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CONSERVATION, KARST AND CAVES

SUBMISSION TO:

LAND CONSERVATION STUDY GROUP

SYDNEY UNIVERSITY SPELEOLOGICAL SOCIETY

BOX 35, THE UNION,

UNIVERSITY OF SYDNEY,

N.S.W. 2006



SYDNEY UNIVERSITY SPELEOLOGICAL SOCIETY

BOX 35, THE UNION, UNIVERSITY OF SYDNEY, 2006.

Land Conservation Study Group,
P.O. Box 1,
Darlinghurst, 2010

8th December, 1977

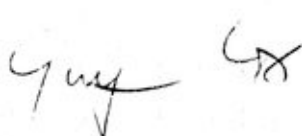
Dear Sir,


Further to the public invitation from the Land Conservation Study Group, Sydney University Speleological Society is pleased to submit the enclosed notes on conservation issues affecting karst regions and limestone caves.

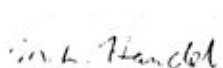
We have attempted to outline the conservation problems faced by cave areas, and proposed some possible solutions, as well as indicating other land uses compatible with conservation in these areas. It is our hope that decisions affecting these regions will be made in consultation with speleologists, and that we may play our part in helping to preserve one of New South Wales' scarcest scenic resources.

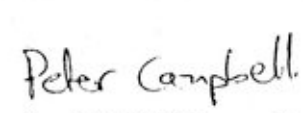
If we can provide further information on any of the topics discussed, we will be very glad to do so.

Yours faithfully,


G.C. Cox, M.A., D.Phil. (Oxon)
President, S.U.S.S.


B.R. Welch,
Editor, S.U.S.S. Bulletin


M. Handel, B.Sc. (Syd)
Secretary, S.U.S.S.


P. Campbell,
Committee Member

CONTENTS

	page
1 KARST AREAS	1
2 THREATS TO KARST AREAS	2
2.1 Threats which destroy caves	2
2.1.1 Quarrying	2
2.1.2 Flooding	2
2.2 Threats to caves which do not destroy them	2
2.2.1 Clearing	2
2.2.2 Vegetation changes	2
2.2.3 Pollution	3
2.2.4 Damage	3
3 PROPOSALS FOR CONSERVATION	4
3.1 Restrictions on limestone mining	4
3.2 Protected status for karst areas	4
3.3 Siting of dams	4
4 SUGGESTIONS FOR MANAGEMENT OF KARST RESERVES	5
4.1 Vegetation	5
4.2 Public access	5
5 OTHER LAND USES COMPATIBLE WITH CAVE CONSERVATION	7
5.1 Tourism	7
5.2 Forestry	7
5.3 Water catchment	7
5.4 Agriculture	7
6 ECONOMICS OF CAVE CONSERVATION	8
6.2 Costs of cave conservation	8
6.3 Profits from cave conservation	8
7 SCIENTIFIC STUDY	10
REFERENCES	11
APPENDICES	

1 KARST AREAS

1.1 Our basic philosophy, as conservationists, is that land should be preserved in a natural state unless there are pressing reasons to do otherwise. We have no sympathy with the viewpoint that land exists, therefore it should be put to the best use. Man has no God-given right to interfere with the natural environment. Further, only by leaving some land undisturbed do we give any right of choice to our children. Should this generation be privileged above those to come ?

1.2 Karst areas - regions of limestone in which the scenery is modified by solutinal processes - are in a unique position among landforms. Both their scenery and their flora are distinctive. Karst areas are scarce in N.S.W., and indeed in the whole of eastern mainland Australia. For this reason alone limestone regions deserve a high level of conservation¹. Caves are perhaps both the least obvious and the most characteristic karst feature. Most characteristic because they are formed by the flow of water underground, and underground drainage is the feature which distinguishes karst scenery from any other. Least obvious because they are concealed beneath the ground, often accessible only by miniscule holes or vertical shafts. Nothing visible on the surface gives a clue to the type of scenery encountered in caves. Geomorphology in caves acquires an extra dimension, since erosion by water is no longer constrained to act only downward, but must operate in all directions. Not only are caves scenically unique, they represent a unique ecosystem, with both fauna and (micro-) flora found nowhere else^{2,3,4,5}.

