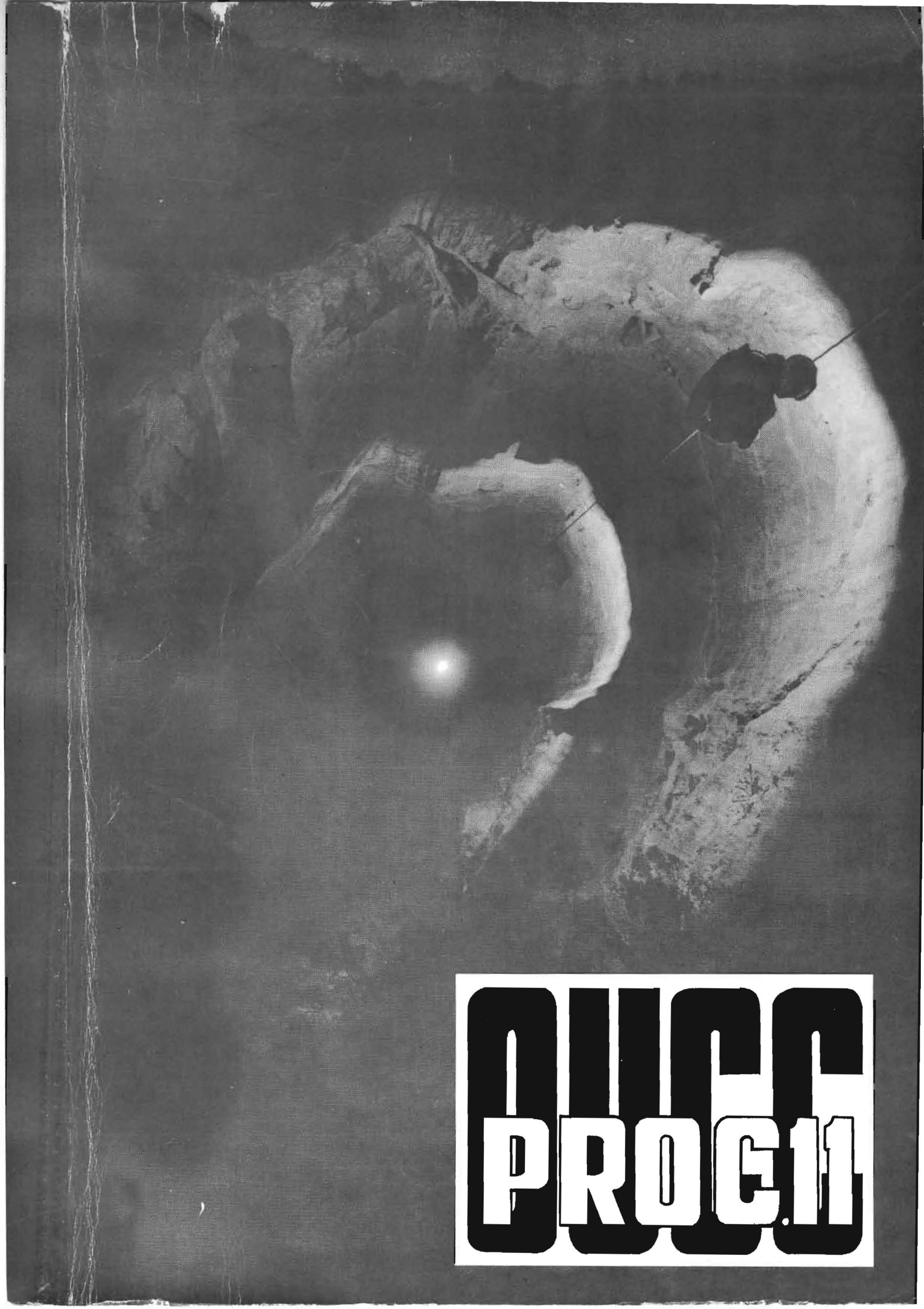


OUCC PROC.11

OXFORD UNIVERSITY CAVE CLUB

Club Rooms: 13 Bevington Road Oxford OX2 6NB

PROCEEDINGS OF THE OXFORD UNIVERSITY CAVE CLUB 11, 1984

Contents

ILLUSTRATIONS are individually labelled with the initials of the artist or photographer.

*STOP PRESS: One of the members of this expedition has now proved to be histoplasmosis positive. Visitors to the area should bear this in mind.

EDITORIAL ACKNOWLEDGEMENTS Many thanks are due to Steve "Super Pedant" Gale for acting as a very efficient assistant editor, Tom "Oh, my artistic...." Houghton for doing the thankless job of pasting and for drawing the cartoons, Steve "This is pathetic pedantry" Cope for typing the whole magazine in 17 hours and Steve "Oh no, not more bloody labels" Roberts for generating yards of lettering for the diagrams.

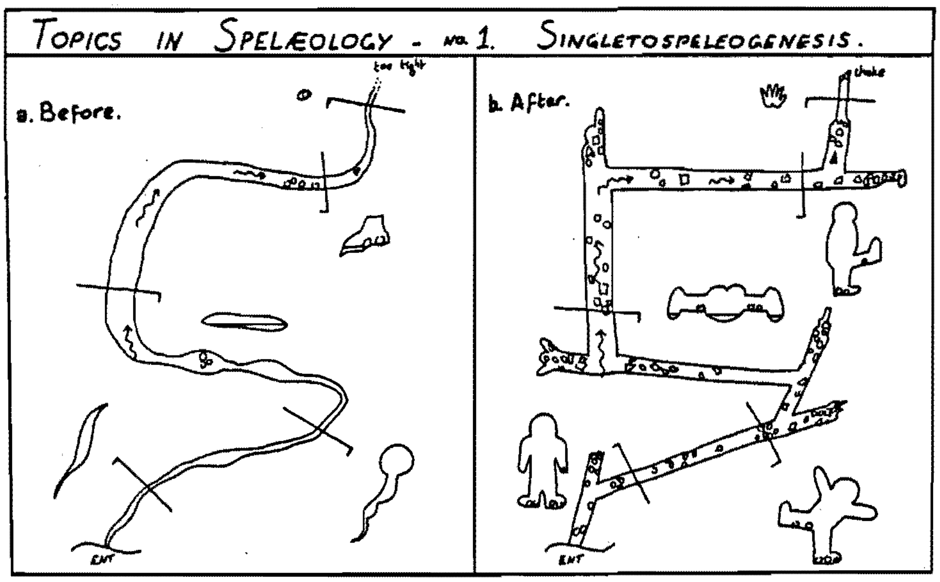
EDITORIAL

Editing an irregular publication like this tends to make you spend far too much time musing on the changes which have occurred since you did the last one, and not enough time sticking lumps of paper together and wading through the results of the grammatical inadequacies of a bunch of semi-illiterate cavers. Yes, although Oxford is supposed to be the centre of human knowledge and the city of perspiring dreams, its cavers, myself included, cannot spell or construct sentences, just like everyone else in England. However, I digress. To get back onto the subject of changes, Xitu is, inevitably, no longer the deepest-ever British exploration and has sunk to fourteenth in the depth-record tables. OUCC sends its hearty congratulations to the lads at Tresviso who just managed to scrape past our 1148 m; we were flattered to have the deepest parts of their cave named the Oxford Bypass and FUZ2 (say it in American). On the positive side, parties from the Club have been active in other parts of the World besides Spain, and this edition contains reports on work done in Borneo and Gibraltar. I hope that this diversification will continue, and look forward to seeing a Proc. Oxford Univ. Cave Club 12 containing, in the style of the old SUSS reports, articles from all the points of the compass.

Since the last Proc., SRT seems to have gained much more public support, Frog systems have crossed the Channel en masse to replace the weird, wonderful and often dangerous Yorkshire variants of the rope-walking and Texas-two systems and the death knell of the trusty old rack has been sounded with the appearance of the more convenient "Bobbins" and "Stops". Inevitably, the ladders versus SRT debate has once again reared its ugly head, and one of our Club members has even written an article for the Guardian on the subject. With all these changes in the air, and the proliferation of gear which accompanies them, it is comforting to know that the various caving journals see fit to publish reviews of the latest thing in knots etc.. What does rankle, however, is the way that these columns can become vehicles for personal enmity. Whilst their acquaintances may well know that columnist X doesn't like manufacturer Y, the vast majority of the caving public is presented with a distorted picture of the equipment scene.

Another inevitable development during the past two years has been the appearance of a replacement for Cullingford's Manual of Caving Techniques. I must confess to being a trifle disappointed in the new book; the water tracing section is hopelessly outdated, the article on expeditions gave no hint as to the usefulness its pile of random references etc., etc.. Some of the sections, such as the chapter on SRT, were very good, but the general feeling I got from the book was one of niggling errors and sloppiness which should have been spotted in the proof stages. An overall verdict would be "good idea; pity about the execution". A bit of pedantry on the part of the Editor could perhaps have made all the difference.

Having put you in a pedantic frame of mind, I hope that you have a satisfying time looking for spelling mistakes and grammatical errors in this rag, as you descend "into the vowels of the Earth!" (Not original)



EXPEDITION HALL OF FAME

Spain 1982-3

Larry "Carbide A-sist" Caldwell (Smokey) ('83)
Ursula "I'm so incompetent" Collie ('83)
Paul "I'm a long way from a place of safety" Cooper (MO '82, T '83)
Chris "It's just a plook near your bum" Danilewicz (Dani)('82,'83)
Steve "Lets have a coup!" Gale (S '82)
Richard "Waah!" Gregson (S '82, '83)
Mark "Apologies, chaps!"Godden ('82)
George "I'm living with a salamander at the moment" Hostford ('82, '83)
Kevin "I'm really into Rohan" Hostford ('83)
Martin "And now one at f8 in STEREO" Hicks ('82, '83)
Ian "My pee glows in the dark" Houghton (Bulls--t Explosion)(AS '83)
Tom "Eheu, Eheu, Eheu!" Houghton (T '82)
Jan "Be with you when I've repacked my fifth rucksack" Huning ('82, '83)
John "Snails are so juicy when they copulate" Hutchinson ('83)
Helen "You thing eat?" Kay ('82, '83)
Martin "It won't go" Laverty (Lavatory)('82)
Steve "Pity there aren't any hard caves in Britain" Mayers ('83)
Chris "Nice to see you" Morris ('83)
Graham "I've got to get out of here....FAST!(sic)" Naylor (L '82, L'83)
Colin "Physician, heal thyself!" Nicholls ('83)
Kathy "This Expedition's a gourmet experience" Pritchard-Jones(Madge)('83)
Andy "I'm taking up canoeing" Riley (T '82, '83)
Steve "We'd be buggered if it weren't for friction" Roberts (TM '83)
Dave "I am NOT a prima donna!" Rose (PO '82, PO '83)
Phil "But I CAN drive" Rose ('83)
John "Well if you won't pee in your stinkie, I will!" Singleton ('82, '83)
William "Harness; Check! Krabs; Check! Ascenders; Check! Brain; Check!..."
"Help! Am I being sick on the bed or out of the window?"
"Can one of the doctors help me?" Stead (Bed-Stead)('82, '83)
Sarah "Richard's got a nasty virus" Whibley ('83)
Iestyn "We're doomed, we're doomed!" Walters (Waldo) ('83)
Mark "When I was in the Falklands....." Willbourne RN ('83)
Penny "Cor Blimey!" Williams ('82)

Spain'83 and Gibraltar

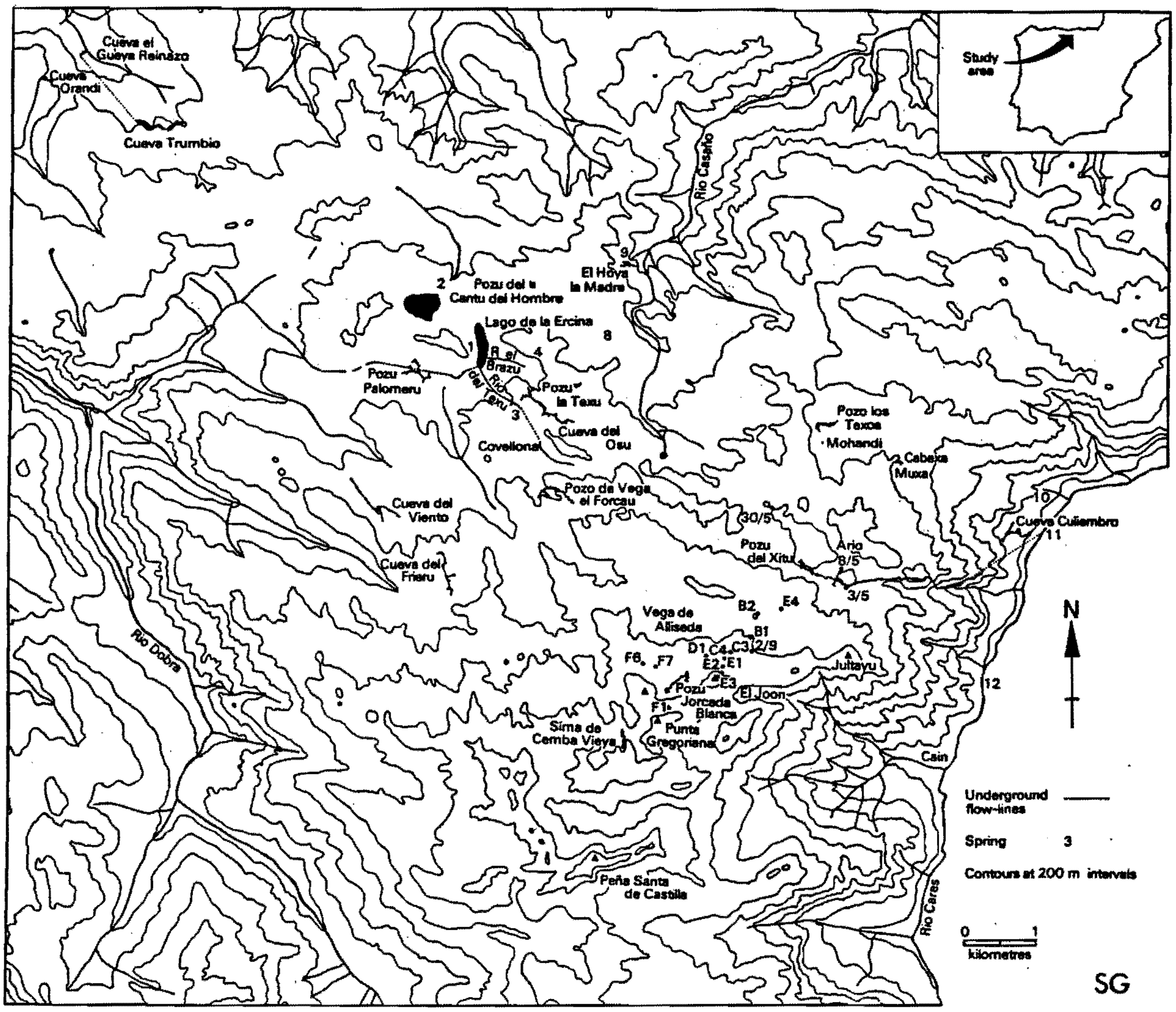
Chris Danilewicz (L)
Andrew Goring
Ray Lyons
Anthony Swithenbank
Michael England
Stephan Grimmer
Sean Sculley (MO)

Borneo '83

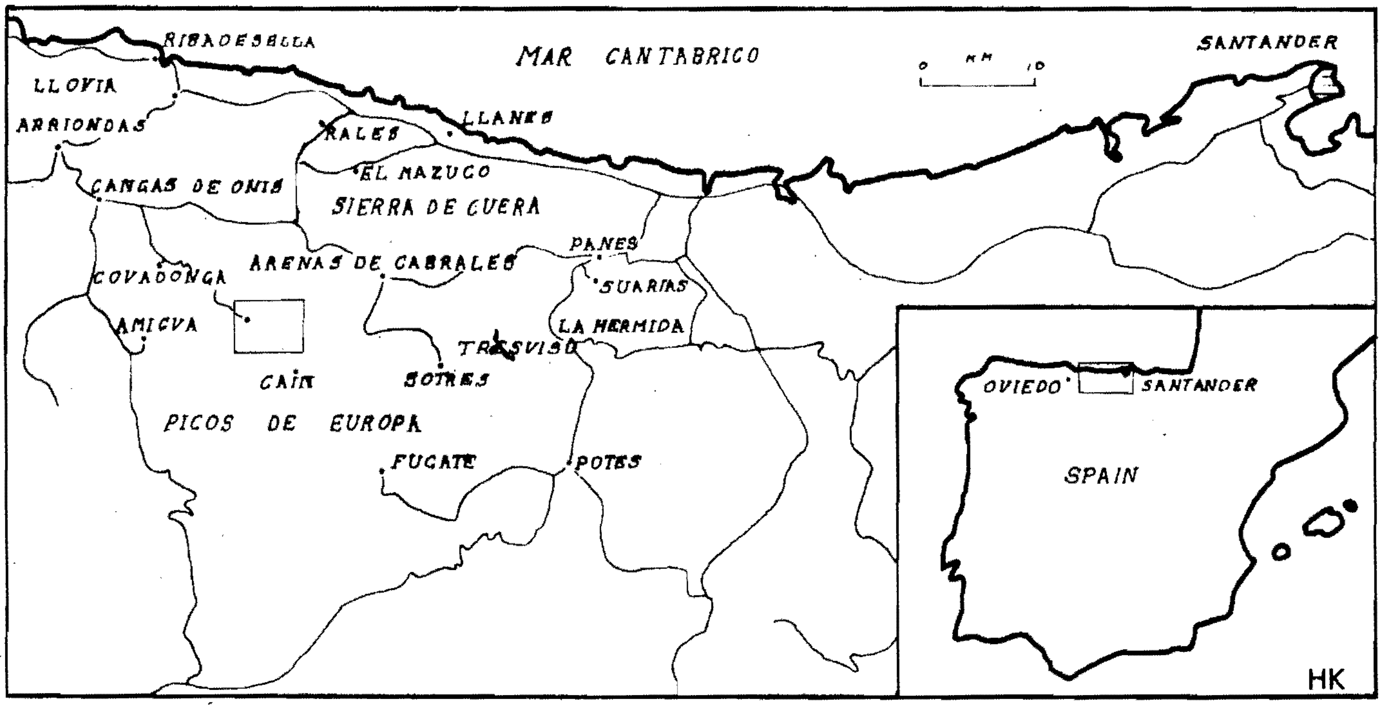
Chris "Rat" Ankcorn (Skippy)(MO)
Tom Houghton (MO)
Pete Shewell (Shoves)(MO)
Richard Gregson (MO)
Martin Laverty

Notes

AS=Assistant Secretary, L=Leader, MO=Medical Officer, PO=Press Officer, T=Treasurer, TM=Tackle-Master.



FRONTISPIECE
Above: Large scale map of the area studied.
Below: Map of general region. The small rectangle indicates the area covered by the top map, the dot indicating the Base Camp at Lago de la Ercina.



THE 1982 AND 1983 OUCC EXPEDITIONS TO THE PICOS DE CORNION, NORTHERN SPAIN

Introduction

In 1982, the Club was faced with a problem: the area around the well-established top camp at the Refugio MVA, Ario (Frontispiece), used since 1979, was almost worked out. Around forty or so shafts had been logged, none of which had gone very deep, with the exception of Pozu del Xitu (Singleton, 1982), and so it was necessary to move on to some other area. There were a variety of suggestions, some more practical than others, including moving to another massif in the Picos or abandoning Spain in favour of Turkey. In the end, access problems in Spain and considerations of time involved in organising an expedition to a country which none of us had visited ruled the above two suggestions out, and the third, and in my opinion most sensible option, of staying in the same area and moving higher into the mountains, was adopted.

At the beginning of July 1982, a top camp was set up at the Refugio MVA, Ario, and a trail of cairns was laid along a bearing of 210° to La Jayada, a massive cave entrance visible from just about everywhere in the Picos, where a tent full of gear was left. La Jayada was to be the initial base for exploring the high basin known as El Joon: the tent was an hour's scramble from Ario and sufficiently isolated to stop anyone getting at the gear, or so we thought! After a week, 75 metres of rope had been stolen and so we started to hide the tackle in convenient cave entrances.

The first two weeks were very productive: many shafts were examined and two of the three most important of the smaller caves, C3 and C4, were found in that period.

By around the 20th July, cave exploration, rather than discovery, was starting in earnest: but by the end of the month the three most promising caves had ended disappointingly at depths of around 120 m.

The team was quite demoralised as the three caves had all shown great promise. Only one obvious lead remained open: F2, a partially snow-filled shaft right at the limit of our search area. For once, the weather actually aided us, as the 1982 winter had been exceptionally mild, leaving shafts which were normally blocked with snow, free. Had we found F2 in its 1983 condition, it is very likely that the cave would have joined C1, C2 and many more as "choked with snow".

The first ten days of August saw some frantic activity as the exploration of F2, or FU56 as it became known, started. The cave was just too far to be pushed from Ario - gone are the days when OUCC 'ard men would walk for two hours from Los Lagos to Pozu de la Vega el Forcau, get changed, go caving for fourteen hours and then walk home again - and so a camp was established on the only piece of level grass between La Verdelluenga and Pica la Jorcada, five minutes from the cave. Water supply is always a problem at this particular site. In 1982, we were reduced to using snow from a snow field below Los Tiros, whilst in 1983, a seasonal spring 5 minutes' walk in the direction of Vega de Alliseda was dammed to produce 10 litres an hour.

The story of the rest of the 1982 expedition is well known from articles published in Caves and Caving (Singleton, 1982) and Descent (Rose, 1983): on the evening of the 14th August, virtually all the expedition gear had been taken into the cave and then out again. The depth of the cave was just over 520 metres, and we were triumphantly stuffing ourselves with fabada back down at the Refugio.

The 1983 expedition did not start off quite as well. In 1982 we had bought the old University Ford Transit minibus and after its performance and reliability, we felt justified in buying another. Unfortunately its 1983 sister was not quite of the same standard and ended up on its side in a ditch near Bordeaux. As a result, two expedition members were briefly detained in hospital and there was yet more delay whilst bits for the battered van were sought. On arrival in Spain, the shaft of FU56, or Pozu Jorcada Blanca as it had by now become known, was found to be blocked with snow. The top campsite just above the Vega de Alliseda was reestablished - it seems to be a good base for future expeditions - and snow digging commenced. In fact, only two and a half days' digging were necessary to break through the blockage. Around a week and a half later the cave had ended, at a disappointing depth of 590 m (Singleton and Gale, 1983).

The passage discovered in 1983 is some of the hardest in the cave: however, most of it is streamway and gains little depth. Many attempts to climb above the stream, or to dig to find a sump bypass were made, especially around the Pleasure Dome and Desperation Dig, but all were to no avail. The cave was surveyed, photographed, studied and derigged, leaving just over a week of the expedition for the remaining eight cavers to find and explore some suitable objectives for the 1984 Expedition. They set to work like maniacs, and as a result two caves, 8/5 and Pozu las Perdices, are wide open at depths of around 120 m, with lots of potential. The two expeditions, 1982 and 1983, show what Spanish caving is all about. You must take the rough with the smooth: after all, it took OUCC twenty years to hit its first 1100 m deep pot. I for one am very satisfied with a 590 m deep system and some promising caves left for the 1984 expedition.

Acknowledgements

We should like to thank the following sponsors, without whose help the 1982 and 1983 Expeditions would not have been possible:

1982

Oxford University
A.C. Irvine Fund
Dunlop Ltd
The Ghar Parau Foundation
W. Jordan (Cereals) Ltd
Karrimor International Ltd
Lyon Ladders
Morning Foods Ltd
Mountain Equipment
Quaker Oats Ltd
The Secretan Bequest
Sports Council of Great Britain
St Ivel Ltd
Thermawear Ltd
Touchwood Sports (Oxford)
Troll Safety Equipment Ltd
Trevelyan Fund

1983

Oxford University
Berghaus of Newcastle
British Petroleum plc
Brooke Bond Oxo Ltd
Caving Supplies
Clogwyn Climbing and Safety Ltd
Colman's of Norwich
Dunlop Ltd
Duracell (UK)
Ever Ready Ltd
The Ghar Parau Foundation
Golden Wonder Ltd
Goodall, Backhouse and Co Ltd
Hodder and Stoughton Ltd
John West Foods Ltd
The Kenco Coffee Co Ltd
Lee and Perrins Ltd
Lyon Ladders
Metal Box plc (Wantage)
Morning Foods Ltd
Nabisco Ltd
NCA Equipment Store
Photo Technology
Pigeon Mountain Industries, Inc
Quaker Oats Ltd
Ringtons Ltd
Rowntree Mackintosh plc
Royal Geographical Society
The Ryvita Co Ltd
Sports Council of Great Britain
St Ivel Ltd
The Sunday Times
Supreme Plastics Ltd
Symbol Biscuits Ltd
Thermawear Ltd
Touchwood Sports (Oxford)
Troll Safety Equipment Ltd
UB (Biscuits) Ltd
Walkers Crisps Ltd
Weetabix Ltd
World Expeditionary Association

Many thanks are also due to:
BCRA, CNE, FNE, CRNE, ICONA and the Spanish Ministries of Culture and

Agriculture for allowing us to work unhampered in the area;
Professor (elect) A.S. Goudie, the Expedition Patron, Dr M.M. Sweeting, the Expedition Home Agent; and Clive Westlake;
Alvaro, warden at the Refugio MVA, Ario for putting up with noisy drunken English cavers with such good humour;
Sr. Amador Gonzalez for jokes, praise, encouragement, hot meals and hot showers;
All the staff of the Banks, the Bar Rio Grande and the Post Office in Cangas de Onis, who always made us feel very welcome;
Martin H., Mark G., Chris D., who brought their vehicles with them on the two Expeditions.

Topography

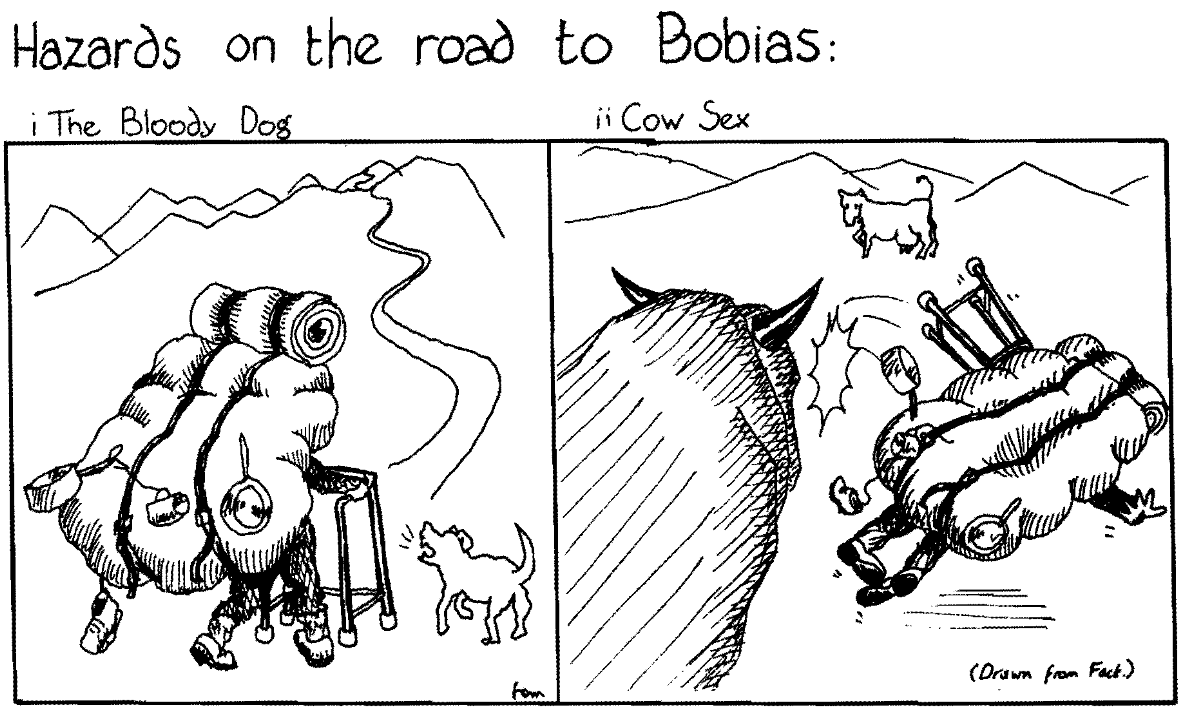
The Picos de Cornion form the western massif of the Picos de Europa mountains in northern Spain. The expeditions were to the part of this area within the Province of Asturias (Oviedo), but Léon and Santander also have territory there. The mountains rise to 2596 m within 30 km of the aptly named Costa Verde: the Green Coast. The climate is therefore strongly influenced by oceanic effects and is rather wet, 2119 mm of rainfall per annum being recorded at Bufferara near Los Lagos. Although June, July and August are slightly drier than other months, the summer can bring periods of prolonged drizzle and fog, as well as severe thunderstorms and occasional snow. The former may be accompanied by hailstones or winds of prodigious size and intensity: both have been seen to wreck tents with great ease! Permanent snowfields are a prominent feature of the peaks and snowplugs persist in dolines and shafts at altitudes as low as 1250 m. The spring thaw with its associated impressive flooding must be an important time for continuing cave development. The evidence for such flood events is particularly clear in the lower levels of caves, where new vegetation chokes appear each year in sites far above observed summer water levels. Vegetation is generally sparse above the level of Los Lagos, and is probably decreasing in extent as a result of overgrazing by goats, sheep, cows, and sometimes horses. Further details of the biology of the area are contained in Fisher *et al.* (1979).

A Note on Map Coverage of the Area

In order to reach the expedition area, road maps obtained from the Spanish National Tourist Office or published by Firestone (Costa Verde y Picos de Europa - 1:250,000) are quite adequate, and usually in agreement one with another. At a more detailed level, no really accurate maps appear to exist. The most accurate looking map is the Mapa de los Tres Macizos de los Picos de Europa at 1:50,000 scale produced by the Federacion Española de Montañismo (Alberto Aguilera 3, Madrid 15; the same address as the Comision Nacional de Espeleologia, from whom permits are required to cave in Spain). This map is on sale only in Potes, Aliva, Posada de Valdeon, and Arenas de Cabrales and is basically the same as the relevant portions of the Mapa Nacional sheets 55, 56, 80 and 81. However, the Lambert grid on those is not reproduced, so map references must be given in terms of latitude and longitude (W of Madrid, not Greenwich!). Another 1:50,000 map is produced by the Federacion Asturiana de Montañismo (Melquades Alvarez 16, 1. Izda., Oviedo) and this gives full details of the network of mountain refuges. Its contouring is far less detailed than the other map, but the rivers, settlements and paths are generally more accurate. The most used map of the area, and the most easily available, is the 1.25,000 Mapa Topográphico - Excursionista produced by Editorial Alpina (Apartado de Correos, 3, Granollers) entitled Picos de Europa I Macizo Oriental. This comes complete with a guide book to walks in the area, but can be rather misleading or confusing to use. This problem is exacerbated if comparison is made with the other maps! The map which is considered best by experienced members of the SIE group of cavers from Barcelona is another

1:25,000 map produced by J.R. Lueje for a book called Picos de Cornion, published by Gijon in 1968. Unfortunately, this is not easily available.

References
Fisher, R.C., Hooper, M.D. and Warren, A., 1979. Proposals for the biological management of the Parque Nacional de la Montaña de Covadonga, Asturias, Spain. Discussion Papers in Conservation, University College, London, 25, 44 pp.
Rose, D., 1983. Revenge in Sight. Descent 54, 26-32.
Singleton, J. (ed.), 1982. Proc. Oxford Univ. Cave Club 10.
Singleton, J., 1982. The Oxford University Cave Club Expedition to the Picos de Cornion. Caves and Caving 18, 24-27.
Singleton, J., and Gale, S.J. 1983. The 1983 Oxford University Cave Club Expedition to the Picos de Cornion. Caves and Caving 22, 12-15.



CAVE DESCRIPTIONS

The location of all caves is shown on the Frontispiece.

POZU JORCADA BLANCA

Location 43° 13' 30" N, 1° 15' 35" W.
Warning: The entrance pitch is liable to fill completely after snow. Penetrating the blockage could take several days.

Pozu Jorcada Blanca is a sporting cave, once thought to be the deepest in the world (Rose, 1983). Unfortunately, it suffers from premature sumping at a depth of about 600 m. The Entrance is situated in a large, generally snow-filled doline at the edge of a rocky plateau about 600 m from La Verdelluenga on a bearing of 280°: the cave is best approached from Ario via the Vega de Alliseda.

Two entrances are available: a gentle stroll over boulders past the snow-plug leads down to the top of the first pitch, whilst in snowy weather, a 1.5 m diameter shaft (10 m) through the rock outcrop above the main entrance can be rigged to bypass the worst of the plug. The first pitch, Snow Joke, descends for 20 m over snow and ice in several stages to a bolt, and another pitch of four metres through a horizontal slot, landing on a steep slope of pebbles, boulders and soil. A traverse line down this to the head of the next pitch, Is Necessary (P.38 m), is advisable, as the slope is highly unstable, and it is best for only one person to be on the ledge and pitch at a time. Is Necessary is a thoroughly unremarkable pitch on which it is best to keep one's eyes shut so as not to see the precariously poised large boulders on the other side of the shaft and the ice-cold water and stones raining down from the melting snow plug above. At the bottom, there are two blind pots; rather than descend part way down the further one and pendule across to the continuation of the cave, the easiest way on is to climb down a small rift to the left and rig a short ladder (P.5 m) from the end of it on to a large ledge. A walking-size passage, quickly diminishing in height, leads from the ledge to the head of the next pitch, the Chair (P.9 m). The reason for the name is obvious; the take-off is tight and the easiest way to get on the rope is to sit in a natural seat with one's feet dangling over the pitch. A mid-air changeover just below a large ledge - unfortunately, no-one saw fit to put a seat here - is necessary to get on to Chair II (P.13 m), a nondescript little climb against the wall. To the left at the bottom, a small section of stream is encountered, but the way on is a climb up to the right over boulders to the entrance of Meander of the Argonauts (Rift I), a constricted, awkward meandering rift passage, of the type in which OUCC cavers have difficulty controlling themselves.

The rift ends at Mistral I (P.18 m), a freehanging pitch which lands on a large ledge where the stream reappears. A climb down through a trench leads to the head of Mistral II (P.20 m), rigged from a "Y" belay, to give the best take-off in the cave. Unfortunately the pitch does not match up to the take-off, the ascent being a scrabble up loose and sharp flakes. At the bottom of Mistral II, a traverse across an unstable boulder ledge leads to the head of Mistral III (P.34 m), a fine free hang, landing in a short section of vadose passage, which ends at the tight take-off to Mistral IV (P.10 m). A short climb leads to the top of Choss Pitch (P.10 m), inconvenient on either ladder or rope, being broken by a ledge and numerous rock projections. The pitch lands in a chamber with a pit in the floor; climbing up to the left, a hairy traverse (Walk on the Wild Side) leads over the pit into a small chamber in a rift, and from here a climb down brings one into Rift II, another tight traverse. There is a bypass to Walk on the Wild Side for tiny cavers: just climb down into the pit with the aid of a rope and thrutch through the rift above stream level. At the other end of Rift II is a short drop (best lined) to the head of Marble Bathroom (P.18 m), which allows the use of a deviateur, for the technically minded and less sporting, to avoid the water. For the first time in the cave one can take more than a few steps in a horizontal direction, but just around the corner lies yet more traversing and climbing (the second climb down is actually provided with a bolt for ease of tackle hauling) and the three Bathroom Steps (Ps.8 m, 12 m, 9 m).

After the third Bathroom Step, the stream tinkles off into a short vadose trench before hurling itself down the 55 m drop of the Font: a magnificent hang is provided by strolling out to where the passage starts to open into the shaft and then using a knob on the right of the passage as a final belay. The shaft is very fine indeed, with walls of smooth polished limestone and a refreshing light to heavy drizzle. From the foot of the pitch, a further drop, rigged in a couple of stages (Ps.8 m, 5 m) is descended to a boulder heap wedged in the passage. From the boulder heap, a pitch (Stead's Braille Blunder; P.18 m) can be rigged to follow the water down to the Watershed, an as yet impenetrably tight rift, which absorbed a day's work with a hammer without yielding its secrets. The way on is in fact to traverse over the Watershed on to a climb known as The Time Warp ("It's just a jump to the left and a step to the right"); it is best to hang the rope from Stead's Braille Blunder down here to act as a hand line. A short traverse in fossil stream passage, and then the head of One Step Beyond (P.22 m) provide a just reward for psychospeleologeneticists who possess sufficient intelligence to ignore the Watershed. Two further pitches (Ps.10 m, 15 m) descend to reach the Valley of the Kings, a dry, eerily quiet chamber, described by one (c/r*)aving (* - delete as appropriate) journalist as "the most astounding discovery ever made by British Cavers" (Rose, 1983). There are two ways on from here: to the right a short ladder pitch leads to a ledge with walls encrusted with strange pyramid formations and the top of Pyramid Pitch, a 20 m descent to an impossible choke; to the left, a short climb down and then Squelch!, a 10 m pitch, drops one on to a big ledge above the Sphinx (P.60 m), another beautifully formed but dry shaft. The pitch head here has an unfortunate tendency to accumulate ironmongery, as each successive caver feels obliged to add a further belay, stuffing bits of metal into every available orifice.

