draft beckons. Throughout its length the cave has a low gradient.

There are five other moderate sized caves in the Coppermine system.

(Y16) *Helictite Hole*
A 15 m tube leads to small rooms and some decoration. Map by Sydney Speleological Society (SSS) (Wellings 1975)

(Y17) *Pitch Pot*
Length 50 m, depth 28 m, map by SSS (Walker and Ellis 1976)

This cave takes a fair amount of water in flood. It starts as a dipping solution tube 16 m long and then expands into a large rockpile cavern and lower down into a tall narrow, intermittent streamway which terminates in a gravel sump.

(Y33) *Mooroolbark Cave*
Length 130 m, depth 15 m, map by SSS (Wellings et al 1976)

A 9.5m pitch leads to a well decorated and very muddy horizontal passage.

(Y34)
Length approx. 200 m, depth more than 30 m, survey in progress UNSWSS

A 12 m pitch leads to muddy tunnels on two levels. The lowest part of the cave terminates in an unusual 'sink hole' in flowstone. A second entrance has been reported.

(Y40)
Depth 78 m, map by UNSWSS and SSS.

A very steeply descending pothole north of Y10. It contains a number of climbs and pitches and is rather tight and sporting. The cave ends in a gravel sump where some hopeful digging has been done without much likelihood of success.

The remaining caves are very small.

(Y36) *Upper Wombat Creek Cave*
Length 35 m, depth 9 m, map by Canberra Speleological Society (CSS)

A large earth walled doline leads to a number of muddy chambers with little hope of extension.

(Y37)
An old swallet of Wombat Creek, short crawls leads to a mud blockage. (Rose 1964)

(Y38)
A shaft 12 m deep leading to a clay blockage (Rose 1964)

(Y39)
A 13 m deep clay filled shaft, blocked by formation (Rose 1964)

(Y41)
A small pit about 50 m above Coppermine Cave, very hard to find (Rose 1964)

(Y78)
A small mud floored chamber with a tight passage leading off (Brush 1973)

(Y79)
A 3 m drop leads to an elongated chamber with holes which lead to 6 m of lower passage (Brush 1973)

(Y82)
A small cave about 7 m long (Middleton 1974)

(Y83)
A small cave about 15 m long (Middleton 1974)

(Y84) *Undernover Cave*
A high arch entrance with a 3 m long upper level and a 30 m long lower level (Middleton 1974)

(Y107)
Cave about 10 m long. (Wellings et al 1976)

(Y109)
A 10 m deep dig near 108 (Wellings et al 1976)

History

Rose (1964) suggests that Coppermine Cave was known in the mid 1800's and visited frequently by parties from the show caves at the other end of the limestone belt. Certainly a number of caves were discovered at the southern end of the limestone belt in the 1800's. Yarrangobilly Village was well established by the turn of the century and the coach road from Tumut to Kiandra must have been used well before this period giving access to the area around Coppermine generally.

Oliver Trickett (1898) reported extensive vandalism in the cave prior to 1897. Trickett says (in part)

> ". . . Following the underground stream up from its exit for 500 feet, wading through icy cold water on the way in places, and then rising about 30 feet, the remains of what has been a magnificently ornamented cave is reached, about 300 feet long as far as has been explored. Axes, crowbars, chisels and cartridges, have been used to demolish or remove the beautiful formations in this part of the cave."

Later Trickett (1917) was able to report that due to the difficulty of protecting the cave from mutilation, the attractive chambers had been closed with iron bars set in cement. Little of this barrier remains today. In the area of the climb scattered pieces of rotten wood and iron bars are occasionally encountered.

The inlet caves (Y8, 9, 10, 45) are located near the highway and not far from the location of the former "Yarrangobilly Hotel" (Trickett 1897). Trickett reported

> "The water descends rapidly after passing though these openings by channels which may be followed for some distance."

Rose (1964) reports signatures from 1891 in an extremity of Y10 but these have not been sighted by the authors.

There is little available historical record between Trickett's accounts and the first visits by members of the Sydney University Speleological Society (SUSS) in the early 1950's. SUSS members visited Coppermine Cave and descended Bath House Cave. The first recorded visit to Bath House Cave (according to Rose 1964) was in 1956 although it may have been descended in 1950-51.

Rose, Cherry, Ballard and Myers were active in the late 1950's to early 1960's and recorded some of their trips in the 'Yarrangobilly Caves Speleological Investigation Log Book No. 1' (Currently held at the Information Centre at Yarrangobilly). Rose started the cave numbering system at Yarrangobilly. The first entries in the Log are the discoveries of Y34 and 39 in November 1959.