The cave environment is not static. It is in a constant state of dynamic flux, with erosion balanced by calcite deposition and passage breakdown, and the deposition and removal of sediments affecting in turn the patterns of water flow. This equilibrium is by its nature very susceptible to outside influences such as variations in water flow, CO₂ content and sediment load.

2 THREATS TO KARST AREAS

2.1 Threats which destroy caves

2.1.1 Quarrying . Mining of limestone is the most severe threat faced by any cave or karst area, since the environment is completely and permanently destroyed. No amount of re-landscaping can restore surface karst features; still less can it replace caves⁶ .

2.1.2 Flooding . Dams for water supply or hydro-electric projects present the other major threat to caves. In many cases caves must first be sealed if the dam is not to leak. Even where this is not so, the drainage pattern is totally altered. The cave passages will be so completely obscured by silting as to be, for all practical purposes, destroyed. The effect would be comparable to that of a major climatic change. Many present-day caves contain evidence that past changes in water level have entirely altered the pattern of development of the system.

2.2 Threats to caves which do not destroy them

2.2.1 Clearing. Clearing of natural forest in the drainage area of a cave system tends to cause severe silting in the cave passages⁷. It may also have more subtle, long-term effects in altering the pH and CO₂ content of percolation water, and hence its tendency to dissolve limestone. This could affect cave morphology in the long term, and calcite formations (stalactites and stalagmites) in the shorter term.

Even the small-scale clearing involved in road construction can cause these problems; an example is seen at Yarrangobilly at present where recent road building has led to heavy silting of both surface creeks and caves.

2.2.2 Vegetation changes. The replacement of natural eucalypt forest by pine can have a profound effect on drainage patterns. Runoff of rainwater is much reduced, partly as result of increased interception of rainfall by pine foliage, and partly because of the pines' higher

water demand⁷. Many formerly permanent creeks cease to flow in dry weather. The effects of this are already becoming visible at Jenolan Caves; much more marked effects can be expected in the long term. This topic is further discussed in the papers reproduced here as Appendix I and Appendix III.

2.2.3 Pollution. Dumping of rubbish, agricultural waste and sewage in shafts and dolines can be a major problem in even slightly developed karst areas. In many cases not only the cave, but water supplies derived from karst springs have been polluted^{8,9} (Appendices I & II). Underground watercourses often provide little filtration, and of course are not subject to the sterilising effects of the ultra-violet component of sunlight.

2.2.4 Damage. Both caves and surface karst features are often subject to damage (vandalistic or accidental) from visitors, whether speleologists or members of the general public. Severe damage has already occurred to many caves in N.S.W. which are easily accessible to the public.

3 PROPOSALS FOR CONSERVATION

3.1 Restrictions on limestone mining

3.1.1 Limestone mining should be restricted to uses, such as cement manufacture, for which there is no substitute available. Limestone should not be quarried for such uses as roadstone.

3.1.2 Mining should only be carried out in limestone areas which show little or no surface or underground karst development. Such areas are less popular with mining companies as they have lower relief, which can make quarrying operations less convenient⁶. The limestone in such areas is often less pure. Nevertheless mining of such areas is perfectly viable if competition from 'easier' areas is eliminated.

3.2. Protected status for karst areas

3.2.1 All karst areas in N.S.W. should have some form of protected status, as National Parks, Department of Tourism reserves, State Forests or Recreation Areas. Careful consideration should be given to the level of access and use appropriate to each area; this topic is discussed in 4, below.

3.2.2 Non-limestone valleys draining into karst areas should be subject to similar restrictions; the drainage area as a whole should be the unit for conservation (see Appendix 3, section 2). Alterations in run-off from surrounding rocks will have a major effect on cave systems (2.2.1 and 2.2.2).

3.3 Siting of dams

In no cases should dams be sited so as to flood caves or karst areas (2.1.2). Existing plans which threaten caves (as at Cliefden) should be reconsidered as a matter of urgency.

