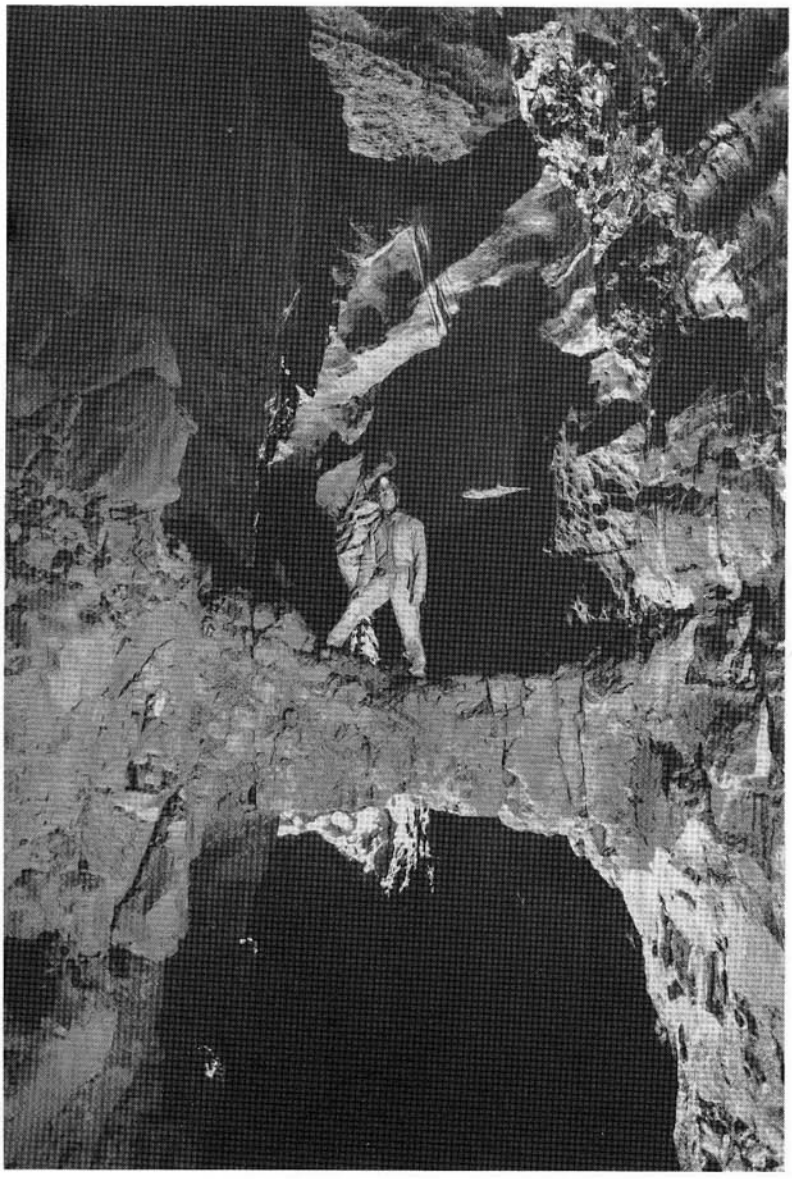
SOUTH WALES CAVING CLUB



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Cover Photo: **Ivan Wolton in Upper Picadilly, Cwmdwr** *Tony Baker*

Make Your Own Caving Lamp and Charger

STUART FRANCE

Summary

Caving lamp design is constrained by the present battery and bulb technology. Past experience making and using lamps of various types is presented here along with construction details.

It was not long after I started caving that I made my first lamp. My motivation was needing one, and I felt I could do better than buy an Oldham. My Mark 1 lamp had nicads sealed in a rubber block: an idea similar to the FX2 which appeared some years later. This lamp performed well for two years before it failed. Water had penetrated through a mechanical failure in its rubber casing and electrolysis had corroded around the terminals: perhaps I had been too economical with the rubber. All my lamps made subsequently have used discast metal boxes to house the batteries, plus internal polyurethane rubber potting or neoprene foam packing as appropriate. There are now quite a lot of these lamps in and around the club: for hire, in the rescue stores, and in members private possession. This design is stable and proven, and it seems simplest to publish the information rather than keep repeating it to individuals.

The usual motivation for making lamps is cost reduction. However, you can better the commercial products on performance as well as price. This article sets out to explain the design constraints within which you must work. It reviews what parts are readily obtainable and suitable combinations for variable lamps. It relates the experience at SWCC over the past 4 years with nicad hire lamps in general use, and sealed lead acid lamps for occasional rescue use. Armed with this information, you can decide on the price/performance you need, then order the parts and make your own lamp and chargers.

I would add a caution at this point: a little knowledge about electricity can be a dangerous thing. Unless you are sure that you can do the job safely, please do not be tempted to experiment. I do not have the time to help you build lamps and chargers or to maintain them. So if the information here is insufficient, then I recommend that you go out and buy an FX2 in preference to a leaky Oldham and also a commercial nicad charger. You will pay a commercial price and the performance will not be optimal, but the equipment will work, and will not cause electrolyte burns, or electrocute you.

In a nutshell, the lack of choice about headpiece dictates the kind of bulbs you ought to use. The bulbs in turn fix the battery voltage and capacity for the desired light duration. The choice of battery is constrained by cost, size, weight, housings, performance and endurance. The type of battery and pattern of normal usage determine the recharging regime. These topics are now presented in more detail.

Headpiece and Cable

There is only one headpiece worth considering, and this is the Oldham miners type seen in common use. As we all know, these are very tough and reliable, albeit not completely water-tight and fiddly to maintain.

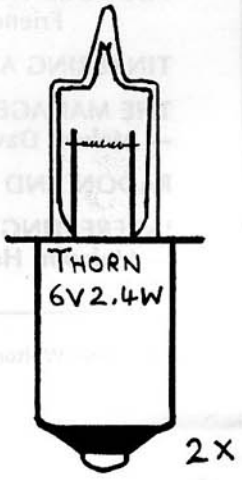
These headpieces dictate that you must use main bulbs with Miniature Edison Screw (MES) fittings with the standard reflector, or the Prefocus (PF) type with the prefocus reflector. The pilot bulb is always the small MES tungsten variety commonly found in hand torches.

The standard Oldham cable is very tough. There is a rubber outer layer which contains 2 insulated conductors spiral wound on a shock cord. I have noticed a tendency for the inner insulation to break down after a few years use. This has happened to me twice. The early symptoms is flickering. Eventually the whole unit fails as the short circuiting becomes more serious. The cable gets hot and this is alarming. I think 30 amp rubber sheathed industrial flex would be tough enough, and less prone to breakdown because the inner insulation is thicker than in genuine Oldham cables.

Bulbs

The best type of bulb currently produced in both MES and PF fittings is the miniature halogen bulb range, the GH series, made by Thorn EMI. The range includes 2.5, 4.0 and 6.0 volt types with various power levels. These are available through the retail trade, for example Caving Supplies (1) or Reflectalite (2) or Radioscope (3).

These bulbs have a very distinctive capsule shape: a small glass cylinder pulled to a sharp point on top. Any bulb having a spherical or ovoid capsule is not a Thorn halogen bulb. As can be seen from the table below, the widest range of options is at 6 volts. The 6V range are also the most efficient of these shown. It is incorrect to think that a 2.4W bulb because 4 is the bigger number: this



Thorn Halogen Bulb.

power rating (watts) is simply a measure of power consumption, not of light output (lumens). Taking this argument to its logical conclusion, a common resistor has any 'wattage' you like, but zero output. Its efficiency as a lamp (measured in lumens per watt) is nil.

Table One. Thorn EMI Halogen Bulb Range

Voltage	*Current*	*Power*	*Fitting*	*Relative brightness*	*Relative efficiency*
2.5V	0.8A	2.0W	MES	15	7
2.5V	0.8A	2.0W	PF	15	7
4.0V	1.0A	4.0W	MES	25	6
4.0V	1.0A	4.0W	PF	25	6
6.0V	0.4A	2.4W	MES	25	10
6.0V	0.4A	2.4W	PF	25	10
6.0V	1.0A	6.0W	PF	55	9
6.0V	1.0A	6.0W	MES	55	9
6.0V	1.7A	10.0W	PF	80	8

The 6V/6W and 6V/10W bulbs are very bright compared to the normal 4V/4W Oldham bulb we all use as a yardstick: the 6V/2.4W bulb gives a light output similar to the 4V/4W bulb. The 2.5V/2W (FX2) bulb is quite noticeably dimer than the 4V/4W bulb. The 10W bulb requires a metal reflector as it gets hot enough to melt plastic fittings: it is impractical for normal caving use. The 6V/6W bulb is very nice to use in a diffuse reflector, or on a normal reflector for looking into high avens, and you can also warm your hands on the headpiece, but it is greedy on battery power.

A dimmer circuit can be added to conserve battery power when you do not need the full light output from the powerful halogen bulbs. An efficient but simple dimmer circuit is shown later. This requires a waterproof potentiometer to be mounted on the battery box. I have an alternative, but more complicated, circuit which avoids the use of a pot by employing a waterproof momentary-make switch instead and 1-to-8 counter/selector chips to set discrete brightness levels. These circuits dim the bulb by driving it with a variable duty cycle square wave. The resultant flashing, like in mains operated lights, is too fast to be detected by eye. A 50% duty cycle at 250Hz drives 6V 2.4W Thorn halogen bulbs at a usable brightness level and extends the battery duration by 80%: very useful for longer trips.

Batteries

The bulb chosen will dictate using a rechargeable battery with near to 2.5 or 4.0 or 6.0 volts output. There are two relevant technologies: nickel cadmium (nicad) and sealed lead acid (SLA). Do not consider using ex-aircraft nicads in rectangular cases: these are not sealed, can leak KOH electrolyte, and have no advantage over Oldham batteries. Sealed nicads are usually cylindrical shape metal cased with a plastic sleeve and yield about 1.25 volts per cell when fully charged. Nicads are always connected in series giving 2.5, 3.75, or 6.25 volts which map on to the 2.5, 4.0 and 6.0V bulbs. SLA batteries are usually rectangular plastic blocks containing 2, 3 or 6 internal cells giving an overall yield of 4, 6 or 12 volts for the complete unit and no additional series wiring is needed.

Table Two. Useful Nicad and SLA Battery Sizes

Manufacture	*Type*	*Voltage*	*AH*	*Approx. Cost incl VAT*	*Weight g*	*Size mm*
Yuasa	SLA	6	4	7.50	900	70×47×109
Yuasa	SLA	6	6	8.50	1250	151×34×101
Yuasa	SLA	6	10	10.35	2200	151×50×101
Berec	Nicad	1.25	4	5.70	140	61L×32D
Berec	Nicad	1.25	7	8.60	225	91L×34D
Berec	Nicad	1.25	10	12.00	345	91L×42D

L = Length, D = Diameter

All these batteries are described as 'sealed'. This actually means that they will not leak electrolyte under normal conditions of use. They cannot, and do not need to be topped up. They are fitted with over-pressure valves which are designed to allow gas (and possibly electrolyte) to escape if short circuited, grossly overcharged or otherwise abused. It is therefore a bad idea to seal up these batteries too enthusiastically as it could lead to a dangerous situation if there is nowhere for the gas to escape to in the event of a serious failure. Fuseless, rigidly potted units, like the commerically produced FX2 lamp, ignore the battery manufacturers' advice against potting and recharging in poorly ventilated enclosures. However, it is common practice to seal up batteries, especially with military ruggedized electronics intended for use in harsh environment. All battery types can deliver enough current in a short circuit situation to boil the electrolyte, burn any wiring (literally), cause buckling, bursting and venting of the contents. So be careful.

The various sizes of sealed nicad and SLA batteries all require different recharging regimes. This is unfortuately because it prevents the building of universal chargers. Simple charger circuits are presented later: these may need some adjustment in accordance with the battery manufacturer's data. Battery working life and capacity retention over years of use are strongly influenced by proper and prompt recharging. You MUST NOT use and Oldham or car battery charger with any of these batteries.

SLA batteries are more easily damaged by bad charging than nicads. SLA batteries are safer to charge than nicads in so far as they are self-limiting due to a build up of internal resistance and timing is therefore non-critical. With nicads on a cyclic (fast) regime the charge period must be timed. With a trickle (slow) charge regime, lack of time or impatience can lead to undercharging. In both cases there is no simple way to measure the degree of charge. This leads to operational problems with nicads, particularly in the club context. The over-riding reason for selecting nicads for club use is toughness and resilience to all kinds of abuse that SLA batteries probably would not withstand.

There is no doubt at all that metal can nicads are mechanically much tougher than plastic cased SLA batteries. There is a range of SLA batteries sold by RS called Cyclon cells which have a metal foil outer and a

polythene cylinder inner. These look quite robust, but I have not tried them as the physical size and shape is not ideal. Yuasa SLA batteries, in common use within SWCC, are easily damaged by shock and require carefully placed protective padding.

Nicads are much more expensive to buy new than equivalent capacity SLA batteries. However, they can be obtained cheaply second-hand through trade advertisements in "Practical Wireless" or at radio rallies announced in such magazines, often for less money than new SLA batteries. It is not worth buying second-hand SLA batteries as they have a shorter working life than nicads, especially if mishandled. The cheapest source I have found for new SLA batteries, by a long way, is Surelife Security Ltd (4) who are agents for Yuasa Battery Company (5). New nicads seem to be roughly the same cost whatever the source.

To power the 2.5V bulb, you must use 2×1.25V nicads in series. For the 4.0V bulb you can use a 4.0V SLA or 3×1.25V nicads in series. For the 6V bulbs, use a 6.0V SLA battery or 5×1.25V nicads in series. The FX2 people have recently started marketing 2 FX2's in series with a 4V/4W Oldham bulb. Not only does this over-run the bulb at 5 volts, thus shortening its life considerably, but it means you need 2 FX2 packs on your belt which only give 7 hours light. This is both expensive and a botched solution for the disappointing output of the 2.5V bulb on the single FX2 units.

Batteries have an amp-hour (AH) rating. This is the product of current flow and a period of time. In theory, a 10AH battery will deliver 1A for 10H, or 2A for 5H, or 0.5A for 20H etc. In practice, the faster you discharge the battery, the lower the capacity actually deliverable. The manufacturer's nominal capacity can be de-rated considerably when the load exceeds the 10 hour rate. For example, with a 4AH battery a load of 0.4A corresponds to the 10 hour rate and you would get about 10 hours; therefore a load of 1.0A, which exceeds the 10 hour rate, would flatten the battery in consideably less than the 4 hours one expects by simple arithmetic. In addition, the AH capacity quoted by Yuasa is achieved at an unrealistic temerature of 40C, and at the 9C of British caves you can de-rate their figures 15% for temperature effects alone. Nicad capacity figures are quoted at 20°C, and a 5% de-rate applies at 10C. There is a normal gaussian distribution of battery performance in any batch. Berec quote a mean capacity of 105% of the rated capacity with 95% of cells having a minimum capacity of 95% or greater. What this means is that there is a 1 in 20 chance of buying one with less than 95% of advertised performance.

You must select bulbs and a battery pack based on cost, physical size and weight that you are willing to carry, brightness and duration required, and what off-the-shelf housings are available unless you intend making your own custom case.

Any of combinations 1-3 can be used with the 6V/6W bulb, costing £5.20 each, and the duration will be reduced to about 3, 5 and 10 hours respectively but the brightness increases to 55. Options 6 and 7 can be used with the 6V/6W bulb with brightness increased to 55, but duration reduced to about 3 and 7 hours respectively.

Combination 1 was used for the rescue lamps. Number 4 was used for the club hire lamps, and this is also the FX2 formula. Number 6 is believed to be used in the Explorer lamps. I have one each of types 1, 2, and 4 (with 10AH nicads). They have all given good service and I have no particular favourite. The 6V/6W bulbs are rather fun while the battery lasts, especially for 'tourist' trips. The one with Chloride cells was once inadvertently left about 2 feet from a small explosive charge in shot holes and survived with damage apparently only to the cable. This says a lot for the resilience of nicads and Oldham head pieces.