From the bottom, it is a short scramble over boulders to the final pitch in the entrance series, Wallop! (P.28 m), where again a deviateur is useful. Just downslope and round the corner from the base of Wallop!, the stream can be seen rejoining the main route on, forming an impressive sight as it plunges from a great height into Lago Victoria, a large clear pool.

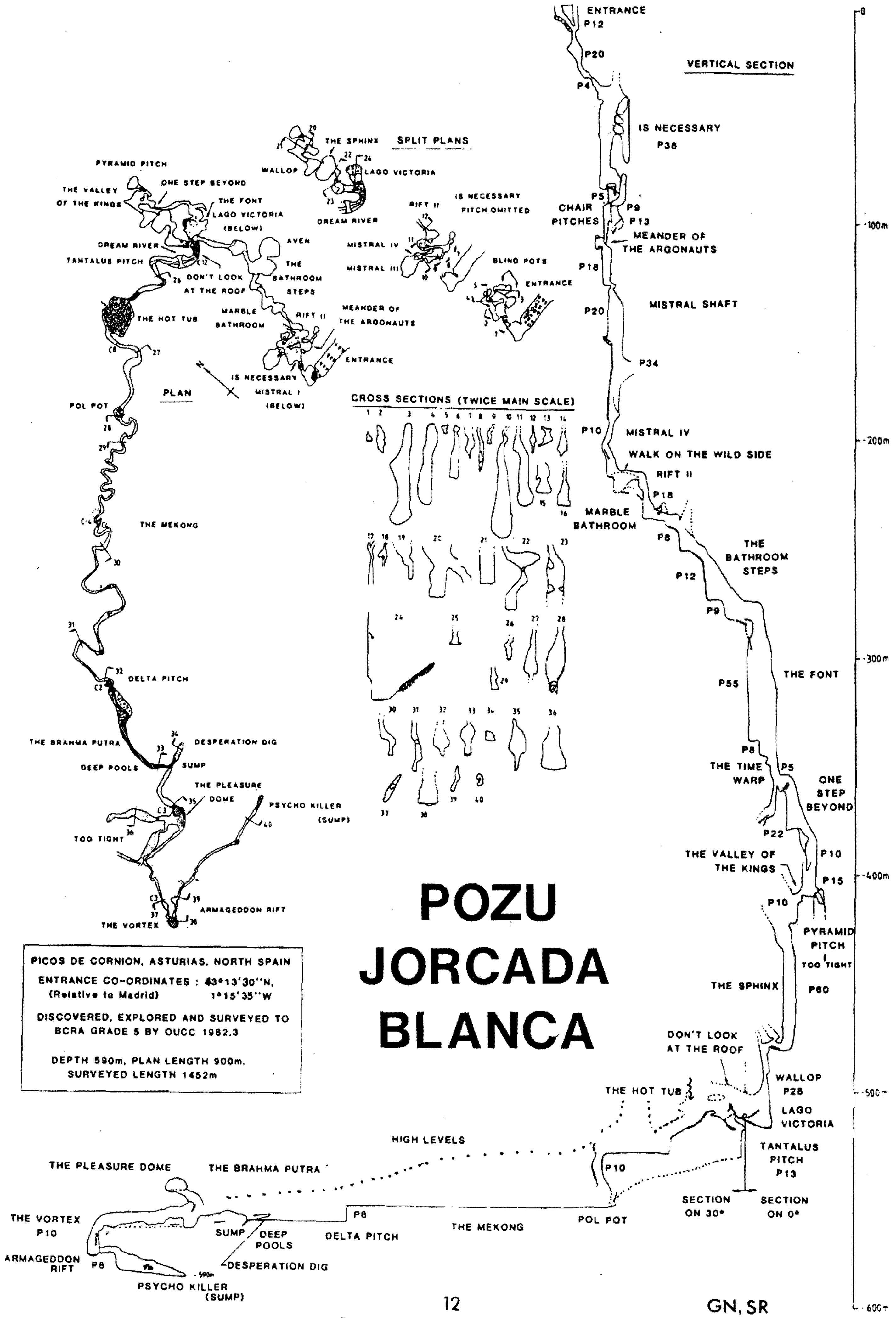
On the other side of this rather draughty and wet place, a crawl under some rather unlikely-wedged boulders called Don't Look at the Roof leads on: for the faint of heart, an easy but loose 10 m climb leads over the top. Following the streamway, Tantalus Pitch (P.13 m) is reached; however, the way on is to traverse over it at high level, the traverse eventually entering a large chamber, the Hot Tub. The chamber is impressive, but not so impressive as to warrant a long stay, as it is basically a huge aven and hence very draughty and wet. At the far side, down the steep boulder floor, a rift leads off, and after a short distance can be climbed down to a large ledge. The walls are covered with 'popcorn' (aragonite?), which tends to make the climb memorable, though more memorable to some than others (Eh, George?). A section of easy strolling over wide ledges on either side of a deep trench ends at Pol Pot (P.10 m), the first convenient point to drop to the streamway. The pitch lands on an unstable boulder-covered ledge and the stream is regained by climbing carefully across this and then bridging down the trench below; behind, the water falls 10 m into a deep pool in the bottom of a well-proportioned elliptical shaft, whilst ahead lies the longest section of streamway in the cave, the Mekong River, a tortuous vadose passage often reminiscent of the Crabwalk in Giant's Hole. Tackle carrying is made tedious by the passage shape and a number of boulder piles blocking the stream. Eventually the Mekong ends in an 8 m drop: Delta Pitch (P.8 m).

The passage beyond this pitch, the Brahmaputra, is spacious and the water flows sluggishly between deep pools. Traversing over these pools can be entertaining and almost invariably (Ed: well, in my case anyway) you fall in. A few metres on, the way appears to divide. Straight ahead is an impenetrable choke of silt, pebbles and boulders marking the old blocked route, whilst to the right the stream flows in a new course. A bit of bridging over the active stream leads up into a fairly large chamber, the Pleasure Dome, which would have made an ideal campsite had the cave gone deeper. Below a climb over sandy ledges, the water enters a section of hading rift, and it is much easier to follow the widest part of the passage a few metres above. The streamway starts to become constricted and then ends abruptly in a feet-first squeeze at shoulder height straight on to a wet pitch known as the Vortex (P.10 m). At the foot of the ladder is a roomy spray- lashed chamber, the only way on being a tiny 0.3 m wide rift running back underneath the water. Movement through the rift is made 'interesting' by its inclination and by the knobbly projections all over the walls; however, relief soon appears in the shape of a 6 m pitch with a tight take-off. The pitch lands in a comfortable-sized rift and an easy traverse in the widest part gives the impression that the cave is getting friendly again. After a manoeuvre under a jammed boulder and a short section of shingle-floored passage, the roof is seen to descend and a deep pool is encountered. Unfortunately it is not another large puddle to traverse over or a short duck but the terminal sump pool, at a depth of 590 m. The sump is known as Psycho Killer and the passage leading to it as, yes, you've guessed it, Psycho Path.

So, a disappointing end to a classically-formed Picos Pot. The trip to the bottom and out without gear would take about ten hours if you really sprinted along, and so if you have ten days to spare, 600 m of rope, a snow blower and a bunch of tackling/detackling fools, I mean friends, it might be worth a shot. Try cordelette perhaps, but I'm not rescuing you.

Tackle (* - optional, @ - alternatives)

Pitch	Name	Rope	Belays
12 m*	Entrance	14 m rope	Long tapes and wires to boulders
20 m	Snow Joke	20 m ladder 30 m rope (used on next pitch)	2 bolts
4 m		5 m rope	1 bolt
Traverse on ledge		10 m ladder	1 bolt
38 m	Is Necessary	40 m rope	1 bolt and long tape to flake. 1 long rope protector needed
8 m@	Pendulum	10 m rope	2 bolts
5 m@		5 m ladder	long wire to flake
9 m	The Chair	25 m rope	Tape to flake and 1 bolt
13 m	Chair II		Long wire to flake
18 m	Mistral I	19 m rope	1 bolt, short belay to knob
20 m	Mistral II	23 m rope	2 bolts: tie Y belay
34 m	Mistral III	36 m rope	Long tape to boulder and 1 bolt
10 m	Mistral IV	11 m rope	2 bolts
10 m	Choss Pitch	2 x 5 m ladders 12 m rope	Tape to large flake; wire belay for 2nd ladder at ledge
Traverse@	Walk on the Wild Side	10 m rope	1 bolt at upstream end; medium length tape through thread at other
6 m@	Martin's Bypass	7 m ladder	Long wire to flake
18 m	The Marble Bathroom	23 m rope	Tape round knob at end of rift; 1 bolt rebelay; deviateur 6 m from bottom
8 m	Bathroom Step I	10 m rope	1 bolt and tape to flake; protector needed
12 m	Bathroom Step II	14 m rope	1 bolt and long tape to flake
9 m	Bathroom Step III	10 m rope	2 bolts; protector needed
55 m	The Font	57 m rope	2 bolts and short tape
8 m } 5 m }	Hammer Death	15 m rope	{ 1 bolt and long tape round flake; { 1 bolt rebelay
15 m*	Stead's Braille Blunder	20 m rope	Long tapes to boulder pile
22 m	One Step Beyond	23 m rope	Short tape and 1 bolt
10 m	One Stead Beyond	14 m rope	Short tape to natural, then traverse down to 2 bolts
15 m	King Pitch	20 m rope	Short tape to natural; 5 m traverse and then long tape round huge rock



POZU JORCADA BLANCA

PICOS DE CORNION, ASTURIAS, NORTH SPAIN

ENTRANCE CO-ORDINATES : 43°13'30''N, (Relative to Madrid) 1°15'35''W

DISCOVERED, EXPLORED AND SURVEYED TO BCRA GRADE 5 BY OUCC 1982.3

DEPTH 590m, PLAN LENGTH 900m, SURVEYED LENGTH 1452m

GN, SR

5 m*	Pyramid Pitch I	5 m ladder	Long wire
20 m*	Pyramid Pitch II	22 m rope	Long tape; long wire
10 m	Squelch!	10 m ladder 12 m rope	Long wire and long tape
60 m	The Sphinx	63 m rope	Long wire and long tape round huge knob
28 m	Wallop!	33 m rope	Short tape; 3 m traverse to 2 bolts; deviateur; 1 protector needed
13 m*	Tantalus Pitch	15 m rope	2 long tapes
10 m	Pol Pot	25 m rope	2 bolts; 1 bolt at base of pitch for traverse
8 m	Delta Pitch	10 m rope	1 bolt; 1 medium tape
10 m	The Vortex	12 m ladder 12 m rope	Long tape; long wire to flakes
8 m	Armageddon Pitch	10 m rope	2 bolts

Reference

Rose, D., Aug. 1983. Revenge in sight. Descent 54, 26-32.

SMALLER CAVES INVESTIGATED IN 1982-3

Introduction

A wide area was covered in the two expeditions: the article that follows deals only with the more notable finds. Small obviously-blocked entrances are not dealt with and only those caves which otherwise might absorb some considerable time of a future expedition are described. For ease of reference the area was divided into five regions, the area around Ario (/5) (Stead, 1982) and areas B to F higher up in the mountains around La Verdelluenga. All OUCC caves are clearly marked at the entrance with OUCC and their code number, all coordinates given are with respect to Madrid, and all mountain names are from the Lueje Map. Good hunting!

Reference

Stead, W.J., 1982. Small Caves in the Ario Area, Proc. Oxford Univ. Cave Club 10, 24-33.

Ario Area

3/5 Pozu de los Caracoles

Location 43° 14' 05" N, 1° 13' 55" W.

Survey: Figure 1.

The entrance lies about 2 m to the right of the path from Ario to Trea and almost directly above the Teresa Series in Pozu del Xitu (Singleton and Naylor, 1982). The cave was noted by the SIE in the early 1970s and explored intermittently by OUCC in 1979, 80, 81 and 83 (Singleton and Thwaites, 1979; Stead, 1982). In 1983, there were also signs of a recent exploration by the SIE. As a whole, the cave is small, awkward and steeply sloping and is more typical of Yorkshire than Spain.

The entrance itself is a small pit from which a sharply descending narrow rift leads off (climbs 1½ m, 2 m). The floor here consists of small stones which, when dislodged, rattle down the first pitch (care!), called Skittle Alley. Just before the pitch head, the rift widens whilst still descending steeply, and the pitch itself is an easy 8 m descent into a small chamber. The way on consists of a very tight, descending rift in the far wall, called Bull's Eye Squeeze because it is the target for stones dislodged in the entrance. At the far end is a 2 m climb, after which the cave widens, followed by a 6 m chossy climb and the second pitch.

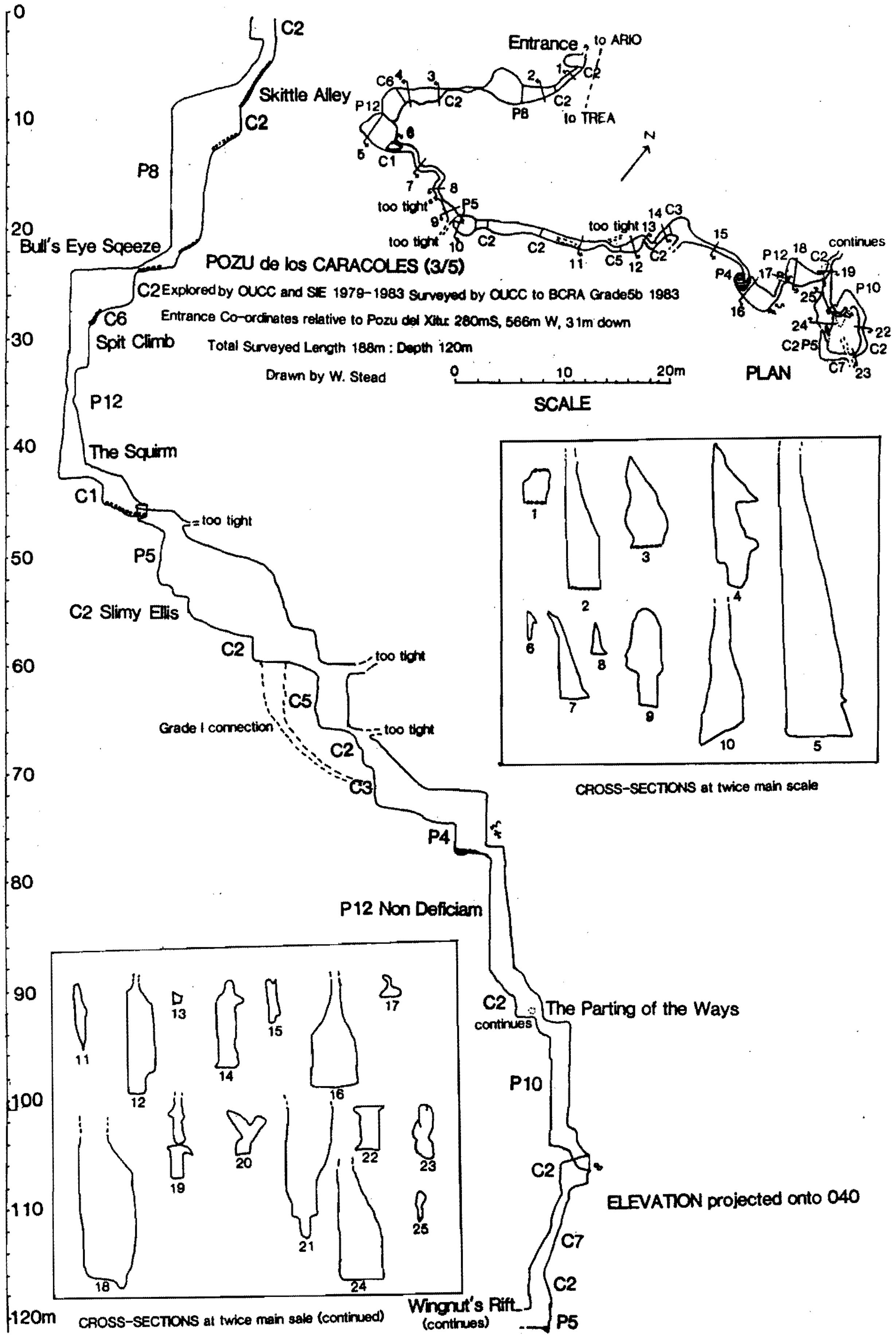


Fig. 1. Pozu de los Caracoles: survey.

The second pitch is a large shaft, 12 m deep, descended on SRT with a rub point 5 m below the belay. From the bottom chamber, two tight canyons lead off which, however, quickly rejoin to form a snake-like grovel. The left-hand canyon is usually reckoned to be less tight and is called The Squirm. Below the grovel, a too-tight passage leads off to the right, whereas straight on lies a tight squeeze which opens out at the head of the third pitch (5 m ladder, bolt).

At the foot of this pitch, the cave opens out, so that it is actually possible to walk upright, and a couple of short climbs (2 m, 2 m) are descended. The first of these was originally covered in moonmilk and is called Slimy Ellis. A handline is unnecessary as there is one good foothold and one handhold.

Passing over a tight trench in the floor, which connects further down the cave, the passage closes in to give two more climbs with tight tops and large bottoms (5 m, 3 m, 2 m). At the foot of the last of these the connection with the tight trench enters from above. The way on is a narrow rift which soon leads to the short fourth pitch (5 m ladder, bolt, spreader). The pitch is free-climbable with care. The ladder lands in a shallow pool in a small chamber with water flowing in over some formations on the opposite wall. A crawl under the drips leads straight into the fifth pitch. This is another substantial shaft, 12 m deep, called Non Deficiam because the bolt at its head is in calcite and needs replacing. At the foot of the pitch is a 2 m climb where the cave splits into two (The Parting of the Ways). The surveyed route goes back under the climb and descends to the sixth pitch. Alternatively, one can continue in the original direction, going through a small hole in the wall to reach a series of loose climbs ending in a pitch. Time did not permit descent of this pitch.

The sixth pitch is 10 m deep with a very awkward, tight take-off and lands in a small chamber. The way on bends round to the right and is a sharply descending small passage leading to a very sharp cross-rift sloping downwards at 70°. The rift is an easy 7 m climb and leads immediately to the seventh pitch which consists of a 2 m vertical squeeze followed by a 5 m ladder belayed on to a very small projection. The ladder lands in a small pool in the final chamber which marks the limit of SIE exploration and the present survey.

On the far side of the chamber lies a tight rift which quickly becomes tighter. One member of the party, using a hammer, managed to get through this rift to an 8 m climb and a chamber from which the passage continues. It is possible that the other route may rejoin this passage, bypassing the rift.

Tackle

The list below gives tackle actually used: however, all pitches are suitable for ladders with self-lines. The bolt on the fifth pitch needs replacing.

Pitch	Name	Rope	Belays
8 m	Skittle Alley	10 m ladder	Bolt, spreader
12m	Second	15 m rope	Long wire belay, sling, rope protector
5 m	Third	5 m ladder	Bolt, spreader
4 m	Fourth	5 m ladder	Bolt, spreader
12 m	Non Deficiam	15 m rope	Bolt, long sling, rope protector
10 m	Sixth	15 m rope	2 bolts
5 m	Seventh	5 m ladder	Short wire belay

References

Singleton, J. and Naylor, G.A., 1982. Xitu, the Cave. Proc. Oxford Univ. Cave Club 10, 8-20.

Singleton, J. and Thwaites, D., 1979. Small caves near Ario. Proc. Oxford Univ. Cave Club 9, 22-24.

Stead, W.J., 1982. Small Caves in the Ario Area, Proc. Oxford Univ. Cave Club 10, 24-33.

30/5 Pozu Optimisto

Location 43° 14' 48" N, 1° 14' 41" W

Survey: Figure 2.

The entrance is very difficult to find in the mist and consists of an obvious shaft about 20 m deep. Two bolts have been located at the lower end to give a free hang into a sizeable chamber with a snowplug. An obvious passage at the far end merely leads to an aven, whereas the way on is a crawl leading to a maze of tight, steeply sloping passages (The Corkscrew). This emerges into a wide rift with a blind hole in the floor and a small passage, off to the left, leading nowhere. At the far end is a huge blind shaft 24 m deep. The way on consists of an awkward traverse round the left-hand side, making use of a large boulder (The Boulder Step).

In the new passage, an attractive flowstone cascade lies straight ahead, but the way on lies to the right through a squeeze to a 3 m climb with moonmilk walls, emerging in a gently sloping passage with a boulder floor, which quickly gets larger. To the left of the largest part of the passage is a small, blind 7 m shaft.

After this, the passage rises and gets much smaller, leading through a squeeze and several twists to a climb and the head of the next pitch, Huning's Horror. This pitch is 11 m long and emerges into a large rift, landing on a small shelf, with a bold step over a rift 7 m deep. A further 2 m climb leads on through a huge sharply dropping rift whose floor consists of enormous boulders. A climb round a small blind pot to a level floor leads to the head of the next pitch, which has a formidable squeeze at its head and is known as The Oubliette.

The pitch lands in a large chamber with water flowing in. An obvious passage leads nowhere, and the way on consists of a tight crawl, which twists and turns, the latter part of which is filled with glutinous mud (Unclean, unclean!). At the end is a 16 m pitch (Lepers' Leap), which lands in a small pool. An obvious rift leads on and soon becomes too tight to follow. The depth gained after this epic turns out to be a paltry 102 metres.

Tackle

Pitch	Name	Rope	Belays
19 m	Entrance	25 m rope	2 bolts
24 m	Blind Pot	26 m rope	2 long tapes*
7 m	Blind Pot	8 m rope	2 long tapes*
11 m	Huning's Horror	11 m ladder	Long wire
13 m	Hywel's Hole (Blind Pot)	15 m rope	2 long tapes*
7 m	Blind Pot	8 m rope	Wire and tape*
10 m	The Oubliette	12 m rope	Short wire and tape
16 m	Lepers' Leap	20 m rope	1 bolt, 1 long tape

* - padding needed

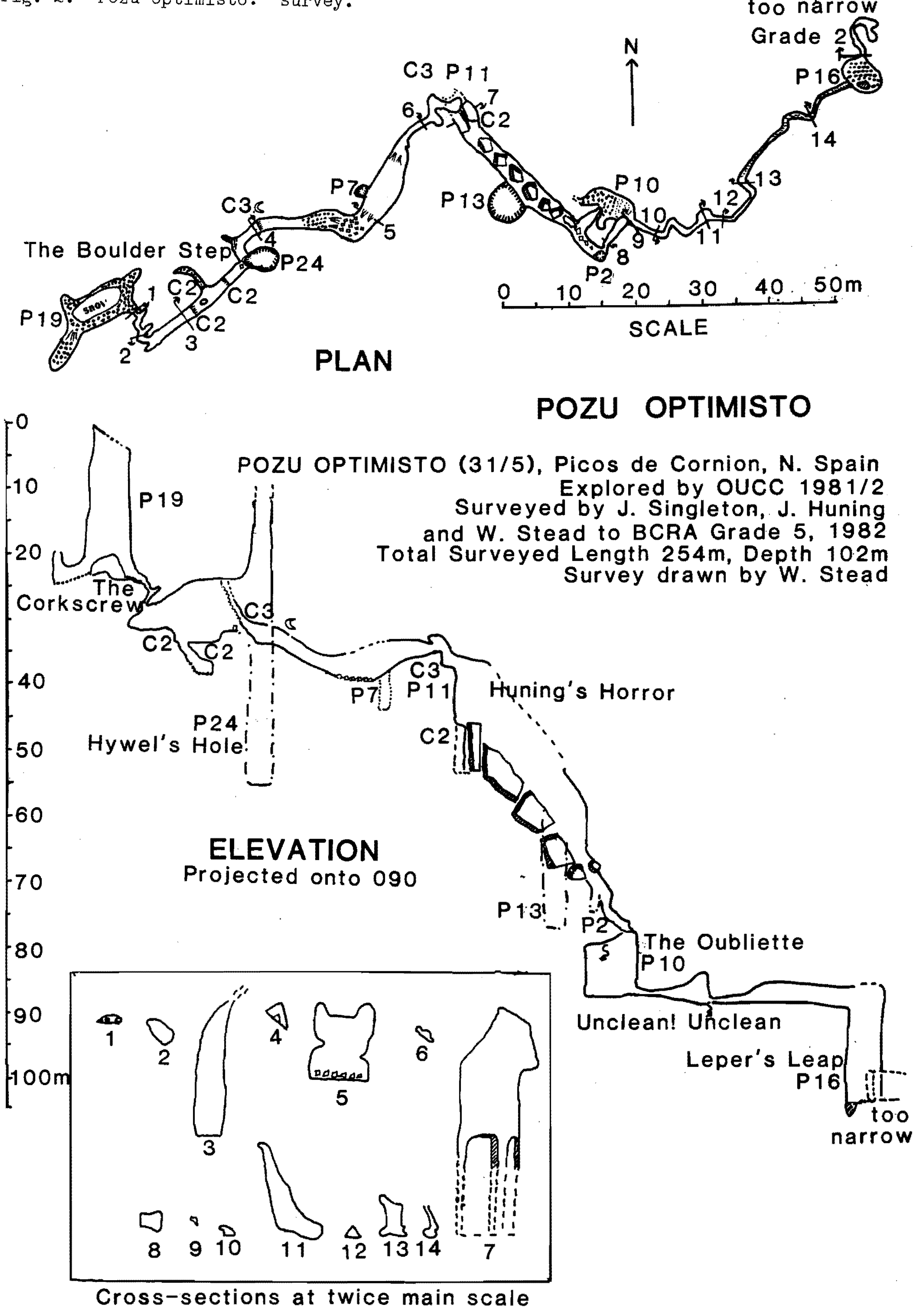
Area B

B1 Bara Shigri

Location 43° 13' 49.3" N, 1° 14' 54.5" W.

The cave is close to the large, very visible, collapsed cave of La Jayada (cave 2/9), and consists largely of an extensive flat entrance

Fig. 2. Pozu Optimisto: survey.



chamber. The chamber has unfortunately been used as a sheep shelter, and so a trip into the horizontal crawls at the back tends to be a messy business. Unfortunately, the crawls choke.

Tackle: none required.

Cave B2

Location 43° 13' 58.8" N 1° 14' 49.1" W

A small entrance in the bottom of a boulder-filled valley 500 m to the north of La Jayada opens into a 10 m pitch. The cave chokes at the base of this.

Tackle

Pitch	Rope	Belays
10 m	10 m ladder	Long wire to boulders

Area C

C3 Sima Verdelluenga

Location 43° 13' 41" N, 1° 15' 07" W

Survey: Figure 3.

The entrance is a superb shaft about halfway between Boca el Joon and La Verdelluenga best found by walking uphill from La Jayada until you are at the following bearings (1982 magnetic). 67.5° to Cabeza Llambria, 94.5° to Cuvicente, and 355.5° to El Regallon. A quick scout around just below the ridge on the Ario side should then reveal a 10 m x 4 m cleft containing the shaft mouth, just below a small subsidiary ridge. The entrance shaft is best taken in several stages: a 14 m first section rigged to a bolt and a natural to form a Y belay, a double bolt rebelay 14 m down, a further single bolt rebelay 6 m below that and a small ledge 7 more metres further down. Two bolts placed on the opposite wall from the small ledge give a nice 17 m hang down to a single bolt rebelay. The final stage of the shaft, which is by now distinctly drippy, is a 24 m hang split by a final bolt 8 m from the bottom. The entrance shaft lands in a decent sized trench which soon narrows sufficiently for a lump hammer to have been used on the initial pushing trip. A squeeze (Manx Manoeuvre) leads to an 8 m ladder pitch and two two metre climbs. A final 24 m pitch drops into a large boulder chamber, from which no way on was found.

Tackle

Pitch	Name	Rope	Belays
14 m	Entrance	75 m	1 bolt, long tape
6 m			2 bolts
7 m			1 bolt
17 m			2 bolts
16 m			1 bolt
8 m			1 bolt
8 m			1 bolt
8 m		10 m ladder	Medium wire belay
24 m	The Huning Naylor Abortion	26 m	2 bolts

C4 Playschool Pot

Location 43° 13' 40" N, 1° 15' 10" W

Survey: Figure 4.

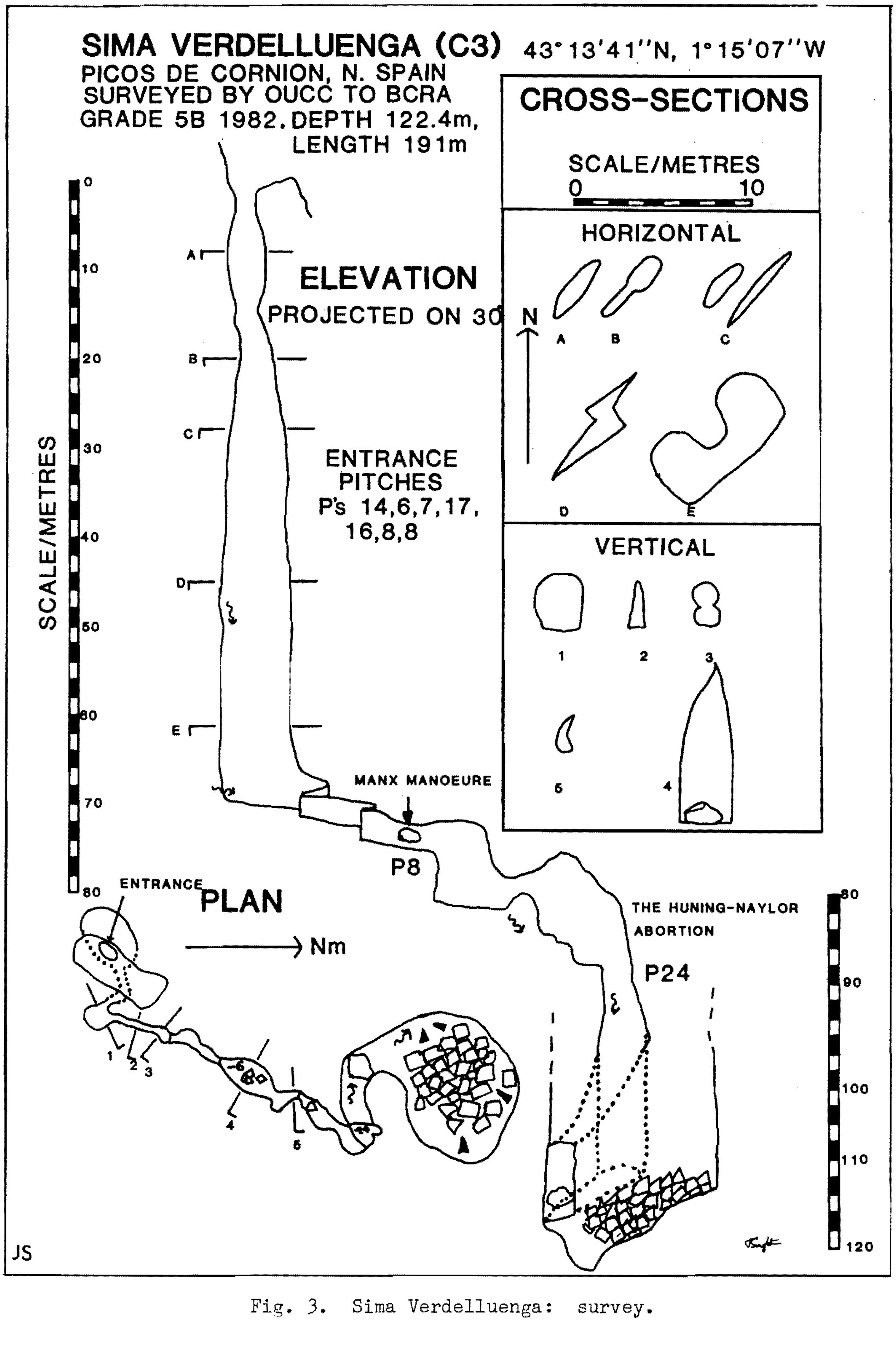


Fig. 3. Sima Verdelluenga: survey.

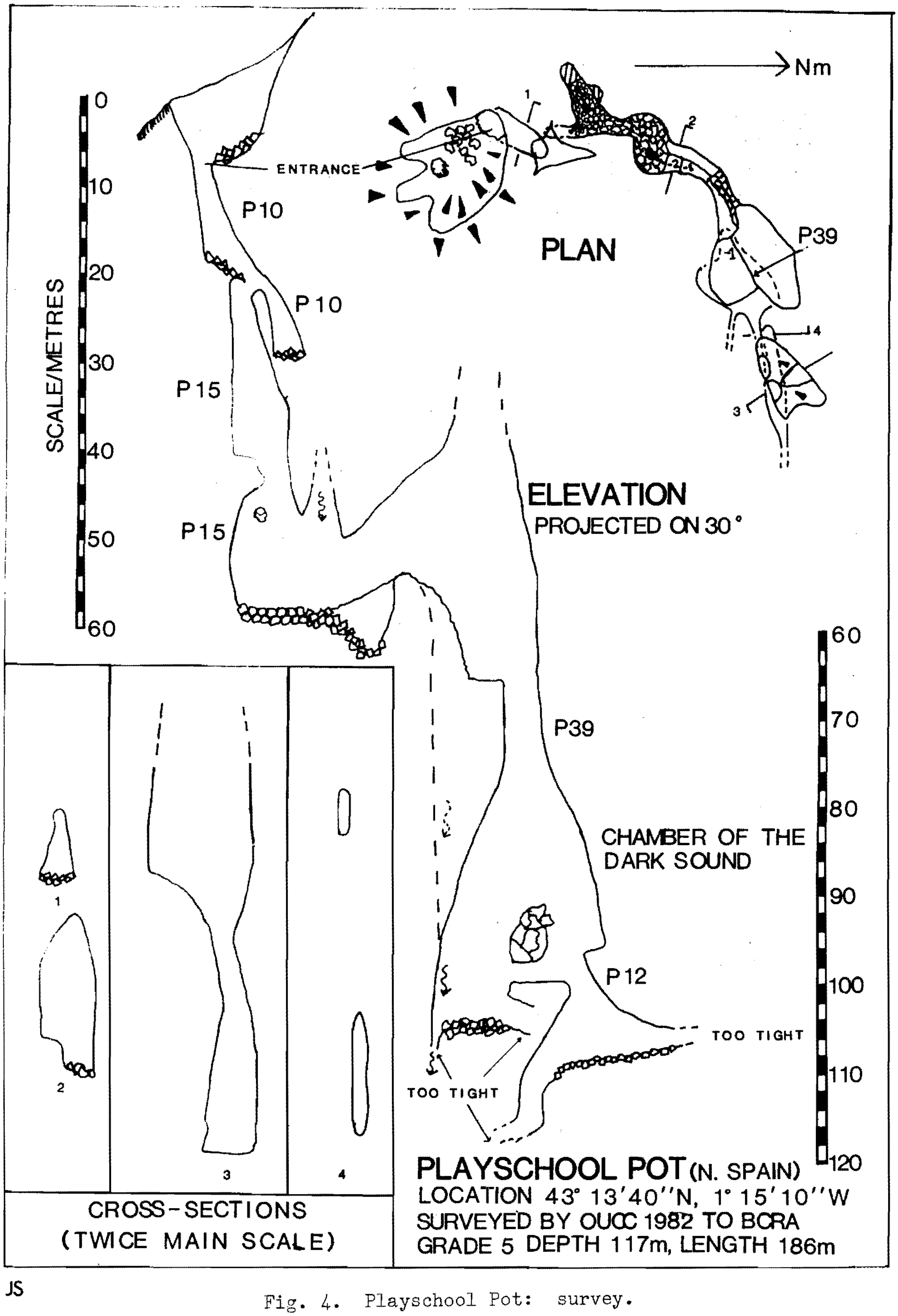


Fig. 4. Playschool Pot: survey.

The entrance is at the same altitude as C3, further over on the ridge towards La Verdelluenga. A subsidiary spur of the mountain meets and crosses the ridge, and in the fold between them is the rock-filled pit containing the C4 Entrance.

A ten metre deep shaft at the western end of the pit can be easily descended, with the help of a 5 m ladder, to a boulder floor with a small, feet-first crawl leading from it. The crawl degenerates into a chossy 10 m deep blind pot; however, about 4 m down, a window in the right hand wall gives access to a spacious shaft. A 15 m pitch from the window lands on a ledge of wedged boulders, from which is rigged the fourth pitch, Alvaro's Leap (P.15 m), which has to be split at a ledge 4 m down for a free hang. At the base of Alvaro's Leap is a section of dangerously loose,boulder-floored vadose passage leading down to the edge of an unstable slope over a large drop. The way round this is to traverse to the right with the aid of a line to a large knob (The Parrot's Beak), where a convenient bolt has been placed in the wall for the other end of the line. Just beyond the Beak is a large ledge from which Space, the Final Frontier (P.39 m) can be rigged. To help avoid rub points, there are two bolts placed 6 m below the ledge. The chamber into which one has dropped, Chamber of the Dark Sound, is very impressive and contains three possible routes on. In the direction of the entrance, a small stream trickles down a 4 m deep slot, which can be descended with the aid of a short ladder to a point where it chokes; just behind the pitch foot a vadose passage quickly becomes too tight; however, the way on is to climb up 5 m on to a ledge just to the left of the trench. From the ledge, a narrow cleft leads to a short scrabble up into a boulder chamber, and at the far end of this a small hole in the floor marks the head of the next pitch. This pitch (P.12 m) never hangs free of the walls and can only be laddered; it lands in a 2.5 m wide vadose passage. To one side the passage rapidly becomes too tight; to the other it drops down two climbs of two and four metres before degenerating into a narrow impenetrable cleft. It is galling that a cave which shows great potential higher up fizzles out in such a frustrating manner.