Myers and Rose found Y16 in 1958 and Y17 in January 1960; the entrance having only recently appeared in the side of a sink. At the same time Y8 entrance was reported as having fallen in and almost buried the number.

In 1960 a party under R.A. Batchelor explored Old Inn Cave to the Strawhaven area and reported the fissures beyond as not going and of little potential. An arrow marked 'out 1891' was found nearby. According to this report Strawhaven had been first entered in 1957.

In 1962 D. Purchase lead a CSS party which broke through into the streamway again and followed it downstream for 50 feet stopping at a narrow crevice. In March 1962 a CSS party under V. Pickering discovered the Lofty Chamber/Rimstone Cavern upper level. A later trip established a connection from Strawhaven to the first sump and this has recently been refound by an UNSWSS party.

On his departure from Yarrangobilly in 1963 Paul Rose commented that the surface at Yarrangobilly hadn't yet been scratched and he was quite right. At that time the numbering had reached slightly more than 40 caves, at the date of writing this paper the number was over 190.

Y40 was greatly extended from the simple 12 m shaft known to Rose, to 78 m deep by an SSS digging party (Smith 1968).

(Y9) Innstable Cave was for many years known as 'around 600 feet of loose rockfall with a stream flowing through it'. Ballard, Cherry and Rose made a 100 foot extension to an area where progress was regarded as sheer folly. We now think this was directly below Portable Chamber. Rose

(1964) stated "All attempts to find a higher level bypass have so far failed but there is no conclusive evidence that one does not exist".

Matthew and Pavey (1974) from UNSWSS found a higher level abandoned stream canyon leading up and on from Culvert Junction to Tea Junction, Hoover Passage, Portable Chamber and Pricker Passage – an estimated length of 345 m of new passage. Further small extensions in this area followed (Pavey 1975) and then Warild et al. (Pavey 1976) discovered the Northernmost Passage which provides a dry route virtually to Portable Chamber. These discoveries pushed the known length of the cave to over 1000 m of passage in the space of 18 months.

Bath House Cave, perhaps the most sporting of the three major inlets has the smallest amount of passage, with only a short abandoned higher level discovered in 1976 (Warild 1976)*. There are good chances of further discoveries.

Geology

The geological structure at Yarrangobilly has not been well studied and we present only a brief outline. The Silurian Yarrangobilly Caves Limestone strikes approximately north-south and dips to the west. On the eastern margin there is a bed of shale separating the limestone from the underlying Goobarragandra Volcanics (porphyries and others) which form the high ground of the Fiery Range to the east. Above the limestone, outcropping on its western margin is another shale unit. The dip in the limestone varies from 70°W on the eastern margin to 30°W on the western margin.

The limestone outcrop in the Coppermine drainage area varies from just over 1 km wide at the northern boundary to 1.5 km in the central section (between Y8 and 12) and necks to approximately 0.5 km wide at Traverse Creek on the southern boundary.

The limestone is capped on Gravel Hill by some Tertiary gravels and by remnants of a Tertiary basalt flow which originally filled the early Yarrangobilly River valley (Nicoll pers. comm.)

Hydrology

The general consensus is that the water which sinks in Y8, 9, 10 and 45 resurges in Y12. Trickett (1897) and Rose (1964) have both recorded this opinion. However, no practical tests are reported before 1966.

On the 15th May, 1966 a party from CSS placed approximately 2 kg of fluorescein in the stream outside Bath House Cave which was flowing at about 0.1 cusec at that time. The colour was observed to be still entering the cave at 4.15pm on the 19th May, while colour was first detected emerging from Coppermine Cave at noon on 22nd May. This gives a time of somewhere between 4 days, 17 hours and 50 minutes and 6 days 18 hours for the underground flow between Y8 and Y12 (Jennings and Anderson 1966).

Wellings (1972) describes placing a quantity of dye into Y45 and charcoal bags into Y12 and elsewhere in April 1971. The bags were collected two days later when there was no sign of colour in the stream in Y12. Only a modest flow of water was entering Y45. There was no written report of the success of this test but apparently it was successful (Wellings pers. comm.) in proving a connection to Y12. In light of the questions raised about the efficiency of detecting fluorescein with silent watchers at Yarrangobilly due to the high background fluorescence (Spate et al page 104 this volume) this positive result must be considered to be in doubt. This argument does not hold for the Y8 to Y12 test as the colour was positively identified.

Pavey and Shannon (1974) describe a 2 kg fluorescein water tracing test from Y112 (Leak in the Creek, 3 km along the strike to the north where the Yarrangobilly River crosses the limestone.) which showed positive results at Y12 and also Bubbling Spring and Hollin Cave (Y46) (both to the south of the Coppermine drainage area). The positive result in Y46 was recorded after 6 days and that from Bubbling Spring after 30 days (Pavey 1975). This result is also in doubt due to the method of detection.