Table Three. Viable Sealed Lead Acid Lamps

1. Battery	Yuasa 6V/4AH	£7.57	Weight	900g
Case	RS 509-945	£3.50	Size	114×89×55mm
Bulb	Thorn 6V/2.4W	£2.70		
Potting	None			
Packing	Neoprene sheet			
Duration	10 hours, brightness 25			
2. Battery	Yuasa 6V/6AH	£8.56	Weight	1250g
Case	RS 509-995	£5.50	Size	114×89×55mm
Bulb	Thorn 6V/2.4W	£2.70		
Potting	None			
Packing	Neoprene sheet			
Duration	15 hours, brightness 25			
3. Battery	Yuasa 6V/10AH	£10.35	Weight	2200g
Case	RS 509-995	£5.50	Size	171×121×55mm
Bulb	Thorn 6V/2.4W	£2.70		
Potting	None			
Packing	Neoprene sheet			
Duration	25+ hours, brightness 25			

Table Four. Viable Combinations for Nicad Lamps

4.	Battery	Berec 2×7 AH	£17.18	Weight 450g
	Case	RS 509-945	£3.50	Size 114×89×55mm
	Bulb	Thorn 2.5V/2W	£2.70	
	Potting	Polyurethane		
	Packing	None		
	Duration	9 hours, brightness 15		
5.	Battery	Berec 3×7 AH	£25.77	Weight 675g
	Case	RS 509-995	£5.50	Size 174×121×55mm
	Bulb	Thorn 4V/4W	£2.70	
	Potting	Polyurethane		
	Packing	None		
	Duration	8 hours, brightness 25		
6.	Battery	Berec 5×4 AH	£27.90	Weight 700g
	Case	RS 509-995	£5.50	Size 171×121×55mm
	Bulb	Thorn 6V/2.4W	£2.70	
	Potting	Polyurethane		
	Packing	None		
	Duration	10 hours, brightness 25		
7.	Battery	Berec 5×7 AH	£42.95	Weight 1125g
	Case	RS 509-995	£5.50	Size 171×121×55mm
	Bulb	Thorn 6V/2.4W	£2.70	
	Potting	Polyurethane		
	Packing	None		
	Duration	18 hours, brightness 25		

Housings

The range of Radiospares (3) diecast metal boxes include sizes that will accommodate the battery packs, as suggested above. Maplin (7) sell better quantity boxes. A metal box is strongly advised to protect the battery packs from shocks and abrasion. As stated earlier, a very thick coating of rubber compound alone (as is used for the FX2) is potentially hazardous in various failure situations. A thinner coating is liable to fail mechanically through wear. A metal box and a much thinner coating of potting compound which could rupture under pressure in a relatively harmless manner seems best. Some of the hire lamp diecast boxes have just worn through at the corners after 4 years use. The alloy has been dented and scratched all over, of course, but does not tend to puncture or tear.

Table Five. Summary of Battery Characteristics

Feature	*SLA*	*Nicad*
Cost	much lower	much higher
Case	plastic	metal
Weight	similar	similar
Volume	similar	similar
Charging	constant voltage	constant voltage
Lifetime	4 years	4 years
Resilience	much lower	much lower
Potting	no	yes
Padding	yes	no

Nicads must be potted because the metal cans are conductive electrodes and require electrical isolation and protection from water corrosion. Rigid potting compounds, such as epoxy, are to be avoided since they confer no protection against shock: the polyurethane rubber or non-corrosive silicone types are best. SLA batteries MUST NOT be potted since plastic cases are already non-conductive and waterproof, but easily cracked. Some soft packing is essential to insulate SLA batteries from shocks, for example a layer of 4mm neoprene rubber sheet or Karrimat material.

Radiospares and Maplin sell polyurethane potting compounds. Material called Devcon Flexane60 supplied by G. N. Hunter Plastics in Cardiff (6) was used to pot up the SWCC nicad hire lamp. The rescue SLA lamps are loosely packed with 4mm neoprene and tyre inner tube sheet rubber material inside the metal cases. Try 'Rubber' in Yellow Pages for local suppliers.

Allow space inside the case for connecting the headpiece cable to the battery terminals. Be careful to prevent the battery shorting out on the inside of the metal case. Think what might happen if the case became dented. The cable should enter the box through a cable stuffing gland which also provides strain relief. I have used brass M20 glands in the past, though I have seen some cheaper plastic ones with integral cable wholesalers, Radiospares etc. Wiring should be soldered and sealed over with a waterproof compound such as silicone sealant or a conformal coating. Insulated crimps are also useful for

making secure, protected wire joints. The inside of the box will get wet, so protect the innards against this and drill drainage holes, if appropriate to the style of case.

Fuse

You should consider fitting a fuse. The rescue lamps have them, but generally I have avoided them. Equipment is much safer when fused. On the other hand there is a certain nuisance potential because fuses do blow due to fatigue or a harmless momentary short-circuit at the most inconvenient of times. You should consider how to change a fuse underground and whether to take tools on longer trips when a lamp failure would be a real handicap.

Chargers

It is important to understand two patterns of battery usage: cyclic and standby. In cyclic use, the battery gets regular discharges and it is run down by a significant amount on each occasion. It is recharged for a limited period, typically 14 hours or overnight, after which it must be disconnected from the charger: this is called cyclic or fast recharging. It is the normal usage pattern for weekend cavers. In standby use, the battery is seldom used and it normally remains permanently connected to a charger in a state of readiness for potential use. A charger which is set up for standby use is said to deliver a float or trickle charge, that is just enough to keep the batteries at full charge and not so much that excess energy causes a build up of heat. This is the usage pattern for emergency lights, such as the small stock in the rescue stores.

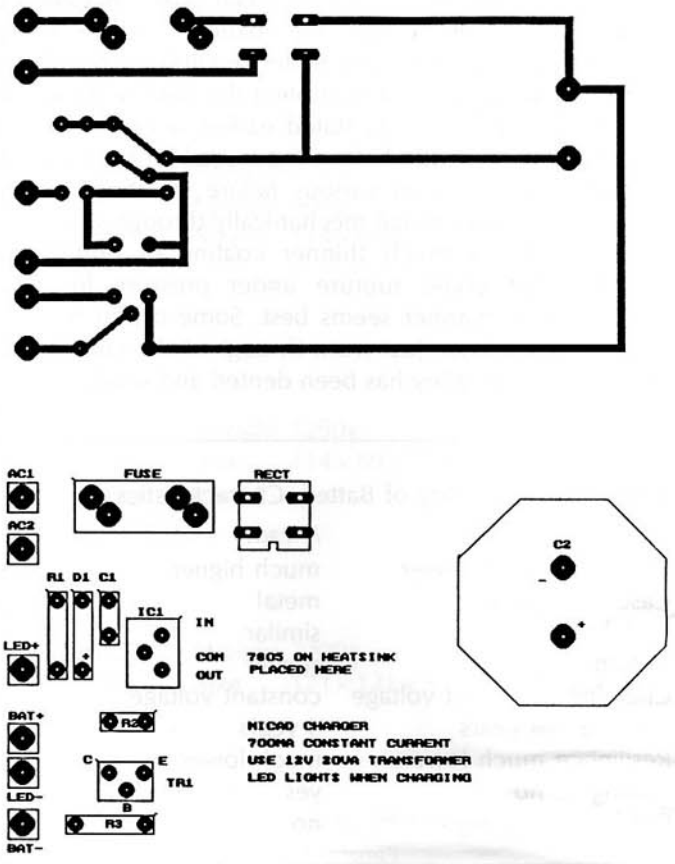
SLA batteries are charged at constant voltage. Nicads are charged at constant current. Unfortunately constant current and constant voltage regimes are conflicting requirements. However, it is possible to build a charger that will recharge both 6V SLA and series 7AH or 10AH nicads up to 6V. This is arranged by building a constant voltage charger with a current limiter. The constant voltage applies for charging SLA batteries, and the current limit comes into play when recharging nicads with low internal resistance. There are regulators which do this very neatly, e.g. Thomson L200, with few external components. If the requirement is to charge nicads only, then a circuit based on a 7805 regulator is cheaper.

SLA batteries are float charged at 2.3V per 2.0V cell, so a 6.0V battery is charged at 6.9V, and so forth. Batteries being float charged may be left connected permanently. For cyclic charging, use 2.5V per cell for a maximum of 14 hours. In both cases, the maximum current should be limited to C/4 amps where C is the AH capacity. For example, a 4AH battery should not be charged at a higher current than 1A. A further limit on current is imposed by the ratings of the transformer, rectifier and smoothing capacitor and heat sinking in the charger. The end point for SLA batteries is easily detected using an opamp comparator and LED display: you are looking for the charge falling below 80mA. A well-regulated power supply must be constructed: a crude circuit like a car battery or Oldham charger is completely out of the question.

Nicad batteries are commonly charged at C/10 amps for 14 hours. For example, 7AH nicads require 700mA for 14 hours. The 14 hours figure may be excessive if the batteries were only in a partial state of discharge. Batteries dissipate heat when overcharged and some chargers use this effect to determine the end point. There is no simple or convenient way to determine the end point of nicad charging. Some chargers overcome this problem by first discharging the batteries down to 1.0V per cell and then

PCB Parts for Nicad Charger

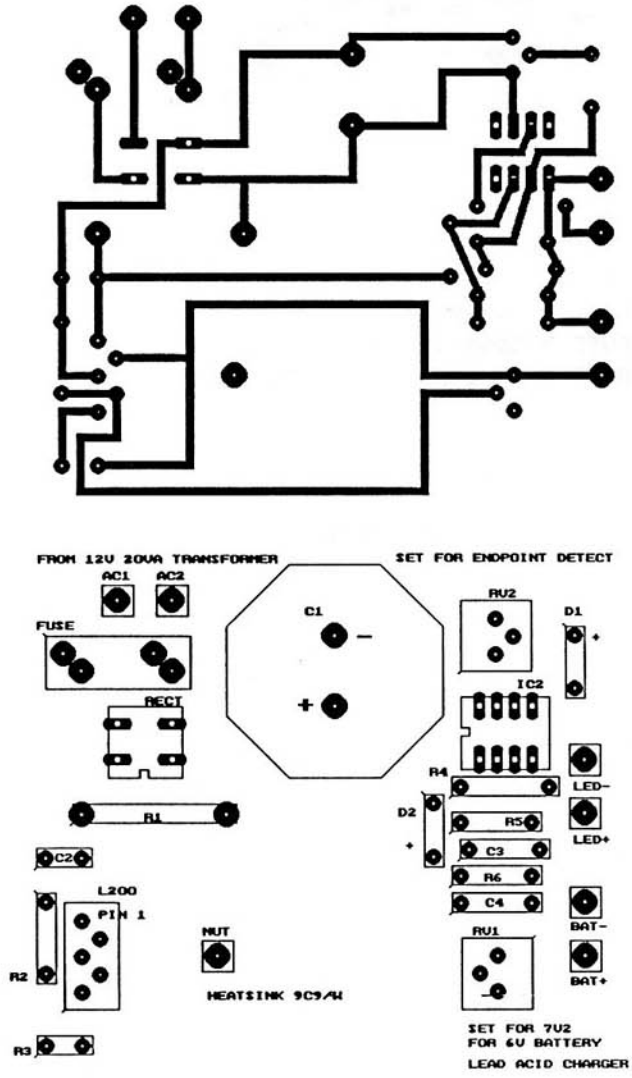
Part FUSE is "FUSE"
Part BAT− is "BATTERY"
Part BAT+ is "BATTERY"
Part LED− is "LED"
Part LED+ is "LED"
Part TR1 is "BC184"
Part R3 is "1R5 2W"
Part R2 is "6R8 4W"
Part R1 is "1K"
Part C1 is "1 UF TANT"
Part D1 is "1N4001"
Part IC1 is "7805 REG"
Part RECT is "BRIDGE RECT"
Part C2 is "10000UF 25V"
Part AC1 is "TRANSFORMER"
Part AC2 is "TRANSFORMER"



Simple Nicad Charger

Figure 1

giving them C/10 amps for a timed period of 14 hours. This would require quite a sophisticated piece of electronics to first perform the discharge, detect the 1.0V end point, then switch over to charge for a timed period of 14 hours. In practice, it is easier to recharge one's own batteries for some multiple of the discharge time (e.g. 2 times) or 14 hours, or overnight, whatever is realistic and convenient.



PCB Parts for Dimmer

Part HP+ is "HEADPIECE"
Part HP− is "HEADPIECE"
Part RV1/1 is "470K LIN POT"
Part RV1/2 is "SWEEPER PIN"
Part RV1/3 is "470K LIN POT"
Part TR1 is "F15N05L MOSFET"
Part GND is "BATTERY"
Part VCC is "BATTERY"
Part R1 is "10K"
Part R2 is "10K"
Part D1 is "1N4148"
Part D21 is "1N4148"
Part D31 is "1N4001"
Part C1 is "10NF"
Part IC1 is "4093"

6V Lead Acid Charger also suitable for 7AH Nicads
Figure 2

When trickle charging nicads, a much lower current is used, typically C/25 to C/50 amps. In the case of 7AH cells 100-200mA would be appropriate. Using this regime, it would take several days to recharge flat batteries but they can be left on charge indefinitely, even for years without serious deterioration of capacity.

When fully charged, SLA batteries will retain their charge on the shelf for months with only a small internal discharge. This is not true of nicads which discharge internally at about 10% per week initially. If you are relying on full capacity being available, it is prudent to give a top-up charge to batteries which have been left standing for more than a few days.

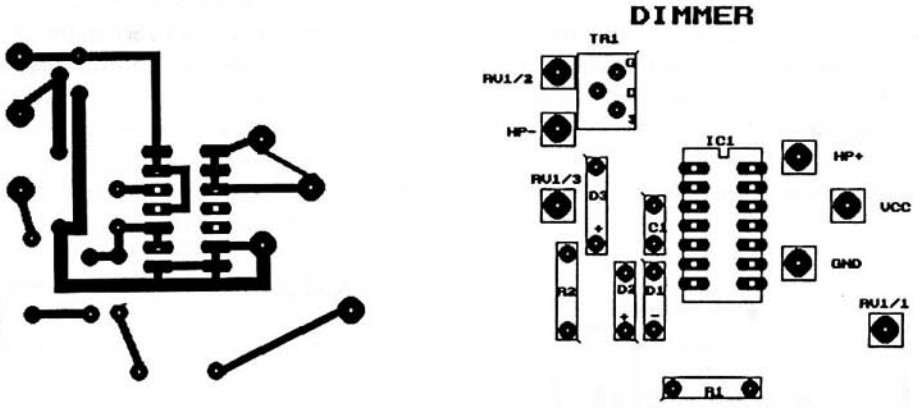
In the Light of Experience

The achilles heel of Yuasa SLA batteries is their intolerance of mechanical shocks. A local outdoor pursuit centre tried Yuasa batteries and experienced a 100% failure rate. However, it is only fair to point out that the lamps are badly abused by being regularly dropped onto concrete, and generally knocked about. Padding in the form of neoprene sheet may not have been used in the construction. SWCRO has had 1 battery out of 6 fail in this way in 4 years of occasional use. Individuals who own lamps powered by well-packed Yuasa batteries have not experienced the problem, presumably because they take more care of personal equipment and the neoprene absorbs the shocks.

The SWCRO Yuasa batteries have suffered no loss of capacity despite being on continuous float charge for 4 years at 6.9V for 6V 4AH batteries. The charger is the basic L200 circuit shown below, without the end-point detect circuitry. The batteries are physically disconnected from the charger by relay if the mains power fails: this prevents back discharge into the charger occuring.

One of the 5 SWCC hire lamps has failed after 4 years usage when one of the 7AH nicads shorted internally, giving zero volts and resistance. These batteries were made by SAFT, acquired very cheaply at a radio rally and appeared at that time to be in as-new condition. They were trickle charged at about 150mA continuously for 4 years. This rate is sufficient to recharge a battery in 4 or 5 days, that is from one Sunday night to the following Friday night. Unfortunately this system broke down when a local OPC started borrowing SWCC lamps midweek, leading to incomplete recharge by the following weekend. Furthermore, the nicads seem less able to accept trickle charge as they have aged. However, the retained capacity is still 80-90% of the rated capacity when charged at the C/10 rate. One can conclude that whilst long-term trickle charging of nicads becomes less effective, it does little harm.

