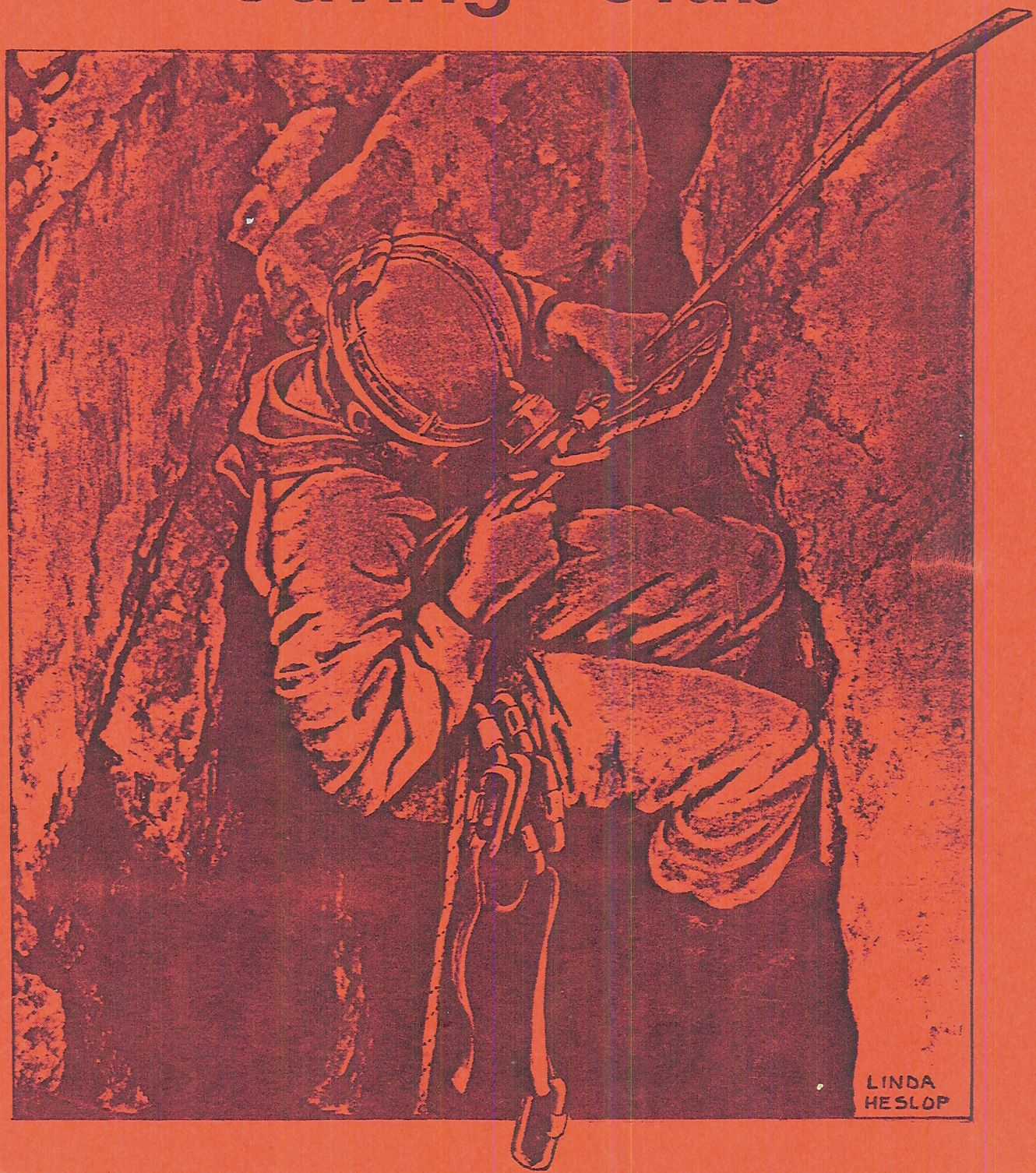
Imperial College Caving Club



Newsletter No.17

IMPERIAL COLLEGE CAVING CLUB

IMPERIAL COLLEGE UNION
PRINCE CONSORT ROAD
LONDON SW7 2BB

NEWSLETTER No. 17 SPRING 1993

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Weekly meetings are held on Tuesday evenings at about 7:30 pm in Southside Upper Lounge. Messages can be left with the Students' Union (tel 071-589-5111).

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INSIDE:

.oo.

COVER:

In Close to the Edge of the Road, Vancouver Island, by Linda Heslop. From Nylon Highway (USA) 34 (1991).

Tim's Bit

It's that time of year again when Imperial College Cavers, young, old, active, inactive, mad, only slightly mad, fat (well developed relaxed muscle) and thin (bodily deprived) , get together for the annual bun fight. A time when old lags can excel in dragging up dirt from the past on each other, and bore the youngsters of the club mindless with stories of daring deeds and gross stupidity.

Therefore I will now give my brief review of the year so far. Having been violently forced to take on the role of the club's president at the last Dinner Meet, because there was nobody else around at the time, I screamed loudly for assistance. It came in the shape of Pete H who manfully took on the job of running the club's finances while Jim was away for a term. I am very grateful for his guidance and hard work. Alva deserves a mention here as well but I can't think what for!

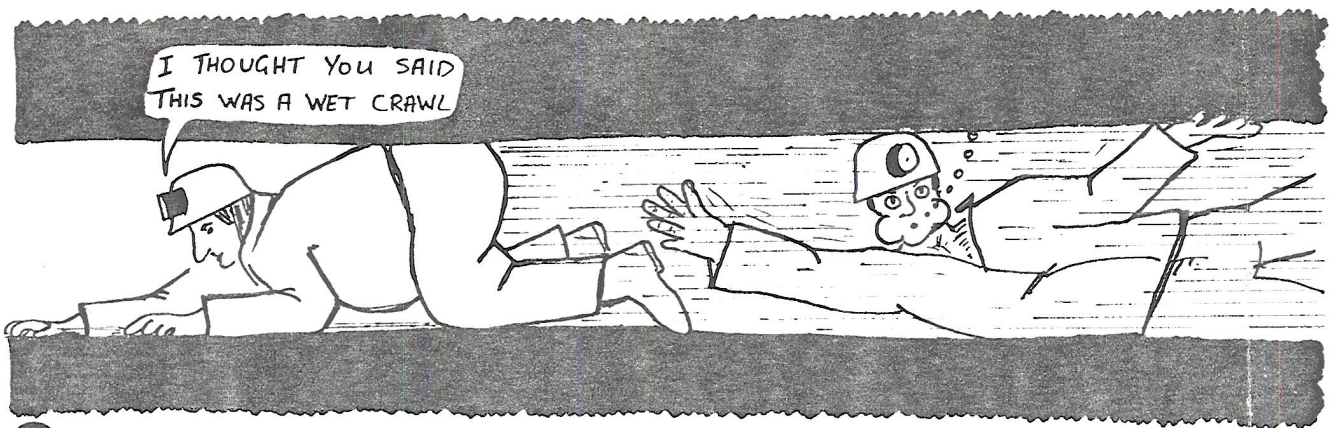
The Christmas Tour was one that those present will probably never forget, especially Pete. It was the Tour of the Flying Minibus. I still don't know exactly how it happened (I wasn't there!), and I don't think I really want to. This event and its repercussions didn't make us too popular with the Union, and with some members of the RCC. But never mind, accidents will happen - especially to caving clubs!

With Jim back at Christmas the club went "from strength to strength", with new keen members appearing from all over the place. We even formed an executive committee. A term of fortnightly trips to Yorkshire ended with the highlight of my caving career so far: the Easter tour to Fermanagh, Ireland. Despite poor/foul weather a fair amount of caving was done in the areas of Fermanagh, Cavan and Sligo, although unfortunately Reyfad and Noons were left untouched. Many thanks again to Pete who, despite doing all the hard work of organising the trip, was unfortunately unable to go himself. Thanks also to Tim P and Rob K for their work and guidance during the trip ..... and for forcing me to drink ten pints of Guiness in one evening. As requested by the Union the minibus was returned undamaged, (which makes a change). The club's remaining big event for this academic year is going to be the Summer tour to the Vercors in July. ALL WELCOME!!!

Well enough of this inane drivel. Another big thanks to the committee who have done all the work this year (most of which I should have done): Jim E, Rich M and Rich A - and all those previously mentioned.

Cheers,

Tim Rogers, The Fat Controller

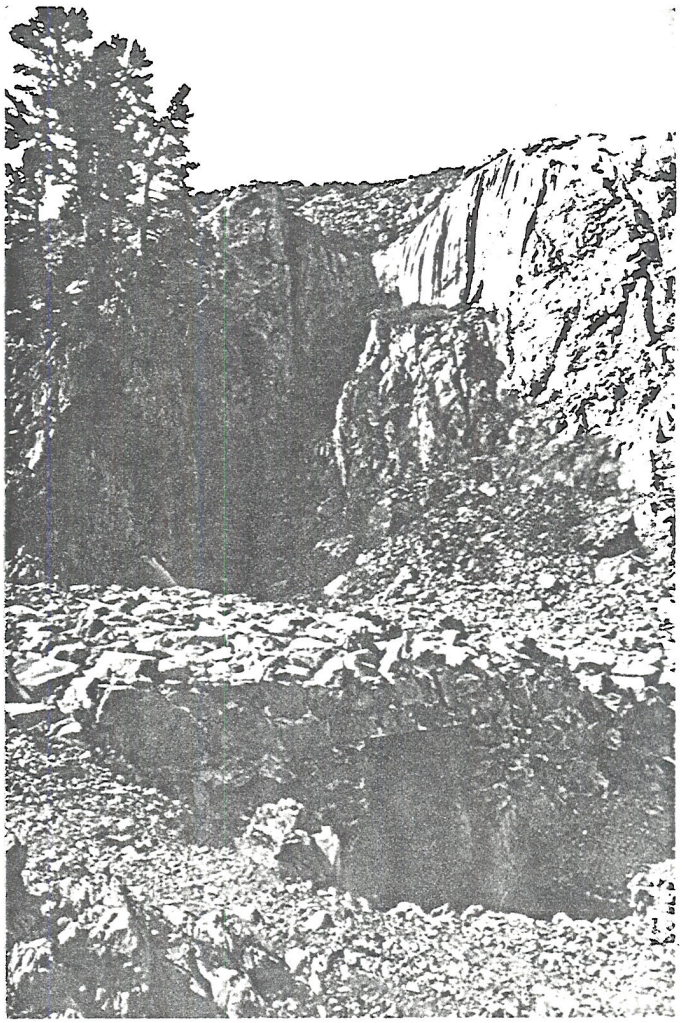


Deep in the South of France

Last summer's IC^3 tour was to the Basque region straddling the French/Spanish border in the Pyrenees, some 50km south-west of Pau. This is an area of high altitude (2000m) limestone where "vast barren fields of lapies extend as far as the eye can see, while jagged dolines, depressions, dry valleys, shafts and caves occur in profusion" (1). The principal cave system of the area is the Reseau de la Pierre Saint-Martin (PSM) and the trip's main objective was the traverse of this system.

The PSM

The first entrance to be found was the Lepineux shaft in 1950. This 320m deep shaft was descended in the summer of 1951 with the aid of a winch (powered by a cyclist) and a parachute harness. In 1952 exploration of the galleries leading off at the bottom began but was interupted by the death of Marcel Loubens, killed by a fall in the shaft when the attachment of the safety cable to his harness broke.



The 320m Lepineux shaft - now capped by a blockhouse.

Exploration was started again in 1953 with improved equipment including a petrol winch, and reached the massive Salle de la Verna - currently the World's 5th largest underground chamber with a volume of 45 300m^3. In 1960 the French electricity company EDF drove a tunnel from the surface above the small town of Saint Engrace into the Salle de la Verna with the intention of tapping the underground river to provide hydro-electric power. On the way the tunnel broke into the Grotte d'Arphina, a cave with no natural entrance but since explored for over 20km. The EDF hydro-electric project was never completed but the tunnel now provides a convenient bottom exit for caving trips.

The Tete Sauvage, a top entrance to the system was discovered in 1965 and was joined to the rest a year later to create a new world depth record of -1171m. The connection between the two caverns is the Grand Canyon and includes the dramatic Tunnel de Vent with its deep canal and constantly howling wind. Another three entrances have been discovered: the highest, M31, in 1982. There have also been extensions below the Verna - mostly a miserable series of meandres and shafts, in contrast with the large and spectacular passages above. The total depth is currently 1342m (10th deepest in 1992).

The Traverse

Of all the top entrances the Tete Sauvage is the least difficult, and the traverse is usually done from here, down the Grand Canyon to the Salle de la Verna, and then out the EDF tunnel. We undertook a couple of familiarisation trips beforehand: the first to rig the Tete Sauvage, and the other to enter the EDF and go as far upstream as the Tunnel de Vent with the boat. The system was then fully rigged ready for everyone to do the complete traverse in four groups.

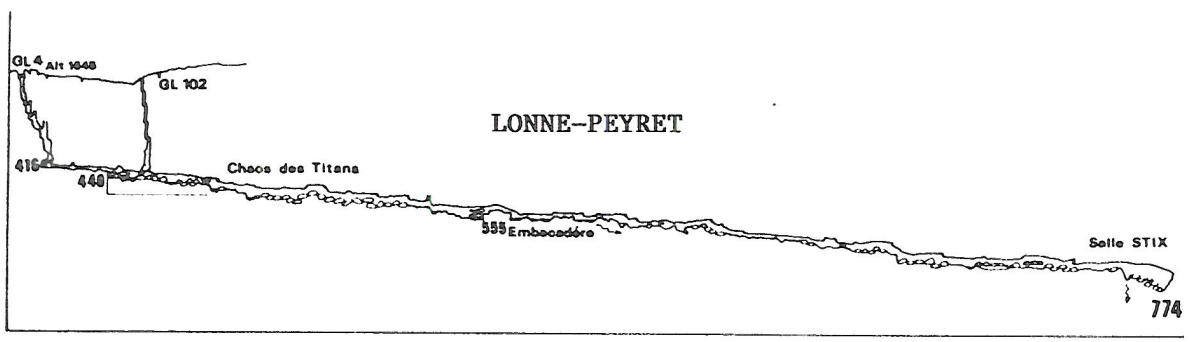
The Tete Sauvage is entered by a 3m high wooden chimney that keeps out snow, and this entrance gives access to a series of pitches that lead down to the Salle Cosyns at -384m. There are 'parrot poles' (single lengths of scaffold pole with rungs protruding from both sides) down to -180m, but these pitches still need to be rigged for SRT, and the whole of the Tete Sauvage requires 400m of rope. In addition to this, it is necessary to take 3 ropes of 20m for short pitches further into the system (plus the boat if it hasn't already been taken in from the Verna). From the Salle Cosyns, the way on is described very accurately in the guidebook (2) and involves traversing magnificent stream canyons and fossil galleries - sometimes climbing, sometimes wading, but never crawling! It is essential to wear either pontonierres or a thin wetsuit long-john under your oversuit until just after the Tunnel de Vent, after which there are no more immersions. The Tunnel de Vent is the crux of the traverse and is a dramatic spot with an icy wind howling through the airspace between the canal and the roof. It is necessary to set up a towing system to retrieve the boat for each party to pass along the tunnel.

After the Tunnel de Vent the large passage continues and the only difficulty is knowing which side of the passage to be on. Be prepared to wander around in circles, by mistake, at the foot of the Lepineux shaft. The book description is again excellent and there is red reflective tape to waymark certain sections. You finally break out into the vast chamber of the Salle de la Verna, and peer out into the gloom, knowing that the other wall is 250m (a quarter of a kilometer!) away. Exit is via the 700m long EDF tunnel. With the Tete Sauvage rigged and a knowledge of the system from the Tunnel de Vent to the Verna, a typical time for the traverse is 10 hours. The sting in the tail is the long trudge down to Saint Engrace, but if you time it right the bar in the village will still be open.

