

**MATIENZO  
NORTH SPAIN**



**THE 1974  
BRITISH  
EXPEDITION  
REPORT**



Note: 4/3/2022

# Matienzo, North Spain

## The 1974 British Expedition Report

Cave surveys published in this 1974 journal were all printed on pieces of paper for purchasers to stick together. These surveys have now been scanned and digitally stitched together.

They are published on the Matienzo Caves Project website in the "Surveys" section within the relevant page description. E.g.

<http://www.matienzocaves.org.uk/descrip/0048.htm> for Reñada.

### Surveys

Oñite Inlet Sima-Cueva del Risco	0027 0025
Torca de la Cabaña (Vera Negra)	0036
Cueva del Agua (Molino)	0059
Cueva-Cubio de la Reñada & Comediante	0048
Cueva del Caravuezo	0081
Cueva Riaño	0105
Cueva Uzueka (Hoyuca)	0107



Report of the  
1974 British Speleological Expedition  
to the MATIENZO area of SANTANDER  
Province of Northern Spain.

Organised by Manchester University Speleological Society

"Oh Spain it is a gallant land where wine and ale flow free.  
There's lots of lovely women there to dangle on your knee.  
And often in a tavern there we'd make the rafters ring.  
When every soldier in the house would raise his glass and sing".

- from Tommy Makem's version of  
"Fare thee well ENNISKILLEN.







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EXPEDITION MEMBERS. (Alphabetical).

<u>Name</u>	<u>Club</u>
Broomer, Wendy	K.C.C.
Clyde, Christine	
Cope, John (J.C.)	M.U.S.S.
Cope, Trish	M.U.S.S.
Cornelia, Sean	
Davey, June	B.S.C.
Davey, Stewart	B.S.C.
Davies, Barry	D.C.C.
Davies, "Goldie"	
Dickenson, Paul	B.S.C.
Dickenson, Tony	B.S.C.
Dickenson, John	M.U.S.S.
Finch, Andy	M.U.S.S.
Hale, Allan	B.S.C.
Henson, Pam	U.L.S.A.
Linton, Dave	M.U.S.S.
Mills, Hilary	M.U.S.S.
Mills, 'Lank' (Leader)	M.U.S.S.
Moys, Chris and Tricia	M.U.S.S.
Plumb, Keith	M.U.S.S.
Rowlands, Dave	
Rugg, Dennis	M.U.S.S.
Rugg, Rhoda	M.U.S.S.
Smith, Pete	M.U.S.S.
Taylor, Ron	B.S.C.
Tringham, Carol	U.L.S.A.
Tringham, Dave	U.L.S.A.
Turner Joe	B.S.C.
Wood "Squirrel"	B.S.C.
Yeadon, Geoff.	K.C.C.
Yeadon, John	K.C.C.







# WHAT THE PAPERS

17 agosto 1974

ALERTA — Crón

## **MATIENZO**

### **COLONIA INGLESA DE VERANEIO**

Una muy numerosa colonia de ingleses ha escogido nuestro pueblo para pasar sus vacaciones de verano. En varias tiendas de campaña, instaladas en el cagigal de "La Secada", jóvenes y mayores de distintas familias y profesiones confraternizan con la gente del pueblo.

Grandes aficionados a la espeleología, algunas simas, de las muchas que hay en el pueblo, saben de sus andanzas.

Es verdaderamente admirable su capacidad de adaptación a las gentes y costumbres del pueblo. En algunos bares, al caer la tarde, y primeras horas de la noche, se organizan veladas musicales de las que son activos participantes.

El pasado domingo se organizó en los campos de "El Molinón" un partido de fútbol entre un equipo del

pueblo y un combinado inglés. La expectación fue grande, respondiendo el partido al interés despertado. El triunfo fue para los "matienzanos" por 7 a 5, adjudicándose, por tanto, el trofeo donado por el Bar Germán Solana; pero éstos, en un gesto de auténtica elegancia, ofrecieron el trofeo a los ingleses, que lo recibieron con gran alegría.

Bien, pues esto nos puede servir como ejemplo para resaltar la hospitalidad de nuestros pueblos, y cómo unas personas totalmente extrañas a nuestros modos de vida y costumbres, se pueden sentir a gusto entre nosotros, participando incluso en nuestra vida cotidiana.

JESUS AJA BARQUIN

## **CASTRO**

### **OBRAS**

Donde se inicia la su Marfa, y desde el final de "Los chelines" hasta la Cofradía de Pescad procedido a la corrección de escaleras, que es defectuoso, color procedentes del derribo de la Villa", amén nuevo piso más anterior, antiguísimas producirse caídas.

Dicha obra romana precisa importancia, y beneficio para

## **NOTICIAS DE ONTON**

### **DIA DEL TURISTA EN**



# SAID !



Translation.

MATIENZO

AN ENGLISH SUMMER COLONY

A large colony of English people has chosen to spend their summer holiday in our village. In various bell-tents they are camped in the copse called "LA SECADA", young and old from different families and professions they mix with the villagers.

Tremendous lovers of speleology they have explored to the limit some of the many caves around this village. It is truly admirable their capacity for adaption to the people and customs of the village. In various bars at the end of the evening and in the first hours of the night, they organise musical (?) SOIREES in which they are active participants.

Last Sunday a football match was organised in the field of 'EL MOLINON' between a village team and an English combination. The expectation was high and the game responded to the aroused interests. The MATIENZANOS won 7-5 thereby winning the trophy donated by the Bar GERMAN SOLANA. However in a truly elegant gesture they offered the trophy to the English who received it with great happiness.

Good! Then this can serve as an example of how to project the hospitality of our villages, and how some people totally unfamiliar with our ways of life and customs, are able to mix amongst us with pleasure including participation in our daily life.

\* \* \*



### ACKNOWLEDGEMENTS

We would like to thank all those in Spain who helped us in making the expedition so successful and pleasurable. In particular we should mention Snr. JOSE MEDINA FERRER of the Comite National de Espeleologia for every assistance in obtaining the necessary permits; Snr. JUAN CARLOS FERNANDEZ GUITTEREZ for his much valued assistance and advice on the geology and tectonics of the area; Snr. GERMAN SOLANA GOMEX, his wife and family and all the villagers of MATIENZO and RIANO for their overwhelming friendliness and hospitality.

The "Editorial Staff" would also like to thank the staff of Frank Peters (Printers) of Kendal and Mr. G.A.Widdop of Newby for their enthusiastic help and hard work without which the report could never have been completed so rapidly.

\* \* \*



## INTRODUCTION

"Particularly wet Spanish fuzz looked at J.C.'s smashed head-lamp and said it is necessary to replace with new 'Pilot' whatever he meant - ignored him and drove to MATIENZO where it was still raining and all wazzaks were still in bed" - J.C.

M.U.S.S. interest in Northern Spain started in 1961 when three members accompanied an Oxford University Expedition to the Picos de Europa. Interest in this particular area continued for many years, with expeditions almost every summer until 1968. In that year several new caves were explored, bringing the total length discovered to over 2 kms.

It had though, become evident over the years that our hopes for the area were not well-founded. A combination of frost shattered rock choking the holes at high altitudes and a near-vertical dip meant that we were expending a great deal of effort for little return.

In 1969 several members went to Spain to visit friends in AMIEVA - the base for previous expeditions. The visit was largely social but was combined with a reconnaissance in the CANTABRIAN mountains further east. Several areas of interest were noted near RIANOSA (Lancaster University cavers have since explored several caves in this area) and the party eventually arrived at RAMALES DE LA VICTORIA in the province of SANTANDER. It was evident from the large cave entrances visible from the road that the caves here were well-developed; so we investigated further. By accident we stumbled across a group of Spanish cavers from the O.J.E. (the Spanish Youth Movement) and were taken down la CUEVA DE CULAVERA. This they said was at least 6 kms long, and certainly the passage we traversed was very big indeed. We then drove on up the RIO ASON noting other entrances on the left and climbed up the steeply winding road to PUERTO ALISAS. Darkness was falling so camp was made on the top of the pass.

Very early in the morning we rose to see the amazing sight of the three interconnected valleys to our right, full of mist, while we could look over to the sea and the rising sun. This was our first sight of the enclosed depression of MATIENZO, and most impressive it looked. It also appeared interesting from a speleological point of view with massively bedded limestone and near horizontal dip. The similarity of this depression to the "POLJES" of Yugoslavia where the KARST is very well developed also seemed to indicate the possibility of extensive cave systems. Later that year as we returned along the coast we stopped at the caves of ALTAMIRA and Lank bought a copy of the Spanish caving publication QUADERNOS II which showed that the Spanish cavers had already done considerable work in the area of MATIENZO.

Next year we organised a small expedition using the club's Commer van. Eleven of us spent about 2 weeks in the MATIENZO area looking at only the most obvious entrances. Descents were made of LOCA II, CUEVA DEL AGUA, SIMA-CUEVA DEL RISCO, JIVEROS I,II,III, CO-MEDIANTE and several other known caves and the entrance to CARCAVEUSZO was discovered. This cave was explored for a short distance to the main river but no way on could be found through the choke. The entrance to CUEVA DE LA UZUEKA was looked at and the small caves nearby were explored.



1971 saw an abortive attempt by a small group to return to the area. The vehicle broke down and altogether little caving was done. (Fairly typical. -Ed.) The only notable discovery was the finding of a way on through the choke in CARCAVEUSZO. Unfortunately the river sumped after a relatively short distance in view of its potential of 3.5 kms. No other way on was obvious.

In the autumn of that year two members en route for South Africa stopped off for a few days to investigate CARCAVEUSZO further. One swam round the terminal lake but could not find a way on.

In 1972 Lank and Hilly visited the area on the way to Southern Spain. They visited the resurgence at Secadura and thought it merited further investigation. The entrance to CUEVA RIANO was found. The strong draught there proved quite capable of extinguishing a camping gaz light - their only source of illumination!

Disappointingly there seemed little interest in organising a trip in 1973 and only J.C., Trish and Martin joined Hilly and Lank. Though organised as a holiday to the South the women did allow the men a few days caving at Matienzo. This turned out to be extremely successful. In three days they explored CUEVA RIANO for an estimated 3 kms and CUBIO DE LA RENADA was extended from c. 600 metres to an estimated 4 kms. Both estimates proved to be a little optimistic! The cave at RI. TUERTO was also explored for about a half km.

The party's return to England with stories of vast galleries and pretties began, at last, to stir the rest of the club into something resembling enthusiasm.

Thus in late July 1974 a full-scale expedition began to arrive in MATIENZO by means both many and varied. By train, boat, car, plane, hitching and even bicycle they cursed and mumbled into the grove of oaks that served as a camp site. Grumbling about poor directions, sore backsides or just grumbling the happy band of pilgrims set up their tents. In the evenings there was celebrating to be done, cheap wine to be drunk and drunk and-- - -.

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"arrived last night in two days hitching from Dieppe. Included - a young frenchie who bought me a vastly expensive meal of lampreys - taste dubious, and a 14 year old flasher on a bicycle" - Pam.

