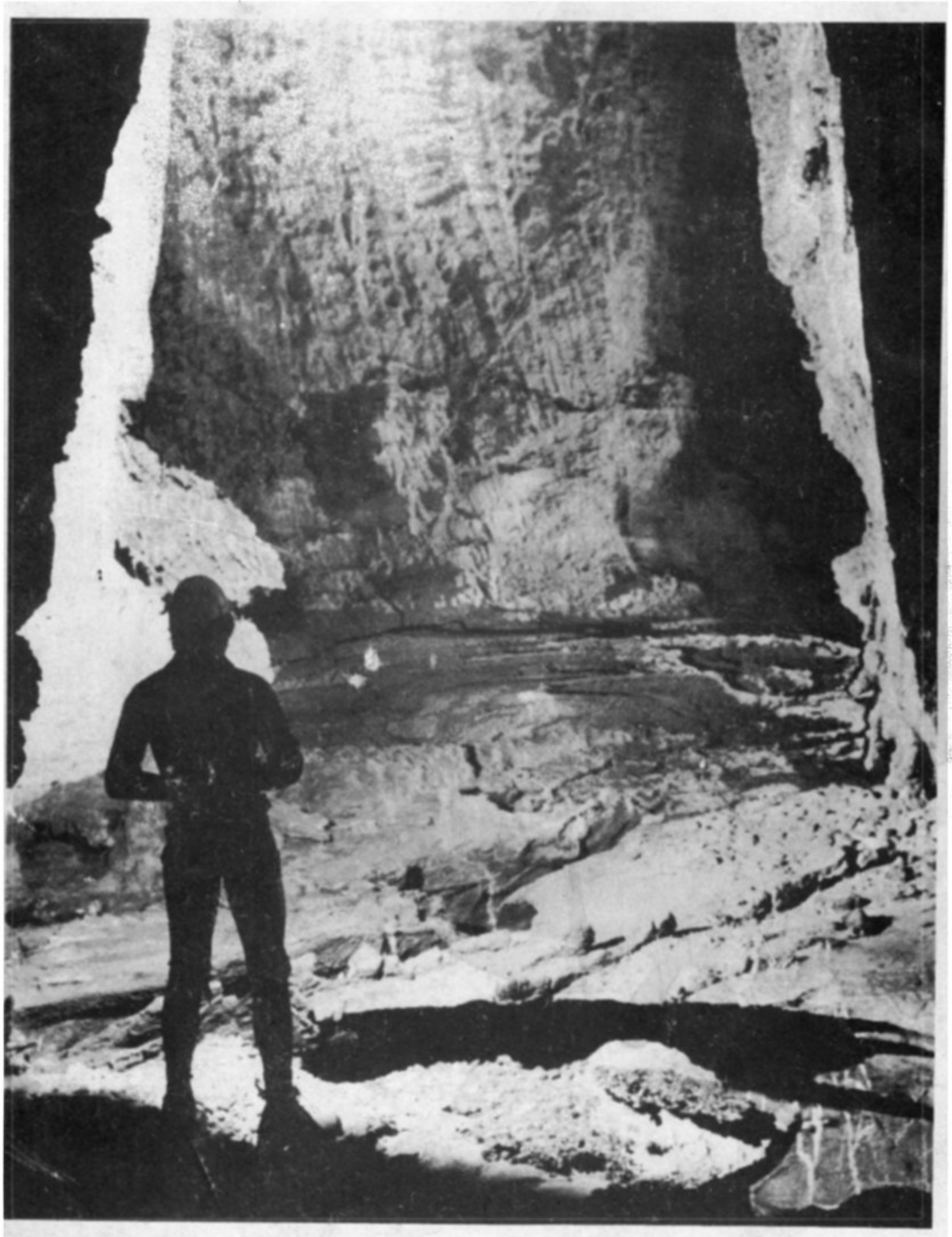
OXFORD UNIVERSITY CAVE CLUB

PROCEEDINGS, 9



1979 EXPEDITION
TO
ASTURIAS, NORTHERN SPAIN

OXFORD UNIVERSITY CAVE CLUB

PROCEEDINGS, 9

CONTENTS

Cover Photo: High level over Trench Pitches, Pozu del Xitu

EXPEDITION MEMBERS

Chris (It's about 40ft) Ankcorn. W.M.C.E.G. & B.U.M.S. (Skippy)
Mike (Oh dear, it's upside down) Busheri. O.U.C.C.
Mike (What are you complaining about) Clarke. W.M.C.E.G. (Skunk)
Al (Greetings World!) Cousins. C.U.C.C.
Ian (My tights keep me warm) Dumbelton. S.U.C.C.
Simon (Cor, its a Camberwell beauty) Fowler. O.U.C.C.
Mark (It can't be that bad) Godden. O.U.C.C.
Stephan (If this was Ffestiniog....) Green. O.U.C.C.
Pete (What's the Spanish for "I want to se.e. your...") Ireland. O.U.C.C.
Martin (Just over the next hill) Laverty. O.U.C.C.
Liz (I never realised cavers were so..) Lloyd-Jones. Bournemouth.
Graham (At a conservative estimate) Naylor. O.U.C.C.
Colin (It's gone septic) Nicholls. O.U.C.C. (Winnie)
Kev (Is there any more) Senior. S.U.C.C.
Jim (I'm making great sacrifices) Sheppard. O.U.C.C.
John (.. it it's broken) Singleton. O.U.C.C.
Dave (Pray it doesn't rain while I have a sh..) Thwaites. O.U.C.C.
Kathy (Food, Kev...) Young.

Jim, 38, appears by kind permission of his wife. He has a standard deviation of 19 years and fancies himself as a big shaft man.

ACKNOWLEDGEMENTS

The expedition would like to thank its financial sponsors:

A.A.Paton Memorial Fund
Barbinder Trust
Draper's Company
Oxford University Exploration Club
Oxford University
Sports Council of G.B.

The Birmingham Evening Mail and West Lancs.Evening Gazette both carried two articles about the expedition and assisted financially. Individual grants were also awarded by the A.C.Irvine Travel Fund, Magdalen College, St.Johns College and Wadham College.

Medical supplies and various other items were obtained through the O.U. Exploration Club Joint Applications Scheme.

The British Cave Research Association, Comite Nacional de Espeleologia, Comision Nacional de Geologia, and Comite Regional Noroeste de Espeleologia all assisted with documentation, as well as the Spanish Embassy in London.

Especial thanks are due to Sr Amador Gonzalez (Ramos) of the Refugio Entrelagos where we obtained spiritual sustenance (bread and wine), relief, and the weather forecast (Manana, Sol); also to Manolo at the Refugio Marquis Villaviciosa de Asturias at Ario.

Al did the surface surveys, mainly by triangulation, and these were redrawn by Martin for publication. Colin and Martin drew most of the other surveys, assisted by Dave and Mike. Graham and John assisted with computing, and Simon with photocopying, which was also used for reduction from originals. Typing and quaint spellings are due to the shared efforts of O.U.C.C., mediated by Martin's editing.

INTRODUCTION

OUCC's last expedition to Spain in 1976 was, to be frank, rather a disappointment. It also coincided with one of the periodic exoduses of experienced members - especially those with Hispanophile or expeditionary tendencies - which tend to bedevil University clubs (especially in such a speleologically isolated area as Oxford.) However, after a year with ULSA and a trip to the caves of Mulu, the leader decided that the allure of the Picos really couldn't and shouldn't be resisted, so an expedition was organised. No going systems where known or talked of, so concrete plans where based around surveying Osu and attempting, once again, to find and explore Hoyo la Madre. It was stressed from the start that hard work would probably be needed to locate new entrances, but that recent French and Spanish explorations showed the potential, which none of the many previous British expeditions had managed to find, was definately there. So rope was bought, a school gym (Oxford University in its wisdom deciding that if you can't do caving competitively then there can be no way you could need a gym .....) provided very draughty (far too realistic!) SRT practice, backed up by a week in Yorkshire at Easter.

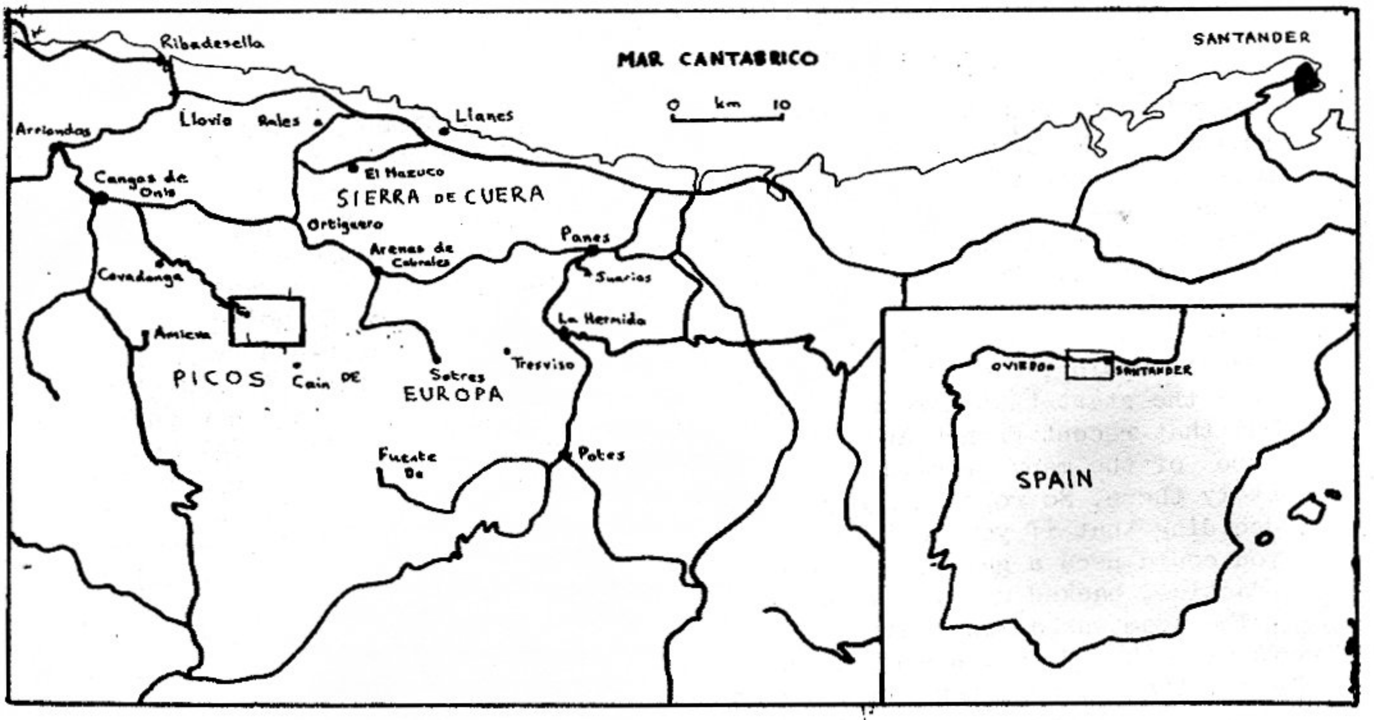
The team was almost entirely new to Spain, or even to caving anywhere more foreign than Wales. A weekend on the Gower was useful as a camping rehearsal - eg. the leader's tent was found to lack poles (whoops!). A V.W. conversion proved excellent as an expedition vehicle with ingenious storage space for items as diverse as old Proc's (guaranteed to break the ice with wandering Spanish cavers), tights for dye tests (or Ian) and chemicals. A Land Rover provided transport for our two representatives from the West Midlands Cave Exploration Group. The third vehicle used was an Escort. The entire Southampton University Cave Club contingent spent a comfortable night in a Plymouth guest house while waiting for the Santander Ferry. The rest had a fairly unique night c/o a drizzly car park. The voyage was uneventful and boring but ensured that everyone reached the campsite and took over the only non-floodable (well - not totally floodable!) corner of yet another car park. After four days, the stunning view could be seen!

Food was bought mainly in Cangas de Onis, with bread, eggs and vino from one of the two adjacent bars. The walk from the upper (Refugio Entrelagos) bar proved to be the most dangerous provisioning trip when our Cambridge University Cave Club renegade damaged his elbow - and two bottles of wine! The road to Cangas also saw its incidents. Cooking was mostly by double burner gas with spare primuses (paraffin can be difficult to obtain). Pressure cookers were invaluable.

There is little to be gained from further introduction except to say that there can be little doubt that the 1979 expedition was the most successful in OUCC's history, with 4.5 km of cave surveyed and an aggregate depth of over 750m, including one cave still going very strongly at 354m. Quite besides this, the expedition members are all still on speaking terms with each other, which is no mean achievement.

So, without further ado:

INTO THE VOWELS OF THE EARTH ....



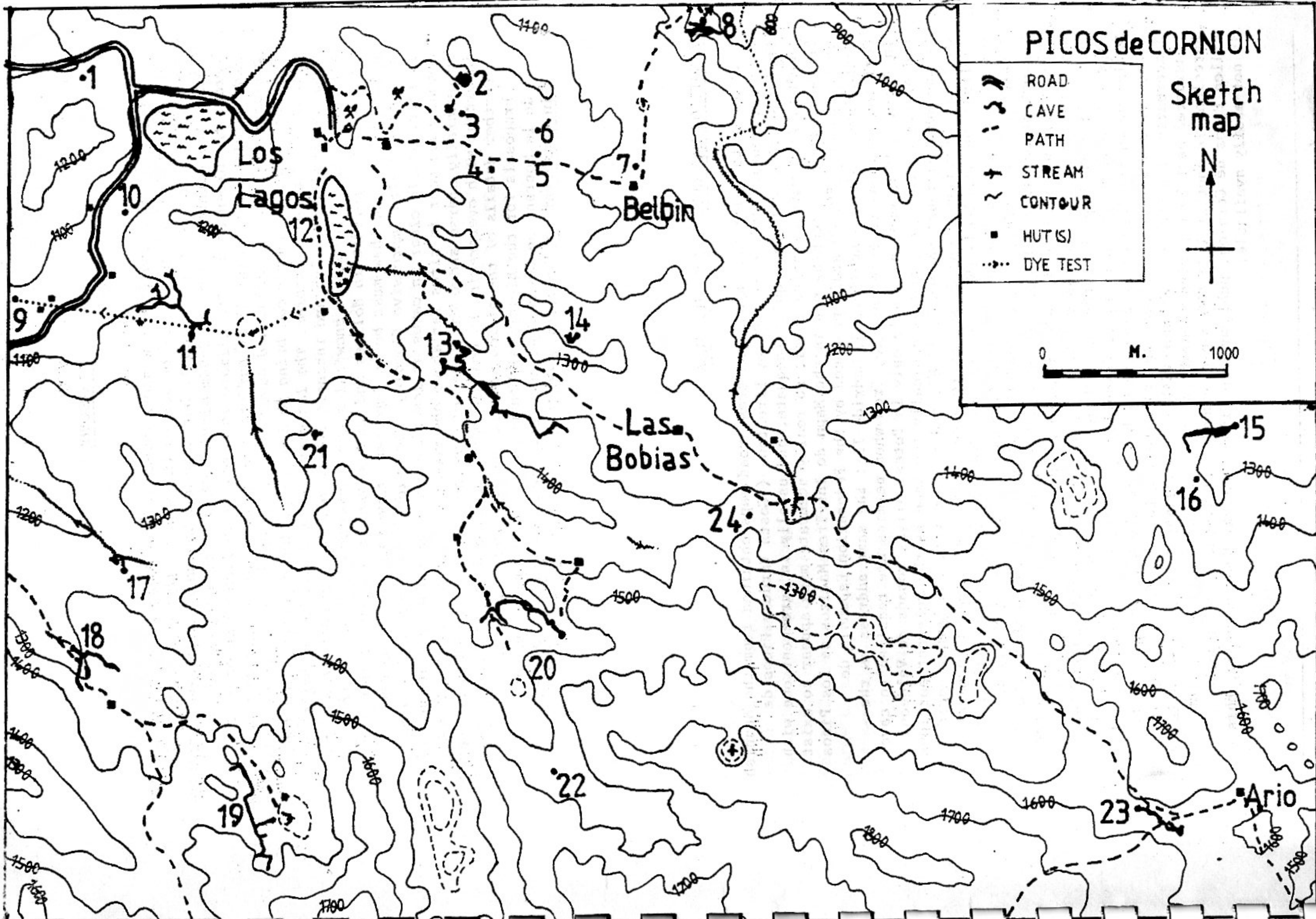
KEY TO AREA SKETCH MAP

1 200ft hole (P17) (CPC, CRG)
2 Pozu del Cantu del Hombre
3 Dead Sheep Cave
4 Pete's Potty
5 Crow Pot
6 Unnamed Cave
7 Belbin Sink
8 El Hoyo la Madre
9 Vega de la Cueva Resurgence (R1)(CRG)
10 Trema spring (CRG)
11 Pozo Palomeru (P1)(CRG)
12 Spring: Ercina fuente
13 Cueva del Osu
14 Pozo la Texa (Alphonse's)(CPC,8)
15 Pozo los Texos (CPC)
16 460ft shaft (Mohandi) (CPC)
17 Resurgence, small cave (SCOF)
18 Cueva del Viento (CRG)
19 Cueva del Frieru (SCOF)
20 Pozo de Vega el Forcau (8)
21 P9 (CRG)
22 Cueva Oscura
23 Pozu del Xitu
24 Smoked Food Cave

References:

CPC--------Journal of the Craven Pothole Club (1963) 3,3,131-137
CRG--------Cave Research Group of GB, Publication No.14 (1965)
SCOF-------Ouarnède (Toulouse) (1976) 7,40-74
8----------Proceedings of the Oxford Univ.Cave Club (1977)No.8

Proceedings of the Oxford Univ.Cave Club Nos. 1-4 (1961-1966) also contain information on early expeditions to the area covered in this report
Cave Science No. 41 (Caves of the Cantabrians, by G.C.Cox) (1973) contains some inaccurate and misleading data on this region.



PICOS de CORNION
Sketch map
ROAD
CAVE
PATH
STREAM
CONTOUR
HUT(S)
DYE TEST
N
0
M.
1000
Los Lagos
Belbín
Las Bobias
Ario

GEOGRAPHY

The Picos de Cornion is the western massif of the Picos de Europa mountains in northern Spain. The expedition was to the part of this area covered by the Province of Asturias (Oviedo), but Leon and Santander also have territory there. The mountains rise to 2596m within 30km of the aptly named Costa Verde: the Green Coast. The climate is strongly influenced by oceanic effects and is rather wet. Rainfall at Bufferara near Los Lagos is recorded as 2119mm per annum, with June, July, and August being slightly drier than other months. Despite this, the summer can bring periods of prolonged drizzle and fog, as well as severe thunderstorms. The latter 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 down to at least 1250m in some cases. The spring thaw must be an important time for continuing cave development with impressive flooding. The evidence for such annual events is particularly clear in caves at lower levels, 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 with overgrazing by goats, sheep, cows, and sometimes, horses.

Further details of the biology of the area are contained in:

Proposals for the Biological Management of the Parque Nacional de la Montana de Covadonga, Asturias, Spain. Discussion Papers in Conservation, University College, London. No.25 (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 made 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, 1º Izda., Oviedo) and this gives full details about 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 in Gijon in 1968. Unfortunately, this is not easily available.

CAVE DESCRIPTIONS

S.W. OF LOS LAGOS (ENOL-VEGA REDONDA)

CUEVA DEL VIENTO

Cueva del Viento was discovered, first explored and surveyed to C.R.G. Grade 2 by the 1961 Oxford University Expedition to Northern Spain. In some respects the original survey and accompanying description require amending. This short note does this.

On the original survey the entrance passages to the main chamber are represented reasonably accurately, with the way on being fairly obvious. However, since 1961 the muddy passage between the first, small, rift passage containing a small pool at its NW end has silted up so that the entire passage contains a deep pool in dry weather. This requires swimming. In wet weather this part of the cave sumps.

This pool/sump may, however, be bypassed to the main chamber via some newly discovered passages at a higher level. Access to this is gained through a short bedding plane crawl at the top of the 5m climb immediately before the small rift passage. Once through the crawl the way ahead along a rift, (probably a NW continuation of the small rift passage at a higher level) ends after 20m, although the entrance passages may again be entered through a tight squeeze in the boulder strewn floor of the rift.

To the right in the small chamber after the bedding plane crawl a white flowstone cemented boulder slope leads up to a 4m climb into an abandoned streamway. This leads on over a wide, almost unrecognisable bridge, for 15m , then divides. The right hand passage slopes down to an abandoned sump pool infilled with sand and small pebbles. The left hand passage continues via a shallow pool, then a muddy crawl and short rift to the top of the main chamber. Part of this route after the ridge may be indicated on the original survey although the description given above and the survey do not tally well.

Returning to the small rift passage another possible way on is via a very tight boulder choke at the NW end of the small rift passage. In wet weather a streamway may be heard and seen beyond this choke. Presumably this stream is a continuation of the stream flowing in the entrance passages.

The conglomeration of rooms and passages on the original survey from which 'Rift Passage' and 'Muddy Passage' lead is in fact one reasonably large chamber. Access to this is via an easy rift climb from the swim passage culminating in a flowstone covered dome at the top of the chamber. The route into 'Rift Passage' follows on up the other side of the chamber via a free climb of 3m on very jagged limestone. After the climb the main passage to the rift is to the left and down, then right and up to the NW end of 'Rift Passage' over or under a ridge of limestone.

The rift itself may be traversed at three distinct levels as far as a series of muddy crawls half way along its length. In places access between levels is possible.

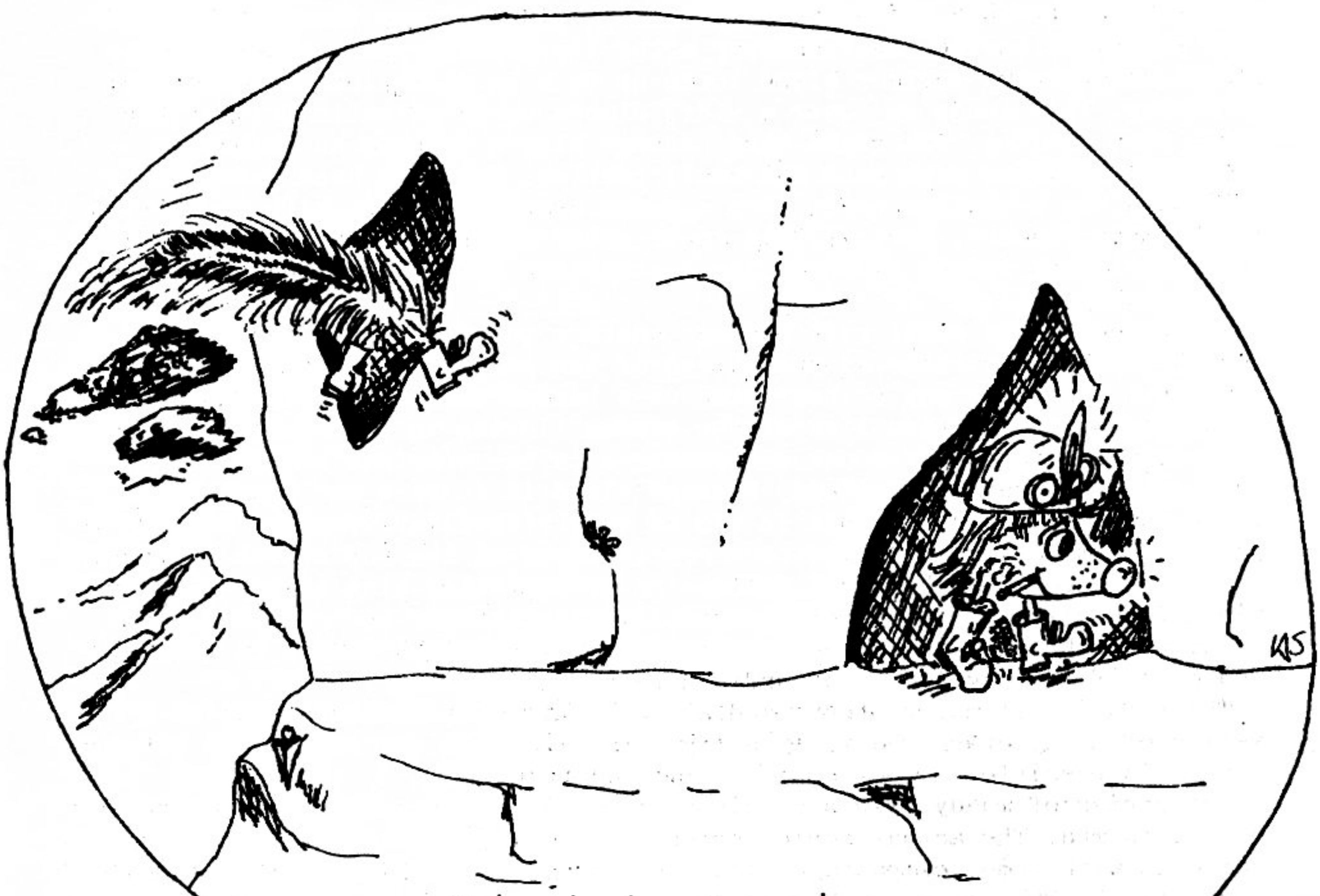
The series of muddy crawls consists of angular passages 0.5m in diameter coated in mud. THe actual series appears more complicated than the survey suggests with some new passage leading to a small 5m high chamber at a lower level. The route to the sump however, is via the 'Low Chamber', more rift passage involving easy traversing and finally a stroll down an inclined (15-20 degrees) abandoned streamway.