Other Caves

Two other cave systems were also bottomed

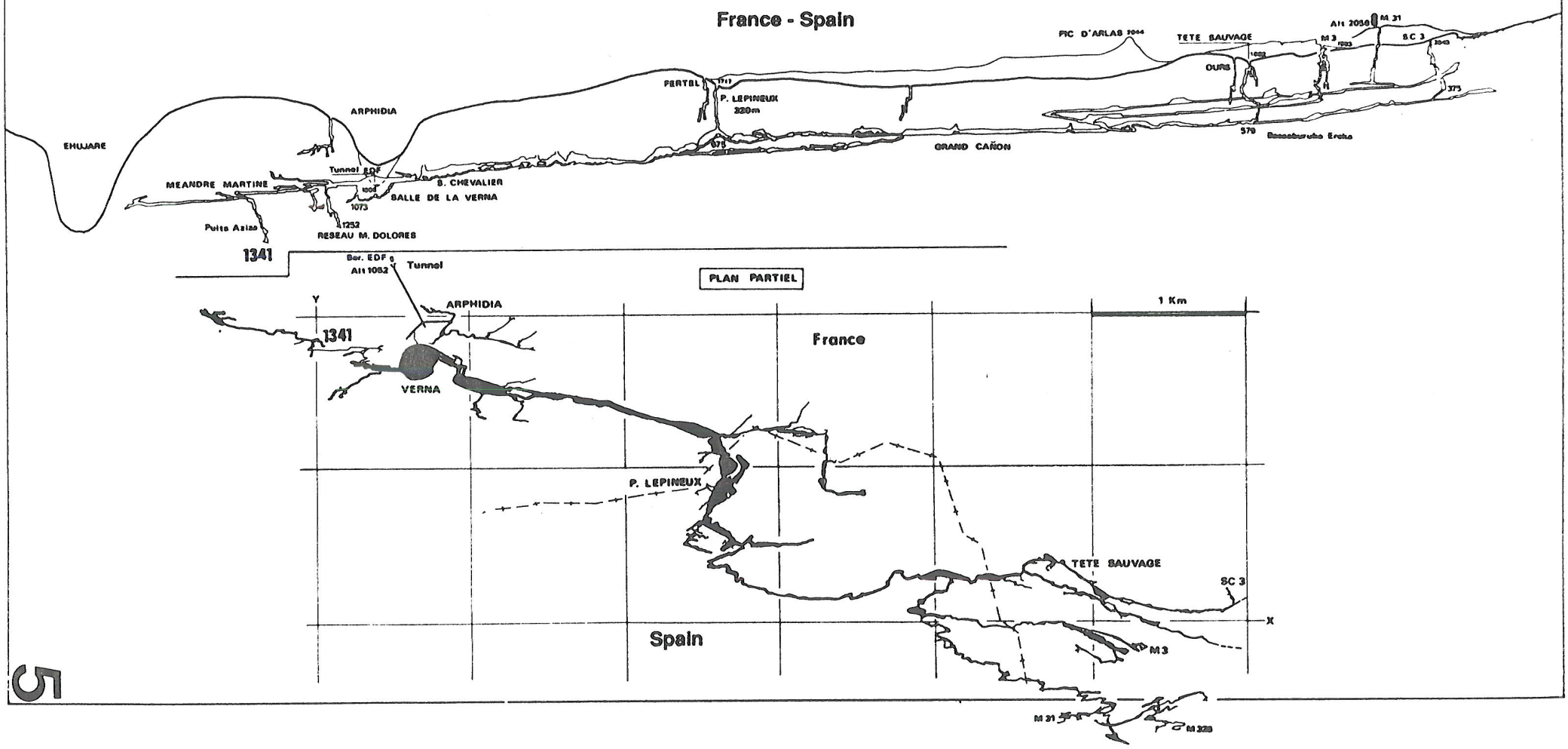
Lonne-Peyret is part of the reseau des Arres Planeres which runs parallel to the PSM. It is as yet unconnected but is part of the same hydrological system and the bottom is very close to the grotte d'Arphina which leads off from the EDF tunnel. Lonne-Peyret was mostly explored in 1970 when it was the first deep (717m) European cave to be descended exclusively by SRT.



RESEAU DE LA PIERRE SAINT-MARTIN

ARETTE-PYR. ATL.

France - Spain



The **Gouffre du Couey Lotge** is in the middle of a lapies field near the road to the Arette ski lifts. It was discovered in 1957 but it wasn't until 1975 that a team reached the terminal sump at -625m.

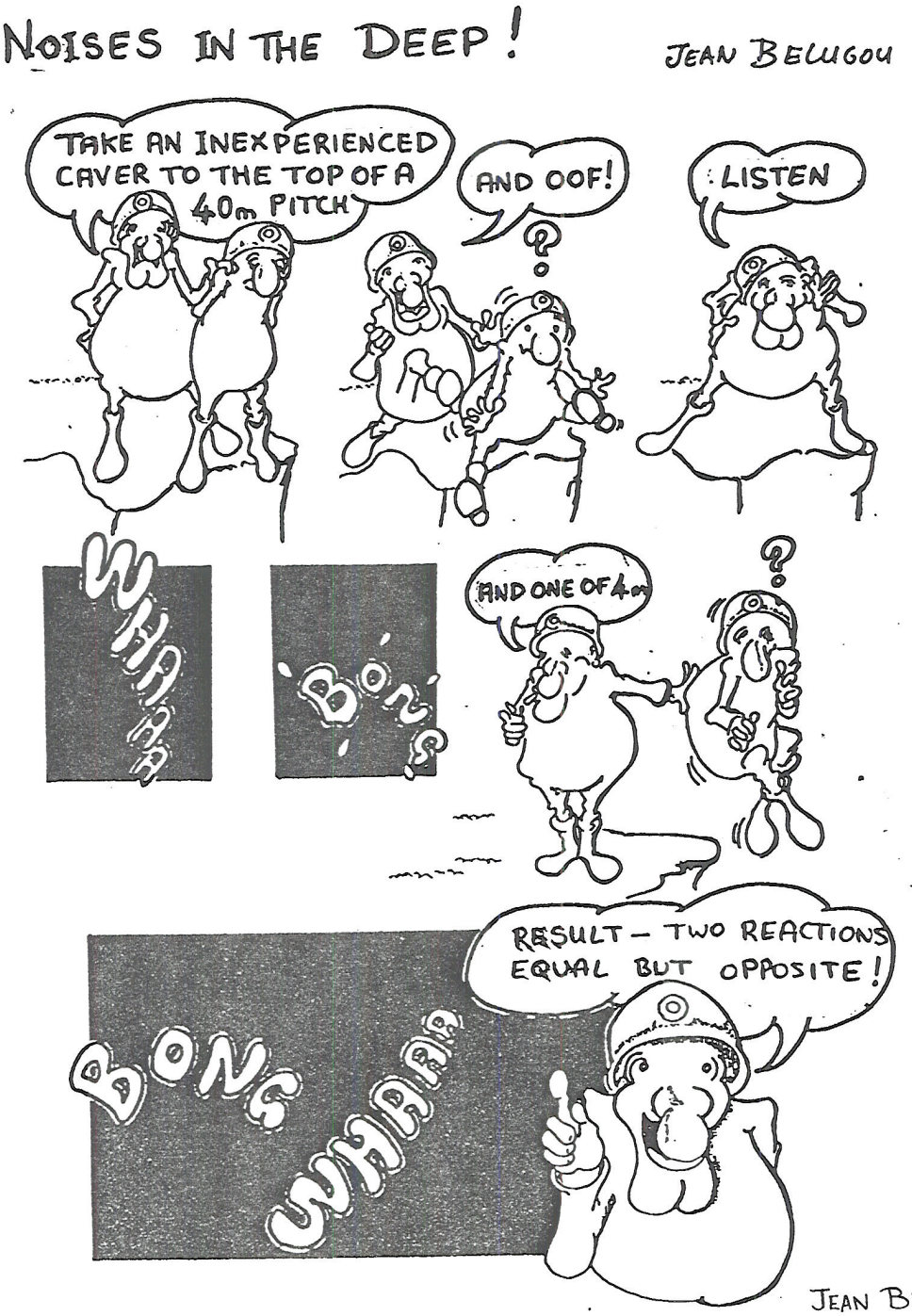
There was also a short trip down the extremely arduous **BT6 (gouffre de Bracas de Thurugne 6)** until the first serious constriction, whereupon we retreated. There was also some exhilarating canyoning and climbing.

From reports by **James Evans & Harry Lock**

References:

(1) J Middleton & A Waltham
"The Underground Atlas", Hale 1986

(2) M Douat, JF Pernette & S Puisais
"Speleo-Sportive 3 - A la Pierre St. Martin", Edisud 1985



FROM "SPELUNCA"

JEAN BELUGOU – DIED ON 5TH DECEMBER 1992 IN THE GOUFFRE DU PETIT SAINT-CASSIEN AT -250m.

Belgium '92 - The Trou Story

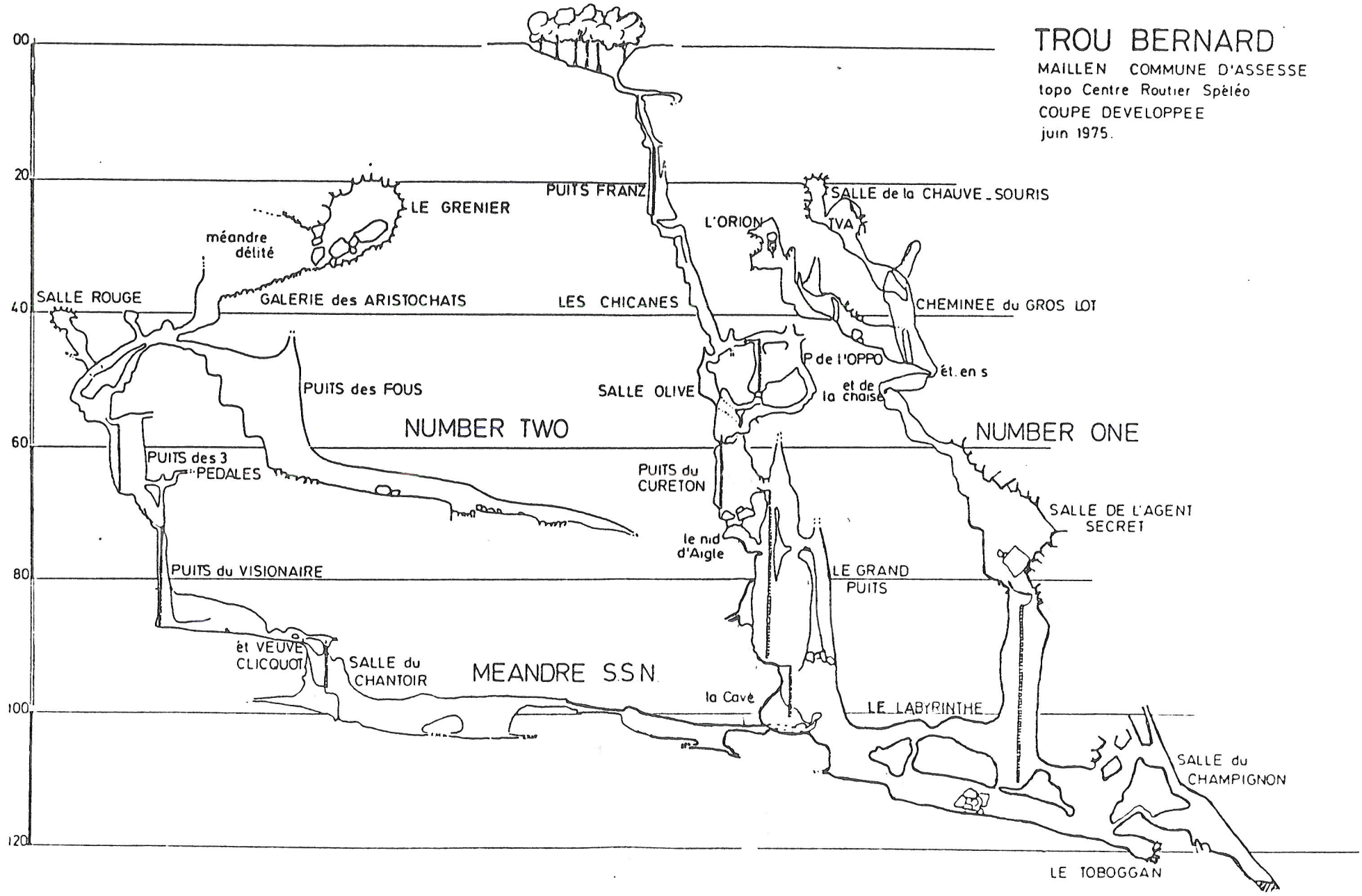
A caving/climbing visit to the Low Countries

Chris and myself went over to belgium a couple of weeks after the end of the PSM trip. The main aim was to attend the European Caving Conference, and maybe to get some caving in as well!

We took the overnight ferry from Ramsgate to Dunkerque, then drove to a motorway services just short of Brussels where we camped. The next morning we drove over to the area between the towns of Namur and Dinart where, after a little difficulty, we located the entrance to the Trou Bernard. The Trou Bernard is Belgium's deepest at 225m and consists of about seven pitches. All the main pitches are equiiped with permanent anchors to clip or tie into directly. The rock throughout is well polished and the whole cave is essentially dry, although Chris could remember having to dam up the surface stream when he first visited the cave in 1980. The way through Le Labyrinthe is fairly straightforward, but beyond the No. 1 Aven we found it necessary to rig two 5m lengths to allow us to reach the sump chamber. Worth doing as a "tick" (!)..... but otherwise rather uninteresting. (See survey). We used the Crewe Climbing and Potholing Club Journal Vol.2 for a guide to the area although at the conference the next day I bought a "Guide Speleo de la Province de Namur" which is available for borrowing. We did no other caving in Belgium but there's definitely enough there to warrant another visit, including some "river caves". It would be possible to have a club weekend in Belgium, maybe even a short Christmas or Easter tour since it's very conveniently placed for us as a London-based club.

After a good night in a well-eqipped campsite by the Meuse at Mont Godinne, we headed north to the Caving Conference at Helecine. For a full account of that see Speleoscene No.6 p.11. This was certainly a very well organised affair in an excellent venue. Indeed one could n't help feeling that it was rather too well organised, especially for us who only wanted to visit for one day (we had to pay the full four day conference fee!!). There did seem to be an absence of grizzled lean cavers (all probably on expedition or pushing local caves) and a preponderance of caving administrators instead. The lectures tended towards the scientific rather than the sporting, but there was an SRT race etc. Frank Facja from Slovenia was on hand to distribute slibovitch from his nation's stand, as if the massive range of Belgian beers wasn't sufficient. In the evening Simon Seward and Gordon Graham arrived from Groningen, eager to show us the delights of climbing at Freyr. So, the next day we headed back south and stayed at Freyr for two days' climbing. Lots of exposed climbing on highly polished limestone using fixed bolts ("clip and go"), but not much "pushing the boat out" was done, although both Gordon and Chris notched up flying hours". And the Chamonix bar constantly beckoned.

We rounded off the trip by going back to Groningen for some "tapping off" with tall Dutch girls and to discover the fabled pastime of "on-on" (but that's another story.....). On


TROU BERNARD
MAILLEN COMMUNE D'ASSESSE
topo Centre Routier Spéléo
COUPE DEVELOPPEE
juin 1975.
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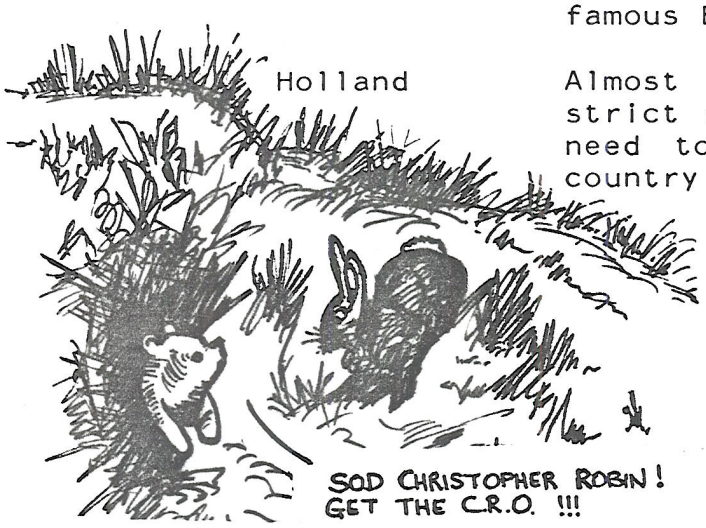
PUITS FRANZ
LE GRENIER
méandre délité
SALLE ROUGE
GALERIE des ARISTOCHATS
LES CHICANES
L'ORION
SALLE de la CHAUVE-SOURIS
TVA
CHEMINEE du GROS LOT
P de l'OPPO
et de la chaise
ét. en s
PUITS des FOUS
SALLE OLIVE
NUMBER TWO
NUMBER ONE
PUITS des 3 PEDALES
PUITS du CURETON
SALLE DE L'AGENT SECRET
le nid d'Aigle
LE GRAND PUITS
PUITS du VISIONAIRE
ét VEUVE CLICQUOT
SALLE du CHANTOIR
MEANDRE S.S.N.
la Cave
LE LABYRINTHE
SALLE du CHAMPIGNON
LE TOBOGGAN

returning from the Netherlands (we stopped for afternoon tea with Malcolm in Den Haag), Chris, myself and the car were searched by customs both sides of The Channel. Luckily they didn't check inside the car tyres (either that or the dog had a cold!).

Summary: Belgium — A few caves, lots of great beer, but I can still name only three famous Belgians.

Holland — Almost no caves, certainly no strict moral codes, and a definite need to improve road markings at country junctions.

Harry Lock



Shock Treatment !

When World War 2 ended, the general scramble by the allies to sieze Nazi documents turned up some really bizarre if sickening material. Amongst that obtained from Himmler's secret cave at Hallein (a speleological connection already) was data relating to experiments at Dachau conducted on humans with a view to understanding hypothermia. In experiments to re-warm intensely cold people, male subjects were cooled by immersion in water at 4-9°C (pretty cold) and then "animal warmth" was applied in the form of naked female POWs from the womens' camp.

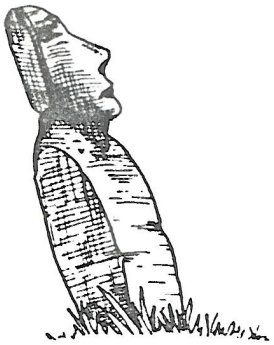
It is documented that although many died, a few of the hypothermic victims managed to huddle close and survived, while four victims recovered very rapidly and managed intercourse!

Is this the breakthrough all exposure-stricken cavers have been waiting for?

From: Report by Maj. L Alexander. Combined Intelligence Objectives Sub-Committee, G-2 Division SHAEF APO.413.