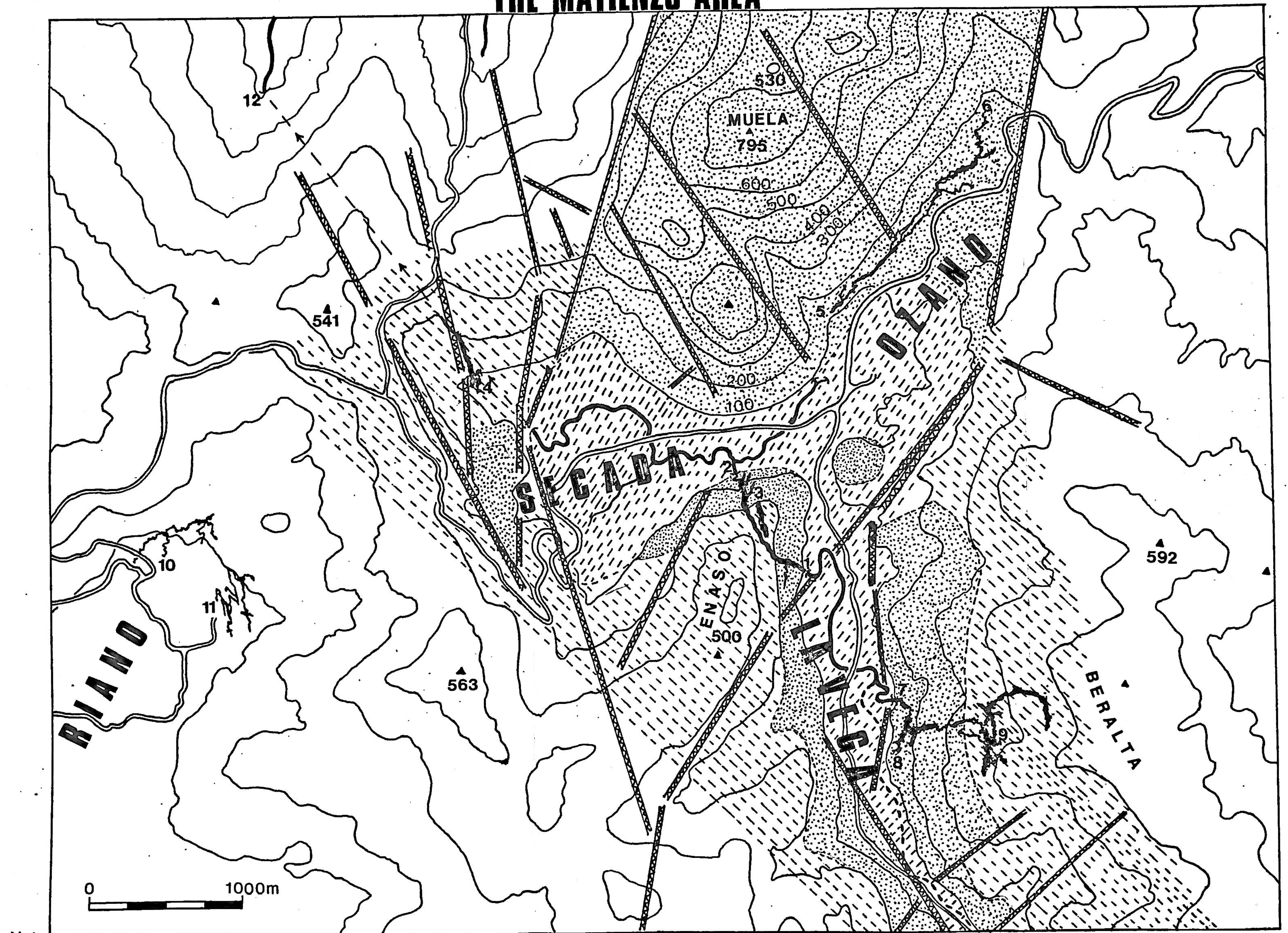
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Unfortunately all good things must come to an end, and so the caving began.

CUEVA TIVA had been investigated by the first arrivals and a draughting aven climbed by Geoff. to a dubious choke. CARCAVEUSZO was surveyed and various nasty extensions pursued without any major discoveries being made. Several groups then set off into CUBIO DE LA RENADA and after several trips reached the end of the main open passages. Five survey trips were required to produce c. 4.4 kms of passage surveyed to Grade 5b standard. With the work in Renada nearing completion new discoveries began to demand attention. CUEVA ONITE was explored and connected to RISCO and almost simultaneously the entrance to LA TORCA DE LA CABANA was found and exploration started. With parties surveying CUEVA DEL AGUA and Geoff diving CUEVONA this period marked the peak of activity.

Attention then turned to the caves around RIANO. Most of CUEVA RIANO was surveyed before the team were diverted to CUEVA DE



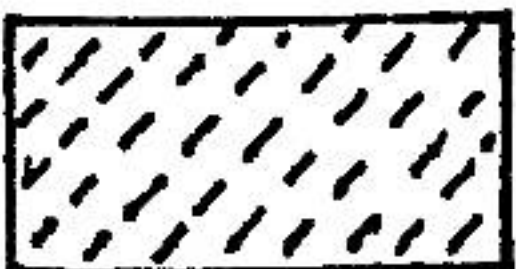
# THE MATIENZO AREA



## KEY

 Urganian Limestone

 Limestone Clay & Sandstone

 Impervious Wealden Rocks

 Faults

1 Agua

2 Cueva

3 Cofresneda

4 Carcaveuszo

5 Risco

6 Onite

7 Comediate

8 Renada

9 Torca de la Cabana

10 Riano

11 Uzueka

12 Secadura resurgence



# THE MATIENZO AREA



- 7 Comediente
- 8 Renda
- 9 Torca de la Cabana
- 10 Riano
- 11 Uzueka
- 12 Secadura residence
- 1 Agua
- 2 Cuevas
- 3 Cofresedo
- 4 Carcavanzo
- 5 Risco
- 6 Onite
- Impervious
- Weakn Rocks
- Faults
- Limestone
- Clay & Sandstone
- Urgonian
- Limestone

KEY



LA UZUEKA where an entrance was engineered and the cave explored and partly surveyed in four trips. As people began to leave Rhoda, Dennis and Keith extended and surveyed CUEVA MORTIRO (or MORTILO).

It now became imperative to recover the tackle in time for J.C. and D.L. to get it back to England so several lengthy trips were made into the TORCA to complete the pushing and surveying as much as possible before detackling. As Dave's Land Rover set off north only a few ladders remained underground in RENADA where they stayed for four days while the heavens opened and torrential rain brought a welcome relief from caving for the three remaining cavers. The trio were still left with much surveying and photographic work in RENADA and UZUEKA. A reluctant J.D. was dragged out of alcoholic retirement by Lank to conduct a surface traverse between RENADA and the TORCA. The traverse unearthed several interesting pots which were carefully not descended.

At 4.30 am one Sunday morning the expedition finally came to a close in the bar when at last Geoff and Lank fell over.

Altogether the expedition was an unqualified success with nearly 15 kms newly explored passage to its credit. Even so, each new discovery seems only to have opened up even greater possibilities. The prospects for the future can only be described as magnetic.

\* \* \*

#### Some Notes on Survey Work

The surveying work undertaken by the expedition was accomplished by an assortment of ad hoc teams dictated in their composition by the condition and availability of cavers. This does not seem to have detracted significantly from the hoped-for speed and efficiency. Roughly 16 kms of cave were surveyed in less than a month. In addition 3 kms of surface survey work was undertaken. The standard aimed at was Grade 5b on the old C.R.G. scale. This was achieved in almost all cases, though in some of the more tedious passages of little significance Grades 1 and 2 were resorted to. In addition the sheer volume of work meant that most large chambers were not fully surveyed - usually just a single line was taken from the point of entry to the exit(s).

Unfortunately time and tiredness left us with some passages still unsurveyed which detracts from the value of some of the surveys and no attempt has been made to sketch these passages on because of their complexity.

The equipment used was as follows:

- 3 Suunto Compasses
- 2 Suunto Clinometers
- 2 30m Fibron Tapes
- 1 20m Fibron Tape.

This allowed one main team (taking fore and back bearings) and one subsidiary team to operate simultaneously. Unhappily the work was hindered by the dismal quality of the two new Rabone Chesterman tapes



which disintergrated with a speed only equalled by President Nixon's.

Finally because of the small scale (1:50,000) of the available maps a number of surface traverses were undertaken. The underground equipment was used on these and while the difficult terrain might have made these suspect, the Agua-Cuevona closure via the sump suggests a reasonable accuracy.

"Next hour or so spent crashing through impenetrable jungle....Nearly lost Squirrel in ear-high gorse bushes". - J.C.

\* \* \*

### THE GEOLOGY OF THE MATIENZO DEPRESSION

This subject is dealt with far more fully in the Notes on speleogenesis. It is however felt that the reader will benefit from a basic knowledge of the set-up and to this effect Figures A,B and C are included opposite. It is hoped that these will help clarify the following text.

\* \* \*

### The Caves of the MATIENZO Depression.

#### CUBIO DE LA RENADA and CUEVA COMEDIANTE.

##### i) Exploration.

This cave was not visited by us on our expeditions until 1973. In QUADERNOS II is a description of the part explored by the Spanish and their survey proved fairly accurate. In 1973 JUAN CARLOS expressed the opinion that the cave deserved further attention. So the M.U.S.S. exploration team of J.C. and Lank was set into motion. They first explored Comediente, finding it much as described. They then went on to try to find the entrance of Renada. The 200m that the entrance was supposed to be away turned out to be considerably more. After thrashing about in undergrowth for half an hour they located the entrance, cold air blowing strongly from it attracting their attention.

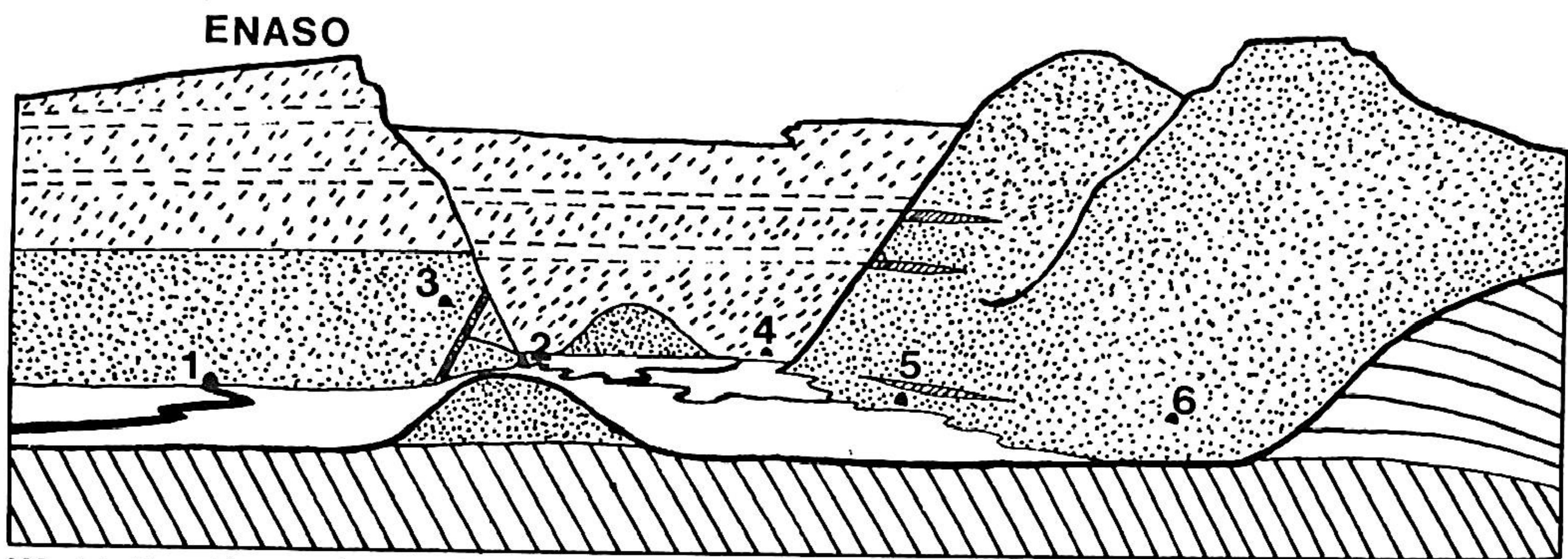
The known cave was soon explored and J.C. climbed the calcite slope at the old end, finding that it choked somewhat higher than the question mark on the Spanish survey. They now turned back to visit the "GOUR PROFUNDO" where written on the wall was the word "FIN" but no gour. (The heavy rains later in the year's expedition caused the reappearance of the lake some 10m long and c. 2m. deep). Crossing the flat mud floor to the other bank the pair ascended steeply into the unknown! Almost immediately light could be seen streaming down from a higher entrance. Climbing up they found themselves looking out over the valley from an entrance larger than the first but almost as well hidden. JUAN CARLOS had mentioned the existence of this second entrance but had never investigated it.