The Y8 and Y45 tests to Y12 would indicate a simple dendritic system, confirming the generally held view that the water which falls on what we have called the Coppermine drainage area drains through to resurge in Coppermine Cave. Clearly more testing with unambiguous results is required before we can positively assert that the water sinking in Y8, 9, 10 and 45 does resurge at Y12.

Just how many of the other caves in the Coppermine drainage actually feed water to Y12 rather

* During the preparation of this paper for publication we were told of a short 50 m upper level discovered by members of UNSWSS at Easter 1977

than to, say, Bubbling Spring will be difficult to establish. The majority take little water, even in flood whilst those that do take sufficient quantities of flood water may well be so choked with gravel, debris and sand as to make dye or spore tracing unreliable.

The further possibility of water from Leak in the Creek flowing under the Coppermine drainage net and resurging at Bubbling Spring clearly needs further investigation following the failure by Jennings et al. to repeat the initial test of Pavey and Shannon (1974). Recent work of diverting water into Leak in the Creek and digging nearby has produced flows of between 1 and 2 cusecs for considerable periods. This water sinks in Y112 and we have no confirmation of where it resurges*.

Speleochronology

Little work has been done on speleochronology in the area and the following is mainly speculation.

The Yarrangobilly River is thought to have had a shallow valley when the Tertiary basalt flows occurred. The basalt flow may well have sealed off the limestone sufficiently for a dendritic pattern of drainage to become solidly established. This pattern remained for a considerable period after the erosion level again reached the limestone. This resulted in the shallow broad valleys of the upper section of Wombat Creek and the now dry valley between Y8 and 9 and the River.

Stream capture through the limestone occurred as the River's base level reduced sufficiently for the water to take the easier course underground. Stream capture forming caves Y8, 9, 10 and 45 may not have taken place sequentially as the current entrances are remarkably similar in altitude. It could equally be argued that stream capture took place sequentially up the dry valley leaving successive cave remnants some of which we now see as Y16, 38, 39, 107, 108 and 109. Certainly the chain of dry channels and sinks to the west of Y8 would indicate some successive capture.

The caves themselves show evidence of successive internal stream captures; for example Rimstone Cavern in Y10 and Pricker Passage in Y9 have been abandoned in favour of the present streamways.

Y45 and Y10 have larger dolines than Y8 and Y9 and perhaps they were captured earlier in the sequence, being at that time slightly higher and due to the differential rate of erosion due to varying stream flow they have lowered at much the same rate as Y8 and Y9. The streamsinks today are at 1050 $\pm$ 5 m.

We have yet to enter cave in Y45 and are probably only seeing part of Y8 at present. The older passages in Y9 and Y10 head more directly west towards the River and with a lot lower gradient than the present streams which tend to the south-west around (but well under) Gravel Hill. No obvious earlier resurgences for the higher level passages exist although Coppermine Cave does have a well developed upper level approximately 5 m above the present stream level.

Y40 has the highest entrance in the area (1082 m) and is the deepest cave (78 m) presumably it has been formed by the stream from the gully where it is located. It follows the strike to the south towards Y10.

Y34 and Y33 probably represent an earlier level of cave which captured the headwaters of Wombat Creek before the period of rapid downcutting commenced. Y36 and Y37 may well have been prior sinks for Coppermine Number 4/Wombat Creek before the sink at Y45 developed.

Coppermine Cave's stream appears to emerge in the most part from the sump approximately halfway into the cave. The pools beyond this point although not much different in level from the flowing stream appear to be either a backwater or to be fed by much lower flow stream coming from the Y34, Y36 area.

Structural Control

A notable feature of Y8, 9 and 10 is the jumbled pile of boulders (rockpile) near their entrances. The size and frequency of these rockpiles is almost unique to Yarrangobilly on the Australian mainland at least. Rose (1964) suggests that these have been formed by the cave streams undermining limestone cliffs and causing large blocks to break away on dip joints. Certainly in Y10 there are at least six large chambers aligned north-south with dip slope roofs and rubble or soil floors, although this feature is not present in Y8 and Y9. Once past the entrance in Y8 and Y9 the cave form is basically streamway, with some minor collapse features present.

* Flow measurements made on a post conference field trip by Shannon (1977) seem to indicate that the Leak in the Creek water is flowing past the Coppermine system and resurging further downstream at Bubbling Spring.

The current lowest section of streamway in Y10 is a jumble of mud coated boulders with little evidence of substantial passage in bedrock. This in contradistinction to the abandoned upper levels which have formed substantial canyons in bedrock.

Coppermine Cave shows distinctive alignment along the strike of the beds throughout its length.