It was very difficult to get the message through to club duty officers that putting Saturday's used lamps on trickle charge for re-use on Sunday was a hiding to nothing. The concept of trickle versus full rate charge was not widely understood. Consequently some duty officers issued partly charged lamps on Sundays (as well as Saturdays — depending on the mid-week activities of the OPC) and members complained that the lamps went out after an hour or two. Another problem was that persons unknown replaced broken 2.5V bulbs with 4.0V Oldham bulbs:



PCB Parts for SLA Charger

Part D1	is "1N4148"	Part RV1	is "10K-POT"
Part D2	is "1N4148"	Part RV2	is "10K POT"
Part R6	is "100K"	Part L200	is "L200 REGULATOR"
Part C1	is "10000UF 25V"	Part IC2	is "741 OPAMP"
Part C2	is "470NF"	Part FUSE	is "20MM FUSEHOLDER"
Part C3	is "100N"	Part RECT	is "1A DIL BRIDGE RECTIFIER"
Part C4	is "100N"	Part BAT–	is "BATTERY"
Part R1	is "1R5 2W"	Part BAT+	is "BATTERY"
Part R2	is "820R"	Part LED+	is "PIN"
Part R3	is "OR68 2W"	Part LED–	is "PIN"
Part R4	is "1K"	Part AC2	is "TRANSFORMER"
Part R51	is "100K"	Part AC1	is "TRANSFORMER"

CHOS Dimmer Board

Figure 3

these drew too much current for too little light output, making for poor performance and short endurance. All these problems were entirely due to incorrect charging and incorrect blubs and not the lamps themselves. It was considered easier to build a new fast charger than educate duty officers and to keep a small stock of the correct bulbs to hand.

The new charger uses a 10 hour digital timer at the C/10 rate. This charges the hire lamps for 10 rather than normal 14 hours. The 10 hours is a compromise between over-charging only slightly used lamps and undercharging well used lamps. Since the C/10 charge rate should not be applied for more than 14 hours, it was considered foolish to provide an untimed charger for the hire lamps since they would undoubtedly be left on charge from one weekend to the next. This would have led to overheating, deterioration and possible venting. The success of this scheme is yet to be assessed but it does, however, prevent gross abuses. The new system requires the duty officer to recharge all the lamps on Friday night, then only those that have been used on Saturday and Sunday nights. I hope this is simple enough to be understood and people will remember to do it.

In some ways I regret not having made the hire lamps with SLA batteries, to simplify the charging. However, I am unsure that SLA batteries are member-proof, even with the soft neoprene padding. It would, however, have prevented all the problems with nicad chargers, duty officers, incorrect bulbs, and OPCs. Maybe we should still try it when the hire lamps come to be replaced. As the Yuasa batteries are so cheap, we can afford to keep slinging them out provided people pay the hire fee.

Suppliers

(1) Caving Supplies Ltd.
19 London Road, Buxton, Derbyshire. Tel. 0298 71707.

(2) Reflectalite Ltd.
19 Orchard Road, Brentford, Middlesex. Tel. 081 560 2432

(3) Radiospares Ltd.
PO Box 99, Corby, Northants. Tel. 0536 201201.

(4) Surelife Security Ltd.
Unit 2, Ely Bridge Industrial Estate, Cardiff. Tel. 0222 551234.

(5) Yuasa Battery Sales UK Ltd.
Hawksworth Industrial Estate, Swindon. Tel. 0793 612723.

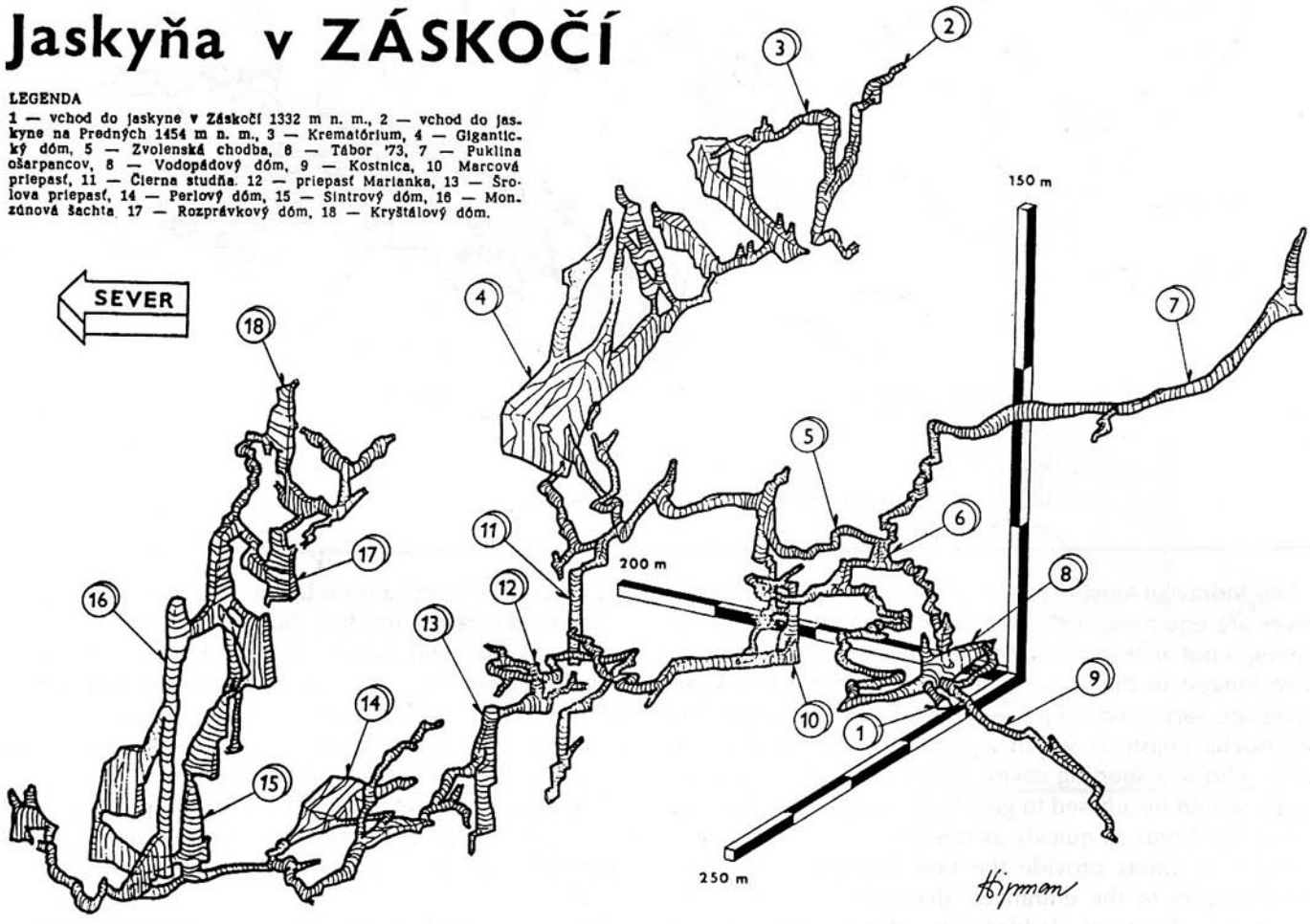
(6) Hunter Plastics Ltd.
Seawall Road, Tremorfa, Cardiff. Tel. 0222 462631.

(7) Maplin Electronics plc.
PO Box 3, Reyleigh, Essex. Tel. 0702 554171.

Caving in Czechoslovakia: 14/8/89

Summary

This summer (1989), the Crewe Climbing and Caving Club went to Czechoslovakia caving as guests of the Brno Caving Club. The following notes are some "off the cuff" comments and useful information for anyone else who is interested in making a similar visit.



Introduction

The CCPC received some Czech cavers (one from Brno) in 1988, who fixed up the contacts with the Brno caving club. The arrangement was that the Brno club would pay all CCPC expenses in Czechoslovakia and the CCPC would do the same for them when they came to the U.K. What actually happened was that they really wanted to raise some western currency for their expedition to Greece in 1989 and so wanted us to give them cash rather than hospitality.

Unfortunately, since the post is likely to be censored, they could not tell us this until we arrived there. To our horror, they wanted us to pay them the "Tourist" allowance of £10 per day, at the "Tourist" rate of 12 Crowns to the £! Some rather commercial bargaining took place which was eventually resolved in a friendly manner, but the Brno club chairman thereafter found that no-one wanted to sit next to him in the pub. To avoid such unpleasantness, it is wisest to get the Czechs with whom one is exchanging to come to the U.K. first so that the finances can be discussed openly before any committment is made.

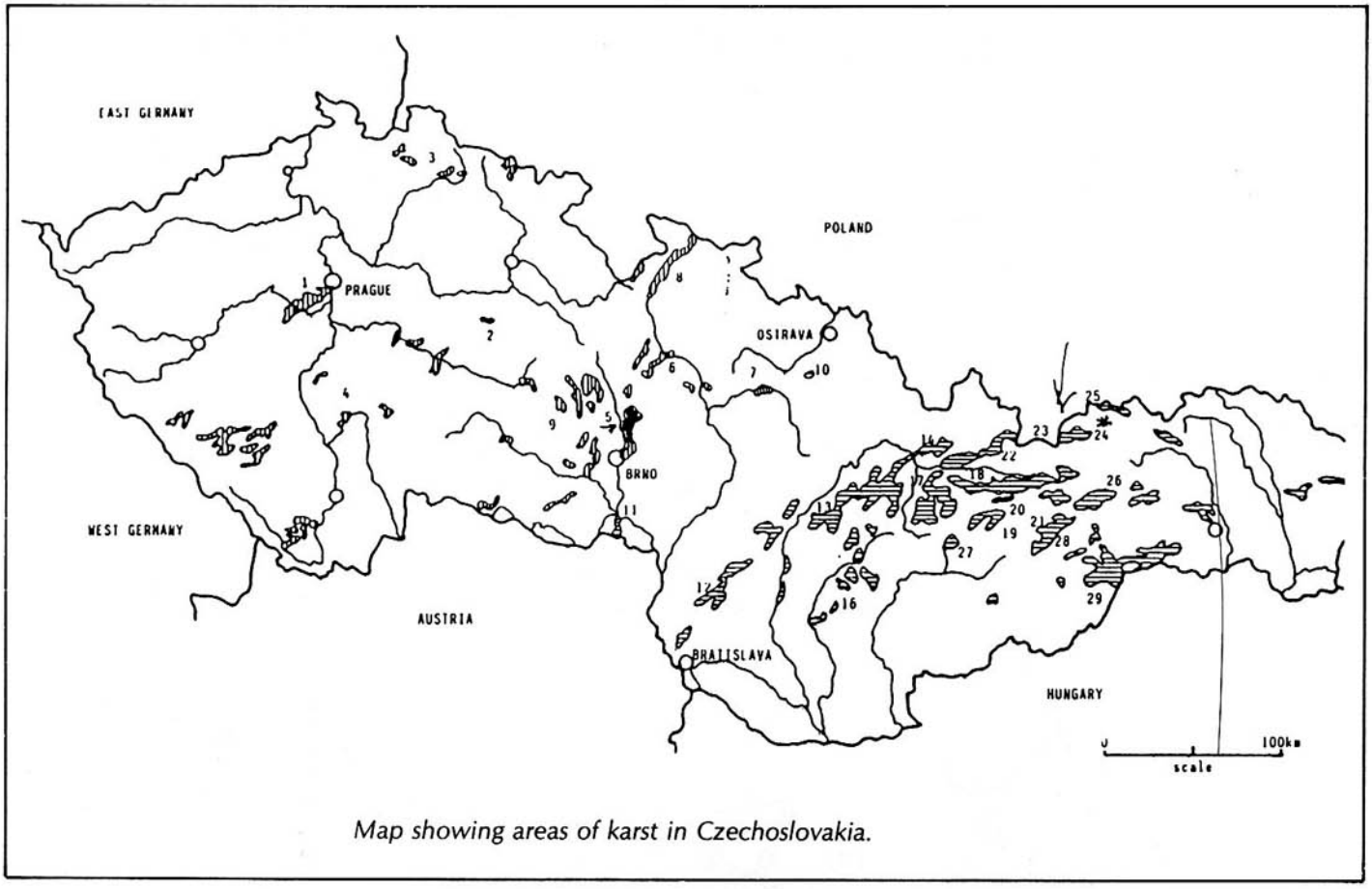
The Brno club organised an excellent caving programme for us with well structured tours and caving expeditions in Moravia and the Low Tatras. Without this programme, the CCPC would not have been able to gain access to the caves or to some of the covered areas of the countryside. Several other clubs were met as a result. The Detva club, who have a superb bunkhouse outside Stary Hrad, the deepest cave in Czechoslovakia, were incredibly hospitable and very keen to do an exchange in 1990. Since the CCPC have just returned, it was agreed that another U.K. club would be contacted on their behalf.

1. Caving Regions

Czechoslovakia has several large areas of karst (see map) with two main areas:

The Bohemian and Moravian karst. (Near Prague and Brno).

The Low Tatra karst. (Near Liptovsky Mikulas).



Map showing areas of karst in Czechoslovakia.

The Moravian karst is very much like the Jura and all the caves are equipped with fixed ladders, handlines etc. The caving is not all technical and even the Amateurskaya cave (The longest in the area) is not very sporting. The show caves are very good value, well lit and quite beautiful. The Machocha chasm is worth a visit. Anyone with limited time, who is a sporting caver, as distinct from a scientific caver, would be advised to give Moravian caves a miss and get to the Tatras as quickly as possible!

The Low Tatras provide the best sporting caves, with superb walks to the entrances, deep ditches (often with tensioned 'Electron' ladders in place) and lots of underground climbing and water. The High Tatras, not far away, provide excellent climbing and "Big" walks. The Demanova show caves are the most beautiful and extensive in Czechoslovakia.

2. Caves in the Low Tatras

Name	*Depth*	*Lengtl*
Stary Hrad	429m	5.1 Kn
Javorova Priepast	305m	1.2 Kn
V Zaskoci	284m	5.0 Kn
Slecneho Luca	113m	0.5 Kn

These have access controlled by the Detva Caving Club. There are many more, for which details are available, but the access control will be different. The Detva club could arrange this.

The Demanova show cave is worth a visit.

3. The Rest of Czechoslovakia

Prague is one of the most beautiful cities in Europe; allow a day there. It is the jewel of the country, however, the other big cities and towns are drab in comparison.

The roads are not too bad, but very slow because of the lorries, Skodas and Ladas. (What's a twin exhaust Lada called? A wheelbarrow!). Petrol stations are fairly plentiful on main routes, but they are not alway open, and sometimes run out of petrol, so it's a good idea to fill up whenever the tank gets below half full.

The people are very friendly, but rarely speak English (and never Welsh!). German is their commonest language, followed by Russian. It is useful to have a few phrases in Czech . . .

The Czech food is rather stodgy, and fresh vegetables are rarely served in restaurants. The national dish of pork, sauerkraut and dumplings palls after one or two days. However, the Czech beer is excellent and very cheap. The schnapps is also cheap and extremely strong. Tea is served in glasses and is very refreshing the morning after an evening on beer and schnapps!

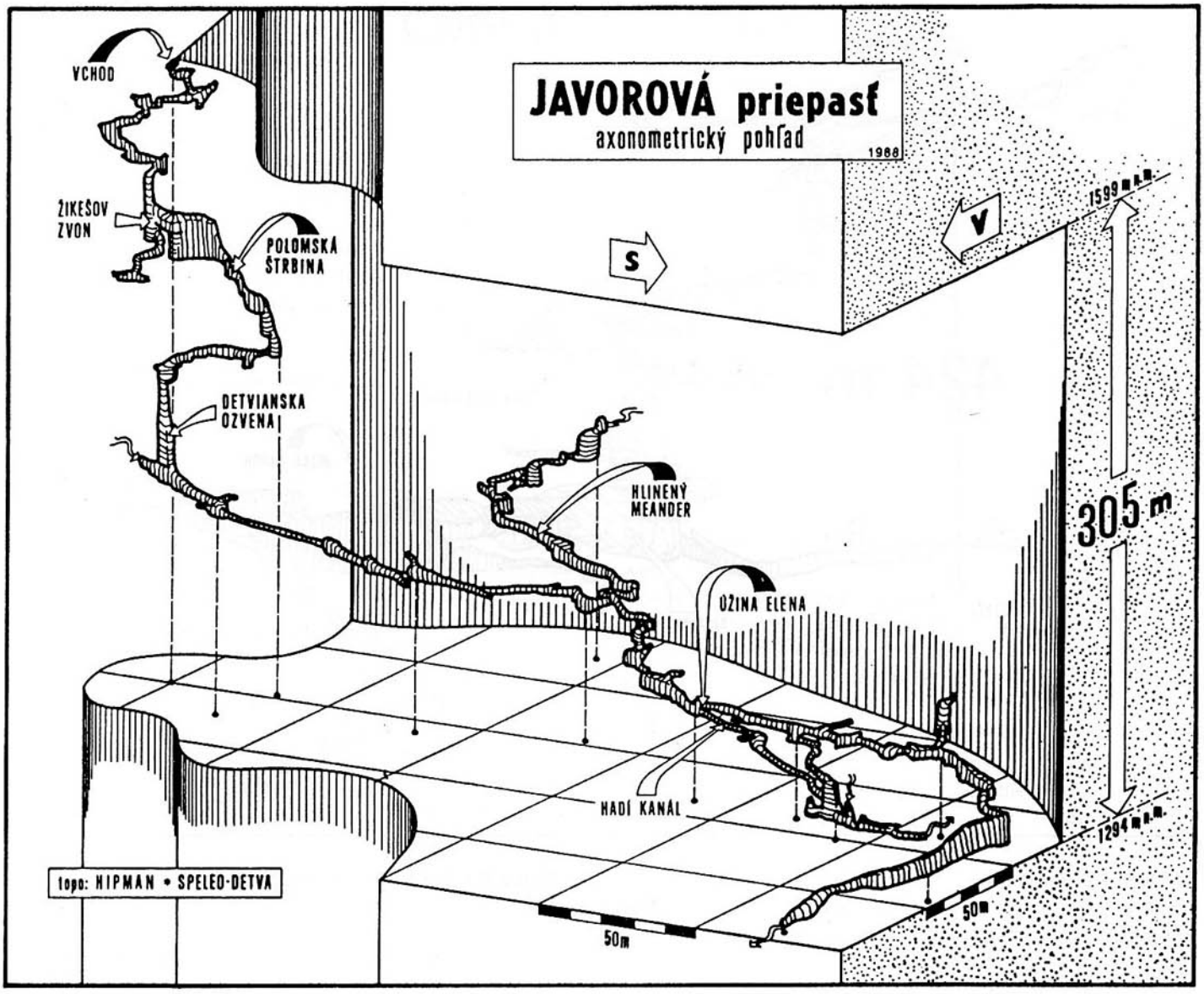
Most streets have loudspeakers attached to the lamp-posts; these are for broadcasting announcements, but first thing in the morning they often have awful music, presumably to drive everyone off to work.