Turning back down the slope they were surprised that the passage split; to the left was the way they had come from. To the right was a steeply sloping calcite slope. It had puzzled them that



# SIMPLIFIED GEOLOGICAL DIAGRAMS

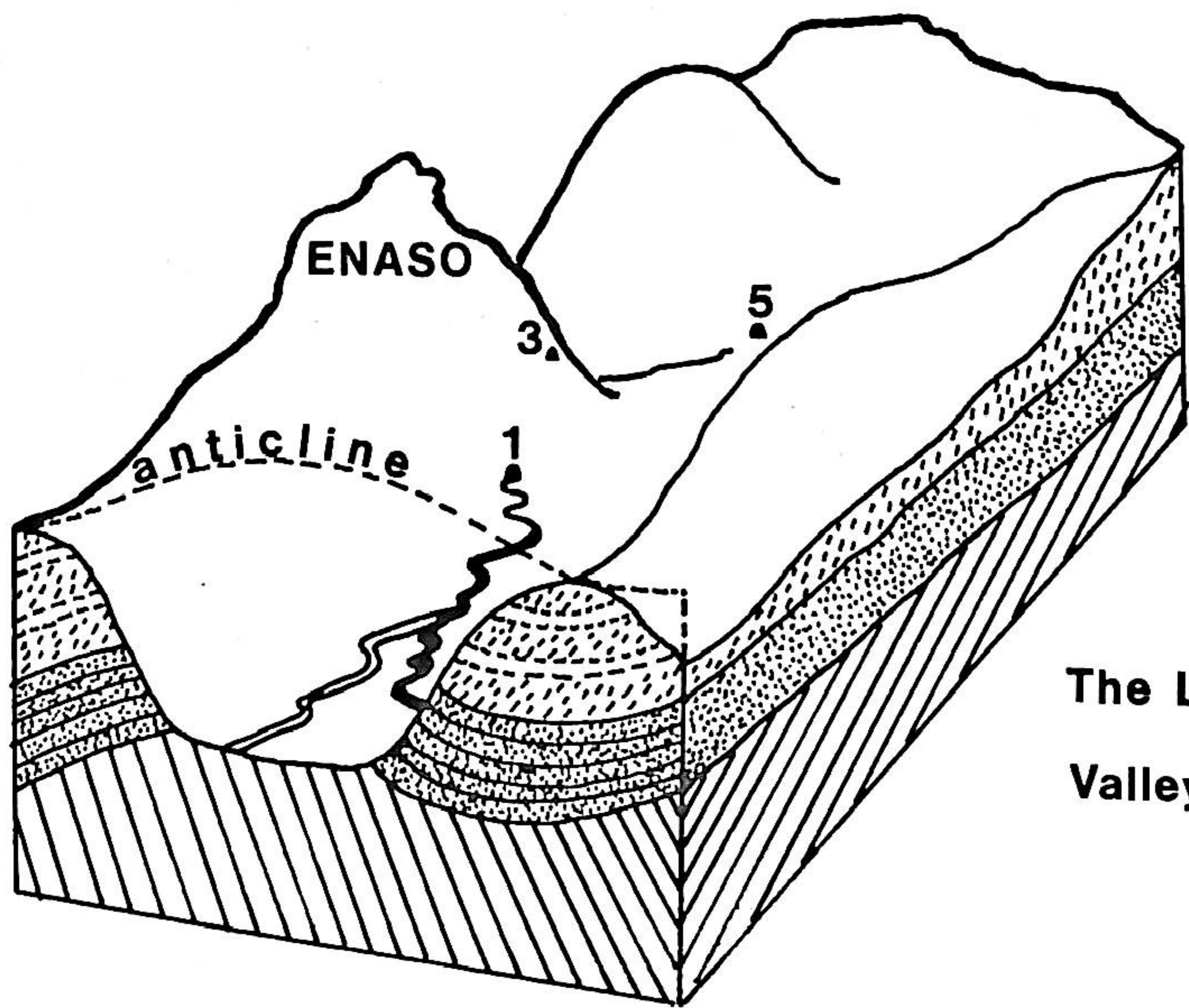
FIG 2



W-E Section through Matienzo



FIG 3



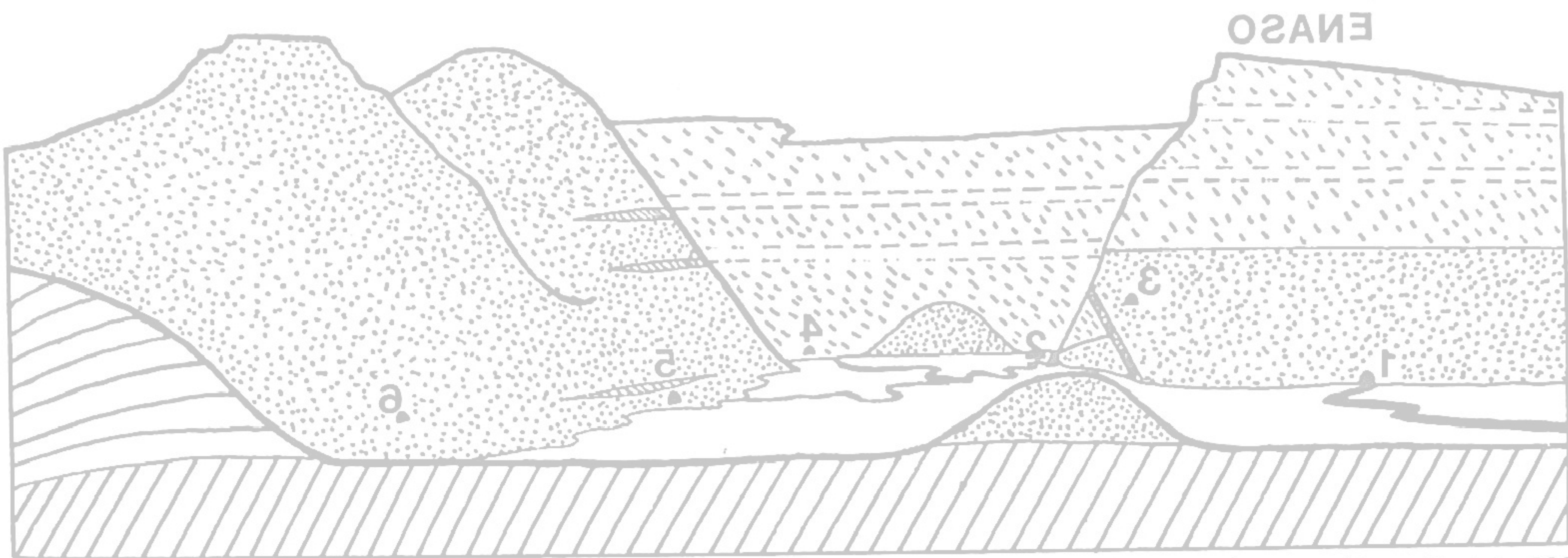
The La Vega Valley looking East

- |           |               |         |
|-----------|---------------|---------|
| 1 AGUA    | 3 COFRESNEDO  | 5 RISCO |
| 2 CUEVONA | 4 CARCAVEUSZO | 6 ONITE |



# SIMPLIFIED GEOLOGICAL DIAGRAMS

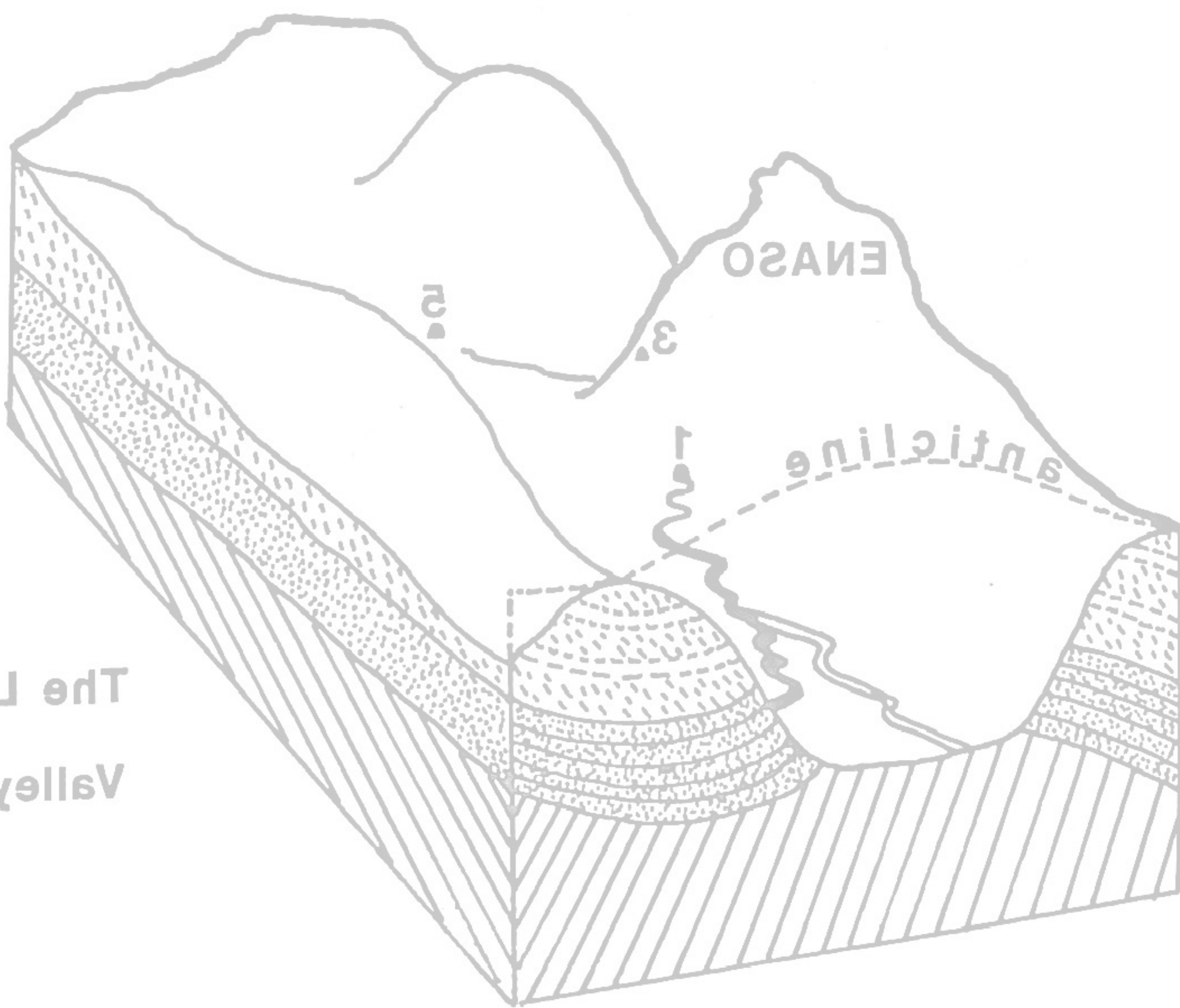
FIG 2



W-E Section through Matienzo



FIG 3



The La Vega Valley looking East

- 1 AGUA
- 2 CUEVONA
- 3 COFRESNEDO
- 4 CARCAVENSZO
- 5 RISCO
- 6 ONITE



there was no apparent draught at the top entrance but now the reason became obvious - a strong draught was coming up from this right hand branch. As it levelled out the floor became very slippery due to a thin mud coating.