Speleothems

In the main part there is very little speleothem development in the caves of the Coppermine drainage area. The notable exceptions are Y33 and the upper levels of Y10 and Y12. It may be these are the two oldest caves and hence the best decorated but that does not explain the relative lack of speleothems in Y8, 9 and 34 which by the above discussion are probably contemporaneous.

Conservation

"I have the honour to report on the mutilation of the Copper Mine Cave, Yarrangobilly" (Trickett 1897) – so starts the first report of vandalism in the area and of the attempts to stop it. Not long after this report a gate was placed on the entrance to the Coppermine Cave upper level. It was, however, easily bypassed and being made in part of wood, soon rotted away. Thus for many years the upper levels of the cave were prey to wandering vandals. After some considerable pressuring from Australian Speleological Federation (ASF) members over the preceeding 10 years a substantial gate was finally placed on the upper level, but this time at the squeeze some two-thirds of the way along the upper level. This site is much better as the squeeze was originally chipped out and is quite tight. It quite effectively keeps out unwanted visitors but protects only a small proportion of the cave. No other caves in the Coppermine area have been gated.

The passage beyond Lofty Chamber in Y10 is well decorated and delicate and could be easily trampled out of existence. A gate would be out of the question in this section due to the tall narrow passage shape, but by common agreement we are hoping to keep purely 'tourist' parties out of this section. Some track marking and signs have been erected to this end.

The remainder of the caves and their passages do not need this sort of protection. For the most part they could do with some keen explorers who might well find some decorated sections. The only exception is Y33 which is well decorated and extremely muddy. Any party in here could do extensive, albeit unwitting, damage. The cave has a measure of natural protection in that it has a difificult-to-locate entrance, and is one of the few caves in the area which requires a ladder for entry.

Conclusions

There is still a lot of cave to be found in the Coppermine drainage area. Considerably more exploration needs to be undertaken especially in Y8 and Y9. The hopes of finding a 'master' cave leading from the inlets to Coppermine Cave should not be totally dismissed. There is still a good kilometre of limestone between the known furthest reaches of Y8, 9 and 10 and Coppermine Cave.

Further work is required in geological mapping and water tracing to establish more precisely the extent of the limestone and the area which feeds water to the resurgence in Coppermine Cave.

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References

BRUSH, J. (1973) (Map of) Y78 and Y79 (with description) *Speleograffiti 10*(3):41
MIDDLETON, G. (1974) Surveying and Exploration at Yarrangobilly *J. Syd. Speleol. Soc. 18*(5):114-115
NICOLL, R.S. (1975) Upper Wombat Creek Cave – Y36 *The Very Latest* 7(3):12-14
PAVEY, A. (1974) Easter at Yarrangobilly *Spar 34:*6-9
(1975a) The Exploration and Surveying of Innstable Cave (Y9) *Spar 43:*6-9
(1975b) A History of Water Tracing Attempts at Yarrangobilly *Spar 44:*5-9
(1976) Easter 1976 – More Discoveries at Yarrangobilly *Spar 55:*3-6
PAVEY A. and SHANNON, H. (1974) Water Tracing Results – Yarrangobilly *Spar 33:*18-19
ROSE, P.V. (1964) An Introduction to the Yarrangobilly Caves, New South Wales, Australia, Part I *Cave Sciences 5* (36):203-216
SHANNON, H. (1977) Post-Conference Field Trips *Down Under 16*(1):14-15
SMITH, G. (1968) Easter 12-15 April Yarrangobilly Caves *Stop Press 12*(7):110-111
(1969) Yarrangobilly, 25-27th January, 1969 *Stop Press 13*(2):16
TRICKETT, O. (1898) *NSW Dept. Mines Ann. Rpt. 1897,* p. 207
(1917) *Guide to the Limestone Caverns of New South Wales, Jenolan, Wombeyan and Yarrangobilly* Immigration and Tourist Bureau, Sydney, pp27-28
WALKER, M. and ELLIS, R. (1976) Some Notes on Pitch Pot (Y17) Yarrangobilly *J. Syd. Speleol. Soc. 20*(3):71-74
WARILD, A. (1976a) A New Year at Yarrangobilly *Spar 52:*12-16
(1976b) Cave Description Bath House Cave (Y8), Yarrangobilly, New South Wales *Spar 52:*16-18
WELLINGS, P. (1975) Mapping, Water Tracing and Tagging at Yarrangobilly *J. Sydney Speleol. Soc. 19*(9):224
WELLINGS, P., ELLIS, R., HALBERT, E., WALKER, M., (1976) Yarrangobilly Status Rreport on Tagging, March 1976 *J. Syd. Speleol.*