Between the 'Low Chamber' and the final sump the rift is possibly at least 25-30m deep terminating in water. This is presumably the active streamway. No easy way was found down the rift due to its steepness and tightness.

The far streamway is impressive, but sadly short. An attempt to trace the water from Cueva del Friero to here was abandoned due to lack of time. The amount of time spent in merely locating the entrances from old reports was largely to blame for this. It is to be hoped that more recent reports will prove more useful to future users!

CUEVA DEL FRIERU

This cave was discovered and explored by the French group, Speleo-Club Orsay Faculté (S.C.O.F.). They also surveyed it, using(as we now realise after consultation of a dictionary and Caving International No. 1) a compass and Topofil. The latter is a device for reeling out cotton thread and recording its length. The thread bestrews the passage like some demented spider's web. The final survey was distinctly uninformative: there is no depth information at all, nor notification of climbs or pitches. We followed the impressive old phreatic roof tube'upstream' and climbed down the narrow, deep vadose trench to the active streamway, which was followed for a short distance up- and down-stream. The stream was of such magnitude that the dye we introduced seemed to exhibit no flow at all. It will be interesting to see if the cave stream is identical with that seen in the adjacent Vega de Justillagar (Jou Seco on Miötkes' map). This certainly seems possible. We will be interested to know the results of SCOF's dye tracing from Frieru : a member of SIE(Barcelona) thought that they had obtained a result, but didn't have any details. The possibilities appear to be that the water goes to Cueva del Viento , or to the large resurgence in the upper Pomperi valley. The chemistry of the latter indicates a large streamway with little solutional activity affecting its water.



Skunk in Skunk's Cave.
(Cueva del Skunk.)

Cueva del Skunk is situated to the left of the path leading E from the Vega de Justillagar, in a prominent cliff face just before the col into the adjacent deep valley is reached. There are two entrances; one has a strong inward draught. Skunk spent about three hours investigating the 10m of passage which conveys this to the other entrance. Awkward bends and squeezes prevent a through trip for normal mortals - and Skunk!

N.E. OF LOS LAGOS (BUFERRERA-BELBIN)

EL HOYO LA MADRE

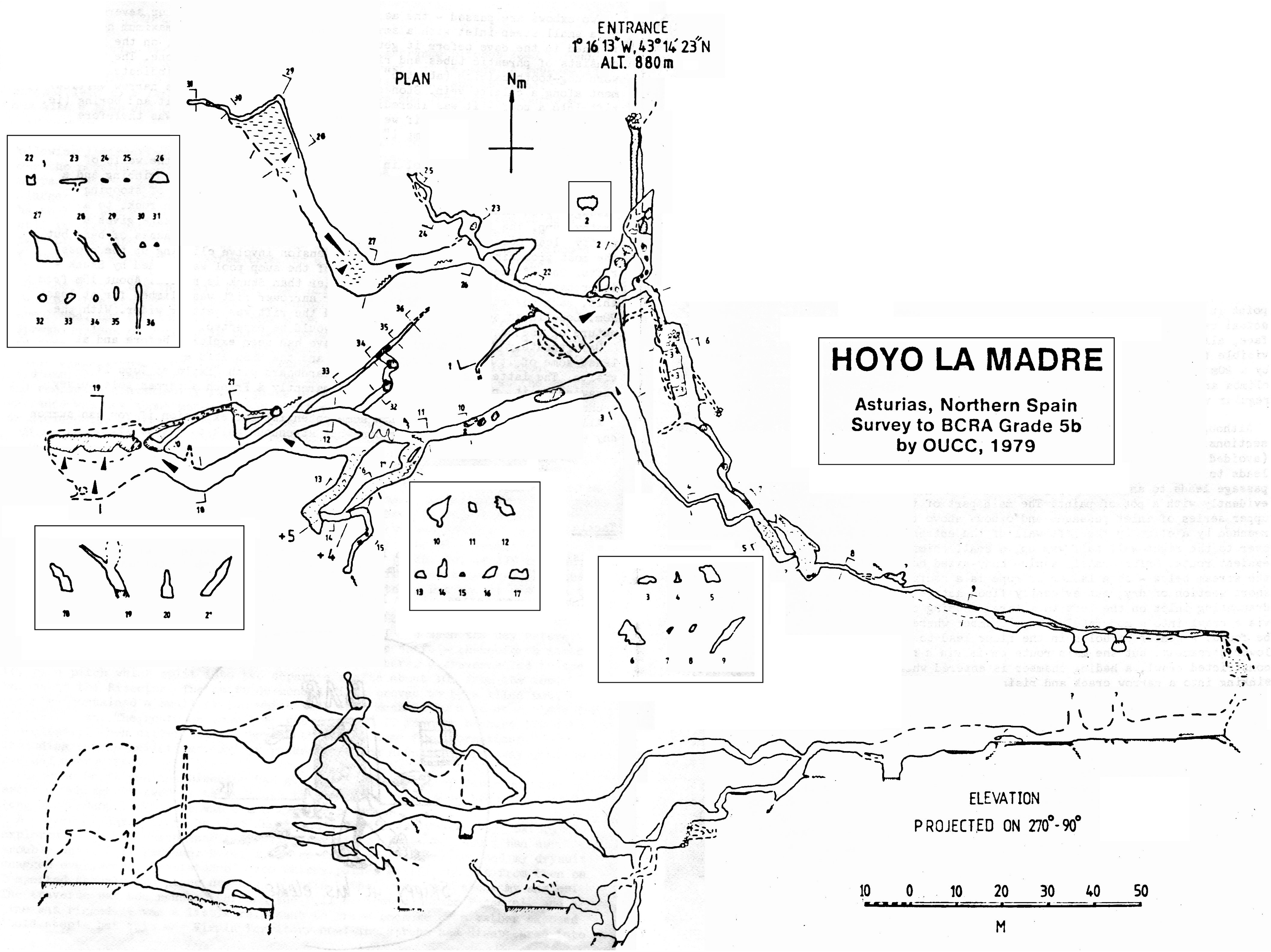
A large and complex resurgence system in an extremely impressive position. Most of the passage is dry, but flooding could be serious. There is evidence of previous exploration, but no details are known to us. Some very interesting and pleasant passages are to be found, along with some less attractive ones. There would still appear to be some potential for extensions, especially by climbing rifts or, of course, sump diving.

The Rio Casano gorge must be descended from the Buferrera - Belbin track which takes you over the Belbin moraine and then deteriorates to an imaginary line on the map. From here aim roughly north for about 400m to a col between two small peaks - this gives an imposing view of the gorge. Descend a bracken covered slope, avoiding Urogallo birds, to a gap in a dry stone wall and a shepherd path. This heads into the steep side valley to the west as opposed to the potentially more rapid routes straight ahead. Then simply (!) follow this steep stinging nettle infested slope down to the well wooded valley which the shepherds evidently use for their supply of firewood. The entire river, at this point in the gorge, originates from El Hoyo la Madre - so the cliff, if not the actual cave, is easy to find. Water gushes out from several points in this cliff face, aligned along a steeply inclined fracture. The entrance itself is not visible from below (it is not the obvious but blind pothole) but can be reached by a 20m climb in two stages from near the base of the main waterfall. The climbs are easy if holds can be found in the moss and grass - however for regular visits ladders are a sensible precaution.

Although a major resurgence cave large streams can only be seen in short sections: from the entrance to sump 1 and just before sump 2. The entrance swim (avoided if visiting only the upper series by a traverse on the left hand wall) leads to a series of cascades carrying the stream from a rising sump. A dry passage leads to another sump pool and a rising crawl first explored by SIE - evidently with a pot of paint. The main part of the cave consists of a complex upper series of inlet passages and oxbows above the level of sump 1. These are reached by a climb up the left wall of the entrance rift about 20m in. Crossing over to the right wall half way up, a small chimney can be reached which is the easiest route. Unfortunately a nice body-sized hole leads vertically down to the stream below - so a ladder or rope is a useful precaution. From the top a short section of dry, but evidently flood-active stream bed leads past a major draughting inlet on the left to a large sloping chamber. This inlet is entered via a crawl into a moderately large chamber where large dog-tooth calcite can be found. A number of holes in the floor lead to a route to the roof of the lower streamway, but the main route on is via a narrow rift. After a wet constricted crawl, a hading chamber is entered where the stream is briefly met, sinking into a narrow crack and rising from a tight sump. A small hole - not negotiated, but surveyed through - leads to another route back to the main chamber. The inlet continues via a traverse around a drop to a pool (could be worth descending sometime) and along to two large avens and a final hading, very muddy rift which was climbed to a chamber. The draught disappears near the end, and it is quite likely that a way on exists here.

Three routes lead off from the large chamber. To the right a large passage with lots of muddy decaying stal. floor ascends in steps to a large moderately decorated rift dipping at the standard 60°ish angle of the cave. At the far end a sandy crawl disappointingly narrows down, but a tiny (Ercina crayfish scale) mud-filled hole under the false floor draughts strongly. Back in the large sloping chamber the route to sump 2 is the obvious continuation. A large pool is passed - more evidence of impressive flooding. There is a reasonable amount of stal. in the form of flowstone, dry gours and the inevitable false floors - all of it dry or re-eroding.

Survey over page


ENTRANCE
1° 16' 13" W, 43° 14' 23" N
ALT. 880 m
PLAN
Nm
HOYO LA MADRE
Asturias, Northern Spain
Survey to BCRA Grade 5b
by OUCC, 1979
ELEVATION
PROJECTED ON 270°-90°
10 0 10 20 30 40 50
M
+5
+4

Two oxbows are passed - the ascending one on the left leads up several climbs to a small steep inlet with a small stream. It climbs to the maximum height reached in the cave before it gets too tight. The other oxbow, on the right, consists of phreatic tubes and rifts in unusually dark limestone. The water-worn dog-tooth calcite (about 6" long) at one end presumably indicates development along a calcite vein. Stones were thrown about 10m down a narrow vertical rift into a pool - it was incredibly slippery, looked difficult and boring (ie. we might find the bar shut if we bothered to descend it) and was therefore labelled "another bit of sump 1" - although the survey now shows this to be uncertain.

Sump 2 is a large deep pool in the bottom of a large rift, the walls of which are covered in small sharp scallops. The sump is very convincing and a bit cool. The stream flows out of sump 2 down a short section of stooping passage, with amazing small, deep potholes in distinctly brown rock, to a frothy sump. The liberal spread of froth over much of the passage gives a pretty clear message! Sump 2 could probably be lowered with masses of bang but the most promising possibilities for extension involve climbing up the cross rifts. One of these above the near end of the sump pool was pushed by Skunk - it probably still goes but someone crazier than Skunk is needed. About 15m from this, back towards the entrance, another narrower rift was climbed for at least 20m. Loneliness set in at this point and the rift was getting wider. With the nature of the cave high level passages would be expected.

Unfortunately for us nearly all the cave had been explored before and at least some of it surveyed. Both the SIE and the SSSG left evidence of former visits. The latter left a nasty bit of cardboard with "Explo et Topo 1977" scrawled on it, plus lots of cotton (apparently a French superman solo survey technique).

All in all a nice cave and with some potential for extension if you can summon any energy for caving after the somewhat strenuous walk to get to it.

Tackle

Outside	5m ladder, short belay. to avoid river 20m ladder, short belay. climb to entrance
Climb to upper series	5m ladder, 4m belay.

Skippy in his element

POZU del CANTU del HOMBRE

A fairly tough, vertical pot with 10 pitches. 8 entrance pitches lead through fossil stal to a decorated chamber and some less vertical passage. A squeeze is easily passable with a little forethought and application, and the final 2 pitches lead to a large, muddy chamber. Two ways on end after only about 25m., one with a sump and the other with a sand choke.

The entrance to this pot may be somewhat difficult to locate, in spite of the following instructions! From the N end of Lago Ercina, follow the Belbin path over the moraine. Head for the shepherd's huts (La Llomba) beyond the old mine and pass between them and over into a small closed depression. Carry on over into a larger, grassy depression, where the ridge to the left shows a narrow break in the rock to the right of a peak. Scramble up to this rift and follow it down until it opens out. The pot is entered through a 0.4m wide hole about 3m to the right of the line of the rift, and about 15m below the ridge. A cairn composed of lumps of flowstone extracted from the entrance may help. Good hunting!

On the second day in Spain Pete, Ian, Liz, Mark, Kathy and I (Kev) explored the limestone east of Lago Ercina. A couple of shafts near the track to Belbin were found, but our initial enthusiasm for cave hunting was soon eroded by a depressing lack of success in the many depressions. I wandered away to the north and then, having given up that area, began to make my way back to the others. Suddenly, in front of my face as I climbed a steep slope was a hole about 15cm in diameter. I lobbed a couple of rocks in. About 20m. I dug away at the entrance and removed a conveniently large piece of flowstone, some half a metre thick. The entrance was now about man-size but still very tight. I informed the others but we decided the shafts by the track were more promising.

About two weeks later I showed Skippy the entrance while we were en-route to el Hoyo la Madre. Soon after, he and Mike descended. To everyone's surprise, it went! Skippy descended the second pitch and forced through Tinkle Crawl to a pitch. I had to be on the next trip, so Skippy and I descended, laddered the new pitch and roped the next. Skippy found Mammary Passage - named after a stalagmite he liked- and led the way down to Pillar Chamber, where he reported another pitch. With my slightly brighter carbide I looked down and could see a flowstone floor with a black area next to it. Was it shadow or a hole? A couple of well-aimed pebbles revealed that it was another big pitch. Now really excited, I kept lobbing stones down and exhorting Skippy to 'listen to this one!' Eventually I ran out of ammo and looked hungryly at the many stals. But no, it was time to go.

Next day, Skippy, Skunk and Mike pushed on down. Skunk descended the pitch below Pillar Chamber and landed on the false floor I had seen the day before, then nearly stepped off into the next section of the shaft - thenceforth named Surprise Shaft. At the bottom of the three pitches here, a traverse led to the top of a pitch which split into two separate shafts about 10m from the top. This was named the Bisector. The shaft descended first proved to be a blind pot, but the othercontained a small stream which fell into Mess Hall, a welcome place for a bite to eat. The route on from here was dubbed G II Passage because 'It cuts you close....then closer still'. Beyond this were some fine formations, including superb helictites. Skippy pushed on alone down the streamway until he reached a traverse.

Surprise Shaft and the Bisector had given the cave a lot of depth and the awkward passages between pitches meant that pushing trips were becoming rather long and arduous. 12 hours was a standard trip length.

A couple of days later, Skippy, Skunk and I descended. On the way, Skippy explored a squeeze which enabled Tinkle Crawl to be bypassed, and I had no trouble until G II Passage. Here, my large frame caused problems and my drysuit snagged everywhere. 'Assistance' from Skippy pulled me through but from then on I sported theonly two-piece drysuit in Spain - the lower half about my ankles. The traverse was son reached through the well decorated 'Limbo Passage', and a line was rigged. I was a little reluctant to cross because of a rather exposed 'bold step'- but this was Virgin Territory now! The stream had disappeared into a trench way below and we continued in the roof tube. A slide down a flowstone slope gained a tube at a lower level. We crawled through mud and Skippy announced from the front that there was another pitch. Only trouble was that the top was about 20cm wide and the only belays would have been in mud. While Skippy and Skunk inspected this, I found a draughting hole under the flowstone we had slid down upon. Some enthusiastic hammer work enlarged the hole and the other two squeezed through. I decided to wait since I was assured they would only be a few minutes. As I waited, my carbide dimmed and eventually expired. Sitting in the dark with the sound of distant hammering for company I began to feel the remoteness of the place. I had a long prusiking exit up more pitches than I had done before to look forward to. I became impatient to leave, then angry that I should feel that way. I'd never wanted to get out quite so much in any other cave. My worries were interupted by the return of Skippy and Skunk who said that ther was a route to the next pitch at stream level through a tight squeeze. We regained camp- food and bed - at about 2am. At this stage, I went to El Mazuco, so Colin takes up the story:

Having surveyed down to Mess Hall with Dave the day before, Skunk and I went on a pushing trip. We had no trouble on the way in, reaching G II in 45 minutes. After passing the squeeze and going along an awkward tube, I reached the constriction and spent half an hour or so 'microadjusting' with Skippy's 2lb lumphammer. With my right arm knackered, I let Skunk in to have a go and he showed me where I should have been bashing. He managed to get through without further adjustment and found a 4m climb leading to a sentry box over a 15m drop. Having spent a long time looking for natural belays, we decided to use bolts. It was then that we found the whole ledge to be made of calcite, and we all know how many cleavage planes that has! Unfortunately there was no alternative and there was a pitch with a chamber below us......

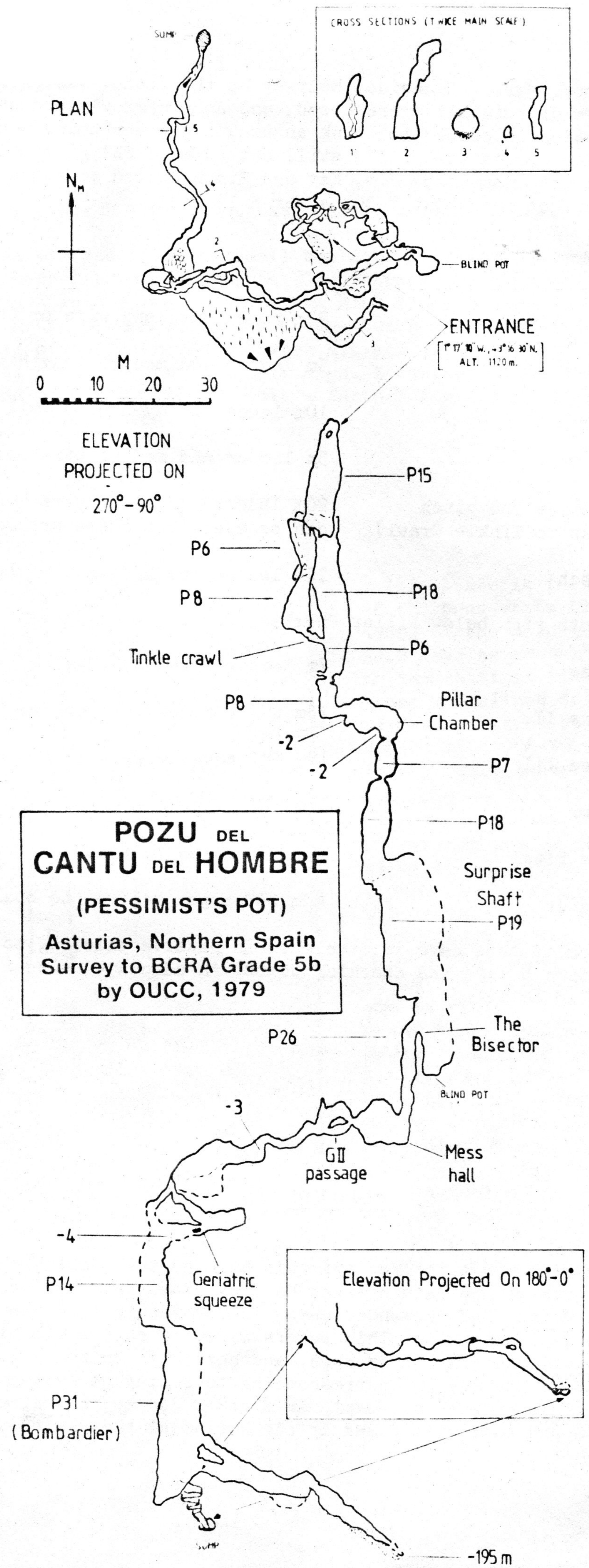
We descended the clean, wet Calcite Pitch into a boulder-strewn chamber, 10m by 5m, with a nasty looking edge over a 30m drop. We removed some of the obvious black flaky material (similar to the stuff found in Black Reef Cave in Yorks.) and, using various flakes and boulders for belays, Skunk descended. I told him I thought the rope was rubbing, but he said it seemed OK when looked at from below. He carried on down and discovered a large chamber covered with dry mud - the Mud Palace.

I abseiled down a couple of metres and reached a place where the rope snagged behind some evil-looking flakes. Giving Skunk at least 2 seconds warning, I started the gardening. Unfortunately the shatteringof the debris at the bottom was so violent that a chunk of shrapnel hit Skunk on the ankle, so he christened the pitch - Bombardier. Apologising profanely, I carried on down the rope to the rub point. The rope (a very old Marlow matt terylene) was cut to the core and I was below it. Oh well...the outside of my Damart was dirty before so it didn't seem too important that the inside was also dirty now. I changed over, prusiked back up, and re-rigged the pitch. Skunk had a look round and found three ways on: a phreatic tube, a muddy crawl, and a passage halfway down the pitch.

Next day, Skippy and Dave went down with some decent rope to re-rig the last two pitches. This they did and had a good poke round in Mud Palace. The ways on choked. The phreatic tube filled with sand after about 25m, while the muddy crawl opened out, only to end in a sump 30m on which gurgled when disturbed. The only other possibility was not entered because of it's inaccessible position. When they had examined the superb mud formations, they ascended the 'Bombardier' and, after a little more tidying up of flakes, made a slow exit.

The next trip saw John, Jim and Kev (back from El Mazuco) descend with the intention of winding up the survey. They emerged 9 hours later having failed to find the squeeze to bypass Tinkle Crawl and also having been unable to get through the constriction to the rift and Calcite Pitch. The amusement this caused was considerable, as was the derision poured onto the three. The result was the naming of 'Geriatric Squeeze'.

