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# BULLETIN of the Sydney University Speleological Society

Lumen in Tenebris
SUSS
FOUNDED 1948

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Box 35, Holme Building, University of Sydney, N.S.W. 2006

Annual Subscription $ 4

## On The Performance of a Titanium Brake Bar

Mike Lake

Commercially available brake bars today are constructed from either tubular steel or solid aluminium Rod. The low heat capacity of steel means that greater surface area is required to dissipate heat generated by friction : hence the use of tubular steel over a solid steel rod.

Aluminium has a higher heat capacity and is considerably lighter compared to steel. However, steel has better abrasion resistance on muddy ropes.

A titanium brake bar was constructed for use on doubled ropes and tested to destruction. The carabiner for which the brake bar was designed was a steel Bonaiti rated at 4000 kg along the major axis and 1000 kg along the minor axis. The Titanium tube used had an outside diameter of 25.4 mm, a wall thickness of 1.6 mm and a length of 9.0 cm.

During the construction process a slip was made with the diamond saw which resulted in a 2 mm long cut in the titanium at the end of the slot. The implications of this will be considered later. On a 4 metre drop the Titanium brake bar gave a smooth abseil on a doubled rope. I deemed it wise to destruction test the brake bar in the laboratory rather than test it on an actual pitch of substantial length. Consequently no measurements on the temperature rise of the brake bar were taken. The thermal behaviour relative to aluminium and steel bars, however, can be obtained from a comparison of the specific heat capacities and masses of the bars:

| Metal | Density | Specific Heat Capacity |
|---|---|---|
| | $gm\,cm^{-3}$ | $J\,K^{-1}\,gm^{-1}$ |
| Aluminium | 2.70 | 0.90 |
| Iron | 7.86 | 0.45 |
| Titanium | 4.50 | 0.53 |

The specific heat capacity of a material is the quantity of heat required to raise the temperature of a one gram mass one degree.

For aluminium, 0.9 Joules of heat are required to accomplish this. Now a typical aluminium brake bar has a mass in the order of 50 grams. Consequently the quantity of heat required to raise the temperature of a 50 gm aluminium bar one degree is

$$0.9\ JK^{-1}gm^{-1} \times 50gm \times 1\,^{\circ}c = 45\ Joules.$$

A steel brake bar however, like a Stubai 9300 Piton, has a mass in the order of 100 grams. Therefore although its specific heat capacity is only one half that of aluminium because its mass is approximately twice as great, the quantity of heat required to raise its temperature one degree is approximately the same:

$$0.45\ JK^{-1}gm^{-1} \times 100gm \times 1\,^{\circ}c = 45\ Joules.$$

Aluminium and steel brake bars thus possess similar thermal behaviour.

The titanium brake bar I made had a mass around 45 grams. Consequently the heat required to raise its temperature one degree was approximately

$$0.53\ JK^{-1}gm^{-1} \times 45\ gm \times 1\,^{\circ}c \doteq 24\ Joules.$$

<u>Obviously then for the same heat input a titanium brake bar will increase in temperature nearly twice as much as an aluminium or steel brake bar.</u>

Does titanium therefore offer any advantages over conventional descender materials ?

Titanium would have superior abrasion resistance on muddy ropes over aluminium or steel; however this must be weighed up against its poor thermal behaviour.

Destruction testing of the titanium brake bar was achieved with the brake bar and carabiner on a doubled 8mm Speleostatic rope, the tension of which was increased using a tensometer. Failure occured at the slot where it splayed open at 12,600 newtons. This force is equivalent to a weight of 1260 kilograms or a little less than 1 -1/4 tonne.

The CRC handbook of physics and chemistry states

> " Titanium is as strong as steel but 45 % lighter, it is 60 % heavier than aluminium but twice as strong."

Consequently the brake bar is adequately safe for abseiling with a safety factor of at least 10 over body weight. Indeed care in constructing the slot so that it rests snugly over the carabiner could easily increase the force required to break it to 13,000 N.

In conclusion a titanium brake bar possesses considerable strength and excellent abrasion resistance but has poor thermal properties, and consequently its use should be restricted to small pitches where overheating is within acceptable limits.