4 SUGGESTIONS FOR MANAGEMENT OF KARST RESERVES

4.1 Vegetation

- 4.1.1 Wherever possible there should be no clearing of natural forest. The restriction on felling on slopes greater than 18° contained in the Soil Conservation Act should be extended to State Forests (2.2.1).
- 4.1.2 Eucalypt forest should not be replaced by pine plantations (2.2.2).

4.2 Public access

- 4.2.1 At present there exists a range of levels of public access to cave areas:
- A. Tourist - commercial guided tours of caves. Caves are managed in this way both by the Department of Tourism (Jenolan, Wombeyan, Abercrombie) and by the National Parks and Wildlife Service (Yarrangobilly). Some local councils also manage tourist caves (Wellington, Wee Jasper).
 - B. Unrestricted access, but no commercial development. (Some caves at Bungonia and Wee Jasper).
 - C. Access by permit. The Department of Tourism controls access to non-developed caves on its reserves in this way. The National Parks and Wildlife Service controls access to all caves in National Parks by a similar system. At present there are widely differing levels of enforcement in different areas. The two bodies have slightly different criteria for granting permits.

There are also caves on private land, the terms of access depend upon the landowner.

- 4.2.2 We suggest that these three levels of accessibility should be maintained, since each represents a valid compromise between public demand and the need for conservation. Level A provides all members of the public with the opportunity to experience cave scenery. Vandalism is largely prevented by supervision, but considerable alteration is made to the cave environment by the installation of paths and lights and the enlargement of inconveniently small passages. Level B gives the opportunity to experience

'wild' caves to those agile and adventurous enough to take advantage of it. At the same time the risk of vandalism by souvenir hunting and name scratching, at least in the more accessible caves, is high. Level C provides a high degree of conservation while allowing access, in effect, to all who are sufficiently interested and responsible to join a recognised caving club and go through the formalities of obtaining a permit.

- 4.2.3 Careful consideration should be given to the status of each area. Some caves are hardly liable to be damaged by unlimited access, while others are very vulnerable. In some areas it might be preferable to make access free rather than preserving the fiction of permits with no enforcement. Particularly vulnerable caves in an area of any status could be protected by gates. Especial care needs to be given to the siting of new roads, tracks and fire trails in and near cave areas, since they could render permit enforcement much more difficult. Speleologists should be consulted (for example through the N.S.W Speleological Council) when such decisions are made.

5 OTHER LAND USES COMPATIBLE WITH CAVE CONSERVATION

5.1 Tourism

Both high-intensity tourism (commercial show caves) and low-intensity tourism (leisure activities: speleology, bush-walking, fishing, etc.) can be compatible with the conservation of caves (4.2).

5.2 Forestry

Commercial forestry, using techniques of selective felling and replanting with eucalypts, should be feasible on karst reserves (4.1). Access trails would have to be sited carefully (4.2.3).

5.3 Water catchment

Provided that any dam is sufficiently far downstream not to threaten caves, karst reserves can well be used for water catchment.

5.4 Agriculture

In areas which have already been cleared for agriculture or grazing there is no reason why this should not continue - provided that slope erosion and silting of watercourses is not (or no longer) taking place. Steps should be taken to prevent the dumping of agricultural waste and other rubbish in karst depressions (2.2.3).

6 ECONOMICS OF CAVE CONSERVATION

6.1 We believe that the unique status of the karst landscapes and cave areas in N.S.W. is the main justification for their conservation. Nevertheless, we appreciate that economic considerations may play a part in decision making, and we enumerate some costs and benefits below. A more detailed analysis is given in a published paper by J. Dunkley, included here as Appendix 4.

6.2 Costs of cave conservation

- 6.2.1 Loss of limestone extraction. The cost of working more difficult deposits as a source of lime, and the cost of using other rocks for uses in which limestone is not essential.
- 6.2.2 The greater cost of forestry by selective felling and planting of eucalypts, compared with clearing and planting pines. This is probably quite small in the long term, but may be substantial in the short term as pines give a relatively fast return - they grow rapidly to a marketable size. Overall, eucalypts probably give an equivalent quantity of wood per annum, and undoubtedly preserve soil fertility better. However, capital is tied up for a longer time as the trees are slower to mature. A State government should be able to afford the long view, so that this cost will be minimised.
- 6.2.3 The cost of siting dams in non-cave areas. This can clearly only be calculated in individual cases. However, given the scarcity of karst areas in N.S.W. the cost is not likely to be large when considered over the entire State.