Tackle

Pitch	Name	Rope	Belays
10 m	Entrance	5 m ladder as aid	Long wire to massive rock
10 m	Riley's Horror	10 m ladder	Long wire to flake
15 m	Window	16 m rope	1 bolt and thread
15 m	Alvaro's Leap	18 m rope	2 long wires to boulders; 2 long tapes for rebelay 4 m further down
Traverse		10 m rope	1 tape to big flake; 1 bolt
39 m	Space, the Final Frontier	43 m rope	1 bolt and 1 piton in big crack; 2 bolts 6 m down
12 m		12 m ladder	Long wire to massive block

Area D

Cave D1

Location 43° 13' 40" N, 1° 15' 22" W.

The cave consists of a 35 m deep shaft, containing two natural bridges, and two small chambers, the total depth being about 40 metres. The pitch opens into the first small chamber (named Sala de la ropa incontinenta del Gome) and the way on continues through a small crawl which widens into another small but choked chamber. The shaft is rigged via a natural belay with a 15 m ladder on to the second natural bridge, and a 20 m ladder is required together with a bolt and thread belay for the second pitch.

Tackle

Pitch	Rope	Belays
15 m	15 m ladder	Long wire to flake
20 m	20 m ladder	1 bolt; long wire to thread

Area E

Cave E1

Location 43° 13' 33" N, 1° 15' 15" W.

A ten metre deep shaft, at an altitude of around 1960 m on a direct line between Pico Gustuteru and La Verdelluenga. Even in 1982 it was completely blocked by snow.

Tackle

Pitch	Rope	Belays
10 m	10 m ladder	Long wire round large rock

Cave E2

Location 43° 13' 29" N, 1° 15' 15" W.

Around 100 m to the south of E1 is an obvious entrance which degenerates into a tight rift pitch. The pitch opens out into a very loose chamber. The only way on is (guess what?) blocked with snow.

Tackle

Pitch	Rope	Belays
15 m	15 m ladder	Long wire to largest rock in vicinity

Cave E3

Location 43° 13' 27" N, 1° 15' 17" W.

E3 consists of a small hole in a dolomitised area below the summit of La Verdelluenga. As an illustration of the difference in resistance between the coarse-grained dolomite and the surrounding Carboniferous limestone, this cave was dug to a depth of three metres in less than five minutes, whereas it takes half an hour to put a bolt into the limestone.

Tackle: none required.

Cave E4

Location 43° 14' 00" N, 1° 14' 35" W.

This cave is just to one side of the red-marked path to the Vega Seca, and consists of a 12 metre pitch down to a crawl, to two loose climbs. The way on rapidly becomes too tight.

Tackle

Pitch	Rope	Belays
12 m	15 m ladder	Long wire

Area F

Area F is the region around the top campsite between La Verdelluenga and Pica la Jorcada.

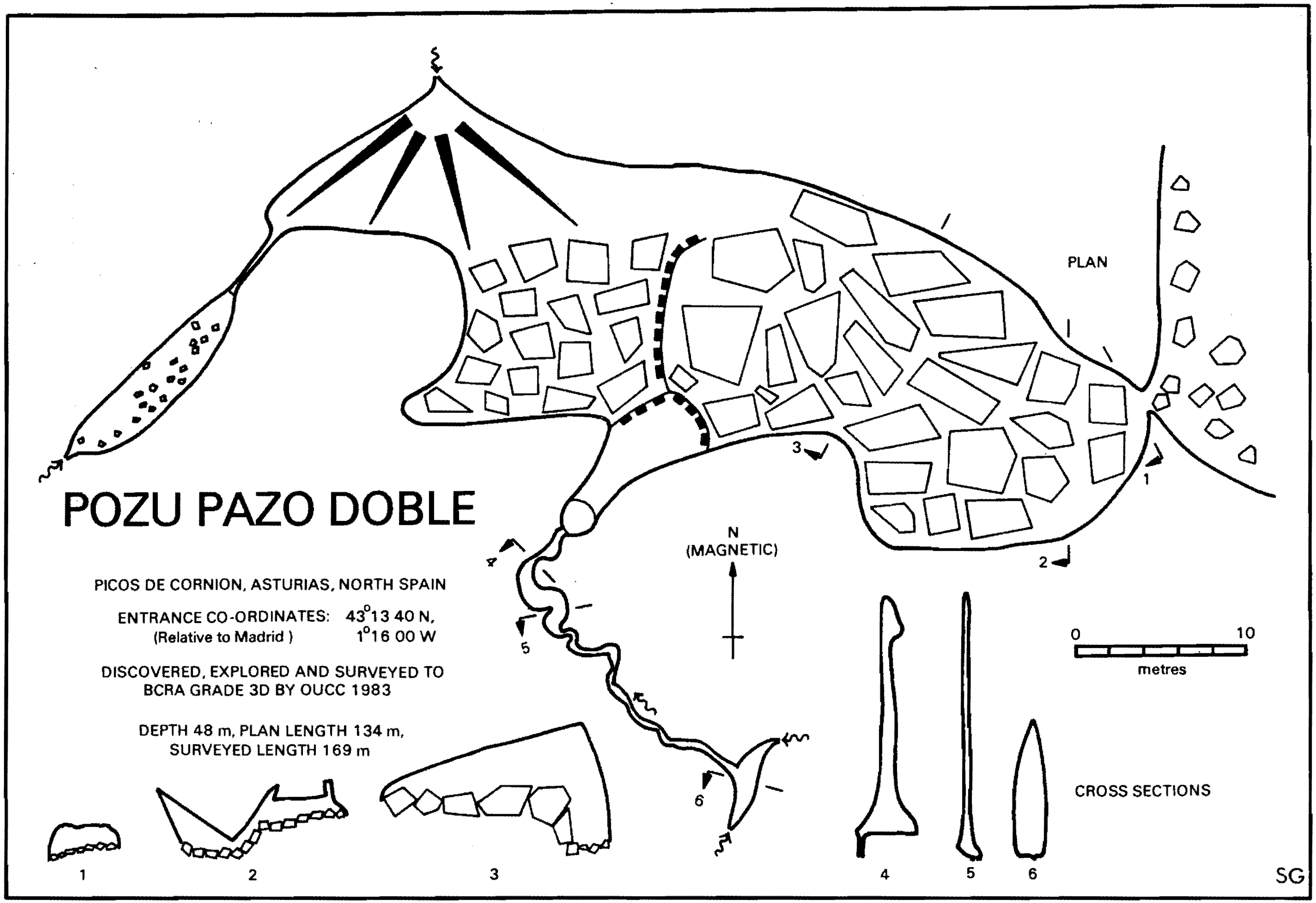


Fig. 5a. Pozu Paso Doble: plan and cross sections.

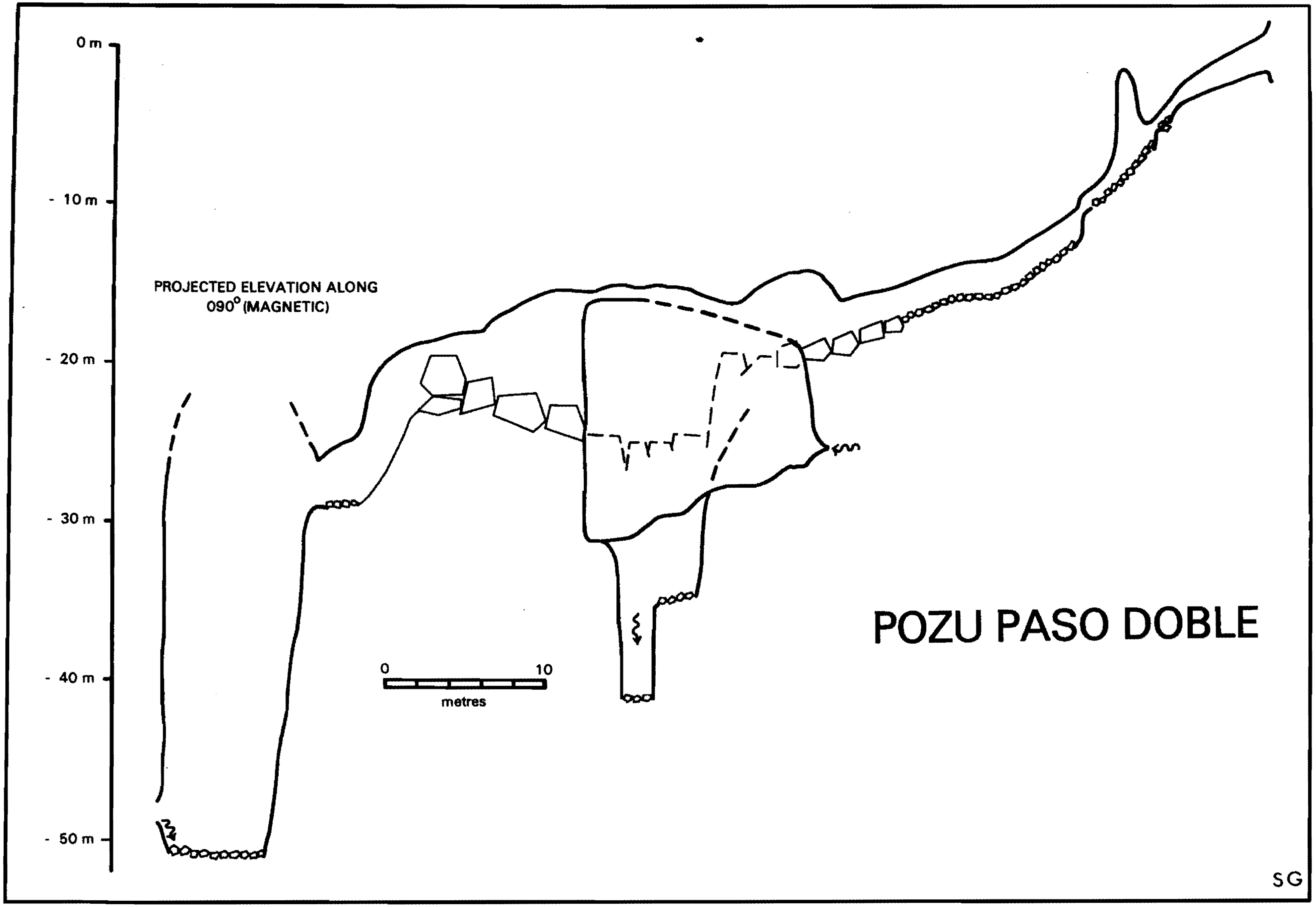


Fig. 5b. Pozu Paso Doble: projected elevation.

F1 Cliff Rift Hard

Location 43° 13' 15" N, 1° 15' 25" W.

Located on the flanks of Punta Gregoriana and plainly visible from Pozu Jorcada Blanca, Cliff Rift Hard is a splendid rift in the side of a cliff. The single 20 m entrance pitch lands on the inevitable snow plug.

Tackle

Pitch	Rope	Belays
20 m	22 m	Two long tapes to naturals

Cave F2 - see Pozu Jorcada Blanca

F6 Pozu Paso Doble

Location 43° 13' 35" N, 1° 16' 00" W.

Survey: Figure 5.

Located approximately 500 m west of Pozu Jorcada Blanca, the entrance to Pozu Paso Doble is an obvious feature at the base of a cliff formed in a distinctive bed of dolomitised limestone. The cave was investigated first by Steve Mayers, and subsequently by the surveying party. The entrance passages to the cave appear to follow the bedding steeply down-dip until the main chamber is reached. Much of this section of the cave is extremely unstable, the 'floor' consisting largely of massive breakdown blocks derived from the ceiling. In fact, even during the brief time spent in the cave, we contrived to rearrange several of these blocks in an attempt to hasten the process of cave collapse. Despite the widespread evidence of collapse, however, the phreatic origin of the entrance passages can still be seen in the form of occasional solutional avens which remain preserved in the roof of the passage.

From the main chamber, there are three routes on. Directly ahead, a short passage leads to the top of a promising-looking 22 m pitch. Unfortunately, as so often in the high-altitude karst of the Picos de Cornion, the shaft is developed along thinly and near-vertically bedded, very friable, dolomitised limestone, with the result that not only is the pitch very unstable, requiring considerable gardening during the first descent, but also all routes on at the bottom are choked by breakdown.

Back in the main chamber, an interesting ladder climb leads down the boulder pile to the head of a short 6 m shaft. Although this turns out to be blind, a short traverse around the top of the shaft leads to a narrow meandering passage which can be followed upstream to a pair of active inlets which are too tight. A climb up above the stream leads to the top of the vadose trench, where remnants exist of what appears to be the early, phreatic stage of passage development. Vadose incision here has been of the order of 16 m. Following this upper route brings one out overlooking and high up in the main chamber, although unfortunately once again with no route on.

Tackle

Pitch	Name	Rope	Belays
30 m	Main	30 m ladder	3 m wire
5 m	Boulder Pile	5 m ladder	3 m wire
Traverse over Blind Shaft		10 m hand-line	

F7 Pozu las Perdices

Location 43° 13' 35" N, 1° 15' 50" W.

Survey: Figure 6.

Like so many caves in the Picos, Perdices is likely to prove difficult to find even for those equipped with a suitable map, compass and description. The three entrances to the system, painted F7a, b and c, are found about 150 m lower than Pozu Jorcada Blanca (50 m below top camp). From top camp (Frontispiece), follow the grassy valley down towards the large scree-filled closed depression. Half-way down, traverse left for about 150 m, until on a line between Jorcada Blanca and the closed depression. If this description works, you should be standing by one of the entrances, which are all within 40 m of each other on a limestone pavement dipping at about 20°.

The most obvious entrance is F7a (Glass Sword), a 3 m wide rift which descends steeply down a snow slope requiring 15 m of ladder. A short but awkward snow and ice bank then almost blocks the entrance to the spectacularly-decorated Iceflier Chamber. At the base of the chamber is a 2 m deep ice-choked shaft. (The rift continues upwards over iceflows and awkward climbing manoeuvres to meet the bottom of the entrance climb in F7b.) Although this chamber cannot be regarded as a 'normal' route into the rest of the cave, the ice curtains, stal and clear iceflows are well worth a visit. In addition, for those interested in 'bugs', we saw hundreds of flies, about 1 cm across, spreadeagled on the ice at the bottom of the chamber, which receives no daylight.

Topofail (F7b) entrance, like Glass Sword, could easily become blocked by snow. The 3 m square shaft is free-climbable, with care, past the snowplug to a ledge 4 m below the surface. The entrance was so named due to the untimely demise of our Topofil; our 7 m survey leg registered 6 cm! The ledge leads to a descending rift over snow, best traversed, joining the routes from F7c before reaching an eyehole squeeze at the base of the rift.

F7c has a tunnel entrance to a 5 m pitch and should remain clear of snow even in the worst winter. The route here forks, and forks again... Three of us descended at different times and followed routes which may or may not be the same. Two routes into the Topofail rift were discovered, one entering directly at the top of the rift, and another entering near the top via a crawl along a horizontal 1 m diameter phreatic tube. F7c is an area of interconnected shattered rifts, mostly tight, and was only partially explored.

Back on the main route, the eyehole squeeze emerges to a thin rift with anti-tackle-bag constrictions. At the end of the rift, the cave suddenly enlarges into an impressive pitch, with an enticing (upward) draught. Natural thread belays and a deviation gives a free-hanging 13 m drop in a widening rift on to a ledge.

This is where the excitement starts! To the right, facing out, is Achilles Rift, an undescended huge rift where thrown stones fall for four seconds with many bounces. The reasons why we went the other way were the absence of natural belays in the smooth solid rock and the obvious absence of an easy hang; well, all right, we weakened.

In the other direction, a rope-assisted climb down followed by a traverse leads to a further rift climb, the Executioner. Exciting when free-climbed without a handline, the Executioner is 15 m deep and lands in a narrow (75 cm) twisting abandoned streambed. Just 'downstream' of the landing is the Howler.

The draught emerging from the small hole leading down to the squeeze and pitch immediately below is strong and cold and the pitch head is not a good spot to wait around. Fortunately the Howler has a superb set of natural belays. As the 6 m upper section of the Howler is tight, it would probably best be rigged with a ladder and fixed line to avoid rope abrasion. Once past this section, SRT or ladder could be used for the inclined 19 m drop in the rift. At this point one gets the distinct feeling of having found something of note. A large, though inactive inlet, an aven

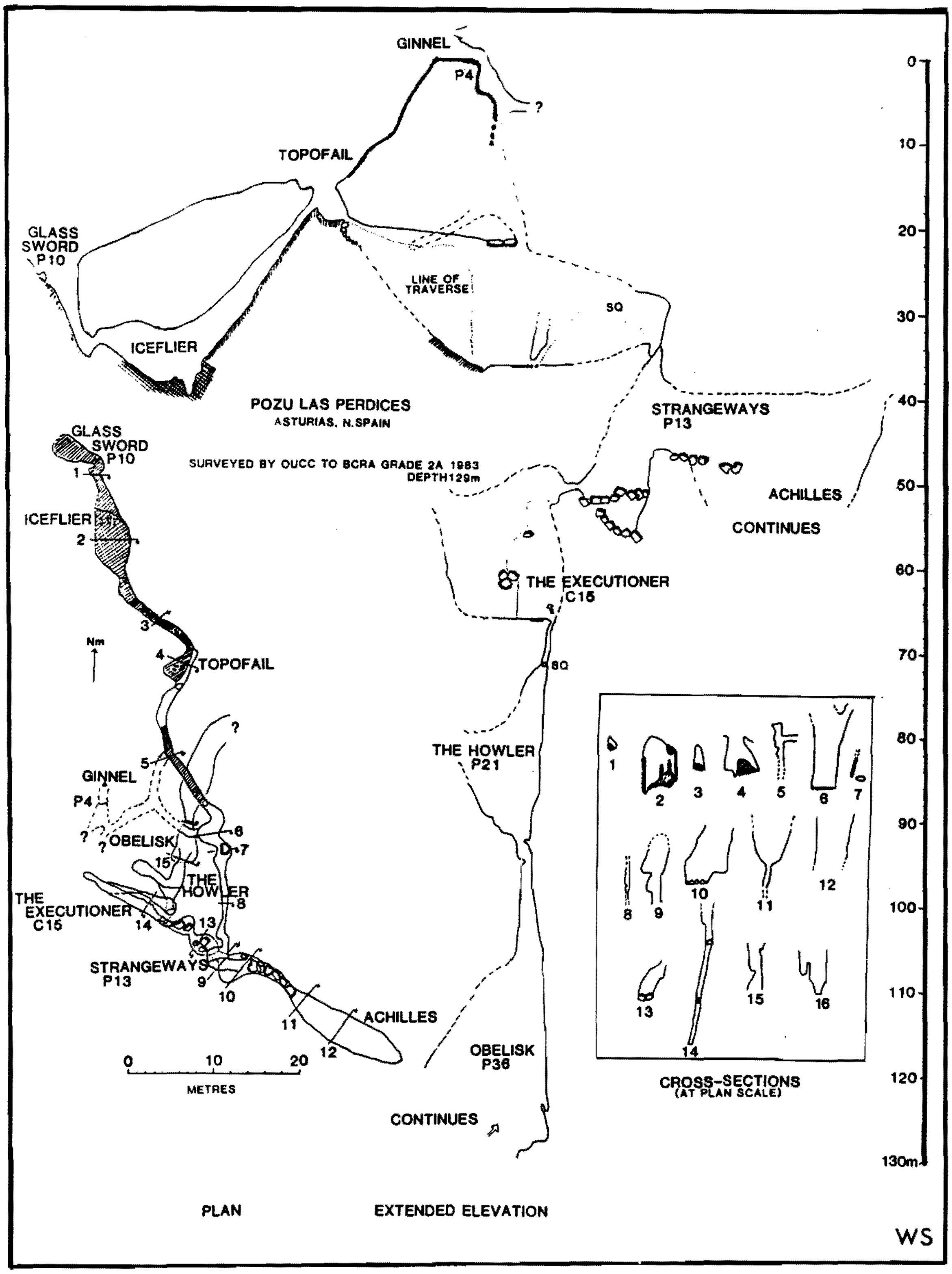


Fig. 6. Pozu las Perdices: survey.

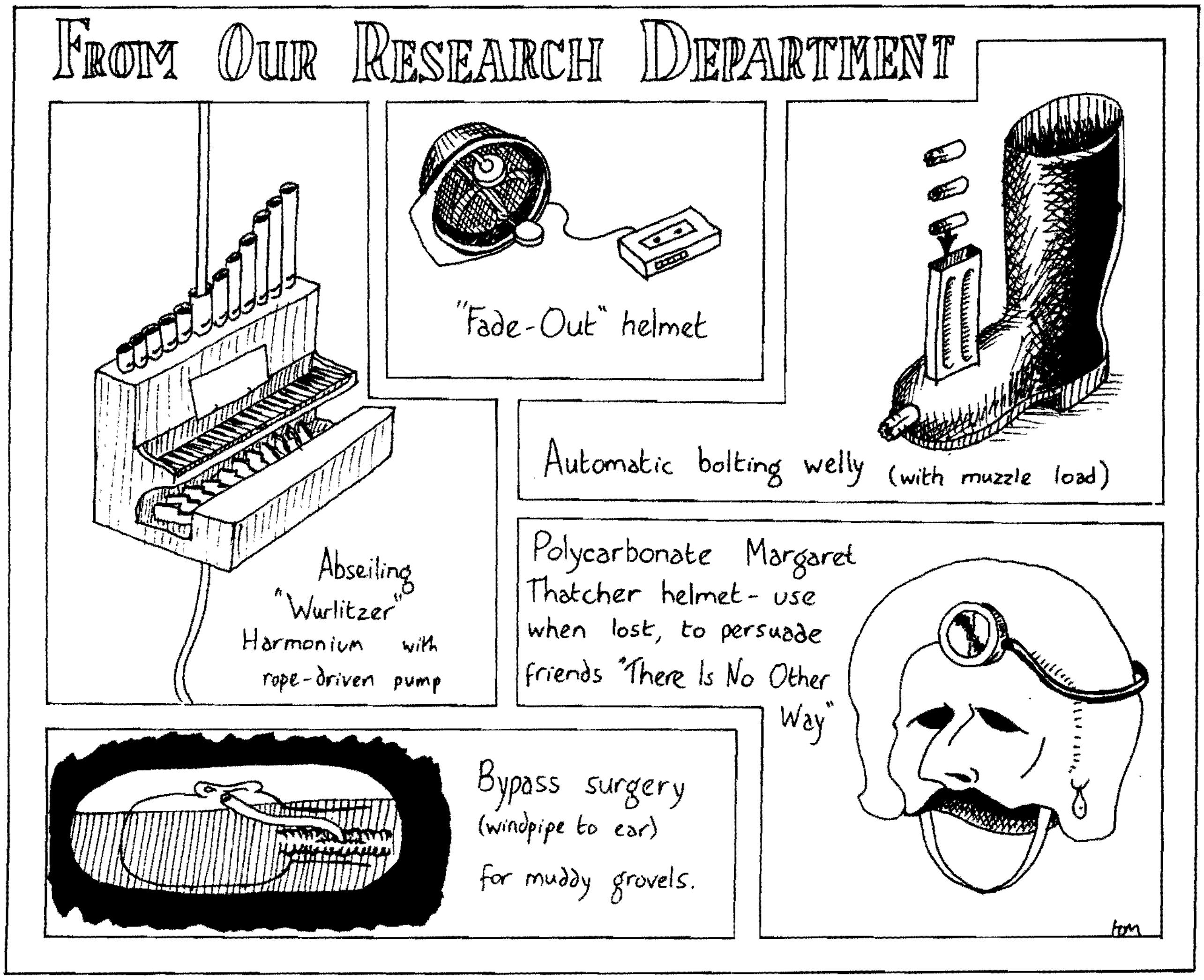
above with roof out of sight created less impression than the disappearance of the rift both outwards and below one's feet beyond the reach of our lights. The next 36 m free-hanging drop in the rift, Obelisk, is again hung from a convenient solid flake, with a tiny but perfectly positioned ledge providing an easy changeover. This drop passes more inactive inlets, and lands on another ledge, with the rift continuing outwards and around a corner with a width of 4 m. This is as far as we got. Downwards a further small ledge can be seen some 15 m down, with the drop continuing past.

Since we were due to pack up our camp and leave the following day, and all our remaining carbide was in our generators (and we'd all but run out of rope), we had to satisfy ourselves with throwing stones. This is recommended, except for those of nervous disposition! They fall for 6 seconds, with two bounces early in their flight.

From the survey, Obelisk is probably independent of Achilles. Hence there will be several routes to explore next year.

Tackle (* = optional)

Pitch	Name	Rope	Belays
15 m*	Glass Sword	15 m ladder 16 m rope	Long wire, long tape to flakes
5 m*		5 m ladder	Long wire
13 m		15 m rope	Medium wire and tape to threads. 2 m tape for deviation
Climb Executioner Rift	}	25 m handline	Tie to flake
25 m	The Howler	27 m rope	Short tape, short wire
36 m	Obelisk	38 m rope	Short tapes to flake



THE GEOLOGY OF JORCADA BLANCA, ASTURIAS, NORTHERN SPAIN

Introduction

The area of Jorcada Blanca is located within the Picos de Cornion in the western part of the Picos de Europa, northern Spain (Frontispiece). The entire region is largely developed in limestones of Carboniferous age which experienced major earth movements during the Hercynian. These began in the Westphalian with northerly thrusting, and continued in early Stephanian times with movements corresponding to the Asturian phase. The movements resulted in comparatively little folding, but in repeated thrusting and overfolding. This gave the mountains their pronounced east-west structure and topography, and means that the same sequence of rock types outcrops repeatedly from the north to the south of the region. Although there have been a number of studies of the Jorcada Blanca area in recent years, notably by the University of Oviedo, Marquinez (1978) and Farias-Arquer (1981), these have only succeeded in mapping the area (Figure 1) and have not made any detailed lithological analysis, let alone facies analysis of the limestones of the area.

Stratigraphy

The Jorcada Blanca area is composed solely of Carboniferous limestones of Lower Viséan to Lower Namurian age, occasionally overlain by various unconsolidated deposits of Quaternary age. Four main limestone units can be recognised (Figure 2):

Mountain Limestone

(i) Barcaliente Formation: The Barcaliente Formation consists of a 'black', fine-grained, tabular limestone within which is found abundant chert, giving rise to alternating light and dark laminations. An erosional unconformity separates the Barcaliente Formation from the stratigraphically-lower Griotte Limestone.

(ii) Valdeteja Formation: The Valdeteja Formation, the upper member of the Mountain Limestone, exhibits a gradational boundary with the Barcaliente Formation. The limestones are 'black' and massively-bedded, although the beds become lighter in colour up-sequence as the chert content of the limestone decreases. Intraformational breccias can be observed at the base of the Formation and beds of bioclastic limestone can be frequently seen throughout the unit.

Picos de Europa Limestone

(i) Lower Member: The Lower Member consist of a grey, bioclastic limestone with a number of chert bands. The limestone is generally finer-grained than that of the underlying Valdeteja Formation.

(ii) Upper Member: The Upper Member consists of a grey coarse-grained bioclastic limestone, with impersistent red beds. It exhibits a gradational boundary with the underlying Lower Member. The fauna of the bioclastic limestone includes foraminifera, corals, bryozoa, brachiopods, crinoids and algae.

References

Farias-Arquer, P.J., 1981. La Estructura del Sector Central de Los Picos de Europa. Unpub. thesis, Univ. Oviedo, Spain.

Marquinez, J., 1978. Estudio geológico del sector SE de los Picos de Europa. Trabajos de Geologia 10, 295-315.

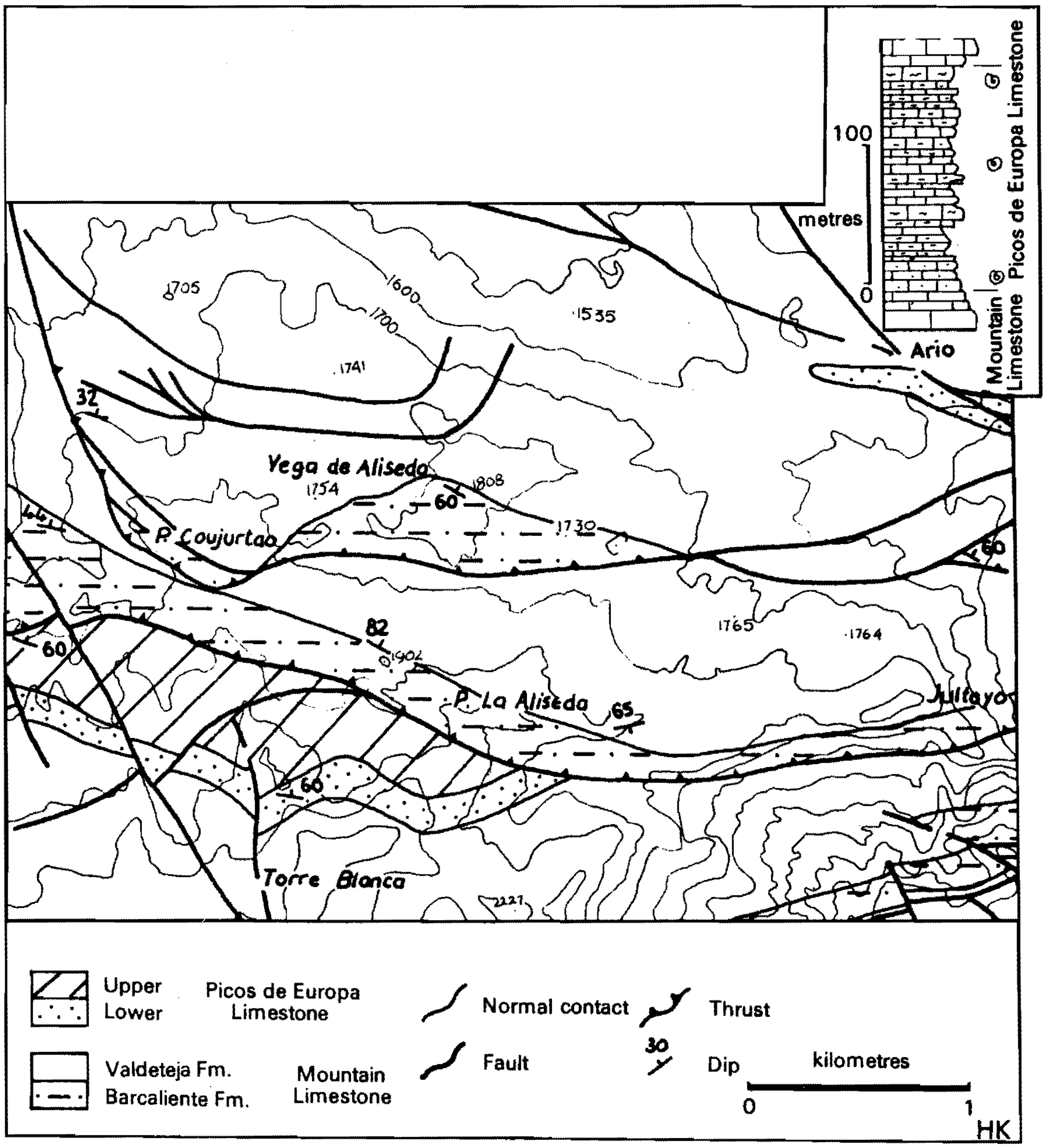


Fig. 1. The geology of the Ario-Jorcada Blanca area, Picos de Cornion, northern Spain (after Farias-Arquer, 1981).

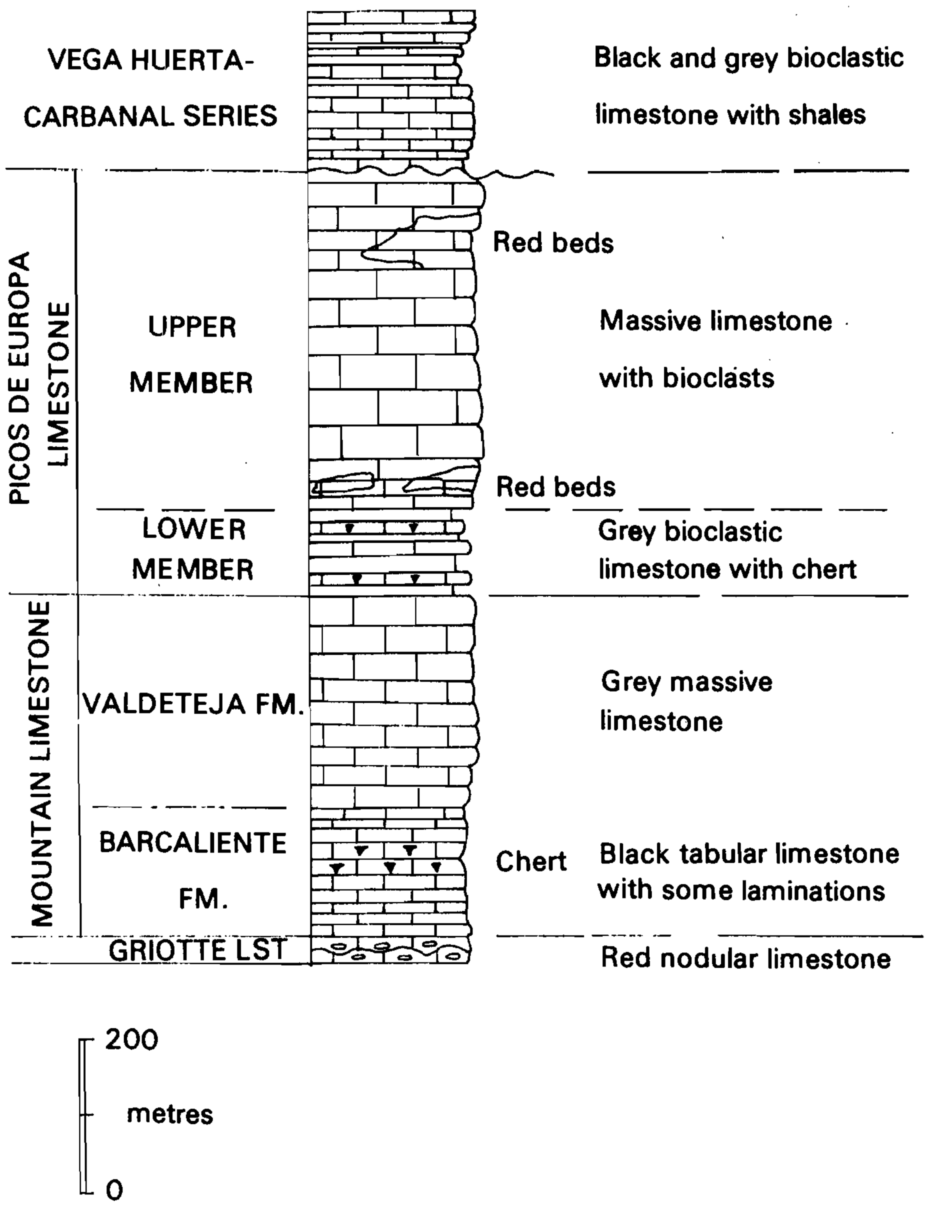


Fig. 2. The stratigraphy of the Carboniferous rocks of the Picos de Cornion, northern Spain (after Farias-Arquer, 1981).

THE GEOLOGY OF THE IMMEDIATE VICINITY OF POZU JORCADA BLANCA

Pozu Jorcada Blanca is developed in a grey, coarse-grained limestone containing occasional beds of thinly-laminated (approximately 1 mm thick) chert and occasional macrofossil-rich beds. The bedding of the limestone varies from thin to massive, with the thinly-bedded units tending to be more easily eroded, forming clitter-filled gullies on the surface and unstable vertical pitches underground. Although the structure of the area is relatively simple on the broad scale, the limestone dipping northwest to northeast at approximately 55-70°, on the small scale the structure is very complex. Many of the bedding features within the limestone show evidence of small-scale flexuring (less than 1 m) which could be syndepositional, and this is replicated on a larger scale by features of tens and hundreds of metres in size. A similar pattern of micro-faulting and small-scale faulting, with displacements of up to approximately 1 m, can also be recognised, but no evidence of large-scale faulting has been seen in the area.

Joints and tension features in the limestone are infilled by calcite, and occasionally by haematite. Vein calcite is also relatively common. Dolomitisation of the limestone is frequently seen, with particular beds usually having been preferentially replaced.