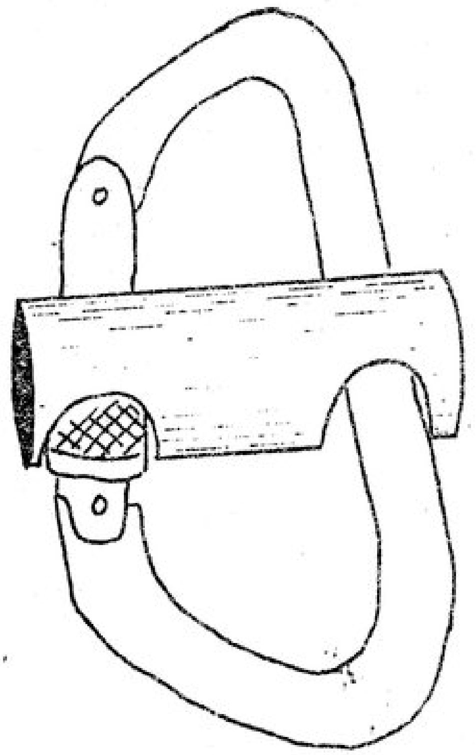
Note:

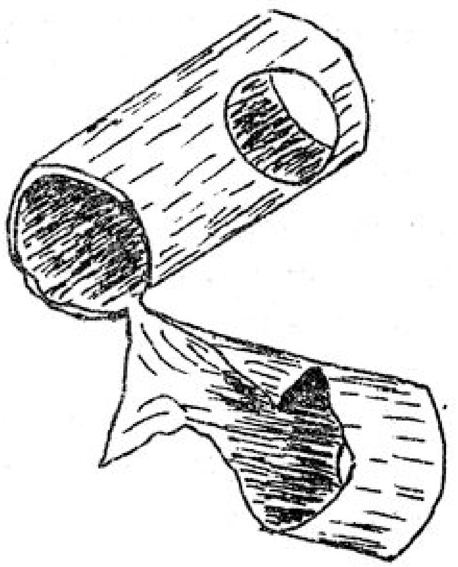
Certain assumptions which are implicit in the simplified argument on thermal behaviour may be unrealistic under actual abseiling conditions.

Michael Lake

References


1. Aylward & Findlay, S.I. Chemical Data
2. R.C. Weast, Ed. CRC Handbook of Chemistry & Physics, 57th Edn, 1977



LEFT : The brake bar in position on a steel krab.
RIGHT : Sketch of the bar after failure at 12.6 kN.

## SYDNEY UNIVERSITY SPELEOLOGICAL SOCIETY

### Financial Statement 16/1/1979 to 29/2/1980

| | | $ | $ |
|---|---|---|---|
| Opening Balance a/c 901-001 | | | 329.68 |
| RECEIPTS | | | |
| Membership: | Full | 156.00 | |
| | Associate | 35.00 | |
| | Family | 27.00 | |
| | Corresponding | 20.00 | |
| | Prospective | 147.00 | |
| | | | 385.00 |
| Loan from Pubilcation Fund | | | 167.50 |
| Sales of Stock (badges etc.) | | | 28.50 |
| Interest on a/c 901-001 | | | 10.79 |
| TOTAL | | | 921.47 |
| PAYMENTS | | | |
| Bulletin: | Paper | 106.30 | |
| | Postage | 61.67 | 167.97 |
| Subscriptions: | A.S.F. 1978, 1979 & 1980 | 318.50 | |
| | Helictite | 22.00 | |
| | N.S.W. Speleo Council | 10.00 | 350.50 |
| Purchase of spray packs | | | 224.00 |
| Administration | | | 25.10 |
| Spider Cave gate | | | 20.00 |
| Closing Balance a/c 901-001 (incl. unpresented cheques) | | | 133.90 |
| TOTAL | | | 921.47 |

### IAN CARPENTER EQUIPMENT FUND

| | | | |
|---|---|---|---|
| Opening Balance a/c 903-904 | | | 47.26 |
| Plus: | Trip Fees | 52.50 | |
| | Interest | 3.21 | 55.71 |
| Less: | Administration | | 3.00 |
| Closing Balance a/c 903-904 | | | 99.97 |

P.J. Winglee
Treasurer

I have examined the books and vouchers of the Society for the period 16 January 1979 to 29 February 1980. Having regard to the explanation given, I am of the opinion that the statement is a correct record of the Society's transactions as contained in the books.