In an attempt at efficiency, the trip the next day was split up so that the 'hard' team could survey and photograph from Geriatric Squeeze down, whilst the 'pensioners' team could help de-rig and lug out the tackle. Having completed the survey, the WMCEG pyromaniacs took over and arranged a flash powder photo of Mud Palace. This was a spectacular success although the resulting photo was



CROSS SECTIONS (TWICE MAIN SCALE)
1
2
3
4
5
SUMP
PLAN
N
M
0
10
20
30
BLIND POT
ENTRANCE
1° 17' 10" W., 43° 16' 30" N.
ALT. 1120 m.
ELEVATION
PROJECTED ON
270°-90°
P15
P6
P8
P18
Tinkle crawl
P6
P8
Pillar
Chamber
-2
-2
P7
P18
POZU DEL
CANTU DEL HOMBRE
(PESSIMIST'S POT)
Asturias, Northern Spain
Survey to BCRA Grade 5b
by OUCC, 1979
Surprise
Shaft
P19
P26
The
Bisector
BLIND POT
-3
GII
passage
Mess
hall
-4
P14
Geriatric
squeeze
Elevation Projected On 180°-0°
P31
(Bombardier)
SUMP
-195 m

rather poor. Mark's backside, halfway up the pitch, was perfectly exposed, the walls were drastically overexposed, and John narrowly avoided third degree burns (which he seemed to think an excuse for screaming) on lighting the half a microsecond fuse (I'm still not sure if Skippy did it on purpose). A slow slog out meant that Jim, Kev and Simon exited at about 3.30am whilst the rest of us got out about 7.30, after a 19 hour trip.

Tackle

Entrance pitch	20m rope plus long wire or tape belay. (SRT).
2nd pitch	5m ladder and medium length wire belay.
3rd pitch	10m ladder belayed onto tail of 2nd pitch.
Tinkle Crawl	5m ladder and medium wire belay.
Alternative 3rd pitch (bypass to Tinkle Crawl)	20m ladder plus long wire belay. An SRT rope can be used, but there are many rub points.
5th pitch	10m ladder and medium wire belay.
Drop into rift below Pillar Chamber : Tape useful.	
Surprise I	7m ladder (pref.),belay to stal.
Surprise II	18m SRT rope belayed to two bolts.
Surprise III	19m SRT rope belayed to two bolts.
Bisector	26m SRT rope belayed to bolt and boulders.
Calcite Pitch	20m SRT rope, belayed to 2 bolts in calcite.
Bombardier	40m SRT rope, belayed to boulders.

NOTE: Much of this cave is developed in massive calcite, so care should be taken in selecting belays and checking bolts. An adequate selection of rope protectors should also be taken.

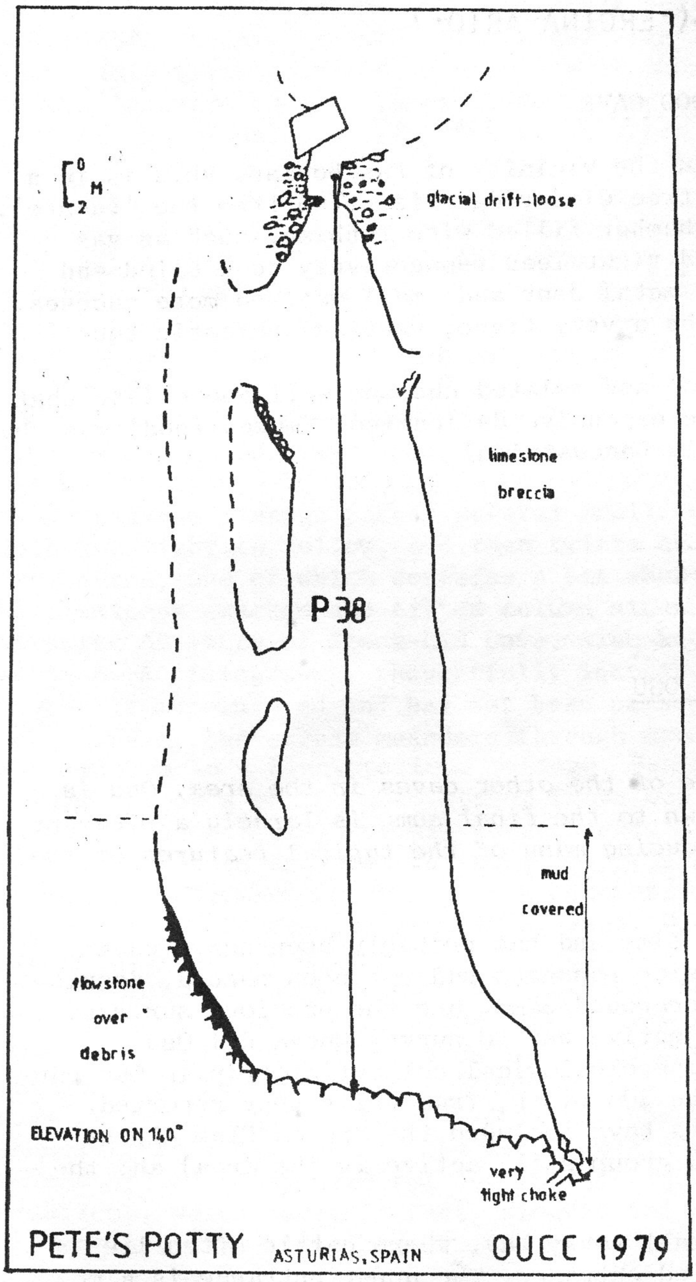
CROW POT

The expdition was informed of this hole by the local shepherd. Located 20m to the north of the path between La Llomba and belbin approximately at the half-way point. The entrance, which is reasonably well camoflaged by vegetation, measures 5m x 3m. This enters directly onto a 35m pitch. A ledge is located just after half-way down. Another shaft to the S.E. of the entrance shaft may be the way on, corresponding to a line of choked sinkholes on the surface. This pot was not explored further due to the rather fine collection of refuse and excrement found at the bottom of the shaft.

DEAD SHEEP CAVE

Located approximately 50m along the valley towards Belbin from the pond at La Llomba on the north side, just past the first animal pen, some 4m up the hill slope.

The entrance is blocked by a few small boulders (for various reasons !). One of these is marked by carbide cross. The entrance is a 4m drop tight at the top,which leads into a small chamber 4m high by 4x4m. The floor of this is covered in a metre of bones, mainly sheep--hence the name. At the bottom of the north wall of this circular chamber a tight crawl 3m long leads north, then eastwards to a chamber 2m x 2m x 1m high. A further tight crawl leads on but is blocked with stal. Beyond this a further small chamber may be seen with two possible routes on.



PETE'S POTTY

This shaft is located S.S.E. of the pond at La Llomba just south of the main (higher) path leading to Belbin. Access to the shaft is via a small steeply inclined doline with a partially buried boulder in the bottom of it. A 2m drop below this boulder leads to a ledge, below which is the free hanging drop to a boulder strewn floor. A possible way on through a tight boulder choke at the bottom of the shaft trends S.E. A bolt is located 1m above the first ledge at the top of the shaft. This ledge is composed of mainly small boulders in a mud matrix.

The name results from a nasty experience had by Mr. P. A.R.Ireland. When first exploring the cave he started to bridge down into the entrance, only discovering that it was a 40m shaft by knocking one of his footholds off. This unnerved him, to say the least.

BELBIN SINK

Two small streams sink at the collection of shepherd's huts known as Belbin. One disappears in the centre of the valley below the morraine into a sand and gravel floored stream. The other sinks through boulders further to the north at the foot of the northern hillslope. Removal of the boulders and a slight effort in digging may allow access into the subterranian streamway.

UNNAMED CAVE

Located approximately half-way between La Llomba and Belbin on the south facing slope at the junction of a cliff and steep rocky incline. Two holes drop 3m; one directly, into a small chamber; the other into a short horizontal stalled' passage and chamber which connects with the former. Not fully explored.

S.E. OF LOS LAGOS (ERCINA-ARIO)

SMOKED FOOD CAVE

The only obvious entrance found in the vicinity of Las Bobias, this is in a small cliff face at the top of the tree clad ridge rising up from the 'fuente'. The passage descends into a large chamber filled with rubbish, such as gas canisters. Side passages to left and right lead respectively to a blind end filled with cheeses, and over a low metal door and small wall to more cheeses. A shelf 3m above floor level contains a very tight, vertical phreatic tube which was not investigated further.

Connoisseurs of 'queso de Cabrales' and related cheeses will appreciate that smoke is used in the curing of these expensive delicacies.'Smoked food' was the description applied by a chauvinistic Lancastrian!

CUEVA DEL OSU

Although less challenging than some of the other caves in the area, Osu is certainly worth a visit. The trip down to the final sump is largely a pleasant stroll along a fine streamway, introducing many of the typical features of the caves in this area.

The cave has been known for a long time and has probably been surveyed at least twice before. However as many side passages had not been pushed, despite the rather obvious remains of an underground camp, and the previous surveys seem unobtainable, one expedition objective was to survey Cueva del Osu.

Derouet et al. (1955) recorded a biospeleological collecting trip in Osu but they did not go beyond the head of the 30m pitch, from which they reported hearing a stream. More recent visitors have included the Speleo Club Alpine Languedocien (1964), STE (a Barcelona group still active in the area) and the Grupo Espeleologica de Gijon.

The main entrance to Osu is in a small rocky bay, where cattle often lie in the cool breeze from the STE initialled entrance. The upper entrance is almost directly above this in a small pile of boulders on a ledge. The leafy main entrance leads into a complex series with a maze of little oxbows where the unwary may find themselves going round in circles or ending up against a blank wall. However, the route is reasonably obvious if the old survey marks are followed. After a 3m climb down between boulders a short rift leads to a 4m descent into an aven, at the top of which the upper entrance emerges. A hand -line is sufficient for the 4m descent, as we found after some unknown person stole our ladder. Another short climb down through boulders, which intimated their unstable nature by falling on John, leads to a short section of high passage, with a boulder floor, and the head of the 30m pitch. The first attempt at inserting a bolt here failed miserably as the rock disintegrated, but the next one was much more convincing and provides a free hang onto the impressively large boulder pile below. The pitch should be descended as far as the top of the pile and not followed down into the 5m deep blind hole below.

The boulder pile ends in a drop of 15m, which can be descended safely via a small crawl down through the boulder floor, ending over a nasty looking but easy climb onto a slope of loose till. It is advisable to stay clear of the base of the pile while people are ascending or descending, as they or small boulders are apt to come thundering out of the crawl.

After encountering an extremely large aven to the right, the cave bends to the left and narrows down to meet a small stream. The many false floors and well preserved pebble beds which are a distinctive feature of Osu begin to occur here, and some pretty helictites are seen in the roof. About 5m up in the left hand wall is one end of a small section of passage discovered by the expedition which eventually emerges high in the wall opposite the 30m pitch. This inlet consists of a series of short thrutchy climbs with some curious 'gruyere cheese' phreatic development. The passage degenerates to muddy crawls, finally opening out at the base of an aven about 15m high. A window, created by touching the wall 4m up the aven, looks out over the 30m pitch - an impressive vista. A small secondary inlet leads of between the muddy crawls, which starts as an amazingly thrutchy climb up through a tight hole. After this there is a little standing room on some fine mud formations. An incredibly slippery climb with some fine helectites probably leads to a too tight hole, but we all fell off!

The stream continues through many piles of pebbles and finally joins the main streamway at the "the T Junction". Above, on the upstream side of the T Junction, is a large chamber with lots of stal. Unfortunately, the many strongly draughting ways leading upwards from this chamber were too tight to follow.

The upstream passage passes several small tunnels to the right, which are again too tight to follow, and then twists and turns past several inlets and a few avens, one of which contains a bat skeleton. Another aven, just before the prominent cracked and tilted column nicknamed 'the Martian Spaceship',is the point of entry of Stone-Lid Cave, also known to its explorers as Dave's Entrance. A rising sump, thoughtfully inscribed with the legend 'sifon', is eventually encountered and has not been passed.

Downstream, the stream meanders through more raised pebble beds and smashed false floors in a high,spacious passage. Behind the first large broken section of false floor a small inlet stream flows out from a very tight wet squeeze, into which Skippy plus wetsuit were shoved. A climb up for about 10m, from where the dry-suited cavers were watching Skippy's semi-aquatic antics, led to a moderately decorated chamber with a connection through to the small chamber that Skippy eventually reached via his squeeze. The stream splatters into this chamber from a truly minute hole.

To the left of the streamway opposite another trickling inlet, a small passage leads to an aven with very loose sides. This was climbed to a limited extent by Ian and John, but no way upwards was seen. The passage then narrows beyond a broken rock bridge which no longer merits the word 'peligrosa' daubed upon it. A climb down into a pool follows and the way on follows the water. However, clambering over boulders to the left reveals part of a large old passage. This was one of the sites used for bug collecting, and also has some large stal formations, which have, in fact, blocked the passage completely. Its continuation, Giga-stal Chamber, is reached either by climbing up a prominent overhanging stal flow before, or up at, Windy Corner. Continuing easily downstream the upper levels are not seen again but a large chamber is soon reached which has a flat mud floor embellished with the rubbish left from an underground camp. However, the stones spelling out 'OPERATION ENTRELAGOS', seen by the Oxford visitors in 1976, have been removed. At a sharp left-hand bend, a large inlet enters straight ahead, and it is easy to stumble up this on return

Survey over page

rather than following the stream. The passage assumes a "Keyhole" section and passes an inlet to the right and a distintive calcite vein in the floor before reaching the first sump. The bypass is opposite a small inlet, and leads up over some boulders to a car number plate marked "0", which indicates the way on. After a short stretch of mud floor the streamway is regained via a small hole in the base of the passage. The streamway continues under a low flowstone arch to a 2m waterfall, which is easily descended in normal water conditions although a wire handline is provided. The passage here is a narrow vadose trench but a climb of about 20m leads to a large high level. Unfortunately, this was muddy and unstable, and was not extensively explored, although it could lead to a bypass to the terminal sump. After a small chamber, the going becomes easier and the stream, joined by a large inlet rushes joyfully down to the left over a series of three cascades. The last two cascades were rigged with wires which were of little use, and one eventually broke under the weight of Mike. These cascades could be very difficult in wet conditions, particularly for cavers in dry kit.

Eventually, after a long uneventful section, the passage becomes very spacious and muddy before narrowing down to a duck, followed by a deep pool. The terminal sump is in the pool, which contains a muddy ledge on the right hand side. No bypass was found, even after extensive and often hair-raising climbing in the avens and on the mud slopes.

Tackle

4m climb down aven	10m handline belayed to flake.
30m pitch	40m SRT rope to bolt (hanger and bolt removed, and anchor left ungreased.) 4m wire tether for back-up belay to large rock arch.

STONE-LID CAVE

An alternative Osu entrance: good, vertical fun, but draughty.

An obvious 4m pit next to a small cliff can be descended by ladder to a ledge with two holes leading off it. The left hand one emerges 10m above the floor of a 15m high chamber. Instead of laddering this, it is best to climb down the passage leading off to the right which enters the chamber at floor level. This route requires a handline.

The chamber has a boulder floor, and light streams in through a crack in the roof. Originally this crack was much wider, but has now been covered with rocks by shepherds (hence the caves name). At first one of these stone "lids" was removed at the surface to give a 15m free hanging alternative entrance pitch.

At the lowest end of the chamber, near a pile of bones, a steep tight passage leads on downwards. After passing two too tight holes, this emerges at the top of a 2.5m climb, which should be descended with great care, as the next (20m) pitch starts immediately below it. At the bottom of the pitch, a rift is encoutered to the left which can be descended for 3m before it widens out. Here two bolts were inserted to give a 10m free hanging pitch into Osu upper streamway.

Tackle

Entrance pit	5m ladder and short belay round rock.
Climb	10m rope tied to pillar or boulder.
2nd pitch	30m SRT. Primary belay is a flake at bottom of 2.5m climb, and secondary one is at top of climb. A 2m tape loop and a crab are required to pull the rope away from the lip of the pitch.
3rd pitch	15m rope, belayed to two bolts, one on each wall. (Anchors only, ungreased).

70m

CUEVA DE LA CAÑA

For those who enjoy physical pain, wallowing in six inch deep liquid mud and lying on their sides in ice cold water, Cueva de la Cana, although short, is an absolute must. It is also interesting because it trends towards Osu, and draughts quite strongly; it is possibly a fourth entrance.

The cave begins in an obvious cleft, by an obvious tree stump, situated about 70m to the south east of Cueva del Osu's main entrance. This leads down over boulders to a muddy feet first crawl to the right, which emerges in a chamber over a section of rift. It is important at this point not to follow the walking stick after which the cave is named by sliding down the crawl and rolling into the rift! The rift can be descended from the far end of the chamber over wedged boulders past Pencil Crack, where a surveying pencil came to grief, and the walking stick, to reach a small stream entering from above just after the first bend in the rift.

The rift eventually widens out into a small chamber full of loose powdery red coloured boulders marking some ancient collapse. Ducking under a slab to the left leads to "Crinoid Corner", notable for its fossils. The way on is through a squeeze between a flat slab and a loose ceiling, part of which decided to attack Al, compelling him to retire to the surface to evacuate his bowels.

A short section of passage which is "interesting" for tall cavers leads to "The Duck," a tight eyehole into a pool of liquid mud. A wet, tight crawl is then followed by a short section of narrow rift which chokes at stream level. The choke can be bypassed by climbing the rift to a small stal-filled chamber which emerges high up in the rift beyond the choke. Running water can be heard a long way below, and the rift continues for about 50m at this level.

Unfortunately, lack of time and the tightness of the rift prevented its full descent. However it would be a worthwhile project for two or three people with "nothing to do" for a day at some time in the 1980 expedition.

SMALL CAVES AROUND OSU

Crowbar Cave is a tight rift leading to a small passage blocked after 10m. Shifting the blockage with a crowbar of wood revealed a 150mm wide rift.

Cueva de los Enanos (Midget's Cave) consists of a drop into a rift with a small aven, leading to a passage which rapidly becomes too tight. Suggestions for pushing parties included ten emaciated dwarves (come back, Graham!) and a tonne of dynamite.

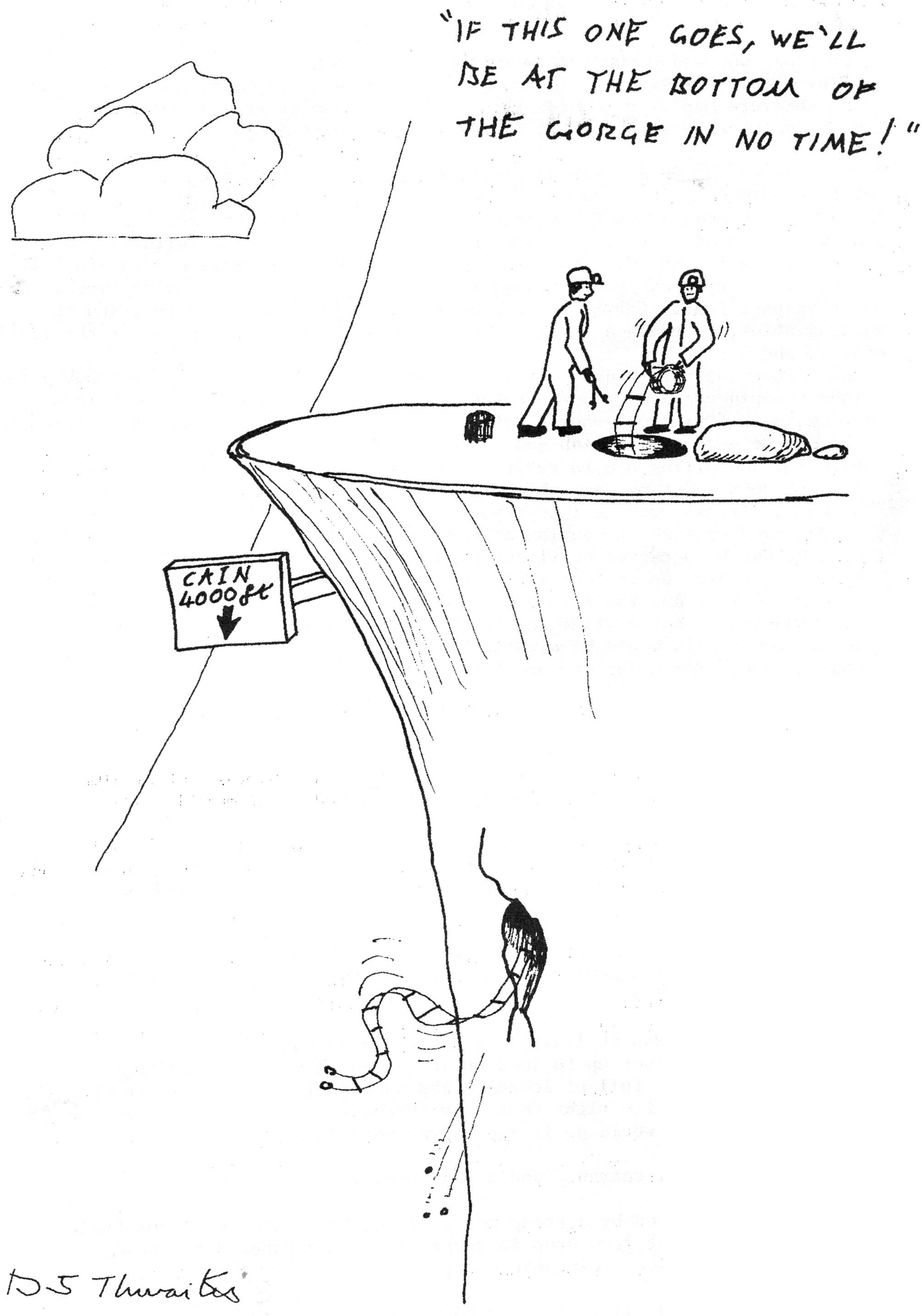
¿Estaba Frondosa? (Was it leafy?) starts with an awkward, greasy climb down into a rift with a floor up to 1m deep in leaves. The cave contains a few small chambers (also full of leaves) and an eyehole to the surface, but the rift rapidly becomes too tight to follow. Perhaps this cave, which has an impressive entrance, would go if the leaves were dug out.

Leaf Cave has a small entrance and a leaf choke.

Another Cave is entered by a steep mud slope at the bottom of a shakehole which leads to a tight 2.5m drop in jagged rock. A chamber after some boulders ends in a blocked 4m deep shaft.

And Another Cave is a small, 3m deep hole.

Yet Another Cave is a rift which leads off from the bottom of a shakehole and chokes after 8m.


"IF THIS ONE GOES, WE'LL BE AT THE BOTTOM OF THE GORGE IN NO TIME!"
CAIN 4000ft
D J Thwaites

POZU DEL XITU

An interesting cave with three very different sections. A vertical entrance series of 13 pitches with very little horizontal developement chokes at a depth of 185m within 50m radius of the entrance. However, the penultimate pitch fortuitously bisects an older cave with dry, grey stal and some interesting mud formations. This leads via a rift passage to a streamway in a very high, meandering rift. A depth of 354m has been attained, but the end has not yet been reached and there are innumerable side passages still to be explored and surveyed.

The entrance to Xitu is remarkably obvious for a previously undiscovered cave; perhaps previous speleologically inclined visitors have been preoccupied with the superb view: we found the cave in mist! To find the cave, the path from Ercina to Ario is followed for about 7km to a broad, rocky col where a panoramic viewpoint indicator is situated. The entrance is about 100m W of this and 30m S of the path.

A climb down at either end of the 9m deep pit reaches the initially unpromising looking floor. However, a small rift at the eastern end drops down 10m to a small chamber, notable for its large crow's nest (c.f. P.S.M.). The rift continues at the far end of the chamber. This 20m section is one of the few tight bits of the cave and has excellent tackle absorbing possibilities. A thrutchy crawl in the rift (easiest at roof level) is awkward, although a 'well-built' member of the SIE managed to get through after removing most of his clothing.