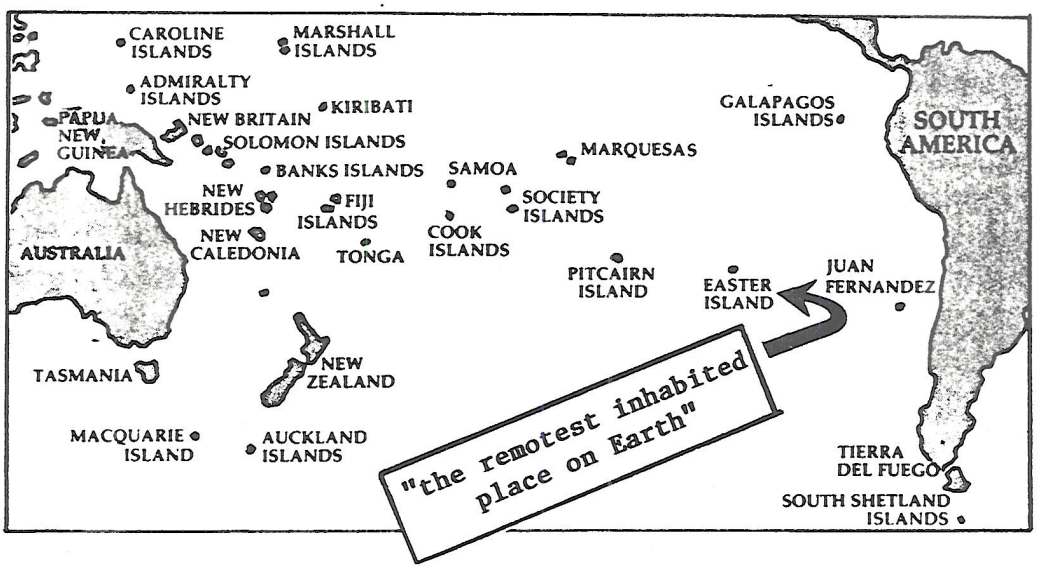
CORRECTION

In the last edition of the Newsletter (No.16 pp24-25) we listed the **1970 British Karst Research Expedition to the Himalayas** among the summary of **ICCC Tours and Expeditions.** This is incorrect. Of the eight cavers on this expedition five were either ICCC or recently graduated ex ICCC members, two were UCLSS and one was currently at Edinburgh University (possibly an ex-UCLSS). However as may be surmised from its name, the expedition was essentially independent of any one particular caving club, being rather a collection of individuals - albeit a group who had all caved together as students of IC and UCL.



The Caves of Easter Island

In the summer of 1992 I was lucky enough to participate in a research cruise in the south east pacific finishing up on the Chilean owned Easter Island in late July. Easter Island (Isla de Pascua) is the remotest inhabited place on Earth, being 5½ hours by plane from Santiago in Chile, and 7 hours from Tahiti. As well as the famous moais (stone heads) and other antiquities, there are also lots and lots of caves. Geologically the island is relatively young, being formed essentially from three volcanoes, the earliest dating from 3Ma. The last volcanic activity on the Island was about 10,000 years ago. It is in the lava of these volcanoes that the caves are found as lava tubes or gas vents.



A French expedition in 1934 (1) found that some of the many "grottoes" had been made habitable with wooden platforms built in them for beds. The party was not sure whether these residences were permanent homes or just temporary shelters. At the time some of the islanders were still living as "cave-dwellers". They also found that many caves were being used as family mausoleums.

The most well known expedition to Easter Island is that of Thor Heyerdahl in 1955-56 (2). A major part of the group's time on the island was spent hunting for and exploring caves:

> "On the first day we were in and out of dark caves from morning till night. Some were quite open, so that we could bend down and walk in. Others were carefully blocked up with stones, so that only a little rectangular opening was left through which we could crawl in on all fours. But most of them were mere rat-holes, into which we could neither walk nor crawl, but had to push our legs with stiff knees and keep our arms outstretched over our heads while wriggling our bodies like snakes down a long and horribly narrow shaft."

Sound familiar?

One of the speleological "highlights" of Heyerdahls' visit to the island was a trip down Ana O Keke (Cave of the Sun's Inclination), now also known as the Cave of the White Virgins. This holy place is where the islanders used to send selected young girls to be confined until their skins became pale and white due to lack of sunlight. Unfortunately, when some slaves returned to the island from Peru, they brought with them small pox. The resulting epidemic wiped out most of the people on the island. In their cave the girls were not affected, however as nobody went to feed them, they soon starved to death. Their skeletons were still there in 1955.Heyerdahl's trip down the cave was led by the local priest:

> "Father Sebastian pointed to a small hole in the back wall and said that if we crawled in there we could get four hundred yards further into the rock. But it was the worst trip he had ever made, and he would never do it again. Halfway in, the passage for a long stretch was so narrow that it was just possible for a man to force his way through, and inside teeth and remnants of human bones were lying about as in a burial cave."

So, armed with these stories, a map, and my trusty Petzl Zoom, I managed to persuade my german colleagues to let me spend some time away from the white sand beach with its palm trees and warm water.

The first speleological extravaganza was a 150m through trip in a section of lava tube at Ana Tepu. A group of eight very trusting souls were led through the entrance shielded in palm trees, and into a large passage of nice shiny lava. An old path seemed to go in about 20m: perhaps it was once a "show cave". The chosen exit was a hole in the roof beneath which a convenient, but highly unstable, pile of boulders had been constructed. Of course, when the last man out (yours truly) climbed up the pile it partially collapsed and a stylish "slug technique" had to be utilised. After this the others decided that lying on the beach was the only activity they would persue from then on.

The next day, while the others were working (collecting rocks in the sunshine), I attempted to find the Cave of the White Virgins, on Poike Peninsular. The 300m, near vertical cliff was, to say the least, dodgy. One slip and it would have been swimming time, after a bit of high diving. Having spent an hour or so clinging to this cliff, trying to find the entrance, I gave up, partly due to the fear of dying so far from home.

Later that day however I did make a successful solo descent of another section of Ana Tepu. The only trouble was that after going in fifty feet, I reached water. Not wanting to get my walking boots wet (my only footwear), off they came. So, there I was, caving in bare feet, paddling through unknown waters carefully checking any emerging boulders for scorpions or other nasties. After about another 150 feet the water was at knee level. It was bottle out time. The passage had an almost perfectly rectangular cross-section, 20-30 feet wide and 10-15 feet high. And it could be seen carrying on in a similar manner as far as my Zoom would penetrate. There were also some small lava stals. Back on the surface, the other end of the tube was found about 500m away in a jungle filled depression.

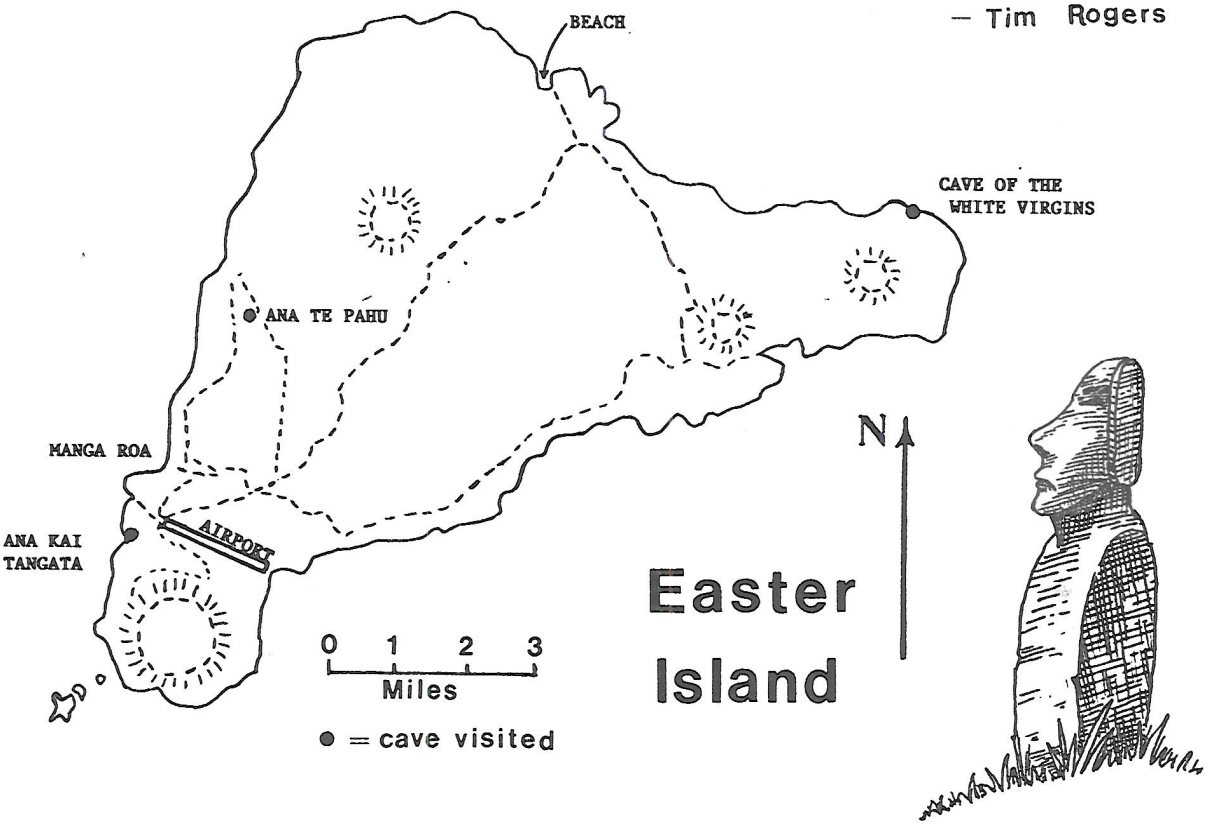
During the rest of my stay on Easter Island I managed to enter several large sea caves, after highly dubious climbs and dodging big waves. One such a sea cave is Ana Kai Tangata, situated close to the airport.

My time spent on Easter Island was great fun, and very interesting archaeologically, geologically and culturally. While there are no massive cave systems to explore, the ones I entered were of interest as they were my first caves not in boring old sedimentary rocks. Many thanks to my fellow visitors to the island from the R.V.Sonne, who put up with me waffling on about the joys of caving, and to the inhabitants of Easter Island who were very helpful and generous during our stay.

References:

(1) Alfred Metraux, "Easter Island", 1957 Scientific Book Club
(2) Thor Heyerdahl, "Aku-Aku", 1958 Penguin Books

— Tim Rogers



QUOTE - UNQUOTE

"..... most caves could be summed up as 'draughts and drips' ....."

H W Tilman
When Men & Mountains Meet

HOT STUFF!

A honeymoon on the romantic volcanic Reunion Island went badly wrong for newlywed Philip. Ryan. Returning with his bride after a midnight stroll, he vaulted the fence which he believed surrounded the honeymoon villa - and fell straight down the open shaft of the Ganga volcano.

SPELEO STATISTICS 1992

The World's Deepest Caves

1.	Réseau Jean Bernard	*France*	1602 m
2.	Lamprechtsofen *	*Austria*	1550 m
3.	Vjacheslava Pantukhina	*Georgia*	1508 m
4.	Sistema de la Trave	*Spain*	1441 m
5.	Ilaminako Ateeneko Leizea	*Spain*	1408 m
6.	Sistema Cuicateco	*Mexico*	1386 m
7.	Boj-Bulok	*Uzbekistan*	1380 m
8.	Sneznaja-Mezennogo	*Georgia*	1370 m
9.	Sistema Huautla	*Mexico*	1353 m
10.	Réseau de la Pierre St-Martin	*France/Spain*	1342 m
11.	Gouffre Mirolda	*France*	1335 m
12.	Siebenhengste Höhlensystem	*Switzerland*	1284 m
13.	Gouffre Berger-Fromagere	*France*	1278 m
14.	Berger-Cosa Nostra-System	*Austria*	1250 m
15.	Ceki 2 **	*Slovenia*	1245 m
16.	Vladimira Iljukhina	*Georgia*	1240 m
17.	Schwer-Höhlensystem	*Austria*	1219 m
18.	Abisso Olivifer	*Italy*	1215 m
19.	Cmelsko Brezno	*Slovenia*	1198 m
20.	Sistema Aranonera	*Spain*	1185 m
21.	Complesso Fighiera-Corchia	*Italy*	1182 m
22.	Dachstein Mammüthöhle	*Austria*	1180 m
23.	Jubiläumschacht	*Austria*	1173 m
24.	Anou Ifflis	*Algeria*	1170 m
25.	Sima 56 de Ándara	*Spain*	1169 m
26.	Kijahe Xontjoa	*Mexico*	1160 m
27.	Gouffre BT6	*France*	1157 m
28.	Abisso W le Donne	*Italy*	1155 m
29.	Sistema Badalona	*Spain*	1151 m
30.	Torca de los Rebecos	*Spain*	1150 m
31.	Sistema del Jitu	*Spain*	1148 m
32.	Sotano Akemati	*Mexico*	1135 m
33.	Arabikskaja	*Georgia*	1110 m
34.	Schneeloch	*Austria*	1101 m
	Sima G.E.S.M.	*Spain*	1101 m
36.	Jäegerbrunntrog	*Austria*	1078 m
37.	Sistema de Ocotempa	*Mexico*	1070 m
38.	Pozzo della Neve	*Italy*	1050 m
39.	Sotano de Olbastl	*Mexico*	1040 m
40.	Çukurpinar düdeni	*Turkey*	1037 m
41.	Mäanderhöhle-Herbsthöhle	*Austria*	1028 m
42.	Torca Urriello	*Spain*	1022 m
43.	Coume d'Hyouernede	*France*	1018 m
44.	Akemabis	*Mexico*	1015 m
45.	Kievskaja	*Uzbekistan*	990 m
46.	Hirlatzhöhle	*Austria*	988 m
47.	Moskovskaja	*Georgia*	972 m
48.	Napra	*Georgia*	956 m
49.	Pozo de Cuetalbo	*Spain*	948 m
50.	Barenschacht	*Switzerland*	945 m

** increased depth from the recent connection to Vogelschacht.*

*** see International Caver No.4*

From: *The International Caver (5) 1992*

The World's Longest Caves

1.	Mammoth Cave System	*USA*	560000 m
2.	Optimisticheskaja	*Ukraine*	183000 m
3.	Hölloch	*Switzerland*	156000 m
4.	Jewel Cave	*USA*	130897 m
5.	Siebenhengste-Höhlensystem	*Switzerland*	126000 m
6.	Ozernaja *	*Ukraine*	111000 m
7.	Wind Cave	*USA*	104070 m
8.	Gua Air Jernih	*Malaysia*	101500 m
9.	Ojo Guareña	*Spain*	97400 m
10.	Coume d'Hyouernede	*France*	90496 m
11.	Zolushka	*Moldavia*	85500 m
12.	Lechuguilla Cave	*USA*	82720 m
13.	Fisher Ridge Cave	*USA*	77248 m
14.	Sistema Purificación	*Mexico*	76332 m
15.	Hirlatzhöhle **	*Austria*	70000 m
	Raucherkarhöhle **	*Austria*	70000 m
17.	Friar's Hole Cave	*USA*	69234 m
18.	Ease Gill Cave System	*Great Britain*	66000 m
19.	Organ Cave	*USA*	60510 m
20.	Red del Río Silencio	*Spain*	58600 m
21.	Réseau de l'Alpe	*France*	56727 m
22.	Réseau de la Dent de Crolles	*France*	55000 m
	Kap-Kutan-Promezhutochnaja	*Turkmenistan*	55000 m
24.	Mamo Kananda	*Papua N.G.*	54800 m
25.	Sistema Huautla	*Mexico*	52653 m
26.	Réseau de la Pierre St-Martin	*France/Spain*	51200 m
27.	Ogof Ffynnon Ddu	*Great Britain*	50000 m
28.	Complesso Fighiera-Corchia	*Italy*	49800 m
29.	Crevice Cave	*USA*	45385 m
30.	Cumberland Caverns	*USA*	44444 m
31.	Gran Caverna Santo Tomas	*Cuba*	44165 m
32.	Pestera Vintului	*Romania*	42165 m
33.	Bolshaya Oreshnaja	*Russia*	42000 m
	Eisreisenwelt	*Austria*	42000 m
35.	Sistema de los Cuatro Valles	*Spain*	41079 m
36.	Dachstein Mammuthöhle	*Austria*	40350 m
37.	Sloans Valley Cave	*USA*	39640 m
38.	Xanadu Cave	*USA*	38623 m
39.	Carlsbad Caverns	*USA*	38600 m
40.	The Hole	*USA*	36838 m
41.	Whigpistle Cave	*USA*	36209 m
42.	Bulmer Cavern	*New Zealand*	35600 m
43.	Blue Spring Cave	*USA*	35405 m
44.	Atea Kananda	*Papua N.G.*	34500 m
45.	Culverson Creek Cave	*USA*	33507 m
46.	Ogof Agen Allwedd	*Great Britain*	33000 m
47.	Amaterska-Punkevni Jeskyne	*Czech Rep.*	32500 m
48.	Complesso di Piaggiabella	*Italy*	32300 m
49.	Binkleys Cave	*USA*	32219 m
50.	Sima del Hayal de Ponata	*Spain*	32000 m

** the increase in length has been obtained through careful re-surveying of the Entrance Series. See International Caver No.4*

*** increased lengths to be confirmed*

Caverns Measureless to Man

When Hillary and Tenzing finally got to the top of Everest in 1953 and so became the first people to stand on top of the world's highest mountain, their exact altitude was already accurately known (8848m ±1m). Mount Everest had been identified as the world's highest summit over half a century before, and was by 1953 thoroughly measured, photographed and mapped.

By contrast in caving, the ultimate, the world's deepest cave, is not even known.

The present depth record lies with the Reseau Jean Bernard in France at just over 1600m from the highest point to the lowest, accessible by man. But the world record has been held successively by some eight different caves this century. The current record will inevitably be broken yet again - probably fairly soon, and almost certainly by another, perhaps unknown, cave system.