"We carefully made our way along a large passage but were disappointed to see the walls apparently meeting the floor in all directions. When we stopped to look about we simultaneously heard an exciting roaring sound. 'The river' J (Lank) shouted and desperately started scrabbling about looking for the source of the sound. J.C. meanwhile had dropped to floor level and shouted 'It's not the bloody river, it's a bloody draught'".

The sound was caused by the air roaring through a very small hole above the calcite floor. Luckily this was easily dug away to allow a body to pass through. They were both soon through into "caverns measureless to man", on to a 'duck' and beyond to a fantastic network of caves. Right they explored up Eagle Passage and stuffed Monk Gallery. To the left they came to the fantastic Blood Alley and passed on to FALSE FLOOR CHAMBER. Time and what seemed to be a pitch down into a lake provided the excuse to call it a day. Here or 'downstream' from Blood Alley were felt to be the ways on - both proved to be wrong assumptions in 1974. Well pleased the pair retreated vowing to return.

1974 saw successive parties pushing on above the "pitch" over "J.C's lake" into the mountain; through large but difficult galleries and massive chambers to find the river passage and to be thwarted by a sump. Some determined work by the Bolton opened up some 'fine' sections of passage below the old dry galleries.

" - revealed a new virgin passage going off somewhere from the big stuff beyond CASTLE HALL, a rather loose extremely sharp and generally nasty passage with a trickle of water in it leading via deep pools and a crawl into a yast chamber (well it seemed it at the time) .... another passage entered at the far side.... led to a sump which S.Davey boldly decided to push whilst Joe decided to have a look down a crawl which he'd noticed was at a lower level than the sump pool. Crawl very tight and awkward".

By feeling through the sump S.Davey could just feel airspace and took the plunge to pass into a small airbell. From this a canal with a 3" airspace into a rift and up through the floor into Ghost Gallery.

Elsewhere the complex web of passages was gradually unravelled and surveyed until over 5.kms of passage had been found with still good prospects of extensions with some effort.

#### ADDENDUM

##### SQUIRREL'S PASSAGE

"Whilst poking about in a passage off False Floor Chamber, a very insignificant boulder choke was passed into a rather undignified crawly passage. After a short distance it was possible to climb down a slope into a more comfortable passage; the left hand branch ran back to the chamber and so the right was pursued. Hands and knees stuff soon developed into traversing in the 'roof tube' of a slanting rift where the sound of water encouraged us to descend and investigate. A 6m drop was negotiated through sharp and heavily-fossilised rock to the edge of a small lake.

The upstream end of the lake sumped after about 20m (1) but



downstream a swim under a low arch brought one into a high canal passage about two metres wide with a series of washed out basins in the floor. Here the first explorer stopped but realised that even though the passage would sump before COMEDIANTE a considerable potential still remained.

A reinforced party returned a few days later and pushed on through deep pools and down cascades to a canal junction. The right hand branch appeared to sump after a few metres with a strong current flowing in that direction. To the left more swimming brought the party to a rift where they could walk for a short while before they took to the water again leaving occasionally to investigate dry cross rifts - all of which choked. Two branches off the canal both sumped but half-expecting and half-hoping the main passage would sump they swam on. Eventually it did sump in a complex area of massive flakes jutting out of the water. (2)

- (1) This was later bypassed to a second sump chamber.
- (2) For practical and health reasons the surveyors stopped at the start of the swims. The estimated length for the whole passage was c. 300m.

#### ii) Description

The resurgence cave of COMEDIANTE provides the outlet for the water sinking on the south side of the LA UEGA valley. The entrance is roughly comparable with Clapham Beck Head though the flow during most of the expedition was less than normal Fell Beck flow. The water itself emerges from a beautifully clear sump just inside the entrance and is met again as static sumps inside the main dry cave. This is the last that is seen of the water until the downstream sump in Squirrel's Passage in RENADA.

COMEDIANTE itself is a large but dull and uninspiring cave developed along a steeply inclined joint and terminating in a heavily calcited choke within a short distance of what was regarded by the Spanish as the end of RENADA.

Further up valley and roughly at the same level as the two dry entrances of COMEDIANTE lies the small but violently draughting entrance of RENADA. The old cave has developed along the same joint as COMEDIANTE and like COMEDIANTE is largely a series of phreatic chambers, increasing in size the further one progresses. The floor, after the initial slope, is completely flat mud suggesting a periodic "lake" in this area. A similar situation exists near the choke at the COMEDIANTE end of the cave. (1)

The intermediate area, surrounding what appears to be a fault chamber, is heavily calcited and well decorated. This chamber acts as a junction with a passage which leads to another of these periodic "lakes" - the terminal point of the Spanish exploration which took place in the autumn.

The 'lake' in fact guards the way on up a massive boulder slope to a higher entrance almost directly above the valley entrance. This slope doubles back on itself to the left, descending into a chamber with a solid calcite floor and two exits, both of which lead to the same level - again a periodic lake. The left hand exit leads to the excavated squeeze of the "blow-hole" which after a short crawl leads into a hading rift and a pleasant but treacherously slippery calcite slope and an equally slippery climb down into a mud-floored but



attractively-shaped passage of comfortable dimensions leading to two short but messily muddy climbs over rock barriers where the passage has changed directions and become more complex. This whole section of passage, until the almost complete blockage of the cave at a large calcited choke, is in effect a phreatic maze developed in a hading joint with several independent sections of passage in the roof which do not appear in the survey for reasons of clarity.

The boulder slope only just misses blocking the passage, leaving only a squeeze at the top with a slope down to a short pitch (c. 5m ladder and short belay) <sup>2</sup>. A crawl under a boulder emerges into a fine rift passage of short duration giving way to a chamber heavily solutionally developed and with a rift in the floor requiring 8m ladder to a short length of stream passage (not the main river). The main continuation is around the left-hand side of the rift and down a very greasy slope which is best laddered from a belay on the left-hand wall. This drops one into the miniscule stream that one finds down the previously mentioned rift. Almost immediately the roof drops towards floor level, stopping just short of the surface of a pool across which blows a veritable gale, making for an unpleasant section of what is, in wet weather, a sump. Beyond this obstacle the roof rises gradually over an ascending mud floor with the stream emerging from an impenetrable bedding on the right. Eventually the roof rises more rapidly as it approaches a boulder slope beneath a massive hading aven which indicates a strong line of weakness represented by huge hading avens throughout the system. At the top of the slope only one passage is obvious, though a second passage lies to the left through a mass of boulders. This way rejoins the main way to the far end of the cave coming in at the bottom of Blood Alley (see under).

The more obvious way on leads to a T junction. To the left, the passage - a beautifully decorated gothic arch which crosses the roof of Blood Alley to end shortly in an aven. To the right, the same fine passage continues up to the junction with a huge passage, which to the left runs into the top of Blood Alley. Within the triangle formed by these three passages lies a virtually indescribable maze in the sloping bedding. Sand, masses of smashed calcite and stal. provide the covering for the floor throughout the maze.

Blood Alley, which provides the left-hand side of the triangle, seems to represent a deserted stream passage now fabulously decorated with bright red and orange formations. Up Blood Alley lies the main way on, but, if one follows the right-hand wall of the triangle to its junction with base and beyond an eerily magnificent gallery of cathedral like dimensions goes for three hundred metres rising steadily to an untimely red earth choke. <sup>3</sup> Off to the left, just before an intrusive aven and an associated pot, a gallery leads off splitting up several times and most of the passages end either in chokes or massive collapse chambers associated with high avens.

Almost at the end of the main passage a small passage leads off to the right and, splitting off to left and right, runs parallel with the main passage. The left-hand branch - finely decorated - runs into a solid wall of red earth. The right hand branch slopes steadily downwards maintaining an almost uniform cross section until it starts to split up where the going becomes increasingly difficult until the various branches emerge, invariably, in high avens on the lines of weakness previously mentioned.

To return to Blood Alley; from the top of the vadose



trench one returns to a deserted phreatic zone covered with concretions of almost every conceivable sort but predominantly a brittle cauliflower-type of matt-black covering interspersed with red stalagmite growths. These calcite flowers cover large sections of this cave, and the TORCA, and seem to mark a lake period in the caves development, covering earlier calcite forms both sound and decaying.

The passage again begins to split with the left-hand branch being an ox-bow and the right-hand receiving an "inlet" passage from the west which, though short in length, is notable for the heavily phreatic "eggboxing" on the roof, and is full of fine helictites.

The two main passages reunite in "false floor chamber" which also exhibits a typical feature of many parts of the system - a thin calcite floor - covering over finely grained sand. The sand has been subsequently eroded in parts, leaving a treacherous surface that will not stand a caver's weight.

On the left-hand side of the chamber a massive slope of boulders leads up to the roof and beyond. Under this lies the tortuous dry section of Squirrel's Passage which is entered a little further along the main gallery on the left. After threading its way through shafts and none secure boulders it drops down into a fine section of the main river passage. Sumping in both directions it still offers a sporting series of canals and cascades.

The river is again met for a very short section below the main gallery just where it splits into a more complex area of avens and a solutionally-developed bedding followed by a series of joint determined passages initially phreatic but more recently modified in the lower parts by free-flowing water. Crowbar Passage is the most exact example of this.

This series is interrupted by Castle Hall which involves a delicate climb down to a small streamway at the base of a very high passage. Indeed the size of the upstream passages off Castle Hall by comparison with Crowbar Passage suggested a missing "downstream" level.

Travelling upstream from Castle Hall, one arrives at the base of a huge sloping rift. To the left, the little stream emerges from a sump and may be an overflow of the main river rather than an inlet. The sump can be bypassed to a series of chambers and tight aquatic passages above which runs a relatively small, deserted level. Both of these connect at several places with the main (known) high-level route - a magnificent phreatic tube which is first met at the head of the previously noted sloping rift. Crossing a "perched" lake the tube enters a cavern of massive dimensions which marks the point of intersection of at least two, and possibly four, levels of passage. Beyond the cavern the tube has bifurcated developing at a staggered angle along the slope of the joint continuing in the same fashion until it abruptly appears in the wall of a river gallery immediately upstream of a choke.

The riverway makes a pleasing contrast with the old upper galleries and offers tantalising glimpses of higher levels - all the more tantalising as in all too short a distance the passage begins to exhibit the typical signs of an approaching phreatic zone.

The feeling is soon confirmed when a small lake is reached with the roof dropping almost to water level. The reprieve offered by a :





**GHOST LAKE**

**ANASTAMOSIS HALL**

**BLOOD ALLEY**



**REÑADA**





▲  
GHOST LAKE  
ANASTAMOSIS HALL  
BLOOD ALLEY  
▼



REYNADA



short section of swimming is short-lived as a bell-chamber with a minimal area of dry land marks the termination of the cave in its southerly course. Even the underwater exit remains a mystery.