The rift opens out near the top of an impressive shaft which is really a downward continuation of the narrow rift. A series of ledges breaks the shaft into 5 pitches - the first of 5m and the others 9m. The shaft is also notable for its superb smooth sloping far wall and the occasional 2ft (0.63m) tidal waves which may rush past you, especially after hail storms. Pilling potholer John Singleton gives an eye-witness account: 'I had just reached the top of the last rope pitch. Suddenly there was a tremendous roaring noise from the tight entrance rift some distance above me. My first thoughts were that the roof was falling in the rift and that we were trapped. These ponderings were rudely interupted by the entrance of a 2ft high wall of water which promptly put out my carbide lamp, leaving me in total darkness. After five minutes of fumbling with flints and blowing on hands whilst standing in ankle-deep rushing water, I relit my lamp to be greeted by the sight of my friend looking like a drowned rat emerging from the previous pitch which was now a waterfall.' Pretty gripping stuff for your local evening paper! At the bottom, the next pitch begins with a short traverse (a rope between the back-up belay, which is a natural one, and the bolt is useful as a safety line) over a rift (surprise, surprise) to get to the bolt and a free hang. This pitch slopes slightly and the unwary may land at the bottom of a blind pot, so swing to the right as you come down!

A short ladder pitch, through the hole at the other end of the chamber, and a climb down bring you to the head of another short pitch. A 5m ladder on a long sling is just long enough but a 10m ladder may save you a tricky flying leap! The next pitch is a little unstable and a protector will be needed if a rope is used. It may also be necessary to pendule around a bit to land on the ledge. From this ledge, belay around a flake boss - a rope can be used but a 10m ladder may be better.

The last pitch of the entrance series is about 10m away, over the rubble with a short traverse to reach the bolt. Halfway down this 13m pitch a passage is visible on your right. This is an older cave which has been cut through by the present one. At the bottom of the rope you land on a natural rock bridge between two blind pots. The left hand one is 37m and a nice if pointless prussik. (Ask Kev who descended several times to collect bits of his disintegrating carbide.) The bottom of the right hand pot is visible.

The way on is behind you, down the other half of the older cave. A stoopy passage, with dry grey formations, leads to a large chamber with a deep unexplored rift in the floor. (Stones thrown down here rattled around for 6 seconds, which should mean 80m. However, 'Brainiac' Naylor used this method to calculate the depth of a 40m as 80m.....) The left end of this chamber leads to some phreatic tubes. Those on the left,behind a large boulder, lead to a rift where water was heard. It is possible that this rift connects back to the one at the blind pots. A narrow passage to the right of the chamber was not explored.

Following the chamber down to the righthand end over a boulder pile gives access to another, smaller chamber with a boulder ruckle on the right. At the opposite end is an interesting and fairly well decorated inlet which was followed for some distance but not surveyed. The way on is over a false floor on the left of the inlet which is over the end of the rift. The 5m climb down this rift is not too difficult. Follow the stream-like passage past several unsurveyed inlets and some small climbs to a T-junction. Turn left here. Immediately to the right is a flake boss with a small chamber behind it. The passage from this chamber leads to a 7m drop into a rift, but a slightly easier descent is made by following the left hand passage. The drop at the end of this passage is only 4m, but the climb down is 'interesting' and the handholds are surrounded by some worrying looking fractures. Over the choss, the easy passage leads to a 4m climb down and a .... streamway! The inlet behind and above you at this point is still unexplored. The upstream section (left) was followed for 70m but not surveyed. Downstream, the passage is narrow and high, though the stream is small.

The passage soon becomes a meandering trench below a phreatic passage, which sometimes looks, in cross-section, like a bedding plane. The rock is a different colour here to in the entrance: grey rather than red. A 1m climb leads to a collapse-filled passage with water beneath. At the end of the passage there is a small hole, but it is easier to dip down to the left and climb down a 4m cascade. Watching your colleagues do this (from below) provides good sadistic sport. Following the water down this higher, but equally tortuous passage,an active inlet aven is passed. The rock is interesting here, being grey/black with calcite veins making it look rather like Marble Showers in OFD. 60m further down the passage, on the left at about knee height, are some opalescent crimson calcite knobs- the 'blood formations'. These are just before the 5m ladder pitch, beyond which there are more calcite veins. The passage narrows down, and the going is faster if you climb up and follow the higher level route above the meanders. Some 90m after the pitch , there is an obvious hole in the floor leading into the 'Trench Pitches'. These are best descended by climbing up and over the hole, descending it from the far side.

Continuing at the same level along the rift, a small stream is seen entering from above. This section was only cursorily explored and thus does not appear on the survey, although it is now considered to be a good prospect for the future. A large shaft is encountered after about 50m which is at least 10m deep and was not descended. Instead, a climb up the rift leads to several boulder floors, and traversing at an appropriate level leads over the pitch to a lengthy, continuing passage with walls covered by vivid, orange flowstone.

The three 'Trench Pitches' are close enough together to enable one to use a single 60m rope. The next pitch is roughly 20m further on down the winding passage. Immediately to the left of the pitch head are some fine nests of cave pearls, containing many small white ones and some larger brown ones. The pitch head is reached by a short traverse to the left, and the easy 18m drop enters a small chamber with a rift to the left which leads to a 23m pitch. The belay for this pitch isaround a dubious flake in the rift above head height. Warning: this pitch has many rub points and protectors are essential - one length of Marlow terylene had its sheath cut in a single 10m abseil. As the pitch has many projections it is best to carry the rope down to avoid snagging.

The pitch lands in a chamber with a shelf about 6m up. Follow the water out of the chamber and traverse over the next drop and descend gradually to the stream again. Four 5m climbs are then reached, the first of which is very awkward

awkward, meriting a line. After these, a short scramble down leads to a large boulder jammed (we hope) above a 4m pitch which can be free climbed with difficulty. The passage descends to the head of a superb wet 15m pitch, where the rock is grey and clean. Behind you as you descend is a ledge 5m up. Climbing up here brings you to a parallel boulder-filled rift which was not followed as it seemed to choke very quickly.

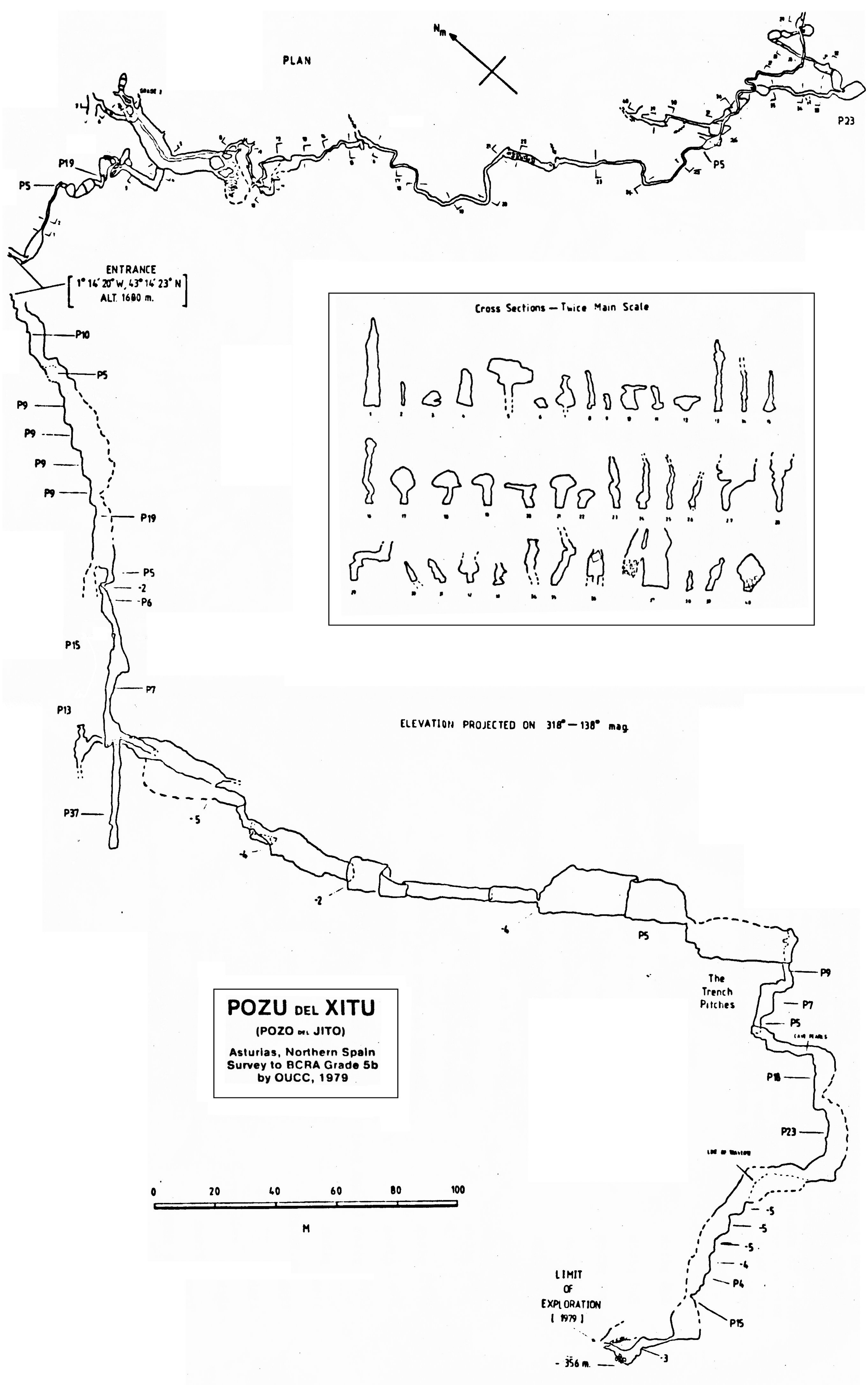
Follow the water down a narrow tube which enlarges from a hands and knees crawl to standing size soon after the water has left via an impassably narrow crack. The passage swings left and a 2m climb leads to a rubble-filled rift. Water is audible below you, and in this tantalising position both the exploration and surveying parties deserted their tasks - for 1979, at least!

Tackle

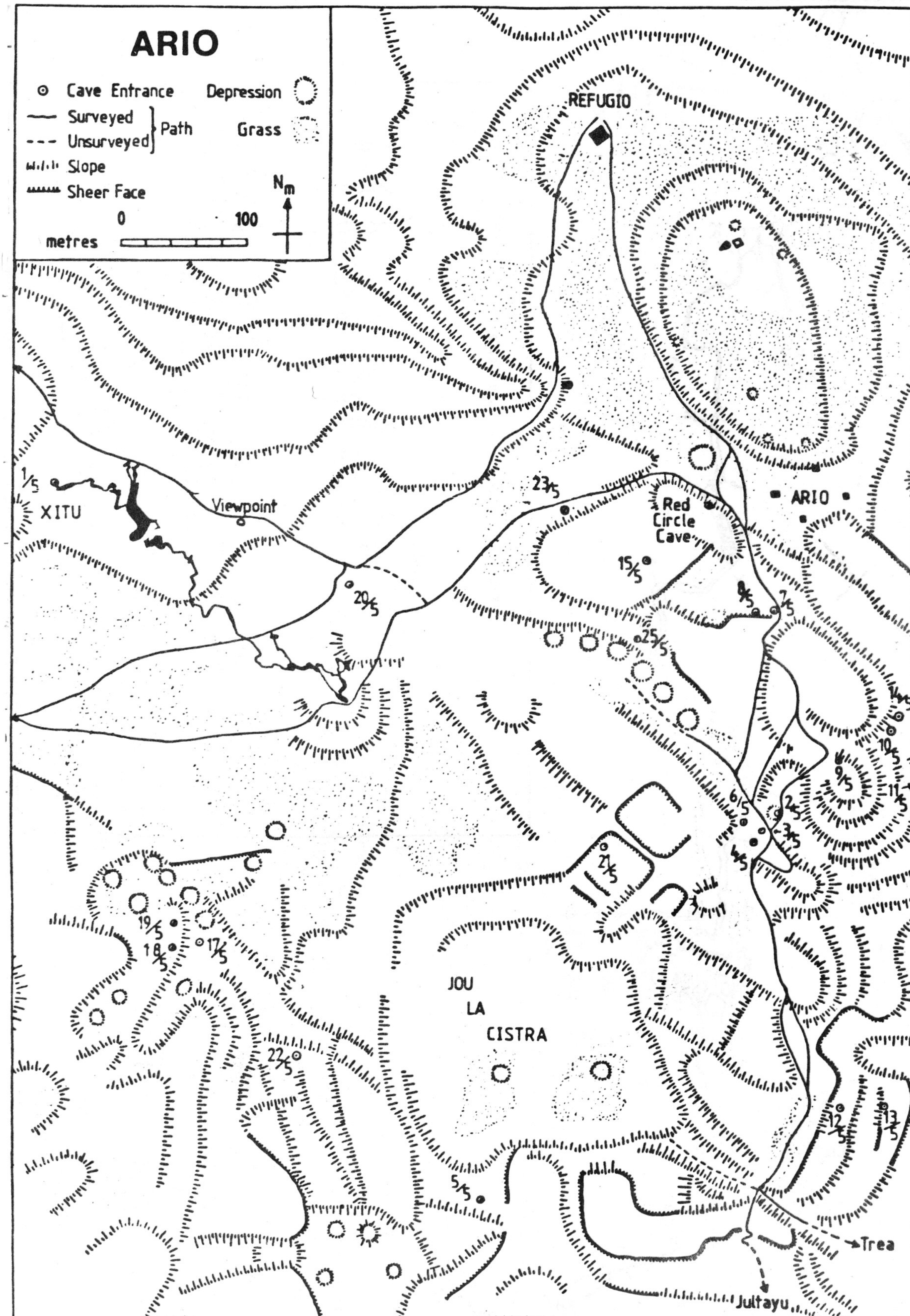
1st pitch	10m ladder belayed to boulder with medium wire.	
2nd pitch	5m ladder to short belay round flakes.	
3rd pitch	10m SRT to two bolts	75m (3rd–7th pitch)
4th pitch	10m SRT to two bolts	
5th pitch	10m SRT. No belay- rope protector needed.	
6th pitch	10m SRT to two bolts	
7th pitch	25m SRT to two bolts. Traverse line to pitch head very useful.	
8th pitch	5m ladder and medium wire belay.	
9th pitch	10m ladder (5 if pushed) to bolt.	
10th pitch	20m SRT belayed by tapes to flakes. Rope protector.	50m (10th–12th pitch)
11th pitch	10m SRT to tape and medium wire belays.	
12th pitch	15m SRT to bolt and natural backup.	
13th pitch (Blind Pot)	40m SRT to natural belay	
14th pitch	5m ladder to bolt	
Trench Pitch I	9m SRT to two bolts	
... ... II	7m SRT to bolt and natural backup	
... ... III	5m SRT to two bolts	
Pearl Pitch	20m SRT to two bolts	
Chopper Pitch	25m SRT belayed by tape and long wire belay. At least three rope protectors needed.	
20th pitch	15m SRT to bolt (N.B. One anchor here is not properly emplaced - avoid)	

N.B. Bolts and hangers were removed on detackling, leaving only ungreased anchors.

Survey over page



PLAN
Nm
P19
P5
P23
P5
ENTRANCE
[1° 14' 20" W, 43° 14' 23" N
ALT. 1680 m.]
Cross Sections — Twice Main Scale
P10
P5
P9
P9
P9
P9
P19
P5
-2
P6
P15
P7
P13
P37
ELEVATION PROJECTED ON 318° — 138° mag.
-5
-6
-2
-6
P5
P9
The Trench Pitches
P7
P5
P18
P23
-5
-5
-5
-6
P4
P15
-3
LIMIT OF EXPLORATION (1979)
- 356 m.
POZU DEL XITU
(POZO DEL JITO)
Asturias, Northern Spain
Survey to BCRA Grade 5b
by OUCC, 1979
0
20
40
60
80
100
M


ARIO
Cave Entrance
Depression
Surveyed
Unsurveyed
Path
Grass
Slope
Sheer Face
Nm
0
100
metres
REFUGIO
1/5
XITU
Viewpoint
23/5
Red Circle Cave
ARIO
15/5
20/5
8/5
7/5
25/5
14/5
10/5
9/5
11/5
6/5
2/5
3/5
4/5
21/5
19/5
18/5
17/5
JOU
LA
CISTRA
22/5
12/5
13/5
5/5
Trea
Jultayu

SMALL CAVES NEAR ARIO

The mapping of the Ario area revealed many caves and potholes. In accordance with Spanish regulations, each entrance was numbered and labelled with "OUCC '79". To allow simultaneous investigation of two areas, the caves were allotted two numbers, the first identifying the cave, and the second signifying the region: Ario was area 5 so each of the following caves has a number ending in /5. Unfortunately, none of the other areas yielded enough caves to warrant further use of the system (except in John's mind) so it was abandonned. Many of the small caves explored previously by the SIE have their entrances described below. This is to avoid duplication of effort by any future expeditions.

Red Circle Cave (Pozo de la Canaleta) was not investigated beyond the SIE mark, partly because of the abundance of broken glass.

Cave 1/5 is Pozu del Xitu and is dealt with elsewhere.

Cave 2/5 is an obvious hole in a small cliff leading to a 10m deep pot. This can be free climbed for 3m to a ledge, where the snow plug and boulder pile at the bottom of the shaft can be seen clearly. Descended by the SIE in the 1970's.

Cave 3/5 begins in a small pit by the Ario-Jultayu path. This drops into a rift with razor sharp walls ending in a small chamber. A very tight hole appears to lead on for a few metres in the opposite wall. Explored by the SIE in the 1970's.

Cave 4/5 is a small tight pot looked at by the SIE in the 1970's.

Cave 5/5 is an obvious 4m x 4m hole, in the bottom of a dry valley, which can be descended easily for 5m to a small snow plug. From here a passage to the side drops further but was not investigated due to a lack of illumination. Explored by the SIE in the 1970's.

Cave 6/5 is a 2m wide, 8m deep rift which seems to be a continuation of the rift in cave 3/5. The rift chokes at all levels a few metres in.

Cave 7/5 consists of a narrow rift with a boulder floor that diverges into two tight passages a few metres in. The left hand passage is too small for humans and the right hand one chokes almost immediately.

Cave 8/5 (Cheese Cave) is at the base of a small cliff in a dry rocky valley. The entrance is covered with boulders to keep sheep out and the first crawl is occasionally used as a shepherd's cheese store. Removing the largest boulder allows a legs first squeeze into a crawl past foul smelling cheeses which emerges in a rift containing the first pitch of 10m. The second pitch (20m) follows immediately and is a nice free hang from the two bolts (ungreased anchors left). At the bottom an awkward climb down is followed by a section of wider, more spacious rift which soon narrows down. Another 5m climb down the rift leads to the top of the third pitch (15m). The rift chokes at all levels about 100m beyond this.

Cave 9/5 (Colin's Calamity) is a small unobtrusive hole in the ground on one of the small hillocks near the Cares Gorge. The 7m entrance pitch lands on a small pebble bed sloping into a small passage. The only possible way on rapidly becomes too tight.

Cave 10/5 is a large obvious pothole about 20m deep in a small valley between two limestone outcrops. It was explored by the SIE in the early '70's.

Cave 11/5 is a strongly draughting boulder choke under a snow plug in a deep ravine. It may be worth digging out during some future expedition.

Cave 12/5 is an obvious hole, 1m x 0.5m in a depression in striated limestone. It leads to a small, very unstable chamber with a boulder ceiling. Two small crawls lead down from this. Explored by the SIE in the early 1970's.

Cave 13/5 consists of a narrow, 7m deep rift which widens out at the bottom. Unfortunately it chokes rapidly at all levels.

Cave 14/5 is a small chamber in boulders in the rift containing 10/5. A choke leads into the 10/5 shaft, but this self-destructed when John tried to get in.

Cave 15/5 consists of twin 11m shafts in bare limestone. One of these is free climable and can be descended to a connection to the second shaft. Lots of plastic bags full of refuse completely cover any way on that there might be.

Cave 16/5 is the same cave as 5/5!

Cave 17/5 is a small entrance that terminates within a few metres.

Cave 18/5 is entered via a ruft running S/W. A 12m pitch beneath a spectacular rock bridge leads down onto a snow plug. The rift divides into two small passages that choke immediately.

Cave 19/5 has a spectacular entrance consisting of an 8m shaft which connects with a rift running NW-SE. The shaft can be climbed with care, as the rock is grassy and slippery, to a snow-plug from which two ways on are seen. The left-hand one is a steeply sloping passage which leads to a junction a few metres on. The right-hand route is a rift which quickly becomes too tight to follow, but the left-hand route is more promising. This ends in a small chamber with a boulder floor, through which another chamber, about 2m high, can be glimpsed.

Returning to the snow-plug, the rift may be followed down the snow for about 5m, when the passage ends in a pebble bed where the roof closes right down to floor level. A line is essential for a safe ascent of the snow-plug. This cave may be worth digging sometime.

Cave 20/5 was not explored due to a lack of time.

Cave 21/5 is entered via a crack which is virtually indistinguishable from the clints and grikes around it. This crack is in fact a 20m pitch which emerges in a slender aven with an alternative horizontal entrance. Two small chambers occur below a climb down from the bottom of the pitch. One of these can be climbed to a small aven, at the top of which a small crack of light is visible.

Cave 22/5 consists of two intersecting rifts in an area of heavily shattered and jointed limestone. A 9m pitch at the centre of the cross lands on a snow-plug. At this level, the W-E rift closes up, and only the NE-SW is left.

Cave 23/5 begins in a small, unpromising hole facing S. Those with large hips will find it much easier to approach the entrance slope feet first and on their back, but should beware of the immediate 2.5m drop into a rift. The rift slopes gently eastwards away from the main Ario depression, and many small roof collapses impede progress. After 50m such a fall effectively blocks the rift, although various small holes at the base of the collapse may lead on. This cave is unusual for the area because all the development appears to be horizontal.

Cave 24/5 was not explored, due to lack of time.

Cave 25/5 is a large open shaft 8m deep, 8.5m long and 2m wide. A passage at one end quickly leads to a boulder choke.

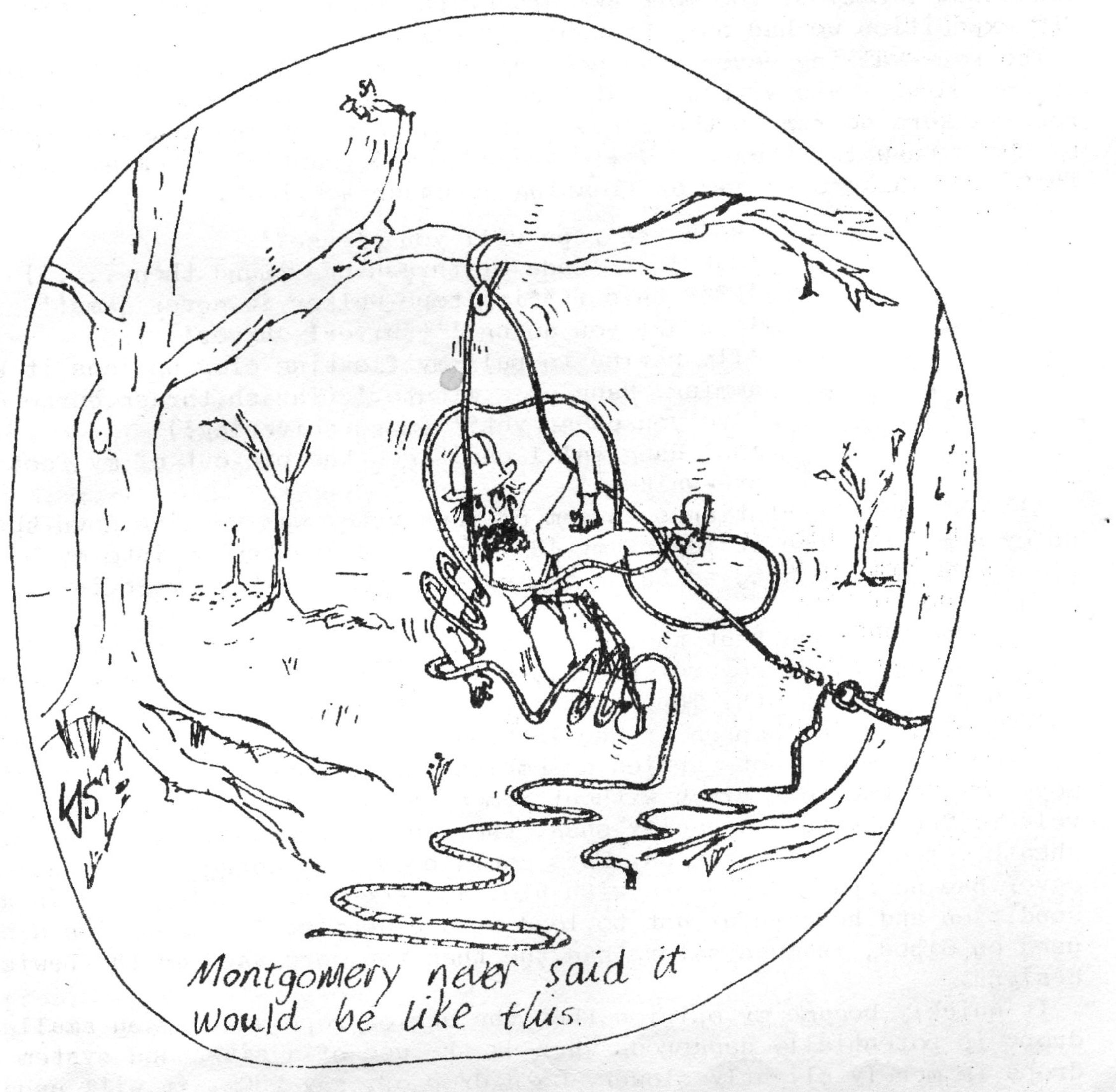
Cave 26/5 is........Cave 5/5!