G. J. Foo
A.A.S.A.

## Analysis for Fluorescein Dye

Fluorescein is readily adsorbed on activated charcoal, and visual tests of the elutriated solution can be made. The suitability of fluorescein for visual tests is one of the primary reasons we recommend this dye for groundwater tracing work. The analysis of the packets is conducted as follows:

1. Empty contents of the activated charcoal packet to be tested into a baby food jar or other similar small glass container which can be sealed.

2. Cover the charcoal with a 5% solution of potassium hydroxide (KOH) in 70% isopropyl alcohol. Ethanol can also be used, but it is more expensive and does not provide better results. Seventy percent isopropyl alcohol is often sold as rubbing alcohol; do not use ethyl or methyl rubbing alcohols, as they are not suitable for fluorescein analysis. Occasionally, one encounters 99% isopropyl alcohol; it must be diluted with water to make 70% alcohol. Without this dilution, the KOH will not dissolve properly.

   The solution of KOH and alcohol must be mixed in a container separate from the charcoal. It is not essential that the solution be exactly 5% KOH. If we are doing qualitative work, we often estimate the amount of KOH necessary and mix it with the alcohol.

3. Do not shake the charcoal and KOH solution.

4. If you are color blind or have trouble distinguishing shades of green, get someone to help you. If you are not sure of your color abilities, go to a paint store and see if you can distinguish between all their shades of green. If not, you need a helper.

5. If fluorescein has been adsorbed by the charcoal, it will be replaced by the KOH and alcohol solution and will appear as a distinctive green haze above the charcoal. In cases where there is a substantial quantity of dye adsorbed on the charcoal, the entire solution will turn the distinctive fluorescein green. Fluorescein dye has a very distinctive color.

6. Naturally occurring organic materials can cause interference in the analysis. These materials can be difficult to separate from weak fluorescein concentrations under ultraviolet or indirect light. They can readily be separated if you work in a darkened room and beam a light into the test solution. For best results, the light beam should be at right angles to the path of your viewing. A flashlight or a small, high intensity tensor type desk lamp provides a very suitable beam.

7. Sample packets with small amounts of fluorescein in them will give you a feel for fluorescein analysis; they can also insure that the activated charcoal being used is fresh and suitable for fluorescein tracing work. A good sample test run can be done as follows:

   A. Make a solution of approximately 1 ppm by weight fluorescein in water. Start with a gram of dye and 1,000 ml of water, and then dilute to 1 ppm.

   B. Pour approximately 500 ml of 1 ppm fluorescein solution through a test charcoal packet; pour at such a rate that it takes 15 or 20 seconds for the liquid to pass through the packet.

C. Rinse the packet in clean water for 30 seconds, then test for the presence of fluorescein. You should get a strongly positive test.

8. A fluorometer can be used in the detection of fluorescein, but in natural water systems, the human eye is more definitive. Using fluorometers, we have been unable to separate the fluorescence of naturally occurring organic materials from the fluorescence of fluorescein; they can readily be separated by eye in a darkened room when a light is beamed through the test solution.

Reliance upon fluorometers for fluorescein determination has resulted in erroneous conclusions that fluorescein was present. For a period of approximately a year, at one week intervals, we pulled and replaced activated charcoal packets from Greer Spring, Missouri. All of the elutriated samples were run on a fluorometer; the analysis approach for each packet was essentially identical. We discovered that fluorescence values, as determined on the fluorometer, would occasionally increase as much as ten fold from one week to another. During our year of investigation, there were three major increases in fluorescence which we might have interpreted as pulses of fluorescein dye. However, there was no dye tracing being done, and visual examination of the elutriated solutions from the packets showed that fluorescein dye was not present.

Natural fluorescence can also mask positive fluorescein dye pulses. We have run small quantities of fluorescein dye through charcoal packets, and then placed these packets in a stream for a period of one or two weeks. Control packets, which were not subjected to the dye, were also placed in the stream. When the packets were elutriated, fluorescein dye could be seen in a light beam passed through the appropriate solution; dye was obviously absent in the control packet. When the elutriated solution samples were run on a fluorometer, total fluorescence in the sample containing fluorescein was about ten percent greater than in the control samples. In practice, a ten percent change in fluorescence from one sample to another is far too minor to attribute to a fluorescein dye pulse. Reliance on a fluorometer could thus result in missing positive traces.