6.3 Profits from cave conservation

- 6.3.1 High-intensity tourism. Caves are probably unique among conservation issues in their potential for profit from commercial cave inspections. Jenolan Caves is the N.S.W. Department of Tourism's largest revenue earner.

6.3.2 Low-intensity tourism. Speleology, bush-walking, fishing and other such uses of land are paid for not individually but collectively through taxation. Such recreational activities can be evaluated in monetary terms both in their value to the participant and in their value to all (availability of options). This is considered in detail in a paper by P. Winglee, reprinted here as Appendix 5.

6.3.3 The profits and benefits from other compatible uses of the land (5).

6.3.4 Pollution prevention. In many parts of the world pollution of karst aquifers has contaminated springs used for water supply^{8,9} (2.2.3). A similar case has been reported in Mt. Gambier (Appendices 1 & 2). Eradication of pollution from water supplies (chlorination, filtration, alternative sources) is expensive; its avoidance is an accountable benefit of conservation.

6.3.5 Oxygen supply. Carbon dioxide is produced by human respiration and burning of fuels. This is converted back to oxygen through the photosynthesis of green plants. Forests play a much more important part in this than does agricultural land - at least 50% of the world's oxygen is produced by forests¹⁰ which cover less than 25% of the world's land area¹¹. The maintenance of land in a forest-covered state is therefore of benefit to all the community, and its cost a legitimate charge upon all.

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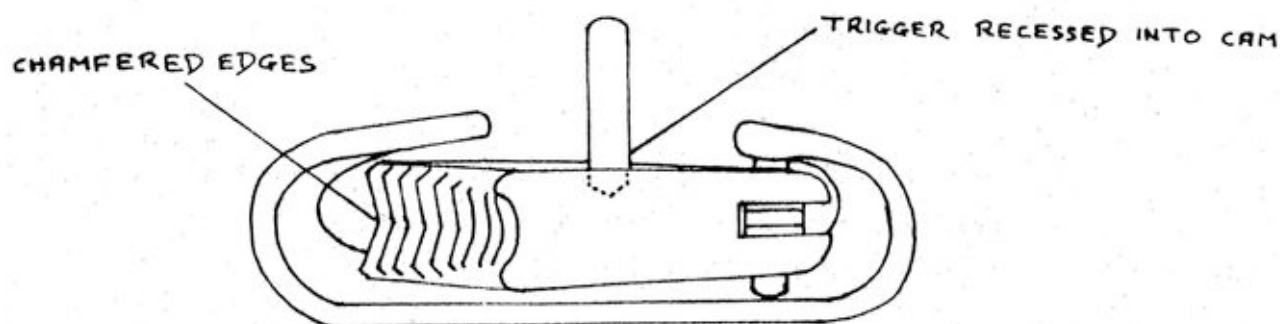
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We wish to thank the authors and publishers of the above papers
for generously giving permission for their reproduction.

ANOTHER SIMPLE SHUNT

by Guy Cox

From Rick Box of Westminster Speleological Group comes a simple modification to a Clog ascender, enabling it to be used to safeguard both descents and ascents. Its main advantage over the Spelean Shunt described recently by Bruce Welch is that a Clog is cheaper than a Gibbs ! Although neither device is designed for this type of use, both seem to be adequately strong - unlike other ascending devices on the market, which should definitely NOT be used in this way.



DETAIL OF TRAILER CLOG

All four edges (leading, trailing and both sides) of the gripping face of the cam are filed until smooth. The main reason for this is that in the abseiling mode the cam is being held open and would otherwise present a sharp edge to the sheath of the rope as it runs through. This should also help to avoid the tendency of the Clog to jam.

A short length of aluminium rod is araldited into the hole of the cam. This acts as a handle, making it much more comfortable to hold the gate open when descending. Rigging arrangements can be identical to those used with the 'Spelean Shunt', though Rick favours a separate safety line ('Double Rope Technique') !