- Notes. 1) These suppositions were confirmed after the article was written, when heavy rain produced shallow lakes in these areas. (see p.6)
- 2) Surface deposits and fauna found here suggest a direct connection with the surface. (see p.7)
- 3) Stuffed Monk Gallery. (see p.7)

\* \* \*



## TORCA DE LA CABANA

### i). Exploration

On Saturday, 10th August, Squirrel, Chris Moys and J.C. climbed MONTE BERALTA in order to inspect the karst above CUBIO DE LA RENADA. They were shown an open shaft situated on a spur of the hill some 250m above the LA VEGA valley. Their guide, a local farmer, assured them that no one had ever descended the hole except for one or two goats - and for them it was ADIOS!

The hole was christened TORCA DE LA CABANA (Cabana = shepherd's house) after their friends house which stands nearby.

On this first visit only 40m of ladder was carried. However, this was sufficient to reach the foot of the entrance pitch and convince the explorers of the need to return with more tackle.

The obvious way on at - 30 metres was blocked with calcited boulders. However, hopes were raised by the discovery of a tight rift about 6 m back from the choke which draughted inwards invitingly.

After 5 awkward metres the rift broke into a clean shaft and the way on looked promising, although laddering was going to be a problem due to the narrowness of the take-off.

Chances now appeared good for a connection with CUBIO DE LA RENADA and the following day Chris, Andy, Keith and J.C. ferried up more tackle. On this trip the second pitch was rigged, not without some difficulty due to the "slot" and J.C. descended a further 30 mtres broken up as follows: 10 metres to a sloping ledge; 5m to a solid floor with a rift dropping a further 10m to calcited chockstones and the remainder to a bowl-shaped ledge. Over the lip of the ledge a hole some 4m x 4m heralded a third pitch of an estimated 30m.

Further exploration was left for another day and the team returned to Matienzo to take part in the much-heralded football international between the English Cavers and the locals.

Tuesday 13th saw a further push. Geoff, Keith, Dennis, Chris, Dave Linton and J.C. toiled up to the TORCA in melting heat. By now the optimum approach to the shaft was direct up the dry valley above the RENADA resurgence at CUEVA COMEDIANTE. Halfway up this valley the rough going gives way to a narrow track designed to accommodate goats. This, if followed round the right over the spur of the hill leads to the depression containing the entrance to TORCA.

Back underground, the third pitch was descended. After 6 or 7 metres against a wall festooned with calcite nodules the ladder swings free in the roof of a fine chamber. Geoff and J.C. set off to explore up-slope from the bottom of the ladder. The way led through a series of sandy chambers and large passages ending in a number of avens and silt-choked sinks. In the more constricted sections the inward draught was still apparent and this is presumed to indicate surface connections via avens to the lower slopes of MONTE BERALTA.

Downslope from the foot of the third pitch a mud-coated rift was descended for 20m to a silt choke. Above this obvious sink a steep, sandy slope led to a further series of large chambers.



These were explored by Chris and Keith who discovered several shafts, one of which was in the clean-washed black limestone which characterises some of the inlets in RENADA. However, the descent of these was left for later trips.

On Friday, 16th August, Geoff, Keith, Dennis and Squirrel returned to survey and investigate the newly-discovered shafts. One of 60m was partially descended by Dennis, but he was forced to retreat through lack of tackle.

Exploration continued two days later when the 60m shaft was descended to an impossibly tight rift. A surface survey was done linking the entrance of the TORCA with the upper entrance of RENADA and this confirmed that the two are tantalisingly close. Next year should see the opening of an extremely sporting and varied through trip.

## ii) Description

On the south flank of the LA VEGA valley is an area of high land reaching a height of 600m. Limestone outcrops almost everywhere in typical scars and clints. However, there is a small capping of sandstone and a few thin layers which outcrop lower down. Geologically the area is a shallow syncline with its axis E-W along the summit. This highland provides at least part of the catchment area for the RENADA - COMEDIANTE system and is dotted with numerous shafts and shakeholes.

The TORCA DE LA CABANA is one such shaft. The entrance lies almost directly above the RENADA entrances at an altitude of c.500m. A small cluster of holly trees and the scream of resident jackdaws are the only surface features. Once the protective layer of foliage has been passed a roomy entrance shaft of 27m with a ledge at 19m brings exploration to the top of a boulder slope. Down the slope a choke is quickly reached. The way on is part way down through a small slot on the right. Following an inward draught through a short section of awkward squirms reveals the second pitch of 21m which opens out quickly after an initial squeeze. There is a sloping ledge 12m down. The third pitch of 7.5m leaps off to the right through a narrow but more comfortable opening. The pace of descent continues below with the fourth pitch of 38m hurtling off in what are now continental rather than Yorkshire proportions. A large ledge at 6.5m is the last stopping place. After a further 15m of climbing against the wall, solid rock suddenly becomes a little remote. Massive stalactites 6m long drape the entry of the shaft into the hall below.

The floor of the gallery is covered with an assortment of debris from fine sand and calcite to rocks and collapsed boulders. From the base of the pitch there are extensions in both directions. To the NE ascending a sand slope gives access to an abandoned phreatic level. In cross section the passage is flat-roofed for almost all of its 10m span and then gently curves into the walls. The floor is covered with a fine sand.

An obvious side passage descends to the left and after a short low section emerges in more comfortable surroundings where several passages diverge. To the left is a maze of partly collapsed phreatic tubes which provide devious routes back towards the ladder pitch chamber, and a climb up through boulders completes the circuit. The point of entry is behind boulders on the north wall. Continuing



along the side passage an ascending slope leads to a large hall full of house-sized blocks.

Back in the main phreatic level a four-ways junction is reached. To the right is a short but well-decorated chamber leading via a window, to a rift containing a series of avens. Straight ahead a sandy crawl through grills of stalactites emerges after 100m in a well-decorated, crater-like chamber with no way on. The main way on is to the left in an ever-widening passage which eventually attains a roof span of over 20m. Suddenly the roof soars up to 25m in a second large hall, again full of house-sized blocks. This hall and the one previously mentioned are in fact one and the same as a scramble up the slope to the left quickly reveals. The reward for the climb is a view into the first chamber from the top of a 20m high boulder.

To the right at the base of the slope in the second chamber is the way to the end of this section of the cave. Exploration involves climbing up and down boulder and sand slopes into two successive chambers before an ascent leads to the final choke. The phreatic level is not seen again, having either turned away from the main line or been obliterated by collapse. The inward draught is also lost before the final choke is reached.

Following the passage to the west from the base of the fourth pitch leads to a network of caverns which in many respects are similar to those just described. They are mostly associated with the same phreatic level and the passage dimensions and cross-sections are remarkably similar. These are the low-profile phreatic cross-sections and the large collapse caverns. The latter are often found where the network crosses fault zones (see survey). In addition, this series contains several vertical systems which are apparently independent of the older horizontal elements. The phreatic level consists of one major passage to a T-junction, both branches terminate in large collapses. En route are numerous calcite formations including the same type of cauliflower deposits as found in RENADA as well as stalactites and stalagmites.

The vertical elements consist of shafts varying in depth from 15m to 70m. Some of these were not explored owing to lack of time (see survey). The deepest shaft is situated to the right of the main bedding in an area of sandy hollows. The pitch is broken by a series of ledges at about the 30m mark and at the bottom a constricted rift prevents further progress. Indeed all the shafts descended were either too tight or silted up. The lack of a draught in this part of the cave indicates that the hoped for connection with the RENADA system will be difficult to forge.

\* \* \*



## CUEVA DEL AGUA

### i) Exploration

This cave was more or less completely explored by the S.E.S.S. (Santander Caving Club) in 1967-68. This took a considerable time due to the Spanish aversion to water. They had traversed above the stream for most of the way, often on very dodgy razor-sharp rock. They had several nasty accidents before reaching the end in 1968. In 1970 the M.U.S.S. expedition ploughed through the water in wet suits and had a very enjoyable trip, reaching the sump and back in  $3\frac{1}{2}$  hours. On their return they noticed a small side passage which was strongly draughting. Lank and Rog followed this for several hundred metres of rather grotty streamway until they reached a choke, which gave them the excuse to retreat. In 1974 they returned and surveyed the main passage in one epic trip using a lorry tyre inner-tube for the lakes. The side passage was done on a later trip and Buddha passed the choke to a further length of even grottier passage until a narrowing of the way on gave another excuse to retreat. Baz and Buddha then avoided the football match by doing a surface survey over to the resurgence at LA CUEVONA. When this was plotted out it revealed that the cave was only 50 or so metres from penetrating the hillside. Stewart Davey, B.S.C. had previously had a dive in the entrance pool and plumbed the depths to confirm the Spanish dive report that it went down for 20 metres. He found a large passage went off down only 2 metres below the surface, also that at no point was it deeper than about 10 metres.

Some days later Geoff, determined to add to the Kendal's quota of glory, amused the assembled multitude with various impersonations of a bald Mick Jagger. Eventually he belayed the line to the dinghy and disappeared. A quarter of an hour later "I'm a cave diver" returned to report to the "Jefe" that he had passed the sump and reached the passage at the bottom of the cascade in Agua

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### ii) Description

CUEVA DEL AGUA provides the sink for all the surface water of the LA VEGA valley, though in all but wet weather the water filters away before it reaches the high entrance and reappears some way into the cave. While the cave is massively impressive, well-decorated and makes a sporting trip it is essentially one large tube down which one progresses over piles of boulders and through lakes and canals. The only significant exceptions are a strongly draughting inlet fissure that enters the cave on the left hand side of the first lake. The air current coming down the passage is positively violent but because of the narrowness and viciousness of the passage it has not been pushed to a definite conclusion.

Downstream of the first lake one needs to be either a competent swimmer or able to use a dinghy, such is the nature of the rest of the cave. Only near the sump is one really faced with other than a single passage where two large 'ramps' head off upwards to be blocked near the surface. Now finely decorated they are presumably



associated with the fault that intercepts the cave between the elongated Agua sump pool and the resurgence of Cueva. Their original purpose may have been as VAUCLUSIAN resurgence passages.

The AGUA-CUEVONA sump.

<u>Site</u>	CUEVONA
<u>Date</u>	14th August 1974
<u>Diver</u>	G.Yeadon.
<u>Aim</u>	GLORY.

The Dive

The diver kitted-up with twin 40's (thanks to Stewart) taking as long as possible, gradually working the crowd up into a frenzy and allowing more and more photographs to be taken. After the crowd had noted that the diver was more ugly with his hood on than without it he quickly disappeared into the murk.

The murk continued at 10m depth for a fair way until a tree was found. Could this have come from a lost world? It's strange how the mind can ponder on such wonders when lost in the murk. Just at the end of his line, suddenly the diver surfaced in a large cavern to be confronted with some boring Spanish cave paintings - obviously the work of Humbrol Spray Man who became extinct sometime in the middle 860's. The diver made a quick exit for more photographs and basked happily in glory for the rest of the day.

\* \* \*

"Went to look at sinks I found yesterday. Non of them went anywhere! Found some-more but they didn't go anywhere either".

Sean.



i) Exploration

The 1970 expedition arrived in MATIENZO without the QUADER-NOS II which described the caves of the area but with this impediment they did the best they could.

In the true Yorkshire fashion they followed the river down to its sink. It was impossible to enter any cave here as it was choked with monster boulders, but to the right an abandoned streamway led across a field into a wood to a strongly draughting area of boulders. A way through a tight slot was soon engineered and the cave explored to the river but downstream was blocked by a choke and it was not until a year later that the choke was passed to a sump. No progress has been made beyond the sump.

The importance of this system is considerable as it drains the entire valley. A dye test by J.C.FERNANDEZ demonstrated that in flood the water traverses the 3.5km to the resurgence in 9 hours. Nor is this a matter of purely academic interest to the local population as the flood mark at head height in the Bar shows!