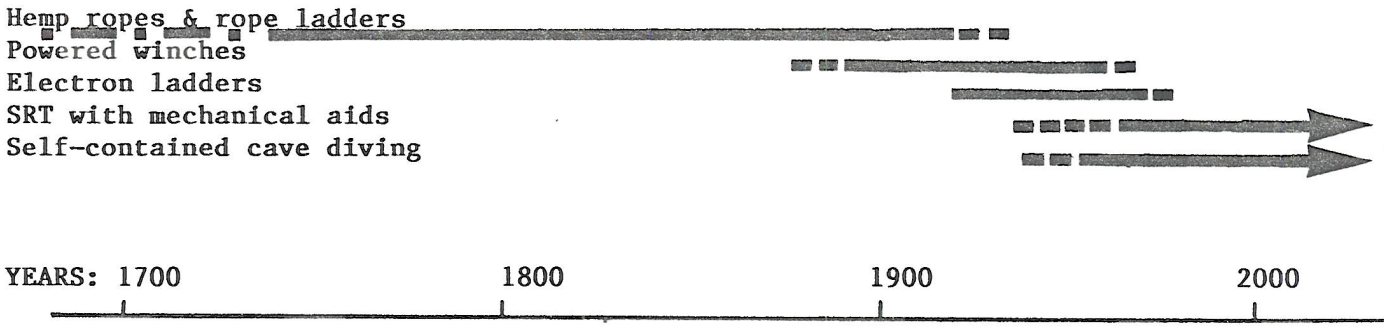
The world depth record has surged ahead since 1950 as a result of the development of more and more sophisticated equipment and techniques for the exploration of deep caves. By extrapolation we should expect to see a record of about 1700m by the end of the century - perhaps 2200m by halfway through the next. But will we ? Will there instead be a levelling off ? Is the Golden Age of deep caving coming to an end ? Are we, quite simply, running out of new unexplored deep caves, or perhaps reaching some sort of geological limit ?

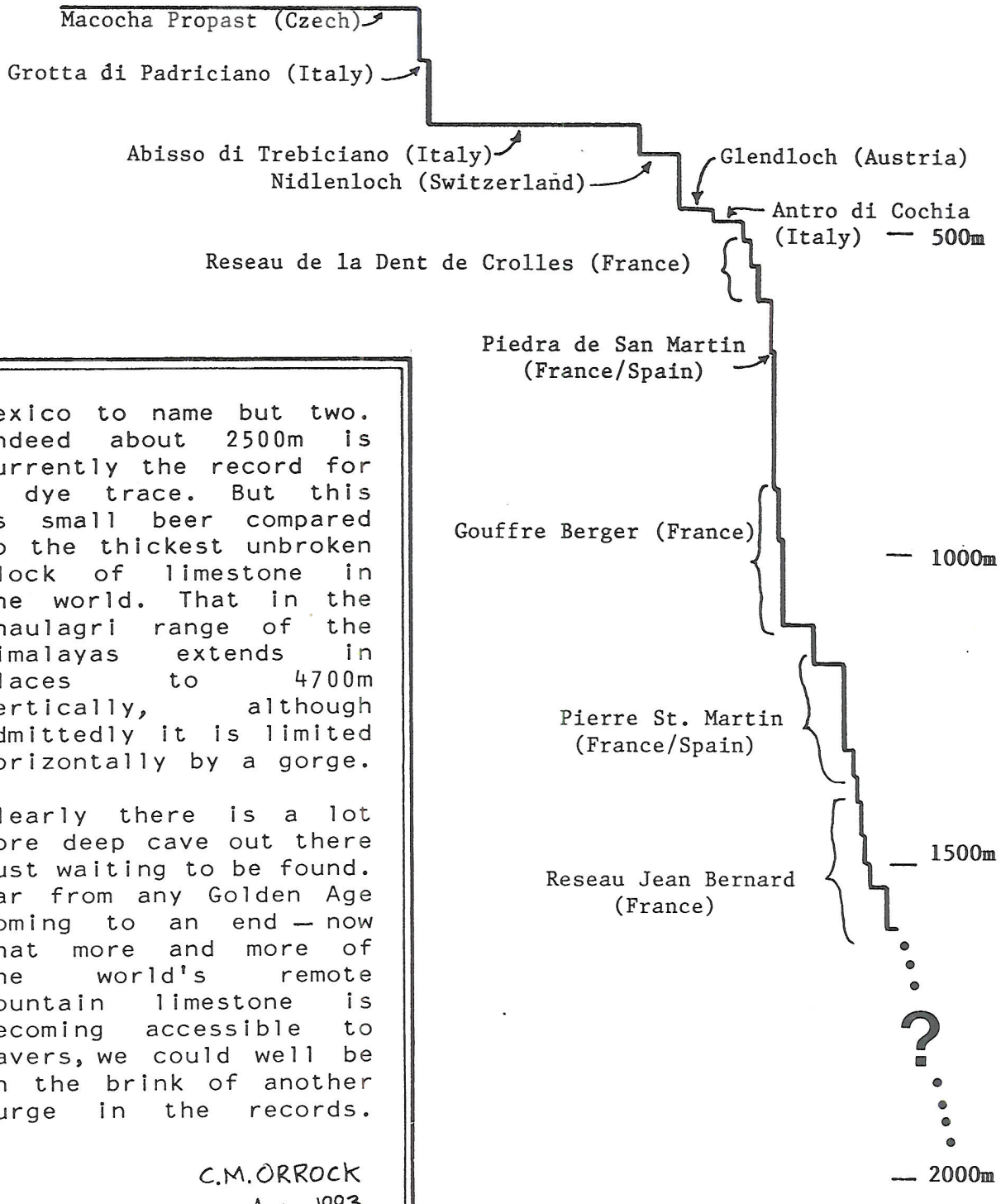
I think not. Since reasonably accurate surveying began, all the world's-deepests have been in Europe, and since the 1930s exclusively in France or on her borders. While the lands of France, Italy and the old Austro-Hungarian Empire undoubtedly contain excellent deep karst, this unfair distribution is rather due to the culture, history, economics and geography of Europe. And in turn, their effect on the development of suitable caving equipment, increased popular leisure time and ease of travel.

If and when the rest of the world's limestone gets to be as thoroughly explored as that of France, how will the record chart look then? Greatly different, almost certainly. Taking the world as a whole, current estimates are that all the caves so far discovered account for maybe just 1% of all the cave there is to find. What, I wonder, lies in the Andes of Chile, Bolivia, Peru and Ecuador; the Zagros Mountains of Iran; the vast mountain ranges and high plateaux of Russia and China; and hidden in the forests of Central America or South-East Asia? The few caves over 500m deep in these areas surely only just hint at their unrealised potential.

Further we don't seem to be getting any where near a natural, geologic limit to cave depth. There are already dye traces associated with known caves which prove rapid hydrologic connections over a 2300m vertical range: from Russia and

THE WORLD'S DEEPEST SURVEYED CAVE - SUCCESSIVE RECORD HOLDERS





Mexico to name but two. Indeed about 2500m is currently the record for a dye trace. But this is small beer compared to the thickest unbroken block of limestone in the world. That in the Dhaulagri range of the Himalayas extends in places to 4700m vertically, although admittedly it is limited horizontally by a gorge.

Clearly there is a lot more deep cave out there just waiting to be found. Far from any Golden Age coming to an end — now that more and more of the world's remote mountain limestone is becoming accessible to cavers, we could well be on the brink of another surge in the records.

C.M. ORROCK
APRIL 1993

"An hour and a half. What a start!"

THE UPPER CRUST

Taken to court in January 1946 by the Ministry of Labour for deserting his conscripted job in the mines, Harold Dobson of Hounslow, Middlesex, stated in his defence that:

"Being a person of high intellectural ability, my mental processes can function efficiently only in the topmost strata of the earth."

He was fined £3 with £5 costs.

South-East Cave Rescue Organisation

On paper, ICCC has been affiliated to SECRO since about 1986 although we've only been called out once. As a college club with a constantly moving core membership mostly based in central London, I feel it is inappropriate for IC³ still to be listed as a call out club. I doubt we could muster much of a team (lights charged ?!) at an incident in, say, Surrey at short notice.

Following the SECRO 1992 AGM I was contacted by the new Hon. Sec. Matthew Clark to review our call-out status. We agreed that it was not really worth drawing up a new list of IC³ members available for call-out. However we both felt it would be useful to include any locally based cavers onto one of the existing call-out lists. Accordingly, I have been added to the list for the Wealden Cave & Mine Soc. (formerly Unit 2) - simply for admin. purposes. If anyone else who is reasonably permanently based within the region feels that they can usefully be included on a call-out list, then contact:

Matthew Clark
SECRO Hon. Sec.
Flat 5, 14 Smoke Lane
Reigate, Surrey. RH2 7HJ

The South-East of England obviously isn't a major caving area, so don't expect to be called out much. There are currently about three underground incidents per year, plus the odd surface missing-person search etc, although as SECRO gains acceptance among the established emergency services this level of "business" is increasing. The area covered is that of the Police Authorities of: Suffolk, Essex, Herts, Thames Valley, Metropolitan, Hants, Surrey, Sussex, & Kent. However the typical underground incident is of kids lost in one of the entrances of the Merstham-Godstone mines (with 10 to 15 Km of passage between them). Rescue practices are held once or twice a year. Associated clubs are: Wealden Cave & Mine Soc., Border Caving Group, Kent Underground Research Group, Chelsea Speleo Soc. and Croydon C.C. Between them these might muster perhaps 80 people and would provide most of the specialist equipment. There is at least one caving M.D.

Next SECRO AGM: 20 June 1993, Oakley Centre, Merstham, Surrey.

C.M. ORROCK
FEB 1993.

Hooked on Heavy Metal?

There is a tendency for cavers to group all the shiney bits of their gear together, labelling them simply "metal", or at best distinguishing only between "steel" or "alloy". However the metallic components of a typical SRT kit: maillons, karabiners, and the rest, comprise a wide range of very distinct alloys. Each of these will have been chosen to meet specific requirements of use, and each will be subject to its own problems and limitations. Such "steel-or-alloy" over-simplification is therefore insufficient for informed evaluation, and fails to do justice to the manufacturers' sophistication. And, now that titanium-alloy karabiners from the ex-Soviet Union are also appearing on the market, what are we to make of these? How does titanium compare to the traditional alloys of steel or aluminium for karabiners?

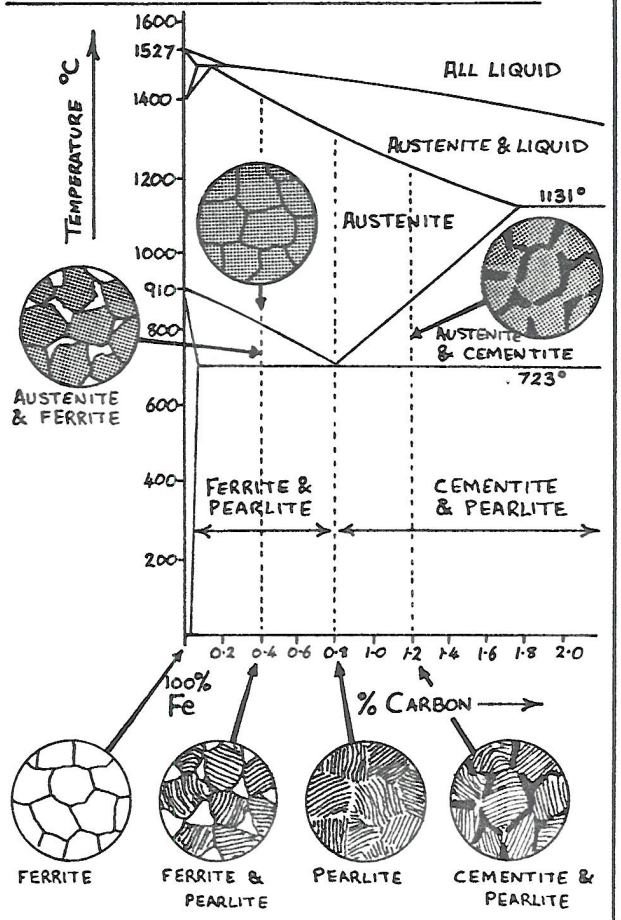
This then is a brief metallurgical appraisal of the alloys used to make caving karabiners and maillons, as well as some speculations for the future. The main text is intended to be comprehensible to the non-metallurgist caver, without being over simplified. The boxes on the right complement the main text with more technical detail for those who want a bit more background information.

Steel

All early karabiners and many still today are made in steel, that is, alloys based on iron. Steel is cheap and very strong, but is quite heavy and rusts unless carefully alloyed. It has a very complex metallurgy and it could be said that the whole of modern civillisation is based on the intricacies of the iron-carbon phase diagram [box 1]. If iron did not have allotropes which dissolve vastly different amounts of carbon, then we would still be stuck, literally, in the Bronze Age. This complex phase diagram, coupled with some 5000 years of use and study means that many different grain structures, and hence many different combinations of properties, can be developed from a simple alloy of iron with up to 1.7% carbon [box 2].

Further, it has been known for about 3500 years that carbon steels, when heated to red heat and then very rapidly cooled, say by quenching into water, become supremely hard and brittle: impractically so, but if then tempered (ie reheated to 300-600°C) the result is a metal both stronger and tougher than the original as-cooled structure.

Box 1: Iron-Carbon Phase Diagram.

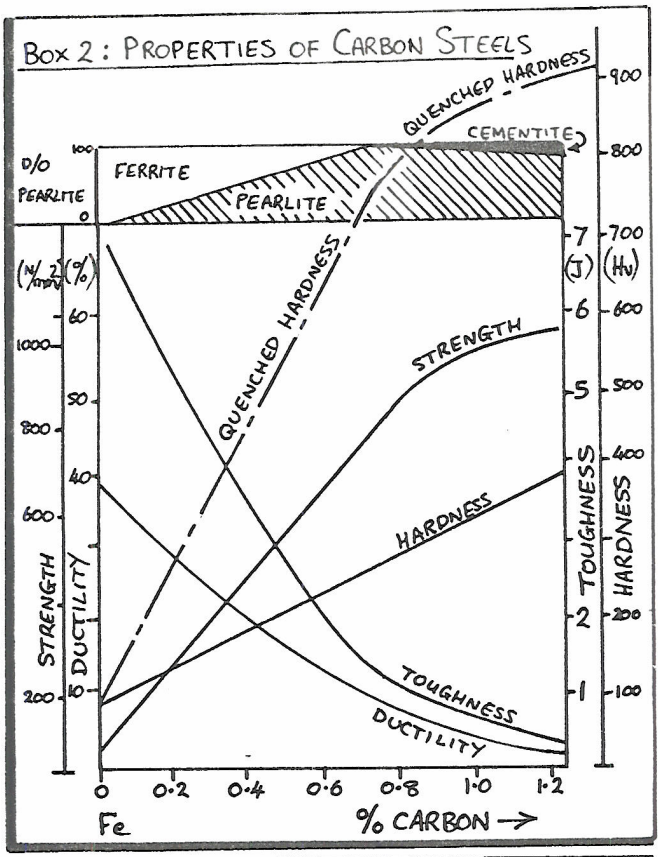


FERRITE = BODY-CENTRED CUBIC Fe SOLID SOLUTION.
AUSTENITE = FACE-CENTRED CUBIC Fe SOLID SOLUTION.
CEMENTITE = Fe_3C.
PEARLITE = EUTECTOID MIX: LAYERS OF FERRITE AND CEMENTITE.

Add to these basic developments on straight Fe-C alloys the effects of other additions:

manganese
nickel
chromium
molybdenum
vanadium
niobium
titanium
tungsten
etc.....

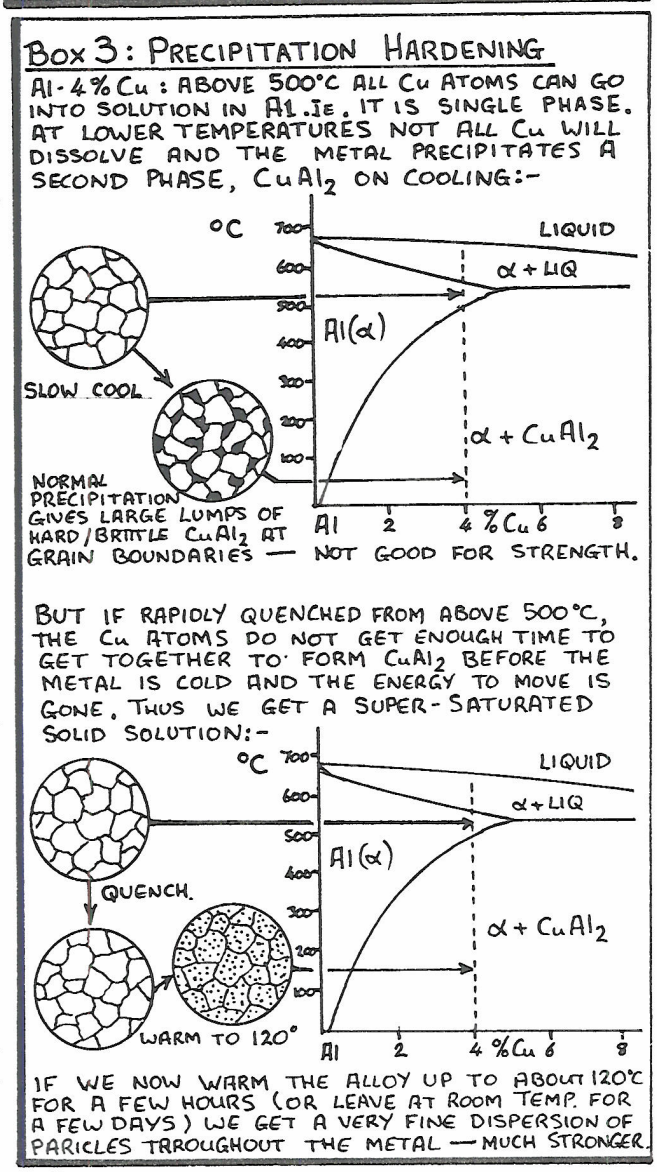
plus the control of all the minor impurities eg sulphur and phosphorus and you get a huge range of possibilities. There are probably as many different steels used for karabiners as there are makers (and these are only a minute fraction of the thousands of industrial steels available). The blanket name "steel" thus blurs the fact that this is a vast range of highly sophisticated materials.