## OTHER ADSORBANTS FOR DYE DETECTION

A number of materials have been used for the adsorption of fluorescein and rhodamine dyes, but in our experience all of these are inferiour to high quality activated charcoal. One material which we have not tried is gelatin coated film (Dry Bimat Transfer Film, Type 2436-A; Product of Eastman Kodak Co., Rochester, New York) (Steppuhn and Meiman, 1971).

The film has been used to provide a continuous measure of rhodamine WT concentration in a stream; it must be used in conjunction with a fluorometer which means a total instrumentation cost of perhaps $4000. The detection threshold for rhodamine WT is claimed to be 1 ppb. The gelatin film system would be about as good as having a recording fluorometer in the field.

If someone is conducting investigations where he must use rhodamine WT, it might be interesting to put some of the film in screen wire packets, and see if it adsorbed more dye than the activated charcoal. It seems unlikely to us that the film would be as effective as the charcoal.

## QUALITATIVE ASSESSMENT OF FLUORESCEIN DYE CONCENTRATIONS

In describing positive dye tests with fluorescein, we have found it helpful to have some qualitative means of comparing the concentrations of dye in packets. We use the following five categories for describing positive fluorescein dye traces as determined by analysis of activated charcoal packets:

1. Very strongly positive: Dye can be seen distinctly with the naked eye in sunlight or in an artifically lighted room within 15 minutes of the time that KOH and alcohol are added to the charcoal.

2. Strongly positive: Same as above, only the time limit is three hours.

3. Moderately positive: Dye can be seen with the naked eye in sunlight or in an artificially lighted room 3 hours after adding KOH and alcohol. The dye is indistinct, and the observer feels it is necessary to verify the results by beaming a light into the sample bottle.

4. Weakly positive: 24 hours after adding KOH and alcohol, dye cannot be detected by the naked eye in sunlight or in an artificially lighted room. Dye can be distinctly seen by the naked eye when a light is beamed through the sample bottle.

5. Very weakly positive: The appearance of the dye is similar to weakly positive tests, but the dye cannot be seen until more than one, but less than 10 days after adding KOH and alcohol. The dye can be distinctively seen by the naked eye when a light is beamed through the sample bottle.

Materials list.

Fluorescein Dye : 1977 US prices ranges from $5.75 to $8.00.

Activated Coconut Charcoal : - specify 6 to 14 mesh. 1977 US price was $8.00 per pound.

References.

See the original Cookbook for details of the references if you wish to do any further reading.

Edited from the Water Tracers Cookbook (Missouri Speleology Volume 16 Number 3) by Bruce Welch.

TRIP REPORT - Jenolan - 1st/2nd December 1979
- Exploration in Spider Cave and a new extension to Henry's Hole -

Present: Michael Lake (trip leader), Graeme Smith, Ross Newbury, Martin Smith (no relation to Graeme).

SATURDAY:

Having entered Spider Cave around midday Graeme and Ross proceeded through the rockpile to the Hairy Diprotodon whilst I led Martin through the alternative route via a joint system and vadose canyons on the northern side of the rockpile.

Graeme, desiring to observe what fauna the cave supported, remained near the Jenolan Underground River while Martin and myself climbed upwards into the rockpile on the River side of the expandible minimum. A rocky chamber which had previously been discovered by Bruce Welch and Richard Mackay, was pushed further southwards, however, nothing of significance was found so a cairn was erected and we descended via a different route back to the rockpile terminus from Cairn Chamber.

After consuming lunch we took a cursory look in the Eyrie and thence proceeded to the surface.

SUNDAY:

Henry's Hole is situated in the wallaby enclosure and directly above an unentered section of the Hairy Diprotodon. The cave is mostly vertical in nature and already 37 metres deep; consequently it could contain exciting prospects.

Finding one's way down Henry's Hole is straightforward; however the Coral'all squeeze, leading to the downpipe, is unobvious.

After the descent of the downpipe I proceeded up to a small muddy incline where in the right hand wall at the passage extemity a small hole was apparent.