\*

ii) Description.

CARCAVUESZO is the sink cave for the entire Matienzo depression and even in dry weather takes a considerable flow and in heavy weather demonstrates an enormous capacity for draining the flood waters of the valley affected only by the degree of blockage at the entrance. The entrance is in fact only a flood sink being at the end of a dry and overgrown old stream bed beyond the actual sink.

Considering the potential, the cave itself is disappointing. The entrance is a constricted drop into an uninspiring passage strewn with unpleasant flood debris. A small, angular chamber with an exit down a shallow slope gives way to a division of the passage. Both ways are comparatively narrow. The left hand is choked and the right steps sideways into a low wide chamber with several apparent exits. The main way on is obvious but to the right of it another exit leads to a complex series of joint determined climbable rifts and crawls. The zone is susceptible to heavy flooding and contains a wide variety of animal life (including a salamander) who are presumably not there by choice. The area has not been exhaustively examined but seems to offer little opportunity for extensions.

The main way on is a tolerably roomy oval-shaped tube that rapidly hits the edge of a large collapse zone in a small chamber with the exit being across a collapsed block and down a squeeze against the left wall. One then drops down steeply and back under to the left to emerge in the roof of a high rift passage containing the main river. A ledge on the right hand wall of the rift marks the junction of the upstream and downstream sections of the cave. Upstream is very short involving only a drop down into the streamway and within a few metres one is faced with an ominously deep sump. To the right of the sump a second rift runs parallel with the first. It offers no apparent bypass to the sump but runs back downstream into the same collapse area as is entered



from the aforementioned ledge. The way through the boulders is neither obvious nor describable. Nor for that matter is the rest of the cave. One rejoins the river down through a slot but continually leaves and rejoins it as vast block collapses are met and traversed. These are however not particularly complicated and are interspersed with short lengths of attractive streamway with large pools and interesting rock forms that make up for the lack of formations.

The terminal sump is met disappointingly early. A wide chamber is completely filled by a lake which extends to the limits of one's lights where the suspicion of a total sump was confirmed by a wet-suited swimmer.

\* \* \*

"surveying a disconcertingly quiet tube in pathetic 10m lengths. Suddenly up into vast caverns brimming over with glory and ego trips!"

T.G.Y.



i) Exploration

SIMA CUEVA DEL RISCO, a major river cave draining the OZANO valley was first entered in 1965 by members of the S.E.S.S. via a small festering pot someway upstream of the lower end of the cave. Several kilometres of cave were explored including the appalling open sewer of the Pinto Gallery. Upstream the cave ended in a huge boulder-strewn crawl - the SALLO CABALLO - with most of the water in the cave cascading down from an inaccessible passage high on one wall.

The interest shown by the expedition in the cave was at first concentrated in the upper galleries around the middle section of the cave. Apart from some short lengths of passage the efforts proved unproductive and interest waned again.

The discovery of CUEVA ONITE and its connection with RISCO came more or less by accident when a party examining the geological structure towards the southern end of the depression were told of a small daughting entrance by a farmer. The party made a quick examination to confirm the story and found the entrance to be a pitch.

A rapid return with the appropriate equipment brought rapid results. A short section of dry passage and the party found themselves in a pleasant meandering stream passage, which led them at length to a second pitch this time estimated to be 15-20 metres deep into a large hall which one of the party felt he recognised. This was confirmed when the pitch was descended later by the survey party and the surveyor's "ferrets" Keith and Andy made the first through trip.

Without more ladders the explorers were forced to retreat and investigate other possibilities back upstream. Just back from the pitch a junction with a small inlet, previously ignored, was now followed up an insignificant little passage to suddenly bell out into a short length of highly decorated passage of considerable size.

Other short lengths of passage, mainly oxbows, were found on the way back towards the entrance, and upstream of the entrance passage the way on is soon terminated by a perched sump. In total almost 1km of new passage had been discovered in addition to making the system into a fine through trip. It is thought that upstream may connect with LOCA II adding even further to the caves potential.

\*

ii) Description

It is not intended here to fully describe the Risco system. The description of the main river gallery alone would be a task comparable with trying to describe DOWBERGILL PASSAGE. It must suffice to say that it is essentially an almost straight rift passage running c 1.5km up the OZANO sub-"polje", with a massive old gallery running above it and connecting with it in places. It receives one major inlet - the Pinto Gallery and by the junction of these two passages has captured most of the surface water of this area.

Prior to 1974 the entrance was a 10m shaft situated



between a small group of farm houses and a very conspicuous dry "waterfall". The shaft leads more or less directly into a large passage that to the left soon chokes and to the right gradually attains the full dimensions of a river gallery. The water actually sinks in the floor of the cave some way up the passage to resurge through impenetrable springs further down valley. Upstream the cave provides a very varied and sporting trip terminating in a massive sloping chamber with a small waterfall entering from high in one wall. This proved to be the point of entry of CUEVA ONITE which is entered much further up valley from RISCO via a farm track and a walk across a field to a tree filled shade containing a short shaft that could be free climbed. The inevitable sloping rift leads into a short inactive section before the stream is reached. Right leads to a perched sump, left the stream is followed on and off for some distance to a fine section of Yorkshire streamway. A few short climbs add to the sport and a finely decorated oxbow to the interest. There is only one short crawl and one rapidly reaches the top of a pitch where the cave has cut through a sandstone bed and dropped nearly 20m into the final chamber of RISCO - a fine damp climb free from the wall.

Back from the pitch lies a junction and turning into unknown territory a most interesting find is made for the meagre passage soon gives way to a low chamber which in turn gives way to a passage of ever increasing size and beauty until it is prematurely choked. Undoubtedly the passage is a continuation of "Galleria Superior" in RISCO.

This discovery brings the remote end of RISCO within easy reach and the possibilities of joining the system to the numerous lesser systems nearby is much increased.

\* \* \*

"Must get more wapped down - gonna get blipped to-night".

T.G.Y.



## The Caves of the RIANO Area

### CUEVA RIANO

#### i) Exploration.

This cave is named after the village which is situated at the head of a large valley 4-5km north of Matienzo.

The entrance is at the foot of a wooded limestone scarp which rings the village, and was discovered by Lank Mills in '72. The cave was first explored by Lank and J.C. in '73 to 1km of stream-way terminated downstream by a sump and upstream by a series of sandy phreatic tunnels with small inlets.

On Wednesday, 7th August '74, Lank, Dave Linton and J.C. descended and followed the river upstream. At the first major junction the left hand tributary was taken. This led, via large sandy passages and a winding "coffin-level" to a draughting aven. At this point the surface must be close by.

On the return journey the cave was surveyed to the river passage and then to the surface by way of the relatively constricted entrance series. This gave 1.6km of passage, very varied in character.

Wednesday, 14th August, saw Pete Smith and J.C. back in RIANO but downstream on this occasion.

The day was warm and the passages in the region of the sump were carrying a noticeable inward draught, whereas the entrance series draughted strongly outwards. The draught was followed, but close to the sump was lost, presumably to the two small inlet passages nearby.

The extensive phreatic development in the roof of the final passages was inspected with a view to by-passing the sump. However, all were choked with silt. Also the presence of two large eels in the muddy pools near the sump suggests that the resurgence is not far distant.

The downstream river passage was surveyed to 600m length. Possibilities for further surface connection via the upstream reaches of RIANO I are good. A surface traverse carried out by Pete Smith and J.C. took in 7 draughting holes set around the base of the 1,500 metre long limestone outcrop which runs in a horse-shoe shape round RIANO village. These known entrances include RIANO I and RIANO II (subsequently explored and surveyed to km.) which are set at opposite ends of the "Hores-shoe".

A major inlet series in RIANO I has been left unsurveyed and largely unexplored. With this in mind the potential length of the RIANO system is well over 5km.

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## Description of CUEVA RIANO I

CUEVA RIANO is situated in a small, vegetated depression some 120m S.E. of the Matienzo-Hoznayo road, 2km before Riano village. A cart-track leads off the road opposite a spring and passes within 10 metres of the entrance.

The cave is set at the foot of a wooded limestone scarp which varies between 5 and 50 metres in height and extends in a V-shape for 1,500 metres around the NE corner of Riano. The village itself stands on a low hill of impermeable clays and sandstones such that the limestone scarp forms a line of sinks for run-off water. Riano I is the most northerly of at least seven cave entrances recorded around the base of the scarp, although under normal conditions none of these take water directly. The hill in fact supports only two stream gullies draining towards the limestone outcrop. Both of these end in vegetated depressions, one between the entrances of Riano 1 and R<sub>7</sub> the other between R<sub>5</sub> and R<sub>6</sub> (see surface survey). Thus under normal conditions the majority of the Riano I stream must originate in sinks on the slopes well above the limestone scarp. All seven of the cave entrances round the foot of the scarp draught outwards to varying degrees and this tends to confirm the existence of higher sinks.

Riano itself starts as an unimpressive crawl in a passage festooned with roots partially blocked by sandy collapses. Flood debris shows that the entrance acts as a sink in extreme conditions. 10 metres of flat-out crawling under stalactite remains leads to a low streamway with a shingle floor. A trickle of water enters from the right. This probably comes from the gully nearby and arrives at this point from R<sub>6</sub>. The next 30 metres of passage is intersected by several sets of cross-rifts. Some of these are wet-weather inlets and one carries percolation water from a series of gours.

The following 150 or so metres of passage is fairly constant in character. The accumulation of percolation water gives rise to narrow canals up to half metre in depth. The passages are developed mainly along the strike of the bedding which dips between 5° and 15° to the SW, alternating with short joint controlled sections. The cross-sections are typical of phreatic opening of a joint or a bedding followed by the cutting of a narrow vadose channel. Passage sizes range from 0.5 to 2 metres in height and 0.5 to 1 metre in width.

As the junction with the main stream is approached increasing breakdown has produced higher levels and caverns above the inlet passage. This breakdown may have been caused by contact with one of the sandstone beds which are in evidence in other parts of the cave.

Boulder falls reduce the size of the streamway some 200 metres from the entrance and the way on is a sandy traverse to an upper level. The stream is regained via a 6m pitch. The passage ahead is now a sloping rift formed on a joint with the stream flowing through a constricted channel at the lowest point and roomier dry passage above. After 30 metres the main stream is reached.

The upstream passage is in effect a continuation of the last section of the inlet series, namely a rift sloping down to the north averaging 5m high by 2m wide. After 75 metres the stream re-surges from a low passage and forms a pool. The way on is to the



right into a dry boulder strewn passage. Again there is evidence of a sandstone bed being met. A further 60m and the river is regained.

The passage now changes distinctly with the river flowing in a narrow channel under a lattice of eroded sandstone and the passage is once more formed on the strike with bedding playing an important role.

160 metres upstream from the inlet junction the stream divides into two similarly sized tributaries. One leading off straight ahead meets a boulder chamber beyond which the inlet continues unexplored. The one to the left is 100m of almost straight stream passage which becomes a low wet crawl on a shingle floor. This may, however, be bypassed by returning to the junction of the two tributaries and going forward to the boulder chamber. Here, in the roof, a sandy tunnel may be followed for around 230 metres in a parallel line to the streamway. The two passages are developed along the same line of joints and are connected via occasional collapses. The major joint responsible for these parallel passages again shows the characteristic northward dip.

After 140 metres in a virtual straight line the main tunnel turns southwards and after 80 metres is interrupted temporarily by chokes, while the lower streamway continues unexplored.

A 40m long loop situated between the diverging upper and lower passages provides a bypass into the continuation of the main tunnel. This large passage is now more boulder strewn and ends after a further 70 metres in a 3-way junction in the shape of a flat-roofed boulder chamber 10m wide by 2-3m high. The way onwards offers a choice of two inlets.