4. Currency

The Czech currency is the Crown. Currency restrictions prevent import or export of Crowns, so it is best to take £ Sterling and cash it there.

The official exchange rate (1989) is 12 Crowns to the £ Sterling.

However, it is easy to get 60 Crowns to the £ Sterling on the street, as almost every Czech seems to be a currency fiddler. It does make it difficult to decide exactly how much things are worth, though. You can sometimes assess



an item for sale on the basis of how many days wages it would be worth. Generally Czechoslovakia is very cheap by western standards if you ignore the "official" exchange rate.

If you go independently, you are required to spend a minimum sum each day (approx. £10) and when you leave the country this has to be explained with bills etc. This presents difficulties if you have been using the unofficial system. It is better to go as an invited group, on a group visa, with a Czech club promising to pay for your stay, and then all these formalities at the border are waived. However, if you have lots of obviously expensive goods in the car, you may have to explain that they are "presents". The Czech club has to make a clear account of their expenditure to the authorities after you have departed, so you will have to sign for what has been provided by them, including presents.

5. Visas

A visa, obtainable from the Czech Embassy in London is necessary. Special arrangements are made for "Cultural Exchanges" . . . details available.

6. How to get there

The cheapest way is by car, but the journey takes about two days. The approximate travelling times are as follows:

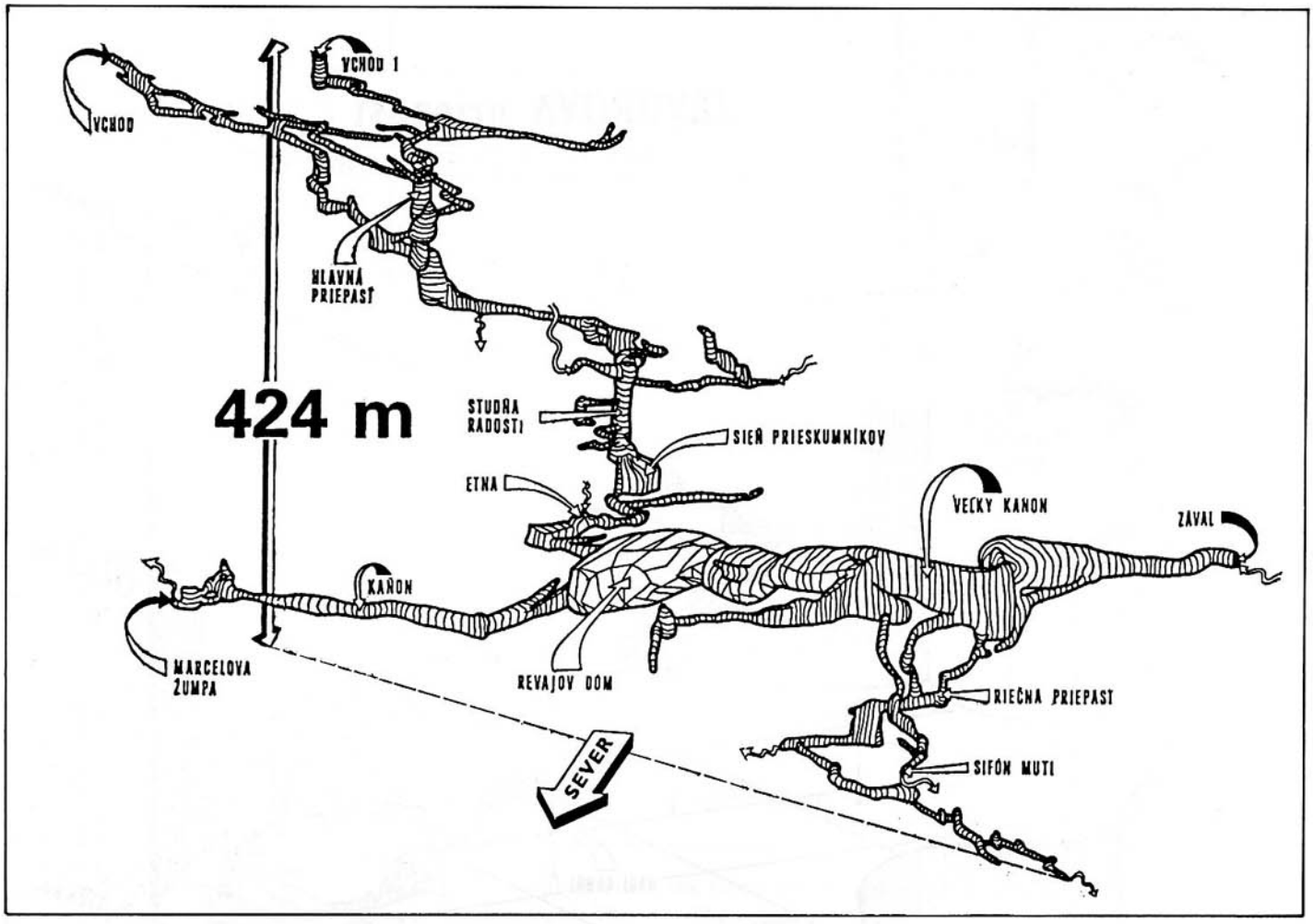
Calais to the Czech Border (Rozvadoz) .	approx. 9-11 hrs
Czech Border to Prague	approx. 3-4 hrs
Prague to Tatras	approx. 8-9 hrs

7. Where to stay

The hotels are very cheap, and it is possible that the host club will make arrangements. The CCPC stayed in a good hotel in Moravia, but the Tatra accommodation was a bit rough. (Possibly after the commercial discussions, as there was an excellent hotel nearby where our meals were served!).

All the clubs have bunkhouses near the caves. The Detva bunkhouse, carried, piece by piece, up the hillside, is superb. Nestling in the entrance arch of a small cave, it has superb views, a shower fed from a sump higher up in the cave, six bunks, and a wood stove.

Camping is not allowed, except at special sites.



8. Useful References

8.1 The Cerberus report of their 1982 expedition contains details of the main Moravian cave systems. There is not much on the Tatras though.

8.2 The Crewe Climbing and Potholing Club (CCPC) report on their 1989 expedition is imminent.

8.3 I have several books and papers, as well as my rough notes, from the CCPC expedition.

9. Detva Caving Club Correspondence

Petr Hipman,
Obrancov mierw 19,
96212 DETVA-SIDLISKO
okres Zvolen.
CSSR.

A copy of his letter asking to make an exchange in 1990 attached.

JOHN GILLETT 14/8/89

Côte d'Or Caving

The limestone caves of the Côte d'Or are rarely visited by British cavers. The majority hurtle through the region on the "Autoroute de Soleil" without stopping, aiming for the Channel ports, or the playgrounds in the Vercors or Pyrenees. A few cavers with a taste for fine wines may stop to buy Burgundy or Beaujolais, but these also do not consider the caving possibilities. The field is thus left open to the hedonists, who not only stop for wine, but include a caving trip and a gourmet meal, allocating a whole day to a leisurely stop-over.

The department of Côte d'Or, or Burgundy, is blessed with two sorts of cave. There are the well known "Caves" or wine cellars, and the less well known sporting caves. The region also has several excellent restaurants, small hotels, and camping facilities. A stop on the Côte d'Or, roughly half way between the Channel and the Pyrenees, becomes, for sybarites, not just a means to an end, but an end in itself.

There are more than thirty sporting caves in the Côte d'Or, the longest having about thirteen kilometres of passages, the deepest about sixty metres of depth. The following list gives some idea of the potentials.

Name	Depth (m)	Length (Km)	Location
Combe-aux-Prêtres	72	.13	Francheville
Creux Perce	63	0.43	Pasques
Creux de Soucy	62	4.20	Francheville
Puits Groseille	30	0.56	Arcenant
Grotte de Neuvon	35	14.2	Plombiers
Rochechevre	+36	4.44	Prenois
La Cretanne	—	1.70	Beze
La Grande Doré	—	0.40	Bouilland
Abime de Bevy	—	0.32	Bevy
Bel-Affreux	—	3.07	Antheuil

A recipe for a day of pleasure would include a visit to the Bel-Affreux, a wine-tasting at the "Marché aux Vins" in Beaune, and dinner at the "Ermitage de Corton" restaurant, also in Beaune. The necessary information to enable such a programme is as follows:

The Bel-Affreux is near the village of Antheuil which is located inside the triangle formed by the A6, the A38 and the A31 (see Sketch Map). Most cavers would visit the region on their return journey, and leave the A6 at the Beaune exit.

In Beaune, drive around the ring road and take the road sign posted "Bligny" (D970). This runs via Bouze and Lusigny to Bligny-sur-Ouche where there are cheap hotels for an overnight stop. Turn right onto the D33 signposted Thorey, and continue under the A6 motorway until the river Ouche appears on the left hand side of the road. Just past the turn for Veuvey take the next right hand turn signposted Antheuil (D115). In Antheuil (see sketch map) continue to a left hand bend and then a bridge which crosses a stream. Just past the bridge there is a rough track to the right which follows the stream. Continue into the trees as far as an obvious parking place next to the stream.

Here is the place to change into dry caving gear and charge the acetylene lamps. The Bel-Affreux entrance is upstream, where the water cascades through an iron grille. The cavers' entrance, leading to the dry passages, is to the left, and a bit higher up. The cave presents no technical difficulty and has two pitches equipped with fixed iron ladders (see sketch map). Although the final sump at the end of the cave is inaccessible in winter due to high water in the gours passage, in summer there is no problem and even the water in the lake is only knee deep. A trip to the first sump, then along the main passage to the lake and the final sump, and then out should take about an hour and a half depending on the size of the party.

There are several other caves not far away, notably La Grande Doré at Bouilland which has a duck in a tightish wet passage, the Puits Groseille at Arcenant, and the Abime de Bevy at Bevy, but these are really too small to warrant a visit on what is intended to be a gastronomic rather than a speleological expedition. So, having cleaned up and changed out of caving gear, the next activity is lunch in Beaune.

After lunch, proceed to the "Marché aux Vins" in the centre of town. There are many tourist distractions here, so it is important to remember that the objective is to taste as many of the Burgundy wines as possible, preferably without excessive inebriation!

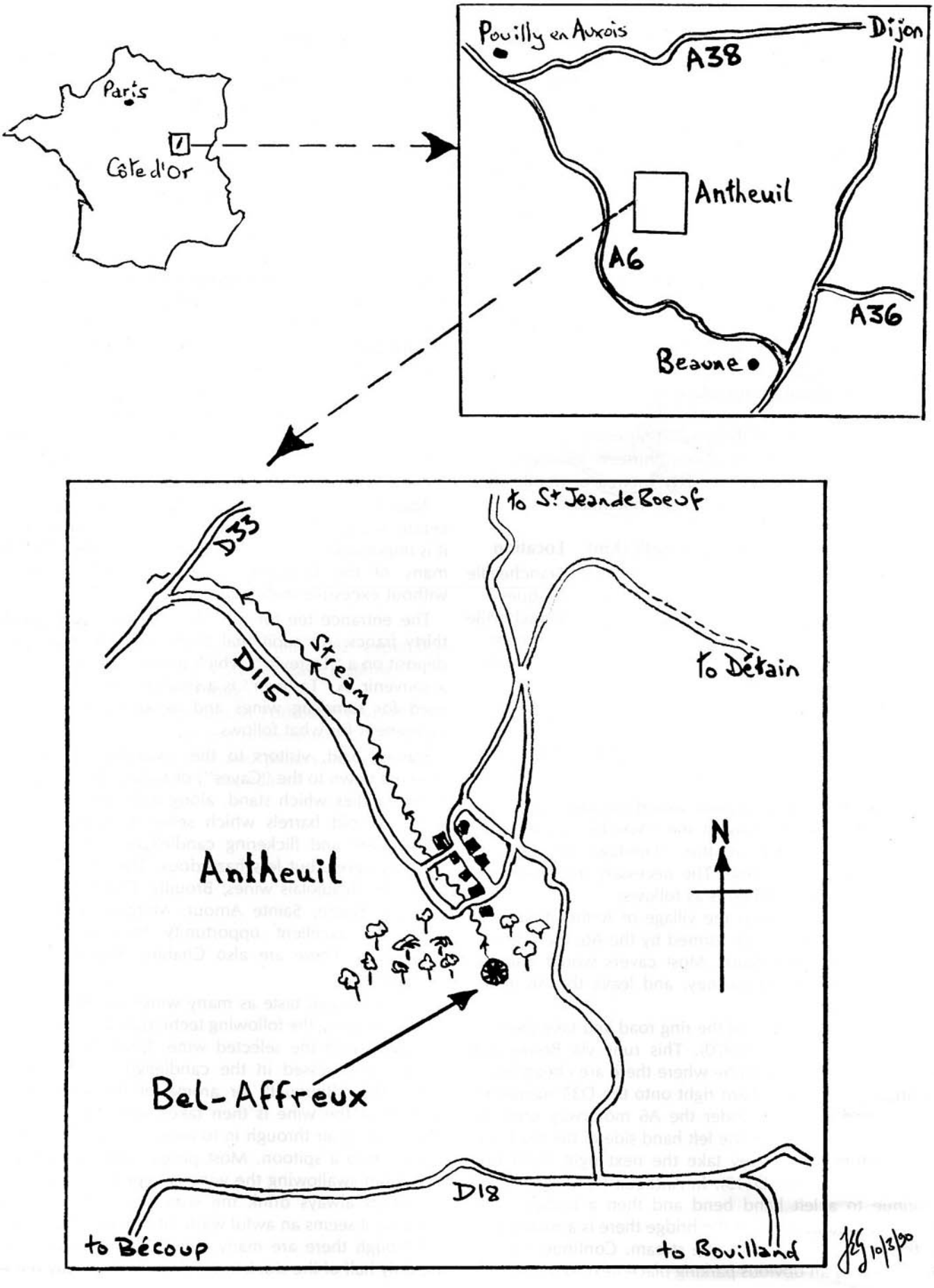
The entrance fee for the "Marché aux Vins" is about thirty francs. An additional thirty francs is required as a deposit on a "Tastevin", which most wine bibbers keep as a souvenir. A "Tastevin" is a small cup of polished metal used for sampling wines and as an essential piece of equipment for what follows.

Having paid, visitors to the "Marché aux Vins" are directed down to the "Caves", or cellars. The "Caves" are lit by candles which stand, along with opened bottles of wine, on old barrels which serve as tables. The cool atmosphere and flickering candlelight is reminiscent of sporting caves, but less hazardous. The "Caves" contain all of the Beaujolais wines; Brouilly, Chenas, Chiroubles, Julienas, Fleure, Sainte Amour, Morgon, and Moulin-a-Vent. An excellent opportunity to taste the village differences. There are also Chablis, Aligoté, and other white wines.