A few minutes' gardening gave access to a small but previously unknown chamber. Ross and Martin enlarged the entrance to accomodate themselves and soon joined me. The floor consists of muddy rocks choking a passage leading vertically downwards. No breeze could be detected.

The Diprotodon dig was duly commenced and after half an hour the floor level was lowered one metre. As our only digging implements were our hands and feet we decided to return with a more appropriate G-pick and spade on a subsequent trip. We proceeded to explore the rockpile and rift a short distance away. Martin removed some 20 to 30 kg boulders which enabled me to descend the rift in the rockpile below the downpipe. It is floored by gravel and probably has no prospects for extension.

Re-investigation of Henry's Hole has confirmed that possibilities do exist for further extensions. Although these extensions are at present small they hold the promise of access to the dwindling remainder of the Hairy Diprotodon.

Mike Lake

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## TRIP REPORT - Jenolan, 12th and 13th January, 1980

- Exploration in Spider Cave and Henry's Hole -

Present : Mike Lake ( trip leader ), Henry Shannon, Rosie Shannon, Peter Winglee, Ross Franklin, Ian Mann, Rik Tunney, Janine McKinnon, Meryl McKinnon and friend, Noel Partridge, Pete Dodson;
Sunday night : Mike Lake, Ian Mann, and guides Ron Newbould, Peter Culley, Ernie Holland, Richard Guy.

### Saturday 12th

Henry was at Jenolan; consequently we were all eager to enter Spider Cave to escape the inevitable rain. Even though we split up, slow progress was made through the cave due to the large party. Eventually, however, we reached Khan passage.

Upon examination of the skeleton there, Henry suggested that it was probably a ring tailed possum.

In the soft light of a carbide lamp the scalloping in Khan passage is evident and suggests that a clockwise turbulence existed in the past. Fossil ripple marks of an ancient flood are visible on the left hand mud bank of the streamway connection to the Hairy Diprotodon. How recently these were formed is not known.

Henry dived the first sump north of Pike Lake to further examine the river way;then we proceeded back to Mammoth Flat.

Sunday 13th

Henry, Rosie and others had departed on Sunday morning. Peter, Ross, Ian and myself returned to Diprotodon Dig in Henry's Hole. Digging last time had progressed at great speed; however, this time we only gained around one foot in depth. For digging in this cave a G - Pick, short handled spade and a tape are the most useful implements.

Sunday Night

Guides, Ron Newbould, Peter Culley, Ernie Holland and Richard Guy met Ian and myself at the bubbler around 7.00 pm to join us on a trip to the Jenolan Underground River.

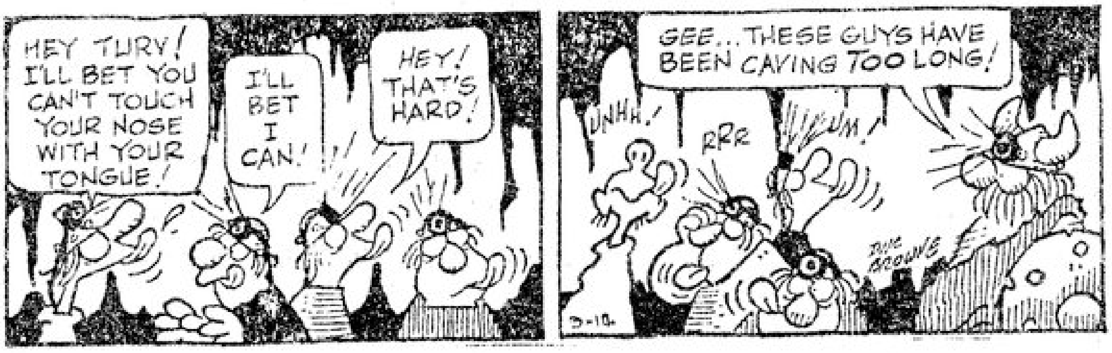
Unfortunately, Pirates' Delight prevented Ernie and Richard from proceeding further.

Ron and Peter also agreed on the skeleton in Khan Passage's being that of a ring tailed possum and identified the faeces of a fox and its footprints in the Whales' Throat. The dispersion of our lights into a spectrum by calcite crystals in pools of water in Khan passage was pointed out to us by Ron, and Peter suggested track marking in the Whale's Throat to preserve the mud floor which consists of small mud spheroidssimilar to those made by soldier crabs on beaches. Exit was made around 11.45 pm after 4-1/2 hours of enjoyable caving.