The left hand passage of some 100 metres in length leads to a calcited aven by way of a series of fine, dry gours. In the lower, mud choked parts of this passage what appeared to be the prints of a cat gave rise to some speculation!

The right-hand junction runs to 250 metres of passage eventually becoming a flat out crawl. This passage, for most of its length has a constant rectangular cross-section averaging 2 metres in height by 1m in width. A similar, constant passage shape is to be found in a third inlet which leads off the main passage on the right shortly after the "40m by-pass". This extends to about 200 metres in length ending in a water-washed aven 15m plus in height.

Both these latter inlets are heading back towards the base of the limestone outcrop in region of  $R_6$  and  $R_5$ . The unexplored streamway beyond the first upstream junction goes in the same direction and is probably associated with  $R_6$  itself. The horizontal distance to be covered in all three cases is about 250m.

Thus considerable extension of the upper reaches of Riano 1 is likely in the future.

Downstream from the entrance series the river follows the typical inclined rift, though now considerably smaller than the upstream passage or even the last section of the entrance series. Indeed it seems possible that part or all of the entrance series may have been formed under phreatic conditions before the opening of the present downstream passage allowed draining and subsequent vadose modification.

After some 70 metres and two short cascades the character of



the streamway changes and a less strongly jointed region is reached. The passages become lower and wider and the bedding of the limestone is apparent as series of eroded ribs on the passage walls.

A short section of rifts ending in a cascade of 8m marks a temporary return to joint control, but below the roof flattens and deep water is met. A short duck gives way to crawling over the upturned edges of the bedding and the passage is frequently divided diagonally by flakes of rock.

350 metres downstream from the entrance series a third set of cascades is reached. Here the vertical is about 7 metres, the last 4 metres requiring a ladder. At the foot of the ladder the stream turns back on itself and enters a low passage.

The way on is to climb into the rift directly facing the cascade. This leads back to the river by a dry upper route. Meanwhile the river has gained two more inlets. One little more than a trickle from the upper level. The other bigger and offering an alternative, if wet way back to the foot of the third cascade.

The river is now sluggish and muddy and the expected sump follows in a further 150 metres. Possibilities for extension downstream are limited. One small inlet passage remains unexplored and may be associated with the sink just below the roadside spring near Riano entrance. The downstream passage is heading off down valley where it presumably resurges to become the Rio Aguanaz. The exact position of the resurgence is not however known.

The surveyed length of CUEVA Riano is 2.2 kms. with a depth from entrance to sump of approx. 40 metres.

\* \* \*



## CUEVA DE LA UZUEKA.

### i) Exploration.

Lank and J.C's examination of the RIANO area in 1973 although cursory because of the time factor nonetheless unearthed several other interesting possibilities in the area. With the excuse of surveying RIANO, Lank dragged Dave Tringham and Buddha over the pass and, having taken a photograph of the entrance, promptly headed in the opposite direction to "have a look" at a draughting hole at the other side of the village.

Having waded through the ubiquitous jungle, a dirty and windy hole was discovered with a 'boulder' in the entrance. Reluctant to get dirty though the intrepid team were, the 'boulder' was removed and, after a tight slot down, a passable way on was reached. The party promptly lost the draught and found a second entrance - a shaft full of former horses. The crawl containing the draught was rediscovered and followed to an unsavoury-looking pool. In the ensuing jostle to get away from the mess, Dave Tringham got pushed into the mire and, just before sinking into the horrible mud, struggled to the far side to announce the inevitable "caverns measureless to man". The other bold pair then followed and line abreast strode out down a fair imitation of a railway tunnel noting innumerable side passages, but ignoring them, while following the main way on. Eventually the main downhill passage began to decrease drastically in height and a low, dismal sump was reached.

Thwarted in their downward journey, the party worked their way back, examining likely sites for extension, until they were back in a wide chamber with sand banks on either side of the small stream. Up on one side, a low passage with a cracked mud floor opened up into a rift passage with indications of a higher passage still. The promise of things bigger to come was fulfilled by a large collapse chamber, through which the group picked a cautious route over and round boulders across the chamber to the only obvious exit - another Gothic passage heading off at right angles to the passage of entry. Skirting a number of nasty-looking holes in the floor, the team reached an even nastier hole taking up the hole passage, across which sat a room-sized boulder. A tentative reconnaissance up an inlet on the right of the pitch marked the termination of the day's exploration.

Three more trips were conducted down the hole. One (thankfully) found a new clear entrance and the other two added a fair length of excellent passages in varying directions but still the assumed connection with Riano was not found. By now lethargy had set in and more time and enthusiasm will undoubtedly pay dividends in the future. We have not even established the whereabouts of the resurgence(s).

\*

### ii) Description

To the south of the village of RIANO, a dry valley runs parallel to the flank of a high ridge. Running along the southern side of the valley is a low, largely-overgrown scar. Along the base of this scar lie a series of strongly draughting holes and beyond



the scar a small ridge and a parallel line of DOLINES.

UZUEKA has three known entrances within a small area. One is a shaft, the position of which has not yet been ascertained, and the other two being draughting slots. The first discovered (the most westerly) leads to a dry and small entrance series that, apart from a strong draught, gives no indication of the passages beyond. The first junction one comes to is crossed to a crawl to a T junction where, still on hands and knees, one turns left; the right hand branch being an inlet. The passage then turns sharp right into a distinctly uninviting pool which covers an apparently bottomless cloying morass. Once through this obstacle the passage becomes tolerable, then comfortable, and then rapidly impressive as a beautiful Gothic passage stretches out into the distance. One is even more surprised when the passage splits at a Y junction and both branches continue almost parallel and of the same shape and dimensions as the passage one has just left.

To the left is an inlet series spreading out from a low chamber. The two passages off to the left from this chamber both maintain the same shape and size as the entrance passage and run parallel to it but in the opposite direction. The almost unbelievable situation therefore arises of four passages with cross sectional areas between 80 and 100 square feet are running parallel to each other with almost the bare minimum of solid rock between them. Neither of these two passages under discussion gets very far. Both end in calcited chokes or very narrow passages with strong indications of the proximity of the surface.

A much smaller passage on the right of the low chamber is the way to the third entrance of UZUEKA via a very complicated and finely decorated (in parts) maze which in the lower levels exhibits the same 'coffin' like proportions as part of RIANO.

Returning to the Y junction to take the right fork the passage continues as large as ever side stepping down dip occasionally but still strongly following the jointing until a stream appears from under one wall which coincides with a more confused area surrounding a large chamber. To follow the water leads one into a low immature passage and a miserable sump, but if one turns right in the chamber and climbs up to a low 'Minarets' type passage with a beautifully cracked mud floor a high rift passage opens up leading to Flash Bulb Hall - a shattered area of massive block collapse with an old high level route leading back over the entry passage and an exit that again exhibits the standard Gothic features but now well decorated. Holes in the unstable floor drop 10-15m making progress delicate until one arrives at a pot in the floor where it becomes positively dangerous. Traversing round the right hand wall leads into the tube at the top of a high keyhole shaped passage. Eventually the rift in the floor decreases in depth to where the passage splits and shortly becomes difficult enough for worn-out cavers to start finding excuses.

The pot in the floor can be descended by a ladder using a "sky-hook" type belay on the very loose available rocks but leads only to an immature stream passage fed from a high aven beyond the top of the pot. Still at the far side of the pot the floor slopes up to meet the roof in a calcited choke but back in the right wall an ascending rift gives access to a higher parallel passage. Again this is a complex of tubes and avens beneath one of which was found





▲  
**LAPIAZ ON MUELA**



▲  
**NEAR THE END**  
◀ **CASTLE HALL**  
**OUTOFHAND HALL** ▼



**REÑADA**








 LAPIAZ ON MUELA

OUTOFHAND HALL  
 CASTLE HALL  
 NEAR THE END





the skeleton of a dog.

The whole area is magnificently decorated but every apparent way on is blocked by infill or calcite.

The relationship between this cave and RIANO is still enigmatic but without a doubt the two will be joined and the result will be a superb system.

\* \* \*

"You need a bodyguard when you bare your bottom,  
don't you?"

- Hilly.



## Miscellaneous Exploration.

### CUEVA DEL VOLVO

The entrance to the cave is found, as described in CUADERNOS, by following the SOLORZANO from the camp site to the Kilometre 21 stone. The cave is then a few yards further on down to the left of the road. The entrance is a descending rift, which, after 25 metres leads to a small chamber. Here the passage turns to the right and, after a couple of crawls, leads to a further chamber. The right hand passage out of this was not explored, instead choosing the downward sloping passage on the left. This led to a pool and a further slope, which led to more water and a sump. To the right, just before this sump, there was a slope up which was blowing a noticeable draught. At the bottom of this slope a gravel obstruction was dug out to gain access to a bedding plane where the draught became quite strong and noisy. During the course of two trips, the floor of this bedding was dug out for 8m until it appeared to choke on all sides, but it was not discovered where the draught was coming from, although it had been strong enough to blow out a carbide lamp.

Therefore the cave remains a problem. The locals are convinced that it connects with the sea. J.C. FERNANDEZ believes it to have little potential as it is in the arenaceous beds. However the draught suggests that there are some large caverns there somewhere. From its position, connections with RIANO or CARCAVUESZO seem possible.

\* \* \*

### ANDERAL II

J.C. and Lank eventually found the entrance to this cave after being attacked by multitudinous wild dogs. It is situated to the right of the road in the doline before the JUVEROS. After changing near the cave in sweltering heat they entered with some relief. This was short-lived because almost immediately things got awkward. After exploring the 30 metres or so of the walking size entrance passages they had to assume that the rest of the survey in CUADERNOS must be of lower passages, most unusual! They crawled on for another 30 metres until the passage split. To the left J.C. went on to the "GATERA INUNDO" marked on the survey, while Lank pushed straight ahead in a flat out bedding. J.C. soon had to return and rescue Lank as his Spanish carbide had gone out. They continued into the crawl following the draught which blew towards them. After another miserable 30 metres and ten relights of the carbide they reached a small unclimbable aven. From here the way on was damp so J.C. first pushed on then, convincing Lank it was bigger ahead, enticing him in. The crawl continued, as miserable as ever. After 15 metres a junction was met and the passage at last increased to hands and knees. Upstream was draughting out of a choke and aven but was impassable. Downstream became more and more dismal and stupid until they decided Spain was not the place for such idiocies. They returned cursing. It was altogether a thoroughly uninteresting and miserable hole.



Back on the surface we looked at ANDERL I which again turned out to be uninspiring. After 50 metres it ended in an aven which, judging by the large quantities of bottles, tins, old boots etc., connected to the surface.

They returned to Dave's Landrover, dumped the gear and walked back to camp. Not really the cave for J.C.'s last day!

\*

#### CUEVA DE LOS. EMBOSCADOS.

The entrance (rediscovered by Joe Turner!) is well hidden by a clump of trees in a recess in the scar. It seemed the perfect site for a prehistoric cave dwelling being a rock shelter heavily overgrown with creepers and containing several avens and small chambers.

A definite cold draught could be detected and this was traced to a very low crawl. This was not apparent on the survey in QUADERNOS and so a second visit was undertaken. The crawl required some digging but after 2m the explorers were amazed to find themselves in a large passage with good formations and heading straight into the hillside. It then side-stepped right and soon hit a calcited choke with the draught issuing from the right hand side. This proved impassable and as a snail and a caterpillar were found the obvious conclusion was drawn. Nonetheless the possibility remains that the cave at one time served the same function as Varcavueszo does today. It may also prove archaeologically interesting as bones and a definite stone circle were found in the new part.