Unconsolidated superficial deposits of Quaternary age (presumably Late and Post-Glacial) are relatively uncommon in the area and consist mainly of angular boulders, cobbles and pebbles of limestone. These have been formed by both solution and gelifraction of the bedrock, the resultant deposits often forming chutes leading into and infilling shafts on the limestone surface. The process of infilling is presumably encouraged by the nivational processes operating in the shafts themselves.

In a number of locations, where the scree and clitter slopes have stabilised, and in small hollows and fissures on the limestone surface, finer-grained sediments have accumulated. Where these deposits have been stable for a number of years, a grey, sandy, carbonate-rich soil of generally low organic content has developed.

Given the recently-glaciated nature of the terrain, there is a surprising lack of morainic-type deposits in the area. The probable explanation of this is that the fine-grained component of such deposits has been reworked into the shafts and fissures which cover the limestone surface, and hence into the caves at depth.

THE TOPOGRAPHY OF THE WESTERN PICOS DE EUROPA, ASTURIAS, NORTHERN SPAIN

The western Picos de Europa is one of the world's classical areas of alpine karst. Its topography has been previously described by Crompton (1965), Miotke (1968), and Laverty and Ireland (1979, 30). The region broadly consists of a series of east-west aligned ridges, rising to altitudes of up to and over 2500 m. The high-mountain karst of the area is largely composed of bare rock surfaces which have been stripped of any superficial sediment, presumably by glaciation. Consequently, the micro-relief is highly structurally-controlled. Since the limestone is steeply dipping, bedding planes in particular are etched by solution to give the characteristic sharp-edged, vertically-aligned micro-relief of the area. Elsewhere, solution by meltwater and rainfall on the exposed limestone surfaces has been gravity-controlled and has resulted in well-developed rillenkarren, maanderkarren and kamenitza. On a larger scale, the area is pockmarked by closed depressions ranging from a few metres to several hundred metres in diameter. These are especially well developed on the northern sides of the mountain ridges where glacial action has given rise to deep cirques backed by cliffed headwalls. These cirques retain snow for most of the year, particularly as plugs within fissures. Consequently, nivational processes, meltwater and rainfall all contribute to the further development of closed depressions within the cirques. These depressions often have vadose shafts in the bottom, although it is rarely possible to descend them to depths of greater than 20 m before they become choked by angular limestone boulders and cobbles. It is clear, however, that many of the closed depressions found in the area, both in the high-mountain karst and at lower altitudes, may have existed prior to at least the last glaciation, their form having been subsequently modified and exploited by glacial activity.

At lower altitudes, the limestone tends to be veneered by moraine and, as a consequence, streams are occasionally found. Nevertheless, such streams tend to be seasonally intermittent and to sink in blind or semi-blind valleys.

The entire range of the western Picos de Europa is bisected by the deeply-incised gorge of the Rio Cares, which reaches depths of up to 1000 m below the general surface of the mountains. Similar deeply-entrenched valleys are found along the courses of the Rio Dobra and the Rio Casaño (Frontispiece). According to Crompton (1965, 21), these valleys are the result of incision by glaciation and by glacial meltwater. On the basis of observations in the Rio Cares and the Rio Casaño, however, the former process appears unlikely. The valleys display all the characteristics of rapid fluvial incision; they are not tributary to the presumed ice source-areas around Peña Santa de Castilla; and their own tributary valleys do not display hanging characteristics. Further evidence in support of the fluvial origin of the Rio Cares gorge is provided by the existence of fluvial, clast-supported cobble deposits on the wall of the gorge below Puente Bolin at about 50 m above the level of the present stream. These can only have been laid down by a river flowing approximately 50 m above the present level of the Rio Cares.

Exposed in the sides of the Rio Cares gorge are numerous cave entrances, most of which display phreatic origins. These can only have been formed when river and resurgence levels were much higher than those of the present. Some of these caves appear to be fossil resurgences, that is, ancient analogues of those resurgences such as Fuente Culiembro and Fuente Puente Bolin which are found at river level at present. A study of such caves and their infill may well elucidate the nature and rate of incision of the gorge across the entire massif of the western Picos de Europa.

References

Crompton, W.J., 1965. Geomorphology. In Oxford University Expedition to Northern Spain 1961. Cave Res. Grp Gt Br. Pub. 14, 20-22.

Laverty, M. and Ireland, P.A.R., 1979. Geomorphological notes. Proc. Oxford Univ. Cave Club 9, 30-31.

Miotke, F.-D., 1968. Karstmorphologische Studien in der glazial-überformten Höhenstufe der Picos de Europa, Nordspanien. Jahrb. Geogr. Ges. Hannover 4, 161 pp.

WATER TRACING IN THE WESTERN PICOS DE EUROPA, ASTURIAS, NORTHERN SPAIN

Very little water tracing has so far been attempted in the western Picos de Europa, all known successful tests being summarised in Table 1. In an effort to increase our knowledge of groundwater linkages in the region, further tests were made during the course of the 1983 OUCC Expedition. However, only one of these yielded positive results. This was made to establish the route taken by water sinking in the northern end of the large closed depression of Covellona (43° 15' 20" N, 1° 17' 00" W with reference

Test made by	Date	Inlet	Outlet	Flow time	Reference	Remarks
OUCC	8.61–9.61	S1 (Los Reblagas)	R1 (Vega de la Cueva)	ca. 35 d	Austin & Wilcock, 1965	
OUCC	8.61–9.61	S4 (SW Lago de la Ercina)	R2 (Los Reblagas)	29 h	Austin & Wilcock, 1965	Straight-line distance = 200 m; straight-line velocity = 1.9×10^{-3} m s^{-1}
Spéleo-Club Alpin Languedocien	1964	Cueva Trumbio	Cueva el Gueya Reinazo	?	Collis, 1975	
Spéleo-Club Orsay Faculté	?	Cueva del Frieru	?	?	Laverty, 1979	
OUCC	5.8.81	Terminal sump, Pozu del Xitu	Fuente Culiembro	under 4 d	Willis, 1981	
OUCC	7.8.81	Head of Flat Iron Shaft, Pozu del Xitu	Fuente Culiembro	9–23 d	Willis, 1981	

Table 1. Known successful water-traces in the western Picos de Europa, Asturias, northern Spain

to the Madrid meridian), which forms the head of the valley of the Rio del Texu (Frontispiece).

A quantity of Rhodamine B dye was introduced into the sink at 12.13 on 18 July 1983. The dye began to reach visible concentrations at the resurgence of Fuente Escondida (43° 15' 30" N, 1° 17' 10" W with reference to the Madrid meridian) during the morning of 19 July 1983, and the peak of the dye pulse was clearly observed at 15.30 on the same day. At the time, the discharge of the resurgence was approxmately 2.5 l s^{-1}.

The straight-line distance between sink and resurgence is 375 m, giving a straight-line velocity for the time to dye-pulse peak of approximately 3.8×10^{-3} m s^{-1}. This obviously provides only a minimum value for the true flow velocity. Nevertheless, this figure is significantly lower than the straight-line velocities measured by Atkinson and Smith (1973, 15) in the crystalline, massively-bedded White Limestones of Jamaica and the Carboniferous Limestones of Mendip. Two possible explanations may be given. First, the flow between Covellona and Fuente Escondida may be highly tortuous and flow velocities may be similar to those normally recorded for fissure flows in carbonate aquifers. Secondly, flow may have been diffuse rather than discrete, that is, taking place through a network of fissures rather than along a single conduit. Insufficient work has been done on diffuse flow to enable comparisons to be made, although velocities of diffuse groundwater flow under unit hydrological gradients in carbonate aquifers have been calculated as 1.03×10^{-3} m s^{-1} for the Carboniferous Limestone of Mendip (Atkinson, 1977, 105) and as a maximum of 1.97×10^{-3} m s^{-1} in the most permeable parts of the Cretaceous Chalk of East Yorkshire (Foster and Milton, 1974, 497).

An attempt was also made during the 1983 Expedition to trace the outlet of the water flowing down Pozu Jorcada Blanca. Unfortunately, it was not possible to recover all the dye detectors from this test, and those detectors which were recovered (from Canal de la Raya, Fuente Puente Bolin, and from the streams above and to the west of Cain) all gave negative results. However, the test did establish that the water sinking at the bottom of The Font in Pozu Jorcada Blanca reappears at the Hot Tub before flowing down to the terminal sump. This suggests the existence of a hydrologically-important bypass which has captured and left inactive the northernmost section of the cave, that around One Step Beyond and The Sphinx.

References

Atkinson, T.C., 1977. Diffuse and conduit flow in limestone terrain in the Mendip Hills, Somerset (Great Britain). J. Hydrol. 35, 93-110.

Atkinson, T.C. and Smith, D.I., 1973. Underground flow rates in cavernous limestones in Britain and Jamaica. Proc. Internat. Congr. Speleol. 6(4), 13-16.

Austin, M. and Wilcock, J.D., 1965. Water analysis and hydrology. In Oxford University Expedition to Northern Spain 1961. Cave Res. Grp Gt Br. Pub. 14, 11-20.

Collis, W.J.M.F., 1975. Cueva el Gueya Reinazo. Proc. Oxford Univ. Cave Club 7, 36.

Foster, S.S.F. and Milton, V.A., 1974. The permeability and storage of an unconfined Chalk aquifer. Hydrol. Sci. Bull. 19, 485-500.

Laverty, M., 1979. Cueva del Frieru. Proc. Oxford Univ. Cave Club 9, 6.

Willis, R.G., 1981. Pozu del Xitu - 1981 dye tests. Proc. Oxford Univ. Cave Club 10, 49-50.

SOME MEASUREMENTS OF DISCHARGE IN THE KARST OF THE LOS LAGOS-RIO CARES AREA, ASTURIAS, NORTHERN SPAIN

An attempt was made to assess the relative magnitude of a number of springs, resurgences and cave flows in the Los Lagos-Rio Cares area (Frontispiece). Although such an exercise cannot hope to characterise flows which may vary widely in response, regime, catchment and aquifer type, it is hoped that it might at least provide an indication of the relative importance of various flows in the area. All measurements were made within a seven-day period during which negligible rainfall occurred, and during a prolonged spell of relatively dry weather. The values may therefore provide some crude comparison of approximate baseflows in the area. By and large, the results shown in Table 1 speak for themselves. However, it is interesting to note the discrepancy between the discharge at the terminal sump of Cueva del Osu and that at the resurgence of El Hoya la Madre, particularly since El Hoya la Madre has been proposed as the resurgence for the waters of Osu. If this is the case, then Osu provides only a minor contribution to the discharge at the resurgence under baseflow conditions.

Acknowledgements

Thanks to Mick 'Wingnut' England, Jan Huning and Helen Kay for their help in measuring discharge and fishing me out of resurgences.

References

Drew, D.P., 1975. The limestone hydrology of the Mendip Hills. In Smith, D.I. (ed.), Limestones and Caves of the Mendip Hills. David & Charles, Newton Abbot, 171-213.

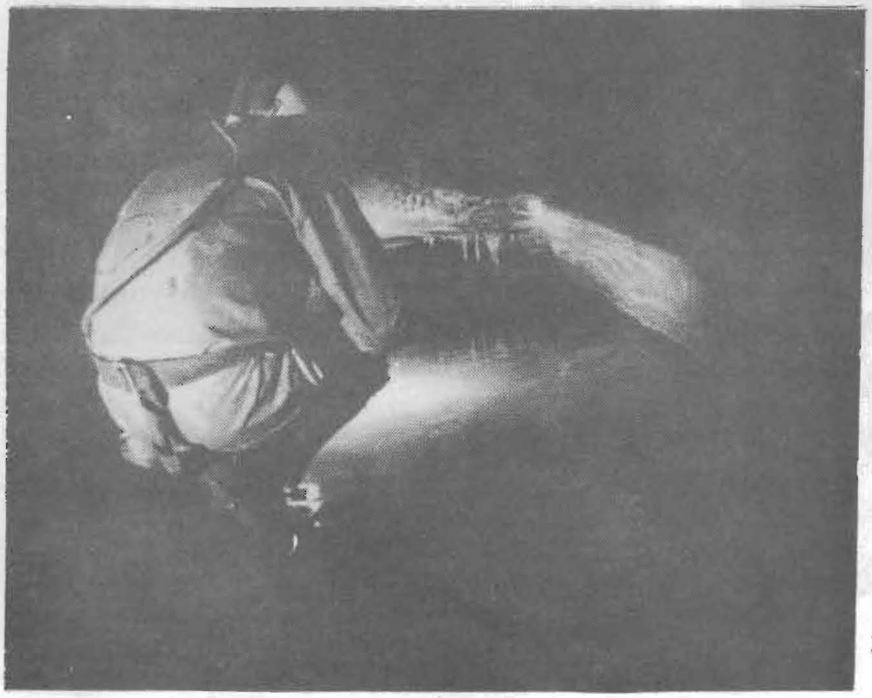
Meinzer, O.E., 1942., Ground water. In Meinzer, O.E. (ed.), Hydrology. Dover, New York, 385-477.

No.	Site	Date	Time	Discharge ($l\ s^{-1}$)	Magnitude	
					1	2
1	Fuente Lago de la Ercina	17.7.83	1710	0.0788	6	4
2	Fuente Lago Enol	15.7.83	1550	0.0085	8	4
3	Fuente Escondida	17.7.83	1820	2.49	5	4
4	Fuente de Vega Vieja	17.7.83	1950	0.063	7	4
5	Inlet sump, Cueva del Osu	19.7.83	2000	0.0	-	-
6	Vadose inlet, ca. 50m from terminal sump, south side of streamway, Cueva del Osu	19.7.83	2225	0.030	6	4
7	Outlet sump, Cueva del Osu	19.7.83	2250	0.1665	6	4
8	Fuente Belbin	18.7.83	2105	0.019	7	4
9	El Hoya la Madre	18.7.83	2010	53.1	3	2
10	Canal del la Raya, Rio Cares	16.7.83	1415	0.1575	6	4
11	Fuente Culiembro	21.7.83	1400	700	2	1
12	Fuente Puente Bolin	21.7.83	1530	1.4525	5	4

Magnitude: 1 = Meinzer (1942); 2 = Drew (1975)

Table 1. Discharge measurements in the karst of the Los Lagos-Rio Cares area, Asturias, northern Spain.

PLATE I Top: The approach to Top Camp, with Punta Gregoriana to the left. Left: Meander of the Argonauts. Right: Walk on the Wild Side. (GH)



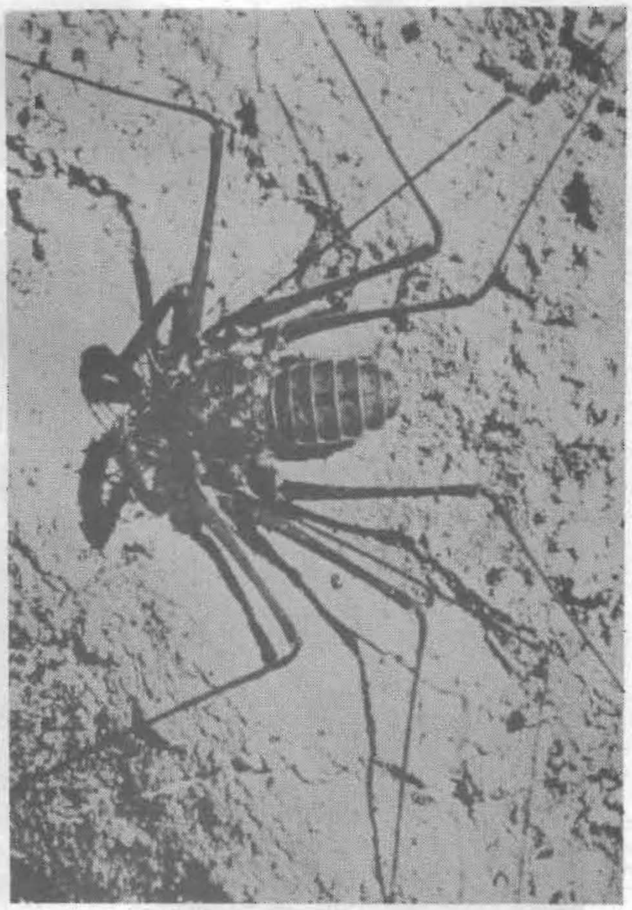


PLATE II Top Left: Chair I & II. Top Right: The Marble Bathroom. Bottom left: Psycho Killer Sump. (GH) Right: Borneo. An inhabitant of Tang Toka (CA)

THE HYDROLOGICAL DEVELOPMENT OF CUEVA DEL OSU, ASTURIAS, NORTHERN SPAIN

The entrance to Cueva del Osu (43° 15' 46" N, 1° 17' 15" W with reference to the Madrid meridian) is located at an altitude of 1230 m on the shoulder of Sierra del Brazu, a ridge between the valleys of the Riega el Brazu and the Rio del Texu. Both streams flow into Lago de la Ercina at an altitude of 1108 m (Frontispiece). The cave has been known for some time and was fully surveyed by OUCC in 1979 (Singleton and Laverty, 1979).

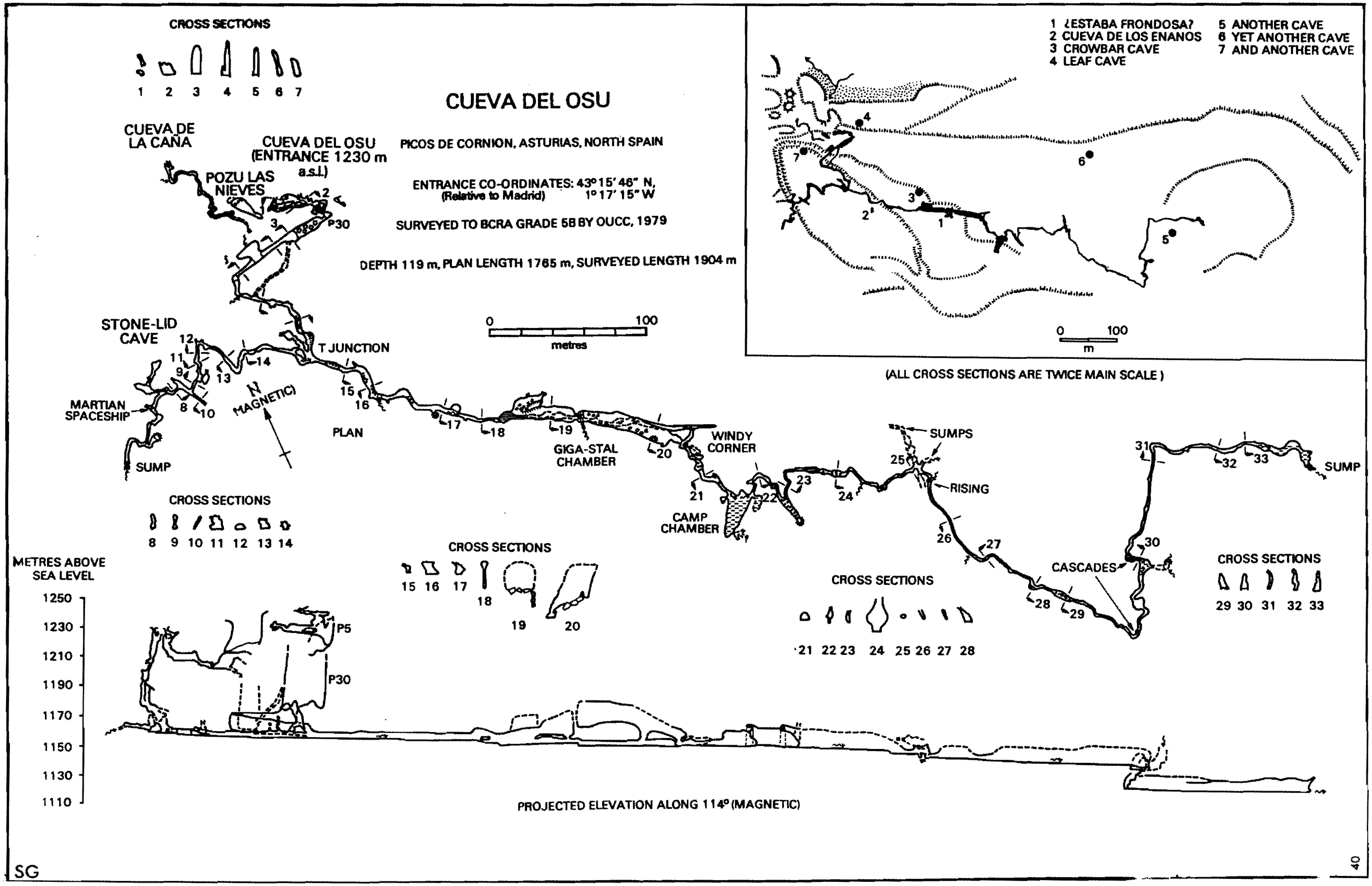
The entrance series of Cueva del Osu consists of a complex, essentially phreatic network, which must have developed beneath a local phreatic level of at least 1243 m (Figure 1). Since the height of the phreatic level within the limestone is ultimately governed by the height of the resurgence levels where the water leaves the aquifer, and since these resurgence levels are controlled by local base-level, in this case probably that of the streams incising across the limestone, then the levels of the valley floors must have been considerably above those of the present during the time of formation of the entrance series.

The passages of the entrance series have subsequently experienced breakdown followed by stalagmite precipitation, although the fractured nature of some of the stalagmite indicates that at least some post-stalagmite collapse has occurred. Neither process appears to be active at present in this part of the cave.

Further into the cave, the entrance series has been deeply incised by vadose flow, with the consequence that the present route on descends steeply along vadose trenches and down several climbs, including a 30 m pitch, to an altitude of approximately 1165 m. The original phreatic morphology of the passage can be traced in the roof of the vadose trench as far as the top of the 30 m pitch. Beyond that point, however, roof collapse has destroyed any evidence of the original phreatic passage, and its former route can only be conjectured. The adjacent cave of Cueva de la Caña (Singleton and Thwaites, 1979) appears to have experienced a similar episode of vadose incision in passages located at almost the same altitude as those in Cueva del Osu (Figure 1). This may indicate its development as part of the same system.

Below the various pitches and climbs, the vadose passage appears to form a discrete element, and the original phreatic cave, if it exists at all, must be presumed to continue at a higher level. This part of the cave consists of an abandoned streamway within which the remains of stalagmite false-floors and fluvial sediment fill testify to the occurrence of several episodes of stream flow and possible stream abandonment during its history. Interestingly, there is little indication of diagnostically phreatic forms in the roof of the passage, and it must be assumed that the phreatic phase of passage development was rather short-lived, and that the cave was largely the result of rapid incision by vadose flow.

Continuing down the cave, the vadose passage joins the present active streamway at the T Junction (Figure 1). The phreatic origin of the main streamway is clearly indicated by avens of up to 0.5 m diameter and scallops within the passage roof. Since the tributary passage is vadose down to its junction with the main streamway and appears to have developed in response to the formation of the main streamway under phreatic conditions, then the phreatic development of the streamway itself must have taken place under a local phreatic level of approximately 1165 m. Other vadose inlets to the main streamway, which may have developed synchronously with that of the abandoned vadose passage, include Stone-Lid Cave (Singleton and Thwaites, 1979) and possibly Pozu las Nieves (Singleton and Laverty, 1979, Fig.1). All these factors indicate that by this time local phreatic levels must have fallen by at least 78 m since the formation of the entrance-series passages. The morphological evidence in the cave



CROSS SECTIONS
1 2 3 4 5 6 7
CUEVA DEL OSU
PICOS DE CORNION, ASTURIAS, NORTH SPAIN
ENTRANCE CO-ORDINATES: 43°15' 46" N, (Relative to Madrid) 1°17' 15" W
SURVEYED TO BCRA GRADE 5B BY OUCC, 1979
DEPTH 119 m, PLAN LENGTH 1765 m, SURVEYED LENGTH 1904 m
CUEVA DE LA CAÑA
CUEVA DEL OSU (ENTRANCE 1230 m a.s.l.)
POZU LAS NIEVES
P30
STONE-LID CAVE
T JUNCTION
MARTIAN SPACESHIP
N MAGNETIC
PLAN
SUMP
0 100 metres
GIGA-STAL CHAMBER
WINDY CORNER
CAMP CHAMBER
SUMPS
RISING
CASCADES
SUMP
CROSS SECTIONS
8 9 10 11 12 13 14
CROSS SECTIONS
15 16 17 18 19 20
CROSS SECTIONS
21 22 23 24 25 26 27 28
CROSS SECTIONS
29 30 31 32 33
1 ¿ESTABA FRONDOSA?
2 CUEVA DE LOS ENANOS
3 CROWBAR CAVE
4 LEAF CAVE
5 ANOTHER CAVE
6 YET ANOTHER CAVE
7 AND ANOTHER CAVE
0 100 m
(ALL CROSS SECTIONS ARE TWICE MAIN SCALE)
METRES ABOVE SEA LEVEL
1250
1230
1210
1190
1170
1150
1130
1110
P5
P30
PROJECTED ELEVATION ALONG 114° (MAGNETIC)
SG

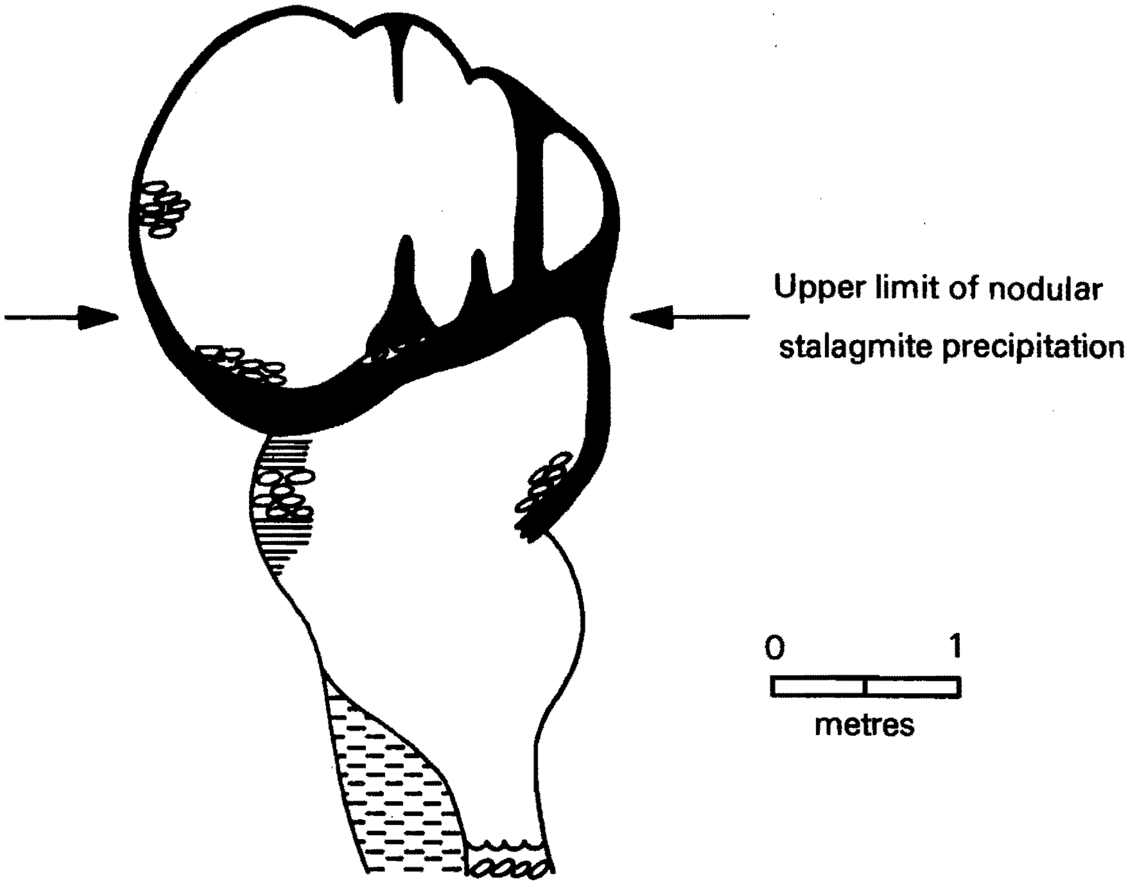


Fig. 2. Passage cross-section 8 m downstream of the Martian Spaceship, Cueva del Osu, Asturias, northern Spain, showing sedimentary sequence. All inactive clastic sediments have been recemented by stalagmite.

Stage	Internal Events	External Events
1	Formation of entrance series and high-level phreatic caves under phreatic conditions. Local phreatic level at more than 1243 m.	Valley floors and resurgence levels considerably above present.
2	Formation of main streamway under phreatic conditions. Local phreatic level at ca. 1165 m. High-level, former phreatic caves act as routes for vadose recharge to phreas and consequently experience vadose incision.	Fall in resurgence levels by more than 78 m.
3	Vadose incision of main streamway. Local phreatic level at/near that of present. Episodes of streamfill, scour and ?abandonment in all active parts of cave. At some time during this stage, catchments of vadose inlets reduced by surface denudation and inlets abandoned.	Resurgence levels lowered to at/near present level.

Table 1. Stages in the development of Cueva del Osu.

suggests that this fall took place rather rapidly, with little time for the development of intermediate phreatic levels. If so, this supports the case for valley incision and resurgence lowering as a result of glacial erosion during one of the sequence of glacial advances experienced by the Picos de Europa in the Quaternary.

The present local phreatic level in the cave, as indicated by the altitude of the terminal sump, is 1110 m, although the altitude of the inlet sump and the existence of active phreatic inlets in the walls of the streamway indicate that some variation around this figure exists. Consequently, contemporary flow along the streamway is vadose, with the result that in many places the streamway exhibits the classical keyhole-type form of a vadose-entrenched phreatic tube. This entrenchment has left the vadose tributary hanging at least 0.6 m above the height of the present thalweg, indicating that the tributary has been largely inactive, at least during the final episode of vadose incision along the streamway. Nevertheless, the sedimentological evidence within the main streamway shows that its development has been far more complex than the morphological evidence would suggest. In many places, particularly upstream of the T Junction, there is evidence of many phases of coarse fluvial-sediment input, and some overbank deposition, separated by phases of stalagmite deposition (Figure 2). The present cave floor at these points consists of an armoured bed of pebbles and cobbles. This is probably reworked from the surrounding sediment banks, since such deposits are absent where no fossil deposits occur.

Downstream of the T Junction, the main streamway passes through a number of chambers which appear to be genetically unrelated to the contemporary hydrological system. This is particularly so in the case of the Camp Chamber, where the present stream merely flows in and out of one corner of the chamber (Figure 1). These chambers and the somewhat higher sections of stalagmite-filled passage such as the Giga-stal Chamber appear to be older features which have been reinvaded by the present streamway.

Downstream of the Camp Chamber, the cave becomes more and more simply vadose, with few floor deposits and little evidence of past episodes of sedimentation in the form of stalagmite floors and fluvial deposits. Indeed, the only stalagmite appears to be that which is being presently deposited.

Finally, at the Cascades, the stream descends steeply by approximately 15 m over a series of waterfalls prior to reaching a long, gently-graded section of vadose streamway ending in the terminal sump. The Cascades may be a knickpoint resulting from vadose incision down to a lower phreatic level. On the other hand, the knickpoint could be the result of local structural control or an increase in total stream discharge where a major tributary joins the flow just upstream of the Cascades.

Cueva del Osu thus contains evidence of a relatively simple pattern of cave development, yet one which reflects major changes in the topography around the cave (Table 1). In particular, it can be seen that cave development has occurred in response to a sequence of progressively lower resurgence levels, themselves probably the result of episodes of valley incision. Although it is tempting to relate each phase of valley incision to that of episodes of glacial advance in the region, such a relationship cannot yet be justified on the available evidence and the establishment of a chronology must await the results of isotopic and magnetostratigraphic studies of speleothems from the cave which are now in progress.

References

Singleton, J. and Laverty, M., 1979. Cueva del Osu. Proc. Oxford Univ. Cave Club 9, 14-16.

Singleton, J. and Thwaites, D., 1979. Stone-Lid Cave. Proc. Oxford Univ. Cave Club 9, 16.

AN ESTIMATE OF THE PALAEODISCHARGE OF CUEVA CULIEMBRO, ASTURIAS, NORTHERN SPAIN

Cueva Culiembro (43° 15' 30" N, 1° 11' 50" W with reference to the Madrid meridian) is a former resurgence cave which, as a result of the incision of the Rio Cares, now lies in the side of the Cares gorge about 30 m above the present resurgence of Fuente Culiembro. The outlet to the cave is largely phreatic in form. At some stage in its development the passage was almost totally infilled by clast-supported cobble-grade fluvial deposits, although this fill has been largely removed by subsequent stream action and now remains only as a carbonate-cemented terrace on either side of the passage. In the roof of the passage can be found solutional scallops. If these can be regarded as having developed during a period when little or no sediment existed in the passage, then the scallops may be used to give an indication of discharge during the period of phreatic development of the cave. This assumption is probably not unreasonable given that the present deposits appear to represent a single sediment input which probably either choked the passage and/or was rapidly re-excavated.

The conditions under which scallops develop has been investigated by numerous workers (see, for example, Allen, 1971; Goodchild and Ford, 1971; Blumberg and Curl, 1974), a number of whom have demonstrated that scallop form is hydraulically-controlled. Under conditions of uniform, steady-state flow, it appears that scallops develop at a stable scallop Reynolds number (Re*), where

$$Re^* = \bar{u}^* \bar{\lambda} \rho_f / \mu \qquad (1)$$

in which $\bar{u}^*$ = mean boundary-shear velocity, $\bar{\lambda}$ = mean scallop wavelength; ρ_f = fluid density; and μ = fluid dynamic viscosity. Published estimates of mean Re* range between 1000 and 3180 (Blumberg and Curl, 1974, 742; Thomas, 1979; Gale, 1984; Hsu _et al._, 1979), and all these values fall within the expected laminar-turbulent transition phase of ca. 1000-3000. Consequently, Blumberg and Curl's (1974, 742) estimate of Re* = 2220 will be used in subsequent calculations, since this lies approximately in the middle of the laminar-turbulent transition range, and since it is perhaps the most reliable estimate of the stable value of Re*.

$\bar{\lambda}$ was established in Cueva Culiembro by measuring scallop wavelength along the maximum length in a streamwise direction, taking the mean of 26 values. Having obtained $\bar{\lambda}$, from which $\bar{u}^*$ may be calculated using equation (1), assuming the conduit fluid to be pure water at 10°C, the mean flow velocity ($\bar{u}$) in the conduit may be computed by use of Prandtl's universal velocity-distribution equation (as modified by Curl (1974, 3) for use in parallel-walled conduits):

$$\bar{u} = \bar{u}^*[2.5(\log_e(d/2\bar{\lambda})-1)+B_L] \qquad (2)$$

in which d = distance between conduit walls; and B_L = Prandtl's bed-roughness constant = 9.4 for scalloped surfaces (Blumberg and Curl, 1974, 742-744).

Having obtained $\bar{u}$, and having estimated the conduit cross-section area (a) at the point of measurement to be 15.3 m^2, conduit discharge (Q) may be calculated from:

$$Q = \bar{u}\, a \qquad (3)$$

The results of these calculations are given below:

$\bar{\lambda}$ = 0.325 m
s = 0.1074 m
n = 26
a = 15.3 m^2
$\bar{u}^*$ = 8.9×10^{-3} m s^{-1}
$\bar{u}$ = 9.4×10^{-2} m s^{-1}
Q = 1.4 m^3 s^{-1}

The estimated discharge is of the expected order of magnitude and may be compared with the measured discharge of 0.7 m^3 s^{-1} under low-flow conditions at the modern analogue of the cave, Fuente Culiembro.

References

Allen, J.R.L., 1971. Transverse erosional marks of mud and rock: their physical basis and geological significance. Sediment. Geol. 5, 165-388.

Blumberg, P.N. and Curl, R.L., 1974. Experimental and theoretical studies of dissolution roughness. J. Fluid Mech. 65, 735-751.

Curl, R.L., 1974. Deducing flow velocity in cave conduits from scallops. Bull. natn. speleol. Soc. 36, 1-5.

Gale, S.J., 1984. The hydraulics of conduit flow in carbonate aquifers. J. Hydrol. 70, 309-327.

Goodchild, M.F. and Ford, D.C., 1971. Analysis of scallop patterns by simulation under controlled conditions. J. Geol. 79, 52-62.

Hsu, K.S., Locker, F.A. and Kennedy, J.F., 1979. Forced-convection heat transfer from irregular melting wavy boundaries. Rep. Iowa Inst. Hydraul. Res.

Thomas, R.M., 1979. Size of scallops and ripples formed by flowing water. Nature, Lond. 277, 281-283.