Mike Lake

*    *    *    *

TURV THE TERRIBLE—



TRIP REPORT - Jenolan - 29th December to 1st January, 1979/80 - Entry into the tomb chamber, Spider Cave

Present: Mike Lake (trip leader), Peter Winglee, David Noble, Shane Beard, Kieth Steenwyck, Neil Jones.

SATURDAY:

Bruce Welch had expressed interest in a mud choked hole behind the Tomb of the Unknown Cavemann so consequently on the previous trip of 22nd/23rd December Andrew Torning (H.C.G.) and myself had enlarged the entrance to perceive a chamber below; however, we were unable to force entrance safely.

On this trip I descended into the chamber assisted by a capable Peter Winglee and my 10 metre tape.

(N.B. A grade ASF 11 map situated at the end of this report)

The chamber has numerous blocks of rock covered in mud forming the floor and blocking access to a rift some 5 metres plus deep heading towards the 10 metre deep hole near the Tomb of the Unknown Cavemann. Opposite is an aven which requires further investigation. Of most significance are the remains of yet another small animal, which has lost its way and terminated its life in a small rift.

At present the animal remains unidentified until someone with more knowledge has a look at it.

Exit from the chamber was substantially more difficult and use of the tape and a strong hauler was unavoidable. The chamber has been named Tomb Chamber.

Visiting the Eyrie a small hole that leads underneath the great fallen slab (after the Eagle's Wing) was investigated however, it terminates in mud and rock blocked passages. Extension is improbable.

SUNDAY:

Serpentine Cave was visited, the purpose being to examine the sink that is mentioned in the Jenolan book. It is postulated that the sink drains flood water into unentered lower levels. We were not certain where this particular sink is located as there are several other depressions (sinks?) in the near vicinity; however, any dig undertaken would be relatively easy as removal of mud is no problem and ample standing room.

Lower River in Mammoth Cave was worth a trip to acquaint some of our newer members with the upstream sighting of the Jenolan Underground River. Neil and Kieth crossed the river and even returned dry, after which we dashed off to the Skull and Crossbones and thence to the exit.

MONDAY:

Returning to the Cairn Chamber, Spider Cave, (see trip report for 2nd December) we commenced surveying the chamber and completed the survey to the reference point at the edge of the 10 metre hole near the Tomb of the Unknown Cavemann.

Cairn Chamber lies above and slightly north of the Tomb of the Unknown Caveman.

Peter thoroughly investigated the passage leading southwards off Cairn Chamber which does not go. Vast potential for discovery still exists high into the rockpile and in numerous other regions for any explorer with some initiative and perserverance.