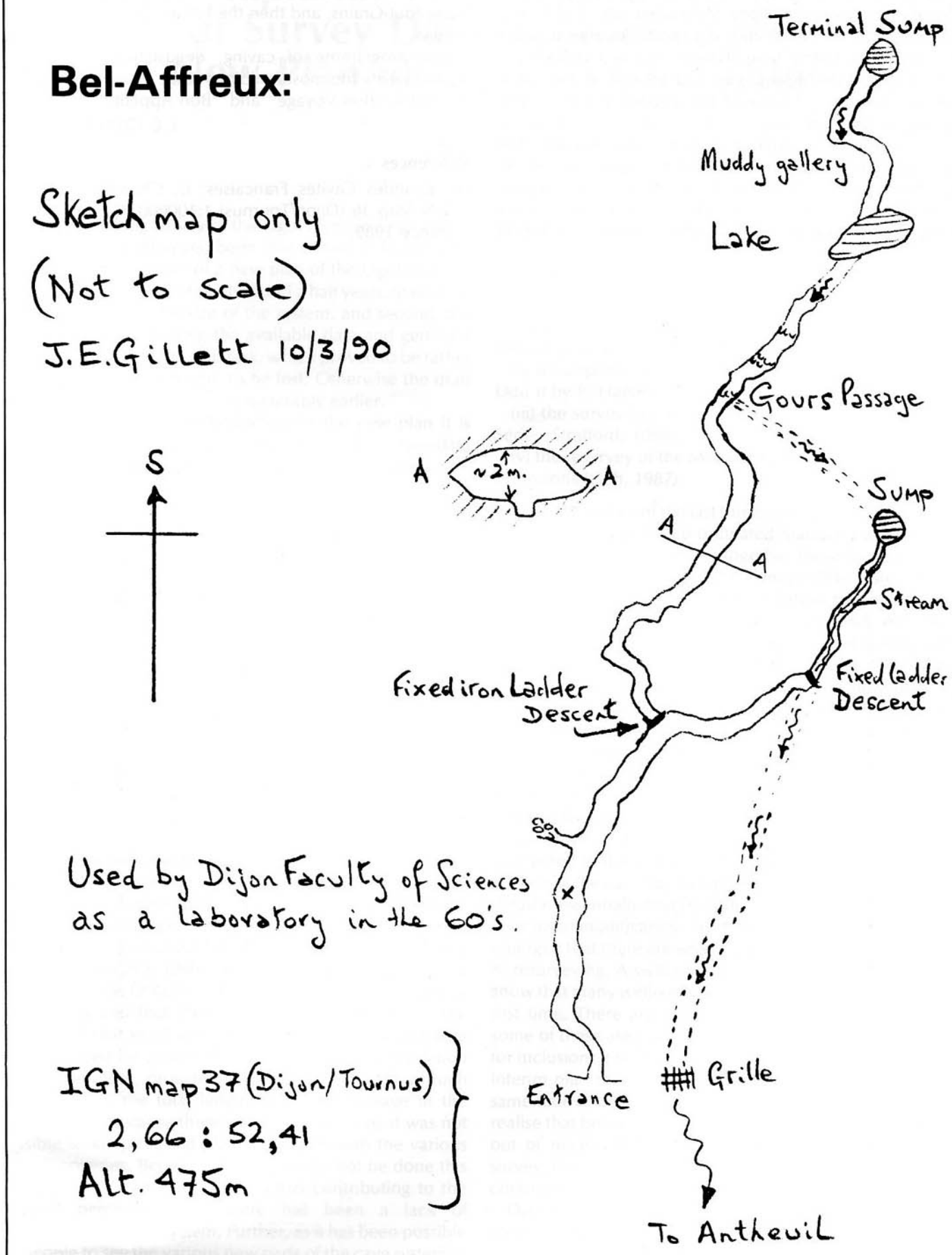
The visitor can taste as many wines as can be taken in two hours using the following technique: The "Tastevin" is half filled with the selected wine. Firstly the colour and clarity are assessed in the candlelight. Then the taster smells the "Bouquet" or aroma of the wine. A small amount of the wine is then taken into the mouth, and, after sucking air through in to assess the taste, the wine is ejected into a spitoon. Most people argue that the after taste from swallowing the wine is important, and swallow it. Others always drink the wine if it is to their taste. Anyway, it seems an awful waste of fine wine to spit it out!

Although there are many wines in the "Caves", these are only half of the stock in the Marché. The way out is via

Bel-Affreux Location:



Bel-Affreux:



Sketch map only
(Not to scale)
J.E.Gillett 10/3/90

Used by Dijon Faculty of Sciences as a laboratory in the 60's.

IGN map 37 (Dijon/Tournus)
2,66 : 52,41
Alt. 475m

stairs which lead up to a large hall on the ground floor. Here are the expensive wines; Pommard, Aloxe Corton, Chambertin, Volnay, Puligny Monrachet, etc. Those who overimbibe in the cellars miss out on the luxuries upstairs! The two hours tasting time allowed pass very quickly!

After the "Marché aux Vins", a snooze in the car is essential to sleep off some of the alcohol, before visiting the Supermarche to buy the chosen wines. However, it pays to reserve a table for dinner beforehand. The "Ermitage" restaurant on the road to Dijon is excellent. (Tel. No. 80-22-05-28). A rosette and four crossed spoons and forks were awarded by the Michelin assessors, and the restaurant lives up to this reputation. There is a 150 Fr menu which is affordable for a special occasion, but the wines are expensive. It pays to select the Aligoté or the Passe-tout-Grains, and then the bill will be less than 200 Fr a head.

This programme of caving, degustation, and dinner should satisfy the most fastidious caver. All that remains to be said is "Bon Voyage" and "Bon Appétit!"

J. E. GILLETT 16/3/90

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Les Grandes Cavités Francaises. C. Chabert. FFS 1981.
IGN Map 36 (Dijon/Tournus) 1:100000. Guide Michelin France 1989.

An Explanation of the Compilation of Survey Data to Produce the New Plan of Ogof Ffynnon Ddu

C. R. L. Friend

The main working survey of the Ogof Ffynnon Ddu system has, for the last 20 years, been that compiled by O'Reilly (1969). The production of a new plan of the Ogof Ffynnon Ddu system has taken about two and a half years, mainly for two reasons. First, the size of the system; and second, the problem of accumulating the available data and getting it into a compatible form. This task, which proved to be rather difficult, caused much time to be lost. Otherwise the draft would have been available considerably earlier.

At the outset of this introduction to the new plan it is emphasised that this is only a *compilation* of the survey data presently made available and for the most part it is **not** a new survey. Because of the size of the Ogof Ffynnon Ddu it is unlikely that any one person could now be responsible for resurveying the whole of it. Therefore, what is presented in this compilation is the result of a team effort and the credit goes to the many people who have spent innumerable hours in cold and uncomfortable conditions obtaining the original data. The new plan is the paper expression of that effort. Whilst there inevitably has had to be some manipulation to join various bits and pieces of survey together, I hope that gross misrepresentation has not occurred and trust that those who obtained the original data think that the exercise to produce this compilation has been worthwhile.

The new compilation has taken data from many sources, some published but much which was unpublished. For the most part it has been based upon what some opinion in the Club considers the most reliable sources, though others may disagree. The new additions and resurveyed areas are taken to be as "complete" as possible and they therefore represent an advance upon that which previously existed.

The idea of producing an updated plan really arose from talking to Nick Geh about his efforts in surveying the Marble Showers and Great Oxbrow Extensions. Here is became obvious that the O'Reilly (1969) compliation was a long way out of date and that there were many omissions. In the resurvey of that small area the total length of cave passage was increased by 2330m (Geh, 1987). A new compilation would, therefore, provide an opportunity to gain a much better idea of the total length of known passage in the system. Also, because there was no master copy it was not possible to keep the old plan up to date with the various new discoveries. Because updating could not be done this has probably been one of the factors contributing to the external perception that there has been a lack of developments to the system. Further, as it has been possible for people to see the various new parts of the cave system in relation to each other the amount of additional exploration has also probably been restricted.

Even though the Ffynnon Ddu system is of considerable size, after an assessment of what data were available it quickly became apparent that there was a good opportunity to create a new compilation. The starting points for this compilation were:

(i) the data from the early survey of Ogof Ffynnon Ddu I by Railton *et al.* which was itself modified in 1967.

(ii) an unpublished line survey of parts of Ogof Ffynnon Ddu II by P. Harvey;

(iii) the survey of the Nyth Bran Series and the Prokofiev Series (Stratford, 1984);

(v) the resurvey of the Marble Showers and Great Oxbow Extensions (Geh, 1987).

The importance of the last three surveys was that they had been carried out in a co-ordinated manner and effectively linked together. Therefore, together these formed a new skeleton for a large part of the Ffynnon Ddu system which allowed the O'Reilly (1969) compilation to be realigned. Because most of the small passages had not been resurveyed the detail of these non-resurveyed passages had to be transferred from the old to the new plan. One further important control was also available. The new plan has greatly benefitted from the high precision surveying of the three entrances to the system such that they are now accurately located on the National Grid (see Appendix 1). This project was started by G. Vaughan and completed with the help of B. Foster.

Using the new skeleton the main passages were redrawn to conform to the new lines and the whole plan was reoriented to the new entrance co-ordinates. Thus a major portion of the cave has had its orientation modified. Passage detail is essentially that from the O'Reilly (1969) survey but with some modification. From this major realignment it has emerged that there are several places that are badly in need of resurveying. A swift comparison with the old survey will show that many well-known passages have appeared for the first time. There are still, inevitably, omissions and whilst some of these are known, the survey data are not available for inclusion. It is considered that it is more useful to have a interim plan that can be discussed and used whilst at the same time to accept the deficiencies. It also is important to realise that because the new plan is only a compilation, and out of necessity has had to rely heavily upon the 1969 survey, some of the errors that existed on that will have been continued onto this one.

Data from other resurveying exercises and survey of new parts of the cave system have been provided by N. Geh, T. Knibbs, S. Moore and G. Vaughan together with their various helpers. Several others have provided information about smaller, but none-the-less important additions. For their willingness to supply their data I am very grateful. The

sump connections between Dip Sump and The Pit, which link Ogof Ffynnon Ddu I and II, historically form an important part of the system. The data, whilst not of high accuracy (Farr, 1974) are therefore considered an essential part of the new plan. To complete the new plan of the system the data for Northern Lights and the Upper Smithy area were taken from Peat & Peat (1985, 1987).

The next stage is to update and correct as much of the system as possible now that people can see exactly what has been added and what, perhaps, is still missing. In the hope that this will take place a project to carry National Grid co-ordinates inside the cave using an infra-red theodolite survey has been commenced. This is also being carried out by Gary Vaughan and various assistants. Whilst this has only just begun, the exercise has presently reached The Big Chamber Near the Entrance and the beginning of the White Arch Series, the eventual aim is to get as long a survey line as is possible. It is hoped that the larger passages such as Gnome Passage and The Chasm can be reached. The majority of the survey stations are only temporary, white typewriter correcting fluid is extremely good in this respect. In addition some permanent metal survey studs with known National Grid co-ordinates are being placed at strategic, but inconspicuous, places within the cave. This would mean that, rather than guessing where a start point is, known positions can be used for resurveying. If these are used the survey can then be directly related to the master and the new details can be quickly transferred. Providing that the project is successful, it is intended to publish a list of these survey stations with their National Grid co-ordinates at some later date.

Additionally, in close proximity to the Ffynnon Ddu system there are several small cave systems some of which have an established water link into the main system. Twll Gwynt Oer, a little to the north of the entrance to Cwm Dwr, is one such system. The proven water link from this is into Cwm Dwr Jama and so the passages have been included in the hope that there may be a breakthrough in this area. The entrance has also been surveyed as part of the location exercise (see Appendix 1). Other water connections, for example the main stream entrance at the Byfre, are of course known about. However, these are at present unlikely to have their passage connections proven and are too remote to be included in this compilation. The entrances to the dig presently being carried out in the old brickworks area and the other small caves which have been broken into by the old quarry behind the brickworks have not yet been surveyed and are at the moment omitted from this edition.

Some of the areas which are in need of resurveying are: parts of Dip Sump Series between OFD 1½ and Piccadilly; Upper Piccadilly; The Maze; and in particular, Ogof Ffynnon Ddu III. In this latter part of the system there are known high-level passages for which no survey data exist (technical climbers please note) and, given the amount of passage which usually accompanies a resurveying project, there must be some potential for extensions in this area. It is also apparent that there are still one or two long-standing blank areas, for example, the large square bounded by Pendulum Passage and The Chasm-Swamp Creek. If anybody has data concerning passages in this or any other area please pass them on. It is hoped that this compilation will provide some assistance in the discovery of new passages. We now need some new breakthroughs and more advances in resurveying to speed up the appearance of the second edition.

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Appendix 1

National Grid co-ordinates of the entrances of the Ogof Ffynnon Ddu system:

Ogof Ffynnon Ddu I	SN 86354 15878
Cwm Dwr	SN 85745 15592
Ogof Y Nos Hir (Top Entrance)	SN 86360 15877
Twll Gwynt Oer	SN 8587 1595

Tinkering Around Top (OFD)

by

Bob and Jenny Peat

Introduction

Following the discovery Northern Lights and the results of the radiolocation and surveying data, it became apparent that passages have to exist in the limestone block to the north west of Top Entrance (figure 1) and between the boundaries of the Wern quarry and the tramroad.

The character of the passages in the extremities of Northern Lights appear to be the continuation of the western development of the Top Entrance series and a considerable amount of passage could still be waiting to be discovered. This stimulated digging activity around Top Entrance for a good many months and although the series to the north west remains hypothetical, a few minor discoveries were made that were worthy of surveying. This information is presented and the implications for further exploration are discussed.

Right Hand Series (length 140m)

At the bottom of the rubble slope from Top Entrance, looking to the right there is a low recess at floor level with a passage leading off to a small series (figures 2 and 3). This is easily overlooked and when we first visited it in 1978 there were very few footprints despite it being so close to the entrance.

A crawl down boulders leads to a squeeze followed by a tight duck; probably the main reason why this series is ignored! Once through the duck, which may need bailing, you can stand up in a mature passage with an aven above. The whole series is a complex network of passages consisting primarily of an upper and lower level. The lower level continued until recently for 28 metres where it closed down at a calcited choke with a few small stal formations.

The upper levels can be entered by a crawl on the right hand side halfway along the lower level. This leads to a small chamber with an easy 2.5m climb into a series of interconnecting passages, some of which intersect the aven and overlook the main lower level route. At this point there is substantial roof collapse originating from the breakdown of shale horizon in the rock strata. This can be seen most clearly in Shale Bed Chamber as a 0.3m thick band around the walls and 0.5m below the flat roof. There are two interesting tight digs leading off from this chamber. The dig is on the left, as you enter the chamber, tends towards the White Arch Series. After 6m there is a right and left turn and the passage is then blocked with sand. A more accurate survey of the White Arch series could reveal the exact proximity of this passage as the current survey is inaccurate. The more promising dig is opposite and to the right of the entance to Shale Bed Chamber. A hole in the floor below the shale bed cuts through a sharp grey rock that marks the transition back into the limestone beds. The tube continues for 12m before coming too tight. It is a reasonably easy dig with a good draught and interesting prospects.

When we came to survey this series we found a dig had been started at the calcite choke in the lower level. This was trending southward and looked quite interesting with good draught and 'blackness' between some of the boulders. The dig had been started by Steve Richardson in 1987. Bob returned to the site with Steve, Malcolm Herbert and Peter Munn. It was anticipated that it might go to the White Arch Series but when they broke through the choke it entered a small, tall chamber which rose steeply to the right up a pile of boulders and terminated as a very nasty choke. A small rift at the foot of the boulder slope was connected with the upper levels.

Wallow Wade (length 82m)

This passage is of a very different character to the Right Hand Series and is at a lower level. Immediately turning left off the entrance passage towards Big Chamber Near The Entrance, a hole at the level takes a trickle of water that runs into a passage (figure 2). This trickle accumulates as a pool along Wallow Wade to various degrees depending upon the weather and causes the passage to alternate between muddy to glutinous and glurpy (try the sound effects!). At the best it is repulsive but it has the advantage that you return to the club as if you have been somewhere more exciting than just Top Entrance. The day we surveyed this series was after a heavy rainfall and we were waist high in mud soup.