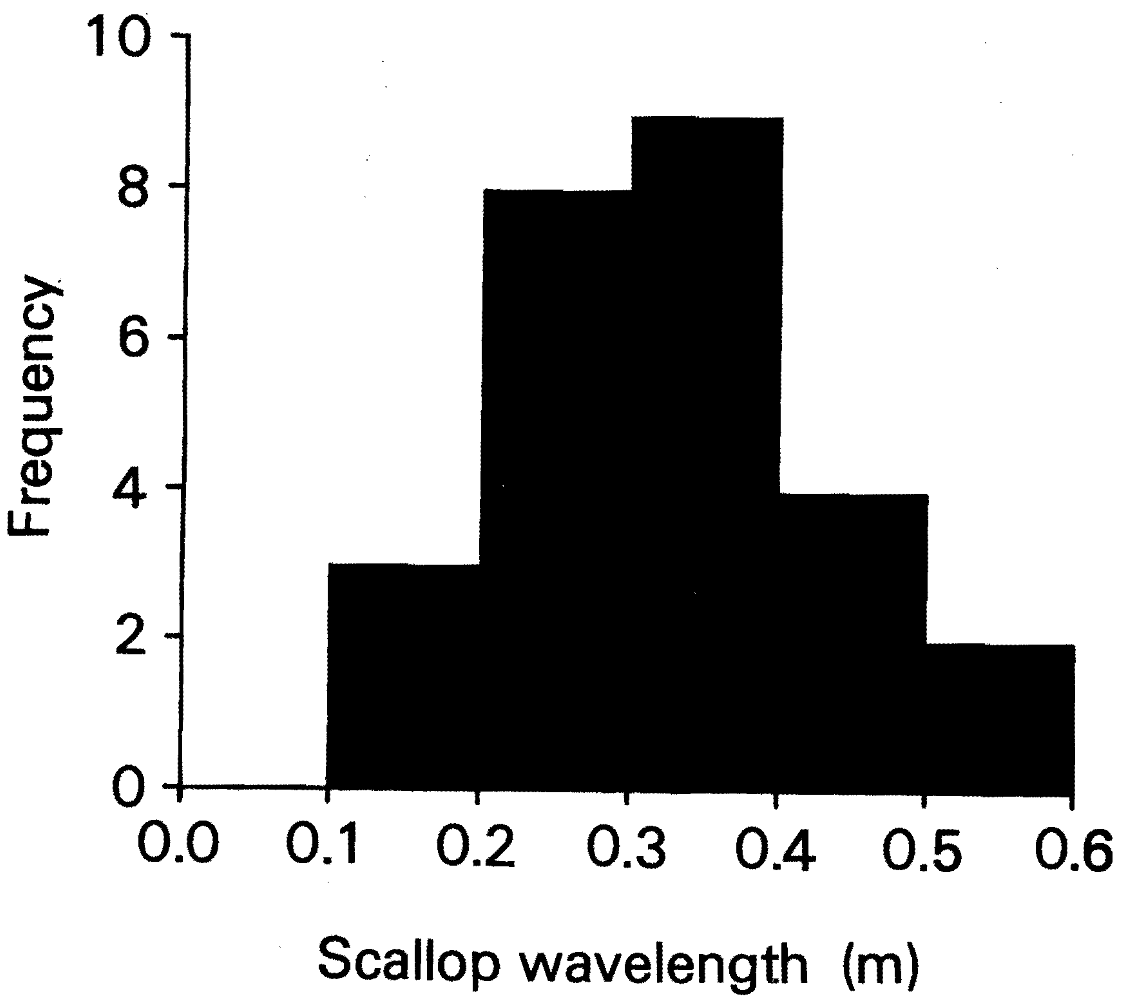
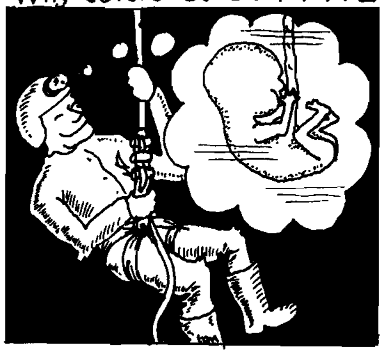


Fig. 1. Frequency distribution of scallop wavelengths on the roof of the entrance passage of Cueva Culiembro, Asturias, northern Spain.

BIOSPELAEOLOGY: A SPELAEOPSYCHOGENETIC HIERARCHY

(i) Dave Rose. Leaps up and down 80 m pitches in one bound. Needs no caving light due to presence of sun in anal regions. Talks to God regularly.
(ii) George Hostford. Climbs 80 m pitches hand over hand. Has flashgun only slightly less powerful than sun. Talks to God from public call boxes.
(iii) Richard Gregson. Gets other people to descend 80 m pitches for him by throwing his prusik bag down them. His light works. Talks to Clive Westlake.
(iv) John Singleton. Ignores 80 m pitches and spends hours hammering down scrofulous tight rifts. Breaks other people's lights. Talks to Clive Westlake but is not understood due to Lancashire dialect.
(v) Bill Stead. Light doesn't work so abseils down 80 m pitches over 'tectors, bolts and anything else that happens to be there. Talks to himself.
(vi) Graham Naylor. Instructs other people to go down 80 m pitches as he is God. Cannot talk.



EXPEDITION TRANSPORT: HIC TRANSIT GLORIUS MUNDI

You will probably have read in the Introduction that our Ford Transit van gave us a wee bit of trouble in 1983. The gory details are given below by Steve Roberts, who helped drive it out, Iestyn Walters, who was carried back in it in a strait jacket, and the Editor, who was unfortunate enough to have to get it back to England...

The third aged Spaniard in succession shakes his head sadly, probably as much at the ragged, smelly, scruffy cavers as the ragged, smelly, etc., van. I have learnt a new word of Spanish. It is 'parabrisa', which means windscreen. Just one of the things the van doesn't have any more. Other things it doesn't have include:

(i) Much of a front end, right hand side or door. Well, the metal's all there, it's just not quite where it started out. The garage near Bordeaux let us drive off, but only after I'd signed a piece of paper absolving them from all responsibility for our future fate.

(ii) Headlights that light anything useful. A midnight session by the road just off the ferry got main beam, if the passengers played games with banana plugs. However, as one pointed right and low, and one left and up, all we got was a fine view of some tarmac and an occasional tree top.

(iii) Two drivers. One had had his knee put back together by a hospital in Bordeaux. The other - well, I don't think Phil wants to drive again.

Mind you, it was a fine crash. Five Pints bottles in all directions, cries of 'Turn off the ignition! Turn off the ignition!' as we lay at 45° in the ditch with Graham's 'ghetto blaster' still playing, having shot through the hole where there had been a windscreen. Moral: find out where the light switch is before you want to use it. Or stop. Or something.

Anyhow, a day later we were blasting through a rainstorm, the front three respectively wearing Petzl suit, full walking waterproofs, and (the driver) battered old Belstaff and specs against the blasting gale and torrential rain. When the sun came out we had great fun waving at pedestrians and drivers aghast at the blue and white battered horror rumbling past. We'd lost the starter motor by now. The border guard was a bit dubious... He let us through, though, after seeing the inside; but I don't think he expected us to leap out and push it... Not to mention the traffic jam we were stuck in on a 1 in 6 hill, where we were thoroughly alarmed by Graham bumpstarting the stalled deathmobile in reverse.

But back to the vendor of parabrisas, Santander -

Some of the biggest Ford stock in Spain, but no windscreen for weeks, even with Rose junior giving the receptionist the full force of his Patagonian patois. Despair yielded to 'Oh, sod it, we'll drive off anyway'. Outside, and there were all the aged Spanish mechanics pounding the new windscreen into place with mighty slams of their fists. Lighter in heart (and wallet), we continued our journey.

At last, Graham was ceremoniously handed the controls, as we set off up the twisty foggy nasty 10 km final approach. At the last stage, with 'Riot in Cell Block No.9' at full volume, we roared into the Lagos Car Park. And no-one, but one sleeping member of Her Majesty's soldiery was there. But what were the party of a dozen or so nuns doing having a picnic by the road, surrounded by sheep and mist?

We now move on four weeks, and the Editor enters the scene...

The contingent who had brought the 'bus out tittered nervously as a troop of squaddies pushed it round and round the Los Lagos car park frantically. "What's up with it?" I asked innocently, not having driven or taken much notice of the machine for the previous two weeks in which I'd been out. "Starter motor doesn't work," someone said; they failed to mention the non-dipping headlights, the fading brakes, the slapping transmission - etc. etc. After the journey down the 22 km of 1 in 4 hills necessary to reach the teeming metropolis of Cangas de Onis, I could see why... Much relieved that the van was now Someone Else's Problem, the journey-out team ran giggling from the vehicle to the relative security(!) of the Spanish railways. The rest of the day was spent mending the starter motor with bed springs, adjusting the timing five times to try to cure a misfire and then finding out that it was due to the exhaust manifold having fallen off... Curing the misfire allowed us to hear the transmission going bang-a-bang-a-bang all the way up and down the hill and for some reason reverse gear failed that evening.

Two weeks of scaring ourselves and several hitch hikers to death (literally, almost) on the hill road passed in a flash... Iestyn describes what happened next.

Hey you! Don't read that, read this! So you think the sharp end of the Expedition came in pushing 500+ m pots? Not so...

It is the end of the Expedition and I am to travel (feeble manic laughter) if not home, at least to England by 'El Sod'. This Ford Transit mongrel has already had a go at me on the journey out. Six weeks, however, have honed it to a new peak of malice. We are leaving a day early (Ed - for a ferry which Graham had convinced us went at midnight on Saturday) to ease El Sod over its teething problems - 5° dead zone in the steering, buckled roof struts which do not make contact with the bodywork anyway, two utterly knackered Universal Joints... My Diary reads: "Funeral minus one day and counting."

The four haggard remnants of the '83 Expedition boldly go from Cangas with the bus, 1500 m of rope, rucsacs, forebodings etc. Jan Huning takes an absent-minded handful of anti-crap pills to replace lost mass. Phil Rose contemplates the earlier drive out to Spain, his shock of forcing the steering wheel to the left as the van veers right into le ditch. John Singleton's hunched form over the steering wheel defies the bus to attempt any indiscretion. Iestyn Walters: "El Sod, a van barely alive. But we can't rebuild it. We can't fix the two knackered Universal Joints. Yea, though we drive the vehicle of Death we shall not fear the fading of the brakes, nor the cracks in the steering column, nor the..." Chorus: "Shut up, Iestyn!"

The Spanish/French border. Dusk. Headlights on, but where on earth is the light? As the night deepens, the left lamp shows the worn tyre under it up nicely while the right one beautifully highlights the open mouths of the oncoming motorists. Still, what is the point in seeing the road when the steering does not work? (Good point, well brought out!)

There are difficulties at a service station as the way on is gently uphill with a stalled engine. Yes, the starter motor (relic of the Great Exhibition) has been fixed, but the battery has only enough 'voom' for one relaxed start per day.

It rains. The left windscreen wiper is convinced the windscreen is under the bonnet and proceeds to hammer the bus to bits. Still, at least this time we have a windscreen.

Whew! Friday lunchtime in some village 100 km south of Chartres. A day to rest and have a look round and... "AAARGH..." (fading into the distance). John disappears in the direction of the parked van. Reappearing a little later, paler and thinner. "The ferry leaves on Friday August 12th/13th which is tonight and not tomorrow night!"

Chorus: "AAAARGH!"

55 mph. The Ghetto-Blaster blasts out Handel's Messiah but cannot compete with the clattering U.J.s. (A sudden stop now and the rope would burst the (non-existent) bulkhead - Spaghetti Bolognaise garnished with caving wellies. It's a good job the brakes are duff.)

Mais le Force est avec nous. Boulogne Ferry Terminal. 40 minutes to harass a poor French official with "Mais non, il ne reverse pas", a time to let the adrenalin drain (or in Jan's case, time to test the French drains).

And thus we made it. The advice:

(i) Tape of Bach organ sonatas for the awkward moments, and the Messiah for all the desperate ones.

(ii) If you knacker a van, for God's sake do it properly and don't spend the rest of the Expedition driving its ghost around.

(iii) Take John Singleton with you.

Editor's Postscript

It is 7.30am and miraculously we are somewhere in London, after having spent a night trying to find a downhill-facing lay-by on the A20 to crash out, whoops, sleep in. I try to pull out to overtake a lorry and with a flash of sparks and a blaring of the horn, the indicator stalk falls off to be fielded neatly by Jan. The overtaking procedure becomes more interesting every time a slow lorry looms. I shout "Right!" and Jan shoves the stalk into the steering column, to the accompaniment of the horn, vast, improbable electrical discharges and manic laughter from the passengers. "Lord, what if the police stop us?" asks Jan. I shudder to think. I have been suffering from Amador's bowel ever since Spain, an ailment which periodically involves stopping the van in a shower of rust and headlamp trim, grabbing a loo roll, vaulting hedges into the nearest field and then ripping my trousers off. In one such field south of Bordeaux, in addition to the obvious, I unwittingly left my driving licence, wallet, cheque-card and all identifying documents except my passport. My passport of course shows a clear-eyed, clean-shaven long-haired lad. I am now short-haired (my carbide set it on fire), unshaven, bespectacled and dirty. Shuddering, I imagine the scene:

Officer "Hello, hello, hello. What's all this then? Let's see your licence."

Me "Well, you see, officer, I was having a crap in a field near Bordeaux and I lost my wallet, honest, and this is my passport and this isn't my van."

But the right sort of Force is still with us and we finally grind to a halt in Oxford, to be met by Steve Roberts, who says "Cor, you take your time! Fancy going in the van to a Fairport Convention concert this afternoon?"

The three of us (Phil had insisted on getting out in London) run off down the road, screaming, while Steve wonders what is wrong. He would soon find out.

Post-postscript

The man who bought and towed "El Sod" away was arrested for towing an uninsured and unroadworthy vehicle... The curse of "El Sod" strikes again!

(SR)

THE FIRST TRIP DOWN POZU LAS PERDICES

We woke up in a glorious blaze of sunshine, and after struggling with the last of the dry Mornflake Oats and syrup, applied ourselves to our last day of caving in Spain in 1983. Our task, suitably climactic, was to explore and survey the promising cave F7b discovered the day before. F7b is in fact one of four interconnected entrances: F7a and F7b are particularly interesting as they are joined by a passage containing spectacular ice formations covered in flies.

Our surveying got off to a good start, with a distance of 3 cm being recorded by the topofil across the entrance snow plug. On opening up this expensive piece of high technology, we were so amused by the array of tatty bits of plastic and cotton reels that we resorted to a more finely tuned instrument: Ian's body. Trying to measure body spans whilst traversing in the tight entrance rifts and then climbing down an awkward 8 m drop proved to be quite interesting.

After the climb there is a short squeeze and nasty piece of rift bringing you to the top of the first pitch. At this point we decided to abandon the survey, and in our euphoria kicked about two tonnes of rock down the pitch, revelling in the crashes and booms from below.

At the bottom we swore for joy: to the right was a large onion-shaped passage with a deep trench, whilst to the left the pitch continued. Following the latter way, for ease of rigging, we landed on a boulder slope which led us to a new 10 m deep trench. Ian, gripped by the excitement, charged right down to the bottom while the more prudent members of the party rigged a line.

Walking downslope, back underneath ourselves, we soon came across a small strongly draughting vertical squeeze. We casually threw a rock down and got the shock of our lives: after the intial extensive rattle, rattle there was a silence. "Great, it's going!" someone said. "Boom!" replied the small hole. "It's really going" (Ed. - loses something in the translation) we all agreed, but the hole still had the last word with a final deep "BOOOOM!". Expletives were exchanged and we set about gardening the rest of the loose rocks.

The small hole turned out to be a graceful shaft of impressive proportions. 20 m down we landed on a ledge at an inlet, and rigged another superb 38 m freehang down to a further ledge. Only 20 m of rope were left, there were no convenient flakes for rigging, and it was getting late. Result: we weakened! Wistfully we threw some rocks down to the next pitch. It sounded very big.

Leaving a cross of soot on the wall, we started the prusik back out. The journey was uneventful but was made interesting by exercises in multilingual swearing when Iestyn had a rock fall on his head and the tackle bags all stuck in the rift.

Back on the surface, we struggled up the hill to camp to find Chris waiting for us with a piping hot stew. Sadly, this was totally inedible. The manufacturers had added six times the normal salt dose!

Why Cavers Cave......3

Why Cavers Cave...4

A LIGHT-WEIGHT CAVING EXPEDITION TO BORNEO

Introduction

The trip described here arose from a chance remark that the logistics of arranging a caving expedition to the Bau-Serian limestone area near the capital city of Sarawak did not seem anywhere near as daunting as arranging a trip to Mulu, or even much more than a trip to Spain. Originally, a full, university-backed expedition was envisaged which would ask permission to work with and through interested Sarawak government organisations. As things worked out, four of the people who wanted to go were medical students (two from Birmingham and two from Oxford) and were closely constrained by their courses as to when they could go. The time was established by informal contacts to be extremely inconvenient for a joint expedition, as Sarawak was about to celebrate the 20th anniversary of its incorporation into Malaysia, a celebration into which all effort was being directed. Consequently, as accommodation could be assured by the fifth member's family connections in the area, it was decided to take all the organisation upon ourselves. In fact, this course meant that a minimum of organisation was needed, and no artificial organisational hierarchy, with all the unnatural strains that can impose on a caving trip, was needed. The only group organisation undertaken was the deciding of mutually agreeable dates, arrangement of cheap, yet flexible, air flights, and discussion of fall-back options and minimum personal finance limits.

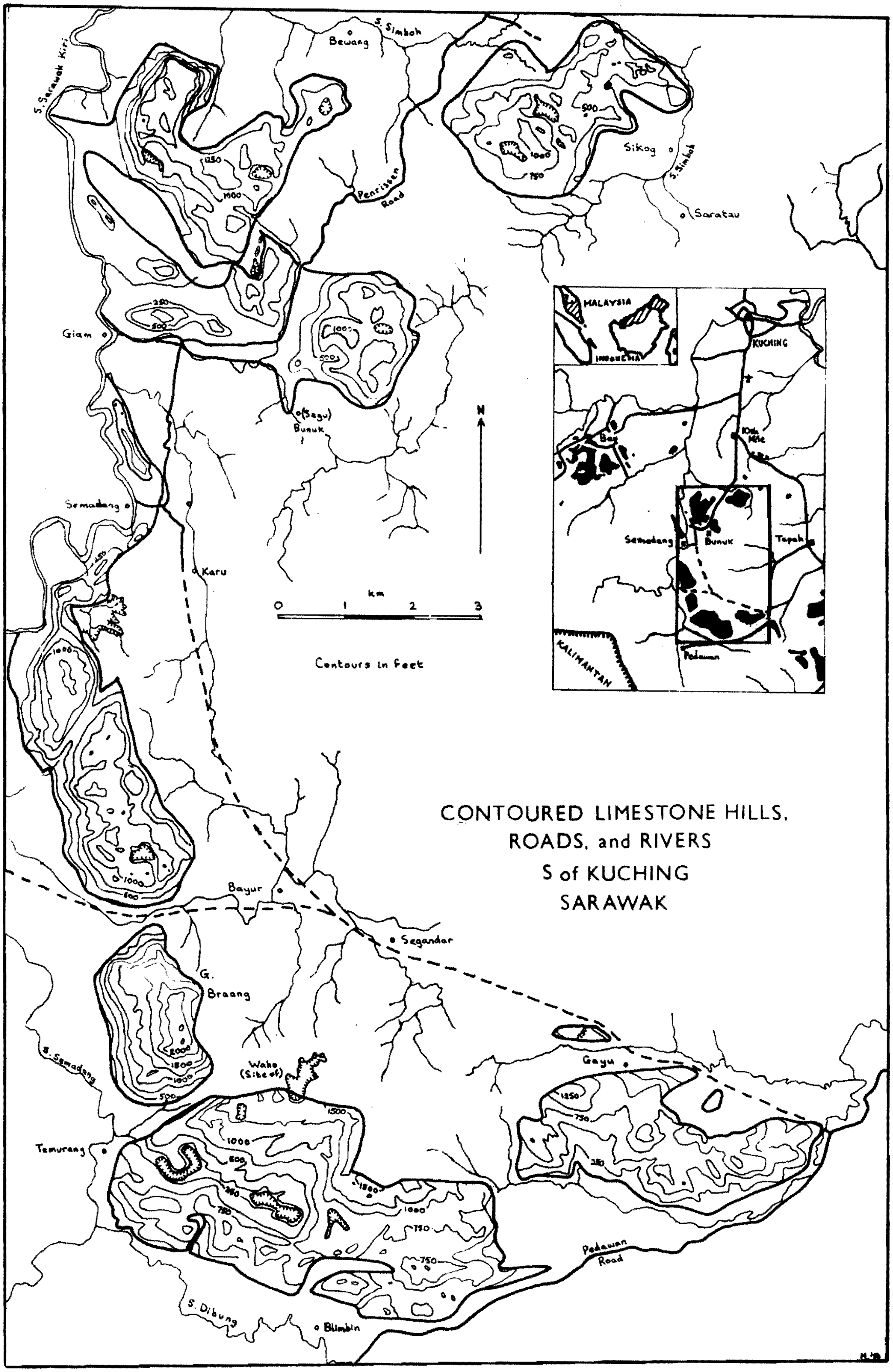
Most organisation was personal: the medics applied for such grants as are available for use by them during electives. Otherwise, organisation boiled down to arranging insurance physically through vaccinations and antimalarials and financially through the BCRA scheme. Choice of baggage was important as we were committed to carrying it all at once if necessary. Fortunately, personal gear requirements are minimal in the tropics, and for group caving gear we took:

- 10 m rope
- 5 m & 10 m lightweight ladders
- selection of slings
- 200 m SRT rope (unused)
- bolting kit (unused)
- survey gear
- large plastic sheet for camping on and/or under
- petrol stove
- cooking canteen
- first aid kit

Once in Sarawak, accommodation was taken in cheap Chinese hotels (where you pay by the room, not the person), or in caves, or with local people, who tend to be very friendly, especially in the more remote areas. (We were said to be the first European visitors to one village for fifteen years, and were very hospitably entertained despite coming unannounced. They would have been very offended if we had insisted on camping nearby and cooking for ourselves to 'save them trouble'.)

We ate the local food, thus keeping costs down, discovering a whole new cuisine, and reducing our load. It can rarely be economic to take your own food supplies on a foreign caving trip, except in very extreme conditions in uninhabited areas.

For transport, we were confined to local buses, which were often slow, hot and crowded, but were cheap, generally efficient, and provided their own entertainments, and our feet. Car hire was investigated and found to be in very short supply, and expensive. Motorcycle hire would have been useful, but we didn't find anyone doing it. A coastal vessel was used to reach the caves of Niah via Miri from Kuching, but the air fare back was thought worthwhile in view of the speed and less monotonous catering.


CONTOURED LIMESTONE HILLS,
ROADS, and RIVERS
S of KUCHING
SARAWAK
Contours in feet
km
0
1
2
3
N
S. Sarawak Kiri
Bewang
S. Simboh
Penrissen Road
Sikog
S. Simboh
Saratau
Giam
(Segu)
Bunuk
Semadang
Karu
Bayur
Segandar
G. Braang
S. Semadang
Wahe (Site of)
Gayu
Temurang
S. Dibung
Blimbin
Pedawan Road
MALAYSIA
INDONESIA
KUCHING
Bau
10th Mile
Semadang
Bunuk
Tapah
Pedawan
KALIMANTAN

Some Karst in the Penrissen area of Sarawak

On the NE coast of the island of Borneo, one degree north of the equator, there is a sinuous band of limestone forming karst towers, hills, and plains. In the spring of 1983, a group of five cavers visited a part of this area adjacent to the Penrissen Road. This road is one of the oldest in Sarawak, having reached the longhouse village of Segu (alias Bunuk), 21 miles south of the capital, Kuching, in 1898. Despite this, only two caves were recorded as having been explored and surveyed (Wilford, 1964).

Geological background

The limestones of the Bau-Serian outcrop belong to the Upper Jurassic - Lower Cretaceous Bau Limestone Formation (Wilford & Kho, 1965; Wolfenden, 1965). They originated as reef limestones (Coo & Lau, 1977) and have been the subject of several undergraduate field studies (Bait, 1980; Jantan, 1969) and of an intensive resurvey by Victor Hon of the Malaysian Geological Survey Department, whose new map and report are awaiting publication. Preliminary reports give some indication of the work involved (1972; 1973). Intrusive rocks appear to have had a considerable effect on the Bau area, but are not important in the Penrissen area. However, the debris of considerable extrusive volcanic activity in the form of large amounts of ashfall-derived allophane deposits is revealed in large amounts in the cave sediments. These very closely resemble those found in the two major karst areas of northern Sarawak, Niah and Mulu (Laverty, 1982). The source of this material is unknown, but there are several distinct possibilities:

(i) Sarawak is within reach of ash falls from volcanoes in both the Indonesian and Phillipine island arcs, and incidences of such falls have been recorded (e.g. Everett (1878) evidently records the Tambora eruption of 1815 as "...according to native testimony slight shocks are by no means rare, and a severe one is particularly held in remembrance, which took place seventy or eighty years ago, and was accompanied by a rain of ashes".). A problem could be that the prevailing winds would not always bring the ash over Sarawak, but there again, the winds may have been different at the time.

(ii) During the late Pliocene and early Pleistocene, there were extrusive volcanoes in central Sarawak which could be the source (Kirk, 1963). Being nearer, this could be more likely.

(iii) Harrisson (1961a; 1961b) began investigating volcanic ash beds in the Niah Caves, in association with Shell geologists. No further reference is made until, in 1972, while discussing the radiocarbon dated lavas of G. Kinabalu, he refers to 'equivalent volcanic ash sills [sic] ...in the Niah Caves'. This correlation would appear unlikely. No supporting evidence on the stratigraphy is known, and Harrisson assumes the deposits to be aeolian whereas Wilford (1963, 173) points out that they are more likely to have been washed into the caves through cracks and fissures.

The solution of this problem will probably require chemical and mineralogical analysis, dating, and perhaps quantification of the deposit to determine whether any distribution pattern can be discovered.

The cave sediments as a whole also show a markedly similar sequence to those in Mulu (Bull & Laverty, 1981), with gravels overlain by silts and sands (the Cricket Muds of Mulu). The gravels are rarely seen, at least in part because corrosion has been so intense that they are now represented by mere ghost images and have physically become silts. With any disturbance their identity would be lost.

Geomorphological background

Climate undoubtedly has an effect on geomorphology. Today, the area has a wet tropical climate (about 4570 mm rain per annum at Kuching), with some monsoonal influence. During the Pleistocene, sea level changes exposed large areas of the nearby Sunda Shelf and are thought to have thereby caused a somewhat drier and more seasonal climate.

The limestone surface takes several forms:

(i) Karst plains which tend to be very flat, but intensely corroded into deckenkarren blocks which are revealed when the soil is excavated manually, as at Bau, or naturally by rivers and streams. River beds often give the appearance of new plains at an early stage of development with prominent notches formed at the flood water level, where not obscured by...

(ii) Debris slopes of blocks of assorted sizes, sometimes clearly derived from landslides which have left...

(iii) Vertical rock faces, above which are...

(iv) Intensely corroded bare rock surfaces, at all scales from rillenkarren to large karst depressions.

Directed phytokarst (Bull & Laverty, 1982) is found in this area, especially in the more inaccessible parts of cave entrances, where visiting feet have not crushed this most delicate and fragile land form into dust.

Biological background

There were no biologists on the trip, so only cursory notes are possible on the wildlife encountered in and around the caves. The vegetation on the limestone slopes can be assumed to be little disturbed, except by what appear to be not infrequent fires on the upper slopes and by cultivation on some of the less rugged and more soil-rich lower slopes. Progress through this natural limestone forest is generally fairly easy; indeed the vegetation more often assists than impedes progress. Virtually all non-limestone areas are either under cultivation or are occupied by secondary forest. These areas are veritable jungle. Little is to be seen alive by the casual visitor - we saw and despatched one snake (as it happens, a fairly harmless Wagler's pit viper) and not much else. Much more is to be heard, especially if a camp is made in the forest.

In the caves, granny frighteners are much in evidence. Rats caused the exploration of at least one passage to terminate early, and centipedes also caused considerable consternation when sighted. Whip scorpions (tailed and tailless) were not uncommon, but did not seem very menacing, being rather like the cave crickets in size and colour. Small white millipedes seemed common in some places, especially around the rotting bamboo, swift and sometimes bat guano which accompany swifts' nesting areas. Small red-brown cockroaches are also sometimes to be found here. Bats were not present in very large numbers, the birds' nest swifts being more obvious by their loud clicking and sometimes poor navigation. Despite this, we saw no evidence of cave snakes.

Human and Historical Background

The Sarawak River delta has been shown by archaeological work to have been in trading contact with the ancient oriental civilisation for well over a millenium. The basis of this trade was the produce of the hinterland now known for administrative purposes as the First Division: the first part of Sarawak taken over by the Brooke dynasty in 1841. The produce included bird's nests, so it is certain that some caves must have very long histories of exploration. The cave entrances have also provided shelter, as shown by excavations and also by observation of shell middens of freshwater snail shells broken for eating. It is probable that these caves have been explored over a longer time span than perhaps any others, with the possible exception of the European painted caves.

The earliest recorded explorations date from 1842 when James Brooke and his associates, like Capt. Mundy, visited a cave in G. Tubband (Keppel, 1846) (Mundy (1848) refers to it as G. Tabong), and from other explorations by Brooke's officers such as Hugh Low. Low's exploration of a cave in Gunong Rumbang in 1845, near a place he called Sempro, is of particular interest here, as the first group of three on our trip tried to find and survey this cave from the village of Emproh. Low (1848) records how the cave passes right through the mountain, and carries a stream from the far entrance. Later, probably in 1852, Spenser St John (1862) appears to have visited the same cave and also succeeded in visiting an upper bird's nest cave, which Low couldn't reach due to the poor state of the route which 'only a Dyak can climb' and which was said to be booby trapped to deter nest robbers. Wilford (1964) records St John's, but not Low's, visit, but did not survey the cave or visit it himself. This is probably because the approach to the closed depression is much easier through the cave from the natural highway of the river than from the new road and an ancient path which, after passing through rubber and fruit groves, patches of vegetables and bananas, ended in a near-vertical padi field. Without, at that stage, a hefty parang, we beat a retreat.

In 1879, A.H. Everett was encouraged by A.R. Wallace and by C. Lyell, who had discussed such a project with Beccari in 1865, to explore the caves of Sarawak in search of the 'missing link'. He was funded by the Royal Society and the British Association for the Advancement of Science. Of course, he didn't find it, although he might have collected what later became the 'Piltdown jaw' (Matthews, 1981); neither of his published reports (1879; 1880) give a detailed indication of where he looked.

Little has been written of local traditions, ownership, or activity in the caves. The local people seem to give loose ownership of the right to collect bird's nests to a few people, but do not mind others if they do not interfere. As for tradition, the traditional religion is animist and so some form of sacrifice to the spirit of the cave is in order on entering it. Cigarettes seemed popular, and we gave bananas. These seemed quite acceptable, and disappeared quickly.

Speleological background

Local cavers, as has been indicated above, have known parts of many, if not all, of the caves for many years. Evidence of visits by literate cavers is abundant in the graffiti - some in English, but most in Chinese ideograms, plus assorted arrows and pictures. Glass bottles are quite common and some appear to be quite old: square-sectioned bottles originating from Rotterdam were the most distinctive. The other evidence of past visits is in the various aids left in the caves. Bamboo is the commonest material and is used both to assist on climbs and to probe for bird's nests. In one place, steps had been hacked out of a stal boss, and in another a projecting flake of rock had been broken off to provide an easier route through a section of cave.

Lighting today is usually by hand-held electric torch, but a flaming torch generated by wicking paraffin up a rag stuffed into a bottle is not uncommon. A more ethnic version of this is to use a bamboo cylinder as the paraffin container. The records of the Sarawak Museum show that an attempt was made to introduce carbide lamps at the Niah Caves in the 1920s, but the recipients preferred to use resin or beeswax candles tied on to a bamboo in the caves and reserve the bright carbide lamps for nocturnal hunting trips in the forest outside. Nowadays carbide is increasingly hard to obtain (we spent several days not finding any in Kuching and eventually located a small supply in a hardware store in Bandar Sri Aman), and the lamps are advertised for sale to rubber tappers, or Thai tin miners. Geological survey investigations seem to have used torches and paraffin lamps for illumination, judging by the photographs in Wilford's (1964) book. Future visitors might be best advised to use electric lighting; mains electricity may not always be available, but generators are not uncommon, and some modern lamps can be charged from car batteries which can be found powering TVs even in areas without roads (e.g. at Temurang).

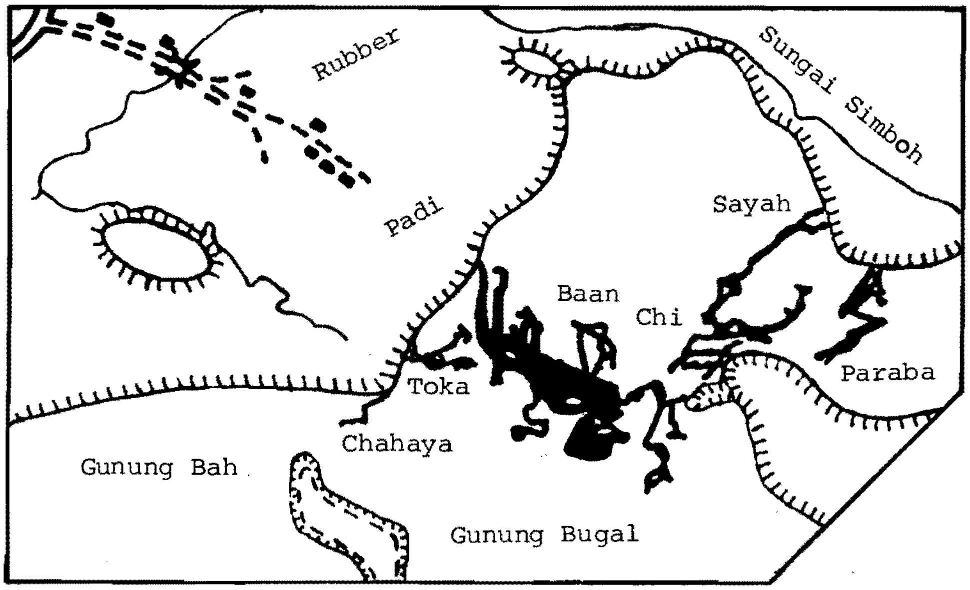
Medical aspects

An important part of our early plans had been to carry out some medical projects concerned with caving in the area. All but one of the 1978 Mulu cavers had suffered some form of fever which was not fully diagnosed.

In 1980/81, four cavers suffered fevers and one a severe allergic response, apparently to guano. Literature references were also found to a case of leptospirosis (attributed to bat and swift guano) affecting a European in a cave at Bau (Harrisson, 1968), and another reference indicated the presence of the histoplasmosis fungus in Sarawak, though not in caves (Harrisson, 1965). Together with the possibility of rabies and the danger of falls and cuts by sharp or jagged limestone, there seemed to be abundant material for further investigation. Do the bird-nesters suffer from problems not affecting their fellows who remain outside the caves? Is everyone histoplasmin-positive through permanent exposure? Could foreigners be exposing themselves to specific medical hazards by visiting the tourist caves at Bau, and if so, were the authorities aware of the danger? Without the assistance of local medical staff we did not attempt to pursue these questions, except for supplying Dr T.W. Tinsley of the NERC Institute of Virology at Oxford with a guano sample from T Baan. This proved devoid of rhabdoviruses, an encouragingly negative epidemiological result, but all the questions remain very relevant.

As to the health of the participants on this trip, one member suffered from a depressing allergy to all the antimalarial drugs he tried; one endured <u>oditis externa</u> (earache), probably due to too much swimming; and another returned to the UK not only with typhoid, but also dysentry (probably not originating in Sarawak, where there was a cholera outbreak). He also left the UK with diarrhoea!