Mike Lake

## SRT TRAINING - KELLY'S FALLS

5th JULY

### HOW TO GET THERE

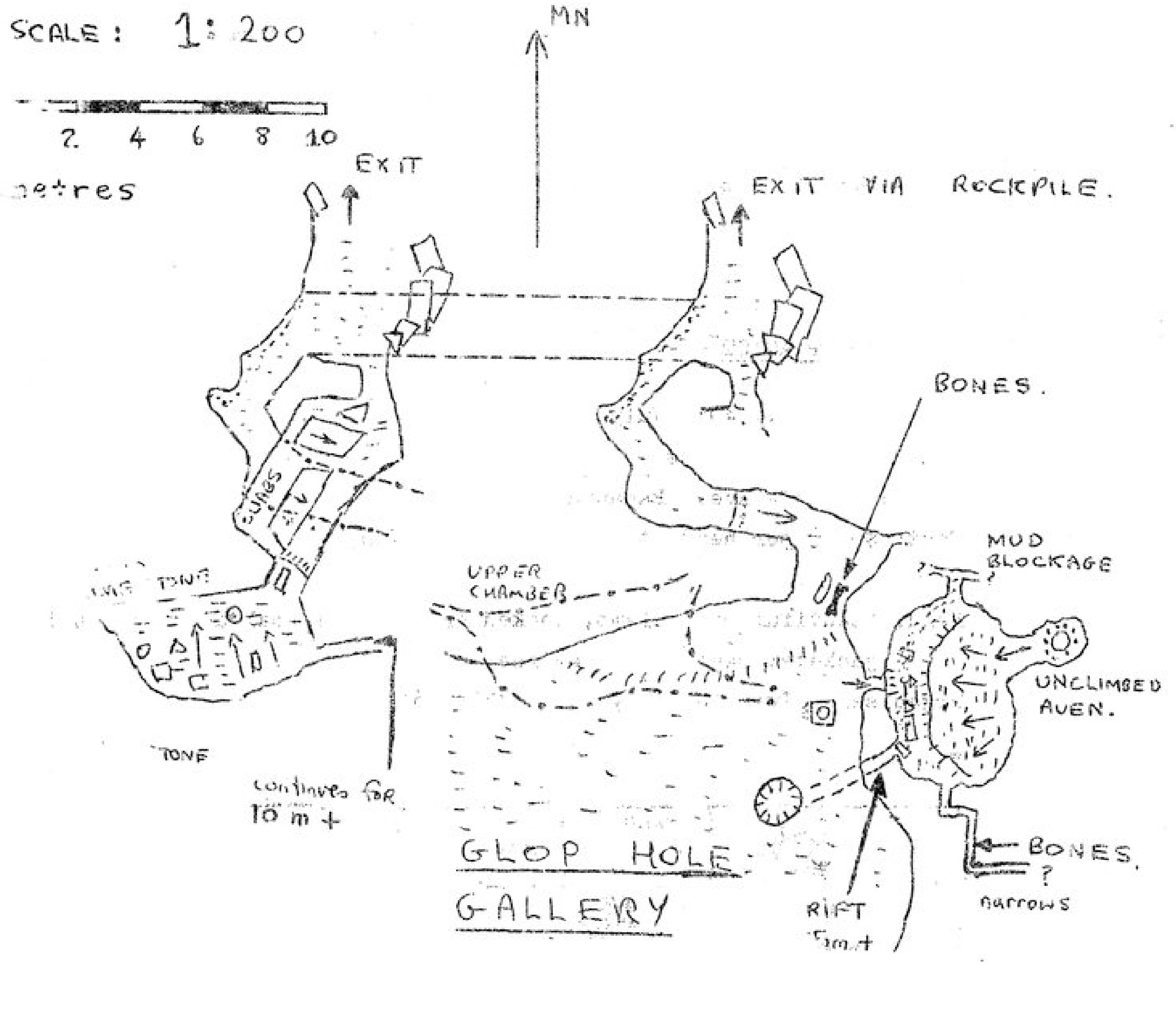
From Sutherland, proceed along the Princes Highway. Do not enter the tollway but continue on the old Princes Highway to the turnoff to Stanwell Tops on your left (directly after the turnoff to Helensburgh).

Continue until you go down the hill and across Kelly's Creek Bridge. Only 100 feet beyond on the left is a house and the first road sign with (don't miss it) a dirt track leads off between them. It soon branches - take the right hand branch and you will reach the car park. A track leads to the abseiling point, 100ft past the waterfall.

SURVEY OF TOMB CHAMBER & CAIRN CHAMBER

Spider Cave, Jenolan, NSW

| | | |
|---|---|---|
| Survey Data: | Cave and location: | Spider Cave, J174, Jenolan. |
| | Survey Date: | 29/12/79 and 31/12/79. |
| | Scale: | 1:200. |
| | Grade: | A.S.F. 42 for upper chamber, useing suunto's and 30m tape. A.S.F. 11 for lower chamber. |
| | Survey leader and drawer: | Michael Lake. |
| | Additional survey members: | Peter Winglee, Kieth Steenwyck. |



## T SHIRTS

You supply the T-Shirt and we will print the SUSS emblem on it for only $1. OR - tell us your size and we will supply the T-shirt and print it too, for $5.