16 PLAIT MATT TERYLENE/POLYESTER ROPES FOR S.R.T.

E. G. Hawkins (Marlow Ropes Ltd.,)

Marlow Ropes Limited is a member of the Hawkins & Tipson Group, a Public Company quoted on the stock market since 1973. Marlow Ropes was formed in 1961 by Hawkins & Tipson, to concentrate on synthetic fibre ropes which were then virtually in their infancy although Nylon ropes had been manufactured since the war.

Our particular involvement was with Terylene/Polyester which seemed at the time to have characteristics which were in many cases more valuable and versatile than Nylon, especially its low controlled stretch characteristics.

The first major market was yachting as at this time prices were so high that all products met with considerable sales resistance elsewhere. Since then, although yachting is Marlow's prime concern as a single market, we are active in the general industrial field which in some cases shows the confidence users feel in Terylene as a fibre — for example, Fire Brigades, Coastguards.

History of 16 plait

We are for a long time particularly concerned with 16 plait because of its special qualities, but we should point out that this is only one of a range of several types of Terylene/Polyester ropes and ropes of other fibres which we currently manufacture and stock. It is clearly the most suitable for this purpose. It was originally designed for yacht winching operations and this is still its biggest use.

The first type of 16 plait (circa 1959) had parallel filament cores with a single 16 plait outer in continuous filament yarn (shiny). Yachtsmen's complaints about the slippery surface and the stiffness of the rope first made us change the outside fibres to matt finish yarns. The next improvement was again in response to yachtsmen's requests, to make the rope softer. This was achieved by covering the parallel core with a loose plait so that there was a parallel core and two plaited covers. This is the rope currently in operation, although there have been marginal improvements in strength over the years due to improved Polyester yarns. Four years ago we introduced colours — red, blue and gold and although these were much appreciated they are rather harder and in some cases weaken the overall strength of the rope.

We are currently working on two developments:-

1. Type 3 White

This is already on sale in 16mm dia. upwards and we are actively considering it for 10-14mm as well. It consists of a long laid 3 strand continuous filament core covered with a single 16 plait matt cover. The advantage of this rope is the considerable increase in strength, especially in bigger sizes, although there is some improvement in 10-14mm as well (see chart below).

2. Type 3 Coloured

We shall in due course be bringing out new shades of red, blue and gold which is in fact a new type of yarn, being stronger and softer. The colours are also better, especially the red which is redder rather than orange. The chart below shows the differences and improvements and it is as well to note that the core strength of current manufacture is 80% and the new manufacture 100%.

	White	Coloured
Current 16 plait matt 10mm	2000kg.	1600kg.
New Colours	-	2000kg.
Type 3 16 Plait matt	2250kg.	?
Current 16 plait matt 12mm	3000kg.	3000kg.
New Colours	-	3000kg.
Type 3 16 plait matt	3000kg. ?	?

16 Plait Matt for S.R.T. - Advantages

1. *Matt finish* — for better grip, friction, adhesion between inner and outer plaits.
2. The 16 plait construction makes the rope virtually un-kinkable and more important non-twist under load (we have an instance of a 500 ft length of rope on a block and tackle on a gantry having no twist at all under load).
3. Protected strength (80% core 20% cover). Most other plaited or braided products are 50/50.
4. Non-rucking. 16 plait will not concertina over ledges etc., and will suffer less damage as a result.
5. The round shape of 16 plait will be kept through working. This prevents flattening around sharp bends which could cause damage due to excessive friction.

Disadvantages

1. Loss of strength after relatively few uses. The reason for this cannot yet be proved but we do suspect it is due to grit particles washing in and out of the rope core and abrading the internal fibres. Microscopic examinations have failed to show any grit or damage but we are not particularly happy with the tests.

2. Lack of energy absorption in cases of free fall dropping on extensive heavy shock loading (see appendix below "The Energy Absorption Potential of Marlow 16 plait Polyester Ropes").