The Caves



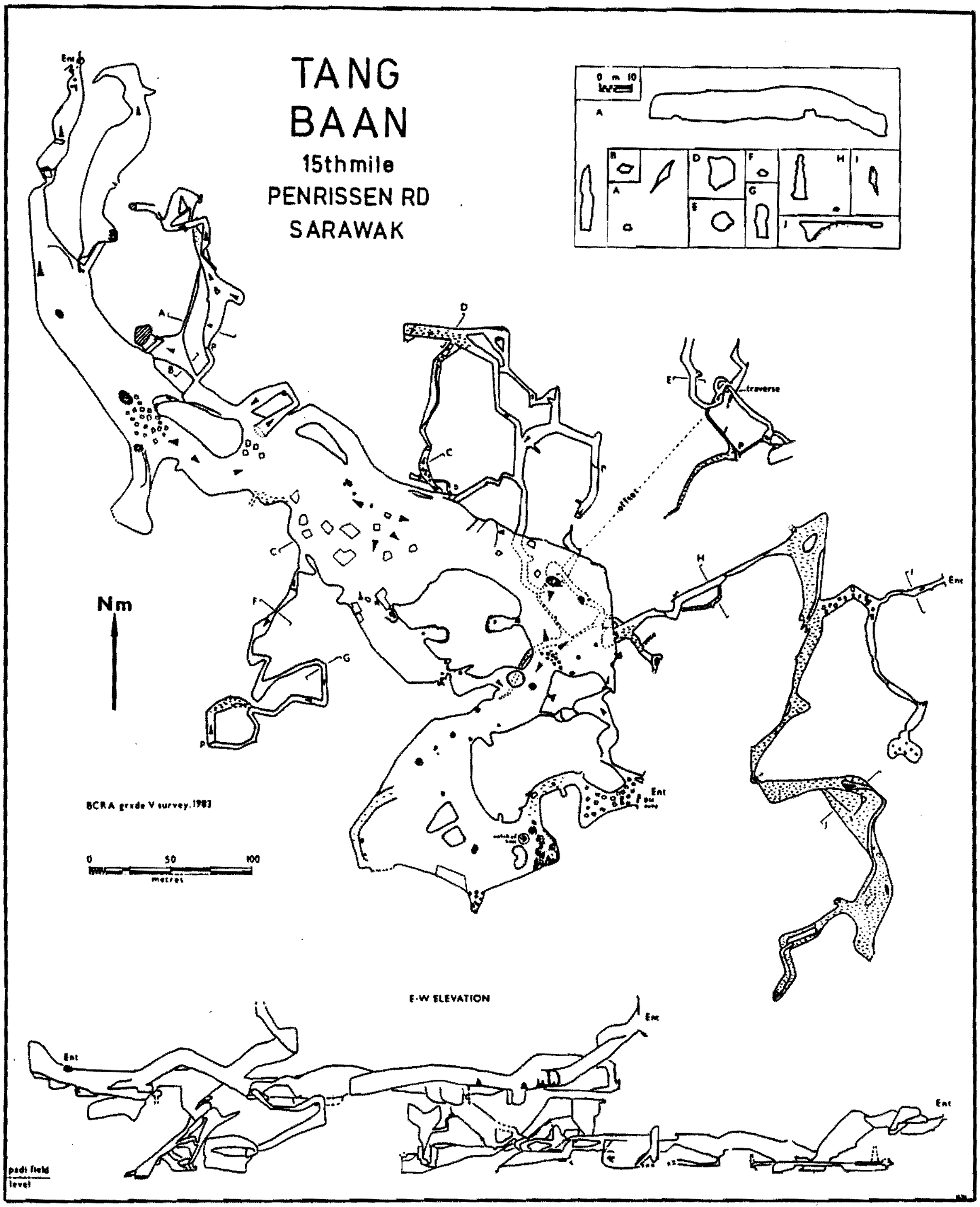
Map of area around Gunung Bugal

Tang Baan

This cave has a somewhat colourful recent history. During the 1970s a group of Communist terrorists is said to have hidden in this cave for almost a year. The story seems true as the only site suitable for a camp has a five-pointed star drawn on a nearby boulder. We stayed there and can attest to its comfort. Their stay was terminated by the security forces machine-gunning them as they left the cave. Another group fared somewhat better, but almost died of thirst when they were stranded in the cave for four days by light failure. Fortunately, our guide came out of retirement to find them and take them to one of the few water sources. The confusing nature of the large passages-cum-chambers may have contributed to this - of

6412 m which we surveyed, 609 m consisted of totally unexpected resurveys following almost exactly the same lines in large chambers!

All three entrances are hard to find, the most obvious being the least accessible. The other two are small, but draught strongly and quickly open out inside. The jungle-hidden entrance is only about 5 m x 1 m, a little



slit in a steep slope. As you move through the cave, however, the dimensions increase so that at the 'Magic Pool' it is about 70 m across and 15 m high. This pool is a curious feature. In the middle of this huge cavern is a small mound on the top of which are three 0.6 m diameter pools ringed by crystals glued together. The water is very clear, and unlike all the other water in Borneo caves is not obviously infested. We saw only one small crab in it. The magic part is that no drips seem to fall into the pool, and we were told that it remained full in all seasons - '100 men drink, no empty'. Our sprightly 69-year-old guide who told us this went on to make a sacrifice at a cleft in the rock nearby which forms a convenient altar.

The half-Chinese guide who showed us the way into Baan didn't really let us take in the beauty of the place. Only when we surveyed it and explored later did we find the fabulous formations and huge chambers. He had led us along a path which followed one wall of a chamber which turned out to be 450 x 150 metres and about 20 m high. The chamber is divided up by impenetrable walls of stalagmites but there is no escaping the frightening size. The largest bit encompassable in a single view is 100 m x 100 m, which is big enough for me. Squeezing through the gap at the far end of this chamber leads you into one of the other entrances in the middle of the jungle. The locals have erected traps here to catch the birds and bats and, no doubt, make them into soup as well.

Many side passages run off this huge chamber, but the route right through to the other side of Gunong Rumbang is so obscure it is impressive that the locals found it. On the way the route passes the most beautiful of the formations the group saw in Borneo; it is an 8 m high perfectly white stal column, probably the only clean thing in the whole cave. The best thing about this column is that it rises out of a pit below you, and is so close to the ledge from which you view it that no photo can ever capture it. Perhaps that's just as well.

Several main types of passage are traversed in the cave: large phreatic rifts aligned along joints; steep phreatic tubes; wide and/or muddy passages which evidently flood (probably backflooding from the surface); wide phreatic passages/chambers with extensive breakdown; small phreatic tubes. There is an almost total lack of clear vadose features.

Tang Chi, Tang Saya and Tang Sungei

Tang Sungei is a small stream cave running near the base of the limestone cliffs on the E side of the hill. It has two entrances over cliff-foot boulder falls and down mudslopes, and leads to a dry passage with an aven which probably connects to Chi, which is entered about 50 m up the cliff and reached by an obscure route. The cave contains a 10 m pitch (once rigged with lianas!) and several climbs and leads to two entrances on the W of the hill, one of which is named Saya.

Tang Peraba

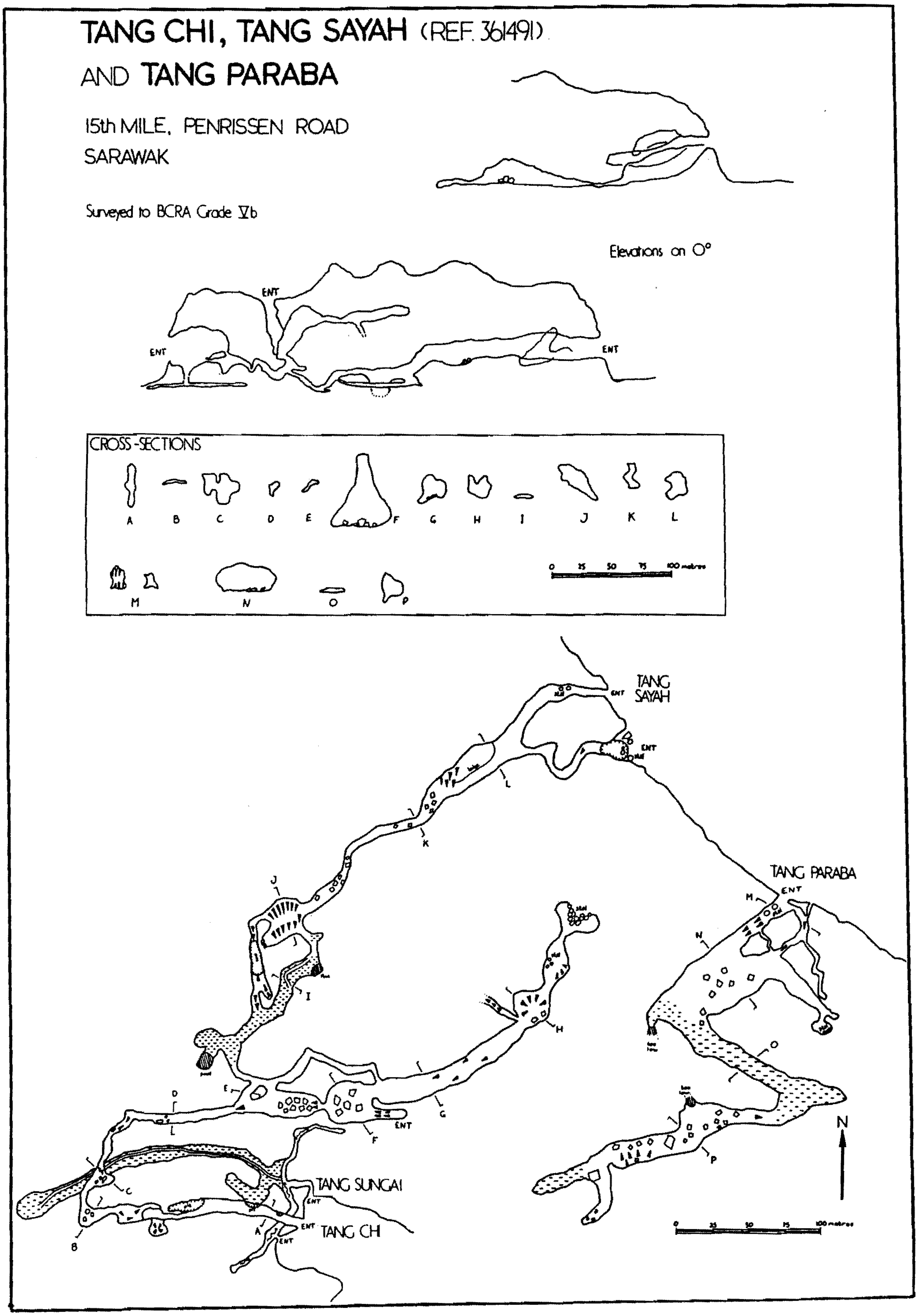
Surveyed by Wilford (1964); our survey agrees in most respects except for the final section of passage.

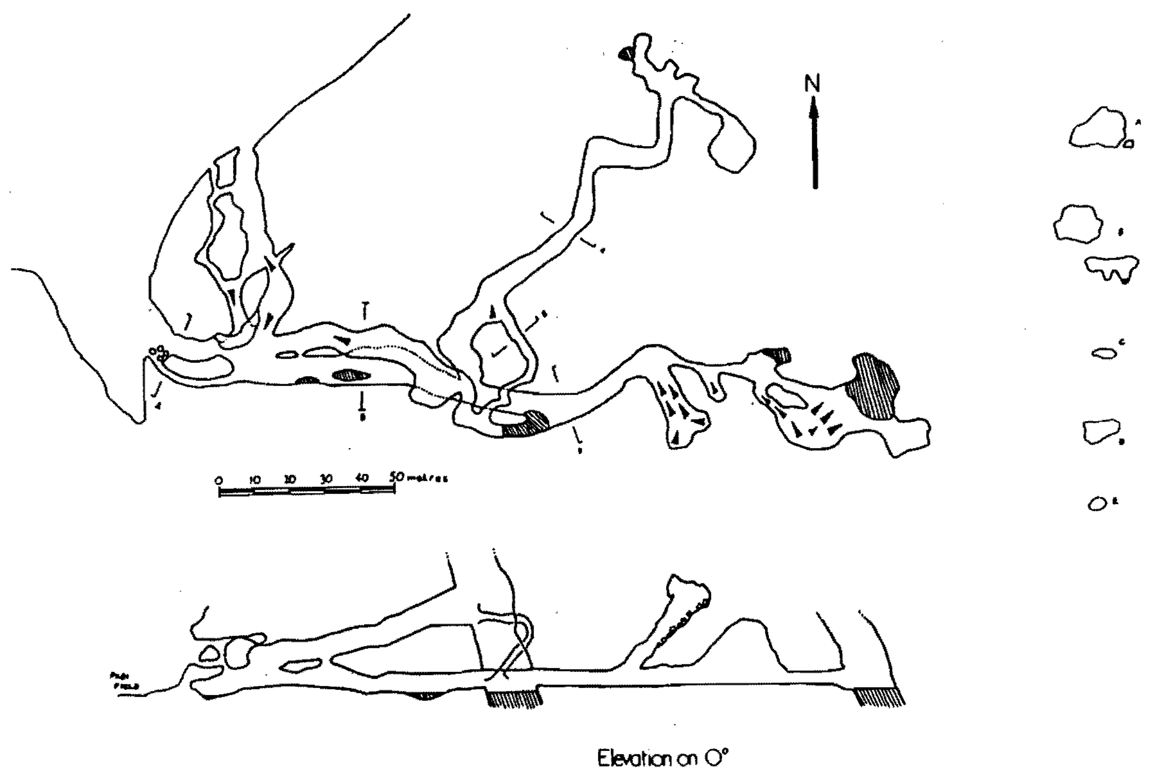
Tang Toka

Named after a huge spider living in a hole near the large entrance which is only a little above the padi field. The entrance appears to be a shell midden. Several sumps are found inside. The cave also contains much wildlife - suffice it to say that on a surveying trip in this cave one of the party was taken short and dashed up a side passage with the bog roll. Only two hours later, when the party reluctantly returned to this passage to survey it there was absolutely no trace left of the deed!

Caves in the Bunuk Area

The following caves are said to be in the Bunuk area and more or less regularly visited by bird's nest collectors: Suira, Jeoi (1 and 2), Mudik, Bai (1 and 2), Tibua, Kebuak, Banti, Keyuak, Menjog, Tiang, Duh, Rasan Kambah, Bayur, Sakuah, Nggang Pasun, Bai Rinyo, Minggu.


TANG CHI, TANG SAYAH (REF. 361491)
AND TANG PARABA
15th MILE, PENRISSEN ROAD
SARAWAK
Surveyed to BCRA Grade Vb
Elevations on 0°
ENT
ENT
ENT
CROSS-SECTIONS
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
0 25 50 75 100 metres
TANG SAYAH
ENT
ENT
TANG PARABA
ENT
TANG SUNGAI
ENT
TANG CH
ENT
ENT
N
0 25 50 75 100 metres



TANG TOKA (SPIDER CAVE) REF. 361491

15th Mile, Penrissen Road, Sarawak Grade Vb

Sinks near Gunung Penyok

On the 1:50,000 map (Munggu Babi sheet 1-110-10), several closed depressions are evident on the limestone hills north of Bunuk. In particular, we decided to visit those on G Penyok. The new geological map shows that these are particularly interesting because they are formed at the junction of limestone with weathered volcanics. True to the textbook, the lower junction was found to be dotted with small sinks. Most were inaccessible, choked shafts, but one gave access to a clean-washed and distinctly vadose sink cave, the first such cave to be surveyed in Borneo. A short pitch dropped into a passage leading to a 10 m pitch into a pool, whence a reticulate set of joint controlled passages led to a low duck, which sumped. Above the pitch, a route led to a larger upper set of chambers more typical of Borneo which were more easily reached from outside.

Pedawan area

The largest single limestone block in the Bau-Serian outcrop is located here and has considerable potential. Wilford (1964, 89-96) surveyed three caves here, and the geological map shows some interesting alluvium-floored closed depressions on the top of the hill, complete with a stream. It is surprising that Wilford makes no further mention of these features.

Blimbin

A night spent in the Islamic longhouse of Blimbin gave rise to the following list of caves (cave = dang in the dialect here) known to the villagers: Sibandir, Pangir (A and B), Singau, Payang, Paiit (A and B), Bung Ayak, Ketak, Spai and Sidug, Batu Sapug, Sekat, Gite, Bait.

Batu Sapug was said to be the largest cave, a visit taking two hours in and two hours out. It is presumably the same cave as Wilford (1964) surveyed to a short drop and recorded as Batu Sempok.

Temurang and Wah

The Bidayuh longhouse village by the river at Temurang is occupied by many people who moved down from the abandoned village site at Braang Wah. We visited three caves here, one being a large resurgence. A very large closed depression near the site of Wah was not entered as a return was intended but never made. The base of the limestone is at about 300 m here and the Temurang resurgence is only at about 60 m, so a reasonable depth potential may be attainable, perhaps in vadose passage. The area is very promising and begs further investigation.

Semadang Cave

A steep climb up an obscure path emerges about 50 m up into a descending entrance to a large passage some 30 m high. Perhaps 100 m of cave leads to a steep upwards sloping entrance. A pitch was left undescended but could be the key to passages behind the resurgence.

Temurang resurgence

Water emerges from sumped rifts to flow shortly into the Sungei Sarawak Kiri, here called the S Semadang. However, about 5 metres above there is a large phreatic tube which is a flood rising and allows the main stream to be seen emerging from more flooded rifts into a moderate-sized chamber. There may be possibilities for extension in higher-level rifts, some of which seemed to draught, and perhaps also connect with higher entrances.

Picnic Cave

Reached by a climb up a path of notched logs, this cave draughted quite strongly through rifts at the end, about 100 metres in.

References

Bait, B., 1980. Stratigraphic and Petrographic Studies of the Bau Limestone, W Sarawak, Malaysia. Unpublished thesis.
Bull, P.A. & Laverty, M., 1981. Cave sediments. In Eavis, A.J. (ed.) Caves of Mulu '80. Royal Geographical Society, London, 47-49.
Bull, P.A. & Laverty, M., 1982. Observations on Phytokarst. Z. Geomorph. N.F. 26, 437-457.
Coo, J.C.H. & Lau, J.W.E., 1977. Recognition of Reef Facies in the Bau Limestone. Geol. Pap. geol. Surv. Malaysia 2, 72-78.
Everett, A.H., 1878. Volcanic phenomena in Borneo. Nature Lond. 17, 200-201.
Everett, A.H., 1879. Second quarterly report on the Bornean cave exploration. Rep. Br. Ass. Advmt Sci. 49, 149-155.
Everett, A.H., 1880. Report on the exploration of the Bornean caves in 1878-9. Proc. R. Soc. 30, 310-319.
Harrisson, T., 1961a. Niah Caves project: 1961 on? Sarawak Gazette 1235, 3-4.
Harrisson, T., 1961b. Niah excavations: progress in 1961. Sarawak Gazette 1240, 98-100.
Harrisson, T., 1965. Histoplasmosis in Sarawak. Sarawak Gazette 1285, 99-100.
Harrisson, T., 1968. Sarawak Gazette Feb 29, 29.
Harrisson, T., 1972. The Borneo stone age in the light of recent research. Sarawak Museum Journal 20, 385-412.
Hon, V., 1972. The Kuap Area Sheet 1-110-10 Area C. Ann. Rep. geol. Surv. Malaysia 1971, 166-170.
Hon, V., 1973. Kuap Area Sheet 1-110-10. Ann. Rep. geol. Surv. Malaysia 1972.

Jantan, A., 1969. Geology of the Kpg Benuk Area, Sarawak. Unpublished thesis.
Keppel, H., 1846. The Expedition to Borneo of HMS Dido for the Suppression of Piracy. London, 2 vols.
Kirk, H.J.C., 1963. Pliocene and Quaternary Volcanic Activity in British Borneo. Bull. Br. Borneo geol. Surv. 4, 137-142.
Laverty, M., 1982. Cave minerals in the Gunung Mulu National Park, Sarawak. Cave Science 9, 128-133.
Low, H., 1848. Sarawak. Richard Bentley, London.
Matthews, L.H., 1981. Piltdown Man (10). The Missing Links. New Scientist 91, 26-28.
Mundy, R., 1848. Rajah Brooke's Journals. London, 2 vols.
St John, S., 1862. Life in the Forests of the Far East. Smith, Elder & Co., London. 400 + 420 pp.
Wilford, G.E., 1963. Limestone cave formation in Sarawak & N Borneo. Bull. geol. Surv. Borneo Region Malaysia 4.
Wilford, G.E., 1964. The geology of Sarawak and Sabah Caves. Bull. geol. Surv. Borneo Region Malaysia 6, 181 pp.
Wilford, G.E. & Kho, C.H., 1965. Penrissen Area, W Sarawak, Malaysia. Rep. geol. Surv. Borneo Region Malaysia 2.
Wolfenden, E.B., 1965. Bau mining district, West Sarawak, Malaysia Part I: Bau. Bull. geol. Surv. Borneo Region Malaysia 7(1), 147 pp.

What Really Happened

The Team

R.M.C. Gregson	(medical officer)	has been deep.
C.T. Ankcorn	(medical officer)	has been very deep.
P. Shewell	(medical officer)	expected to go deep.
T.A. Houghton	(medical officer)	dreams of going deep.
M. Laverty	(patient)	would go deeper than anyone to avoid the above four.

It was a wet Saturday afternoon in Oxford when the team met for the first time; Houghton was late, as he had overslept, suffering from some kind of viral meningitis. When he did arrive it was all he could do to sit on a chair and moan. Laverty's slides of the area in Borneo showed steep limestone hills and jungle covering everything. It looked impenetrable. Shewell said it didn't look very hot; rather rainy and cloudy. He said if he didn't get a decent tan his girlfriend would kill him. Laverty paused, and then showed some more slides of brown natives hacking down the jungle. Ankcorn said that the jungle didn't look very pleasant and the natives looked quite primitive and smelly. Laverty became silent, and Ankcorn realised that he was married to one of the natives. Things became less tense, however, when Gregson left to watch his girlfriend win some race or other. He was late back because he had fallen off his bike. The next time they would all meet would be in Borneo.

The flight was awful. Houghton and Gregson, in an attempt to avoid jet-lag, took large quantities of sleeping tablets, the only effect of which was that they couldn't cope with knives and forks and so could only eat by falling face-first into the airline food. They spent three hours in Karachi, queueing to have their passports, tickets and baggage looked at before they were let into a room for half an hour which contained a broken drinks machine and a number of dead flies. Then another three hours queueing to get back on the plane just as dawn broke. In order to make the weight limit they had such heavy hand luggage that they nearly died of exhaustion, and Gregson almost killed a Pakistani porter by turning around too quickly. Houghton complained of the heat the whole time. After stopping in Singapore just long enough for Gregson to get so drunk that he was sick on the plane, they arrived in Bunuk, Mrs Laverty's village. Houghton retired to bed with the heat.

The next two weeks were spent exploring the hills: chopping up snakes, being stung by exotic new insects the size of kittens, eating strange new food and drinking Guinness. A man of 79 showed them a cave he had explored in his youth. It was so large that Laverty fell silent with awe. Gregson fell over, tearing open his arm, and Houghton came out in a rash. They hacked through the jungle to a village called Temurang where they were feted with rice and bottles of Guinness. Laverty was speechless with enjoyment, but Houghton asked if they could have less rice. A native boy showed them another cave so huge that Laverty was silent with astonishment. Gregson twisted his ankle and Houghton's health began to decline.

At this point Shewell and Ankcorn arrived, bringing the rest of the expedition equipment. There was far too much, especially since Houghton had fallen ill with a fever in addition to his rash. The other three medical officers had innumerable arguments about the diagnosis - Laverty, hearing words such as 'malaria', 'typhoid', 'dengue fever' and 'supre-tentorial decompensation', wisely chose to make no comment. They could not agree, and so Houghton was taken to hospital whilst Laverty visited some of his relatives and the others ate steaks in the Supersonic Restaurant.

Houghton, though battling against illness, was keen to come on the trip into cave Baan. In they went, and immediately got lost in the vastness. They decided to leave an object as an initial survey station, and survey the cave to grade 5b, discovering the way out as they went. The object they left turned out to be Houghton, who filled the role ideally, and the surveying began. In the confusion, Laverty was silent, but Gregson fell and dislocated his shoulder. Ankcorn complained of the smell of the guano endlessly, and Shewell said he wished that his girlfriend (or was it his fiancée?) could see the vastness of the cavern.

Later on, Gregson was taken back to the first survey station (Houghton) to lie down and they settled for the night. Ankcorn complained of the smell of Shewell, who said that it wasn't him but must be Laverty. Laverty, speechless with rage, indicated that the smell must be Gregson - eventually they decided that it was due to Houghton, who was asleep and so couldn't argue. During the night, they were crapped on by cave swifts and bitten by cave crickets, and it was a disgruntled Ankcorn who emerged into the jungle, followed by the rest of the party, two days later. He had never really been able to sleep in the cave (unlike Houghton, who rarely awoke) because of fear of the insects and the smell of their droppings.

Back in Bunuk they drew up the survey, which showed that the cave was about 11 km long with a chamber 400 m x 100 m. They woke up Hougton, whose rash was worse, and he agreed that it was a good survey just before he lapsed back into a coma. He was getting no better. The doctors thought that he might have malaria and increased his anti-malaria tablets; eventually it transpired that he was allergic to the tablets. He slowly began to improve.

Laverty and his charming wife eventually had to leave for England. He was speechless with regret at leaving. The others got on with the business of exploring the caves of Borneo. After a three-day boat journey of indescribable horror, they arrived in Miri, a town not quite bad enough to make getting back on the tramp stéamer immediately worthwhile. On the boat, Ankcorn had spent his time looking for the source of the smell while Gregson dressed his gashed hand. It wasn't healing well, as Ankcorn had mistaken Guinness for the iodine when dressing it. Shewell wrote long letters to his fiancée and kicked the cockerel which crowed all day and night and yet never woke Houghton up ...what could?

They had come to see Niah Caves, and so marvellous were they, huge and airy, with poles for collecting bird's nests hanging from the roof, that the team wished that Laverty could have been there to comment on them. They flew back, mainly so that Houghton could enjoy the air conditioning - it was on occasions such as these that he did wake up and talk in raptures about snow.

In the last few days they surveyed a huge cave 6-7 km long, which Ankcorn disliked because of its smell. Afterwards they found another, smaller cave in which Houghton could manage to sleep; but unfortunately Ankcorn smelled a rat, and stayed awake. In trying to catch the rat, Gregson smashed open his arm. Shewell was a problem to the very end. He fell in love with a local girl and the others had to dictate the letters to his fiancée. When the time came to go the others bundled him with difficulty into a bus for the airport.

On the journey home the team had to wait for fours hours at Karachi in order to get into a room with a dented spitoon and a lizard. There they said goodbye to Ankcorn, who went off for four days in Karachi town, in which time he caught four kinds of chronic diarrhoea and typhoid. Despite severe temptation, however, that was all he caught. Back in Britain, hot baths removed most of the guano and sun tan, and revived Houghton, who by now was complaining of the cold.

THE ST MICHAEL'S CAVE SYSTEM, GIBRALTAR

Situated at the southern extremity of the Iberian Peninsula, Gibraltar is probably the most famous limestone outcrop known to mariners. The Rock scrapes in at a touch over 5 km long (N-S), up to 1600 m wide (E-W excluding jetties), and rises to a maximum height of 424 m. The only part that is not limestone is the sand on the beaches. There are over 140 natural caves recorded as well as many kilometres of man-made tunnels, dating from the early British occupation to the Second World War. However, there are many obstacles in the way of the sporting caver. These are mainly windsurfing, waterskiing, sunbathing and drinking, not necessarily in that order. If one manages to survive the acclimatisation process, the troglophilic existence of the true caver can be pursued in pleasant surroundings with no long slogs across bleak, desolate, rainswept moor. The caves, however, are limited in what they can offer, most being no more than hollows in the flanks of the Rock. Of the few sporting caves, the Saint Michael's system provides the finest situations in all Gibraltar. The system was first described in writing by the Romans who occupied Mons Calpe; however, long prior to this the caves had been used by early cave dwellers. The Romans believed the cave to be bottomless, with a route under the Straits to North Africa, and this route was supposedly the way by which the Barbary apes crossed to Gibraltar. Surprisingly, many people still believe this to be the case.

The system falls naturally into four parts - Old Saint Michael's Cave, Lower Series of Old Saint Michael's Cave, New Saint Michael's Cave and Leonora's Cave. Unfortunately, there is a great deal of confusion amongst the uneducated about which bit is which, the most common mistake being that New Saint Michael's is called Lower Saint Michael's. Even the Gibraltar Tourist Office gets this wrong! In addition, Old Saint Michael's is commonly referred to as plain Saint Michael's Cave.

Old Saint Michael's Cave

This cave has the only natural entrance to the system and is therefore used as the starting point of this description. The entrance is easily found, as it is next to the road and known by all the taxi drivers on the Rock. Behind a log cabin type building, which contains a bar, is a turnstile and the way into a unique show cave. A short flight of steps descends to an illuminated description of the cave and its formation. To the right, row upon row of red plastic seats descend on neat concrete steps to a large stage; this area is known as Main Hall and is probably the only naturally excavated auditorium in the world. The flooring was originally installed when the cave was turned into a hospital during the last war. Since then it has been used as an auditorium, and the regular concerts performed by the band of the resident battalion are well worth attending.

Beyond the stage area, a concrete path wends its way through stupendous arrays of stalagmitic columns over 20 metres high in the area known as Cathedral Cave. Interspersed with these natural displays of beauty are several unnatural tableaux of Homo neanderthalis, provided by the Gibraltar Tourist Office. At the southern end of Cathedral Cave, beyond the columns, one arrives at The Precipice, a slope down of over 15 metres, nearly vertical in places. Railings prevent further progress down this serious obstacle.

On the western side of the cave, a man-made bridge crosses a deep pit (accessible by staircase) to a dug-out entrance level, which emerges in the cave car park. This entrance is kept locked and a barrier prevents access to the bridge.

Access to the cave is unrestricted except for an entrance fee and opening times. In the war against vandalism, much of the cave is wired with alarms, and so it is advisable to stick to the paths. Although a tourist cave, it is still well worth a visit just for the chance to see such extensive formations lit by more than a muddy Oldham lamp. Wet suits and helmets are not required.

Leonora's Cave

The entrance to Leonora's Cave is found by following the left wall of Old Saint Michael's auditorium. Where the concrete floor ends at a loose soily slope covered in litter and broken glass, a climb over or under the railings gains the start of The Passage. This is a grotty stooping-height descent past a short section of dry-stone walling into the cave. The Passage ends at a step down around some stals into First Chamber. A short low section leads from First Chamber to the more impressive Main Chamber which is dominated by a fine stal slope and three pretty stal columns. Unfortunately, the cave has been severely damaged by generations of visitors. A staircase has been cut into the stal slope and this marks the way on. It leads to a short hands-and-knees crawl in a narrow passage with a pool of water about one centimetre deep covering the floor. This crawl goes by the imaginative name of The Crawl. The Crawl ends at a junction. By turning left and upwards a rift can be followed for a short distance. Right and down is the obvious way on, with one or two useful steps cut into the walls to aid descent. A bob down around a corner enters the eastern section of Bell Chamber at the top of a flowstone-covered slope. Again steps provide an easy descent. On reaching the foot of the slope, a crawl can be entered in the right wall - this is Gas Passage. Bell Chamber itself is dominated by the stalagmitic Partition, which effectively divides the chamber in two. Several short passages radiate from Bell Chamber. These are of varying degrees of tightness and stability but all close down with no possible way on. Although one passage goes by the name of Twin Rope Pitch, no tackle was required by the author or friends in any part of the cave.

Access to Leonora's Cave is controlled by the Gibraltar Tourist Office. Permission to enter can easily be obtained by calling in person at the main office in town one or two days in advance. Once permission is granted, cavers should book in and out via the turnstile at Old Saint Michael's Cave. The entrance fee is normally waived.

New Saint Michael's Cave

This section of the system is without a doubt the paragon of Gibraltar caves. It is crowded with an abundance of fine formations which must surely rival any in the world. What is more, the whole is contained in a cave which would only merit a technical grade II in Yorkshire!

The entrance was discovered in 1942, when a level was being driven from the surface to the chamber at the foot of The Precipice in Old Saint

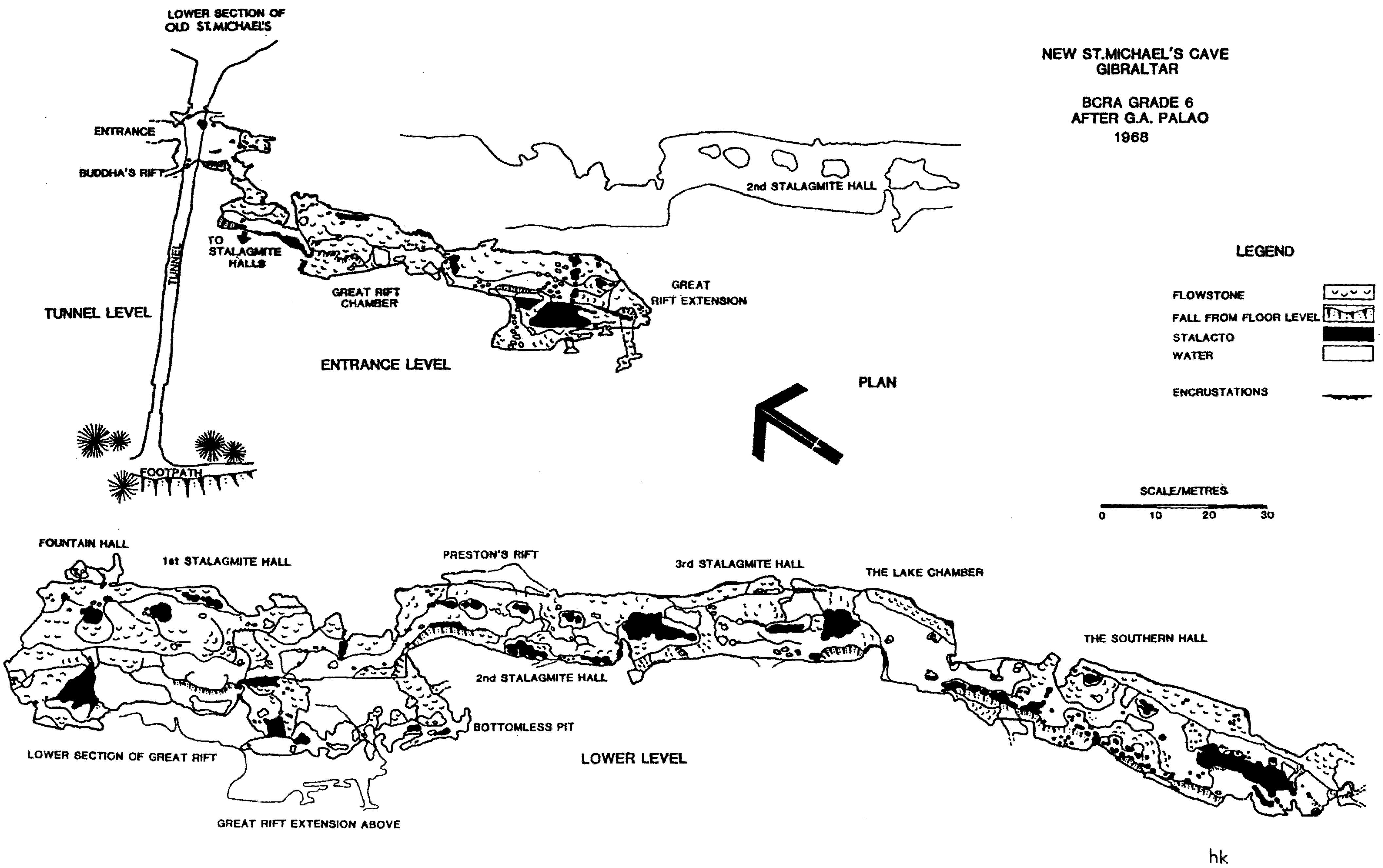
Michael's Cave. At the time, the chamber was being converted into an operating theatre. The entrance level is found by walking down the metalled track from Old Saint Michael's car park to a small flat area from which a level footpath leads northwards to the way in. Just before the mined level reaches the operating theatre, a narrow wooden staircase descends into a hole. This is the start of New Saint Michael's Cave.

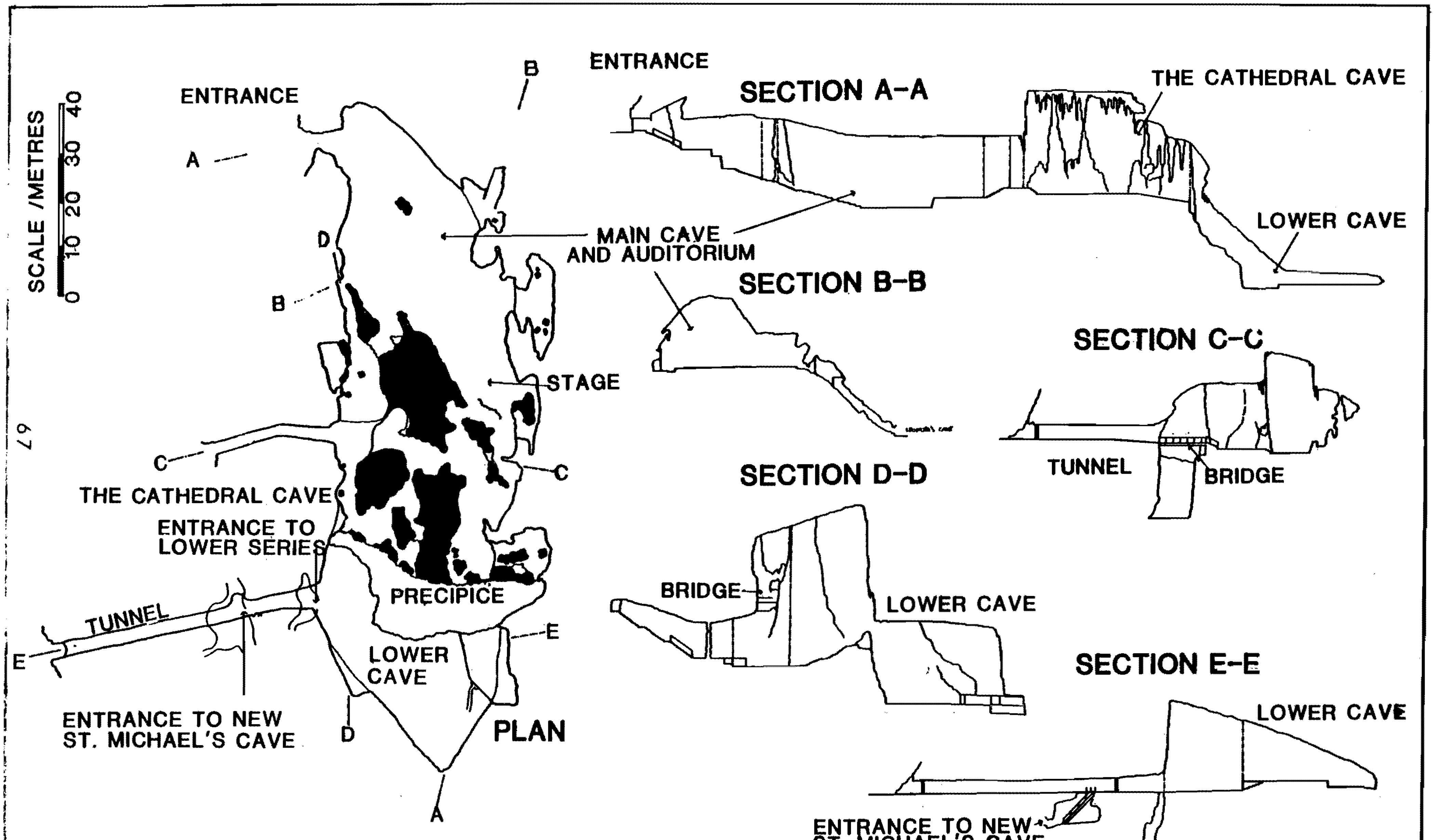
From the foot of the wooden staircase there are two ways on. Northward is the Northern Series (Ed: really?) and south leads to the main cave. The Northern Series is a group of rift passages, generally sandy and uninteresting. A claimed 19 m pitch was never found, but the remains of a rope ladder descended a climbable rift for some ten mentres. Going south from the entrance, a short, stooping-height passage emerges at the head of a climb down flowstone of some three metres. A knotted handline is in place to assist. The obvious way on enters a short crawl which emerges in the impressive Great Rift Chamber, dominated by a 'boxing ring' tangle of fixed ropes to aid progress for the less agile. The formations in Great Rift Chamber whet the appetite for what is to follow, and include a fine painter's palette high up at the top of the chamber.