Aluminium Alloys

Aluminium is twice as abundant as iron in the earth's crust but due to its more difficult extraction and processing is considerably more expensive per tonne. It is very light and quite weak, but when alloyed can be made much stronger. The tensile strength of "strong" aluminium alloys is about half that of steel per mm^2 cross-sectional area, but is stronger per kg. When pure it has excellent corrosion resistance in fresh water but does suffer in salt water.

Some strengthening of aluminium can be attained by dissolving copper, silicon, magnesium etc into the aluminium, but more strength can be obtained by a process of age-, or precipitation-hardening. A German metallurgist, Dr Wilm, inadvertantly discovered this important process in 1906 using an Al-4Cu-1Mg alloy. In 1909 Wilm gave his sole rights to work the patent to the Durener Metallwerke Corp. at Duren who marketed it under the name Duralumin. This is still strictly a specific alloy trade name but duralumin has since been adopted as a family name for a series of alloys based on Wilm's origainal Al-Cu-Mg alloy.



Nowadays however the majority of aluminium alloy krabs and maillons are made of an even more sophisticated precipitation-hardening alloy of:

Al-6Zn-2.5Mg-1.5Cu trace Mn & Cr

This is often known by the French trade name, Zicral, eg by Petzl or Maillon Rapide, or as 7075 alloy in Britain. This alloy was specifically developed for the most highly stressed parts of aircraft and missiles and is the strongest (and most expensive) of the commercially available structural aluminium alloys. For Zicral you pay the premium price not for the alloy constituents that are added, but for the strict control of those elements that must **not** be present (Fe,Si) or present in small but precise amounts (0.03%Mn, 0.21%Cr), and for the complicated heat treatments that are necessary to develop great strength without causing brittleness, localised stress-induced corrosion and other problems to which this alloy might otherwise be prone.

"Alloy" vs. "Steel"

Whilst sophisticated aluminium alloys can be produced with great strength and toughness, they are not generally as robust as steels. They are not particularly wear resistant ie against abrasion, scratches or dents. And the strongest aluminium alloys will look and be in a far worse state through corrosion than even a cheap mild steel maillon if left for a month, say down a cave or in an undried SRT kit. Red rust will brush off leaving the underlying steel largely sound, but oh dear! what about all that pitting and piles of white powder erupting from the surface of that expensive lightweight alloy karabiner!?!

Titanium Alloys

In terms of its occurrence in the earth's crust titanium is relatively abundant: of the engineering metals only aluminium, iron and magnesium are more plentiful [box 5]. However the very high affinity of titanium for both oxygen and nitrogen makes

Box 4 : Zicral

In Zicral the main age hardening effect is given by a very fine dispersion of $MgZn_2$ particles. The Cu remains dissolved in the Al matrix and so contributes some solid solution strengthening. The small but critical amounts of Cr and Mn act as grain-size refiners by inhibiting the growth of large grains during the high temperature solution anneal prior to quenching. Fe and Si if present would form long needles of very brittle inter-metallic compounds, giving ideal crack paths, so they must be kept at very low level.

Zicral is very strong but does tend to be rather prone to stress-corrosion cracking. This is a failure phenomenon that occurs because of the simultaneous presence of tensile stress and a corrosive agent. Failure by SCC is often in a seemingly mild chemical environment and at tensile stresses well below the metal's yield stress. In Zicral karabiners and maillons the form of SCC most frequently encountered is exfoliation. This causes separation of the metal layers, starting at exposed edges where residual stress causes delamination. Accumulation of voluminous corrosion products also serves to propagate exfoliation by a wedge action. Relief of residual stress and maintenance of the correct hardening anneal temperature make the metal much less prone to SCC. Modern Zicral karabiners and maillons are considerably better in this respect than those of five years ago. But the risk is always potentially there, so don't tempt fate - always clean and dry Al-alloy krabs after use.

Box 5 : Analysis of Earth's Crust
(Useful engineering metals in **bold**)

Oxygen	46.46%	**Magnesium**	2.07%
Silicon	27.61	**Titanium**	0.62
Aluminium	8.07	Hydrogen	0.14
Iron	5.06	Phosphorus	0.12
Calcium	3.64	Carbon	0.009
Sodium	2.83	**Manganese**	0.009
Potassium	2.58	Sulphur	0.006

it difficult to extract, whilst the molten metal itself reacts with nearly all known refractories. Thus titanium is expensive because of the cost of extraction and forming, rather than from any scarcity of its ores. It is those nations capable of extracting and working titanium: Britain, France, Germany, Russia, Ukraine, Japan and the U.S.A. that control the world market, and not those states that have the major ore reserves.

Like iron, titanium is a polymorphic element and thus with careful alloying and heat-treatment there is vast scope for developing combinations of properties through stabilizing various phases, martensitic-type structures and precipitation hardening - sometimes all simultaneously. Strong titanium alloys are as strong as steel per unit cross-sectional area, but are nearly 50% lighter. It is this good strength to weight ratio, coupled with an ability to withstand corrosion and high temperatures far better than aluminium, which have fostered the development of titanium, primarily for the aerospace industries, and especially because of its cost, for military aircraft, missiles and spacecraft.

Titanium in the Soviet Union

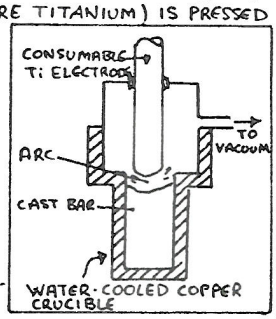
Caving (and climbing) equipment manufactured in what was the Soviet Union has for years been dominated by titanium. Industrially made karabiners have been produced from the metal (or rather alloys of it), while the widespread availability of titanium allowed numerous "home-made" titanium ascenders, descenders and even carbide generators to be produced. Compare this situation to the USA and EEC where not one karabiner, or any other bit, is manufactured from a titanium alloy. Why this difference?

The price of titanium in the West has for the past two decades been governed by the state of the aircraft industry and due to the general recession in this business since the early 1980s production capacity still

Box 6: From Beach to Billet.

Rutile (TiO_2) sand is mixed with coke, then chlorinated at 800°C with chlorine gas to give $TiCl_4$. This red liquid is distilled to purify, then reduced by reaction with molten magnesium or sodium. The resulting sponge (95% pure titanium) is pressed into a thick bar to make an electrode.

The Ti metal can then be melted in a consumable electrode arc furnace and cast into another bar. It is then remelted at least once and alloy additions made. Finally the bar is hot forged to a solid, pore-free billet.



Box 7: Titanium Metallurgy

Like iron, titanium has allotropic forms. Up to 882°C it has a close-packed hexagonal, CPH, crystal structure (α): above 882°C up to the melting point at 1668°C it is body-centred cubic, BCC, (β). The temperature of the $\alpha \rightleftharpoons \beta$ transition is greatly altered by alloy additions giving rise to 3 main classes of titanium alloy:-

Additions of Al stabilize CPH α to higher temperatures, and when solution-strengthened by Zr or Sn, these α-type alloys are good for high temperature creep resistance and so are used for turbine blades in jet engines etc.

Most transition metals (Mo, V, Mn, Fe, Cu, etc.) stabilize BCC β to temperatures lower than the 822°C transition temperature. These alloys generally form a phase diagram similar to that produced by carbon in steel. As in steel it is therefore possible to get a martensite by rapid quenching, although Ti-martensite lacks great hardness. Pure β-type alloys are little used - they have a good combination of strength and ductility but the need for large amounts of heavy transition metal additions pushes the weight up.

The most useful class of Ti-alloys are the $\alpha+\beta$ type. These are basically β but with some α phase formed by an ageing treatment. The ductility is less than in β alloys but they have good strength and adequate toughness. This is the type used for high strength-to-weight aerospace applications.

exceeds demand. Through the 1970s the USSR exported large quantities of titanium to the West, clearly indicating a huge production capability. But in 1980 all Soviet titanium exports ceased reflecting a greatly increased domestic demand. This has since been shown to be due to the building of the Typhoon and Alpha classes of nuclear submarine which have all-welded titanium alloy hulls (being non-magnetic titanium makes them very hard to detect). Further, throughout the 1980s considerable effort was put into titanium alloy research by Soviet Universities with the result that by the late 1980s the Soviet Union was probably more technologically advanced in the use of titanium than the West.

The Soviet titanium industry was always closely integrated with the armaments industry. During the 1980s recession , while Ti production in the West was cut back to about 70% of capacity, that in the USSR was maintained at the full and very large level. In all probability production exceeded domestic military demand and so titanium alloys were soon being used by other manufacturing industries where the high price would have precluded its use in a free market economy. Couple this with the notorious lack of control of stocks (which often went missing in transit etc) meant that comparatively large amounts of cheap, military grade Ti-alloys found their way into the community at large. Thus we find numerous "home-made" items of gear made in titanium alongside some industrially made stuff. These were made when the price of titanium within the USSR was being kept artificially low. This situation no longer exists. It is currently not viable to make titanium karabiners in the West and any still being made in Russia or the Ukraine are effectively government subsidised.

Brittleness of Titanium

One bit of folk lore concerning Ti-karabiners is their supposed tendency to brittle failure after a period of time. This has been fostered by

Box 8: Soviet Titanium Krabs

All the karabiners I have seen on sale in the UK were made commercially by Irbis. Analysis showed them to be Ti with additions only of Al and Cr. Metallography indicated them to be $\alpha + \beta$ type. The twistlock variety weigh 185g are stamped 3000 and have been tensile tested to at least 3300Kg. (A Clog Al-alloy screwgate rated to 3000kg weighs exactly the same ie. there appears to be no weight saving in the use of these Ti krabs, only a slight bulk saving).

Failure of these Ti krabs in tensile load was by the retaining hook on the gate straightening out as the D-shape tried to straighten. There was no deformation of the spine or the rivet or the hinge. Note that the hook on the gate deformed plastically - it did **not** snap in a brittle manner. Both the rivet and pin, and probably the spring are plain carbon steel and so prone to rusting. The springs also seem weak and there is a tendency to develop sticky gates.

The examples of Irbis karabiners circulating in the UK all seem to my mind poorly designed with an awkward twistlock or offset gate action. Nevertheless they do give useful indications of the general performance we can expect from Ti-alloy karabiners.

They wear much better than aluminium alloy krabs, do not corrode in water and perform better when subject to high friction eg when used as brake krabs (but are still less preferable than steel for this). Given the choice I would prefer a well made, military-grade titanium alloy to Zicral for its better wear performance and overall robustness. Titanium alloys, unlike both steel and alloy also have good resistance to salt water, thus there is a lot of interest in them for safety equipment on oil rigs etc.

a few well-advertised failures in other bits of equipment (cycle handle bars, ice-axes, ski-bindings etc.). However if properly made and processed titanium alloys should not exhibit brittleness: the wings don't fall off Tornado aircraft nor do artificial hip joints break!

Indeed titanium alloys usually have excellent fatigue resistance. Like mild steel (but unlike aluminium alloys) titanium alloys have a definite fatigue limit - that is a stress limit below which they can be repeatedly loaded (fatigued) without **ever** failing. In titanium alloys this is typically as high as 50% of the tensile strength.
However, titanium alloys as a whole do have rather poor notch sensitivity and so considerable care must be taken to remove potential stress-raisers eg. sharp changes in section, and sharp cutting or damage marks.

It is also true that some early titanium alloys tended to be brittle and to fail unexpectedly. Titanium is a very reactive element with a high affinity for non-metallic elements including gases. Hydrogen especially can dissolve into the solid metal, and has been shown to cause brittleness when present to as low as 100ppm. However, now that this specific cause is known, procedures are taken to minimise pick-up of hydrogen during processing and strict analysis of the metal is done, so that hydrogen embrittlement should no longer be a problem to the user. It may however occur if the articles were manufactured in a "cottage industry" situation where contamination may easily occur with no facilities to either detect or control it.

Part of the high price of titanium alloy articles is due to the strict control of process conditions (eg vacuum or inert gas processing) and to the analysis equipment required to detect non-metallic impurities at low levels. Industrial grade Ti-alloys in the USSR will have been subject to these stringent controls, but once they have found their way to the various workers' cooperatives etc. this may not be so. Material

Box 9 : Whither Titanium?

Even today when titanium alloys have proved themselves in numerous and diverse applications, they are still seen as exotic, high-tech, high cost materials, of interest only to aerospace companies. Consequently, with the current cut-backs in military and civilian aircraft, plus a general atmosphere of recession, the demand for titanium remains low (at Feb'93 at its lowest since 1983). Western Ti manufacturers are struggling with losses and are slashing prices drastically. Competition is keen, and the ex-Soviet Commonwealth of States, with their vast production capacity are a further threat to price stability. Nevertheless the price of aerospace Ti alloy is still only just cheaper than the same weight of pure silver!

A tradition of huge swings in the price of Ti has tended to frighten off all potential users other than aircraft makers. A pity: titanium is ideal for a vast range of applications throughout industry. If usage increased the demand could be readily met from existing capacity, the price would stabilize and then come down. Only then can I see Ti alloys being commonly used for karabiners.

That day may not be so far off. Increased interest in the metal is finally being shown by industries other than the established users. Simultaneous with the drive for new applications, a lot of work is going into developing cheaper Ti alloys. A similar situation has been seen before. In 1890 aluminium was a new, rare, exotic metal, literally worth its weight in gold. In 1900, a few years after the discovery of electro-extraction of aluminium, it was already being used for cheap tools, household utensils, camping equipment etc. Then in 1906 Dr Wilm discovered age-hardening and Duralumin was born..... What opportunities, then, for titanium, and for caving equipment?

bent to shape without adequate annealing, or worse annealed with a gas torch (possible reducing conditions) can all too easily be reduced from a high grade alloy once suitable for the critical components of Foxbat or Flogger fighters to a dangerously brittle alloy just waiting to cause an accident. Krabs made commercially, whether by Irbis or perhaps in the future by a Western company, should be OK, but beware the home-made job. Equally don't try and repair or modify any load bearing bits of gear made out of titanium - or any other alloy for that matter. However, at least for the next few years I cannot see many titanium karabiners being available. The high world market price currently precludes their manufacture in the West and must soon stop their production in the Commonwealth of States.

Other Materials - The Future?

Of the engineering metals, magnesium is the most abundant after aluminium and iron. It can be economically extracted from the sea ($1\frac{1}{2}m^3$ of sea-water yields 2kg Mg) and so reserves are virtually limitless. It is also very light; just two-thirds that of Al. Mg alloys (usually with Cu, Zn, Al, Zr) have been in use since the 1940s where their good strength to weight ratio made them ideal for a range of domestic and industrial fittings. To date however Mg alloys have not been able to supplant Al alloys (eg Zicral) at the very high strength end of the market. In general Mg alloys are highly impact and dent resistant, and the high purity alloys have corrosion resistance comparable to Al alloys. Magnesium has the **potential** to become a cheaper, lighter alternative to strong Al alloys. With a bit more development they could make ideal material for lightweight krabs.

Even lighter than Magnesium is lithium: at one-fifth the density of Al it floats in water. It is of course **highly** reactive but can be used as a major addition to, say Al, to reduce the weight for the same strength. Several Al-Li alloys are now available which are up to 10% lighter than conventional Zicral type Al alloys of the same strength. Their widespread use however is currently restricted by process difficulties and consequently high costs. Nevertheless the European Fighter and Airbus, and Dassault Rafale all use Al-Li for critical components, and its use is expanding. My initial expectation was that Al-Li alloys would be liable to corrode but in practice they seem to behave similar to more conventional Al alloys. Fostered by aerospace research Al-Li alloys might actually beat Mg alloys to lightweight karabiner use.

What about non-metals?

Ceramics is a rather vague term typically used for those ionic substances based on alumina (Al_2O_3) or silica (SiO_2) etc either in crystalline or glassy form (pottery-&-glass), but also for concrete and arguably for things like pressed graphite. In general these materials are strong in compression but weak in tension and can be alarmingly brittle. They do not therefore immediately commend themselves to karabiner manufacture. But to their credit they are often cheap, light, wear resistant and corrosion resistant.

Plastic is a similarly vague blanket term smothering a vast range of materials. Generally plastics are fairly weak, typically less than 20% the tensile strength of Al alloys. They are however usually lightweight and very corrosion resistant. And they can be reinforced to make "composites". Adding chopped glass fibres to a common plastic, say nylon, can double its strength without reducing the toughness. More sophisticated composites use plastics or metals reinforced with long fibres of glass, carbon, boron or Kevlar to develop light materials as strong as high tensile steel. In short composites allow you to pick'n'mix properties. The karabiners of Tomorrow's World might well have an Al-Li alloy body, clad in plastic for corrosion resistance, or flame-sprayed with ceramic for wear resistance!

CLIVE ORROCK
APRIL 1993

Seeing the Error Of their Ways!

This article originally appeared in the BEC's "Belfry Bulletin" No.338, 1976, by "Alfie". But, given the current club interest in cave surveying it seems well worth a second airing.Though whether it encourages any surveyors is not certain.