S.R.T.

Silly Rope Techniques?

During May-June of this year Iwas eagerly looking forward to my first expedition caving. My only experience of SRT in caves was gained on aCerberus Yorkshire meet when Ken taught me the rudiments of the sit-stand system in Sell Gill Holes. I knew that I needed more experience before Spain and when I heard that most of the Oxford cavers would be using rope-walkers I was forced to ponder again over the choice of sit-stand or rope-walkers. "If we find a 280m pitch like French did recently," I reasoned, "I'm going to be left behind. They'll curse me for holding them up on pitches." I decided to play safe, talk to my bank manager (again), and buy some rope-walkers as well. " I'll use sit-stand on long drops and rope-walkers on big ones," I told myself. I wasn't sure what I would do in a cave with some small drops and some big drops.

My new SRT goodies arrived in June. I had only a few weeks to teach myself rope-walking. I headed for the nearest suitable tree on Southampton Common followed closely by several sniggering university cavers anxious to witness any accident." Don't worry about them," I told myself. " The most difficult bit will be rigging the rope." An hour or so later I thought I had proved this point having tried several routes up the tree before one was successful. I rigged the rope as suggested by Montgomery and tried sit-stand first, partly to demonstrate the system to the spectators but mainly to give me confidence. No hassle. They were all most impressed. Ego well boosted I descended and rigged my ropewalkers.



I had little trouble actually climbing the rope as long as someone was holding the rope fairly taught. My foot rope-walker needed an inconveniently large kick to get it to jam and I found that after a while my arms became tired with the effort of holding my body in a vertical position. At the end ofthe 50m rope I told myself that it was much quicker than sit-stand. It had to be because I was knackered!

The problems began when I ascended the rope to de-rig it from the pulley. At the pulley my shoulder rope-walker got jammed up. My struggles to free myself caused the shredding of the elastic for my floating ascender, and the separation into it's component parts of my shoulder rope-walker. The sheath of this eventually plummeted to the ground. " Don't panic," I thought. " Find what's caught and sort it out." I ignored the laughter from below and tried to remove my right foot from behind my left ear. After much thought, swearing, gnashing of teeth and flapping of limbs I managed to extricate myself, get the rope out of the pulley and descend on a double rope looped over the branch.

" Just goes to show the importance of practicing on the surface before going underground," I said, trying to recover the situation. " I think I need a little more practice."

And so to Spain.....

Some-how I never got around to that extra practice with my rope-walkers. I retreated into the familiar simplicity of my sit-stand system. As it turned out I was never called upon to prove myself on rope-walkers because none of the caveswe explored in Spain had pitches big enough to warrent their use. The rope-walking cavers soon became frustrated with their systems. The cave which really sorted them out was Xitu. 19 small pitches and none of them over 25m. Most of the pitches were difficult at the top and rope protectors had to be used frequently. Many of the more awkward drops should have been laddered but as an SRT expedition we had only brought a few ladders.

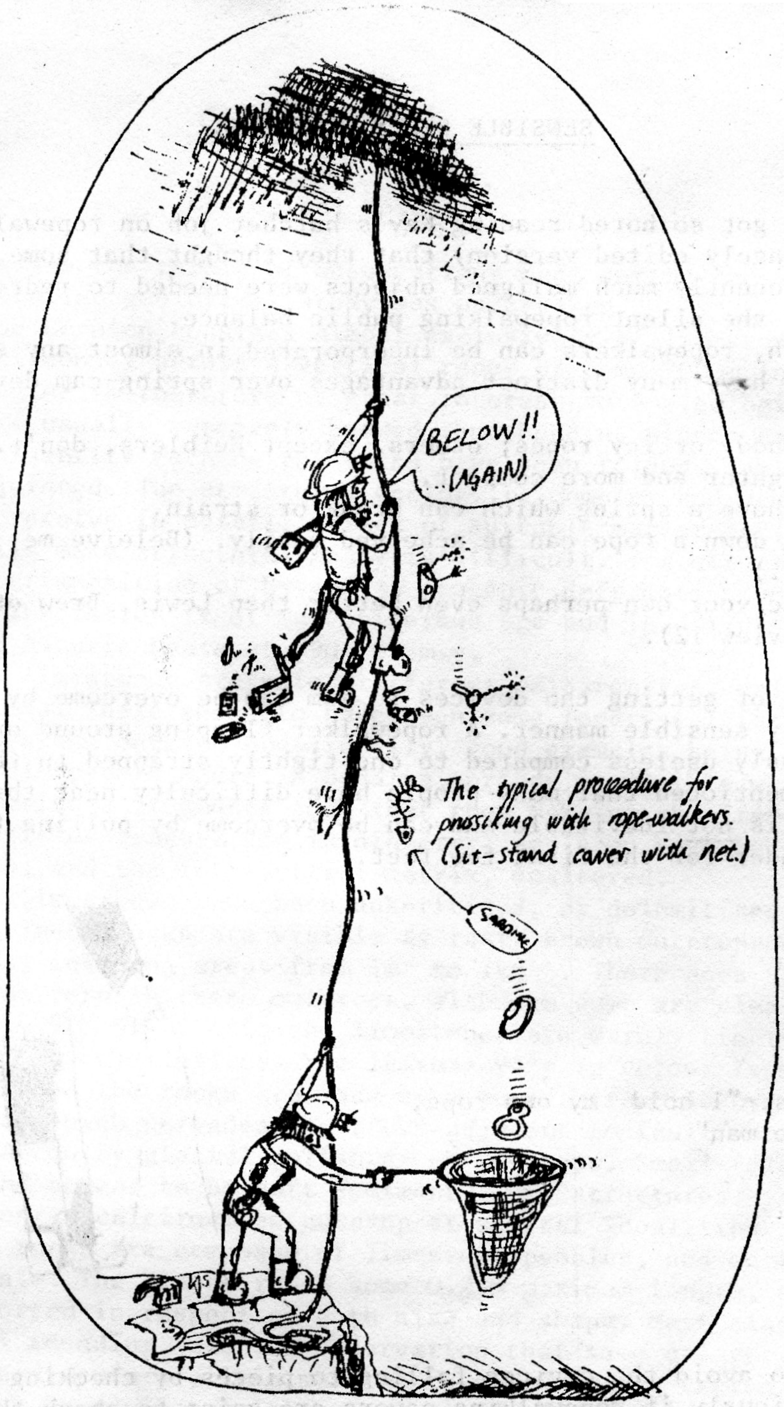
The rope-walking cavers had amazing problems in Xitu. I had to come out last of any party I was with so that I could keep the rope taught enough to allow rope-walkers to run up the rope. Vast amounts of energy and time were waisted by the rope-walking cavers while swearing and franticly kicking to get their foot rope-walkers to jam or floating ascender to float.

Episode:- 'Hold the rope will you please?'
'O.K.' (Sounds of thrashing around then .....)
'F*** this f***ing rope-walker it never jams!'
'How are you doing?' (shiver!,shiver!)
'I'm having to pull my floating clog up 'cos it keeps jamming. Hang on a minute.' (Thrash,thrash,curse etc.)
'Are you clear yet?' (more shivering!)
'No! Hang on! I can't get the pin out of my foot rope-walker.'

All this time a continuos stream of icey water was running down the rope, up my arm, down the inside of my 'dry'suit and eventually into my boots. I had plenty of time in Xitu to think how useless rope-walkers were in these conditions.

Some cavers found that the cord linking the sheath,pin and cam of their rope-walkers broke after several trips,usually at the crimped ring where the cord is attached to the sheath. The crimped rings themselves do not last long if bent repeatedly, as can happen if the locking wire is pulled out to roughly, or if the rope walker is not carried assembled. At pitch heads it is easy to start to move off to the next pitch without remembering to re-assemble the foot rope-walker. The sheath can easily snag, the linking cord snap under load, and the sheath descend into darkness. This could be a very dangerous situation if the caver had no spare ascenders with him. So, keep the linking cord in good condition and be careful not to load it accidently. In my opinion a chain, as used on Gibbs, is much safer than the than the cord used on the Lewis or Brew designs.

It quickly became my opinion that the use of rope walkers on small awkward drops is potentially dangerous whereas the use of a sit-stand system on long drops is merely slightly slower. On a drop of, say 280m, it will usually be possible to rig the pitch as for 70m drops. This allows a maximum of four



cavers to be climbing at one time. Rope-walkers will clearly be faster than sit-stand over 70m, but what about the rest of the cave? If there are some small pitches aswell, the time gain by rope walking the 280m pitch could easily have been lost on these pitches. In Xitu, much time and energy was undoubtedly wasted because the rope-walking systems used were unsuitable for those sort of pitches. I think it would have been better if everyone had bought sit-stand systems and been content to be a little slower on longer drops. However, many of the difficulties encountered were probably made worse by the fact that most of the cavers had only a little experience with their systems.

My only problem in Spain concerned my foot loops. I had passed them through a chest crab to encourage a more upright stance. Unfortunately, wear of the loops at this crap was much worse than I had anticipated, and on the way up the 23m pitch in Xitu one loop suddenly failed although there had only been a slight furring visible before I went down. The footloop was also in a bad way so I prusiked slowly and carefully to cause the least strain on it. All went well untill I reached the last pitch. On the very last step at the top of this pitch the foot-loop snapped! I muttered something like, 'I thought they would be good enough for just one more trip!', and tried to stop my legs shaking. Next time, I will have spare foot-loops with me-just in case.I don't fancy the idea of prusiking all the way out of Xitu on knots, although it should be mentioned that one caver was so frustrated with his system that he reverted to that! A fair comment on the efficiency of rope-walkers on small pitches?

Untill the art of rope-walking efficiently, especially on short and/or awkward pitches,is explained to me, I'm sticking with my sit-stand system!

SENSIBLE REPLY TECHNIQUE

Many members got so bored reading Kev's hatchet job on ropewalkers (the above is a savagely edited version) that they thought that some words in fa-vour of the recently much maligned objects were needed to redress the Eyre/ Senior versus the silent ropewalking public balance.

To start with, ropewalkers can be incorporated in almost any system(even sit-stand) and have many distinct advantages over spring-cam devices,viz:-

a) They grip muddy or icy ropes; others, except Heiblers, don't.
b) They are lighter and more compact.
c) They don't have a spring which can break or strain.
d) Ropewalking down a rope can be acheived easily. (Beleive me, this can be very useful.)
e) You can make your own-perhaps even better than Lewis, Brew et al.(see U.L.S.A. review 12).

The problems of getting the devices to jam can be overcome by attaching them in a reasonably sensible manner. A ropewalker flapping around on a foot of tape is obviously useless compared to one tightly strapped to the foot. The article also mentioned that many people have difficulty near the bottom of pitches. This is not inevitable and can be overcome by pulling the rope through the foot ascender for the first few feet.

In John's words:-"I hold my own rope, I'm a self-made man"

It is easy to avoid the devices falling to pieces by checking the linkages regularly. Obviously if ropewalking cavers are going to check their linkages as infrequently as Kev checks his foot-loops, accidents will happen.

Ropewalkers with easily cut string and split-rings which break (even if not in the manner described by Jim Eyre) can be either avoided or modified by the use of bog chain, as in the Mark's system.

With a little bit of practice, the difficulties at the top of pitches can be overcome and ropewalking systems can provide a safe, fast, efficient met-hod of prusiking. Perhaps Kev's jaundiced views result from his apparent failure to overcome these simple technical difficulties.

Floating devices have their own pros and cons depending on what is used, where, how and by whom. Suffice it to say that, as with most SRT systems, some swear by them while others swear at them. Pay your money, make your choice and then practice as much as possible in as many invented situations as possible; familiarity with your own system invariably breeds contempt for someone elses, but in SRT you are responsible for your life so only do what you are happy with.

If you want to waste an awful lot of time reading lots of vituperative comments about ropewalkers, start with Jim Eyre's article in the 1979 Journal of the Northern Pennine Club. Follow this up in Caves and Caving Nos 5&6, where some comments are more balanced than others. The National Caving Assoc'n contribution seems just about the most useful- and brief!

GEOSCIENCES

Geological Notes

These notes are the result of observations made during the expedition, although no detailed geological study was undertaken.

The Picos de Cornion consists almost exclusively of limestone which outcrops continuously across a vertical range of some 2000m in certain areas. The region is therefore of great interest to speleologists. The limestones are usually massively bedded, but bedding planes are often difficult to identify because the rocks have been folded, faulted, and intensively jointed. The structural geology is complex and would require much work to resolve in detail. A lack of suitable marker horizons and of macrofossils make structural analysis difficult. The structure is the result of superimposition of Pyreneean orogenic deformation on Cantabrian deformation. The latter is of Carboniferous age and is dominated in this region by the Asturic Phase at 290- 295m.y.

Most of the limestones are unfossiliferous calcarenites, calcisiltites, and calcilutites. There seems to have been some re-crystallisation. Beds of crinoidal limestone outcrop occasionally, good examples being seen on the path down to el Hoyo la Madre. A bedding surface is visible which is crowded with crinoid fragments such that they make up the framework of the rock. Some ossicles reach 2.5cm in diameter, and some have been ankeritised leaving others, and the interstitial matrix, unaltered.

Some of the limestones have been ankeritised, or dolomitised, on a larger scale. These rocks are visible as rusty brown outcrops on the mountain sides, covering areas from 1m to 1km . There does not seem to be much spatial pattern to these outcrops, although some are clearly veins.

Approximately 2km SW of Ario the limestones are mainly finely laminated calcisiltites and calcilutites. The laminae vary in colour from white through black, and the rocks are made even more attractive by polyphase calcite veining which pervades the rocks adjacent to fault zones. The effect is enhanced by glacial polishing of outcrops. Small folds predate the veining and appear to be soft sediment slump structures.

Extremely coarse calcirudites outcrop at several localities. These extraordinary rocks are composed of limestone pebbles, and occasionally, calcareous shale. The clasts reach some 0.25m maximum length, and the rocks are unsorted in respect of both size and shape. Most clasts show some degree of rounding, and the observation that some are very rounded means that a sedimentary origin must be favoured over a tectonic one. These rocks may be similar to those described by N.J.Hancock in Cueva de Tinganon and Cueva Negra (Proc.O.U.C.C. 7), although they were described as fault breccias. Fault breccias are common features of the caves of the Picos de Cornion, but are clearly identified by their angular clasts and, usually, a calcite cement. The calcirudites are possibly a submarine slide deposit.

At one locality, rocks which appear to be turbidites were found. The outcrop is in the stream near the path from Los Lagos to Ario, about 2km from Ercina. The rocks are easily recognised because they weather to a brown colour. Boulders in the stream illustrate the Bouma Sequence, including calcilutite lithoclasts in a graded calcarenite A horizon. Cross lamination in the C horizon is not well developed.

The calcirudites and turbidites suggest that the limestone shelf environment was subject to tectonism before the main Asturic Phase deformation. The early syn-depositional tectonism is probably related to the Bretonic and Sudetic Phases. The Asturic Phase deformation caused decollementfolding of the limestones. These large scale features were not seen, but large recumbent folds verging N were visible in the mountain sides. The recumbent folds are probably only one of several folding episodes, but more detailed work will be required to erect a deformation chronology.

Faulting is certainly polyphase and much fault movement postdates folding. There are some low angle faults, probably thrusts, which represent a further stage in deformation beyond the recumbent folds. Many of the faults are visible in detail because all the caves visited are strongly controlled by by fault zones. Thick fault breccias accompany the faults and even calcite veins are brecciated and then recemented by further calcite intrusion. Pozu del Cantu del Hombre is developed along a mineralized fault zone. The first mineralisation was of haematite and quartz, the latter appearing particularly clear and attractive in the cave. No large crystals were found but polished pebbles abound throughout the streamway and are especially common in Mess Hall. These minerals were brecciated and then caught up in an extraordinarily massive calcite intrusion. The whole of Pillar Chamber and most of Surprise Shaft are in calcite. There is reason to beleive that the whole cave is developed within the mineral vein as weathering on the first ledge in Surprise Shaft has revealed the cleavages of the calcite and shows that about a square metre of the wall consists of a single calcite crystal. Jointing is irregularly developed but at some locations at least three conjugate joint sets can be identified. These testify to the repeated deformation of the limestone in the area.

Geomorphological Notes

The Picos de Europa is an area of 'alpine karst' in that it is 'at a high altitude,...at or above the tree line,...where all surface water is frozen for an extended period each year' (Werner,1979). The main reference to academic work is Miötke (1968), and articles based on early OUCC expeditions are by Crompton (1964) and Walker (1966). Miötke is concerned almost exclusively with surface geomorphology, which he mapped, along with vegetation and snowcover, from air photos. Most of the present landforms are glaciokarstic *sensu lato* (Ford,1979), with fluviokarst at lower altitudes. The influence of pre-glacial forms is not clear, but post-glacial karren development is commonly seen, and scree deposits are seen overlying glacial drift, as at Lago Ercina. Glacial drift is present as superficial deposits on some valley floors and as moraines of impressive size. It contains small striated boulders in a clayey matrix and frequently gives rise to marshy conditions. Erratic boulders are common, but not exotic. The drift blankets a distinctive type of pinnacle formation of limestone at Buferrera, the pinnacles now having been exposed by extensive mining activities. It is difficult to know to what extent these features owe their form to fracturing and mineralisation as opposed to solutional processes.

The landscape of the Picos de Cornion is largely made up of closed depressions of many different shapes and sizes, separated by ridges and hills of likewise diverse form. Cliffs and steeply inclined slopes are common and can be attributed to glacial action. However, limestone pavements are not found because the strata generally dip too steeply. Valleys also occur, but are frequently dry over much, some, or all of their length - at least during the summer! The long profiles of these are often stepped, and glacial scour has often produced closed depressions along them which may now be bare or, if drift filled, marshy. Some of the closed depressions are 'true' poljes and are subject to flooding from the streams which traverse them, examples being the Las Reblagas depression into which some Ercina water drains, and the Jou Seco, where the stream may well be identical with that seen in the upstream and downstream active sections of Cueva del Frieru.

Cave Development.

Walker (1966) considered that the caves then known in the Picos de Cornion fitted a developmental scheme comprising two cycles of erosion, each taking the form of solution followed by stal deposition followed by clastic deposition. One of these cycles would have happened in the Riss-Würm interglacial, and the other in the Holocene. Surface shafts were considered to continue developing under the action of snowbank meltwater.

With the development and application of accurate isotopic (and other) dating techniques such simple schemes are today being laid aside in intensively studied areas like the Dales and the Mendips, so it seems inappropriate to overinterpret the scanty evidence available today. However, it is possible and useful to point to the lines of enquiry which might be worth following up in much more detail than has so far been attempted. The clastic sediments will probably not be of great importance, because of lack of intelligible variety in the source areas and, also, their relative rarity, arising from the lack of surface drinage. Many pebbles and coarse sediments must be derived from the cave environment itself and modified therein, whereas finer material can enter through the same fissures as the percolation water. Induration of deposits by calcite deposition are important in protecting deposits from later erosion and redeposition, and false floors may result from such a sequence of events. These features are very common in the caves of N.Spain, and might well be worthy of further study to see wether it may be possible to correlate them from cave to cave, and perhaps to date them from associated stalagmite samples. Submerged or broken stalagmites may also be useful in studying the development of a cave. For example, the Martian Spaceship in Osu must have formed after the deposition of the sediments it rests upon, and before the downcutting of the stream undermined these. The layering of a stal also contains information on the periods when conditions favoured stal deposition. To illustrate this we can note that some 0.5m of recrystallised flowstone from the entrance to Pozu del Cantu del Hombre showed three main periods, defined by mud bands. At least 14 layers could be identified in all. Pozu del Xito will, doubtless, be interesting to explore further as at least two separate periods of passage formation appear to be found here. Two periods can also be inferred in Osu and in Frieru. The draining of phreatic conduits and initiation of vadose downcutting is to be related to the lowering of base levels by glacial erosion, but insufficient is known about this to be able to say much more.

The caves are clearly strongly influenced by geological controls in the form of faulting, jointing and bedding. Dominant trends show up clearly on maps of both the surface and subterranean features, as illustrated by the Osu and Ario area surveys. The entrance series of pitches in Xitu occupy a fault breccia; those of Hombre, a massive calcite vein.

It is likely that the main time for cave development at present is during the spring melt period when considerable volumes of water must flood through the caves. The development expected in such 'flood phreatic' conditions is sketched by Palmer (1971). He says that the 'turbulent,solutionally aggressive water under unusually steep hydraulic gradients'(relative to the slow, laminar flow, low aggressiveness water typical of true phreatic conditions) leads to 'rapid development of diversion passages and blind solution pockets....and the following features: 1) ungraded passage profiles, 2) spongework, 3) ceiling pockets, 4) large variations in cross-sectional area, even in zones of uniform solubility, 5) extensive and rapid deposition of clastic fill, 6) local maze patterns, and 7) extensive solution along exposed joints.' These correspond to many of the features observed in the caves of this area, and with the annual regime expected.