Contact - Ian Mann on 631 4321

*    *    *    *    *    *

## CARRY MATS

We have arranged a discount deal nn closed cell foam mats.

| | | | |
|---|---|---|---|
| cost: | 50cm x 150cm | - | $5.50 |
| | 50cm x 175cm | - | $6.50 |

Contact - Bryan Cleaver on 522 7190

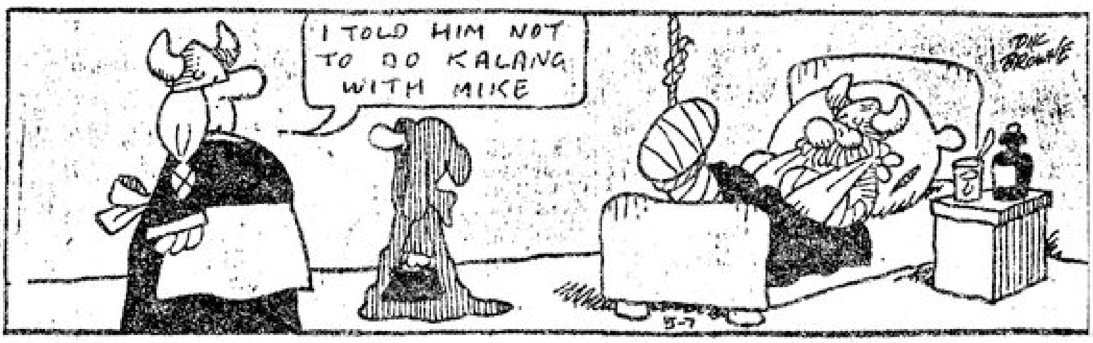
*    *    *    *    *    *

## SHEEP ROAST

When: Saturday, 19th July
Time: 4.00 pm onwards
Place: 7 Eddie Ave. Panania
Cost: $5.00 per head, to be paid by 5th July

Menu: Beautiful roast lamb, cooked on the spit; salad; potatoes in jackets; pavlova and coffee.
Organiser: Ivan Desailly 773 3861

*    *    *    *    *    *



## FUTURE EVENTS

Thursday 5th June. SUSS General Meeting, 7.30 pm, Holme Building Common Room. Steve Bunton will talk on Tasmania.

7th - 8th June. Bungonia, Argyle Hole etc. Contact : Guy Cox 818 1896

14th - 16th June. Billys Creek. Contact : Ivan Desailly 773 3861

21st - 22nd June. Jenolan - J 51, Mammoth, Spider. Contact: Paul Greenfield 797 6975

Monday 23rd June. SUSS Committee Meeting. Ivan Desailly's place - 7 Eddie Ave, Panania.

28th - 29 th June. Tuglow Caves and Kalang Canyon. Contact : Ian Mann 631 4321

JULY

Thursday 3rd July. SUSS General Meeting, Common Room, Holme Building 7.30 pm.

Saturday 5th July. Field Day at Kellys Falls, followed by Barbeque at Mike Lakes. Contact: Mike Lake 524 5229 . (See separate advert on page 24 )

12th - 13 th July. Kalang Canyon and Jenolan Southern Limestone. Contact Mike Lake 524 5229

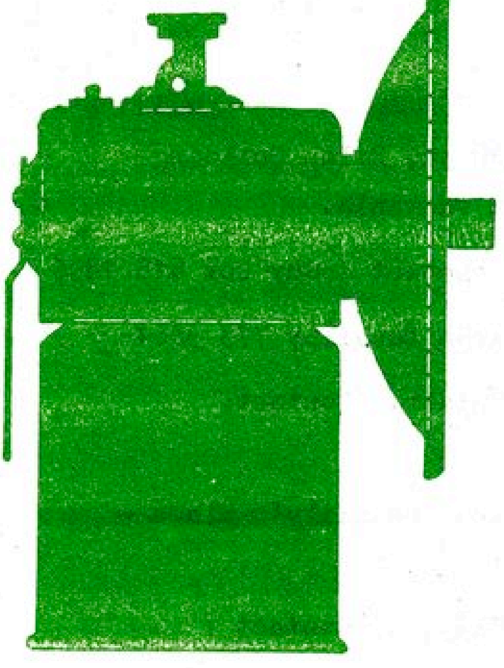
Saturday 19th July. SUSS Sheep Roast. See advert on page 26.

AUGUST

23rd - 24th August. Speleo Sports, Macquarie University. Contact Ian Mann 631 4321 to join the SUSS team.

Last week in August. Caving at Buchan, Victoria, for 4-6 days. Contact: Mike Lake 524 5229 WELL IN ADVANCE

**Lumen in Tenebris**



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# SUSS

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