After 30m the westerly trending passage meets a larger chamber which climbs upwards to the right hand side. The climb is slightly exposed, awkward and slippery but Steve Richardson and Aiden Phippard recently attempted it and to their amazement found 30m of virgin passage.

To the left of the Large Chamber the passage becomes prgressively tighter and is blocked by moonmilk. It is very reminiscent of the passages leading out of Mudlust Hall in Northern Lights. Steve, Aiden and Malcolm Herbert persevered for a time digging the moonmilk and made good progress furthering the passage by 15m into a small moonmilk chamber with a solid right hand wall of boulders. This passage is approximately 14m beneath Top Entrance and optimistically could lead to further passages to the west of the Entrance but more realistically it seems probable that it will just complete a round trip to the left hand wall of Top Entrance just below the position of the gate.

The westward continuation out of the Large Chamber consists of shattered blocks with many dead flies indicating that it is close to the surface and possibly truncated. It could be an interesting dig as it has the potential of leading into an empty space on the survey.

Figure 1. Survey showing the relationship of Northern Lights to Top Entrance and the Midnight/Lugubrious complex of Passages.

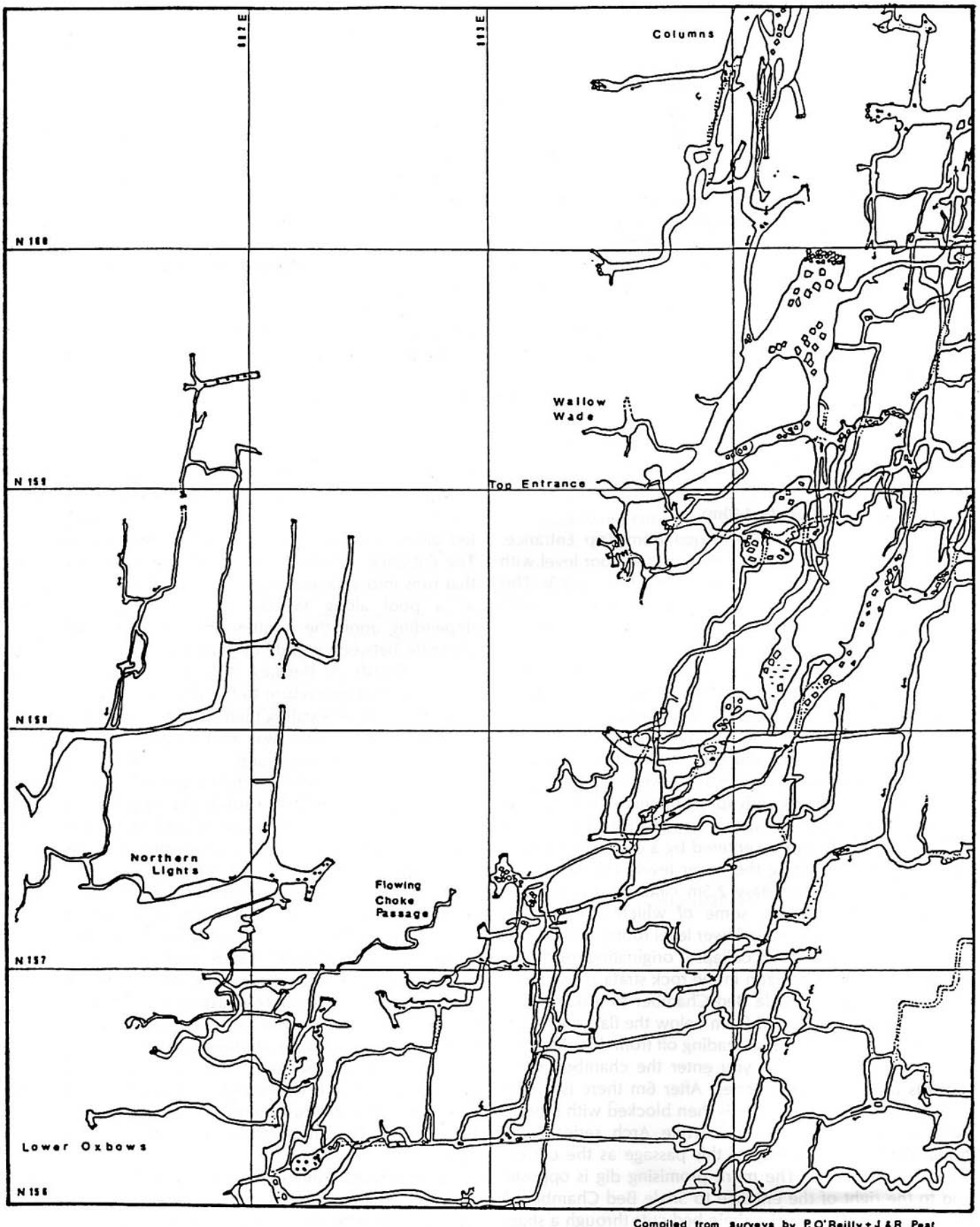


Figure 2. Diagram of the passages surveyed in close proximity to Top Entrance.

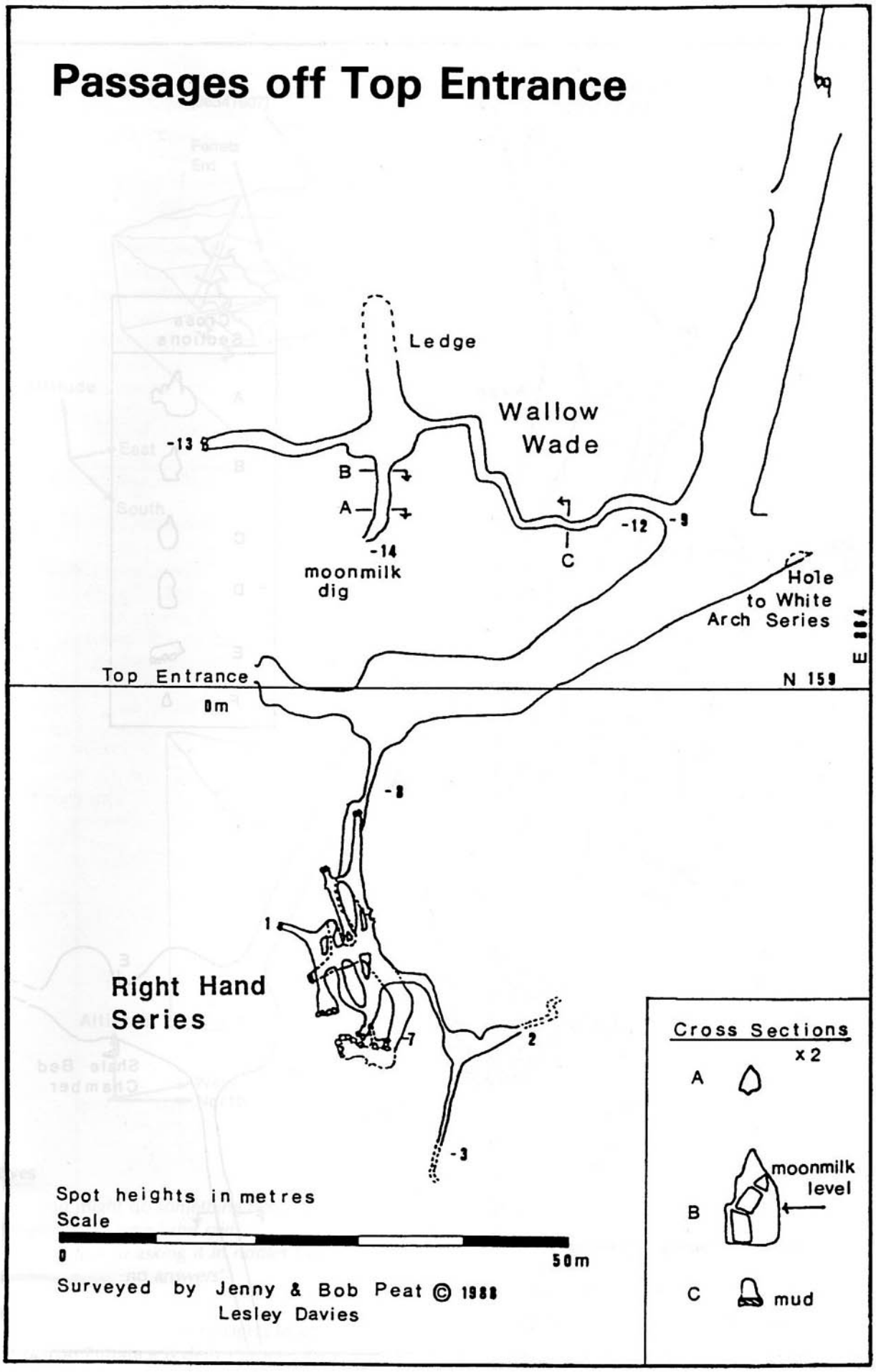


Figure 3. Detail of the Right Hand Series of passages.

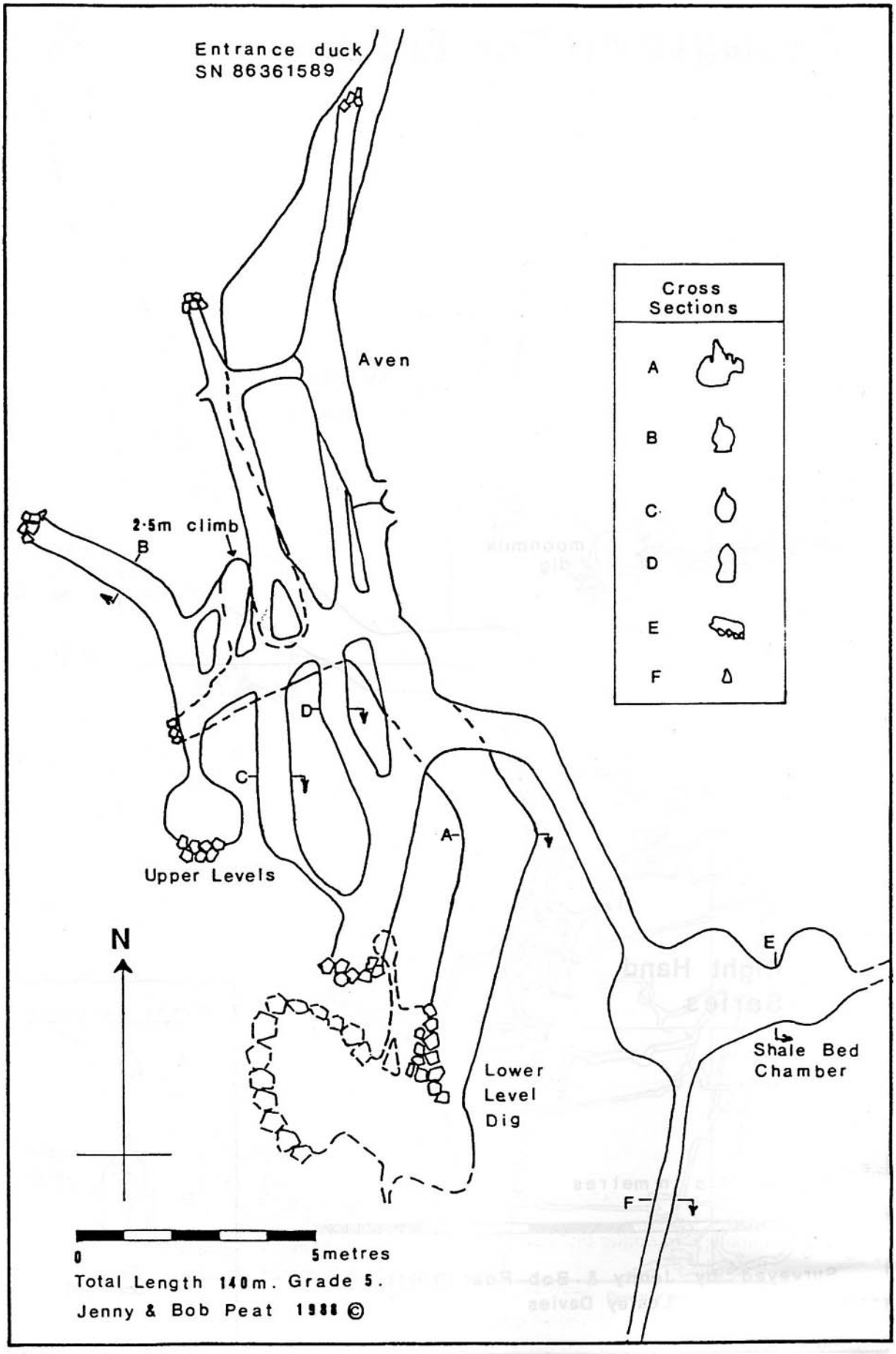
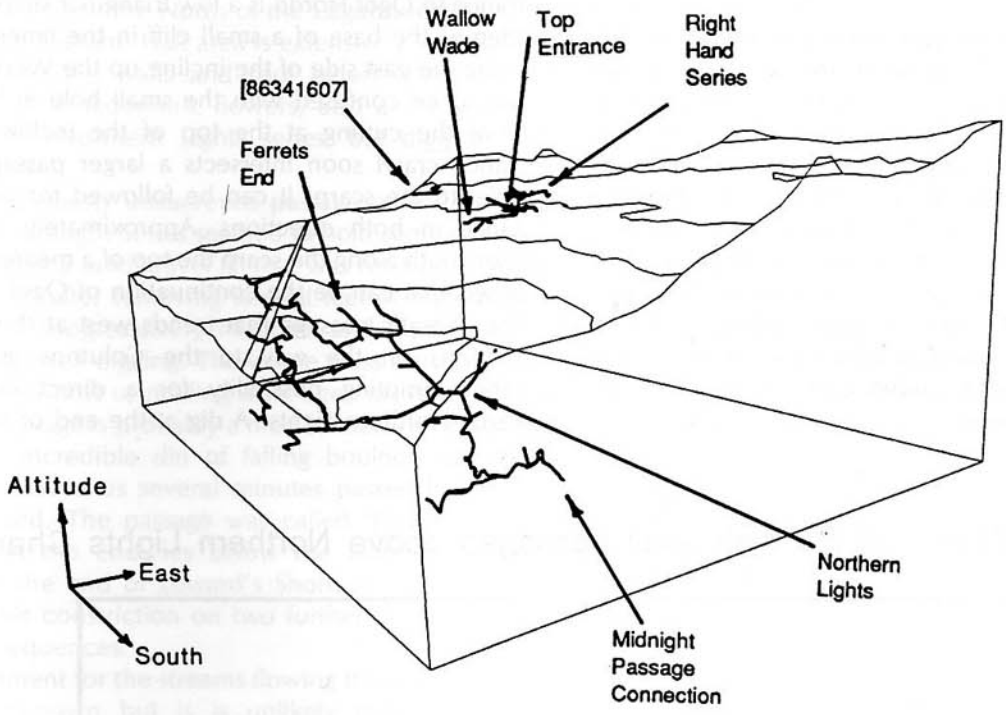
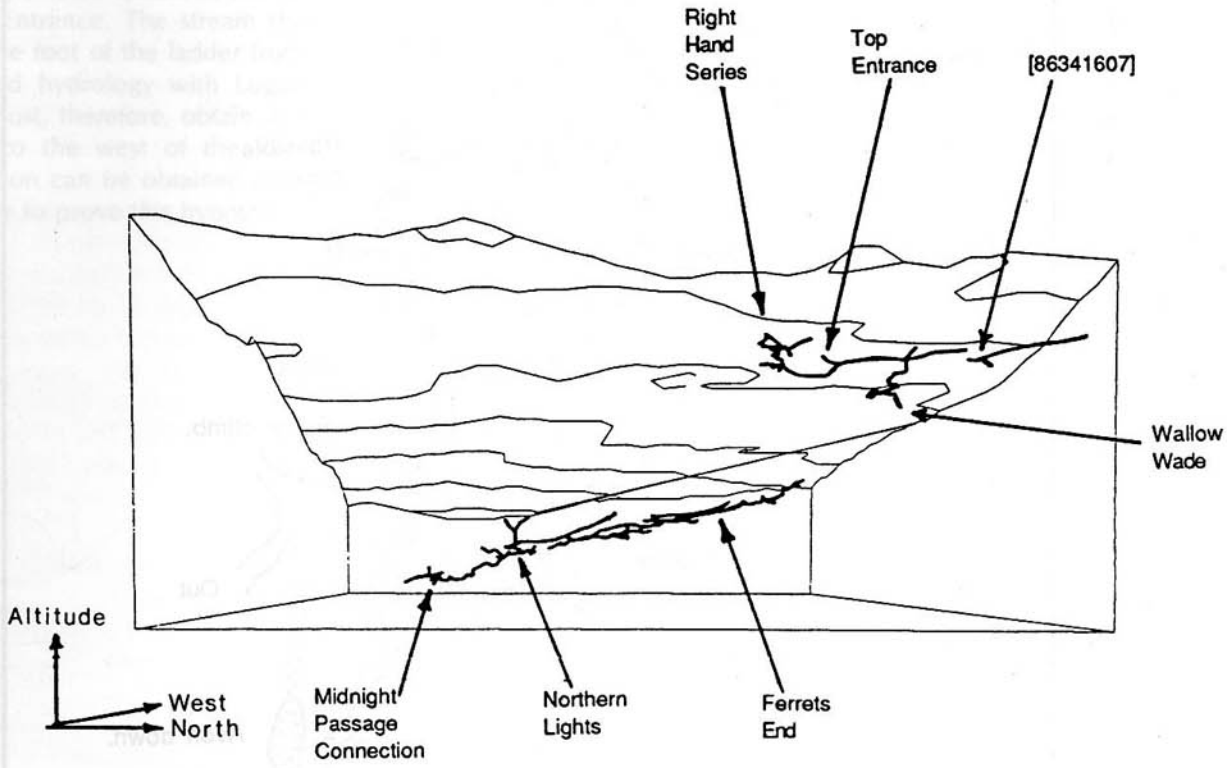


Figure 4. Perspective Drawings of Northern Lights relative to Top Entrance and the surface topography.