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Hydrological Notes

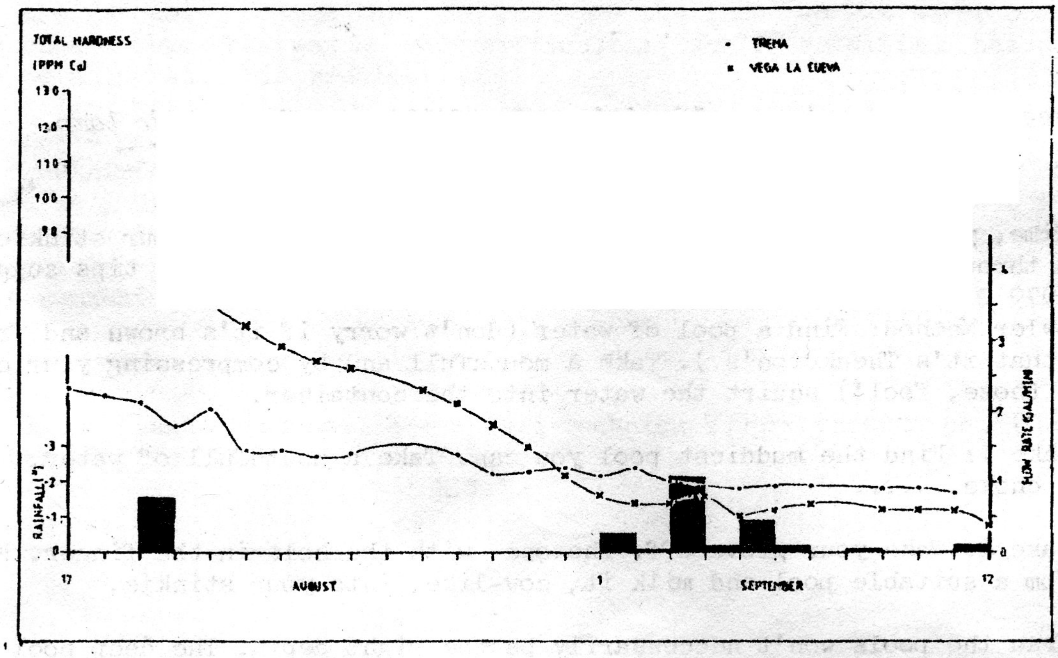
Little attention has been paid to the hydrology of this area since the 1961 Oxford Expedition monitored flow at two springs, and hardness at one, over a 4 week period. They also proved two hydrological connections by dye tracing. Their results are reproduced here and on the area sketch map for ease of comparison and completeness. During the 1979 expedition, an attempt to trace the water from Cueva del Frieru to the sump in Cueva del Viento and/or to the large resurgence of the Rio Redemuna was attempted but not completed, due to lack of time and people to collect the detectors. A number of water samples were, however, analysed for Ca and Mg hardness, using the standard EDTA titration method with plastic burette, pipettes, beakers etc. A number of conductivity readings were also taken, and the response of cave streams to rainfall noted.

Titration Results

Location	Date	Hardness in p.p.m. $CaCO_3$ Ca	Ca+Mg	Comments
Cueva del Osu main stream	13/7	94	96	Moderate flow
	17/7	94	96	Much lower flow
Cueva del Viento entrance spring	23/7	92	95	
	2 /7	88	98	2 days after hail
C. Viento sump	2 /7	80	82	' ' '
Hoyo la Madre entrance pool	26/7	92	96	
Fuente (water supply) Ercina	27/7	98	100	
Lago Ercina	27/7	64	66	
Seepage on path to Osu	13/7	118	122	
Fuente at Ario	31/7	98	108	
Trema spring	/8+ /9 1961		113 (mean)	Reported as p.p.m. Ca (=282 p.p.m. $CaCO_3$) by mistake?

The nature of this area with predominantly bare limestone surfaces and very little allogenic drainage suggests that it should be a rather good place to study limestone solution in an environment almost unaffected by the organic matter or CO_2 which is so important in soil covered areas, or by the mixing of authigenic and allogenic waters. The relative uniformity of the results is thus quite encouraging for a carefully arranged sampling programme to be organised in the future to identify the spatial and temporal influences and their effects in more detail.

It appears that water in the caves nters through the percolation system and becomes saturated at about 90p.p.m. $CaCO_3$, with a low percentage of Mg in most cases. Higher solute levels could well reflect the influence of soil cover, in the examples above, or may be related to longer residence time in the aquifer. The water in Lago Ercina must gradually build up its hardness in the dry periods in between storms, when considerable contributions of very dilute rainwater enter it, sometimes even in the form of saturated overland flow.



Discharge results for the Trema and Vega la Cueva springs, and eight total hardness values for Trema, recorded by the 1961 Oxford University Expedition to Northern Spain. (C.R.G.Pub.14 (1965))

The Trema and Vega la Cueva springs obviously require checking to determine whether or not the 1961 results were reported in the wrong units (1ppm Ca= 2.5ppm $CaCO_3$). If so, they correspond with the value for the very small seepage on the path to Osu. Otherwise, the situation is more complicated, perhaps in a similar way to that found by Tringham in the Teverga area to the west of Oviedo. There, Namurian limestone resurgences all had Ca values around 77ppm $CaCO_3$, but a resurgence from a Devonian limestone yielded water with a hardness of 180ppm.

Conductivity readings for the seepage springs feeding the Rio Resecu, Rio Redemuna, and the small stream rising outside the Cueva del Viento entrance tend to indicate that they show a variety of fairly high hardness waters. Single springs are sometimes fed by several sources with different hardnesses. Temperatures also vary from about 4°C or less to 13°C. A large resurgence from a boulder choke in the Redemuna valley has good prospects for a lengthy cave behind it, as judged from the low conductivity and low (6°) temperature of its waters - mainly meltwater, perhaps.

The response time for flowing water in the cave streams or in drips was very fast. In both Osu and Xitu a sudden increase lagged about 2 hours behind surface storms. The flow also decreased quite quickly, indicating a very well developed rapid percolation system.

It is clear that flooding could be a significant hazard, even in caves which usually appear rather dry. Thus, Viento is usually described as a dry cave, but the entrance series clearly sumps, and the normally dry stremway in Osu can become quite sporting - and possibly impassable at the cascades. Xitu entrance series has also been seen to become very wet.

Tringham, M. (1975) Notes on karst water hydrology. Report of the 1976 Imperial College Expedition to the Cantabrian Mountains, Teverga. 19-21.

THE STINKIE DILEMMA

A weegee's guide to the peculiarities of refilling one's carbide lamp.
(From an original idea inspired by Skunk.)

Some time, you, the ever safe caver, are going to find that your stinkie goes out through lack of water. So, what do you do? Here are some tips suggested by the 1979 O.U. Carbide Club Expedition.

The Fowler Method: Find a pool of water (don't worry if it's brown and frothy- imagine that it's Theakston's.). Take a mouthfull and by compressing your cheeks (No, not those, fool!) squirt the water into the container.

Kev- take 1: Find the muddiest pool you can. Take a mouthfull of water, swallow, choke.......

Kev- take 2: Take your glove off. The one with the hole in the finger. Fill it up from a suitable pool and milk it, cow-like, into your stinkie.

Of course the pools won't neccessarily be the right depth. The deep pool is a common trap for the unwary:

Pete's Method 1: Immerse stinkie till container is full. The flint is wet; the jet is waterlogged. Your stinkie doesn't work. Have a fag- no, you can't light it.....

Kev- take 3: Drop stinkie into deep pool. immerse your warm, dry body and feel around with your feet. This may take some time... Raise stinkie from the depths and see if it is full of water. If not, repeat the process. If full, you probably have hypothermia, so will drop stinkie into....
(Potential rescuers should note at this stage that the third verse of 'On Ilkley Moor Bah T'At' is not the ideal choice for cheering up your victim - is it, John?)

Waterfalls,especially in the guise of wet pitches, usually prove fateful for the faithful flame and are of little use for filling carbides.Indeed, you will rarely spend long in them, the exception being on photographic trips. Your penance as model is to be drenched so as to demonstrate that the photographer's flash gun is fast enough to freeze your violent shivering motion - and incidentally,that of the water. But I digress....

Small trickles of water are ideal for your purpose but avoid drips unless you like a challenge, a tired, wet arm or a practical demonstration of the concept of capture cross-sections.

Of course, you might get stuck in a totally dry part of the cave. Several methods can be adopted here:

Pete's Method 2: Remove your welly and pour putrescent liquid into stinkie, ignoring collegues' protestations until the vile smell asphyxiates them. Complain that your carbide smells odd and pass out.....

Failing this, other body fluids can be utilised....

The Laverty Method : Simplicity itself. Spit in the carbide reservoir.(Join U.L.S.A. to learn more about this .)

The Skunk Method : Think of water. Allow yourself to be influenced. You do wish to urinate , don't you? So, extract the ideal tool for directing a jet of water into a small orifice and pee in it.(Some wetsuits are better designed or evolved towards this function than others; so are about half the world's population.).

All the foregoing assume that you can take the lamp to pieces or open the water tank's cap. This may be very difficult if you're cold. Simon has perfected a way to alleviate this problem:

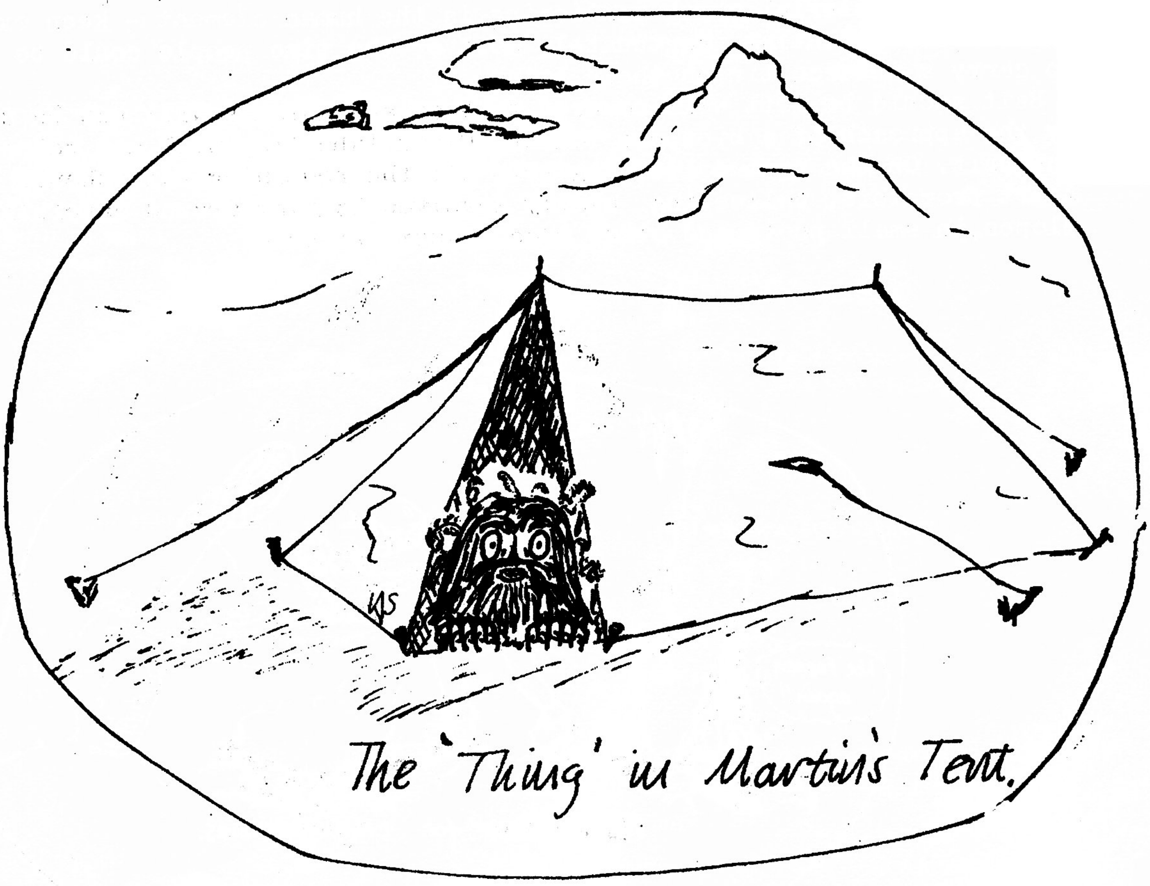
The Loris Technique: OK , so no-one in O.U.C.C. is quite sure where Lorises come from(Africa?,Asia?,South America?),but you can still take a tip from them and pee on your ears. This won't help. However, when you realise that your ears are now warm as well as supple you can utilise the high intelligence which distinguishes you from your furry, nocturnal distant relation and take one small step for mankind, a giant leap for Simon and warm your hands in the same way!

And so we come to the final solution:

The Singleton No-nonsense, Never Fail Technique: Open carbide container. Pour in water. Strike flint above container.

R.I.P.

BIOSPELEOLOGY



The 'Thing' in Martin's Tent.

BIOSPELEOLOGICAL COLLECTING

Introduction

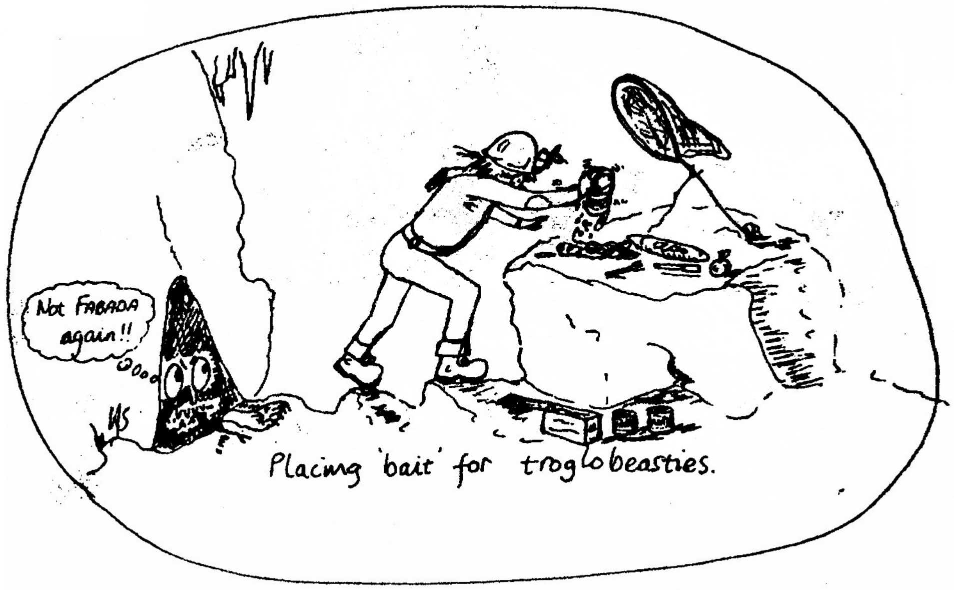
The aim of this project was to make a zoological collection from the caves that we visited, with the long term hope that this would help future workers in more biologically significant fields. Small portable collecting kits in tobacco tins enabled collecting to be carried out at any site. However attention was focussed on two caves: Cueva del Osu near Los Lagos and Pozo de Fresno at El Mazuco in the Sierra de Cuera. Bait was left for several days in each and temperature readings were taken at convenient points about 50m from the entrances. The secondary nature of this project in the expedition programme led to its neglect as the demands of exploration increased with time. In particular, threshold zones were ignored and in the most potentially interesting cave (Pozu del Xitu), collecting was somewhat incidental.

Materials and methods

Four tobacco tins containing:	7, 2"x 1/2" plastic tubes, 6 filled with 70% ethanol. 1 brush. 1 pencil+ mounted needle. Jeye cloth. Greaseproof paper. (In future a very small pooter will be added)
One ammunition can including:	More tubes, some of then larger than those above. Max/Min thermometer. 2 large pooters. FAA (formalin, ethanol and acetic acid) for fungal fruiting bodies and entomogenous fungi.
Thermometer:	Standard Max/Min are best.

The final material worth mentioning is the human element - keen expedition members are essential. Fortunately most of the time people could be persuaded to carry a tobacco tin on their trips.

Bait should be left well covered so that any animals will not be disturbed by the approach of a biospeleologist! Clear labelling will aid relocation of the bait. On the last collecting trip all the remaining bait should be removed. Apart from this, collecting simply involves looking around carefully on mud slopes, in small pools and other good beastie sites.



Placing 'bait' for troglobeasties.

Discussion

A considerable number of specimens were collected even at the relatively high altitude Cueva del Osu. These have yet to be identified to a detailed level. Prior to the expedition there was certainly some doubt as to whether anything would be found. Not surprisingly cave fauna was much more abundant in Pozo de Fresno than in any of the other caves visited. The higher temperature (12 C as opposed to 4 C) and the presumed higher organic input are probably responsible for this.

Temperature readings are best taken using a Max/Min thermometer. This should be well hidden, otherwise large fluctuations may be recorded due to inqisitive heavy-breathing cavers.

The experience gained from this years collecting attempts will help with future expeditions eg. chicken bait proved to very successful in Fresno: after three days as many as 3 species were found on one bait. In contrast the cray -fish bait in Osu attracted only a few diplurans. The position eg. whether on dry, damp or wet mud, did not seem to be particularly important: All baits yielded the commonest species of beetle in numbers varying from 4-10. With the sudden appearance of such a rich food source, this lack of habitat preference is not surprising.

With the experience gained in 1979 some standardization of baiting techniques will be attempted in Pozu del Xitu in 1980.

Results

The specimens are being identified through Phil Chapman, who has spent three seasons collecting with Lancaster University S.S. at Tresviso, so at present only a rough idea of the groups collected can be given.

CUEVA DEL OSU altitude 1230m 4.5 $\pm$ 0.5 ° C	Arthropoda	Arachnida	Opiliones
		Crustacea	Isopoda (*Proasellus* sp.)
		Insecta	Collembola
			Diplura
			Coleoptera
		Diplopoda	
		Chilopoda (complete dead remains)	
HOYO LA MADRE altitude 880m	Arthropoda	Arachnida	Opiliones
		Insecta	Trichoptera
			Diptera
			Lepidoptera (Noctuidae and Geometridae)
		Diplopoda	
	Mollusca (empty gastropod shells)		
POZU DEL XITU altitude 1680m	Arthropoda	Insecta	Coleoptera (Carabidae)
		Arachnida	Opiliones
POZO DE FRESNO altitude 355m 12° C	Arthropoda	Insecta	Collembola
			Thysanura
			Coleoptera
			Lepidoptera (Noctuidae)
		Crustacea	Isopoda (inc. *Proasellus* sp.)
		Annelida	Oligochaeta

THE ECOLOGICAL RELEVANCE OF CAVE COMMUNITIES

The curious faunas of caves are of great interest for purely scientific reasons and this is justification enough for wanting to study Biospeleology. However, with further study the unique environments and associated unique communities to be found in caves may yield some interesting ecological results. Two significant features of cave ecosystems which distinguish them from most other communities are as follows:-

1) Abiotic Factors: In non-floodable passages the physical factors affecting any biological community(such as temperature, light(!), humidity etc.) are often incredibly stable and probably constant for relatively long periods of time.

2) Energy Supply: The net energy input into the systems is extremely low. It may depend entirely on organic matter from the surface, though the possibility of chemotrophic bacteria must not overlooked.

In the past twenty years it has almost become a biological axiom that community stability increases with community complexity(Elton 1958). Community stability is difficult to define but, for example, communities including the lemming are cyclically unstable probably for intrinsic reasons, whereas complex tropical communities are classically held to be very stable. Community complexity can be measured by some index which takes into account the number of species and species biomass etc.. The actual evidence for this complexity/stability hypothesis is circumstantial, and recently the idea of environmental stability as the primary factor in determinig community stability has become more popular(May 1975). Cave communities have a low species density(low species biomass and low species number) and a stable environment - so the two hypotheses predict opposing results: an unstable or stable community , respectively. The stability of cave communities is therefore potentially of crucial interest in this controversy.

The theory of island biogeography(Macarthur and Wilson 1967) is another controversial hypothesis which has been applied to cave communities(Culver 1970 1971). Habitats can often be regarded as "islands" in a "sea" of unfavourable environment (e.g. genuine oceanic islands, forest remnants, nature reserves etc.). With only small population sizes(at least on small "islands") there will be a reasonably high chance of random extinctions of species. This will reach an equilibrium with a rate of immigration and establishment of new species - or at least that is how the theory goes. The problem is that extinction rates, immigration rates etc. are very difficult to measure reliably. Many karst regions consist of islands of limestone, isolated by different rock types. Culver has suggested that the terrestrial hypogean faunas have been isolated in these islands since they were created in the Pleistocene. Thus the extinction rate has not been balanced by an immigration rate (since the latter is non-existant). The possibility of a permanently non-equilibrium island community adds another facet to the theory of island biogeography and the simple, sometime undisturbed nature of cave communities may provide a chance of making a valid test of the hypothesis.

So, in two controversial areas of theoretical ecology that are of particular importance to the possible conservation of our own increasingly island habitat, Biospeleology may be able to make a significant contribution.

Culver,D.C.(1970) Analysis of Simple Cave Communities I. Evolution 24, 463-473

Culver et al (1973) Toward a Predictive Cave Biogeography. Evolution 27, 689-695

Elton,C.(1958) The Ecology of Invasions by Animals and Plants. Chapman and Hall

Macarthur,E.H. and Wilson,E.D.(1967) The Theory of Island Biogeography. Princeton Univeresity Press

CAVING AS A BEHAVIOURAL STRATEGY

Caving is succesful in the sense that the number of cavers, or attempted cavers is increasing (whether we like it or not).In biological terms a succesful strategy must increase fitness.The latter is a unit of evolutionary success - probably not connected to physical fitness;the number of caving beer guts testifies to this.Biological fitness simply involves an increased ability to survive and reproduce successfully.It is notable that caving is mainly restricted to males and that males are biologically notable for their desire to mate with as many females as possible:in this way they, unlike females, can increase their biological fitness enormously.

There is a dilemma here - caving would not seem to increase either survival or reproductive success. First there is clearly a survival risk inherent in caving - at least for active cavers. Novices are obviously a high risk category,which is reasonable since most cavers do not spend long under this label. However all the superheroes of the caving world including pushers of huge sumps,enormous boulder chokes,miniscule passages and dangerous foreign caves are also in an ongoing high risk situation.

Secondly, caving seems superficially unlikely to increase reproductive success.Not only is the likelihood of sexual encounter reduced but the sheer difficulty of mating underground would seem to be an insurmountable (!) problem. Just think what it would be like in those unstable boulder chokes. However some old graffitti in Swildons barn refers to some success in sump 4 - it must have been bloody tight!

With these great biological disadvantages, caving must have some enormous counter-advantages. Invoking Zahavi's controversial handicap theory presents a way around this problem.(Zahavi 1975, 1977a). Females who actively select males that are fitter(biologically speaking) will be successful - by producing fitter offspring. Female choice is therefore a potent force in evolution - but how can they make the choice reliably, avoiding cheating males who merely pretend to be fitter? Zahavi suggests a simple anwer to this:a male that has managed to survive with a major handicap (use some imagination here - it's quite amusing) must be fitter on average than males without such handicaps. The offspring of such a sensible female will then consist of handicapped males and non-handicapped females (assuming that the handicap is sex-linked).The lattee will have some of the father's super-fit genes, not counter balanced by the handicap - hence a race of super-fit females?

The somewhat ludicrous desire to cave is thus a handicap which females select, since,on average, it must be counteracted by fitter genes.

So can caving be regarded as an evolutionary stable strategy (E.S.S.) i.e. no other strategy is better? If so, then the spread of caving to fixation (entire population of cavers) is inevitable! However even the handicap principle is open to cheating. A non-caver who pretends to be a caver is not exposed to the risks but reaps all the benefits. In a society of 100 % cavers such an individual would do very well! So cheats will prosper - but a society of nearly 100% cheats is unstable since it would be advantageous for females to select against them. Consequently a mixed strategy is the only stable possibility with either a small percentage of cheats or with each caver cheating a small percentage of the time!

How stable is your club?

REFERENCES

Dawkins,R. 1976. The Selfish Gene. O.U.P.

Zahavi, A. 1975. Mate selection - a selection for handicap J. Theor. Biol. 53 , 205-214

" 1977. The cost of honesty (further remarks on the handicap principle). J. Theor. Biol. 67, 603 - 605.

SPELEOPSYCHOGENETICS

Readers of the preceding paper may recall the selective breeding experiments reported by Checkley (1972). Here in the city of dream/ry spires 'gedruncken' experiments are frequently indulged in, although the club does still go caving as well. Despite the gritty sediments found in baths after trips, many aquaintances can understand S.R.T. gear only in terms of its potential as bondage equipment, and wet suits as indicative of rubber fetishism: indeed single grope techniques interest them far more than any Freudian theories. So why do some people need to go caving? The idea of a desire to return to the womb does not apply: whoever heard of a cave that rumbled like that, although I suppose that it would be an appropriately bloody mess if it did. Mammary and phallic symbolism showed itself to be a potent factor for some visitors to Pozu del Cantu del Hombre, but this can't satisfy everyone.