Work Progress

We would like to produce as a supplementary to our retail price list a "guide to cavers" which could give guidance to cavers on care and protection of ropes, a list of do's and don'ts and most important, of all if possible establish length of life recommendations. This will have to be established with the recommendation of B.C.R.A. on work carried out by Brian Smith of the Bradford Pothole Club.

Experimental Work Currently in Progress and Activities Considered

1. Current type 16 plait and new type is with a climbing expedition to be used as a fixed rope.
2. Current type 16 plait and new type with Brian Smith to compare one with the other.
3. Once we have established the answer to (2) a sample length of the chosen type in new colours on the outer plait to be sent to Brian Smith for evaluation.

Note:

If Type 3 proves unsuitable (but we may decide to go ahead anyway with Type 3 for yachting) we will carry a range of the present 16 plait for cavers. In this situation we may or may not decide to stock all colours in 10 and 12mm but would like to seek guidance at this stage to which colours would be preferred.

4. Proofing of external fibres to close the pores (see sample). The work so far done experimentally on proofing has been encouraging but not wholly successful.

Reasons for above Work

1. (Climbers — To widen the market.
 2. (Type 3) — Greater initial strength to counteract strength loss due to grit. (Better resistance to grit "flow" due to solid strand core?).
 3. (Colours) — Identification.
 4. (Proofing) — To protect the core from strength loss due to grit, by closing the pores.
- We welcome questions and criticism.

Postscript

I should add that the *Type 3* 16 plait as referred to in my article has subsequently been eliminated from our programme for cavers, since its outer cover would slide down the core in a potentially fatal manner if it were completely severed. We heard at the SRT symposium from B. Smith that this is an undesirable quality in an SRT Rope and for this reason, for the present we do not intend to stick to our current design of 16 plait matt.

Appendix

The Energy Absorption Potential of Marlow 16 Plait Polyester Ropes — A.E. Willis (Marlow Ropes) Limited

Marlow 16 plait polyester rope in 10mm dia. size has been proved highly successful in caving operations.

When this success first became evident, we immediately began extensive research work, as the result of which we think it desirable that all cavers should be made aware of certain facts about the ropes when they are subjected to shock loads in an emergency.

This is not in any way to introduce an alarmist element but purely to explain, for the benefit of all, the facts as they exist.

Nobody, not even a mountaineer, falls on a rope deliberately, but it must be pointed out that if in emergency a rope is called upon satisfactorily to arrest a falling body the rope must be technically capable of absorbing that load. It is, we think, correct to say that in caving, the chances of a fall are not anywhere near so great as in mountaineering and in the rare event of a fall, the distance is considerably less.

The energy absorption of 16 plait polyester rope is of the order of 6,000 foot pounds per pound weight of rope. Calculated as figures applying to 10mm and 12mm 16 plait ropes, this means an energy absorption rate of 325 foot pounds per foot of rope for 10mm rope and 466 foot pounds per foot for 12mm rope.

If, for the purposes of illustration, we assume lengths of 10, 15, 20 and 25 feet of rope, we have energy absorption capacity of 3,250; 4,875; 6,500 and 8,130 foot pounds respectively for 10mm rope and 4,665; 7,000; 9,300; and 11,650 for 12mm rope. If we now look at the effect of a man falling these distances, the figures that follow presume that a man is falling an equal distance to the length of the rope — that is, for a 10 foot length of rope the man falls 10 feet; for 20 ft. of rope a fall of 20 feet and so on. This is the way that the shock-absorbency of ropes is determined in laboratory testing and represents the worst possible conditions that could exist. In fact, they are worse conditions than are likely to happen in most actual usages of the rope, excepting possibly industrial and yachting safety harnesses.

Firstly then, let us assume that a fully dressed and equipped man weighs 200lb. The energy produced by a falling body is the multiple of the static weight of the body and the length of fall so that at a free fall of 10 feet he will have developed 2,000 foot pounds of energy and at 15, 20 and 25 feet the figures will be 3,000; 4,000 and 5,000; respectively.

When we compare these energy figures to the energy absorption potential of the rope we see that there is a margin of about $1\frac{1}{2} : 1$. For 12mm rope the margin is around $2\frac{1}{4} : 1$.