A cave surveyor is approached by a digging team. They want to sink a deep shaft to break into the far reaches of a big cave. Unfortunately, the passages in this part of the cave are small, so they want to know where to sink the shaft to the greatest degree of accuracy possible. Other methods, such as electromagnetics, have proved unsuitable, so they are depending entirely on the surveyor, who they approach with high hopes.

The surveyor points out that however carefully he checks and calibrates his equipment, and however carefully he takes his readings and avoids mistakes, there will be an error left due to the imprecision of his readings. It will be a random error, but should not amount to more than 0.5° in bearing, and a total of 0.1m in position and distance combined (let us conveniently forget elevation to make the argument simpler). The diggers say that this is fine; 0.1m is about 4 inches, and they weren't expecting anything quite as good as this. The surveyor (noting that the diggers are all bigger and uglier than he is) points out that these errors are for each leg of the survey. As the cave is about 1km long (5 furlongs to you) there will be about 100 such legs from the entrance to the point in question.

The diggers scratch their heads, and finally ask the surveyor how far out he reckons to be. The surveyor says that he reckons to be about 1½m out. The diggers, after more head-scratching, point out that over a hundred measurements, he ought to be about 400inches out and 50°, since these figures are a hundred times his error for a single leg.

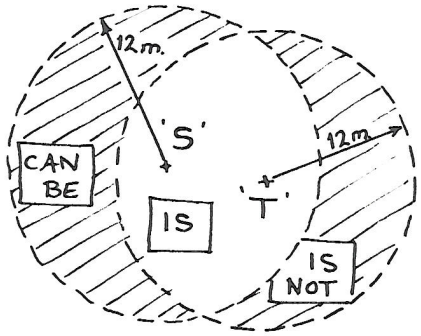
The surveyor, assuming a crafty expression, says that you might expect that sort of thing, but luckily the errors tend to cancel each other out. His figure of about 1½m allows for this.

One of the diggers, who has been lost in thought asks the surveyor just what he means by the errors "tending" to cancel each other out. Does this mean that the surveyor is taking a gamble when he says that he is within a metre and a half of the real point underground?

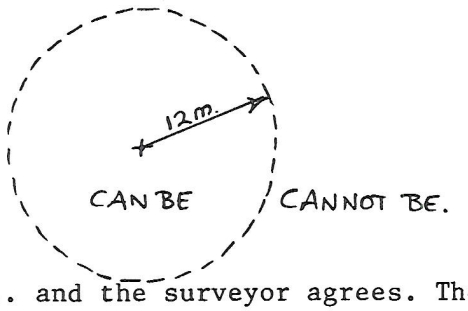
The surveyor, abandoning his crafty expression, has to agree that this is so. He points out that there is about a 70% chance of his point on the survey being within 1½m of the true point underground. The diggerssay that this is all very well, but they are going to have to sink a three hundred foot deep shaft through solid rock, and they don't want to be fobbed off with excuses (if the shaft misses the passage) about what rotten luck it was. The surveyor, noting that the diggers are getting somewhat belligerant, says that if they want certainty, then he cannot guarantee that his end point is better than about 12m from the real point, but adds that it would be very unlikely indeed to be so far out.

The diggers, after much calculation, agree that 12m is a little over 39 feet. They ask the surveyor if he can tell them in what direction the true point will lie. The surveyor admits that he cannot. One of the diggers, a more educated man, then draws a diagram illustrating the state of

affairs. If 'S' is the surveyed point and 'T' is the true point, then the situation is as shown, except of course that the true position of 'T' will not be known. Thus all one can say with certainty is that 'T' must lie somewhere within 12m of 'S'.



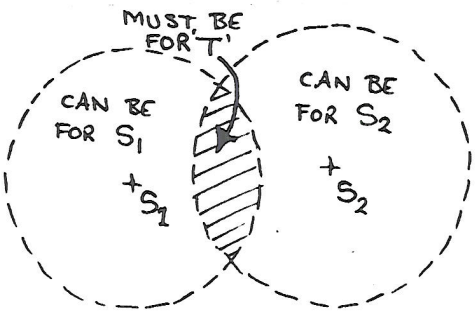
The surveyor says that this is true, but again it would be very hard luck if the distance was anywhere near 12m. He says that if they are really worried about the chances, then he can run a second independent traverse from the entrance to the point in question, by a different route if necessary. He will then have two points representing the point they want, and the real point will almost certainly lie somewhere between them. He points out that this will reduce the whole uncertainty by quite an amount.



The digger who drew the diagram shakes his head. He asks the surveyor straight out if he accepts the 12m radius from the surveyed point as being all that can be stated with certainty about the position of the true point..... like this.....

..... and the surveyor agrees. The digger now says that if a second point is surveyed, the same sort of thing will also apply as for the first, except that the radius might well be different, depending on the second route through the cave.

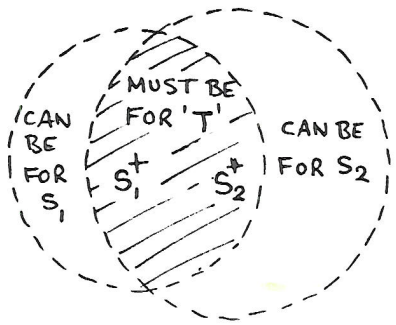
He now draws this diagram.....



The surveyor agrees that this is so, but says that it is unfair the way the digger has shown his two points to be almost as badly out as possible. He says that he is quite sure the two points will be very much closer together than the way the digger has shown them to be.

With a crafty leer, the digger accepts this challenge. He draws a new diagram showing a much smaller error.....

As the surveyor looks at the new diagram, his jaw drops and beads of sweat form on his brow. The amount of misclosure between the two traverses is now much less, showing that the surveys are more accurate, and yet much less is now known about the true position of the point in question!! It would appear that the less accurate the survey, the better would be the knowledge of the position of the actual point!



The diggers wait patiently for the surveyor to come to some conclusion. They finally (because it is getting dangerously close to opening time) ask the surveyor what this means. He replies that it means he will be giving up caving and taking up some entirely different pursuit in future. The diggers, faced with the possibility of having to drive adits from the bottom of the shaft, agree to join him.

A Wild Stab in the Dark

Being a reprint from the reminiscences of John H Watson, M.D. late of the Army Medical Department.

In all the time I have had the priveledge of being associated with Mr. Sherlock Holmes, he has perpetually astonished me with the extent of his learning. When first we met and came to share lodgings in Baker Street, I found him a most unusual creature. By all the usual reckoning he was very poorly educated for he seemed to know nothing of the classics, literature, politics, geography or history. He did, however, have a detailed knowledge of certain limited aspects of chemistry, anatomy, and medicine - and of cheap, lurid, popular literature. When I queried this, he replied that he preferred to leave the majority of his mind uncluttered by trivial facts, the better to pursue his deductive reasoning. He claimed, therefore, that he only bothered to learn subjects which would be of practical use to him. Yet as I came to know him better I came to perceive a very high and wide-ranging learning. Furthermore what really surprised me was his depth of knowledge, when required, in subjects which even he would admit to being of no practical use whatsoever.

I well recall one May evening in 1893 when we were closeted together. I had spent the early evening at a lecture on the archaeology of Victoria Cave, Settle, at the Imperial Institute in South Kensington, and our discussions had now rambled into the realms of the evolution/creation debate. I say discussion; Holmes knew nothing of the arguments either for or against, and moreover cared even less. He could see absolutely nothing of value in knowing whether Man was put on Earth by the Lord, or descended from an ape. Finally he declared that if men were fool enough to want to go grubbing about in caves, then at least if they had an accident it saved the trouble of burying them. With that parting shot we both fell silent, I absorbed in my pipe of tobacco; he in whatever exotic substance he was smoking. He'd had no cases for some time and, since his only divertissment was in the exercise of the mind, he was bored. It was somewhat like living with a caged animal.

At that moment Mrs. Hudson's daughter came in to say that a letter had just been received by the last post.
"At last - a case!", cried Holmes, leaping from his chair so violently that the poor girl shrank back against the door.
"If you please, Sir, it's for Dr. Watson".
I took the envelope, opened it, and began to read. Holmes slumped back into his chair, put his feet on the table and began aimlessly picking at the strings of his violin.
"Well it may be for me, but as your doctor, I reckon this is the tonic for you my friend. It's from my old colleague Dr. Bannister up at Clapton in Yorkshire. It seems that one of those grubbing speleologist fellows has been killed down a cave. No accident; he was murdered by "cavemen" or so this rather lurid cutting from the "Craven News" suggests. The police are at a loss, as usual, and he begs us to go with haste to Yorkshire as the matter has quite upset the whole village. Come Holmes, I believe you might now have some interest in these caves and their explorers".

Since the completion of the North-Western and Midland Railway's link to Carlisle via Settle, the western Dales of Yorkshire are not so remote as formerly. Indeed, the natural delights of the glens around Ingleton have made the place quite cosmopolitan in its quiet rural way. Nevertheless it was not until late the following evening that we alighted at the small station of Clapton. Dr Bannister was waiting outside the adjacent "Flying Horseshoes" Inn.

"Watson, how good to see you again", said Bannister, warmly pumping my hand. "And you, Sir, you must be Sherlock Holmes".
"An accurate, though elementary, deduction, Sir. How did you enjoy your holiday - Italy wasn't it? And how is your wife's family?".
"Oh very well, thankyou....but....?".
"You have a fine, fresh sun-tan in early May, clearly you have recently returned from sunnier climes. I know you to be a country doctor in a quiet practice, so I doubt work has taken you abroad. You wear a locket with a picture of a woman a little younger than youself with the name Francesca on it - you wife is apparently of Italian descent. And you also have a new set of cameo cuff-links of Italian workmanship. You and your wife have obviously recently returned from Italy, Naples I suspect, where youhave spent a few weeks visiting your wife's family".
"Amazing!".
"On the contrary: your whole being tells me as clearly as if you'd spoken it yourself. Now, if you'll collect your hat which I think you'll find you've left in the saloon bar of the inn, we'll be off."

We were soon settled in the doctor's drawing room and over a restorative cup of tea (topped with a dash of whiskey when his wife wasn't looking) he proceeded to fill us in on the details of the case:
"The major landowner here is, or rather was, Professor Farer. He it was who owned the majority of the valley up as far as Troll Gill, the narrow gorge where the dale climbs out onto the open fells on the slopes of Ingleborough. However he generally left the running of the estate to his son Reginald. He's an ambitious fellow: a big mill owner, although recently I hear he's run into some financial troubles and had to remortgage a lot. The Prof. devoted himself and his not inconsiderable personal fortune to his passions of archaeology and speleology. He and his son had often clashed over Rginald's dream to turn the estate into a tourist attraction. While the professor was the sole owner, however, his son's plans were thwarted. The old man had decreed that all were free to walk through the estate, but it was not to become a cheap tourist trap, 'Over my dead body', was his frequent reply to the suggestion.

In the village the professor was respected enough. People thought him a bit eccentric but he was always civil and often quite generous, and he was, well, enthusiastic. I used to get on with him very well. The only one, not family, who didn't always see eye-to-eye with him was Rev. Gilpin. Vicar's a bit cranky, a devout creationist and not very tolerant of what he saw as the professor's profane investigations. When the old man published his 'Evolution of Carboniferous Brachiopods', Vicar countered that such shells were fakes put there by Satan to lead men astray. And when he brought that old skull out of the cave, vicar refused to let him give a talk about it in the church hall, said it was a drowned sinner from the Great Flood and wasn't to be allowed on hallowed ground. However to be fair their arguments, though frequently vehement, were always conducted at an academic level: it was never personal. And, since his death, the vicar's gone out of his wasy to say how much he respected the man, though he had little good to say of him in life.

Anyway as I was saying, at the far end of the estate next to the Clapton Beck resurgence, is The Cave. Since the discovery of that skull a few years ago it's been kept locked with a big iron gate, although in fact it only went in about fifty yards before the way was blocked by a big dripstone dam. That was until last week when the professor got some of the local lads to break through the stalagmite blockage. I was there when they broke through the last bit. There was a lot of water held back, but a day later, once the flood had subsided and the cave beyond was drained, we could get in.

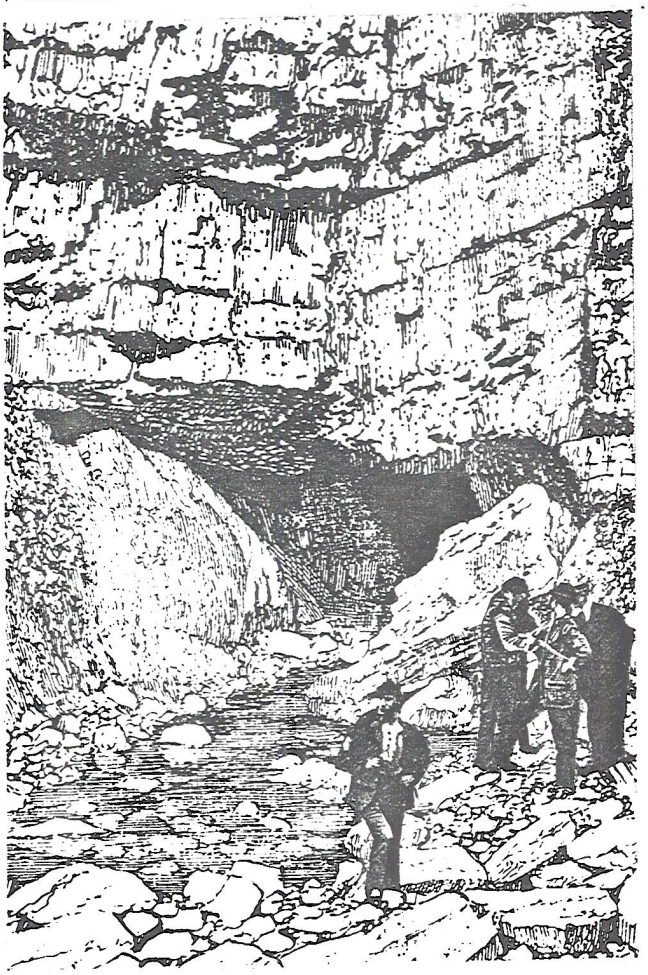
There was the Prof, myself and the three workmen. With the professor leading the way we all trooped in. The main passage carried on past the breached stalagmite dam to a large

chamber, most of which was still occupied by a deep pool. We skirted this and got into a smaller passage on the right-hand side. At the end of this, in an area that had clearly been above the flooded level, were some old bones and implements. The professor was over-joyed, I've never seen him so extatic. He promptly ushered us all out before we disturbed anything. He left with us, and locked the cave as normal once we were out.

The following morning, two days ago that is, the professor went back into the cave alone to examine his find. Young Robert, his odd-job boy, was there repairing the dry-stone wall damaged by the outpouring from the cave. He says he saw the old man go in alone and lock the gate behind him. Robert was outside the entrance all day and saw no-one enter or leave. At five o'clock Robert came home to the village, but called in to say that the Prof. still hadn't emerged. We weren't concerned: we all knew how engrossed he got in his work. However his son had just arrived from Bentham, and I had been invited to dine with them that evening, so Reginald and I took the spare key to go and find the old man. There are only two keys that I am aware of: the Prof. had one and Reginald keeps the other.

Anyway to cut matters short, we found the cave still locked and on entering found him dead. He had sustained a fatal stab to the chest with a fairly blunt instrument. I estimate that he'd been dead about three hours when we found him at a quarter past six. With young Robert's help we brought the body out leaving the site as undisturbed as possible".
"Did you re-lock the cave?".
"Yes, in fact I locked it with the professor's key and then gave both keys over to Reginald".
"And how did he take his father's sudden death?".
"Well, silent and grim should describe it fairly accurately - he didn't show much emotion, but then he always was a rather cold fish. All I can remember him saying on first seeing his father's corpse was, 'Oh Lord, what's the d--- fool done now!".
"And the police?".
"They were called immediately that evening and an inspector arrived here the next morning; yesterday. He has interviewed Reginald and myself: he got basically the story as I've just related to you, and then he examined the body. It's still in the ice-house should you want to see it. The police wouldn't allow his burial until they'd completed their enquires, but they don't seem to have progressed very far".
"Have they visited the Cave?".
"Not yet, so far they've only been as far as the entrance".
"Thank the Lord for the plodding inefficiency of rural police. I think we should all visit the Cave first thing on the morrow".

The following morning we assembled at the cavern's mouth. The doctor was there and at Holmes' request had brought along the three original labourers: John Hutton, the smith's son; Robert Balderston, the Prof's odd job boy; and Richard Poole the verger from the rectory. Judging from the mud on their clothes, this was going to be a messy business, only Poole the verger looked reasonably clean.



The six of us trooped into the stygian blackness in indian file. Though the cave had been drained, a small stream still trickled along the passage and water dripped from the roof. It took some time for my eyes to get used to the darkness but gradually as we progressed I began to get a better appreciation of where we were. By the light of our lanterns, I could see we were in a broad tunnel, the walls smoothely curved and sculpted, and the roof flat a comfortable foot or so above our heads. The going was moderately easy, although a chaos of round gritstone boulders littered the passage threatening to trip the unwary. All was covered in a film of muddy slime, attesting to the fact that this had been flooded up to barely a week before. Our boots and gaiters were soon caked, as were our hands from groping along the walls, but we had no need to stoop and so our upper bodies remained perfectly dry and comfortable.

Presently we reached a large roundish chamber which only the doctor's hissing acetylene bicycle lamp could fully illuminate. Two-thirds of the floor area was occupied by a deep pool. Directly ahead a splashing cascade, more of separate drips than a single column of water, rattled down from roof fissures onto the stoney floor. To the right another passage led on into the mountain. I admit I found the lure of the unknown quite exciting.