A new approach to the problem surfaced in the collective expedition consciousness through the medium of the logbook. If a mutation causes the brain to replace the concept of sex by that of a cave, we should obtain the S.R.T. man (Selectively Retarded Troglophile). A few examples will suffice to illustrate the principle:

A .... is virgin until discovered, surveyed and entered.
Some like their........ wet and tight, others like them warm and large.
It is best to obtain permission to enter......
Some........ charge for entry
You must beware of Weil(pronounced vile) diseases.
etc.

It does appear that the process is reversible, as shown by the following:

Biblioll College *

Dear Sir,

On having Dave Checkley's article on Solo Caving in Descent No.41 read to me, I was interested to hear that for some of his friends "weary of the same old hard trips" "caving has little left". If Mr Checkley will allow me to summarise, they resorted to soloing for several reasons:

i) A natural progression from once large parties to small groups and thence the one man team.

ii) Improvements have eroded the difficulties and risks that in part make it worthwhile.

viz: i) Certain items of equipment have been specially designed and not borrowed from some other activity.

ii) Greater comfort makes it more enjoyable and enables a finer appreciation of the environment.

They did however appreciate the increased risks:

i) The soloist submits himself to great risks not only because, solo, he can dispense with certain safety precautions but also because rescue could be delayed.

ii) A minor injury is likely to result in a full scale operation.

Any call for assistance would be rather embarrassing, especially as "many among the public consider it a totally unacceptable risk for themselves".

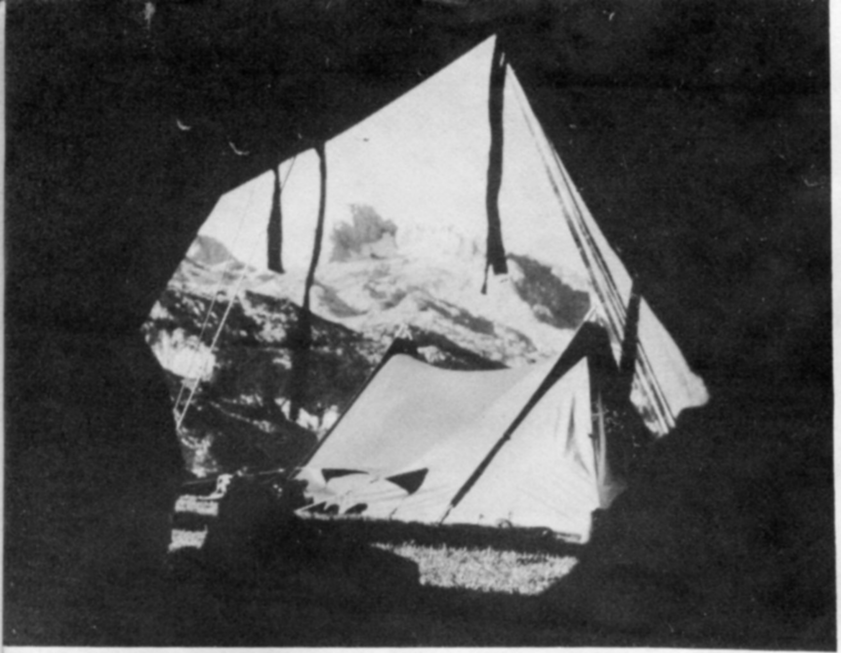
I and many of my friends feel much the same about sex.

W.Anchor

P.S. On the subject of injury, I know of no case in which anyone's sense of hearing or vision has been affected by soloing.

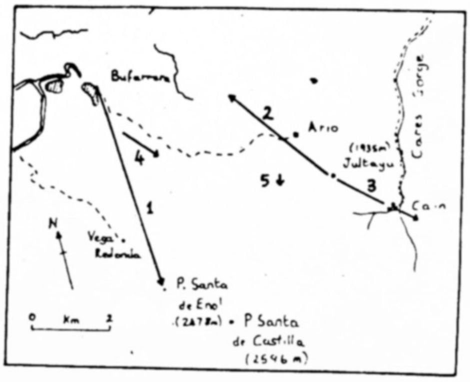
Checkley,D. (1972) A New Approach to Cave Exploration in Britain. Lancaster U.S.Journal 1,2,29-31

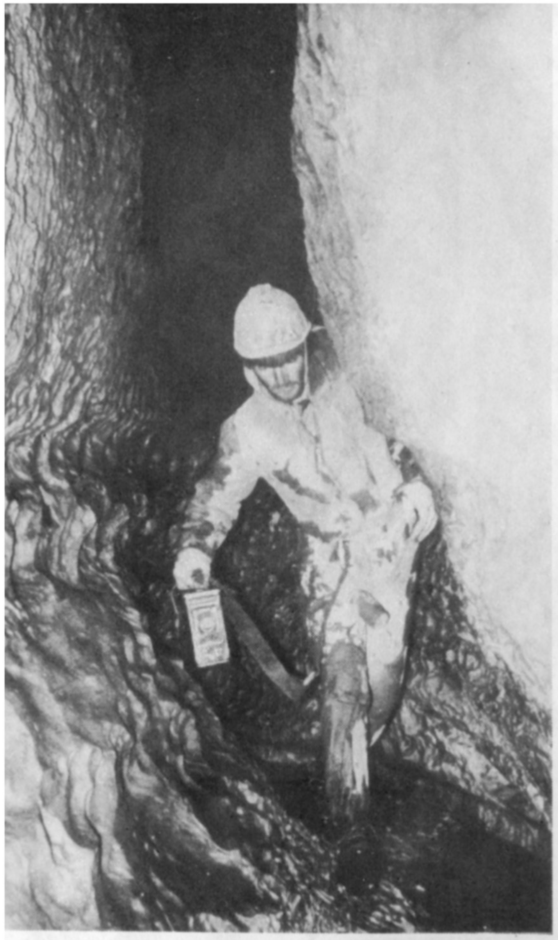
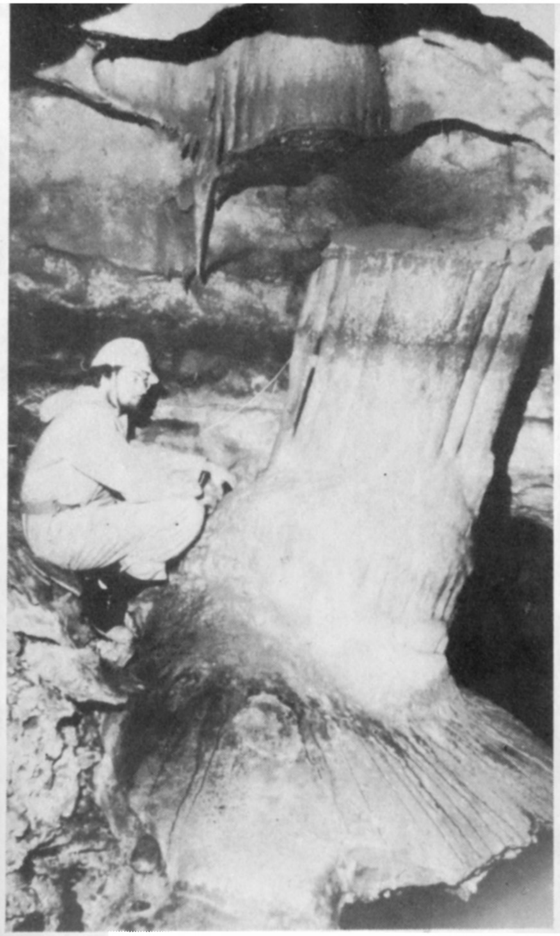
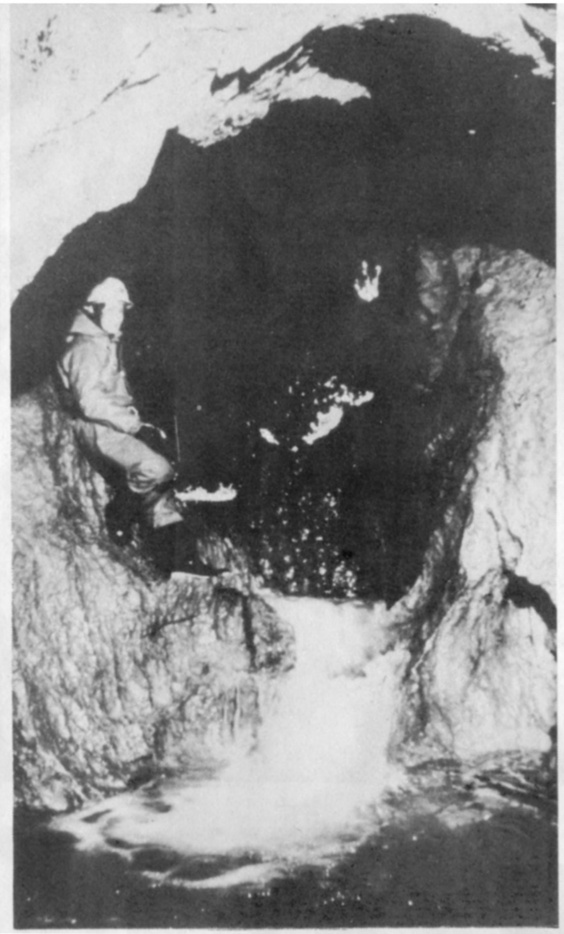
* This is a rather obscure literary joke



SURFACE KARST IN THE PICOS

1:Peña Santa de Enol (from campsite)
2:Ario area (from Jultayu; note Refugio & faults)
3:Cain and Rio Cares (from Jultayu)
4:Glacial valley on route to Vega el Forcau
5:Surface karren forms



CAVE PASSAGES IN THE PICOS

Top, left to right:

Streamway in Pozu del Xitu
Martian Spaceship- fractured stal in Osu
Cascade in lower series of Hoyo la Madre
Entrance pitch of Pozu del Cantu del Hombre

Left: Massively decorated Main Chamber in
Pozo de Fresno at El Mazuco.

Right: Streamway in Cueva del Osu

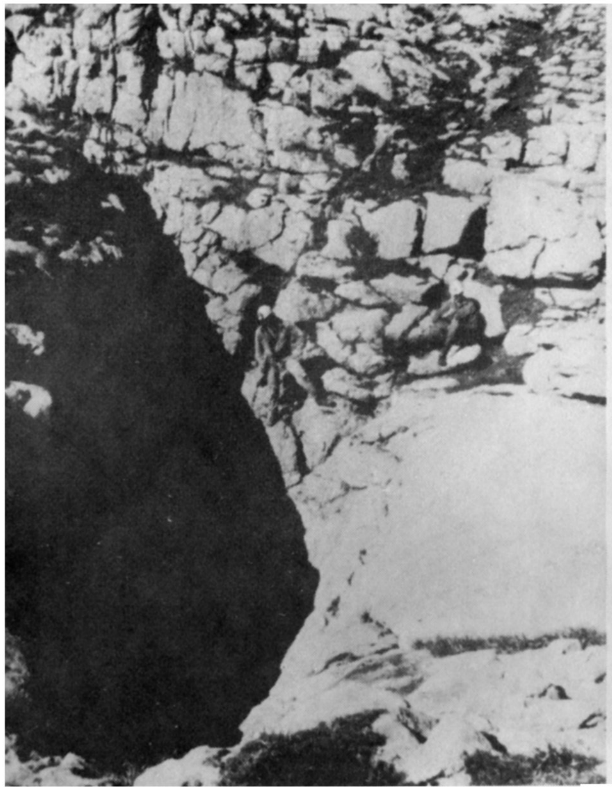
THE UNACCEPTABLE FACES OF.....

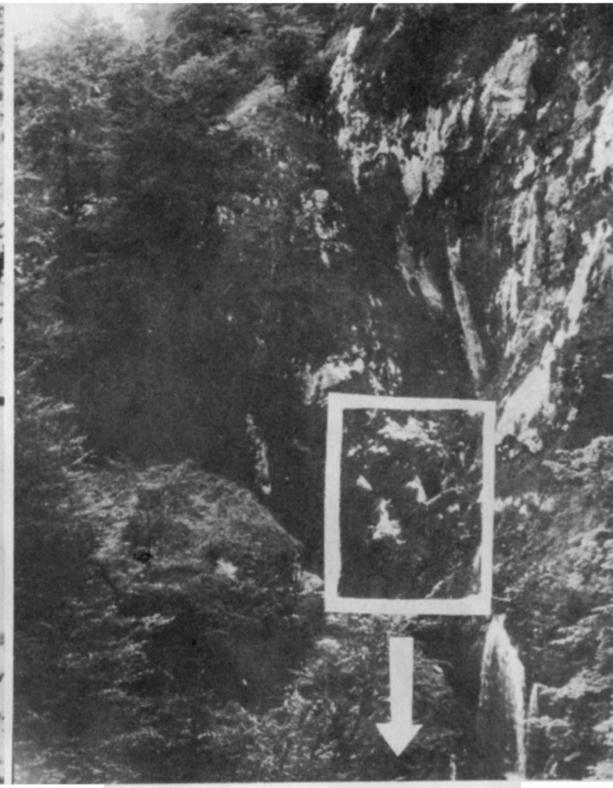
Top, left to right:

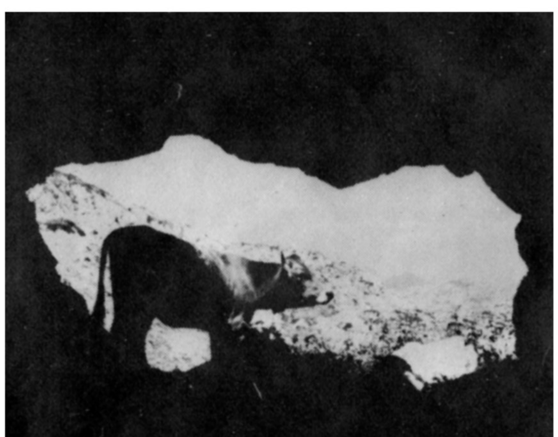
Ian	Martin	Dave	Skunk
(Tight rating)	(Titrating)	(Tit rating)	(Twit waiting)

Right: Kev (another essential component for Page 3)

Far right: John (who rivals Dave as shown above in Mammary Passage, Pess, as a model for what a selectively bred troglophile might be expected to look like)







CAVE ENTRANCES IN THE PICOS

Top, left to right:

Pozu del Xitu (in shadow)
El Hoyo la Madre (from Rio Casaño; arrow over 5m pitch)
Stone-lid Cave (one of the three entrances to C.del Osu)
Pozu del Cantu del Hombre (almost Skippy-size, now!)

Far left: Cueva Oscura (plus inhabitant, from end)
Left: Inset of caver on 20m entrance pitch to Madre

THOUGHTS OF BRUMMIE EXPEDITION GUESTS

Sometime last year, Winnie asked me if I might be interested in an OUCC expedition to Spain. Keen caver that I am, I naturally jumped at the opport -unity. Skunk was also enthusiastic, he being the type who would rather have a muddy weekend in Yorkshire than a dirty one in Brighton.

I fondly imagined Spanish caves to be nice warm places full of enormous chambers and free-hanging pitches just waiting for someone to throw a rope down them. Skunk however, being of a different mentality, fondly imagined them to be tight and wet, full of technical difficulty and only yielding their tremendous depth after many long and arduous trips. I sometimes think that Skunk enjoyed the expedition more than I did.

My only worry (apart from the prospect of sharing a tent with Skunk for 6 weeks) was of how well we would get on with all those university type academics. The only OUCC member I had ever been caving with was Winnie, and I hoped they weren't all theoreticians like him who design SRT systems of incredible complexity, requiring 15 minutes of assembly and two volunteers at each end of the pitch. This is done purely for the technical satisfaction of knowing your system is unique, and that you don't need to carry 6 spare krabs, harnesses, bits of elastic, lengths of rope and tape, auxiliary ascenders etc., since they are already incorporated into the system.

I was also worried about Winnie's disconcerting habit of falling off things at regular intervals, and hoped the rest of OUCC weren't like that. I needn't have worried; OUCC turned out to be as typical a collection of warped individuals as any caving club could boast of.

Since Skunk and I had done lots of SRT, I got the impression that we were regarded as supposedly being good at it. In my case however, pride came before a fall: I found that my ropewalking system that had worked almost perfectly for years in Yorkshire had been affected somehow by the journey to Spain. Where previously an ammo can on the end of the rope had provided ample tension for a good prusik getaway, I now needed a couple of heavies swingingon it. Despite cam modifications, stronger elastic etc., the situation did not improve. Switching to Winnie's homemade imitation Lewis ropewalkers did not help either, lowering my opinion of him still further.

The other problem was my brand new super compact shiny Goldlock rack, bought especially for the enormous pitches we were going to find. This turned out to be as controllable as Skunk's bowel habits. Attempts at modification resulted in 32ft per second per second abseils or alternatively stuffing the rope through by hand to get anywhere, so this was eventually discarded and I went back to my trusty figure of eight.

Having thus shattered my hoped for image of a competent SRT man, salt was rubbed in my wounds as the iexperienced sit-stand men nonchalantly climbed everything with ease, raining scorn and derision on ropewalking systems.

One slightly worrying aspect of OUCC's behaviour was the tendency of some members to drop things downs pitches. I noticed that these members were always careful not to go up last so they would always have somebody to aim at and never have to redescend to fetch anything. In one trip alone I found myself the ungrateful recipient of a rope, a krab, an ascender, a stinky, and last but not least, nearly a cubic metre of the lip of a pitch.

As for Skunk, he seemed to enjoy it more the worse it got. The more physically unpleasant, tiring and arduous the caving got, the better he liked it. As the rest of us grew tired of marathon trips day after day, Skunk stoically looked forward to each trip like a junkie waiting for his fix, never complaining as he held the rope for the ropewalking cripples, sometimes doing wet pitches several times to relight stinkies for poor unfortunates who had no piezo electric lighters on their carbides.

It was a great expedition, I look forward to the next one almost as much as Skunk.

SURVEYING

A COMPUTER GOES SURVEYING

1/ Introduction

Many people have quoted the use of a computer in the processing of cave surveying data (Refs. 1-4) but, despite the claims of Ellis, as far as I know only Wilcock has produced a program listing and this program did not include a loop misclosure routine. There are good reasons why a listing is of limited value:- there will be language incompatabilities between machines and most people with access to a computer will be able to write their own program. It is also possible that authors willnot want to admit in print that they have used someone else's expensive computing time for their own ends.

However, in this article I give a listing in BASIC(a widely used language with only minor differences between machines) and a flow chart(of sorts) which together should enable a surveyer to adapt this program for his specific requirements. I also hope that publishing this program could save a surveyer considerable time and effort. I told the Editor that I could write a programin a morning(after all, it's only a spherical polar/rectangular cartesian conversion, isn't it?). To date Ihave been working on it on and off for two months. Even so, the program presented is not completely optimised, takes a hefty chunk of memory(about 19K on our Research Machines 380Z microcomputer) and requires some thought when dealing with very complicated passage(eg loops on loops on loops), but it does work and starting with distance, bearing and inclination readings it will give the x, y and z coordinates of the survey station; the extended elevation data; the coordinates of the point projected onto any vertical plane; will close loops using an equal distribution of errors on each leg and will give the loop misclosure errors.

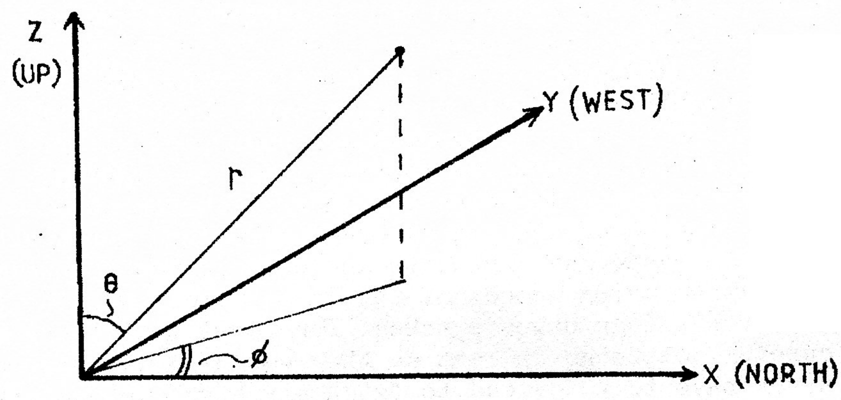
2/ Basic Methods

The standard method of cave surveying using a tape measure(to obtain distance), a compass(for bearings) and an inclinometer(for inclination) gives a form of Spherical Polar Coordinates. In fact

$D=r$ $B=\varphi$ $I=90-\vartheta$

D is the distance, B is the bearing and I is the inclination and r, ϑ and φ are the usual Spherical Polar coordinates(see Diagram 1)

DIAGRAM 1



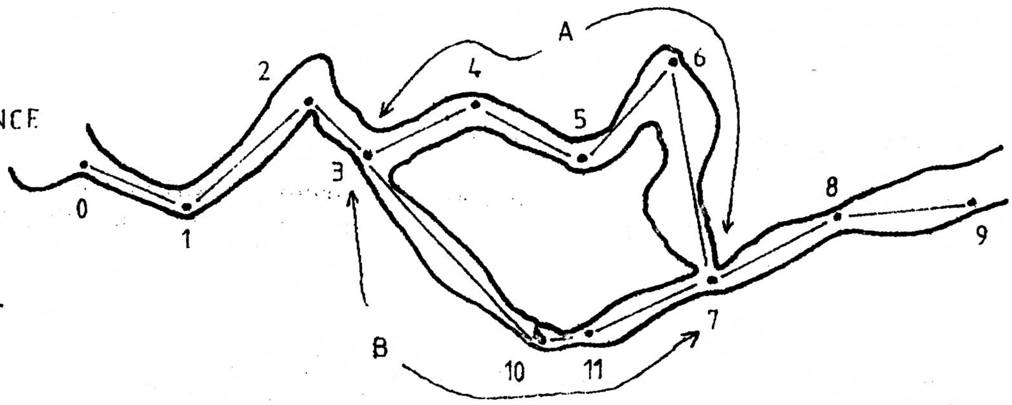
A little "A" level maths shows that the changes in x, y and z, Δx, Δy and Δz respectively between two stations whose readings are taken as D, B and I are

$\Delta x = D\cos I.\cos B$ $\Delta y = D\cos I.\sin B$ $\Delta z = D\sin I$

If we then assume that the entrance has coordinates (0,0,0), we can work out the coordinates of the first station by adding the first Δx, Δy and Δz to the coordinates of the entrance station. The second station's coordinates can be found by adding the second Δx, Δy and Δz to the coordinates of the first station. In this cumulative way we can determine the coordinates of stations further down the cave.

Consider a passage which forks and then rejoins itself as in Diagram 2:-

DIAGRAM 2



Using the techniques just described, we can find the coordinates of all the stations from 0 to 9. If we now restart from station 3 and this time survey around path B we again reach station 7, and since we know the coordinates of 3, we can deduce the coordinates of stations 10, 11 and 7. This gives two ways of finding the coordinates of 7:- surveying via path A or via path B.

Obviously station 7 is in the same place whichever way round the loop we survey and so we should hope that the coordinates obtained via the two paths are the same. Unfortunately, any survey is to some degree inaccurate and therefore we will get two values for the coordinates of station 7, either of which could be right, or more likely, wrong. There are several ways of correcting for this error (Refs. 4 and 5). We of course chose the simplest. Ellis (Ref 6) claims there to be little difference between any method - so why not chose the easiest?

In this method the distance between the two sets of coordinates representing point 7 is divided into N equal parts, where N is the total number of legs around the loop (in diagram 2 path A has 4 legs and path B has 3, making a total of 7.) If we call the size of one of these parts E, then we assume each leg is wrong by E, and hence add this on to all the readings.