An easy traverse, aided by the top fixed rope, leads to a simple climb down by a large calcited boulder. Straight ahead is the continuing Great Rift Extension, but the way on is to descend to where a handline drops to a low archway. A short traverse line leads through the archway and to a continuing descent over a flowstone, with a handline, into The Antechamber. Here, a small knee-deep pool is the first standing water to be encountered. The way on is the obvious route up to a two-metre climb, with handline, over a stal wall. On the far side of the wall is the First Stalagmite Hall and the start of the fine formations. Of particular note are several large chunks of stal which have fallen from the roof and have subsequently been calcited down. A short climb up leads to the way out of First Stalagmite Hall by way of a walking-size passage, with a drop into The Bottomless Pit on the right. The well-decorated passage emerges at the stupendous Second Stalagmite Hall, whose formations are largely controlled by the square pattern jointing displayed in the ceiling. Preston's Rift, a short narrow passage, starts at the entrance to Second Stalagmite Hall. An easy route passes through the Hall and leads to a largish pool covering the floor, avoided by traversing on rimstones. A short way on is the start of the Third Stalagmite Hall. Although smaller than the other two Halls, it is nonetheless impressive. The final Stalagmite Hall terminates at the waters of the magnificent Lake, a body of water that occupies the entire passage and is up to ten metres deep in places; a life-belt and an inflatable dinghy are kept here as a safety precaution! The Lake is easily circumvented with dryish feet by traversing along rimstones which form a ledge down the left-hand side. This splashy traverse gains a particularly obscene stalagmite, from whence some planks lead to further rimstone traversing and, eventually, to Southern Hall.

Southern Hall is dominated by a near-perfect column about ten metres high and is the last chamber in the cave. The end of the cave lies a short way beyond, down a passage on the left, where a superb painter's palette can be seen.

Access to New Saint Michael's Cave is strictly controlled by 1 Fortress Specialist Team, Royal Engineers (1 Fortress STRE) who run the trade route as a show cave. The entrance is kept locked but a guided trip can easily be arranged. A guided tour takes approximately two hours but the journey from beyond Southern Hall to the surface can be accomplished in under fifteen minutes! Permission to explore the unlit sections of the cave can be arranged for 'bona fide' cavers through the Army Watermanship Training Centre (AWTC) on Queensway, Gibraltar.


NEW ST.MICHAEL'S CAVE
GIBRALTAR
BCRA GRADE 6
AFTER G.A. PALAO
1968
LOWER SECTION OF OLD ST.MICHAEL'S
ENTRANCE
BUDDHA'S RIFT
TUNNEL
TO STALAGMITE HALLS
GREAT RIFT CHAMBER
GREAT RIFT EXTENSION
2nd STALAGMITE HALL
TUNNEL LEVEL
ENTRANCE LEVEL
FOOTPATH
PLAN
LEGEND
FLOWSTONE
FALL FROM FLOOR LEVEL
STALACTO
WATER
ENCRUSTATIONS
SCALE/METRES
0
10
20
30
FOUNTAIN HALL
1st STALAGMITE HALL
PRESTON'S RIFT
3rd STALAGMITE HALL
THE LAKE CHAMBER
THE SOUTHERN HALL
2nd STALAGMITE HALL
BOTTOMLESS PIT
LOWER SECTION OF GREAT RIFT
LOWER LEVEL
GREAT RIFT EXTENSION ABOVE
hk



OLD ST. MICHAEL'S CAVE, GIBRALTAR. BCRA GRADE 6

Lower Series of Old Saint Michael's Cave

This section of the cave is without a doubt the most sporty cave in Gibraltar. It is a good grade III fun cave. The entrance is situated at the end of the tunnel in which New Saint Michael's Cave was found and is usually covered by a large wooden board to prevent accidental entry! Beneath the board is a climb down of three to four metres on to some very loose deposits which funnel down a further drop of some two metres. A handline is essential as the whole floor is unstable and a fall would land on an assortment of boulders, broken glass and scrap iron. As a further precaution, only one person should be on the climb at any one time and the whole group should be well clear of the cave directly below when someone is climbing.

From the foot of the climb, a slope of assorted detritus descends to a solidly-shored wall of timber, about three metres high, which acts as a dam. Below this, a small scree slope has to be traversed to the start of The Corkscrew, a series of small chambers and awkward descending squeezes. A long continuous handline marks the route through The Corkscrew to emerge at The Grotto. In The Grotto it is possible to wander in circles but there are two ways on. By following the right-hand wall the entrance to Ringing Rock Cave is easily found. This chamber derives its name from the musical properties of the rock flakes which cover parts of the walls, and all ways out quickly close down. The main way on from The Grotto is a flat-out crawl a short way past Ringing Rock Cave. A small chamber to the left of the crawl is known as Warren's Cave, but the main route is straight on through a particularly nasty squeeze, best tackled without helmet and battery. Beyond the squeeze is a second, of similar dimensions, known as Smith's Hole, and a low crawl continues over a small drop into squatting-height passage, leading to Brown's Bath. This pool is between five and fifteen centimetres deep in a chamber with a maximum height of about one metre. The acrobatic antics produced by trying to stay dry whilst traversing this obstacle usually put any observers into such paroxysms of laughter that they end up in the water themselves. Over Brown's Bath is a short flat crawl which emerges about four metres above the floor of Prison Approach. The use of Great Walenda tactics can overcome this disparity in altitude and place one at the foot of another four-metre slope, which has to be climbed to go to The Prison. The name is derived from a fine stal grille which produces a fair imitation of some rather robust bars.

For those who have not yet tired of bodily contortions whilst in intimate contact with sharp rock, there is an escape route from The Prison via Hanson's Passage. Unfortunately, it is only an escape for those who are sick in mind, for Hanson's Passage is a tight, sharp squeeze which ends at a two-metre drop with no hand-holds and a less-than-thigh-length gap to the opposite wall. It thereby acts as a very efficient leg breaker or knee reverser. Reversing Hanson's Passage is the crux of the cave. Beyond Hanson's Passage there are two ways on. Left leads to Hanson's Cave, a large, dusty chamber in bouldery, shattered rock. Going right is a short crawl to a three to four metre climb into Hanson's Grove, a fine long rift chamber walled with flowstone. At the far end, a short climb up reaches a broad, gently sloping expanse of flowstone. This is Brown's Seat and the end of the cave.

Access is controlled by 1 Fortress STRE. However, this is effectively delegated to the AWTC. The Lower Series is well worth a visit by any caver on holiday on the Rock with a spare pair of jeans, a sweatshirt and a pair of boots. The hire of helmets, lamps and belts may be possible by prior arrangement with the AWTC.

Surveys

Surveys of the Saint Michael's Cave system were kindly supplied by Mr G.L. Palao, BEM of the Gibraltar Cave Research Group. A BCRA grade 5 is claimed for the survey of Leonora's Cave. The remainder are grade 6, having been surveyed using theodolites and levels.

SOME KARST NEAR OXFORD

To most Oxford cavers, Cumnor Hill is the bleary-eyed, early morning prelude to a Mendip caving trip. Few realise that it is Oxford's nearest karst area, with sinking streams, dolines and springs. Fewer care.

From the sporting point of view, this is not unreasonable, but it is suprising that little scientific work has been done there as Oxford has someting of a reputation as a centre of karst studies.

The most obviously karst features of the area, the sink or 'swilly' (or gully) holes, are referred to by the brewery-owning geologist Arkell (1947), and more detailed references to the area are given by both Craven and Sanders in the Craven Pothole Club Journal for 1965 and in OUCC's own Proceedings (1966). Since the publication of these articles, more digging was undertaken by OUCC in the mid-sixties, which is now filled in and covered by a bridge, and I did some limited water analysis which is reported here and assisted digging operations started by Richard Rose, a Mendip caver, and continued with no real success by OUCC in the late seventies. It is hoped that this article might prompt someone to carry on with the chemical observations, perform dye tracing, and make other hydrological observations before the economics of modern farming dictate the complete obliteration of the natural karst order here. The area to the N of Oxford at North Leigh has suffered already.

The limestone in which the karst is developed is known as the Coral Rag, a shelly reef limestone of Corallian (Jurassic) age. Analysis of one sample showed it to be very pure, with only 0.09% insoluble residue, with a fairly high Fe/Mn ratio which probably accounts for its yellowish colour, and high Sr as a result of incorporation of aragonitic shells. Development of karst features seems to be along joints.

There are a number of sites identified on the map (Figure 1), which is identical to the one in Sanders (1966) except for the addition of new sites at

Spring:

(i) Water seeps out of sand into a boggy area and collects into a stream which drops over a small waterfall into a pool. Water was sampled at the fall, where tufa deposition on twigs and leaves is evident.

(ii) Another boggy spring.

(iii) Yet another boggy spring.

(iv) A spring capped by the Thames Water Board.

Well:

(v) In the front garden of no. 72 Cumnor Hill (Hidsfield House). Not descended, although descent might be interesting.

Sinks:

(vi) Pothole dug to about 3 m depth with rift to S taking water when dammed.

(vii) Sink under large tree which backs up by several metres in flood.

(viii) Sink under bridge crossed by track referred to as dug in '60s. Further details, including photos, are rumoured to be in possession of the farmer.

(ix) Prominent sink in depression in field which backs up to form a large pool in floods.

Chemical points

Triangular graphs (Figure 2) show the composition of the waters quite well, and permit general trends in their chemical evolution to be seen. One rainwater sample which was collected in Oxford itself is included. Clearly (provided you are familiar with trilinear plotting!) the main trend is the enrichment of the waters in Ca and HCO_3 ions from rain to sink to spring.

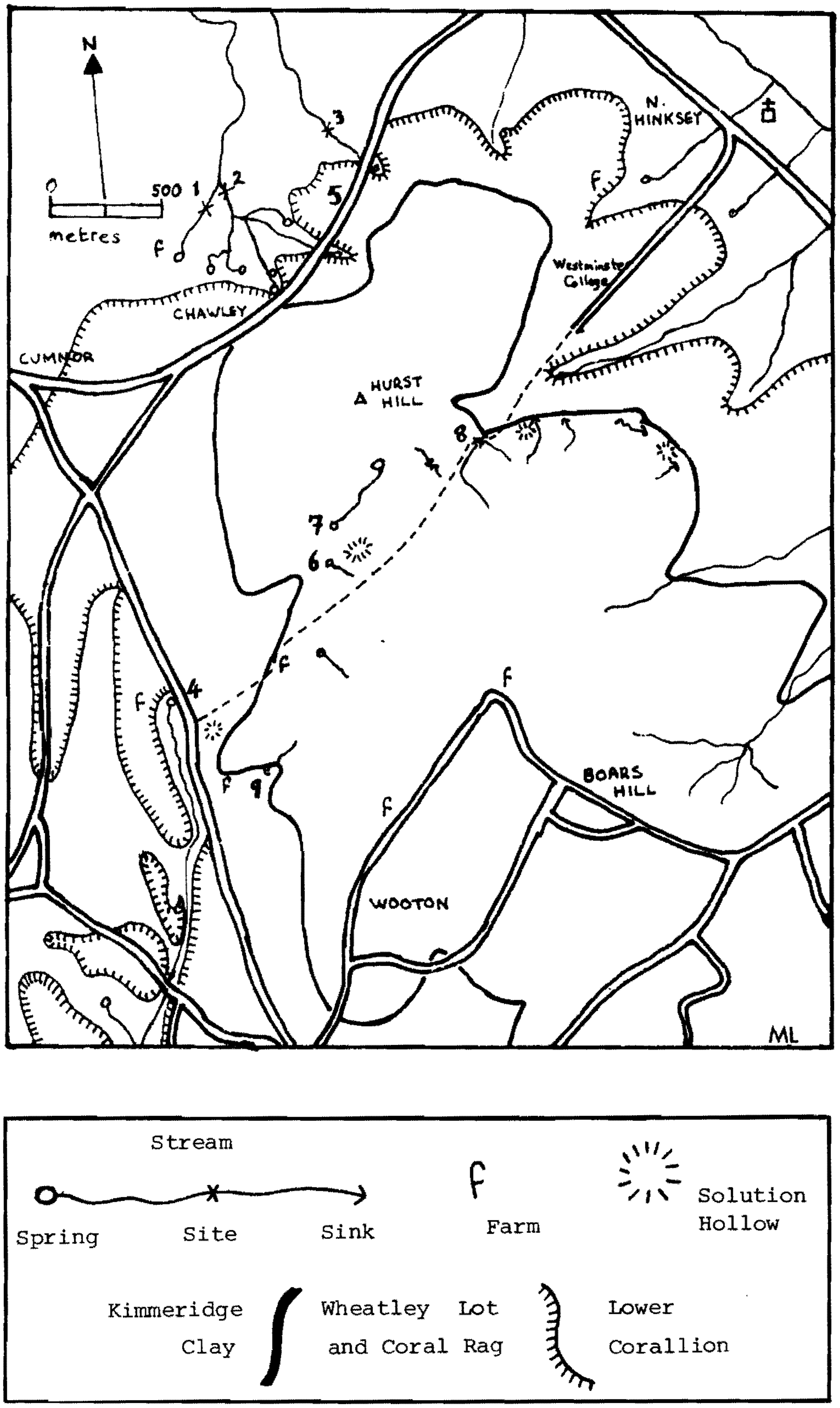


Figure 1: Map of Area.

pH

The sinks were notably more acid than the springs (6.0-7.1 against 7.4-8.0), with the highest pH during dry periods, as would be expected.

Concentration ranges observed

	Sinks	Springs	Well	Units
Ca	114-207	317-425	448	ppm $CaCO_3$
Mg	25-41	6-32	20	ppm $CaCO_3$
K	4-6	2-27	1	ppm K
Na	12-32	15-22	11	ppm Na
HCO_3	55-140	281-311	290	ppm $CaCO_3$
Cl	37-60	41-61	68	ppm Cl
Si	3.9-7.3	9-1.3	1.7	ppm Si

Aggressiveness

The sinks are aggressive whereas the springs are saturated. Specific values are not given as they are not easily reproducible unless continuous shaking and temperature control are employed. They weren't used in this case, as the samples were used to investigate the effect of shaking. This is a point not brought out in references in the caving literature to aggressiveness measurement.

Organic matter

Using the ratio of ultraviolet absorption at 400 nm to that at 600 nm (the E4/E6 ratio) the nature of the organic matter can be compared with values from soils in other areas. In the latter respect, the value of ca. 2 compares to ca. 5 for the W Kingsdale System, and is lower than any of the values quoted for soils by Kononova (1966). This could be an agricultural effect.

References

Arkell, W.D., 1947. Geology of Oxford. Clarendon, Oxford, 245-246.

Craven, S.A., 1965. Henwood Pots (Berkshire). Craven Pothole Club Journal 3(5), 234-235.

Kononova, M.M., 1966. Soil Organic Matter, its Nature, its Role in Soil Formation and in Soil Fertility. V.V. Dokuchaev Soil Inst., Acad. Sci. USSR, 2nd edn.

Sanders, F.E., 1965. An Account of the Findings of the Oxford University Cave Club at Cumnor. Craven Pothole Club Journal 3(5), 236-237.

Sanders, F.E., 1966. Some solutional features in the area around Oxford. Proc. Oxford Univ. Cave Club 4, 11-15.

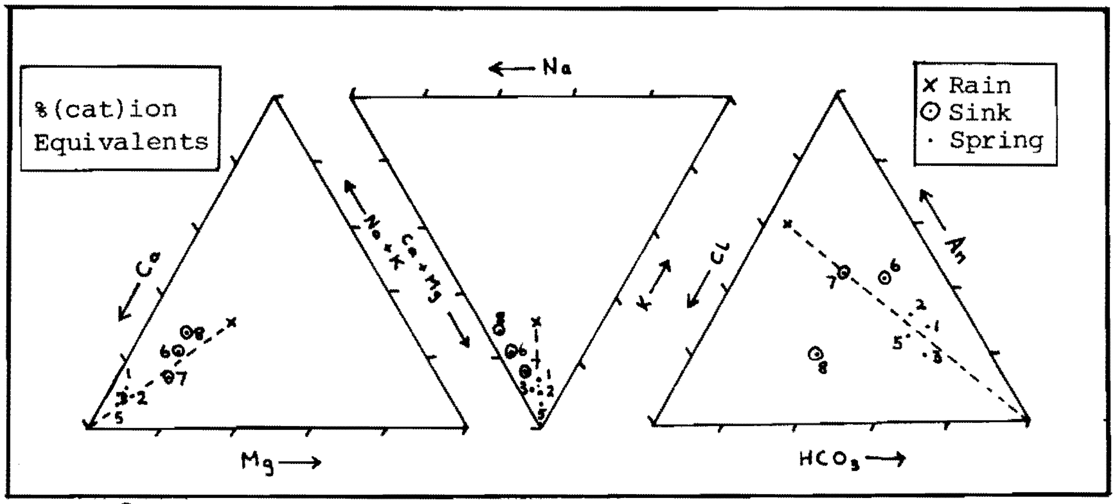


Figure 2

CAVING TECHNIQUE

A REAPPRAISAL OF THE TECHNIQUES FOR DESCENDING PITCHES BY LADDER - A CASE FOR A SAFER METHOD OF BELAYING

Almost all the caving clubs in the UK use ladders on many occasions to descend vertical pitches. Some of the reasons which are put forward for using them are:

(i) The pitch cannot be made free-hanging without a lot of effort and without creating awkward take-offs in order to avoid SRT rope rub.

(ii) They are essential for novice meets where there isn't enough time to instruct novices in SRT even if there were spare equipment available.

(iii) They are convenient on the entrance series to a deep system where short pitches may have a large amount of use (Singleton and Naylor, 1982, 13).

(iv) They are fun, and provide sheer enjoyment.

Of these, reason (ii) is of most importance to OUCC, where large numbers of novices exist who may try the sport only once or twice and do not want to become involved enough in caving to learn SRT and spend a not inconsiderable sum of money on new equipment. After all, how can you tell if you like caving without trying it? It is therefore likely that ladders will continue to be used in the foreseeable future in caving, especially in University clubs, where a large percentage of British caving novices are trained.

The problem, then, is 'how safe is laddering?'. In my opinion, not very! A quick look at the caving accident statistics shows that the misuse of ladders features significantly. My main complaint is the way in which the lifeliner at the top of the pitch holds the rope. In virtually all situations I have seen or heard of, the 'round the waist' belay is used. This is a technique much criticised in the climbing literature for a variety of well-publicised reasons:

(i) Lack of control by the belayer during a fall of a climber.

(ii) A large, twisting load is applied to the belayer himself.

(iii) After a fall it is not easy for the belayer to lock off the rope and aid the climber.

The obvious solution is the friction belay, a Sticht plate, a figure of eight or even a rack. However, the Sticht plate is smaller, easier to feed rope through, and can be used to abseil with if necessary. This has some useful advantages:

(i) It is a dynamic friction belay; during a fall the rope passes through the plate at a controlled rate, thereby absorbing energy and lessening the force transmitted to the climber and belays.

(ii) The device may be locked off and the belayer can give assistance or lower the climber safely.

However, there are problems in implementing this technique as lifeline rope tends to be hawser laid with a large variation in diameter; it is then difficult to get a belay plate to fit all the different ropes. An answer is to use kermantle rope which has a roughly constant diameter of 11 mm. The conventional 'wisdom' is that SRT rope should not be used in lifelining; SRT rope is generally a static rope, with low stretch properties, and consequently has lower shock absorption than dynamic lifelining rope. A quantity known as fall factor 1 is often quoted to assess the performance of equipment in shock load conditions, the determination of the parameter assuming that the rope is fixed at the point of fall. However, as I have pointed out, with a dynamic belay the rope is not firmly attached to the belayer, and the shock is much less severe.

An additional advantage of the Sticht plate is that it transfers the shock directly to the belay rather than through the intermediary of the lifeliner. What is more, the process is much less strenuous for the lifeliner, enabling him to keep up far better with rapid climbers and so avoid the possibility of a long fall. In the event of a larger fall due to rope snagging, the shock can be far better borne by the belays than by the lifeliner, as mentioned above.

The point I have been trying to make is that the fundamental objection to using SRT rope in lifelining can be removed by proper belaying practices. The implications of this are interesting for the tacklemaster as well as the caver. The tacklemaster can now get rid of large quantities of 'tow rope'/lifeline which were previously needed for laddering, but not used for regular caving in the club which is now dominated by SRT, and hence save scarce club resources. Underground, it means that abseiling can be the standard method of descent, which wouldn't be feasible with hawser laid rope, because of its tendency to kink and even melt. Self-lining is easier as ascenders move better on kermantle rope than hawser laid. Yet lifelining is still possible, and made even safer by use of a belay plate.

More realistically, there are problems in trying to implement this technique. SRT rope is more expensive per metre than conventional lifeline rope. It must also be made clear that there is no excuse for 'good' or 'bad' SRT rope, rope for SRT or rope for lifelining. Laddering rope must be as good as any other rope in the club and be thoroughly checked. Good rope sense must therefore be encouraged more than it is at present. Some types of SRT rope would be more suitable than others for belaying. Polyester (Marlow) ropes have less intrinsic stretch (0.9%) than nylon (PMI = 2%). Nylon is also stronger than polyester. All of which suggests PMI would be more suitable than Marlow in this instances (Ed: However, I'd much rather prusik on Marlow).

I was prompted to write this article for two reasons. OUCC is in the position of having to scrap virtually all its lifeline and spend a large sum on replacing it; it is also a club which becomes more and more predominantly SRT-based as time goes on. However, I disliked the attitude of some cavers in high places in the caving establishment who believed SRT to be the only way to go caving (Champion et al., 1983; Eyre, 1983; Ellison et al., 1983). A major problem with SRT is its expense, and I cannot see why people should have to make a large financial commitment to try a new sport. It is totally impractical at University to be able to teach novices on SRT before they have any caving experience.

In climbing there has been a move away from equipment with the realisation that one can 'fix' any climb technically; in other words, it is better 'style' to do without such gear. I feel caving is going through such a 'gear' period, and although the SRT advances have made for safer and easier caving, that this trend will eventually stop. I for one would hold as the epitome of caving style and elegance a solo descent of the world's deepest cave, using one length of SRT rope and a variant of the cordelette technique; using knots to prusik with, and a belay plate to rappel with! Don't laugh! No-one thought Everest could be climbed without oxygen, solo...

References

Brook, A., 1983. Ladders and lifeline technique. Caves and Caving 21, 17.
Champion, A., Graham, N. and Ryder, P.F., 1983. Ladders or S.R.T. - the choice is yours. Caves and Caving 21, 14.
Ellison, C., Soul, R. and Lyon, M.K., 1983. Letters. Caves and Caving 22, 34.
Eyre, J., 1983. Ladders - a reappraisal. Caves and Caving 21, 15.
Singleton, J., and Naylor, G.A. 1982. Xitu - the cave. Proc. Oxford Univ. Cave Club 10, 8-20.

HOW TO ROPE-WALK

Introduction

Of the two main methods of prusiking, rope-walking and sit-standing, it is only the latter that is properly documented or taught in this country. Sit-stand is thought to be the only practical means of rope climbing underground whilst rope-walking is left to the perverse. This is in marked contrast to the American attitude, where prusiking is synonymous with rope-walking. Despite what people in the know say, rope-walking isn't just good for long unrebelayed pitches. A good rope-walking system has the versatility to out-perform sit-standing on the most complicated rebelays characteristic of European caving.

Sit-standing is rightly the system taught to SRT novices due to its simplicity, but despite its extra complications, rope-walking is a more powerful technique for those committed to SRT. It is however an art, and not acquired easily.

A practical European prusiking system must be lightweight, compact and capable of negotiating changeovers. Compared to sit-stand, rope-walking needs only a simple sit-harness and a backbelt instead of a chest harness. The third 'spare' ascender is incorporated into the system leaving the option of converting - I was tempted to use the word 'downgrade' but I wouldn't want to stir up the sit-standers too much - to sit-stand in case of failure of an ascender. This extra ascender actually facilitates changeovers for the competent.

I put forward here a suggested basic rig.

Sit harness

Unlike a sit-stander a rope-walker does not spend most of his time on his backside, so a simpler sit harness will suffice. Figure 1 shows the design for a simple harness combining comfort with compactness. It can be seen that the bottom strap is adjustable and can be pulled up and tightened round the waist to form a belay belt.

The ½ inch tape in the diagram serves only to position the bottom strap. The end hooks to one of the roll-bar buckles at the front and does not impede movement or comfort.

Ascenders

The ascenders required for the system are shown in Figure 2. The right foot carries a Warsaw walker (Nicholls, 1981), which retains the advantages of a conventional Gibbs and yet is quick to attach or remove from the rope. At first sight, a lower ascender might seem to add inconvenience at changeovers; however, it is very useful for raising oneself above the belay at tight pitch heads, or where the belay is low down. Attachment to the foot must be secure for ease of control, and is best achieved by having a short tape loop, slightly bigger than the circumference of the boot, around the foot at the instep and an adjustable strap around the ankle.

The floating ascender is either a standard or expedition Petzl, sitting around knee height. The foot-loop cord attaching this to the left foot is doubled, so that by removing one of the foot-loops from the foot, the ascender can be raised to head level. A simple piece of knotted elastic or car tyre inner tube around the ankle serves to keep the foot-loops on the foot when the prusiker is at speed. For safety, a second length of 9 mm dynamic rope attaches the floating ascender to the sit harness. The ascender is raised by a loop of elastic either placed round the neck (Editor) or taken over the shoulder to the rear of the harness (Graham). The elastic is clipped on to the ascender by means of a hook.

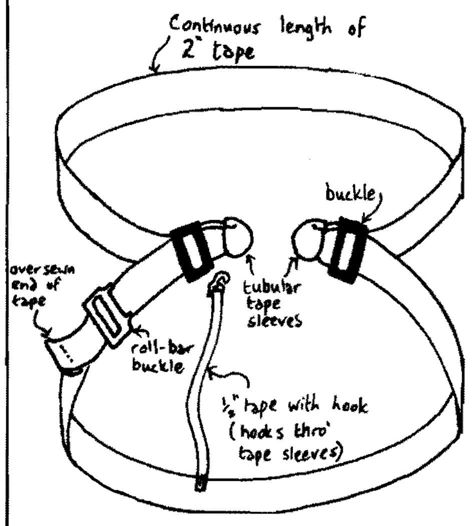


Figure 1. Simple sit-harness.

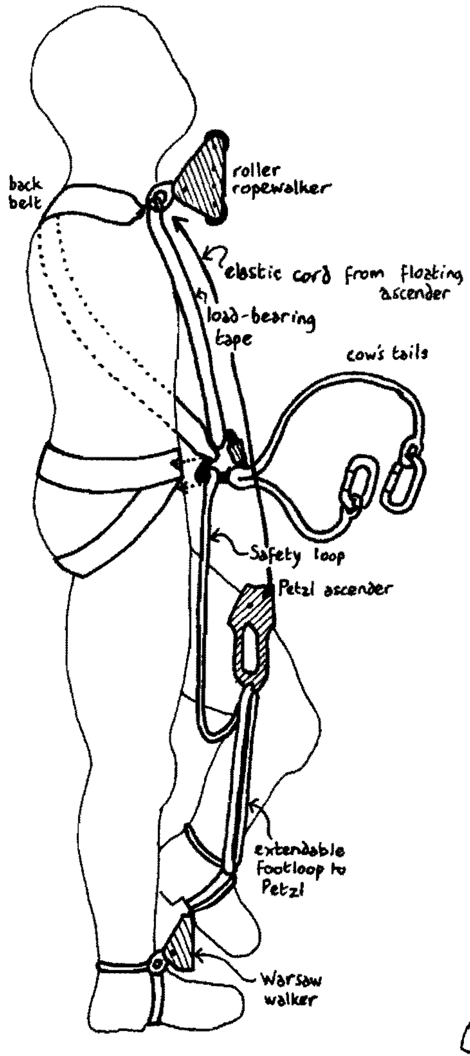


Figure 2. Main rope not shown; delta maillon shown detached from harness.

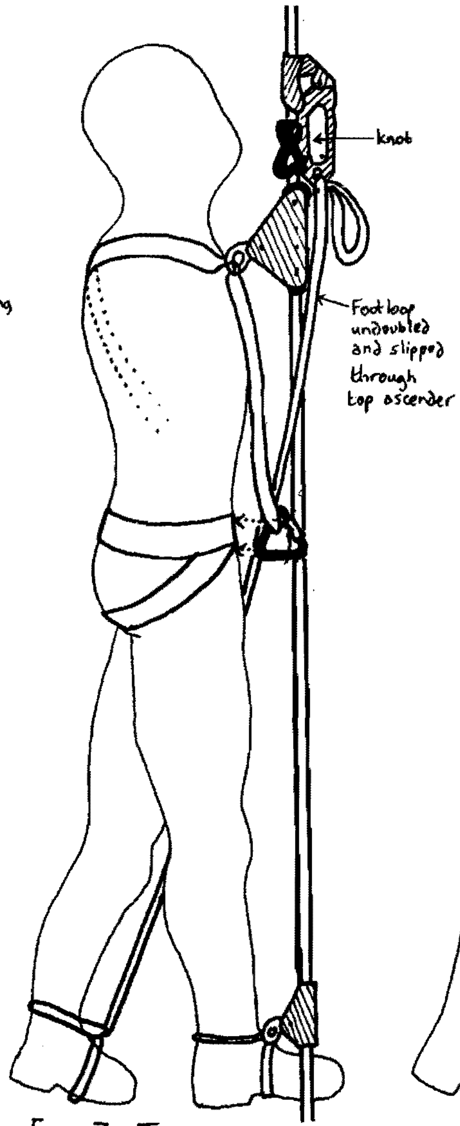


Figure 3. The changeover.

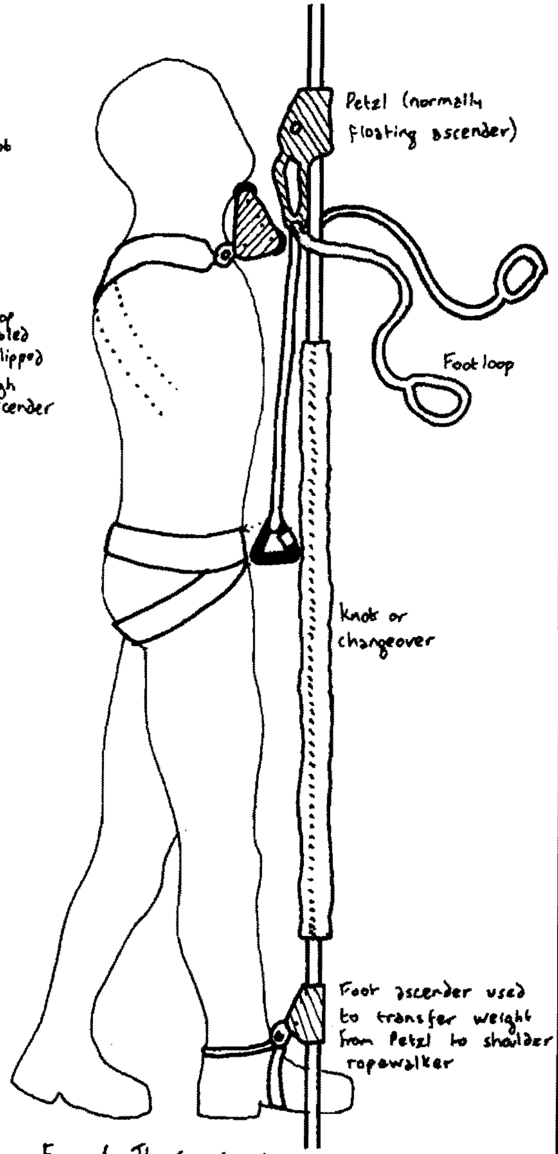


Figure 4. The four-foot knot.

The top ascender is a roller rope-walker, which is fixed to the sit-harness by a load-bearing tape running down the front of the chest, a fixture which is useful when resting (Ed: resting?), enabling the prusiker to sit down. A standard Howie belt is attached to the ascender by means of a hook or snap-link krab, to keep the prusiker upright and yet allow him to pass pitches on which there is a lip. To speed up putting the system on, all attachments to the sit-harness can be made by karabiners, though this does increase the system weight.

Changeovers

To pass a belay whilst prusiking, one foot-loop of the floating ascender (Figure 3) is removed from the foot and the floating ascender is taken off the rope and placed above the obstacle. The prusiker then removes his shoulder ascender and transfers that above the belay. Finally, the Warsaw walker, which will have allowed weight to be transferred between the two top ascenders easily, passes the knot and the floating ascender is moved to its normal position. Knots can also be passed in this manner.

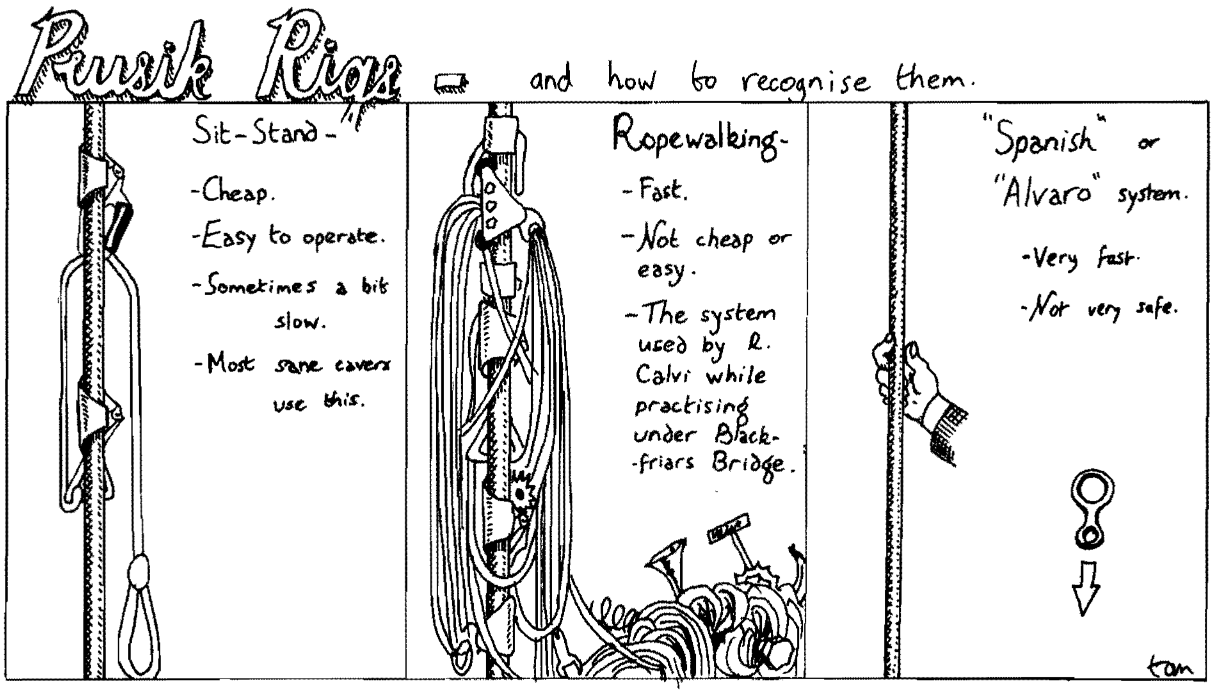
Such a system can pass any obstacle encountered underground with ease, and can pass some rebelays which would defeat sit-stand (Figure 4). Such a rebelay (the four-foot knot) would represent bad belaying technique, but something similar could be encountered in an emergency.