"Where Alph, the sacred river ran,
Through caverns measureless to man,
Down to a sunless sea", recited Holmes.
"I didn't know you were keen on poetry", I commented.
"Only the inspired stuff", he replied with a curious sidelong glance, and then drew deeply on his pipe. In the sterile cave air the smell of his tobacco smoke was strong and there was also the strangely sweet hint of something else.

We left the three workmen in the large chamber. Holmes, the doctor and myself followed the shelves of rock along the right-hand wall and filed into the small side passage, tramping along in the muddy foot prints of previous groups. Holmes in the lead had his nose to the ground like a bloodhound. Presently the floor rose and became hard and dry indicating the edge on the undrained water level. The contrast to that which had been underwater was very apparent as the churned track of a single line of prints which had strayed from the hard ground showed.

About forty yards further on, in a small chamber where a narrow cleft entered on the left, was a riot of old bones and implements.
"The body was there", said the doctor, indicating a vaguely flattened patch of the floor adjacent to a scuffed area.

"He was on his back, head towards us here, his hands over the bloody mess of his chest. When I checked the body I found a small fragment of old bone, antler or such still embedded in the wound. That's what gave rise to the "Revenge of the Cave-man" story in the cheaper papers. I admit, though, that it was pure luck the fragment was still there and we haven't been able to locate the rest of the actual weapon". With a sweep of his hand he indicated the numerous scattered bones and remains. There were a few boot prints on the hard floor but nothing that looked promising. On all fours Holmes inspected them all, but even he could gain no intelligence from them. No-one seemed to have continued ahead down the passage, which was in fact clearly blocked by boulders about ten yards further on, but the left hand route was as scuffed as the floor of the small chamber.

Carefully the three of us entered the left-hand fissure. There were a few more animal bones jumbled up along the walls. By these we found the professor's patched canvas knapsack still containing his archaeological tools, a couple of candles, some bits of sacking and an old garden spade. The passage was blind and ended in a small pool. The water was still and clear: the bottom flat clay. Nothing seemed to have been disturbed.

Holmes spent some time examining the bones and implements, and finally with obvious satisfaction announced that he'd found the murder weapon. He carefully lifted an old antler pick from the top of a pile of bones. It was stained and clearly

very old, but the point was freshly broken. Holmes turned it in his hands and finally tested its strength. Despite its great age it was still sound.
"We can match this to the bone fragment you found in the wound, but I'm certain they'll fit. It was a stroke of luck that the point broke, for we'd never have picked this out as the fateful weapon. See, there's no blood on it: probably got wiped off as it was withdrawn through his clothing."

We retraced our steps to the main chamber where we joined the three workmen sitting on a ledge where we'd left them.
"When first you entered the cavern, which route did you take?", asked Holmes.
"Exactly the same as today, Sir", replied John Hutton. "We came in following the wall, stopped about here and shone our lights across the chamber. I went down to the pool's edge and then the professor entered the side passage and called for us to follow".
"So those are your prints there?", said Holmes indicating a single line which led from where we sat down to the water's edge. "They do not continue back, I notice", commented Holmes,"but I assume you went from there directly across into the side passage, that way, which would mean that your return prints have been washed clear by the cascade".
"Yes, that's so, Sir".
"And there is no other way in?".
"No Sir", answered Poole, "leastways we ain't found one. We did look all round on the first day, as we left".
We shone our lights around the chamber: the walls fell vertically into the pool unbroken by any crack or crevice, while on our side only the known passages led off.

"Tell me", continued Holmes, "when you were digging through the blockage, how long did it take?".
"About five hours, leastways we started mid-morning and, but for a break fer dinner, we got through just before tea-time", answered the verger.
"How did you break the last bit, it was holding back a lot of water, wasn't it?".
"Well we cleared a lot of debris an' stuff by shovel so we could get at the solid crystal wall. Then we blew it with a bit of bang".
"Dynamite", explained the doctor, "the professor had got hold of a bit from Ingleton quarry".
"I see, and when the flood poured out, what was it like? Did anything get washed out?", asked Holmes.

"No sir", answered Poole with a shrug, "just water",
"Just water! Come, was it clear or muddy? Any leaves? Anything unusual?".

Young Robert took over as spokesman: "Well, it came out all in a sudden rush, like, just after we blew the choke. The water then was a bit muddy, brown mud not reddish like here and it pushed out a fair quantity of stones and debris and bits of broken stal' an' stuff. Then it cleared , while the main cave was draining, I suppose. After about half an hour the force of the flow was much less, down to probably about twice what the flow normally is. I'd say it remained much like that through the night 'cos it was still draining at a bit more than normal flow the next morning. We could clearly see all the debris then. Apart from mud an' rocks, there was only a few slimey leaves and quite a few coins. People were wont to throw pennies in over the stal' dam, as a sort of wishing well. There weren't nothing worth much: there was only one silver coin an' that had been cut so it weren't worth nothin'. Does that describe it for you Sir?".
"Yes thankyou. Well done, lad, an excellent summary of observations and deductions. We'll make a scientist of you yet", said Holmes.

"Now finally, the cave gate. On the day the dam was breached, was it locked straight away that evening?".
"Yes, about half an hour after it blew: after the initial rush had mostly gone down".
"And the next morning, when you all went in with the professor, it was locked behind you?".
"Oh yes, he was always most particular about that. In fact when we'd all got this far he asked Poole to go back and check. What with all the excitement, none of us was sure

he'd relocked it".
"Had he?".
"Yes sir", replied Poole.
"Weren't you afraid to go through the cave, alone in the dark?".
"Oh no sir, I'm used to it, done it many times on my own. I used to be a miner, you see", he quickly added by way of explanation.
"I see, and the day the professor went in alone. Did he lock it again after him then?", asked Holmes, adressing Robert.
"I was outside all day, mending the walls, and I saw him go in and lock the gate behind him. I know it was locked 'cos I tried it".
"And while you were outside the cave, did you see anyone else during the day?".
"Just three people. There was vicar, he came up the valley about mid-morning with his gun, off to do a bit o' shootin', I guess. Then much later, not long before I came down in the late afternoon, there was that Frenchman Le Mart. He came down Troll Gill and on down the valley back towards Clapton. He'd got his caving gear and was covered in mud, but he didn't stop or speak".
"And the third person?".
"Oh. That was Margaret, the gamekeeper's daughter. She, she came out to see me. We had a bite to eat together". Even in the gloom he clearly had blushed a deep red.

"Well Holmes", I said, breaking into his pensées, "my lantern is almost spent and so am I. I vote we head back to the warmth of the surface world.

And so shortly we re-emerged from the cavern's portal. We were all thoroughly soiled, being caked in the reddish clay up to our thighs. To add to this discomfort, a fine drizzle was now falling. By the time we got back to the village we were all soaked and bedraggled. Only young Robert still had a bounce in his step. Caving, it seems, agreed with him.

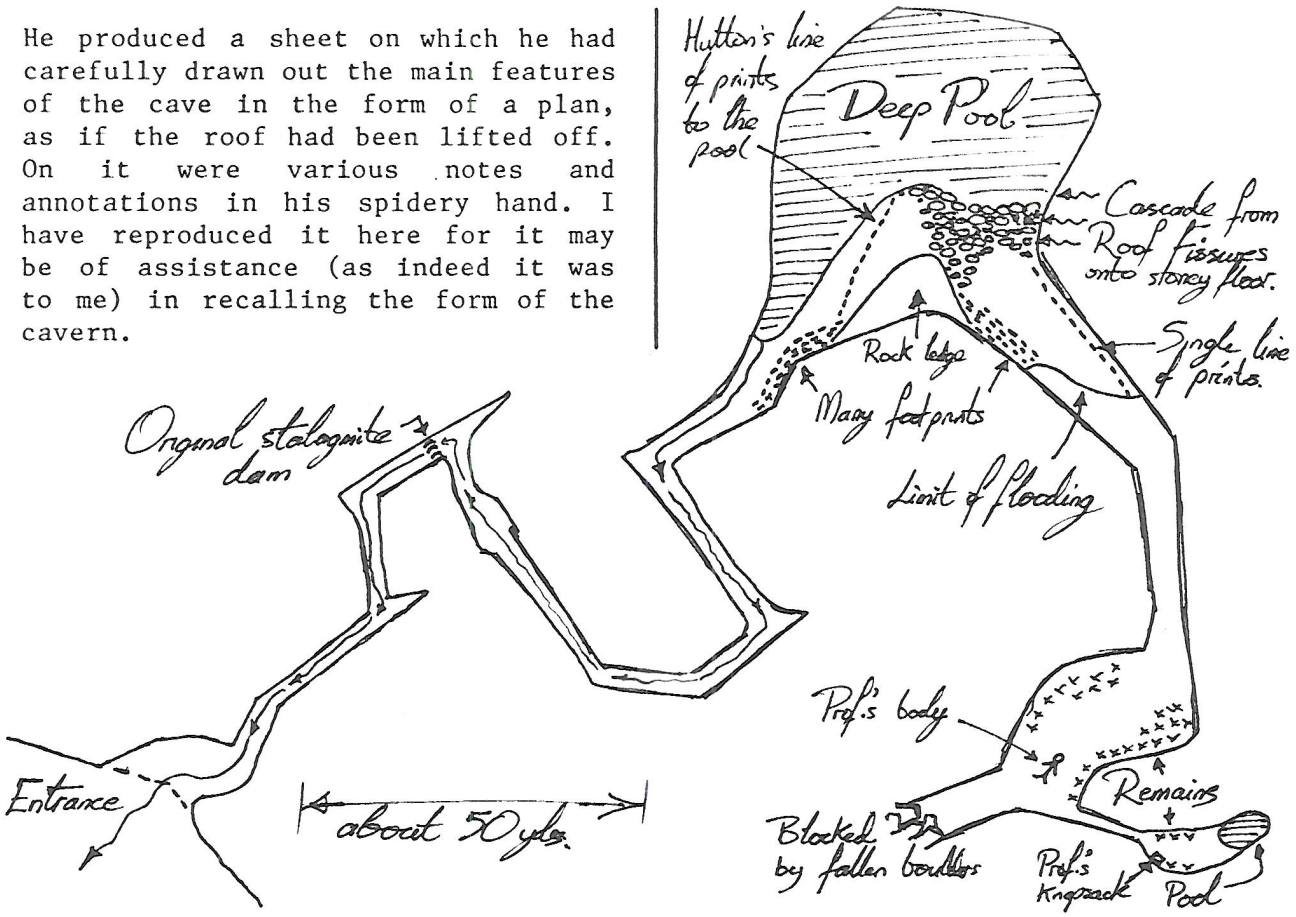
For ourselves, however, there was one more investigation to undertake before Holmes would call the day's work done: he insisted that we look over the body. In the chill of the ice-house the professor's body lay on the hurdle by which it had been carried from the cave. He was laid out straight, breast up, with his arms down his sides. There was a dark bloody stain over his chest. Holmes checked the palms - they were both unbloodied - clearly he had had no time to clutch at the wound as he died. Under the finger nails, one of which was broken, there was just mud, as Holmes pointedly observed although what he suspected to find I know not.

The cloth around the wound had been neatly cut by the doctor's examination. Laid bare it revealed a single, deep puncture penetrating to the heart which must have been virtually instantaneously fatal. Embedded in the wound was a half-inch fragment of the weapon. As expected it matched the antler pick perfectly. There was a lot of blood: it soaked the clothing of the chest and down over the abdomen. But it was the face, even to my untutored eye, which was most revealing.

Frozen in death, as in the last moments of life, the look was not of fear nor panic, but of grim purpose, perhaps even anger. This, to me, was more the visage of a murderer than of one about to be murdered.
"I thought you said he was a peaceful man, doctor", I remarked.
"Well yes, or so I knew him to be. This look I've never seen in his life, nor would ever want to".
"Maybe not", commented Holmes, "but it is nevertheless most interesting".

That evening, restored by a hearty supper we gathered by the good doctor's drawing-room fire and partook of his excellent port.
"Well Watson, so what do you make of today's exploration?".
"Fascinating, Holmes. I never realised that such a diverse and interesting world existed beneath the earth. Just think, only we half dozen men have ever been to the regions we visited today. Why, there are regions of darkest Africa better trodden: it makes the Upper Congo quite cosmopolitan by comparison. You know, if I had not become a surgeon and joined the army, I rather fancy I should have liked to have been a geologist".
"Indeed. But what about the case?".
"Oh".
"Well then let me precis today's observations. Here, I have sketched a map".

He produced a sheet on which he had carefully drawn out the main features of the cave in the form of a plan, as if the roof had been lifted off. On it were various notes and annotations in his spidery hand. I have reproduced it here for it may be of assistance (as indeed it was to me) in recalling the form of the cavern.



"So Watson, we have a man murdered in a cave, with only one entrance which is always kept locked. The keys are held by only two people: the victim and the victim's son".

"That suggests to me that the murderer got into the cave before the professor entered, and hid there, did the deed when his victim entered and then left unseen, probably when Robert went for help".

"That would have to be someone with access to either of the keys".

"That's so", said the doctor,"but he never let anyone have his own key and he certainly wouldn't have parted from it after the finds of the previous day".

"Reginald's key then?", I suggested.

"He likewise always kept the key on his person, so I doubt anyone else could have used it without his knowing".

"But that suggests just one person", I reasoned.

"You're thinking, I take it, of Reginald. An interesting thought. Yes, I admit it is possible. Moreover he has apparently been unable to establish an alibi for the afternoon, to the satisfaction of the police. He claims he walked over from Bentham, 'for the exercise', although strangely no-one seems to have encountered him. Yes I admit it is a possibility".

"And", I persisted, "all will vouch for the animosity there was between them".

"My dear Watson, animosity is one thing; murder is quite another. Why should he have wanted to kill him?".

"Inherited wealth?".

"You said, doctor, that he was in financial trouble. Yes, that could be a motive, but it does seem a bizarre way of going about it".

"Well if not Reginald, then who?", queried the doctor.

"Well", I replied, "both the vicar and Monsieur Le Mart were seen around the cave on the fateful day in question. And I gather that the police have been asking questions about them. Mrs Bannister tells me that several of the villagers have reported the arguments and battles between Prof. Farer and Rev. Gilpin".

"I'm afraid that folk will always gossip", retorted Holmes, "the art of the detective is to winnow out the exaggerations and petty deceipts from the obscured truth. Mind you", and now his tone softened, "while it affronts me that ignorance and prejudice should disrupt innocent lives, I must admit that an air of mutual distrust and accusation does serve to mask the probings of any searcher after the truth, such as I.

It may distress the accused innocent, but it invariably also lures the guilty to a false sense of security by hiding from his view the true direction of the hounds on his trail. But come, Watson, forget gossip, let us rely on fact. You said that both the vicar and Monsieur Le Mart were witnessed in the vicinity of the cave, but you seem to have forgotten that Margaret Martin, the gamekeeper's daughter was also there, was she not", chided Holmes, with a wry smile.

"Alright, I take your point. But, I still ask you to consider the evidence against that Frenchman Le Mart. He's been in the district for some six weeks prospecting around the caves. He was seen by Robert on the day near the cave. He, perhaps alone among all people, would have the knowledge, courage, equipment and skill to find another way into the cavern. What is more he had clearly been underground earlier the same day".
"Ah, now you're thinking clearer. But what motive?".

"Well, he is a renowned expert on archaeological remains in caves, and moreover was searching for remains of prehistoric man in the area. Knowing that the professor was onto an important discovery could it perhaps have been professional jealousy. Kill Farer and take some of the finds for himself".
"I find that a little unlikely: too many people already knew of the discovery. Besides murder seems a bit extreme to me however fanatical Monsieur Le Mart is".
"Alright", I countered, "he had been searching caves all summer. Could it not be that he had actually broken into the cave before Farer got in, but couldn't announce it since it was on private land. He might have been intending to remove the remains. But then the professor managed to get in past the stal' blockage. Perhaps he even came upon the Prof. underground", I admit that my imagination was starting to run riot.

"Now that might be nearer the mark. Yes that is indeed a possibility", replied Holmes.
"Well Holmes, you seem to know more than you're telling. Who, if not these three: Reginald, Gilpin or Le Mart, was it?", I demanded.

"Frankly Watson, at this stage it could be anyone". At this point he even had the temerity to look sidelong at Dr Bannister."But I do think we are a little nearer piecing together the events at his death. You commented on his face as being one of anger, and, though I doubt you noticed it, a hint of suspicion. What does that suggest to you?".
"That the murderer was seen by him, probably recognised by him, and that he had some, albeit limited, time to defend himself".
"You're saying he put up a fight?".
"Yes".
"Evidence?".
"There was a lot of scuffing on the floor and the wound was in the chest, inflicted by a short-hafted weapon. He wouldn't have just stood there and let himself be struck down at close range. I'm not surprised he was angry: I'd be if a chap was trying to stick me with a bit of antler".
"I agree there was a struggle. But why, if you're trying to kill someone who is unsuspecting, why not strike from behind?".
"I guess the killer bungled. Remember Holmes, it may have been dark with plenty of places to hide, but it wouldn't be at all easy to creep up on someone silently".
"True enough. But then why use a bit of old antler, it's hardly the most reliable weapon, although sadly it proved capable enough?".
"But Holmes, that's obvious!", I cried, pleased to find I'd bettered him at his own profession. "In a place filled with old bone implements it would be easy to discard the murder weapon. As you yourself said, it was only the luck of the point breaking off in the wound that allowed us to locate the weapon. Otherwise it would have been untraceable: an ideal murder weapon".
"That's as maybe", sulked Holmes, "but we really seem to still be no nearer the who, or the why. Yet I think that sufficient data should already be present, if only I could but realise it. I confess I need a few extra clues. I'd like to go back to that cave. Let's see how your new found love of caving survives getting into wet and muddy clothes in the chill of tomorrow's early morn!".