\*

#### CUEVA ORILLON

The cave was examined by small party intent on pushing through without really knowing where the cave was likely to lead. The end of the Spanish survey was reached and a small draughting hole found and dug into a short series of chambers connected by crawls. The draught at floor level was eventually lost and it is assumed that it was coming from a higher level requiring a maypole. The direction of the cave suggests that it may be unconnected with Risco and may in fact head southward.

\*

#### CUEVA DE MORTIRO

##### i) Exploration.

The entrance to this resurgence was discovered by Lank and Hilly whilst having a swim nearby. It was then pushed by Dennis and Rhoda several days later, Rhoda stopping after about 100m and Dennis going on until stopped by a deep pool.



Two days later Keith joined the team and they set off to survey this cave. This trip pushed past the deep pool, actually only chest-deep around the edge, only to discover a sump after about 50m. Dennis and Keith had a look in the roof to try to find a high level route, but that failed. Dennis rooted in the sump and, deciding it must be very short, dived in. He was right; it was only about 1m long. Rhoda followed him through and they pushed on for about 200m to find an entrance which involved about 8m climb into a deep depression.

ii) Description.

This is a resurgence cave situated near RIVA in a valley of the RIO ASON south of the MATIENZO depression. It consists of one stream passage which seems to be completely joint controlled, the joints being at an angle of  $30^{\circ}$  to the vertical.

The stream has significantly developed the cave, widening the joints and causing downward erosion. Although the cave does not take a great deal of water, there are plenty of deep pools. There are very few significantly great changes in height with the cave rising gently from the entrance. At various points it is necessary to climb up a few metres because the stream sumps.

After about 600 metres the stream sumps. This sump is only short, about 3 metres. The water here is deep, requiring any explorers to swim, but it is only necessary to dive down about 1m in order to get through. The water remains deep until a climb of some 8m to the surface is reached. The stream passage carries on; this upper entrance taking no water but being a roof collapse.

\* \* \*

NOTES ON SPELEOGENESIS

The following descriptions and discussions are based mainly on a rough translation of the work of J.C.Fernandez GUTIERREZ (QUADERNOS DE ESPELEOLOGIA 2, 1966) and a relationship of this to our own observations and survey work.

The MATIENZO depression is basically a 'Y'-shaped hollow with the left-hand arm 5km long, the right-hand 2km and the base 3km. The three limbs are in fact smaller depressions and are known respectively as UZANO, LA VEGA and SECADA. The area is completely surrounded by mountains none of which exceed 900 metres in altitude and which are devoid of any surface drainage. The lowest point in the depression is near the entrance of CARCAVUESZO at c.150metres.

CARCAVUESZO represents the exit for all the water entering the depression and is situated near the end of the SECADA limb. The resurgence is 3km away and c.55 metres lower and represents the source of the RIO CLARION at SECADURA. Dye tests have shown that the water takes only 9 hours to complete this journey.

Turning upstream from CARCAVUESZO the drainage pattern



becomes more complex. The RIO MATIENZO meanders across most of the SECADA limb before it bifurcates and shortly after both branches follow underground courses. The left-hand branch collects its waters from the mountains of MUELA, MULLIR and BERALTA. All the water unites underground in the various caves of the UZANO limb and most of this is seen in the main drain of RISCO before resurging in a number of risings near TIVA. In contrast the right-hand branch reappears via the singularly impressive resurgence of CUEVONA. Only 85m of submerged passage hinders an easy through-trip of just over 1km up through AGUA into the LA VEGA limb. A branch passage accepts water from the RIOTUERTO on the North side of the LA VEGA valley. From here the RIO MATIENZO takes a surface course across the LA VEGA valley before the largest proportion resurges from COMEDIANTE. This water is last seen in the terminal upstream sump of RENADA almost a kilometre into the LIMON and TRILLOS ridge. The catchment area for this stream may well be outside the MATIENZO depression as the sudden rise and the murkiness in the stream after a storm seem to suggest. Water from the RIO ASON may well have found a more direct route to the sea via RENADA and the MATIENZO depression. Continuing up the LA VEGA valley a much diminished stream can be followed to ARENAL. This resurgence is the only known outlet for underground streams draining the CALZADILLAS mountains at the head of the valley.

The geology of the area dictates the morphology of both surface and underground scenery. The succession is made up almost entirely of CRETACEOUS rocks and has been well-defined and documented (FERNANDEZ, 1966), so only the factors which have speleological significance will be discussed.

Generally the strata is nearly horizontal with the different beds lying conformable one on top of another. Therefore the oldest rocks are to be found in the base of the depression and the youngest on the tops of the surrounding mountains.

The limbs of SECADA, LA VEGA and part of UZANO are floored by impervious sand and clay deposits of WEALDEN facies and oil borings have shown that over 500m of impervious WEALDEN rocks lie beneath. This then provides the downward limit for cave development and acts as a local base level. This perhaps accounts for the lack of any deep-seated, phreatic networks in the valley.

Most of the known caves are found in the URGONIAN limestone and the change from the WEALDEN is recognised by a bed of marine fossils. On the surface the change is clearly visible with outcrops of massively bedded limestone on the valley sides and streams resurging near the junction of the two rocks e.g. at COMEDIANTE. Within these limestones lenses of sandstone interbed and have formed local base levels in the caves e.g. in RISCO at the head of the pitch into SALA CARBALLO. In addition this limestone has been subjected to dolomitization in areas of faulting e.g. on the ridge of FUENTE LAS VARAS near the road to SANTANDER. This may well have hindered cave development in the affected areas. Various subdivisions within the limestone have been recognised but for the purposes of this report it is sufficient to say that as one proceeds into the upper beds so the limestones become progressively more interbedded with sands, clays and marls. This must have hindered the vertical development of caves in the past although there is now an absence of surface streams. Whether or not these barriers have been passed either in fault zones or in thinning of the most impervious strata has yet to be determined by direct exploration.



The relatively simple pattern of the karstification of a succession of near horizontal strata is far from being the whole picture. The tectonics of the area have led to many complications both underground and on the surface.

Pyrenean and Alpine upthrusts were largely responsible for mountain building and because of the rigidity of the CRETACEOUS rocks, combined with the tensile rather than the compressive forces involved, the area has been divided by faults into blocks of both local and regional proportions, rather than folded. The upthrust has determined that fractures follow two major directions: North-west to South-east and North-east to South-west. The centre of the upthrust is marked by an East-west anticline across the centre of the depression. To the East this ends in a half-dome while to the West in a series of transverse fractures. It is thought that the first stages in the development of the Matienzo polje were centred on the weaknesses provided along the axis of this anticline and at the junction of several different associated fault zones (FERNANDEZ, 1966).

The influence of the above structural controls on cave development is obvious. There are relatively simple situations, e.g. at RISCO where a number of down-dip, joint-orientated inlets eventually unite in the main drain of RISCO. The strike is followed down valley before a short up-dip section gives rise to a phreatic zone at the resurgences near TIVA. AGUA similarly follows the strike through the spur of ENASO until a North-west to South-east fault is met. In the past the water has been forced to resurge up-dip, parallel to the fault rather than cutting through it. The fault has now been passed but even so has given rise to a short but deep sump. Another example of faulting hindering or rather confusing cave development can be found in RENADA, just beyond FALSE-FLOOR chamber. Here a large phreatic tube suddenly diminishes into a number of smaller, shattered passages and then, further on, regains its former dimensions. Directly above in TORCA DE LA CABANA there is a fault aligned in the appropriate direction. In CABANA the faulting has increased the size of many of the passages by block collapse.

The diverse effects of the dip on cave development are best seen in RENADA. Most of the explored passages from the entrances, are down-dip, up-joint, deserted, phreatic tubes as the cave progresses back into the hill. The longest sections are down-dip because of the shallow angle. The present water system is mostly unexplored and it is likely to consist of down-dip phreatic networks. However, short sections of open streamway are met along the strike and where short up-joint sections have initiated vadose downcutting especially in lower water conditions e.g. SQUIRREL'S passage and the BOLTON series. RENADA is formed in a shallow syncline so that near the end of the cave, as it nears the axis of the syncline, the passage preferentially follows the strike rather than the now much shallower dip. The passage is now a predominantly vadose streamway except in flood conditions. The terminal sump is inevitable as the passage once again turns down-dip. If RENADA is fed by the RIO ASON then there must be several kilometres of open streamway awaiting discovery on the up-dip side of the syncline.

The speleogenesis of the caves is directly related to the deepening of the MATIENZO polje. This deepening has taken on a pattern of gradual erosion to a stable base-level followed by rejuvenation and rapid down-cutting.



Remnants of abandoned phreatic tunnels at 400 to 500 metres altitude can be seen throughout the depression. For example, in the LA VEGA valley the caves of ADILLOS and COTRESNEDO provide good examples and on the opposite side of the valley the more recent shafts of CABANA actually intersect an old, phreatic level at a similar altitude. In the UZANO limb CODISERA best represents this level of development.

The occurrence of these caves and of large, undercut cliffs at the same altitude indicates a stable period in the speleogenesis. The remnants of this old level give little, if any, indication of past drainage patterns. However, it is interesting to note that there are three major passes out of the depression which range from 364m in altitude to 450m so it is possible that this level of cave development was associated with conventional river valley drainage rather than that of an enclosed hollow.

At a much later date water must have begun to find an underground exit, perhaps through CARCAVUESZO, but more likely through a higher, now choked exit. It would seem that the same faults along which CARCAVUESZO was developed might have been utilised and that the old resurgence levels of the upper entrance of RENADA, of the now-choked, abandoned rising for AGUA and of TIVA mark the altitude for the old sink. It would have been about 190 metres above sea-level. Whether this sudden deepening of the depression by over 200 metres was entirely due to fluvial erosion is open to doubt. Little is known about the intensity of glaciation in the area or whether the depression was hollowed out of CRETACEOUS limestones or QUATERNARY deposits.

However, what is certain is that the deepening was followed by yet another period with large phreatic tubes developing on a base-level at about the 190 metre mark. These are represented by the roof passages in RISCO, AGUA and RENADA.

These passages have gradually been drained by a second move gradual rejuvenation, perhaps a reaction to a drop in sea-level at the end of the ice age. A speedy rejuvenation is no longer possible as the base-level is now the impervious WEALDEN rocks. This gradual rejuvenation is still going on and is represented by the vadose canyons in RISCO and AGUA and because they are essentially strike caves the vadose passages have followed the same courses as the old, phreatic, upper levels. In RENADA the situation is more complex and a continuous vadose streamway has not developed because the path to the resurgence is up-dip so the streamway follows a separate passage and has remained epi-phreatic in part.

In CABANA are a series of shafts which intersect the first phreatic level at 400 to 450 metres altitude. They are obviously out of phase with this level but not with the second, lower level in RENADA where several large avens soar up to mirror the shafts above. They contain virtually no flow compared with their dimensions so it would seem reasonable to suggest that they gathered their waters from snowfields during the ice age and left behind the several banks of sorted sand and pebbles to be found in CABANA.

Thus it can be seen that the MATIENZO depression contains several different types of cave passage which owe their characteristics to both the local structure and the environment within which they were formed. The stable periods of erosion have given rise



to large phreatic networks, the rapid rejuvenation to the shafts of CABANA and the more gradual rejuvenation to the vadose canyons of RISCO. Several kilometres of passage await discovery in all zones before a more complete picture of the speleogenesis is possible.

\* \* \*

"A great dimbo espagnolo hav filled up my glass and  
all the bloody page with wine".

- anon.