Setting up

A rope-walking system is highly personalised. It is very advisable, once you've got your ascenders, to spend a day dangling from a tree getting the lengths of foot-loops and tapes exactly right. Try every conceivable situation: an ideal loop length for foot prusiking may make changeovers from prusiking to abseiling impossible, for example. However, once you've picked the skill up and got the system right, it's like riding a ten-speed racing bike compared to the sit-standers on their metaphorical tricycles. Try it!

Reference

Nicholls, C., 1981. A novel ropewalking device - the Warsaw Walker. Proc. Oxford Univ. Cave Club 10, 68-72.



TECHNICAL

CORROSION FOR CAVERS I
SOME ASPECTS OF THE CORROSION OF CAVING LADDERS

In a short article it is difficult to deal with corrosion in a thorough manner, as it is an exceedingly complex and as yet not well understood science. However, I hope to make cavers aware of some of the basic electrochemical and metallurgical ideas in the theory of corrosion as applied to caving equipment.

Any metal or combination of metals when immersed in solution attains an equilibrium, or corrosion, potential which can be measured against another fixed reference electrode in the same solution. This potential is what is known as a 'mixed' potential and is the result of the addition of all the potentials caused by anodic and cathodic reactions on the metal object's surface. In any example of corrosion there has to be at least one cathodic and one anodic reaction. A cathodic reaction is one which uses up electrons (a reduction) and an anodic reaction is one which liberates electrons (an oxidation). Because there must never be a net surplus or deficit of electrons, the total cathodic current must exactly balance the anodic current. On a metal surface, for instance iron, several reactions are possible (Figure 1).

E_1 $$Fe = Fe^{2+} + 2e \quad (1)$$
E_2 $$O_2 + 2H_2O + 4e = 4OH^- \quad (2)$$
where E_1 and E_2 are the reversible potentials for the reactions.

What determines which will be the cathodic or anodic reaction is the relative sizes of the reversible potentials (Appendix 1) for these reactions. If E_2 is more positive (or noble) than E_1, then reaction 2 will be cathodic to reaction (1) and vice versa. This is the case in practice as $E_1 = -0.44$ and $E_2 = +0.790$ in household tap water (pH 7). This means that iron dissolves or corrodes away. The problem the corrosion scientist has is to measure how fast the iron is corroding. He cannot measure the corrosion current with a meter as he cannot physically separate the anodic and cathodic sites on a metal surface. He has therefore to employ some other means (Appendix 2).

Both the anodic and cathodic reactions obey an equation which relates current (how fast they go) with potential (driving force). This is the Tafel equation:

$$E = b.\log(i) + a \quad (3)$$
where i = current, E = potential and a and b are constants: b is the Tafel slope, used in Appendix 3.

When we plot these corrosion reactions on a log current-potential graph we have what is known as an Evans Diagram. It is now easy to see that the corrosion potential is the potential where the two currents are equal and opposite (Figure 2). This is the corrosion current. In all cases the reaction which is the slowest or hardest to occur for a given potential dominates the corrosion process and in most cases this is a cathodic reaction, the reduction of O_2. This is because the diffusion of oxygen to the metal surface is the rate controlling step. The effect of increasing the availability of O_2 can be easily shown in an Evans Diagram and has the effect of increasing the corrosion current by raising the corrosion potential (Figure 3).

This is the reason why moist surfaces corrode faster than those totally immersed: there is a greater availability of oxygen. Turbulent waters (e.g. cave streams) have a higher O_2 content than stagnant water and hence corrosion will proceed at a faster rate.

The phenomenon of galvanic protection is a more complicated case of mixed potentials. It is often assumed that inspection of a table of standard Nernstian potentials of metallic elements will determine which

FIG. 1

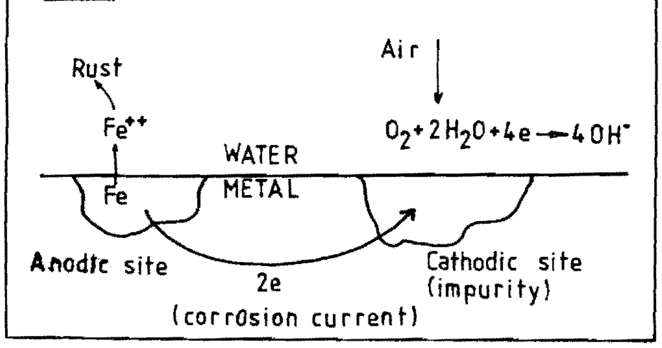


FIG. 2 Evans diagram

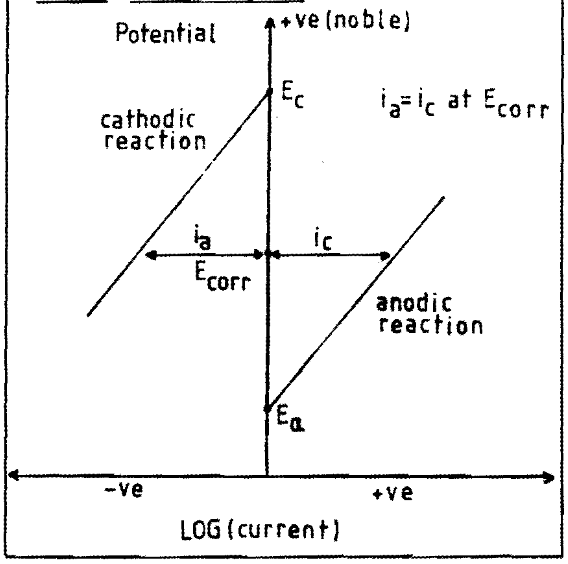


FIG. 3

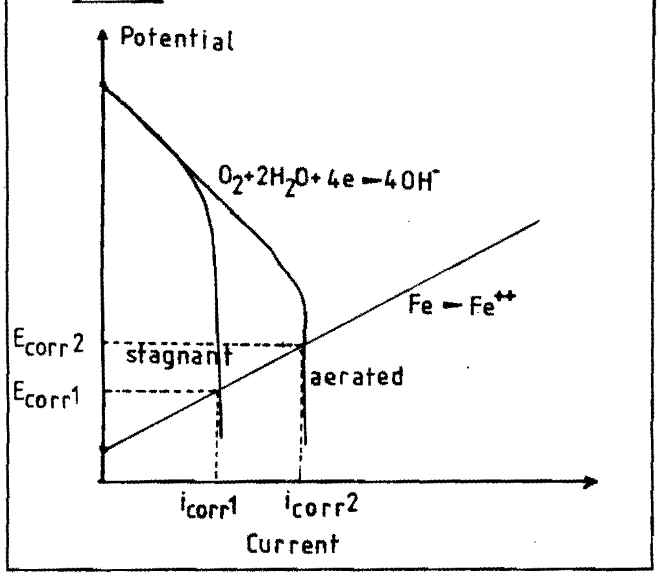


FIG. 4

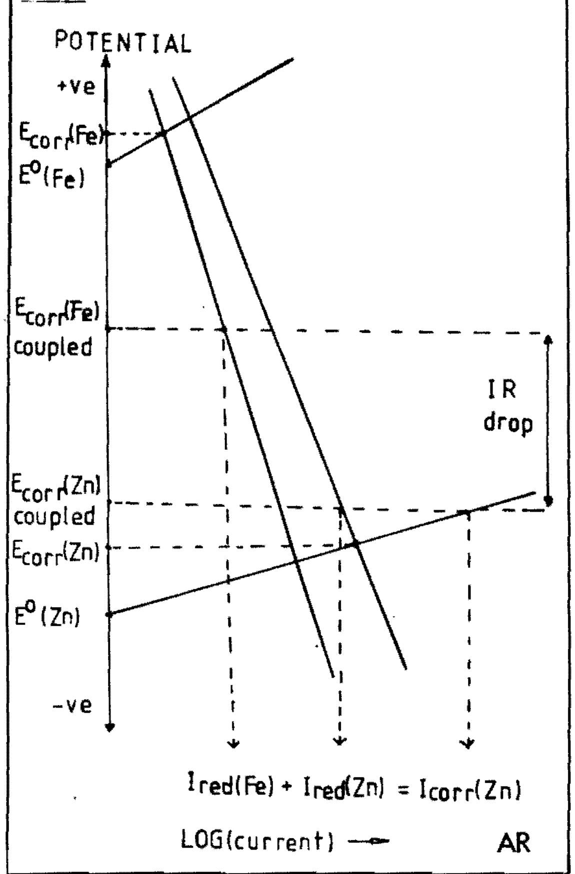
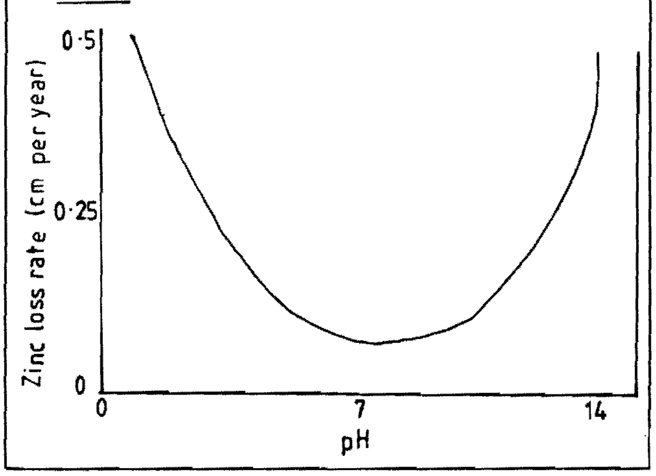


FIG. 5



metal will be the anode and which the cathode in a bimetallic couple. In most situations this is not the case. The Evans Diagram for a zinc and iron couple demonstrates the complexity (Figure 4). The size of the corrosion current is determined by the sum of all the cathodic and anodic areas (Appendix 3).

I shall now discuss the case of a caving ladder as an example of a situation where three metals, iron, aluminium and zinc, are in contact.

Zinc is applied to steel wires (British Standard BS443) with the intention of cathodically protecting the base metal; in other words, the zinc acts as a sacrificial coating. The potential of zinc is normally lower than that of iron and steel and hence it will act as an anode and preferentially dissolves instead of iron. However, the rate of dissolution depends on several conditions, including the pH, oxygen content and temperature of the liquid environment. Figure 5 shows the pH dependence of the rate of loss of the zinc coating.

In aerated water it is possible to get a reversal of polarity (Uhlig, 1971) between zinc and iron, making the zinc more noble than the iron, and pitting of the base metal can result. Waters high in carbonates and nitrates can assist in this reversal, due to the formation of a ZnO film on the zinc instead of $Zn(OH)_2$ (Rowe and Walker, 1961). The ZnO is a semiconductor which is electrically conducting and behaves as an oxygen electrode whose potential is more noble than zinc or iron. Bicarbonate ions (as found in cave water) have been shown to stimulate the production of ZnO.

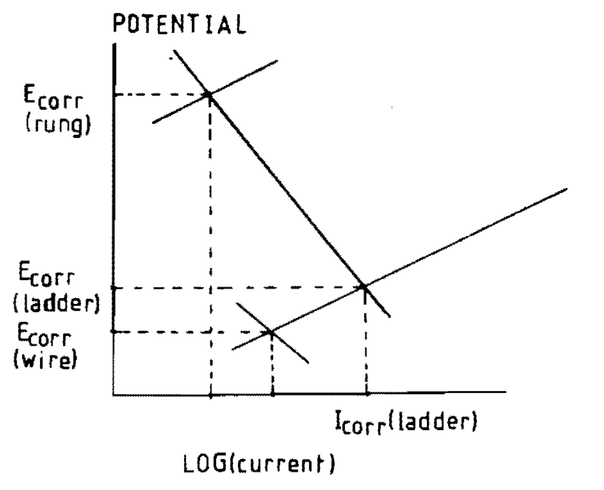
It is important to note that galvanic protection is only really effective if the object is totally immersed, and the water should have adequate conductivity. In water of low conductivity (e.g. distilled or soft waters) any defect in the coating greater than a millimetre in size will not be protected at its centre and the underlying metal will corrode. This is because the current density sufficient to protect the underlying metal can not be maintained over the entire surface.

The coupling of aluminium rungs to the galvanised wires has the effect of raising the corrosion potential of the wire. I have measured the corrosion potentials of an aluminium rung and a piece of ladder wire in cave water. The rung had a potential of -0.578 V/SCE* and the steel wire -0.810 V/SCE. The corrosion potential of a piece of ladder (rung and wire) was -0.724 V/SCE. Aluminium has a passive film on its surface which causes it to have a potential much more noble than expected from a table of metal electrode potentials. By raising the corrosion potential the corrosion rate on the galvanised wire has also been increased (Figure 6). In other words, the use of aluminium rungs makes the ladder wires corrode more quickly.

Because of the traditional method of coiling ladders, the ends of the wires undergo a lot of flexing, which fractures and flakes off the brittle hot-dipped zinc coating. This can create large coating defects which will not be protected and corrosion attack will be intense and localised, leading to eventual failure. It is recommended that another method be used, perhaps coiling ladders loosely, and then carrying them in a tackle bag.

* - All electrode potentials must be measured with respect to a reference electrode, which in this case is a standard Calomel electrode (SCE), i.e. V/SCE = volts with respect to the SCE.

FIG. 6



Appendix 1

The Nernst equation defines the equilibrium thermodynamic potential of a metal in contact with a solution of known concentration of metal ions.

$$E = E^{o}_{Fe/FeII} + \frac{RT}{zF} \log_e [FeII]$$

where E^o is the standard potential, T is the absolute temperature and z the number of electrons involved in the redox couple.

Appendix 2

Measurement of the corrosion current can be made using the Stern equation

$$I_{corr} = \frac{1}{2.3} \frac{b_a . |b_c|}{b_a + |b_c|} \frac{DI}{DE}$$

A small potential shift (DE) is made from the corrosion potential and a change in current (DI) is produced. By measuring the anodic and catholdic Tafel slopes (b_a and b_c) one can estimate I_{corr} (see equation (3) for definition of b).

Appendix 3

$$I^{system}_{corr} = I^{system}_{a} + |I^{system}_{c}| \qquad (6)$$

The total current on any site depends on the current density ($i^j{}_a$) and its area (f_j). Rewriting equation (6),

$$\sum_j (f^j i^j_a) = \sum_j (f^j |i^j_c|) \qquad (7)$$

Corrosion on a polyelectrode can be represented by

$$\frac{i^B_a}{i^N_a} = \frac{f^N}{f^B_1}\left(\frac{|i^N_c|}{i^N_a} - 1\right) + \frac{|i^B_c|}{i^N_a} \qquad (8)$$

B = base, N = noble, a = anodic, c = cathodic, i = current, f = area.

Galvanic protection occurs chiefly when f^N is much greater than f^B and therefore $i^N{}_a$ tends to 0 and $i^B{}_a$ tends to $|i^B{}_a|$.

References

(For a general review of corrosion, see Shreir (1976) and West (1970)).
British Standard BS443.
Rowe, L.C. and Walker, M.S., 1961. Effect of mineral impurities in water on the corrosion of aluminium and steel. Corrosion 17, 353t-356t.
Shreir, L.L., 1976. Corrosion. Butterworth, London, 2 vols., 2nd edn.
Uhlig, H.H., 1971. Corrosion and Corrosion Control. Wiley, New York, 2nd edn.
West, J.M., 1970. Electrodeposition and corrosion processes. Van Nostrand, London, 2nd edn.

CORROSION FOR CAVERS II
CORROSION OF ALLOY KARABINERS

During a caving trip down Swinsto Hole, Kingsdale, N Yorkshire, a heavily pitted karabiner was found at the bottom of the 20 foot pitch lying under 0.5 m of water in the gravel bed (Figures 1a and b).

The whole of the body of the karabiner was covered in pits several millimetres wide and deep. At the bottoms of the pits was a white, insoluble deposit. Only the screw-up gate was unaffected by corrosion. The unattacked parts of the surface did not show any more abrasion damage than would be expected to be caused by normal caving use.

A section was made across the backbone of the karabiner which was hot-mounted in perspex and polished to a 1 micron finish.

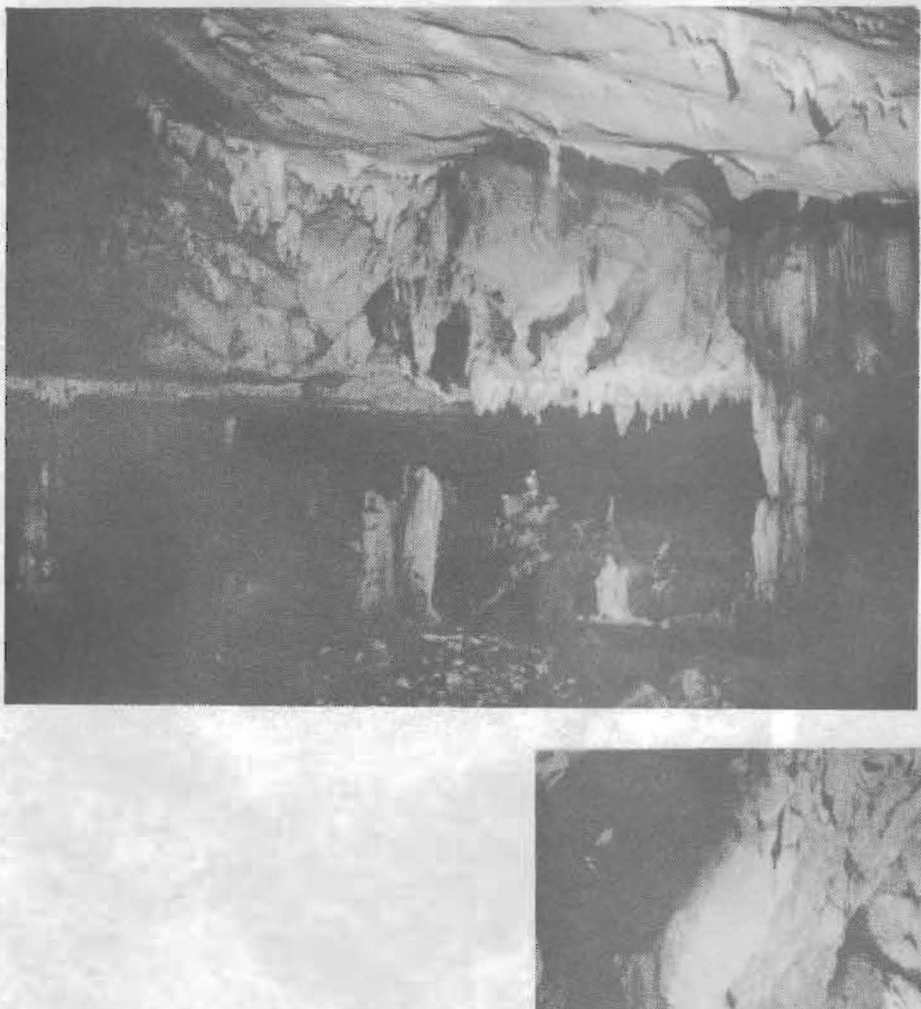
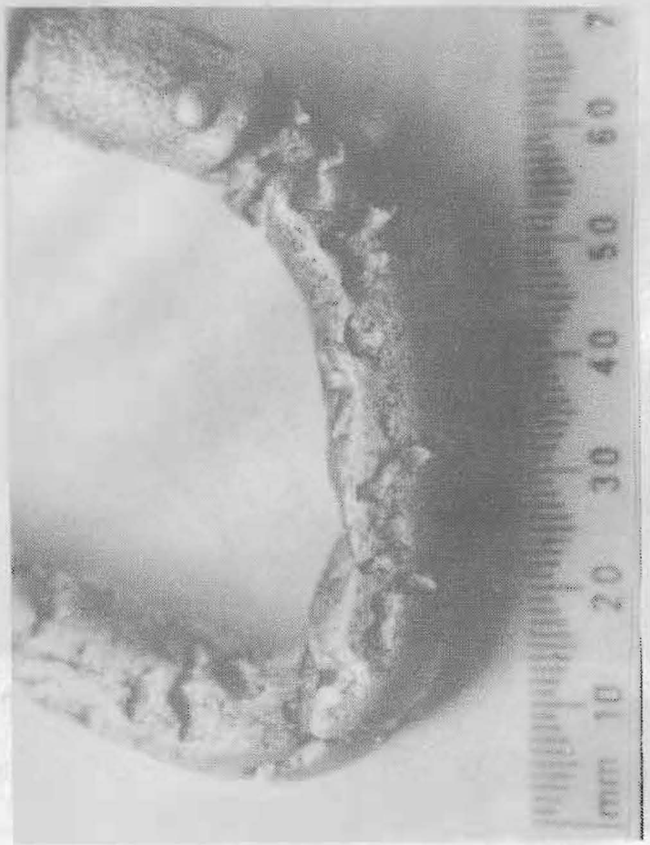
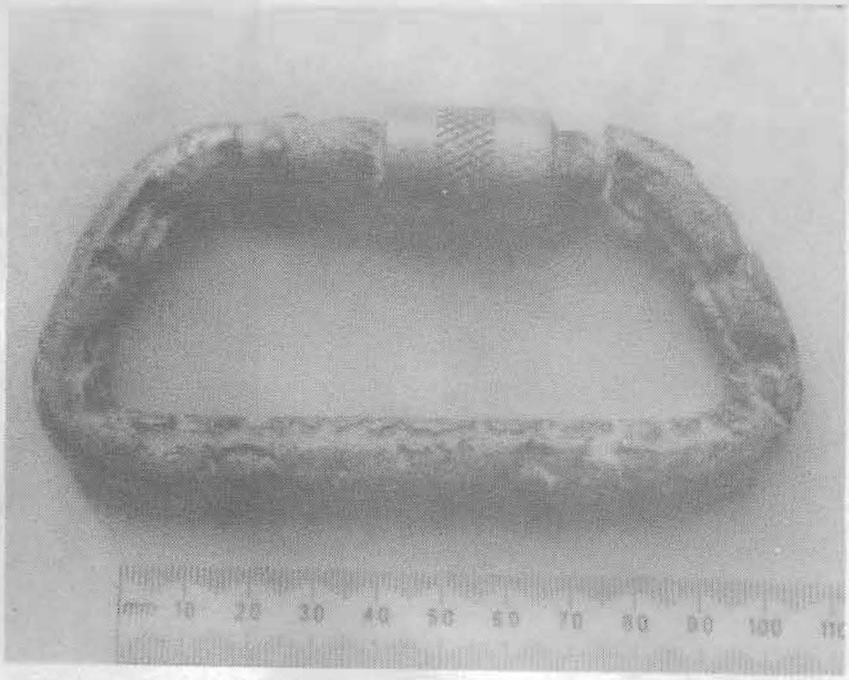


PLATE III Borneo Portfolio. (CA)





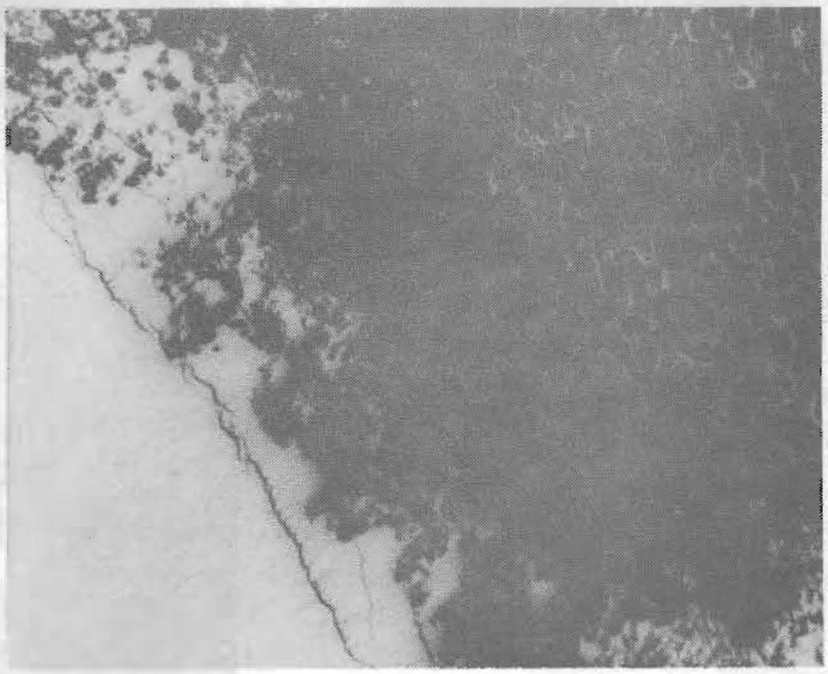


PLATE IV Corrosion article. Top: Figures 1a & 1b. Right centre: Figure 2 (x100). Left: Figure 3 (x100). Right: Figure 4 (x100).(AR)

Under optical examination, the entire section was found to be full of cracks. This unexpected discovery led us to make further investigations into the nature and origin of the cracks.

Under low power observation, all the cracks were seen to run in circles, concentric with the outer circumference of the section. The cracks were extremely numerous, branched and finely divided (Figure 2). They seemed to be evenly distributed throughout the whole section and were not located primarily at the surface. The bases of some of the pits were examined. There was a definite orientation dependence of the cracks to the base of the pits. In many of the pits, the cracks were seen to emerge at the bottom (Figure 3), the pit growth direction lying parallel to the crack direction. In other pits, the crack direction was perpendicular to the direction of pit growth (Figure 4) and had not yet reached the surface. All the pits had a deposit at their base. The aluminium metal at the base of the pits showed signs of extensive corrosion attack and was very spongy and porous in nature.

The composition of the karabiner was unknown, but was determined by electron microprobe analysis to be an Al-Zn-Mg-Cu alloy (see Table 1). An analysis of the deposit in the base of the pits was attempted using energy dispersive analysis (see Table 2). Wavelength dispersive analysis would have been superior but was unavailable at the time of writing. The deposit was predominantly composed of aluminium oxide.

Discussion of observations

The chemical analysis suggests that the karabiner is a high-strength Al-Zn-Mg alloy. Shreir (1976) suggests that these alloys have a high risk of suffering stress-corrosion cracking which can be accelerated by incorrect heat treatment. It seems likely that the surface pitting was probably initiated by the emergence or interaction of the internal cracks with the surface. Once pitting has been initiated, the pits grow unhindered by external effects or microstructure. This is because pits generate an acid environment at their base which prevents reformation of the passive film on the exposed aluminium surface (Robinson, 1960) and therefore corrosion proceeds rapidly. Impurities in the water can assist in the initiation and propagation of pits - a combination of carbonates, chlorides and copper ions can be very damaging (Davies, 1959). In hard water, as little as 0.02 ppm of these ions can initiate pits (Porter and Hodder, 1953; Rowe and Walker, 1961).

The orientation of the cracks in the section strongly suggests that the microstructure is exerting a major influence on their growth direction. The very fine branched nature of the cracks suggests that they are intergranular. Unfortunately, I was not able to etch up the grain boundaries in order to demonstrate this. Exfoliation corrosion is a well-known phenomenon in high strength aluminium alloys. Robinson has examined the effect of elongated grain structure and heat treatment on the formation of surface blisters (Robinson, 1982). It seems likely that an elongated grain structure is formed in the alloy karabiner during manufacture as it is extruded and that this initiates surface and filiform attack. Grain boundary attack then causes the production of corrosion products, creating large stresses at the grain boundary which force up grains at the surface to create blisters. If these blisters reach a certain size, a pit will form and pitting corrosion will dominate.

Conclusion

Grain boundary attack has probably occurred because of precipitation and segregation of alloying elements at grain boundaries during heat treatment. Exfoliation corrosion produced blisters on the surface which in turn caused deep and severe pitting. The intergranular attack and pitting in this karabiner has become apparent due to its immersion for an unknown time in cave water which might be expected to contain the necessary impurities for this kind of corrosive attack. It would be interesting to know how long it would take for such attack to occur and whether such slight attack which may occur during normal caving use has any effect on the strength of the karabiner.

References

Davies, D.E., 1959. Pitting of aluminium in synthetic waters. J. appl. Chem. 9, 651-660.

Porter, F.C. and Hadden, S.E., 1953. Corrosion of aluminium alloys in supply waters. J. appl. Chem. 3, 385-409.

Robinson, F.P.A., 1960. Pitting corrosion - cause, effect, detection and prevention. Corros. Technol. 7, 237-239, 266.

Robinson, M.J., 1982. Mathematical modelling of exfoliation corrosion in high strength aluminium alloys. Corros. Sci. 22, 775-790.

Rowe, L.C. and Walker, M.S., 1961. Effect of mineral impurities in water on the corrosion of aluminium and steel. Corrosion 17, 353t-356t.

Shreir, L.L., 1976. Corrosion. Butterworth, London, 2 vols., 2nd edn.

Table 1. Electron microprobe analysis of karabiner alloy composition
Standardless eds analysis (zaf corrections via magic v)

Element & line	Weight %	Atomic %	Precision 3 sigma	K-ratio	Iter
Al KA	92.54	6.77	1.18	0.9279	
Cu KA	1.11	0.49	0.34	0.0108	
Zn KA	6.35	2.74	0.91	0.0613	6

+ ca. 1% Mg

Table 2. Electron microprobe analysis of pit deposit composition
Standardless eds analysis (zaf corrections via magic v)

Element & line	K-ratio	Weight %	Precision 3 sigma	Oxide formula	Oxide %
Al KA	0.6654	37.40	1.10	Al_2O_3	70.66
Si KA	0.0511	6.20	0.68	SiO_2	13.27
S KA	0.0075	0.58	0.17	SO_3	1.44
Ca KA	0.0168	0.77	0.18	CaO	1.08
Fe KA	0.0358	1.42	0.36	FeO	1.83
Cu KA	0.1418	5.95	0.99	CuO	7.45
Zn KA	0.0817	3.42	0.82	ZnO	4.26
O*		44.25			

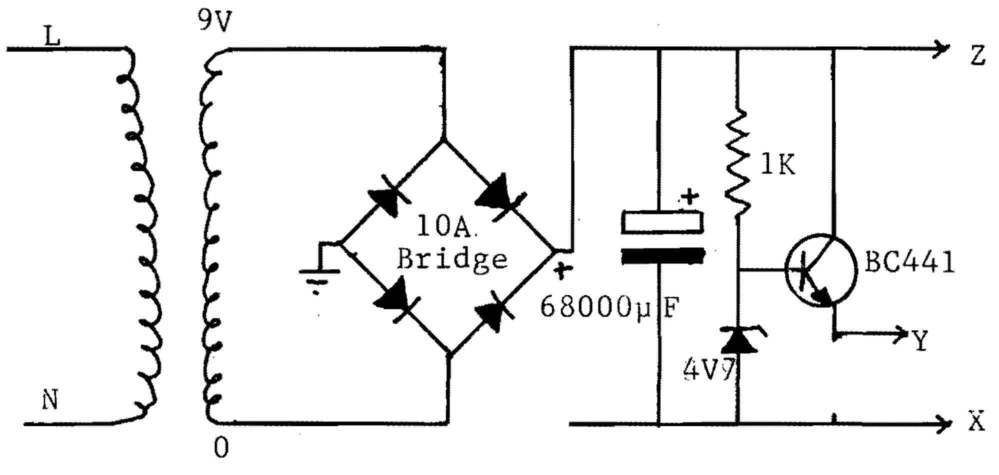
* - determined by stoichiometry

A SIMPLE CHARGER FOR NI-CDS AND LEAD ACID CELLS

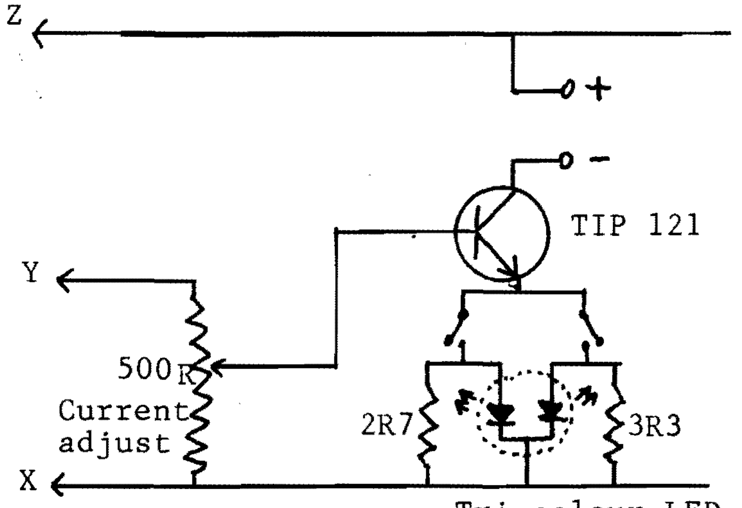
We present here a simple design for a constant current charger. Two circuits are given: the first will charge Ni-Cds and lead acids at three possible charging rates (0.7, 1 or 1.7 amps, others being possible by the use of different resistors) whilst the second is a design for the new sealed Ni-Cd from Speleo-technics, requiring a charging rate of only 0.7 amps.

1. Lead acid/Ni-Cd charger (Figure 1)

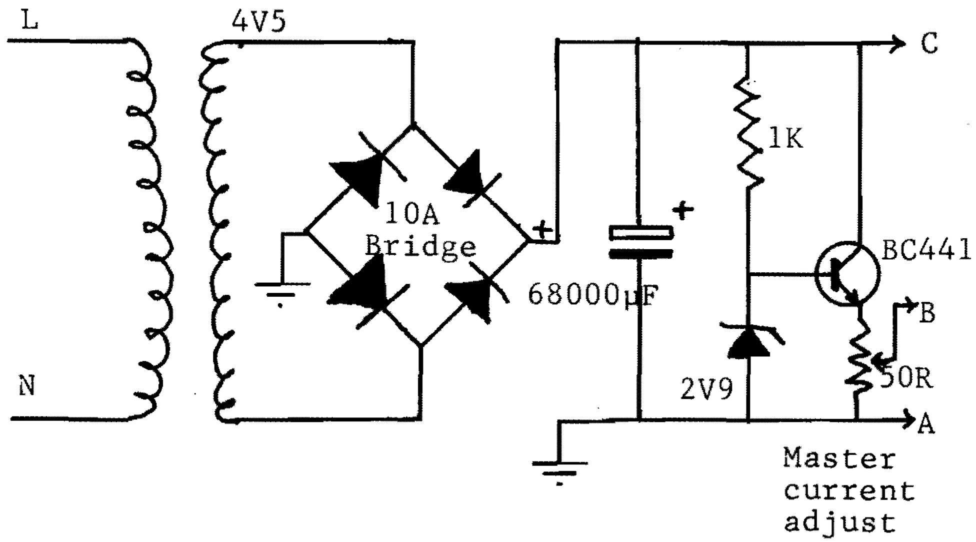
A 9 V (rms) transformer is required, which should be rated at about 20 VA or greater per number of cells the charger is being built to charge



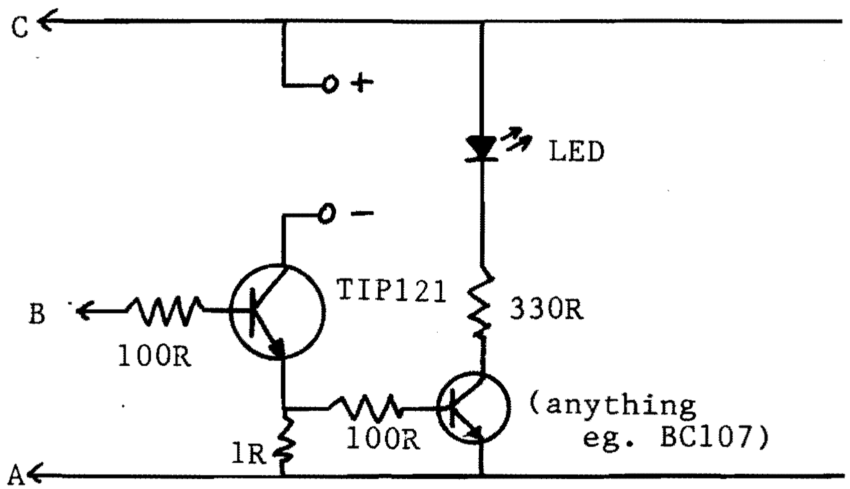
LEAD ACID/ NI_CAD CHARGER



To be repeated for each cell bracket



FX2 CHARGER



To be repeated for each cell

(e.g. for a 5-cell charger a 9 V, 100 VA transformer is required). Two switches (per cell) are used to select the charging rate. A tri-colour LED is used to indicate the charging rate, red and green indicating the two normal charging rates (0.7 and 1 amps) and a mixture (orange/yellow) indicates the higher charging rate (1.7 amps). This LED is available from Radio Spares (part no. 587-771).

2. FX2 charger (Figure 2)

A 4.5 V transformer is required with a rating of only about 5 VA per cell. No switches are required and a fixed charging rate of 0.7 A is given with a simple LED to indicate that charging is proceeding.