End of Part One

Was it Reginald, the Rev. Gilpin or that garlicky Frenchman Le Mart who murdered Prof. Farer? Or, did Margaret Martin, the gamekeeper's daughter, kill to protect the secret of her illegitimate love-child by the professor's "odd-job" boy, Robert? Forget Eastenders, Eldorado or Emmerdale: the real action is in the **IC³ Newsletter.** But only if you write something. The Newsletter needs articles, stories, reports, cartoons, reviews... anything, to keep going. And so keep you informed of all IC³s doings, provided you don't go missing without trace.

But what of Holmes' missing person? The clues are all in place - can you solve it before the great Sherlock Holmes? The final part is already written but cannot be published until there are enough other articles to go with it. So get writing.

IC³ Newsletter needs YOU
to write something (anything) NOW!

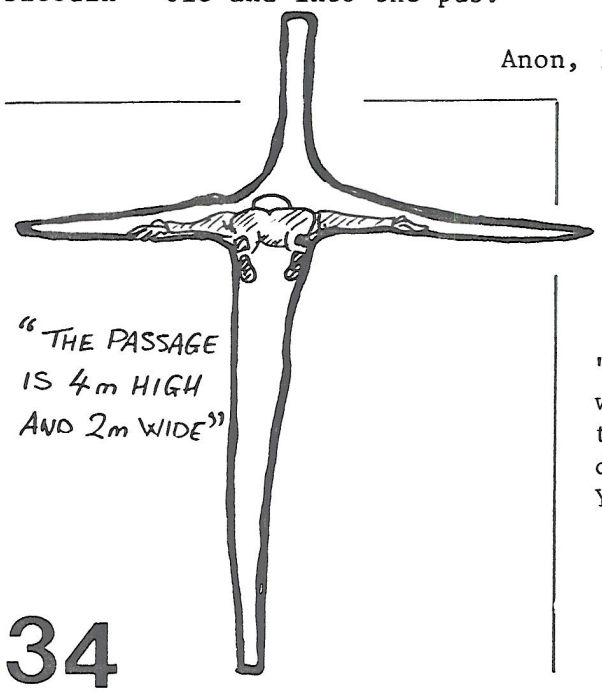
QUOTE - UNQUOTE

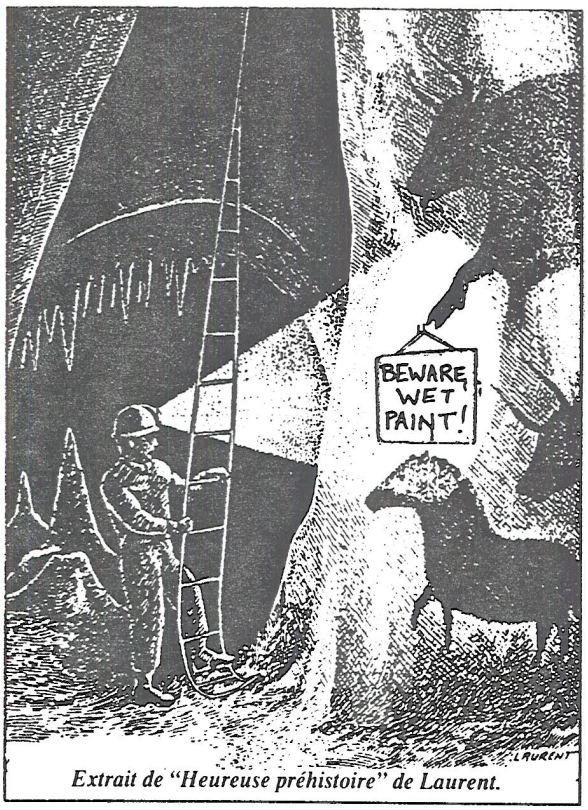
"What I love most is to battle with the waters of an underground river, to hold my own against water that tries to freeze my blood, to scale walls where danger lurks, where fear is gnawing at my heart. To share all this and more with my companions, bound together as a team, each one relying on each other to survive these dangers, scale the pitches and return once more to the surface, exhausted yet content."

Jean Cadoux, 1955

"What I love most is to get out of the bleedin' 'ole and into the pub."

Anon, 1993





Extrait de "Heureuse préhistoire" de Laurent.

QUOTE - UNQUOTE

"Yet I would still climb, even if there were no scenery to look at, even if the only climbing available were the dark and gruesome potholes of the Yorkshire dales".

AF Mummery

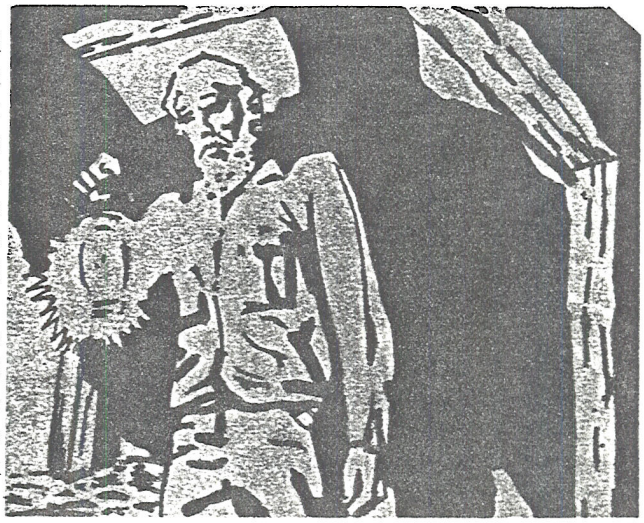
6. Who, searching for the Holy Grail is directed to Tim the Enchanter, who: .... "Knows of a cave, a cave which no man has entered", the Cave of Caerbanog? Its guardian killer rabbit they dispatch with the Holy Hand-grenade of Antioch, and so proceed to the Gorge of Eternal Peril.

7. An ex-potholer from a BBC thriller: who is he?
After his Green-activist daughter, Emma, is shot dead (by mistake?) this police officer finds himself warned off, misled and finally used, by higher powers. However his private investigations lead him to intrigues at the highest levels of Whitehall and big business, and eventually to a dark secret, hidden deep underground.

Accompanied by a CIA agent he manages to penetrate Northmoor, a low-level nuclear waste store located on an old mine. They are met with "ultimate force" but manage to get into the highly radioactive "hot cell" to discover the awful truth. The company, IIF, is operating an illicit plutonium reprocessing plant.
[For an extra 100 points: where does Imperial College get a mention?]

8. A mining engineer by profession, this army deserter unwittingly gets involved with smugglers bringing cheap Italian booze into austere post-War England.

Originally the goods were landed into a sea-cave at Wheal Garth an old tin mine at Botallack, Cornwall. But now they've got a skilled miner, the leader, Monack, wants him to blast through the roof of an undersea mine level so that they can dump the goods overboard into the flooded tunnel and so haul them up unseen into the mine. But they haven't allowed for Monack's obsessive father who has discovered a rich lode of tin, and who will do anything, even murder, to protect his beloved mine from being flooded from the sea. [Right]



9. A family of neanderthals migrate from the coast to their summer home in the mountains: a secure cave perched in the walls of a river gorge, just upstream of a large waterfall. But their peace and safety is shattered by the arrival of a different type of humans: ones that can control fire, build huts, make weapons and kill neaderthals. The cave is no longer any protection and only one survives. Who is he?

10. Which film made in 1951?
When an amateur archaeologist is trapped by rockfall in a cave behind an ancient indian cliff dwelling in New Mexico, the (un)timely arrival of a newspaper reporter (Kirk Douglas) makes the story big news. The ambitious reporter deliberately prolongs the rescue to increase his newspaper fees. Joe Public turns up en masse and the whole incident turns into a grotesque carnival. But the fun turns sour when the trapped man dies before they can get him out.

11. Leaving the island of the enchantress Circe, this adventurer had to pass the caves of Scylla and Charybdis. Who was he?

12. Who followed a rabbit underground?
"The rabbit-hole went straight on like a tunnel for some way, and then dipped suddenly down, so suddenly that she had not a moment to think about stopping herself before she found herself falling down what seemed to be a very deep well."

QUOTE - UNQUOTE

"A hole is nothing at all, but you can break your neck in it".

Austin O'Malley 1858-1932

Ten Little Cavers

Ten little cavers,
Went off to do a mine.
One found a hidden shaft,
And then there were nine.

Nine little cavers,
Found Lancaster in spate.
One tried the water's depth,
And then there were eight.

Eight little cavers,
Exploring down in Devon.
One got locked inside a cave,
And then there were seven.

Seven little cavers,
Clearing chokes with picks.
One caught a falling rock,
And then there were six.

Six little cavers,
Learning how to dive.
One stayed down too long,
And then there were five.

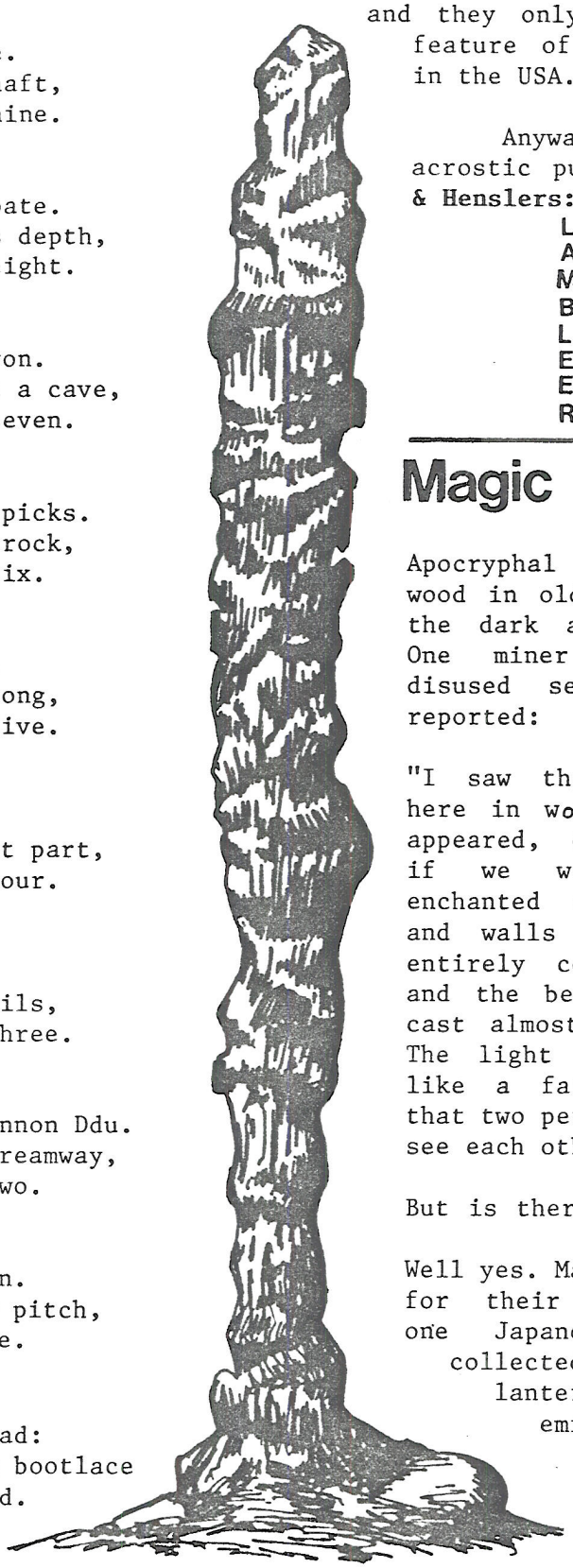
Five little cavers,
On a calcite floor.
One sat on the weakest part,
And then there were four.

Four little cavers,
Abseiling down G.G.
One forgot his cowstails,
And then there were three.

Three little cavers,
Splashing through Ffynnon Ddu.
One slipped in the streamway,
And then there were two.

Two little cavers,
Prospecting in the sun.
One found a brand new pitch,
And then there was one.

One worried caver,
Took up dancing instead:
Tripped on a trailing bootlace
And now he too is dead.



ANSWERS TO ACROSTIC in issue 16.

Now overtaken by crosswords, acrostics were the most popular form of word play in English-speaking countries from about 1860 to as late as the 1920s. By 1915 eight London newspapers ran a daily acrostic: today they are virtually unknown. In contrast crosswords, in a form deserving of the name, can only trace their lineage back to 1913 and they only became a regular feature of newpapers in 1924 in the USA.

Anyway, the solution to acrostic puzzle was **Lamb Leer & Henslers:**

LANGSTROTH
A L P I N E
M A I L L O N
B O G G A R T S
L A T E R A L
E N T R A N C E
E A S T E R
R E B E L A Y S

Magic Mushrooms

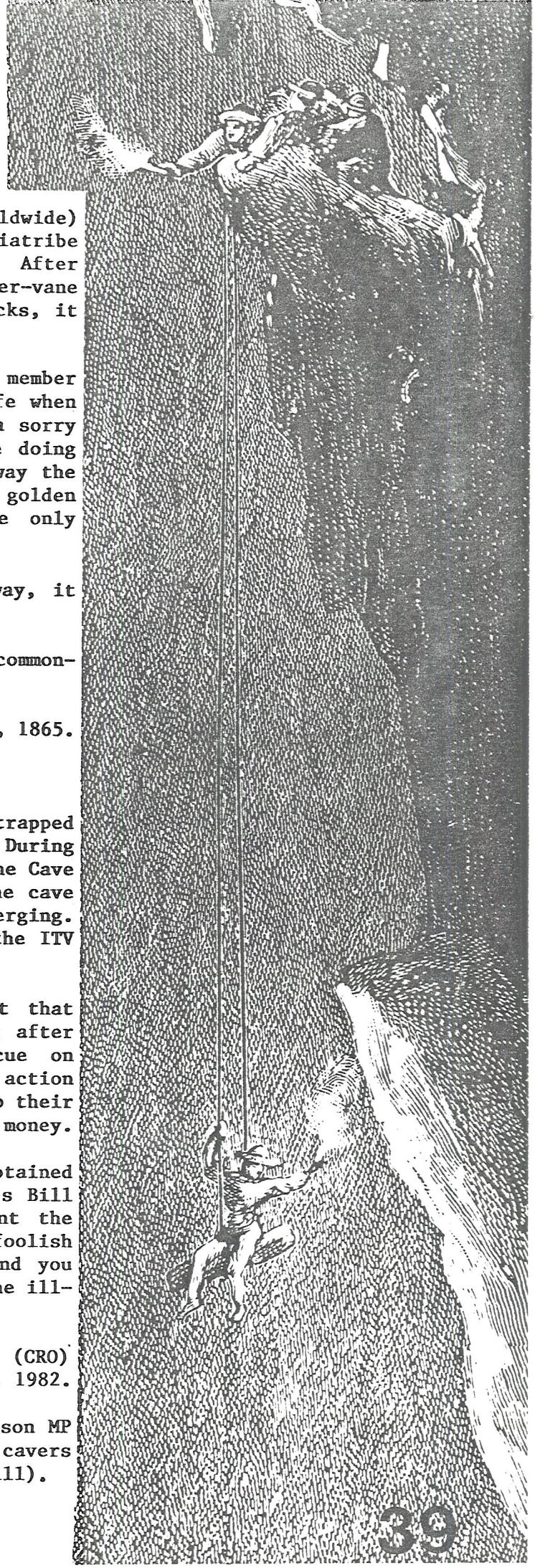
Apocryphal tales of rotting wood in old mines glowing in the dark are well recorded. One miner on entering a disused section of a mine reported:

"I saw the luminous plants here in wonderful beauty. It appeared, on descending, as if we were entering an enchanted castle. The roofs and walls and pillars were entirely covered with them, and the beautiful light they cast almost dazzled the eye. The light they gave out is like a faint moonshine, so that two persons could readily see each other".

But is there any truth in it?

Well yes. Many fungi are noted for their luminescence and one Japanese mushroom is collected for use as lanterns. Why some fungi emit light is not clear though it may attract spore-dispersing flies.

Now & Then



In 1865 (a time of great explorations worldwide) "The Times" launched a bitter diatribe questioning the ethics of climbers. After applauding the feats of sailors, weather-vane cleaners, chimney sweeps and steeple jacks, it continued:

"But in the few short moments that a member of the Alpine Club has to survey his life when he finds himself slipping, he has but a sorry account to give of himself. What is he doing there and what right has he to throw away the gift of life and ten thousand golden opportunities in an emulation which he only shares with apes, cats and squirrels?"

Then, concluding that they'd do it anyway, it ended:

"But is it life? Is it duty? Is it common-sense? Is it allowable? Is it not wrong?"

Editorial, "The Times", 1865.

.oOo.

In January 1982 a group of cavers were trapped by flooding in the West Kingsdale system. During the rescue an ITN camera crew persuaded the Cave Rescue Organisation to take them into the cave so that they could film the victims emerging. The film was used as the lead story on the ITV evening newscasts:

"Now it is a well-established fact that everyone becomes an authority on caving after seeing five minutes cover on a rescue on television, and this syndrome swung into action that night. About a dozen people wrote to their MP deploring this waste of taxpayers' money.

The MP for Skipton, John Watson, obtained Parliamentary Time for a Private Member's Bill on May 5th, and hit the media. Present the public with a scheme to charge those foolish enough to get in trouble down caves, and you will tend to get waves of support from the ill-informed."

Dr John Frankland (CRO)
"Caves and Caving", 17, 1982.

(After a meeting with the CRO, John Watson MP was taken on a caving trip, met local cavers in the pub afterwards, and withdrew his Bill).