Perspectives

'I think you might do something better with the time,' she said
than waisting it in asking it in riddles that have no answers'

Lewis Carroll.

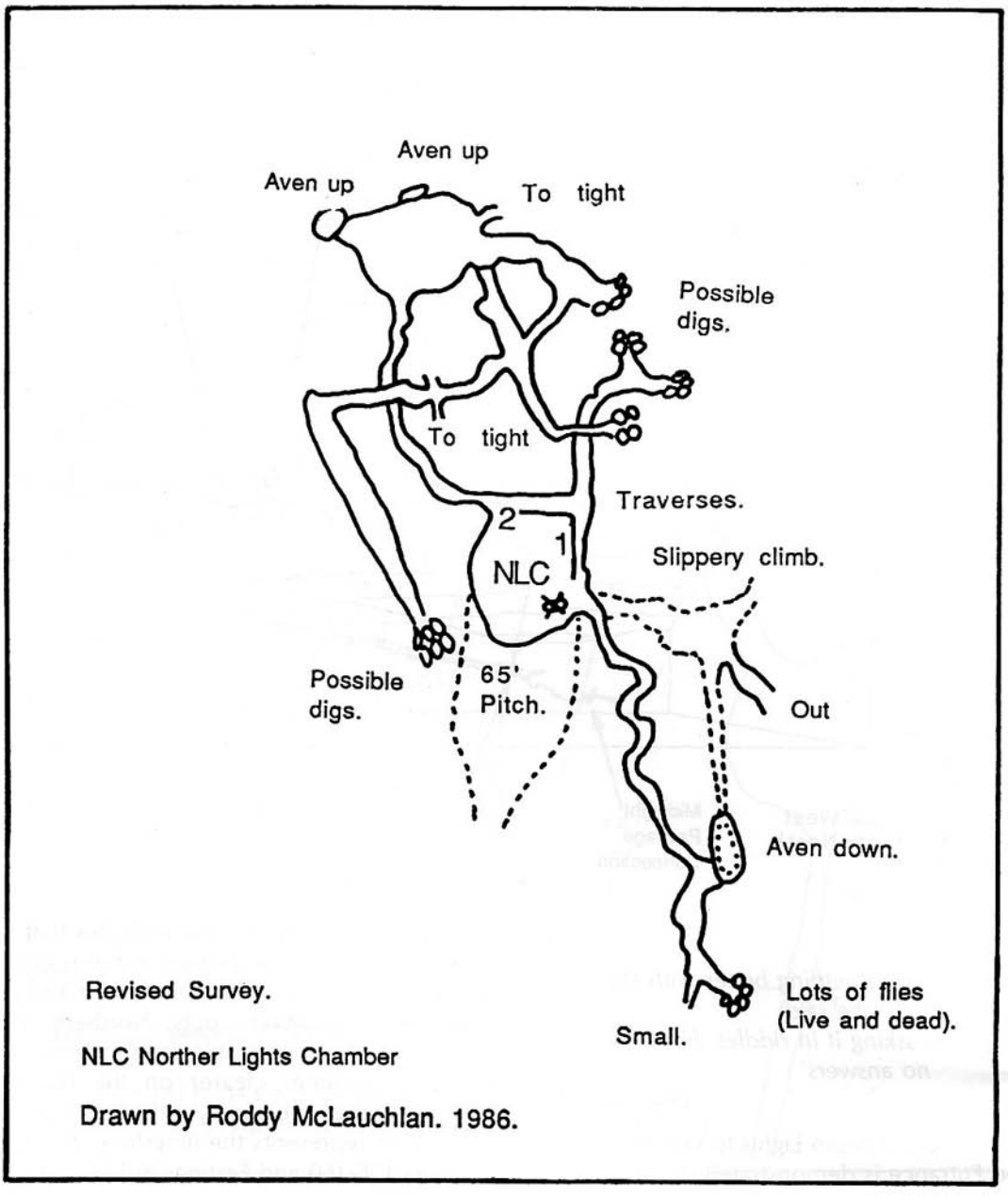
The close proximity of Northern Lights to known cave in the region of Top Entrance is demonstrated on the survey in Figure 1. The radiolocation indicates that Ferrets End is roughly 30m below the surface in the region of the small area of shakeholes 100m to the west of Top Entrance. The extra depth, however, puts Northern Lights in the limestone beds comparable in sequence with Column Hall. This becomes clearer on the three dimensional representation of the survey data shown in figure 4. This construction represents the limestone block bounded by Northings 156-160 and Eastings 861-864 but unfortunately

the passages in the Lugubrious and Northern canyon areas have had to be excluded due to absence of data. It can clearly be seen that Northern Lights is developed at an angle consistant with the dip of the strata at 12° to the south.

The passages that have just been described off Top Entrance are close to the surface and too high in the limestone sequence for any likely connection to the west. However, passages are known to exist at a high level above Northern lights. These high level passages were discovered by Roddy McLauchlan and his team following a carefully planned assault on the 20m aven in the Northern Lights Chamber (figure 5). The party had to negotiate a traverse along a 'rotten' ledge but no specific mention was made of the existence of the shale beds marking the top of the S_2 limestone. A radiolocation from the eastern choke at the bottom of the aven recorded a depth of 40 metres, which fixes the high levels only just below the surface to the east of the dry valley that marks the old footpath up to Top Entrance. There also evidence of cave development in the limestone beds above Pen and Ink as two passage remnants are exposed on the surface in this area. The entrance to Ogof Ffordd is a low triangular shaped passage hidden at the base of a small cliff in the limestone scarp forming the east side of the incline up the Wern quarry. It is not to be confused with the small hole in the eastern wall of the cutting at the top of the incline. The low entrance crawl soon intersects a larger passage running parallel to the scarp. It can be followed for only a short distance in both directions. Approximately 100 metres further south along the scarp the top of a meandering rift is exposed that can be the continuation of Ogof Ffordd.

The phreatic passage that trends west at the stalagmite formations on the way to the Columns gate offered another tempting possibility for a direct continuation towards Northern Lights. A dig at the end of this passage

Figure 5. Sketch of the high level passages above Northern Lights Chamber



(86341607) was instigated by Gavin Newman but despite considerable effort the roof became dangerously unstable and the site is now considered as a 'no go'. Further possibilities may still exist off Northern Canyon, at the Column Hall and to the North of the Lugubrious/Midnight complex. The Column Hall area is extensively infilled with moonmilk and the walls and roof before vandalisation were covered in moonmilk flowers, also a predominant feature of the Northern Lights series, but digging here would be futile.

A small previously unsurveyed passage off the nothern extemity of Midnight Series seemed to hold some promise. It terminated in a sand/gravel fill that was relatively easy to dig. However, after removing several feet of material the infill became progresssively muddier and liquid until it finally became self digging. The whole mass started a slow noisy creep towards us refilling what been previously been dug. The blockage is probably a mud funnel with dig at the bottom, an incredible din of falling boulders could be heard from above us several minutes passed before the activity ceased. The passage was called 'Flowing Choke passage' and the end lies below the large breakdown chamber at the end of Edward's Shortcut (figure 1). We have dug this constriction on two further occasions with similar consequences.

The catchment for the streams flowing through Northern Lights is unknown but is is unlikely that the source corresponds to any known stream in the cave to the north and east of Top Entrance. The stream that flows out of Column Hall at the foot of the ladder from the Column's gate has a proved hydrology with Lugubrious Passage. Northern Lights must, therefore, obtain its water from the limestone block to the west of the Wern quarry and providing permission can be obtained an attempt will be made in the future to prove this hypothesis. A recent dye test conducted under extreme flood conditions proved a connection from Northern Lights to the main sump in the Lower Oxbow Series. This contradicts a previous test conducted under drought condition with a positive connection only to the small stream that flows beneath Trevors Wimp (SWCC Newsletter No. 100). Both tests were strongly visible to the naked eye. The result suggests that a flood bypass exists to a parallel streamway connecting with the sump in Lower Oxbow. Two other tests were conducted. The stream in Sordidia was proved to be the feeder for the small waterfall at the junction of the Pen and Ink Passage with its high level bypass. The small stream that flows into boulders in the floor at the southern end of Keyhole passage continues south in the trench beneath the 'Devil's Dagger' formation and disappears at a small slit. It reappears at the western tributary at a small confluence at the foot of the traverse halfway along Northern Inlet. The eastern tributary had not been noticed on the previous tests under low water conditions.

In total the Right Hand Series, Wallow Wade, and Flowing Choke Passage adds 325m to the surveyed length of OFD.

Acknowledgement

Thanks to Trevor Netherway and Ivan Wolton who persevered in Flowing Choke Passage. Steve Richardson, Ian Anderson, Kevin Davies, Malcolm Herbert, Steve West, Ian Alderman, Aiden Phippard, Lisa and Mo helped with the dye test. Anthony Kucernak provided the program for the three dimensional survey and Roddy McLauchlan drew the sketch of the High Level passages above the Northern Lights Chamber.

The Management of Caves on the South Gower Coast

by Melvyn Davies

Cave management in Wales in one form or another has now been employed for some 50 years. When Dan-yr-Ogof was opened as a show cave just before the war, entry for potholers began to be controlled, and an access agreement was implemented at Ogof Ffynnon Ddu soon after it was opened in 1946. In 1959 the Agen Allwedd Cave Management Committee was set up and I served on it from its first meeting on 28th October until 1971. The Castlemartin army authorities began to control access to the caves on its tank-firing range in 1969, and some clubs have gained complete control over caves which they discovered. In each of these cases management extended over a single cave, a small area containing caves, or a cave system with several entrances. Except for two caves gated by the South Wales Caving Club, the Gower peninsula was unaffected by these developments despite having several square miles of limestone containing many caves.

After coming to live in the area in 1981 I discovered several new bone caves by means of trial excavation in small cliff holes, and I also came to realise that the well-known like Minchin Hole and Bacon Hole were by no means worked out. I helped in the British Museum (Natural History) excavations in both these caves and was also fortunate to be on the scene when a London caving club discovered bones in an old cave in Fall Bay in 1985. A local teacher found human remains in a new cave on Pwlldu Head in September 1986, and I identified them for him. What was lacking at this stage was a comprehensive list of Gower caves showing which ones were archaeological or palaeontological or both, and which ones could be dug by potholers searching for extensions without causing damage. As the local Nature Conservancy warden with cave experience stretching back to 1947, I was able to get permission to include cave evaluation as part of my work. Fieldwork and searches in old records occupied much of 1986 and my first publication listing some 52 cave sites appeared in January 1987. When a copy was sent to the National Trust authorities, who by then included two professional archaeologists working in Wales, it was decided that the caves needed some form of management and access control. Although the Nature Conservancy managed one section of Gower Coast, the Trust owned almost all of it, so a meeting was called for May 1987 at which both bodies were represented as well as people from the Glamorgan/Gwent Archaeological Trust, the Natioal Museum of Wales, the Royal Commission on Ancient Monuments, and the Wales Group of the Council for British Archaeology. At my suggestion the Cambrian Caving Council was invited to the first business meeting of what then became the "Gower Caves Advisory Group" held in July 1987, and that body has met regularly ever since. My field work was continued up to May 1990 a total of 97 caves being visited and assessed. The details are then laid before a Group meeting for a decision on access to each and every cave.

In addition to field meetings are held by a small "Steering Group" so that my assessments can be checked, but so far no excavations have been undertaken. Some 52 pages of data have been transformed into a database, and revision goes on after every field visit. So far the work only covers National Trust and private properties stretching from Worms Head in the west to Pwlldu Bay in the east, a distance of 19 km. Most of this section of coast is notified as a Site of Special Scientific Interest and some of the caves are scheduled as Ancient Monuments. Discussions are now proceeding to see whether further caves could be scheduled. There is no doubt that a few of the caves are of international importance because of full sequences of deposits stretching back to the beginning of the last interglacial period and perhaps earlier. The following table gives a summary of the situation to May 1990. In brief it records the following:

Caves with Pleistocene animal remains	17
Caves with human remains	10
Caves of general archaeological interest	3
Total number of caves assessed	97

NO	NAME	NGR		EXC	ARCH	POT	ALT	FUTURE
Caves on the island of Worms Head								
1	Worms Head Cave	3836	8769	Yes	Yes	Some	10	Pleist. fauna
2	Worms Head Upper C.	3836	8770	Yes	Yes	None	20	Holocene fauna
3	Worms Head Blowhole	3854	8774	None	None	Yes	0	Sea Cave
4	Worms Head Archway	3865	8774	None	Poss	None	15	Dig required
5	Worms Head Fissures	3934	8758	None	None	None	35	No interest
Mainland Caves on the South Gower Coast								
1	None	4120	8736	Some	Poss	None	15	Dig required
2	Lewes Castle Cave	4141	8729	Yes	Yes	Yes	24.06	Pleist. fauna
3	None	4150	8729	Some	Poss	Poss	49	Dig required
4	None	4153	8723	None	Poss	None	12	Dig required
5	None	4168	8732	None	None	None	40	No interest
6	None	4174	8723	Yes	Poss	Yes	25	Dig required
7	Mailing's Cave	4177	8721	Yes	Yes	Yes	12	Pleist. fauna
8	Mewslade Quarry C.	4244	8753	Yes	Yes	Yes	40	Inhumation
8a	Pitton Cliff Cave	4253	8752	Yes	Yes	Yes	45	Inhumation
9	Richards Rock Cave	4230	8740	None	Poss	Yes	35	Dig required
10	None	4223	8728	Some	Poss	None	33.97	Dig required
11	Mewslade Cave Lower	4219	8724	None	Poss	Some	25.09	Dig required
12	Mewslade Cave Upper	4221	8724	Some	Yes	None	44.24	Dig required
13	Mewslade Spring	4213	8718	None	None	Yes	0	Hydrological intrerest
14	Mansel's Shelter	4269	8670	Yes	Poss	Yes	30	Dig required
15	None	4263	8676	Some	Poss	Yes	15	Dig required
16	Red Fescue Hole	4266	8678	Yes	Yes	None	20	Inhumation
17	Red Chamber	4264	8674	Yes	None	Some	0	Old Mine
18	Ram Grove Spring	4290	8657	Some	None	Yes	15	Hydrological interest
19	None	4305	8683	Some	Poss	Yes	45	Dig required
19a	None	4309	8675	None	Poss	Poss	45	Dig required
19b	None	4302	8650	Some	None	Some	35	Dig required
20	Ogof Arllechwedd	4324	8632	Yes	Yes	Yes	35	Bronze Age
21	Ogof Wyntog	4327	8630	Yes	Yes	Yes	25	Pleist. fauna
22	Ff. Wyntog Upper	4330	8632	Yes	None	Yes	30	Pot. interest
23	Ogof Ffynnon Wyntog	4330	8632	Yes	None	Yes	20	Pot. interest
24	Knave Cliff Shelter	4328	8632	None	Poss	None	40	Dig required
25	None	4333	8633	None	Poss	None	20	Dig required
26	None	4335	8633	None	Poss	None	40	Dig required
27	Deborah's Hole	4338	8629	Yes	Yes	Some	36.41	Pleist. fauna
28	Deborah's Cliff Shelter	4339	8628	Yes	Yes	None	33.89	Bronze Age
29	Pothole	4356	8614	None	None	Yes	50	Pot. interst
30	None	4366	8594	Some	None	None	35	No interest
31a	Paviland Cave	4373	8588	Yes	Yes	Yes	13.34	Pleist. fauna
31b	Paviland Chimney	4373	8588	None	Poss	Yes	32.08	Dig required
31c	Hounds Hole	4370	8588	Yes	Yes	Some	13	Pleist. fauna
31d	Paviland Cliff Holes	4372	8588	None	Poss	Some	30	Dig required
32	Foxhole	4383	8601	Some	Poss	Some	40.67	Dig required
33	None	4388	8598	Some	None	None	48	Dig required
34	Spring Squill Hole	4393	8578	Yes	Yes	Some	45	Neolithic
35	Blackhole Gut Cave	4415	8558	None	None	Some	3	Pot. interest
36	Upper Blackhole	4422	8557	Yes	Yes	None	45	Inhumation
37	Rockrose Hole	4488	8519	Yes	Yes	Some	35	Inhumation
38	Stonecrop Holes	4493	8514	None	Poss	Yes	35	Dig required
39	Longhole	4513	8505	Yes	Yes	Some	50	Pleist. fauna
40	None	4516	8503	None	None	Some	40	No interest
41	None	4518	8491	Yes	Poss	None	18	Dig required
42	None	4518	8505	None	Poss	None	45	Dig required
43	None	4526	8493	None	Poss	Some	10	Dig required
44	None	4539	8494	Some	None	None	45	Geological interest
45	Wilbower Cave	4558	8492	Some	None	None	30	Historical interest
46	Culver Hole	4655	8460	Yes	Yes	Some	2	Pleist. fauna
47	Porteynon Pt. Cave	4682	8436	Yes	Yes	Some	2	Pleist. fauna
48	W. Slade Spring	4792	8556	No	None	Some	4	Pot. interest
49	None	4855	8562	?	?	Some	20	Not reached
50	None	4972	8536	No	None	None	45	No interest
51	None	4981	8529	Some	None	None	40	No interest
52	None	4983	8527	No	Poss	None	40	Dig required
53	None	5003	8523	?	?	Poss	40	Not reached
54	None	5027	8520	No	Poss	Some	45	Not reached