Thus we assume that the coordinates of point 3 are correct but that the readings from 3 to 4 were wrong by E. Hence station 4 is shifted by an amount E. The readings from 4 to 5 were also wrong by E and thus station 5 is moved by 2E. One lot of E due to the error in the readings from 4 to 5 and another E because station 4 was also in error by E.

In this way station 4 is wrong by E, station 5 by 2E, station 6 by 3E and station 7 by 4E. Going round path B station 10 is out by E, station 11 by 2E and station 7 by 3E. In this way the two values for the coordinates for station 7 are averaged to give the corrected values.

All points past station 7 (ie. stations 8 onwards) have to be corrected by the same amount (ie. 4E if their coordinates were derived by surveying via path A or 3E if they were derived via path B).

To avoid having to tell the computer if the readings are forward or back bearings in this program the computer assumes that the higher the station number, the further into the cave the station is. The difference in station number between adjacent stations does not have to be one provided that the highest number is furthest down the cave.

Thus a problem arises in diagram 2. Readings taken from station 11 to station 7 are forward bearings, whereas since 7 is less than 11 the computer will think of them as back bearings.

Since the program closes the loops between specified stations, and does not close the loop onto a station with the same number, one station may have two numbers according to the path via which it is reached. For example, we could number station 7 as station 12 when surveying round path B. The computer will close the loop between stations 7 and 12 (see section 3d). It would therefore have been possible, but even more confusing, to label stations 3,10,11 and 12 in path B as 3,4,5 and 6 if desired.

Since the computer needs to remember the original coordinates of the stations to correct them, the coordinates of the stations on path A and path B have to be kept separate. This is done by storing the coordinates of the first path in the computer arrays with locations from 0 to 99, with the stations on the second path stored in locations 100 onwards.

3/ Detailed explanation of Program (c.f. flow chart)

The order in which the blocks are given follows the order in which the computer does them. The letter beside each block designates that block in the program listing.

Blocks

a) The arrays are initialised, subject to a maximum of a 100 points in the first branch of the loop and 150 in the second branch. The cave name and the number of stations in the first branch are entered, as are the coordinates and the number of the first station. These can be set to (0,0,0,0) at the entrance or to the previously derived figures if the branch is part way down the cave.

j) (The calculation subroutine.) For each set of readings (distance, bearing, and inclination) the starting station and the finishing station are specified as well as the recorded readings. When all the readings for one particular section of the cave have been entered (determined by the entered value of the total number of stations in the first branch) all the readings are printed out to allow any typing errors to be found and corrected. The incremental increases in X, Y and Z, the extended elevation coordinates and the total leg and plan lengths are calculated.

b) The required number of copies of the data is put in and the print subroutine is called.

k) The incremental coordinates are added to the coordinates of the previous station to obtain the coordinates of the next station. The results are printed out, rounded to one decimal place, along with the total surveyed leg length and plan length.

c) The program asks if there are any loops - Y (yes) going to block (d), N (no) going to block (g).

d) The first and last stations in the loop are entered (ie. 3 and 7 in diagram 2) along with the number of stations in the second branch (4 - 3,10,11 and 12). The station number of the first station in the second branch is entered and the program goes through the subroutines for calculation and printout.

e) The differences in the X, Y and Z positions of the final point are calculated as is the total error (called E in the program). The loop is then closed as described in section 2. The total correction E is added to all the points after the loop has closed since these have to be shifted down by this amount (ie. station 8 and onwards).

The printout routine is called twice to print the corrected data for the first and second legs (branches).

f) The total loop misclosure error (E) is printed as is the error expressed as a percentage of the total distance round the loop.

g) The required number of projections onto a vertical plane is entered. P1=0 going to block (i).

h) The angle of the plane is entered and the projected length, height, extended elevation and station numbers are printed. This enables projected elevations to be drawn.

i) All the data is loaded onto a cassette for fast retrieval and easy access for further processing.

(a)

```
10  CLEAR 300
20  DIMN(250),Y(250),Z(250),G(250)
30  DIMV(3,3),M(250),W(250),O(250)
40  DIMO(250),B(250),C(250),J(250)
50  DIMD(5),S(5),PR(250),PD(250)
60 PI=0 01745329252
70  INPUT"CAVE NAME",A$
80  INPUT"NO. OF STATIONS"IM
90  J=1:F=M-1
100  INPUT"STARTING CO-ORDS (E,Y,Z,EXT.EVN)",N(0),W(0),O(0),PD(0)
110  INPUT "NAME OF ENTRANCE STATION"JG(0)
120 L=1
130  GOSUB1270
```

(b)

```
140  INPUT"NO. OF COPIES"IJ3
150  GOSUB1630
```

(c)

```
160  PRINT"LOOP MISCLOSURE SUB ROUTINE"
170  INPUT"ANY LOOPS (Y/N)"IG0
180  IFG0<>"Y" THEN790
```

(d)

```
190  INPUT"STARTING STATION"IA1
200  FORI=0 TOM
210  IFG(I)=A1 THEN230
220  NEXTI
230 I1=I
240 N(101)=N(I1):W(101)=W(I1):O(101)=O(I1):PD(101)=PD(I1)
250  INPUT"LAST STATION"IA2
260  FORI=0 TOM
270  IFG(I)=A2 THEN290
280  NEXTI
290 I2=I
300 V(1,1)=N(I2):V(1,2)=W(I2):V(1,3)=O(I2)
310  INPUT"NO. OF STATIONS IN SECOND LEG"IN2
320 J=102:F=100+N2
330  PRINT"MISCLOSURE ERROR SECOND LEG"
340  INPUT"NAME OF ENTRANCE STATION"IG(101)
350 L=2
360  GOSUB1270
370  GOSUB1630
```

(e)

```
380 V(2,1)=N(F):V(2,2)=W(F):V(2,3)=O(F)
390 E=V(2,1)-V(1,1)
400 EY=V(2,2)-V(1,2)
410 EZ=V(2,3)-V(1,3)
420 E1= SQR(E*E+EY*EY+EZ*EZ)
430 N1=N2+I2-I1-1
440 N3=I2-I1:N4=N2-1
450 E1=E/N1
460 E3=EY/N1
470 E5=EZ/N1
480 N=0:N1=0
490  FORI=0 TOM-1
500  IFI<=I1 THEN560
510  IFI>I2 THEN530
520 N=N+1
530 N(I)=N(I)+N*E1
540 W(I)=W(I)+N*E3
550 O(I)=O(I)+N*E5
560  NEXTI
570  FORI=101 TO100+N2
580 N(I)=N(I)-N1*E1
590 W(I)=W(I)-N1*E3
600 O(I)=O(I)-N1*E5
610 N1=N1+1
620  NEXTI
630  PRINT"CORRECTED VALUES FOR FIRST LEG"
640 M=M-1:L=1
650 J=1 F=M-1
660  GOSUB1630
670  PRINT"CORRECTED VALUES FOR SECOND LEG"
680 J=102:F=100+N2:L=2
690  GOSUB1630
```

(f)

```
700  FOR I=J1+1 TO J2
710 Y1=N(I)-N(I-1):Y2=W(I)-W(I-1):Y3=O(I)-O(I-1)
720 D(3)=D(3)+ SQR(Y1*Y1+Y2*Y2+Y3*Y3)
730  NEXTI
740 [illegible]
750 [illegible]
760  PRINT"TOTAL ERROR ="E1"M"
770  PRINT"TOTAL LOOP LENGTH ="D(3)"M"
780  PRINT" ERROR ="D(5)"%"
```

(g)

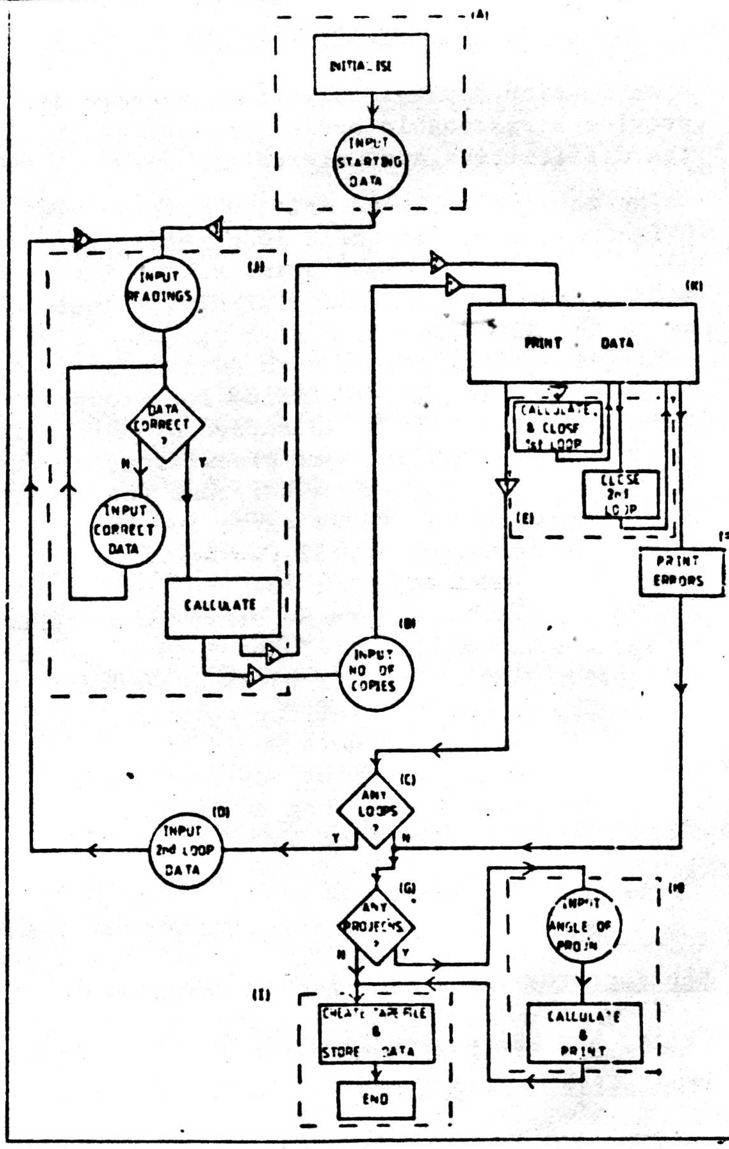
```
790  INPUT"NO. OF PROJECTIONS"IP1
800  IFP1=0 THEN1020
```

(h)

```
810  FORI=1 TOP1
820  INPUT"PROJECTION ON"IP0
830  PRINT"  STN.     PROJ.     VERT.     EXT.EVN"
840 [illegible]
850 [illegible]
860  GOSUB[illegible]
870 [illegible]
880  GOSUB[illegible]
890  GOSUB[illegible]
900  FORJ=J TOF
910 [illegible]
920 [illegible]
930 [illegible]
940 [illegible]
950  PRINTG(J): PRINT SPC(3): PRINTPR(J)
960  PRINT SPC(3): PRINTO(J)
970  PRINT SPC(3): PRINTPD(J)
980  NEXTJ
990  RETURN
1000  PRINT: PRINT: PRINT
1010  NEXTI
```

(i)

```
1020  FILES 0
1030  INPUT "OUTPUT FILENAME "IO$
1040  INPUT "IS CASSETTE RUNNING "IO$
1050 J=0:F=M
1060  FILES 3,O$
1070  GOSUB1130
1080 J=101:F=100+N2
1090  GOSUB1130
1100  FILES3
1110  PRINT"END OF FILE"
1120  END
1130  FOR I=J TO F
1140 N(I)= INT(N(I)*10+0.5)/10
1150 W(I)= INT(W(I)*10+0.5)/10
1160 O(I)= INT(O(I)*10+0.5)/10
1170 PR(I)= INT(PR(I)*10+0.5)/10
1180 PD(I)= INT(PD(I)*10+0.5)/10
1190  PRINT G(I)
1200  PRINT N(I)
1210  PRINT W(I)
1220  PRINT O(I)
1230  PRINT PR(I)
1240  PRINT # PD(I)
1250  NEXT I
1260  RETURN
```



(j)

```
1270  FORI=J TOF
1280  INPUT"STARTING STN. TO FINISHING STN.",G,0
1290 [illegible]
1300 [illegible]
1310  INPUT"READINGS (D,B-T)"IA(I),B(I),C(I)
1320  NEXTI
1330  FORI=J TOF
1340  PRINTI,A(I)B(I)C(I)
1350  NEXTI
1360  INPUT"ANY MISTAKES (Y OR N)"IJJ$
1370  IFJJ$="Y" THEN1390
1380  GOTO1450
1390  INPUT"WHICH"IPP
1400  PRINT"CORRECTED VALS. FOR PT."IPP" (D,B,T)"
1410  INPUTA(PP),B(PP),C(PP)
1420  INPUT"MORE (Y/N)"IJJ$
1430  IFJJ$="Y" THEN1390
1440  GOTO1330
1450  FORI=J TOF
1460 [illegible]
1470 [illegible]
1480 [illegible]
1490 [illegible]
1500 [illegible]
1510  GOTO1530
1520 [illegible]
1530 B=B*PI
1540 E(I)=D0 COS(T)
1550 [illegible]
1560 [illegible]
1570 [illegible]
1580 [illegible]
1590 [illegible]
1600 [illegible]
1610  NEXTI
1620  RETURN
```

(k)

```
1630  FORL=1 TOJ3
1640  PRINT: PRINT"        CAVE IS "IA$
1650  PRINT: PRINT: PRINT"   N        Y        Z"
1660  PRINT"  STA.
1670 [illegible]
1680  PRINT SPC(3)
1690  PRINTN(I)
1700  PRINT SPC(3)
1710  PRINTW(I)
1720  PRINT SPC(3)
1730  PRINTO(I)
1740  PRINT SPC(3)
1750  FORI=J TOF
1760  IFI=0 THEN1790
1770  IFI=101 THEN1810
1780 N(I)= INT((N(I-1)+N(I))*10+0.5)/10
1790 W(I)= INT((W(I-1)+W(I))*10+0.5)/10
1800 O(I)= INT((O(I-1)+O(I))*10+0.5)/10
1810  PRINT SPC(3)
1820  PRINTG(I)
1830  PRINT SPC(3)
1840  PRINTN(I)
1850  PRINT SPC(3)
1860  PRINTW(I)
1870  PRINT SPC(3)
1880  PRINTO(I)
1890  PRINT SPC(3)
1900  PRINTPD(I)
1910  NEXTI
1920  PRINT: PRINT
1930  PRINT"TOTAL LEG LENGTH IS",S(L),"M"
1940  PRINT: PRINT"TOTAL PLAN LENGTH IS ",S(L+2),"M"
1950  PRINT: PRINT: PRINT: PRINT
1960  NEXTL
1970  RETURN
```

PROGRAM LISTING & FLOWCHART

4/ Comments on writing the Program.

As mentioned previously, this program is published in the hope that it will provide a reasonable basis for adaptation. I therefore feel some comments on the difficulties encountered and possible extensions might be of value.

The main problems in writing this program were concerned with keeping the data from paths around a loop separate, whilst at the same time only including one calculation and one print subroutine. The essential problem here was in getting the starting and finishing values for the various 'I' loops correct - hence the abundance of J's, F's, I_1's, I_2's etc.

To keep the different path data separate I chose the apparently clumsy method of using one array, but fixing locations to which the data was restricted according to path. The advantage of this, is that all X coordinates say, which all require the same processing, are in one array. Hence only the location values need be changed rather than the array names.

There are many possible extensions to the program eg. subroutines to calculate bearing from origin, total passage lengths in any given direction etc. (See Ref 2 for more examples), but the routines in this program are sufficient to enable a basic survey to be drawn from the original data. Besides which the extentions are easily included into the program in much the same way as the projection routine (block h) is included in this version.

I purposely did not get the computer to plot the survey stations as I felt the resulting mess of dots would be confusing unless they were labelled or the skeletal line of site plot was done at the same time. I think it is probably a lot quicker and in the long run will produce a clearer survey if the surveyer plots his own survey from the list of coordinates.

Bibliography

Ellis, B.M. Surveying Caves. — Introductory work, fairly comprehensive.

Transactions of the C.R.G. (1970) 12,3 — Interesting vol., concerns some of the more academic points.

References

1 Hanna, K. 1964 'The Survey' Proc. U.B.S.S. 10, 285.

2 Gardner, J.W. 1971 Journal L.U.S.S. 1, 26-29. — Contains only an output listing, not as Ellis claims, a program.

3 O'Reilly, P.M. 1970 Trans.C.R.G. 12, 149-154. — Although the article claims a listing 'below', none appears.

4 Wilcock, J.D. 1970 Trans.C.R.G. 12, 211-219. — A program in Algol 60 is listed.

5 Irwin and Stener. 1975 Trans. BCRA. 2, 4.

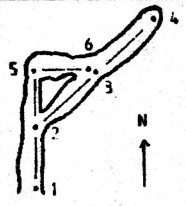
6 Ellis, B.M. 1966 Journal Shepton Mallet C.C. 4, 2 10-20.

VARIABLE LISTING

LINE	VARIABLE	COMMENTS
20	X(I),Y(I),Z(I)	The incremental increase in x,y,z between two survey stations
	G(I)	Survey station number

30	V(I,J)	The J'th coordinate of the uncorrected end of a loop going round path I. e.g. V(1,1) = x coord. of sta. at end of 1st path V(2,1) = x coord. of sta. at end of 2nd path V(1,2) = y coord. of sta. at end of 1st path etc.
30	M(I),W(I),O(I)	The actual x,y,z coordinates respectively of the I'th survey station. i.e. $M(I)= \Sigma X(J)$, $W(I) = \Sigma Y(J)$ etc.
40	A(I),B(I),C(I)	The distance,bearing and inclination readings respectively,between two stations - neeeded to enable data corrections before calculation.
40	U(I)	A flag - = 1 for forward bearings = 0 for back bearings enabling the computer to tell which it is.
50	D(1)	The total leg length along 1st path $D(1) = \Sigma A(I)$
	S(1)	Total plan length along 1st path $S(1)=\Sigma A(I)*Cos(C(I))$
	PR(I)	Extended elevation coord. of station I
	PJ(I)	The plan length, from the entrance station along the designated vertical plane of the I'th survey station.Used in projected elevations.
60	PI	$= \pi/180$ - a conversion factor from degrees to rads.
70	A$	The name of the cave.
80	N	The total no. of stations in the part of the cave. which is being calculated.
90	J,F	Indices- J is the first and F the last values of I for the various loops.
120	L6	A flag - = 1 for the 1st path round a loop. L6=2 on the second path.Needed to ensure that plan and leg lengths for each path remain separate.
140	J3	The number of copies of the data to be printed.
170	G$	= Y if there are loops to be closed or N if none.
190	A1	The no. of the 1st station in the 1st path of loop.
230	I1	I value " " " " " " " " " "
	A2,I2	As for A1 or I1 but for last station in loop.
310	N2	The no. of stations in the 2nd path round a loop.
390	EX	The difference in the two x coordinates of the last station in a loop as obtained by surveying round the two paths in the loop.
	EY,EZ	Same as for EX but y and z differences.
420	ET	Total distance between the two sets of coordinates of the last station in a loop.
430	N3	Total no. of legs round the complete loop. (= 7 in diagram 2)
480	H	A counter to add the appropriate correction to the station coordinates.
	H1	Same as H, but for the stations on the 2nd path.
640	H4	A flag to bypass the coord. summing routine.
710	Y1,Y2,Y3	X,y,z differences between adjacent stations on 1st path . Used in percentage error calculation.
720	D(3)	Plan length along 1st path round loop.
740	D(4)	Plan length round complete loop.
750	D(5)	Percentage error of misclosure.
790	P1	Required number of vertical projections.
820	PA	Required angle of projection
850	K3,K4	First and last I values for use in projection calculation routine.
1020 - 1260		System for storing data on cassette.As this differs from one machine to another, explanation is of limited value.
1280	R,S	Survey station numbers.Bearings are taken <u>from</u> station R <u>to</u> station S.

```
RUN
CAVE NAME? EXAMPLE
NO. OF STATIONS? 4
STARTING CO-ORDS (X,Y,Z,EXT.EVN)? 0,0,0,0
NAME OF ENTRANCE STATION? 1
STARTING STA. TO FINISHING STA.? 1,2
READINGS (D,B,I)? 1,0,0
STARTING STA. TO FINISHING STA.? 3,2
READINGS (D,B,I)? 14.142,225,0
STARTING STA. TO FINISHING STA.? 3,4
READINGS (D,B,I)? 1.4142,45,-5
 1  1  0  0
 2  14.142  225  0
 3  1.4142  45 -5
ANY MISTAKES (Y OR N)? Y
WHICH? 2
CORRECTED VALS. FOR PT. 2  (D,B,I)
? 1.4142,225,0
MORE (Y/N)? N
 1  1  0  0
 2  1.4142  225  0
 3  1.4142  45 -5
ANY MISTAKES (Y OR N)? N
NO. OF COPIES? 1

        CAVE IS EXAMPLE


   STA.    X     Y     Z        EXT. EVN
   1       0     0     0
   2       1     0     0        1
   3       2     1     0        2.4142
   4       3     2     -.1       3.82302

 TOTAL LEG LENGTH IS 3.8284 M

 TOTAL PLAN LENGTH IS  3.82302 M


 LOOP MISCLOSURE SUB-ROUTINE
 ANY LOOPS (Y/N)?  Y
 STARTING STATION? 2
 LAST STATION? 3
 NO. OF STATIONS IN SECOND LEG? 3
 MISCLOSURE ERROR SECOND LEG
 NAME OF ENTRANCE STATION? 2
 STARTING STA. TO FINISHING STA.? 2,5
 READINGS (D,B,I)? 1.0,0,0
 STARTING STA. TO FINISHING STA.? 5,6
 READINGS (D,B,I)? 0.9,90,2
  102  1  0  0
  103  .9  90  2
 ANY MISTAKES (Y OR N)? N

        CAVE IS EXAMPLE


    STA.    X     Y     Z       EXT. EVN
    2       1     0     0
    5       2     0     0       2
    6       2     .9     0       2.89945

  TOTAL LEG LENGTH IS 1.9 M

  TOTAL PLAN LENGTH IS  1.89945 M
```



EXAMPLE CAVE 'SURVEYED' IN THIS OUTPUT

```
CORRECTED VALUES FOR FIRST LEG

     CAVE IS EXAMPLE


  STA.    X     Y          Z                   EXT. EVN
  1       0     0          0
  2       1     0          0         1
  3       2     .966667    0                   2.4142
  4       3     1.96667    -.1                  3.82302

TOTAL LEG LENGTH IS 3.8284 M

TOTAL PLAN LENGTH IS  3.82302 M


CORRECTED VALUES FOR SECOND LEG

     CAVE IS EXAMPLE


  STA.    X     Y          Z                   EXT. EVN
  2       1     0          0
  5       2     .0333333        0          2
  6       2     .966667        0         2.89945

TOTAL LEG LENGTH IS 1.9 M

TOTAL PLAN LENGTH IS  1.89945 M


TOTAL ERROR = .1 M
TOTAL LOOP LENGTH = 3.29084 M
  ERROR = 3.03874 %
NO. OF PROJECTIONS? 1
PROJECTION ON? 45
  STA.      PROJ.      VERT.        EXT. EVN
 1       0      0     0
 2       .7      0      1
 3       2.1      0      2.4
 4       3.5      -.1      3.8
 2       .7      0      1
 5       1.4      0      2
 6       2.1      0      2.9


OUTPUT FILENAME ? EXAMPLE
IS CASSETTE RUNNING ? Y
END OF FILE

>READY
```

SURVEY STATISTICS

(All figures in metres)	Xitu	Cantu Hombre	Osu	Madre
Approx. altitude	1680	1120	1230	880
Plan length	649	270	1765	991
Surveyed leg length	908	482	1904	1077
Surveyed depth	-354	-195	-119	-3,51

All loops surveyed were found to be within the error limits corresponding to the claimed survey grade: BCRA Grade 5