These figures are for new rope and are highly satisfactory but account must be taken of the reduction in strength of ropes through use. It is known that after a reasonable period of use, the strength of ropes used in potholing applications depreciates by up to 50% — even though ropes are invariably washed after use. Extensive research in our laboratory has not so far been able to account for the cause of this but, although examination of used ropes has never defined to any great extent the presence of silt that has penetrated into the rope, this seems the most likely cause. The abrasive nature of silt will, of course, produce some permanent rupture of the fibres from which the rope is made. We know that the reduction in strength is not caused by any tendency to acidic conditions either in cave water or the environs. Neither do the clamps used in descending or prussiking appear to be the cause of damage.

To return to the energy absorption capacity of the ropes, it is essential then, that we look at what is available in them when they have reduced in strength by 50%. Obviously, their absorption capacity is also reduced by 50% — from 6,000 ft. pound per pound weight of rope to 3,000. If we now look again at the figures given for new rope, where we see that for 10mm rope a factor of approx. $1\frac{1}{2} : 1$ exists between the rope absorption capacity and the energy developed by the falling man, this will reduce to $\frac{3}{4} : 1$ for a rope of 50% strength reduction. This means of course that the rope will break.

I repeat that this is, however, when tested under deliberately hazardous laboratory testing conditions and hasten to add that actual conditions encountered in caving operations are not likely to be anywhere near so stringent. If the figures for 12mm rope are examined, a rope of 50% reduction will have an energy absorption factor of approximately $1\frac{1}{8} : 1$ — not a very great margin of safety, but at least the rope should not break.

We have set out our figures in this way to highlight the worst conditions that could occur, but since it is not likely that a potholer will fall without some (possibly quite considerable) length of rope above him the actual shock load transmitted to a rope should be very considerably less than in laboratory testing. The longer the length of rope already out above a caver the greater is the ability of the rope to absorb the load.

To illustrate this, let us say that there is 40 feet of rope above the potholer and that he slips off a ledge. The capacity to absorb energy of a used 10mm rope of 50% strength is 6,500 foot pounds. There will therefore be ample margin to arrest the falling man safely because, since he is in contact with the rope he cannot fall very far even if the rope is lying slack at the start of the fall.

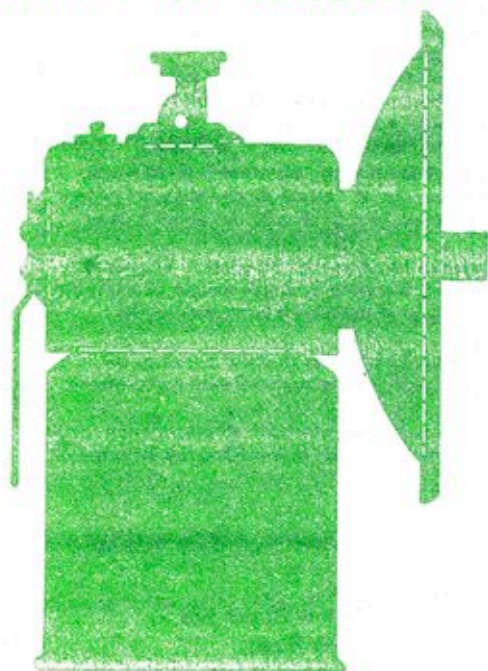
In conclusion, let us repeat that whilst conditions in caving are unlikely to be so serious as to cause a rope to fail, even allowing for a 50% drop in strength due to circumstances of usage, it is always as well to be acquainted with performance under extreme conditions.

Under the terms of the Health & Safety Act it is the duty of a supplier to acquaint the user with all information relating to his product to ensure safe usage. I feel that we are conforming with the requirements of this Act in providing the information given in this paper.

March 1976

Marlow Ropes Ltd.
South Road,
Hailsham,
Sussex BN27 3JS.





SUSS

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CONTENTS

Page	
107	Submission to Land Conservation Study Group
122	Another Simple Shunt Technique G. Cox
123	16 Plait Matt Terylene/Polyester Ropes for SRT Marlow Ltd

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