NO	NAME	NGR		EXC	ARCH	POT	ALT	FUTURE
55	None	5032	8516	?	Poss	Poss	40	Not reached
56	Ramsons Hole	5039	8508	Some	None	Yes	25	Pot. interest
57	None	5047	8504	No	Poss	Yes	50	Both interests
58	None	5049	8503	No	None	None	35	No interest
59	None	5049	8502	No	None	None	35	No interest
60	None	5049	8498	No	None	None	35	No interest
61	None	5047	8497	No	Poss	Poss	35	Both interests
62	None	5047	8497	No	None	None	42	No interest
63	None	5047	8497	No	None	None	41	No interest
64	Nicholaston Wd. Cave	5139	8795	Some	Poss	None	6	Dig required
65	Crawley Rocks Cave	5186	8791	Some	Poss	None	6	Dig required
66	Great Tor Caves	5295	8768	No	Poss	Poss	40	Dig required
67	Great Tor Face	5296	8765	No	Poss	None	10-15	Dig required
68	Leathers Hole	5299	8767	Yes	Yes	Yes	45	Pleist. fauna
69	None	5311	8773	No	None	Poss	25	Pot. interest
70	Threecliff Pge.	5382	8778	No	None	None	2	Scientific interest
71	None	5419	8763	No	Poss	Poss	35	Dig required
72	None	5429	8744	No	Poss	Poss	15	Dig required
73	None	5431	8741	Some	Poss	Poss	15	Dig required
74	None	5434	8743	No	None	Poss	25	Pot. interest
75	Double-arch Cave	5452	8728	No	Poss	None	20	Dig required
76	None	5461	8735	No	Poss	None	45	Dig required
77	Ravenscliff Cave	5463	8729	Yes	Yes	None	15	Pleist. fauna
78	Resurgence Cave	5473	8729	No	None	Yes	1	Hydrological interest
79	Spurge Hole	5472	8728	Yes	Yes	Yes	25	Inhumation
80	Forester's Cave	5506	8719	Yes	Yes	Yes	15	Pleist. fauna
81	Foxhole	5532	8631	Yes	Poss	Yes	50	Dig required
82	Minchin Hole	5554	8687	Yes	Yes	Yes	10	Pleist. fauna
83	None	5567	8684	No	None	Yes	5	Hydrological interest
84	None	5572	8691	No	Poss	None	50	Dig required
85	None	5572	8683	No	Poss	None	10	Dig required
86	Bowen's Parlour	5575	8683	No	Poss	None	10	Dig required
87	Crow Hole	5577	8681	Yes	Yes	None	10	Pleist. fauna
88	None	5582	8688	No	None	None	40	No interest
89	Bosco's Den	5591	8684	Yes	Yes	None	10	Pleist. fauna
90	Bacon Hole	5605	8682	Yes	Yes	Yes	10	Pleist fauna
91	Ogof-y-Cregyn	5668	8668	Yes	Yes	None	40	Inhumation
92	None	5678	8658	No	None	None	30	No interest
93	None	5684	8656	No	Poss	Poss	40	Dig required
94	None	5687	8641	No	Poss	None	20	Dig required
95	None	5707	8637	No	None	None	35	No interest
96	None	5707	8637	No	Poss	None	40	Dig required
97	Pwlldu Bay Cave	5739	8700	No	Poss	None	10	Dig required

Before digging on any National Trust property prior permission should be sought.

KEY

NO — Number of the cave in the list prepared by M Davies and, in some cases, marked on the cave wall to aid identification. Used in all references to the cave by National Trust and Nature Conservancy Council.

NAME — The name by which the cave is generally known and is the name used in the literature. Alternative names may exist and will be found in some publications.

NGR — National Grid Reference; here all in square SS.

EXC — Whether the cave is known to contain archaeological or palaeontological remains. "Poss" is used where the cave contains deposits which might prove to be archaeological if excavated and sieved. Sea caves and rock-floored caves are marked "None".

POT — Whether the cave is of interest to potholers or not. Even small caves are considered to be of interest if they are blocked by deposits which, if removed, might provide access to a system. Some caves are small dead-ends but are still of interest and will occasionally be visited by potholers.

ALT — This is usually an estimate of the altitude of the cave above ordnance datum. Where a figure is given in two places of decimals, the altitude has been determined by Geodimeter. An estimate is often useful in locating an entrance, but the accuracy is sometimes only +/− 5 metres. Sea caves have their floors at about 2m while the Gower interglacial coastal platform is in the range 8 to 11 metres OD and some caves open on to this platform.

FUTURE — This relates to the future management of the cave. Where a cave is known to contain a Pleistocene fauna or, in one case, a Holocene fauna, no digging would be permitted to avoid disturbance. Some caves are of scenic, geological or historical interest, and those of hydrological interest hold the most attraction for potholers. Where the phrase "Dig required" is used it means the archaeological potential has not been proved one way or the other. "Inhumation" means that human remains have been found in excavations usually without dating evidence. In the case of Paviland Cave both Pleistocene animals and an inhumation were found. Sometimes dating evidence is available, e.g. Bronze Age for Cave 28, and Neolithic for Cave 34; this is based on pottery or flint tool form. For Paviland Cave there are radiocarbon dates published. Some caves contain more than one feature of interest, e.g. Cave 17, Red Chamber, is worth a visit by potholers, but it has also been minded and contains unusual red sandstone deposits of uncertain age.

Radon and Caving

Radon is a naturally-occuring radioactive (alpha particle-emitting) gas and is a daughter product of uranium. Since uranium is widespread, although in trace concentrations, radon is also widespread, but there are certain environments where radon concentrations are higher than normal and this is especially so in any underground structure.

Recent reassessment of the radiation dose rates for the mythical average British person carried out by the National Radiological Protection Board, has shown that slightly over one half of the total radiation dose is due to radon. On an individual basis the absolute amount and proportion varies according to where one lives and the nature of employment. There have been very recent determinations of radon levels in caves by Gunn, Fletcher and Prime (1989) who have shown that there are significant concentrations of radon, and have recorded particularly high levels of this gas in the Castleton area of Derbyshire.

Radon itself is a noble gas and as such is relatively inactive both chemically and biologically. It has a half life of 3.82 days so that most of any Rn breathed into the lungs will be breathed out again. However Rn does decay to give solid daughter elements, some of which are alpha particle emitters, and these may be suspended in air in the form of aerosols with moisture and dust particles. They may thus enter lungs and some may remain there. Generally as long as alpha emitters stay outside the body they do little harm since the alpha particles are not very penetrative. Once inside the body however, because they are not penetrative the radiation is concentrated over a small volume and tissue damage may result, which may in time lead to cancer. Since the breathing passages are the first to make contact, then lung cancer seems to be the greatest danger.

The Health and Safety Executive have indicated that the radiation dose rate due to radon should be limited for workers in specific working environments. These include working mines, tourist mines and caverns. It is up to management and workers to make sure that these suggested limits are adhered to. This may be undertaken by improvements in ventilation, or by restricting the hours of exposure. Even though caving is a dominantly voluntary sport it would be worthwhile to consider what these working limits are and how they may relate to levels encountered in caves.

In the working environment the annual whole body dose limit for employees aged 18 years and over is 15 milli Sieverts (mSv). Exposure to radon daughters is commonly expressed in units of a Working Level Month (WLM), and a working month is considered to consist of 170 hours.

15 mSv = 1.44 WLM or about 250 WLHours (WLH).

The NRPB recommend that members of the public should receive a maximum of one mSv per annum (= 13.6 WLH).

The health effects of exposure to these doses are very difficult to assess. They are based upon studies of uranium miners, who were exposed to very high levels of radon, and whole body radiation exposures of Hiroshima atomic bomb victims. There are also some animal studies. It is assumed that there is a linear relationship between these exposures and incidence of cancers and so it is possible to predict the health effects of the relatively very low exposure that may be encountered in more normal working environments. The best estimate at present, is that for a non-smoker, a lifetimes exposure about 200 WLH in each year may double the risk of dying from lung cancer. The incidence of lung cancer in non-smokers is low and it is uncertain what the effects of exposure to other chemicals in the workplace are. To place this in context, a lifetimes exposure to cigarette smoke increases the chances of dying of lung cancer by about ten times i.e. one order of magnitude, varying according to the quantity and individual genetic susceptibility.

As far as can be judged the radon concentration in the caves of the Tawe Valley are equivalent to about one WL but range from 0.01 to 3, (date from Ashford Price, and from Gunn, Fletcher and Prime, 1989). The concentrations appear to vary extensively from place to place and with time, but since cavers do the same maybe an assumed average rate of about 1 WL is reasonable.

In a caving context I suppose it would be reasonable to accept the industry standard for exposure as guidelines. If you are starting caving and intend keeping up the sport for the next 70 years or so then it would seem to make sense to keep ones caving activity down to about 4 hours caving a week on average through the year. Judging by what I see at the club these days this may seem an overestimate.

It should be borne in mind that these figures relate to a "Life-time's" exposure and there are few cavers who still cave from youth into dignified maturity. I would guess that the average caving time-span is much less than this and I have heard figures of about five years bandied about. In this case one could accept a higher exposure rate for this shorter caving lifetime.

In other words the radon exposure in the caves of the Tawe Valley is not excessive. There is furthermore a choice available. Just as smokers should weigh up the pleasure obtained, or the anxiety reducing effects of nicotine addiction, against the risk of lung cancer, so cavers have a choice. It should be weighted in the balance of the pleasure derived from caving (or when it stops), and good healthy exercise in an otherwise unpolluted environment against the difficulty of quantifying the risk.

A final word of caution however. If you have an occupational exposure to radon or live in houses in which the levels exceed the action level of about 200 Bq/m_3, then you might well be receiving a high dose, and the caving exposure may well tip the balance. It also appears that if you smoke and are also exposed to radon then there are synergic effects. This may mean that the risks are multiplicative e.g. instead of the risks being assessed by a factor of say 2 for radon plus 10 for smoking, one may have to assess it as 2 for Rn multiplied by 10 for smoking,

equalling 20. Finally the health effects of radon on very young persons (18 years) is extremely difficult to quantify but is expected to be more severe than for adults.

Basically the choice is ultimately up to the individual, but the decision should be based upon the best available knowledge. On a personal basis I find that I have been caving for the past thirty years or so, but on reflection I find that my caving exposure has been substantially less than 4 hours per week on average and especially so recently.

Keith Ball

FURTHER READING

Gunn J., Fletcher S. and Price D. 1989. *Radon and Caver Health: A Case for Caution.* Descent Feb/Mar 1989, **26-27.**

Health Focus: Radon Risk. Occupational Health and Safety. June 1989, **24.**

Appraised Code of Practice — Part 3. Exposure to Radon. The ionizing Radiations Regulations, 1985. Health and Safety Commission.

Exposure to Radon Daughters in Dwellings. National Radiological Protection Board. January 1987.

Interesting Membership Facts as of 28th February 1990

Hopefully the brief facts listed below will be of some interest to some of the membership of the Club. If you are like myself and are an avid cricket follower then this could be seen as SWCC's answer to Wisden.

Currently there are 290 records on file, which equates to 346 members, (there are 56 Joint member records).

Men and Women

Sex	*Numbers*
Male	255
Female	91

This would mean that all the lucky women who are members of the club have 2.802 men each, so there's plenty to go round. I would presume that 0.802 of a man would be the smaller members (no names).

Current Membership Classes

Class	*Numbers*
Full	188
Provisional	33
Joint	112
Honorary	13

Currently the way that the software (DB III Plus) stores the information there are only 290 records in that there are 2 joint members for each record. Currently the number of provisional members is at it's highest for a number of years and none of these (as in the past) has been a member for more than the allotted year.

New Full Members

Year	*Numbers Joined*
1985	9
1986	16
1987	23
1988	10
1989	16
1990	3*

* (Joined up to 28/02/90)

This list has shown a fairly constant influx of new full members but unfortunately there is no record of how many Provisional members there were for each year.

Various Titles

Title	*Numbers*
Mr	191
Mr & Mrs	43
Dr & Mrs	3
Mr Miss	1
Miss	17
Mrs	13
Ms	5
Dr	15
Prof	1

This list is not definitive, as I am sure that some people fall in between categories or whose title is incorrectly filed.

When Current Members Joined

Years	*Numbers*
before 1960	9
1960-1964	13
1965-1969	29
1970-1974	24
1975-1979	36
1980-1984	39
1985-1989	76
1990-after	3

Obviously this does not provide a true insight to actual joining levels as quite a few people who joined in the 1960's and 70's have since left the club and no longer appear on the club records.

Where SWCC Members most like to live

County	*Numbers*
West Glamorgan	32
Powys	22
London/Middx	21
Avon	19
Dyfed	16
Hampshire	15
Mid Glamorgan	14
South Glamorgan	13
Gloucestershire	12
Wiltshire	8
Here & Worcs	7
Gwent	5

Other places not on this list but of some note: Norfolk (mainly one family); United States of America; Yugoslavia; Australia; France; and New Zealand (has done more trips to Far North than most in the last 5 years). Also Swansea is the top town, but this has been collated by postcode so it does cover most of South West Wales.

Other facts and figures which I would like to be able to link into the database would be —

The number of Club members for each year
Occupation of Member
Number of caving trips per year
Number of Penwyllt nights per year
Date of Birth of member

but I have no doubt that I may run into trouble in collating the information, which I feel would give quite interesting figures about the current state of the club and of the sport of caving.

If anybody would like the membership list in computer format for their PC, please send 2 × 360k disks to me. Hopefully I will in the future be able to issue an updated membership list each year.

MALCOLM HERBERT

MAKE YOUR OWN CAVING LAMP AND CHARGER
— Stuart France

CAVING IN CZECHOSLOVAKIA — John Gillet

CÔTE D'OR CAVING — John Gillet

AN EXPLANATION OF THE COMPILATION OF SURVEY DATA TO PRODUCE THE NEW PLAN OF OGOF FFYNNON DDU
Friend

TINKERING AROUND TOP (OFD) — Bob Peat, Jenny Peat

THE MANAGEMENT OF CAVES ON THE SOUTH GOWER COAST
— Melvyn Davies

RADON AND CAVING — Keith Ball

INTERESTING MEMBERSHIP FACTS AS OF 28th FEBRUARY 1990
— Malcolm Herbert

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